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Infrared spectra of mineral species

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Preface

Infrared (IR) spectroscopy as a method of analysis of molecular structures and identification of chemical compounds was first used at the end of the nineteenth century, when the relationship between absorption of IR radiation and vibrations of atoms in molecules had been established. At present this method is widely used in organic chemistry (for the identification of substances and chemical groups), in polymer chemistry (for the investigation of structural features of macromolecules), in study of surfaces, identification of molecules and investigation of vibration–rotation dynamics in gases, in matrix isolation studies, in the field of semiconductor microelectronics, etc. (see Barnes and Orville-Thomas 1977). However, IR spectroscopy is not widely adopted as a method for the identification of mineral species which is mainly due to the absence of sufficiently complete reference books and databases in this area.

The book "The Infrared Spectra of Minerals" (Farmer 1974) is still the most popular reference book on the IR spectra of minerals. However, as the book was published in 1977, it is now out of date. It contains only several hundred IR spectra of minerals. Since 1977, the number of known mineral species has doubled. At present it is close to 4,800, and every year it increases by 60–100 entries. What is more important, since 1977, there was a substantial expansion of knowledge on many minerals, their crystal chemistry, taxonomy and nomenclature. Many crystal-chemical formulae have been revised.

Recently a library of IR spectra of inorganics (NICODOM IR Inorganics 2006) was published. It contains 600 spectra of minerals from the National Museum in Prague, Czech Republic; the number of mineral species presented in this library is no more than 400. The identity of samples was verified by X-ray diffraction analysis. IR spectra of several hundreds of minerals have been published by H. Mönke (1962–1966), Boldyrev (1976) and Peng Wenshi (1982). However, these publications do not contain any analytical data for reference samples. IR spectra of separate classes, groups or families of minerals and synthetic inorganic compounds are presented in numerous publications (Weir 1966; Nekrasov 1970; Potter and Rossman 1979; Pechkovskii et al. 1981; Melnikova et al. 1985; Chukanov and Kumpanenko 1988, 2012a; Čejka 1999).

The creation of a more representative library of IR spectra of minerals was planned by A.S. Povarennykh, but his untimely decease in 1986 prevented the realization of this project.

This book is the result of an almost 30-year work of the author during which about 150 new minerals have been discovered. The library contains 3,309 IR spectra of about 2,000 minerals (including spectra of 237 holotype samples accompanied by their detailed characterization). The main goal of this book is to present a representative library of IR absorption spectra of mineral species together with additional data on each sample including locality, general appearance and mineral association. In most cases, analytical data (empirical formulae e.a.) are given. The library of IR spectra of minerals could be useful for specialists in inorganic chemistry and inorganic materials (cements, ceramics, glasses, microporous materials, etc.). In addition, in the next chapter some modern trends in IR spectroscopy of minerals and some new data and approaches are discussed.

The general theory of vibrational spectroscopy and experimental methodics of infrared spectroscopy as applied to minerals are beyond the scope of this book. These aspects are considered in numerous publications (Farmer 1974; Povarennykh 1978; Smith 1979, Stuart 2004; Nakamoto 2008; Theophanides 2012).

This work would be impossible without the help of numeral researchers. The long-time collaboration with Prof. I.V. Pekov was most important. Reference samples and valuable analytical data were kindly granted by B.V. Chesnokov, A.P. Khomyakov, G.A. Sidorenko, S.V. Malinko, A.V. Voloshin, A.I. Brusnitsyn, A.E. Zadov, D.I. Belakovskiy, Yu. P. Menshikov, R. Ďuďa, V.Yu. Karpenko, L.A. Pautov, P.M. Kartashov, Z.V. Shlyukova, A.G. Bazhenov, D.A. Kleimenov, D. Atencio, V.V. Subbotin, N.V. Ledenyova, A.M. Skrigitil', A.N. Sapozhnikov, E. Jonssen, S. Jancev, M.M. Moiseev, O.A. Ageeva, V.V. Rudnev and many other mineralogists, as well as mineral collectors, of which the contribution of W. Schüller, B. Ternes, G. Blass, R. Allori, M.N. Murashko, A.V. Kasatkin, G. Möhn, C. Schäfer, B. Otter, J. Hyršl and P. Paananen is most appreciated. The collaboration with crystallographers R.K. Rastsvetaeva, S.V. Krivovichev, N.V. Zubkova, D.I. Pushcharovskiy, S.M. Aksenov, E. Tillmanns, S. Merlino, M. Pasero, G. Ferraris, F. Nestola, S.N. Britvin, O.I. Siidra, O.V. Jakubovich, N.A. Yamnova and K.A. Rozenberg, as well as with specialists in different areas of geosciences and analytical methods (G. Raade, P. Voudouris, A. Magganas, A. Katerinopoulos, J. Göttlicher, A.N. Nekrasov, K.V. Van, A.A. Virus, L.A. Levitskaya, O.V. Karimova, A.S. Astakhova, L.A. Korshunova), was especially fruitful. All of them are kindly appreciated.

A significant contribution to the editing of figures was made by A.D. Chervonnyi. Editorial work of S.A. Vozchikova and S.M. Orlova in part of the preparation of illustrations was also significant.

Chernogolovka, Russia Nikita V. Chukanov

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The Application of IR Spectroscopy to the Investigation of Minerals

1

1.1 The Discrete Approach

Traditionally, the application of IR spectroscopy in mineralogy is reduced to the determination of wavelengths or frequencies of *discrete absorption maxima*. These values are brought in correspondence with normal vibrations of different chemical bonds or groups of atoms forming covalent bonds – complex anions (e.g. CO_3^{2-}, $C_2O_4^{2-}$, SO_4^{2-}, PO_4^{3-}, SiO_4^{4-}, and $Si_2O_7^{6-}$), polyatomic cations (H_3O^+, NH_4^+, UO_2^{2+}, etc.), neutral molecules (H_2O, NH_3), as well as lattice vibrations of infinite chains, layers or frameworks as parts of crystal structures of minerals. Another approach, also based on the use of discrete band maxima, is based on correlations between vibration frequencies and different characteristics of minerals (hydrogen bond strengths, degree of isomorphous substitutions, etc.). In this section, we consider several examples of the application of this approach to the investigation of structural features of minerals.

A customary application of IR spectroscopy for the investigation of minerals is the identification of different groups of atoms by their characteristic absorption bands. The ranges of frequencies of characteristic vibrations of most important coordination polyhedra and complex anionic groups are listed by Miller and Wilkins (1952) and Povarennykh (1978). The identification of cationic and anionic isolated groups and polyhedra containing elements with low atomic numbers (H, Li, Be, B, C, O, N) is most important because the determination of these components by electron microprobe analysis is difficult or impossible. However, in many cases such groups can be easily determined by their absorption in characteristic IR ranges. The individuality of numerous new mineral species approved by the IMA Commission on New Minerals, Nomenclature and Classification during last decades has been first revealed by means of IR spectroscopy. Several examples are given below.

Eudialyte-group minerals are trigonal zircono- and titanosilicates characterized by very complex and variable crystal-chemical features (Johnsen et al. 2003). Their general crystal-chemical formula is $N(1)_3N(2)_3N(3)_3N(4)_3N(5)_3M(1)_6M(2)_{3-6}M(3)M(4)Z_3[Si_{24}O_{72}]O'_{4-6}X_2$ where $N(1\text{–}5) = Na, H_3O^+$, K, Sr, REE, Y, Ba, Mn, Ca; $M(1) =$ Ca, Mn, REE, Na, Sr, Fe; $M(2) =$ Fe, Mn, Na, Zr, Ta, Ti, K, Ba, H_3O; $M(3)$ and $M(4) =$ Si, S, Nb, Ti, W, Na; $Z =$ Zr, Ti, Nb; $O' =$ O, OH, H_2O; $X(1)$ and $X(2) =$ Cl, F, H_2O, OH, CO_3, SO_4, AlO_4, MnO_4. Usually these minerals are Cl -dominant in the sites $X(1)$ и $X(2)$ situated around the axis of threefold symmetry. CO_3^{2-} -dominant minerals of this group with different occupation of *N*-sites, mogovidite and golyshevite have been discovered recently in the Kovdor massive of alkaline-ultramafic rocks and carbonatites, Kola peninsula (Chukanov et al. 2005a). IR spectra of these minerals contain series of absorption bands in the range from 1,350 to 1,550 cm^{-1} (Fig. 1.1).

A cancrinite-group mineral kyanoxalite, $Na_7(Al_{6-5}Si_{6-7}O_{24})(C_2O_4)_{0.5-1}\cdot 5H_2O$, has been

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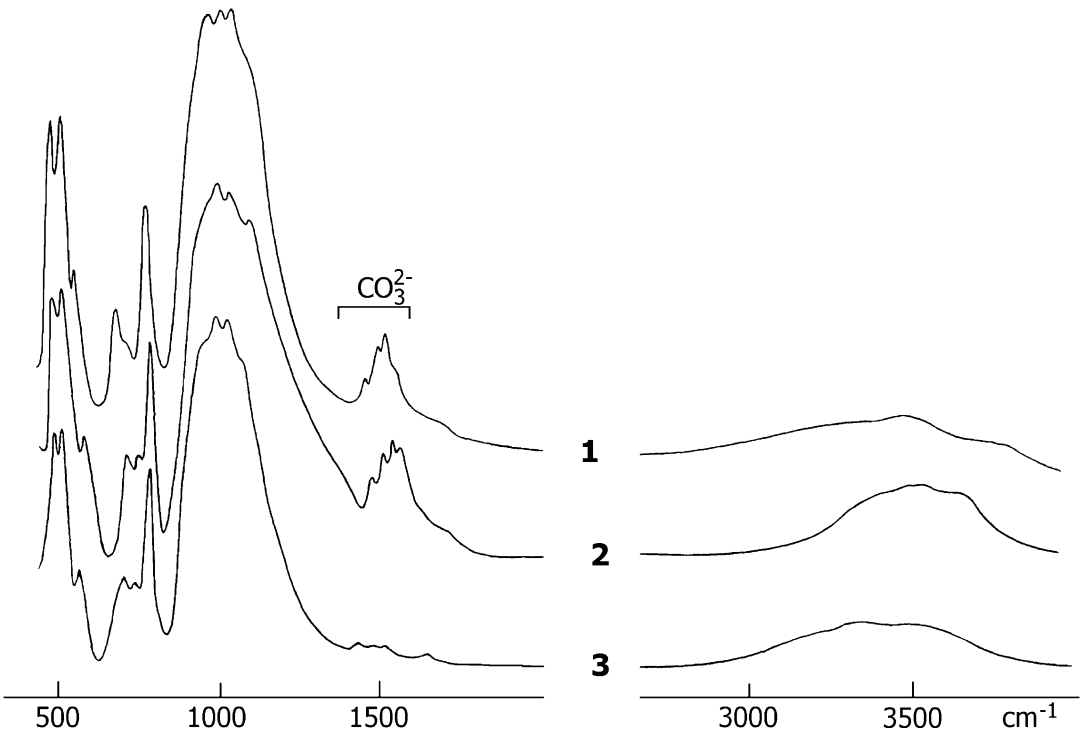


Fig. 1.1 IR spectra of high-calcium eudialyte-group minerals from alkaline pegmatites of the Kovdor massif: (*1*) mogovidite (CO_3^{2-} -dominant), (*2*) golyshevite (CO_3^{2-} -dominant) and (*3*) feklichevite (Cl^- -dominant)

first determined as a new mineral species different from cancrinite, $(Na,Ca)_{7-8}$ $(Al_6Si_6O_{24})$ $(CO_3)_{1-2}{\cdot}2H_2O$, by characteristic IR bands of oxalate groups at 1,713, 1,373 and 817 cm^{-1} (Figs. 1.2 and 1.3).

Similarly, the presence of NH_4^+ groups in the first ammonium arsenate mineral of the autunite group uramarsite discovered in the Bota-Burum U deposit, Southern Kazakhstan, was detected by characteristic bands in the ranges 1,400–1,500 and 2,800–3,200 cm^{-1} (Sidorenko et al. 2007, see Fig. 1.4). Earlier this mineral was considered as trögerite.

The *factor group method* for calculation of the symmetry properties, and selection rules for vibrational modes of crystals with known structures, has been reviewed by DeAngelis et al. (1972). The selection rules for each irreducible representation of the factor group are determined by noting the transformation properties for the dipole moment operator (for IR activity) or the polarizability tensor (for Raman activity). This method is effective only in case of simplest structures. In most cases, the determination of the number of active modes in IR spectra of minerals is impossible due to the overlapping of spectral bands, resonance splitting and different factors distorting translational symmetry of real crystals (solid solutions involving different complex anions, alteration of different kinds of stacking of layers, local defects, etc.). For this reason, the interpretation of vibrational spectra of crystalline solids has been limited largely to empirical approaches.

The wavenumber range approximately between 400 and 1,700 cm^{-1} is called the *fingerprint region*. Usually IR spectrum in this region contains very complicated series of overlapping bands. The importance of the fingerprint region is that each mineral species produces a different pattern.

Symmetry lowering accompanied by the transformation of structural sites into groups of non-equivalent sites can result in the splitting if corresponding absorption bands. This phenomenon is very typical for IR spectra of minerals. Several examples are considered below.

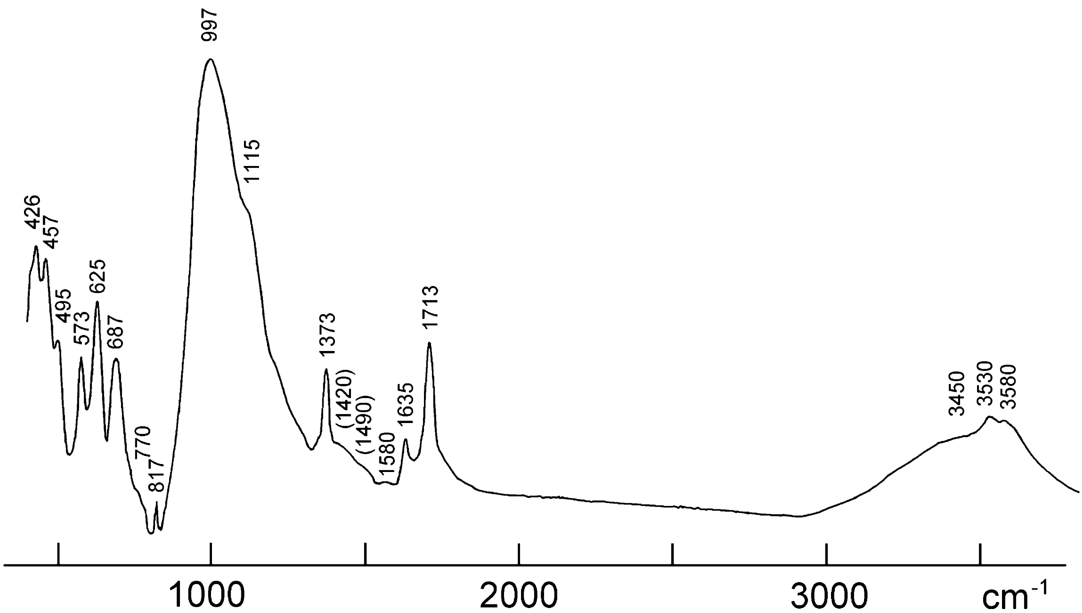


Fig. 1.2 IR spectrum of kyanoxalite from Alluaiv Mt., Lovozero alkaline massif, Kola peninsula, Russia (After Chukanov et al. 2011)

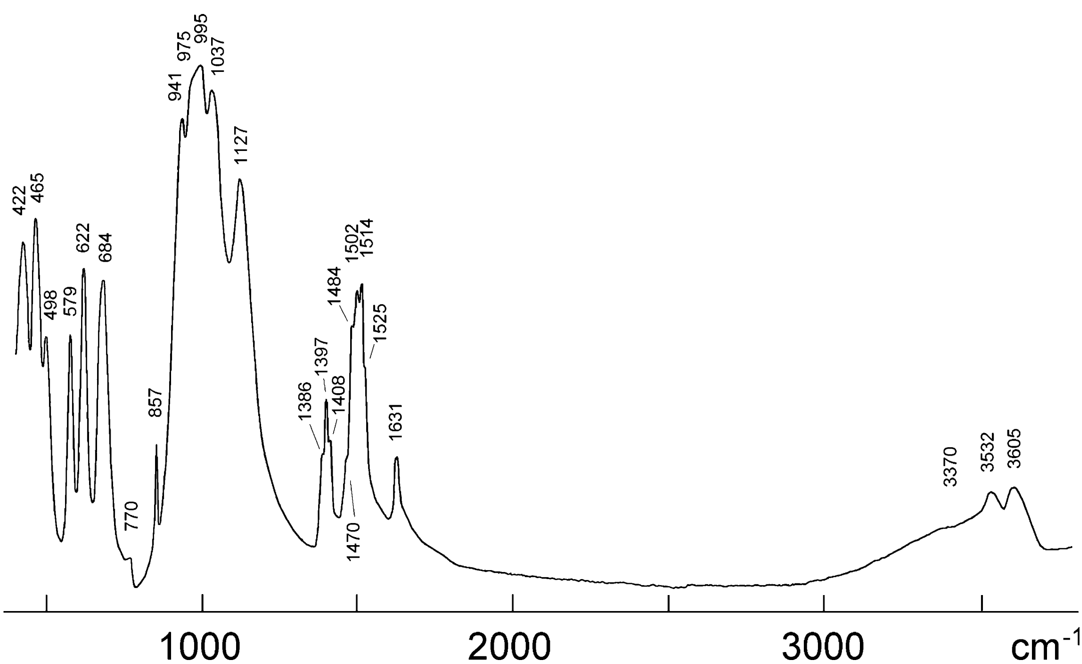


Fig. 1.3 IR spectrum of typical cancrinite from Vishnevye Mts., Urals, Russia (After Chukanov et al. 2011)

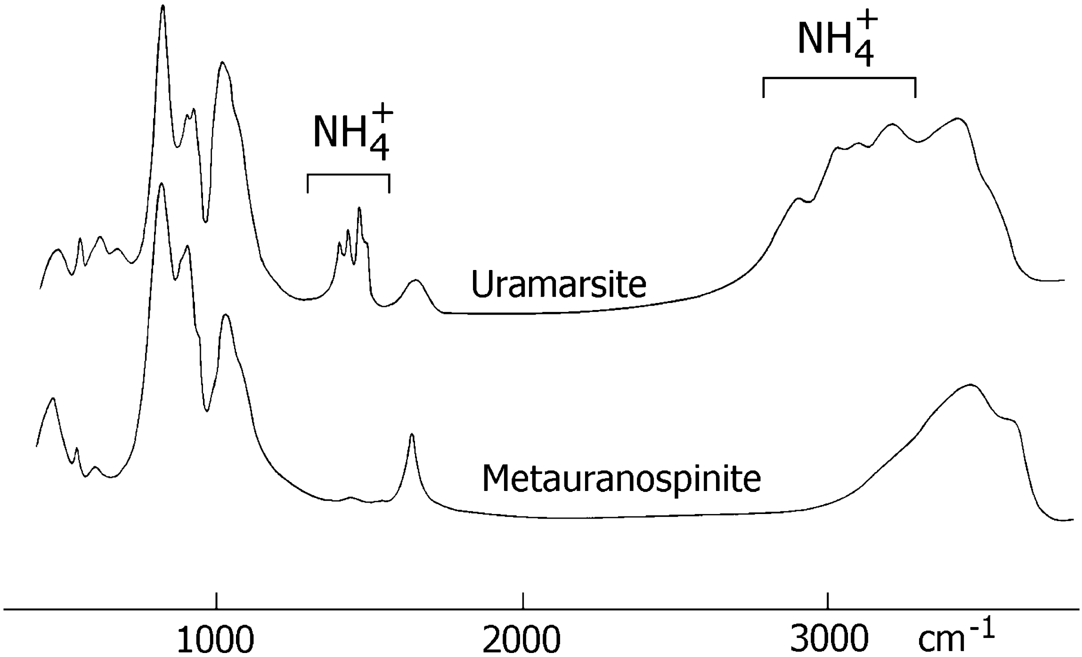


Fig. 1.4 IR spectra of uramarsite and metauranospinite (After Sidorenko et al. 2007)

IR spectrum of nabalamprophyllite Ba(Na,Ba){$Na_3Ti[Ti_2O_2Si_4O_{14}](OH,F)_2$} (Chukanov et al. 2004) is clearly different from the spectra of lamprophyllite and barytolamprophyllite in a pronounced doublet 921 + 954 cm^{-1} in the range of Si–O-stretching vibrations (Fig. 1.5). The splitting of the IR band in this case is a result of lowered symmetry. In centrosymmetric minerals of the lamprophyllite–barytolamprophyllite solid-solution series $(Ba,Sr)_2${$Na_3Ti[Ti_2O_2Si_4O_{14}](OH,F,O)_2$} (space group *C*2/*m*), the groups Si_2O_7 are equivalent, whereas in nabalamprophyllite (space group *P*2/*m*) there are two types of Si_2O_7 groups as a result of the ordering of interlayer cations Na and Ba.

Eveslogite (monoclinic) and yuksporite (orthorhombic) are very close in chemical composition, powder X-ray diffraction patterns and physical properties. However, their identification is easy due to characteristic additional splitting of some bands in the IR spectrum of eveslogite as compared to that of yuksporite (Fig. 1.6) (Chukanov et al. 2008).

The crystal structures of the roscherite-group minerals are based on a heteropolyhedral

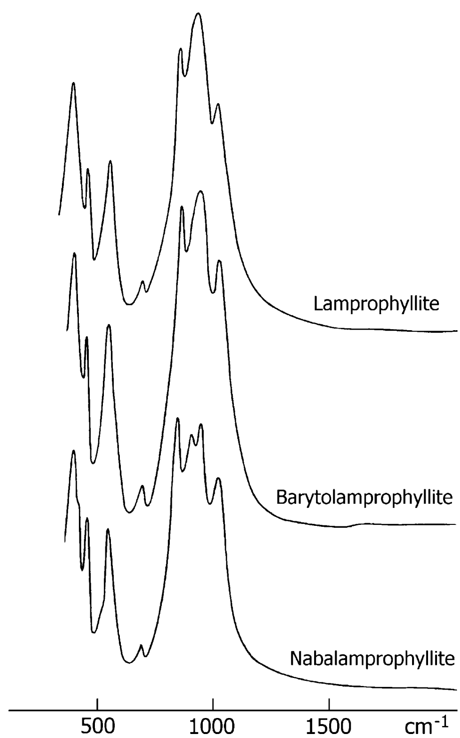


Fig. 1.5 IR spectra of lamprophyllite-group minerals

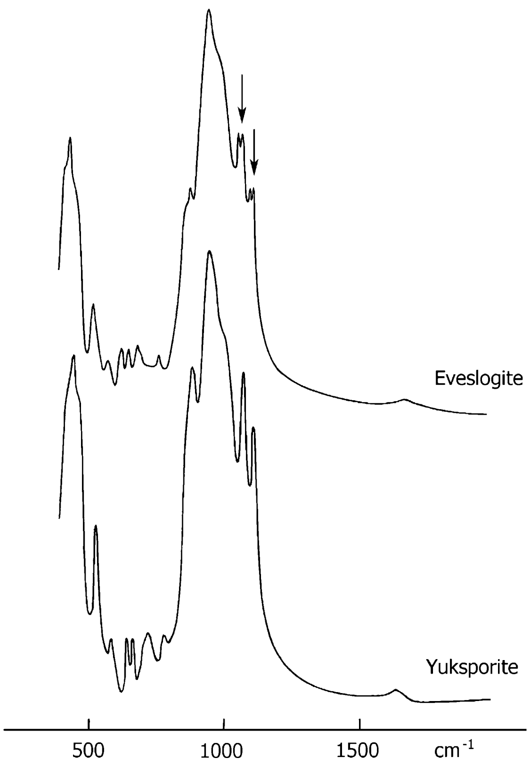


Fig. 1.6 IR spectra of eveslogite and yuksporite

framework composed of atoms with four- and six-fold coordination. Among these minerals, monoclinic and triclinic members are distinguished. The general formula of monoclinic roscherite-group minerals is $Ca_2D_2M_4Be_4(PO_4)_6(OH)_4X_2{\cdot}4H_2O$ where D and M are octahedral cations Mg, Zn, Mn^{2+}, Fe^{2+}, Fe^{3+} and Al. The transition from monoclinic to triclinic members of this group with the general formula $Ca_2D(1)D(2)M(1)_2M(2)_2Be_4(PO_4)_6(OH)_4X_2{\cdot}4H_2O$ is accompanied by the doubling of the number of octahedral sites and the increase of independent tetrahedral sites from 3 to 5 (from 1 to 2 for Be and from 2 to 3 for P). As a result, additional splitting of the bands of P–O- and Be–O-stretching vibrations is observed (Chukanov et al. 2005b; Atencio et al. 2008).

1.2 The Full-Profile Analysis

Unlike traditional treatment of IR spectra of minerals as a number of discrete absorption bands, the *full-profile analysis* is based on the consideration of the whole spectral curve within a certain range of frequencies (Dubovitskiy and Chukanov 2004; Chukanov et al. 2008). Spectral curves are considered as elements of a multidimensional vector space. The key-point of the method consists in best fitting of analyzed spectrum by nonnegative linear combination of spectra of known samples from the base set. This approach is numerically stable due to the application of the concepts of integral error functional and generalized positive solution. Automated data processing is possible with practically unlimited base set of reference spectra. The application of full-profile IRS analysis makes it possible to avoid combinatorial stage from the procedure of identification of minerals.

Generally, the full-profile analysis implies the solution of the following minimization problem:

$$F(x,\xi) = \int_{\Omega} |\sum_{j\in J} x_j\theta_j(L_j,\omega) + \xi(\omega) - \theta(L,\omega)|^p d\omega \to \min,$$

where $\theta(l,\omega) = \ln(I(0,\omega)/(l,\omega))$ is absorbance spectrum of a layer of a mineral under investigation with the thickness of l; $\theta_j(L_j,\omega)$ are absorbance spectra of minerals from the available database; $x_j \geq 0$ are nonnegative coefficients to be found as a result of the solution of the minimization problem; $\xi(\omega)$ is a scattering correction function; $p \geq 1$ is Hölder factor that determines the norm of the function space. The function $\xi(\omega)$ can be expressed as a polynomial with optimized parameters or as a linear combination of experimental scattering curves with optimized coefficients. On the first step, of the full-profile analysis, the optimized nonnegative coefficients x_j are determined. In the course of iterations, negative coefficients are rejected. As a result, from the database containing several thousand spectra, no more than several tens spectra giving positive contribution can be selected. On the second stage, normalized optimized coefficients x_j^* are determined in accordance with the condition $\sum_j x_j^* = 1$.

When any analyzed mineral species is present in the database, it will be recognized automatically (the spectrum of corresponding sample from the database will have a coefficient x_j^* close to 1).

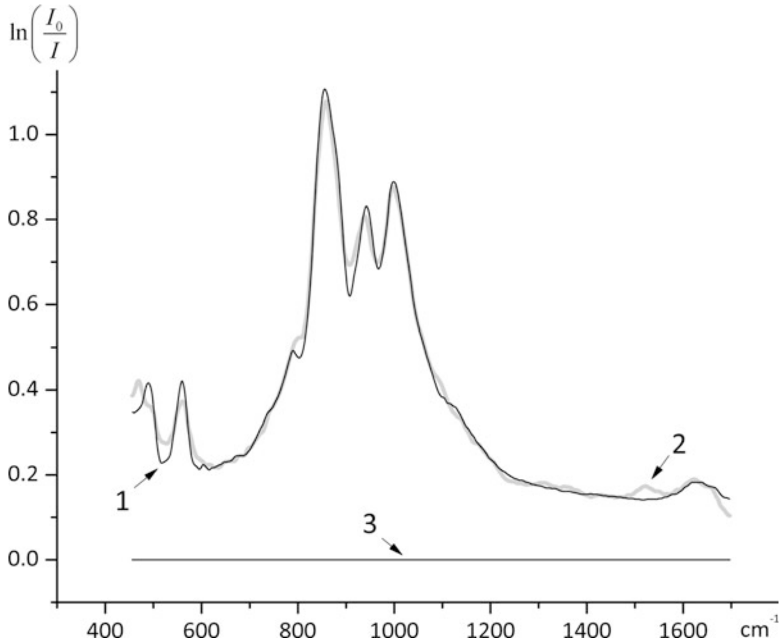


Fig. 1.7 Approximation of the IR spectrum of sodium boltwoodite (*1*) by a linear combination of IR spectra from the database (*2*); the *line* (*3*) is scattering correction curve (After Chukanov et al. 2008)

When analyzed sample is a mixture of several minerals, the result of the full-profile analysis is a set of the coefficients x_j^* reflecting the composition of the mixture. In most cases when a sample under investigation is absent in the database, the result of the full-profile analysis is a combination of spectra of minerals that have a close chemical or structural relationship with this sample. For example, the full-profile analysis of the spectrum of sodium boltwoodite $(H_3O)Na(UO_2)(SiO_4){\cdot}H_2O$ on the basis of 3,126 spectra of other (except sodium boltwoodite) minerals (Fig. 1.7) results in the linear combination of only 19 nonzero components with the contribution of silicates of 81 %. Among silicates, uranyl nesosilicates boltwoodite, $HK(UO_2)(SiO_4){\cdot}1.5H_2O$ and uranophane, $Ca(UO_2)_2(HSiO_4)_2{\cdot}H_2O$, make the greatest contribution of 72 % to the total absorbance in the approximating spectrum. Numerous examples of the application of the full-profile analysis to IR spectra of minerals are considered by Chukanov et al. (2008).

On the basis of the above-described approach based on the full-profile analysis, an IRS-based quantitative criterion of crystal-chemical similarity (CCS) can be introduced for pairs of minerals to be compared. CCS can be expressed as normalized square deviation of an analyzed spectrum from a reference spectrum or from an approximating nonnegative linear combination of reference spectra. Being based on empirical spectroscopic data, this criterion reflects real crystal-chemical relationships: pairs of minerals with similar structure type have the lowest CCS values. Within a given structure type, CCS characterizes compositional relationships.

In order to make full-profile IRS analysis a customary method in mineralogical investigations, during last 20 years a representative collection of IRS of well-characterized mineral samples was formed by the author. It includes about 3,400 spectra of more than 2,200 mineral species. In frames of this work, IRS database was created, and more than 150 new mineral species have been discovered.

1.3 Polymerization of Coordination Polyhedra and Structure Topology

An empirical correlation between the number of edges shared per MnO_6 octahedron and major Mn–O-stretching band positions in IR spectra of tetravalent Mn oxides was obtained by Potter and Rossman (1979). Similar correlations are known

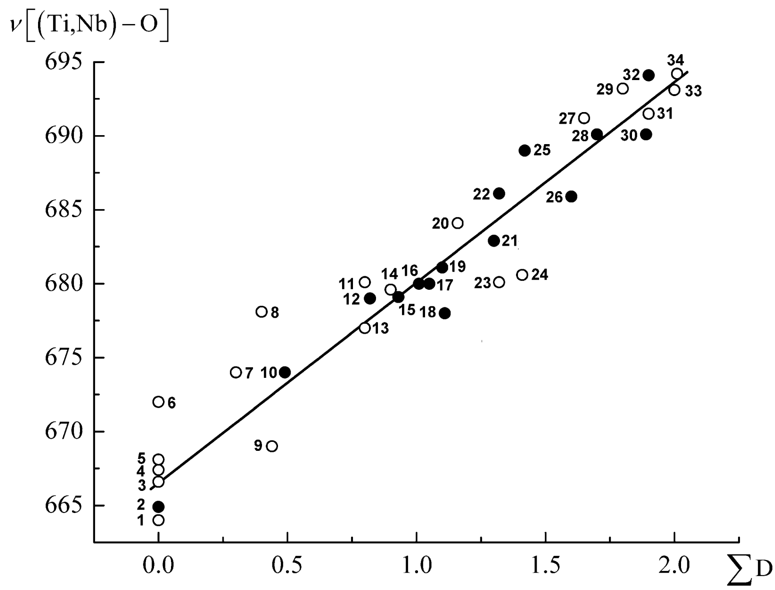


Fig. 1.8 Correlation between the stretching frequency of (Ti,Nb)–O and the content of D cations in labuntsovite-group minerals calculated from structural data (*open circles*) and as $\Sigma^{VI}M^{2+}$ = Ti + Nb + Mg + Mn + Fe + Zn − 8 for samples with unknown structures (*black circles*). The numbers correspond to korobitsynite (1–3), nenadkevichite (4, 5), lemmleinite-K (6–8, 10), tsepinite-Na (9), "paralabuntsovite-" (11), "labuntsovite-" (12, 14, 15), lemmleinite-Ba (13), labuntsovite-Fe (16), labuntsovite-Mg (17, 21, 22, 26), paralabuntsovite-Mg (18), labuntsovite-Mn (19, 21, 23), vuoriyarvite-K (20), karupmøllerite-Ca (24), kuzmenkoite-Mn (25, 27, 30), kuzmenkoite-Zn (28), organovaite-Mn (29), gutkovaite-Mn (31), organovaite-Zn (32, 33) and parakuzmenkoite-Fe (34) (After Chukanov et al. 2003; Chukanov and Pekov 2005)

for different groups of minerals. Theoretical background of this phenomenon, first observed in IR spectra of organic polymers, is considered in Loghinov et al. (1979); Chukanov (1980); Chukanov and Kumpanenko (1988).

In labuntsovite-group minerals $A_4B_4C_4D_2M_8(Si_4O_{12})_4(OH,O)_8{\cdot}nH_2O$, chains of vertice-sharing MO_6 octahedra (M = Ti, Nb) are linked by the rings Si_4O_{12} and additional octahedra DO_6 (typically, D = Fe^{2+}, Mn^{2+}, Zn, Mg or Ca); A, B and C are low-force-strength extraframework cations. The presence of vacancies (from 0 to 100 % of the D site) is typical for these minerals. In terms of the cluster approximation and the first-order perturbation theory, it was shown (Chukanov et al. 2003) that the linking of chains of $(Ti,Nb)O_6$ octahedra (M-octahedra) by additional D-octahedra with lower-force characteristics (D = Fe, Mg, Mn or Zn) in the labuntsovite-group minerals results in a linear correlation between the number of D atoms per formula unit and the wavenumber $\langle \nu_{M-O} \rangle$ of the IR-active band of (Ti,Nb)–O-stretching vibrations (in the range 660–700 cm^{-1}). This band is single and its position is almost independent on the Ti:Nb ratio. Indeed, as one can see from Fig. 1.8, the position of the Ti(Nb)–O-stretching band does linearly correlate with the occupancy of the D site (for samples with unknown crystal structure, the occupancy of the D site has been obtained from the chemical data alone as $n - 8$, n being the total number of octahedrally coordinated atoms Ti, Nb, Fe, Mg, Mn, Zn). The scatter of points in Fig. 1.8 is due mainly to the presence of lower-force-strength cations (Ca and Na) in the D site. On the basis of structural and IR spectroscopic data for labuntsovite-group minerals gjerdingenite-Na and gjerdingenite-Ca (Pekov et al. 2007), the correlation was generalized for the case D = $(Fe,Mg,Mn,Zn)_xCa_yNa_z\square_{1-x-y-z}$ as follows:

ν[(Ti,Nb)–O] (cm^{-1}) = 667 + 27.02x + 18.32y + 8.60z. The coefficients 27.02, 18.32 and 8.60 reflect force constants of bonds formed by oxygen and cations (Fe^{2+}, Mn^{2+}, Zn, Mg), Ca and Na, respectively.

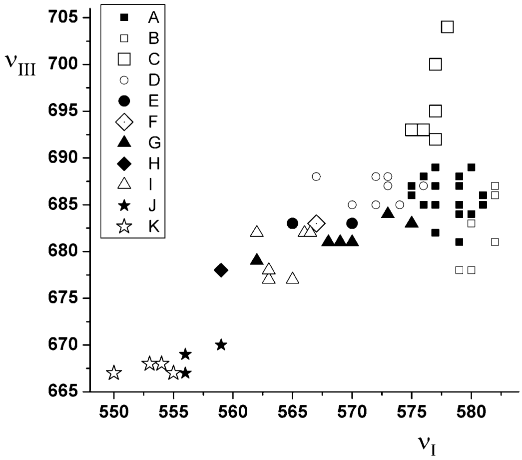


Fig. 1.9 Wavenumbers of absorption maxima of the bands ν_I and ν_{III} in IR spectra of cancrinite *s.s.* (*A*), H_2O-poor cancrinite (*B*), cancrisilite (*C*), kyanoxalite and C_2O_4-rich members of the cancrinite-kyanoxalite series (*D*), hydroxycancrinite and a CO_3-poor member of the cancrinite-hydroxycancrinite series (*E*), depmeierite (*F*), vishnevite (*G*), pitiglianoite (*H*), balliranoite and CO_3-rich members of the davyne-balliranoite series (*I*), davyne (*J*), quadridavyne (*K*) (After Chukanov et al. 2011)

A simple correlation exists between the weighted average frequency $\langle\nu_{Si-O}\rangle$ of the Si–O-stretching vibrations (in the range from 800 to 1,200 cm^{-1}) and the mean number of vertices that a SiO_4 tetrahedron shares with other SiO_4 tetrahedra (Chukanov 1995). For aluminosilicates with the anion stoichiometry $Si_xAl_yO_z$, the correlation is the following (Chukanov 1995):

$$\langle\nu_{Si}-O\rangle(cm^{-1}) = (337.8t + 1{,}827)(0.6428t + 1)^{-1}$$
$$\text{where } t = z(x + 0.5y)^{-1} \tag{1.1}$$

This correlation can be violated in case of the presence of protonated SiO_4 tetrahedra (see below), but for neutral silicates there is a distinct trend to the increase of $\langle\nu_{Si-O}\rangle$ in the series of Al-free minerals: nesosilicates → sorosilicates → silicates with triorthogroups Si_3O_{10} → inosilicates with simple chains and cyclosilicates with simple rings → amphiboles → phyllosilicates and silicate with double tetrahedral rings → modifications of SiO_2. The presence of Al and especially Fe^{3+} in tetrahedral sites results in the lowering of the $\langle\nu_{Si-O}\rangle$ value.

The range of wavenumbers from 500 to 800 cm^{-1} can be considered as "fingerprint region" sensitive to the composition and the topological features of the tetrahedral frameworks (Si, Al)O_2 and (Si,Be)O_2 in tecto-aluminosilicates and beryllosilicates. The most well-known example is presented by the zeolite group.

Another example is cancrinite mineral group. Feldspathoids of the cancrinite group (Bonaccorsi and Merlino 2005; Pekov et al. 2011) are hexagonal or trigonal tecto-aluminosilicates with frameworks consisting of layers containing six-membered rings of Si- and Al-centered tetrahedra perpendicular to the *c* axis. The rings centered by six-fold or three-fold axes [1/3 2/3 *z*], [2/3 1/3 *z*] and [0 0 *z*] are usually denoted by the letters *A*, *B* and *C*, respectively. Rings of each type form layers (levels). Every ring is linked to three rings of the preceding layer and to three rings of the succeeding layer. The stacking of the *A*, *B*, *C* layers along the *c* axis determines the type of framework that contains zeolitic cavities forming channels running along [001]. The channels host extraframework cations (major: Na^+, Ca^{2+}, K^+), anions (species-defining: CO_3^{2-}, SO_4^{2-}, Cl^-, OH^-, S^{2-}, $C_2O_4^{2-}$, PO_4^{3-}) and, in many cases, H_2O molecules. The diversity of cancrinite-group minerals (CGM) is determined by the type of Al,Si,O framework and the composition and distribution of extraframework cations and anions.

For cancrinite-group minerals with the simplest attacking sequence *AB*, three bands, ν_I, ν_{II} and ν_{III}, corresponding to mixed vibrations of the framework tetrahedra (in the ranges 550–581 cm^{-1} for ν_I, 608–630 cm^{-1} for ν_{II} and 667–704 cm^{-1} for ν_{III}), are observed in the range 540–720 cm^{-1} (see, e.g. Figs. 1.2 and 1.3). The positions of these bands depend on the combinations of extraframework cations and anions in different sites (Chukanov et al. 2011; see Fig. 1.9), but generally IR spectrum in this region is characteristic of all these minerals.

In IR spectra of cancrinite-group minerals with more complex structures and the number of layers more than 2 per unit cell, the number of absorption bands in the range 540–720 cm^{-1} is more than 3 (see, e.g. IR spectrum of biachellaite, a cancrinite-group mineral with the stacking sequence *ABCABCACACBACBACB-CACBACBACBABC* per unit cell; Figs. 1.10 and 1.11).

Beryllosilicates with the common formula $BaBe_2Si_2O_7$, clinobarylite (space group *Pm*, $a = 11.618$, $b = 4.904$, $c = 4.655$ Å, $\beta = 89.94°$) and barylite (space group $P2_1na$ or *Pmna*; $a = 11.65$, $b \approx 9.8$, $c \approx 4.65$ Å), are another example of dimorphs with different framework topology (Rastsvetaeva and Chukanov 2003). These polymorphs are similar by the powder X-ray diffraction patterns, but they can be easily distinguished by IR spectra (Figs. 1.12 and 1.13).

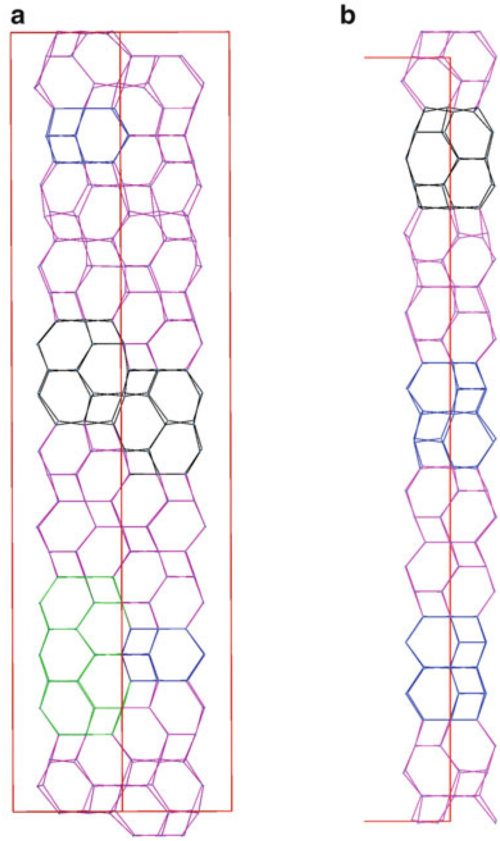


Fig. 1.10 A fragment of the tetrahedral framework (**a**) and cancrinite-type column (**b**) in the structure of biachellaite (After Chukanov et al. 2009). The unit cell is outlined

1.4 Hydrogen-Bearing Groups and Hydrogen Bonding

As noted by Libovitzky and Beran (2004), hydrogen is a major, a minor and a trace constituent of a broad variety of minerals in the Earth's lithosphere. In minerals and inorganic compounds, hydrogen can be present in different forms including isolated H_2O molecules and OH^-anion; free (non-covalent-bonded) proton H^+; hydronium ion H_3O^+ and its hydrated complexes $H_3O^+{\cdot}nH_2O$; different acid anions like $HCO3^-$, HPO_4^{2-}, $H_2PO_4^-$ and $HAsO_4^-$; primary, secondary and tertiary silanol groups and ammonium cations

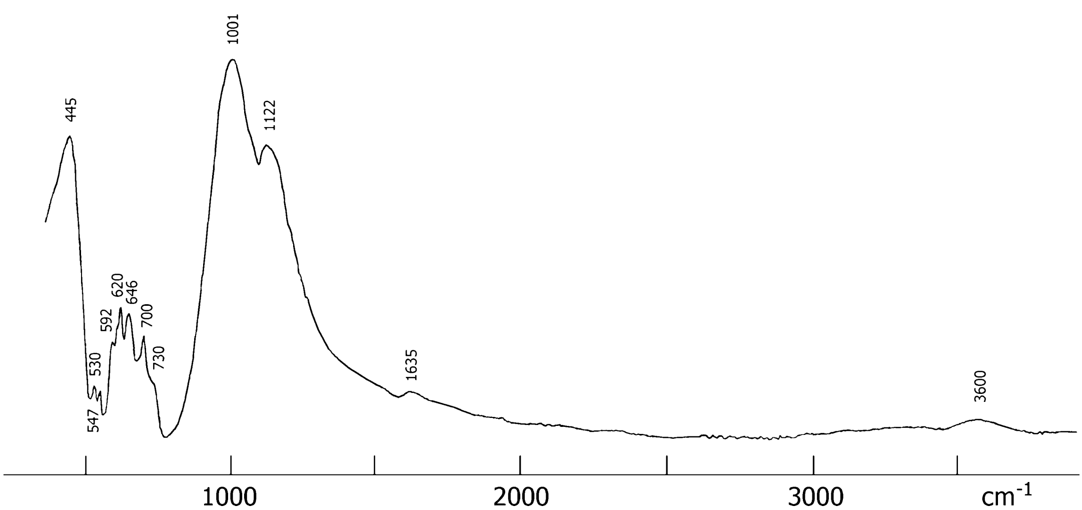


Fig. 1.11 IR spectrum of biachellaite (After Chukanov et al. 2009)

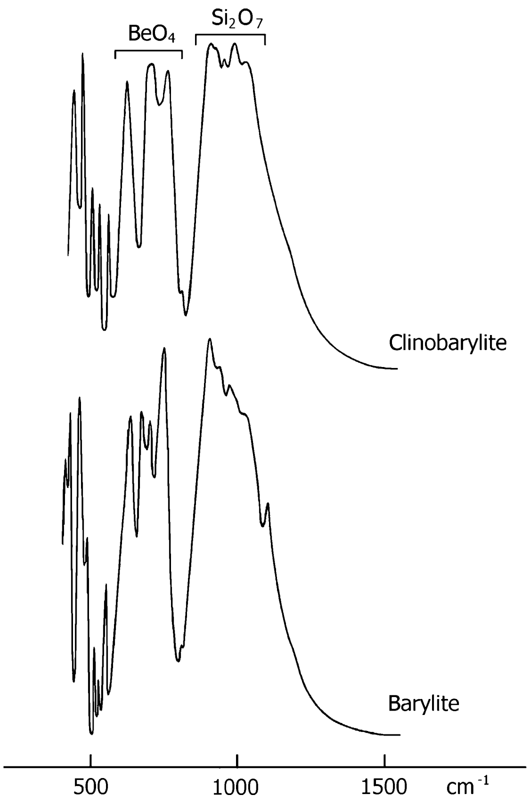


Fig. 1.12 IR spectra of clinobarylite and barylite

NH_4^+. The diversity of the nature of hydrogen in minerals is caused also by the formation of hydrogen bonds of different types and by different vibrational states of hydrogen-bearing groups.

Among different factors hindering the investigation of the chemical nature of hydrogen in inorganic solids, the most important are high mobility of this element (promoted by its small size, tunneling effect and low energies of heterolytic dissociation of acid groups), inapplicability of electron microprobe analysis and restricted applicability of methods based on the diffraction of X-ray radiation. It is important to note that H atom contains only one electron that in different compounds is involved in the formation of a binding orbital. As a result, only the determination of the position of the electron pair (but not of the H atom itself) is possible by means of structural methods based on X-ray diffraction. In particular, the lengths of covalent O–H bonds determined from X-ray diffraction data are, on the average, 0.2 Å less than the real values (Baur 1972). Moreover, isolated H^+ cation cannot be detected by X-ray diffraction methods because it does not contain electrons.

IR spectroscopy is one of the most sensitive methods in determining hydrogen-bearing

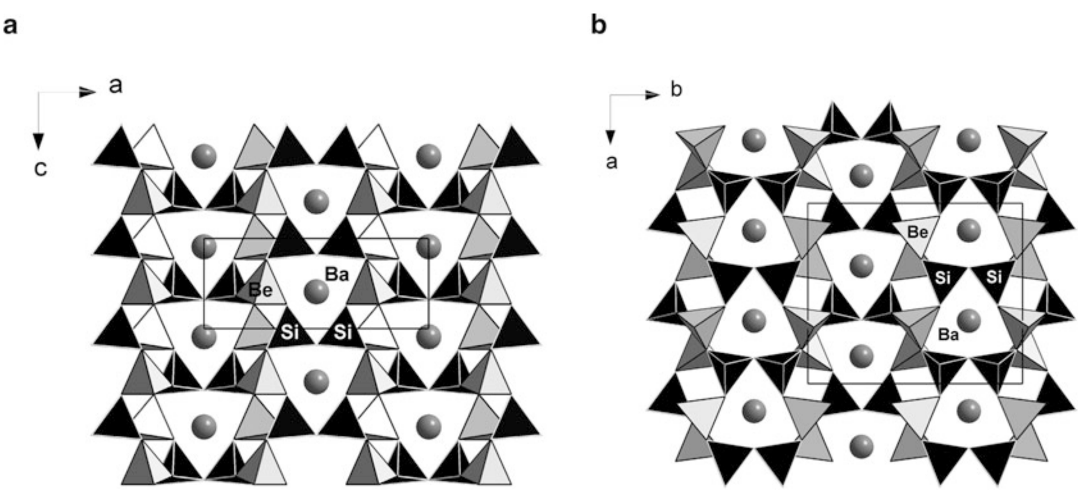


Fig. 1.13 The crystal structures of clinobarylite (**a**) and barylite (**b**)

groups in minerals. Apparently, the most appropriate approach to the investigation of the nature of hydrogen in minerals would be a combination of structural, chemical and spectroscopic (IR, Raman, NMR) methods.

Generally, the formation of hydrogen bond is accompanied by the weakening of the covalent bond formed by H atom with an electronegative *A* atom and as a result by the lowering of the frequency of *A*–H-stretching frequency $\nu(A\text{–H})$ (usually, $A = \mathrm{O}$ or N). One of the first attempts to find correlations between $\nu(A\text{–H})$ and the length of H-bond in crystals was made by Pimentel and Sederholm (1956).

Later the following improved empirical correlations between O–H-stretching frequencies in IR spectra of minerals and O···O and H···O distances (obtained from structural data) were established by E. Libowitzky (1999):

$$\nu\left(\mathrm{cm}^{-1}\right) = 3592 - 304 \cdot 10^{9} \cdot \exp[-\mathrm{d}(\mathrm{O}\cdots\mathrm{O})/0.1321]. \quad (1.2)$$

$$\nu\left(\mathrm{cm}^{-1}\right) = 3632 - 1.79 \cdot 10^{6} \cdot \exp[-\mathrm{d}(\mathrm{H}\cdots\mathrm{O})/0.2146]. \quad (1.3)$$

As noted above, the lengths of covalent O–H bonds determined from X-ray diffraction data are about 0.2 Å less than the real values (typically, from 0.95 to 1 Å). For this reason, the value d (H···O) in the correlation (1.3) should be considered as the distance between O atom and maximum of electron density of the bonding electron pair.

It should be also noted that at high frequencies (above 3,500 cm^{-1}) substantial deviations from the correlations (1.2) and (1.3) are possible because O–H-stretching frequencies depend not only on O···O and H···O distances, but also on the nature of cations coordinating O–H groups and H_2O molecules, as well as on the angle O–H···O, and the influence of these factors becomes most evident in case of weak hydrogen bonds. The equations (1.2) and (1.3) predict that maximum possible values of O–H-stretching frequencies for minerals are 3,592 and 3,632 cm^{-1}, respectively. However, for numerous minerals bands of O–H-stretching vibrations are located at higher frequencies. For example, in IR spectra of magnesium serpentines, brucite and kaolinite, the strongest O–H-stretching bands are observed between 3,650 and 3,700 cm^{-1}.

In case of weak hydrogen bonds formed by OH groups, O–H-stretching frequencies depend mainly on the nature of triads of cations coordinating the OH group (e.g. MgMgMg, MgMgFe^{2+}, Mg$Fe^{2+}Fe^{2+}$, $Fe^{3+}Fe^{3+}$□, MgMgFe^{3+}, AlFe^{2+}□, where □ is vacancy). Corresponding relationships are considered in numerous publications dealing with rock-forming minerals (amphiboles, micas, clay minerals). A similar approach was applied in the first description of zincolivenite $CuZn(AsO_4)(OH)$ (Chukanov et al. 2007).

Holotype zincolivenite, as well as “cuprian adamite” by Toman (1978), is a natural analogue of cation-ordered synthetic phase with Cu:Zn = 1:1. In this mineral, Cu atoms form distorted octahedra with Cu–O distances from 1.986 to 2.409 Å (Jahn-Teller distortion). Zn atoms occupy five-coordinated sites with Zn–O distances from 1.998 to 2.074 Å. OH groups occupy one site coordinated by two Cu atoms and one Zn atom. IR spectrum of zincolivenite confirms high degree of cation ordering: in the range of O–H-stretching vibrations (3,400–3,550 cm^{-1}), single band of CuCuZnOH clusters is observed; bands of CuCuCuOH, CuZnZnOH and ZnZnZnOH are absent. Intermediate members of the series olivenite-zincolivenite and zincolivenite-adamite give more than one band in this range (Fig. 1.14) having maximums at 3,420–3,430 cm^{-1} (CuCuCuOH), 3,470–3,480 cm^{-1} (CuCuZnOH), 3,490–3,500 cm^{-1} (CuZnZnOH) and 3,530–3,540 cm^{-1} (ZnZnZnOH). Similar conclusion was made by J.E. Chisholm (1984) on the basis of IR spectroscopic data for synthetic series olivenite $Cu_2(AsO_4)(OH)$ – adamite $Zn_2(AsO_4)(OH)$.

The above consideration shows that zincolivenite is isostructural with Cu-Zn-ordered phosphate zincolibethenite $CuZn(PO_4)(OH)$ (Braithwaite et al. 2005) and is its As-dominant analogue.

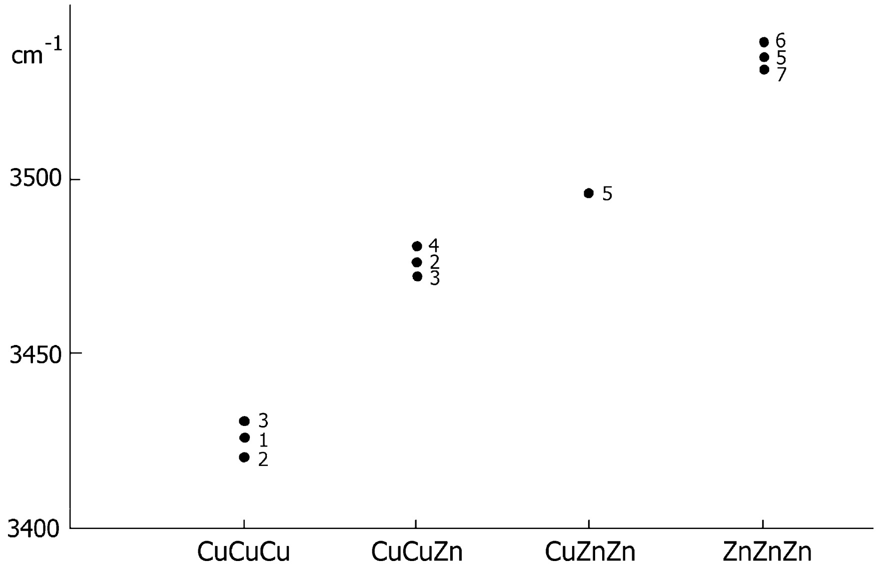


Fig. 1.14 Wavenumbers of the bands of O–H-stretching vibrations for differently coordinated OH groups in Zn-poor olivenite from Tsumeb, Namibia (*1*); Zn-enriched olivenite from Tsumeb, Namibia (*2*); Zn-enriched olivenite from Novoveská Huta, Slovakia (*3*); zincolivenite from Lavrion, Greece (*4*); Cu-enriched adamite from Dalnegorsk, Russia (*5*); Cu-poor adamite from Lavrion, Greece (*6*) and Cu-poor adamite from Ojuela mine, Mexico (*7*)

IR spectra of *acid salts* (silicates, carbonates, phosphates, etc.) possess a number of specific features including the presence of relatively broad bands of acid OH groups (in the range 1,700–3,000 cm^{-1}), splitting and shifts of the bands of stretching vibrations of anions. As noted above, the correlation (1.1) between the weighted average frequency $\langle\nu_{\mathrm{Si-O}}\rangle$ of the Si–O-stretching vibrations and stoichiometry of tetrahedral part of aluminosilicates can be violated in case of the presence of protonated SiO_4 tetrahedra. This phenomenon is graphically illustrated in Fig. 1.15.

As seen from Fig. 1.15, different acid silicates show different degree of the deviation from the correlation (1.1). For some formally acid inosilicates (pectolite, serandite, babingtonite, nambulite, marsturite and some other related minerals), these deviations are almost absent. As it was shown by Chukanov and Pekov (2012), the cause of these differences is connected with the character of chemical bonds formed by hydrogen. In pectolite and related anhydrous acid inosilicates, silanol groups SiOH are absent: H^+ cation does not form strong covalent bond with oxygen, and the influence of hydrogen on the vibrations of silicate chain is weak. In IR spectra of these minerals, a distinct band corresponding to vibrations of H^+ cation is observed in the range 1,250–1,500 cm^{-1}. In most other acid silicates, silanol groups forming strong hydrogen bonds are present which results in the increase of the $\langle\nu_{\mathrm{Si-O}}\rangle$ value.

It was shown (Nyfeler and Armbruster 1998) that "the Si–OH distance decreases with the number of bridging O atoms (Si–O–Si) from average values of 1.668 Å for orthosilicates to 1.604 Å for tetrahedra with three bridging O atoms". Additional distortions of silicate anions can be due to strong hydrogen bonds between silanol groups and water molecules. As a result, the strongest deviations from the correlation (1.1) are observed for acid silicates with isolated groups $HSiO_4^{3-}$, $H_2SiO_4^{2-}$, $HSi_2O_7^{5-}$, $HSi_3O_{10}^{7-}$, $H_2Si_3O_{10}^{6-}$, as well as for hydrous acid silicates with polymerized SiO_4 tetrahedra. Several examples of IR spectra of these minerals are given in Figs. 1.16, 1.17, 1.18, and 1.19. For silanol groups forming three bridging Si–O bonds, a series of rather strong bands is usually

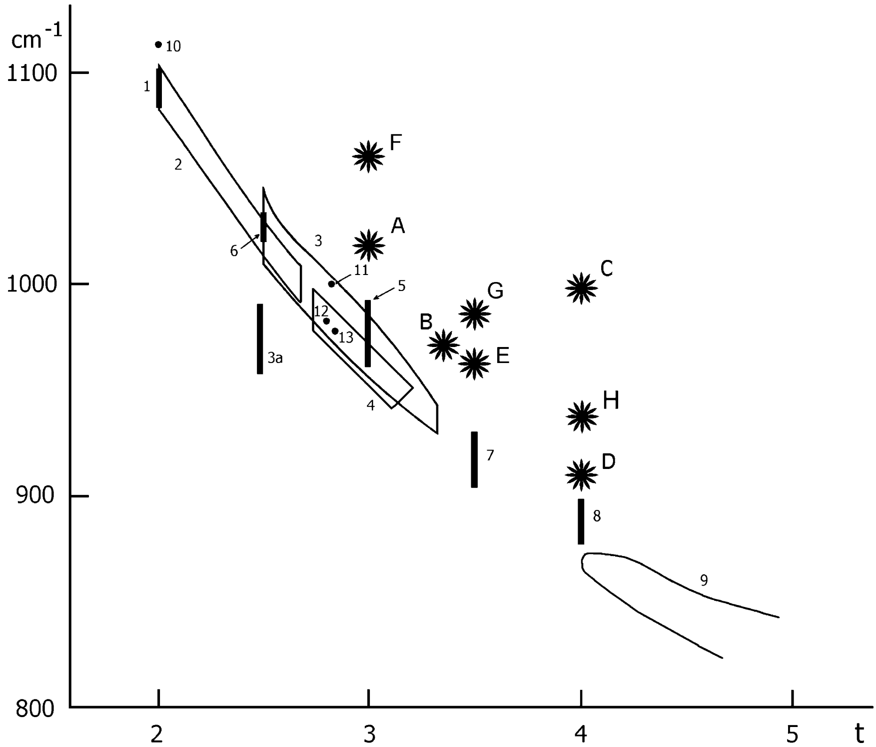


Fig. 1.15 Correlation between $\langle k \rangle$ and t for different modifications of SiO_2 (*1*), tectosilicates (*2*), phyllosilicates (*3*), including magnesium serpentines (*3a*), amphiboles (*4*), inosilicates with chains $(SiO_3)_\infty$ (*5*), silicates with tubular anion topology (fenaksite, agrellite etc.: *6*), sorosilicates (*7*), nesosilicates (*8*), aluminates (*9*), melanophlogite (*10*), nordite (*11*), inesite (*12*) and xonotlite (*13*). Points deviating from the correlation towards high-frequency values (denoted by starlets) correspond to acid silicates megacyclite, lovozerite, tisinalite and litvinskite (*A*), rosenhahnite (*B*), chesnokovite (*C*), afwillite and bultfonteinite (*D*), aklimaite (*E*), yegorovite (*F*), suolunite (*G*), olmiite and poldervaartite (*H*)

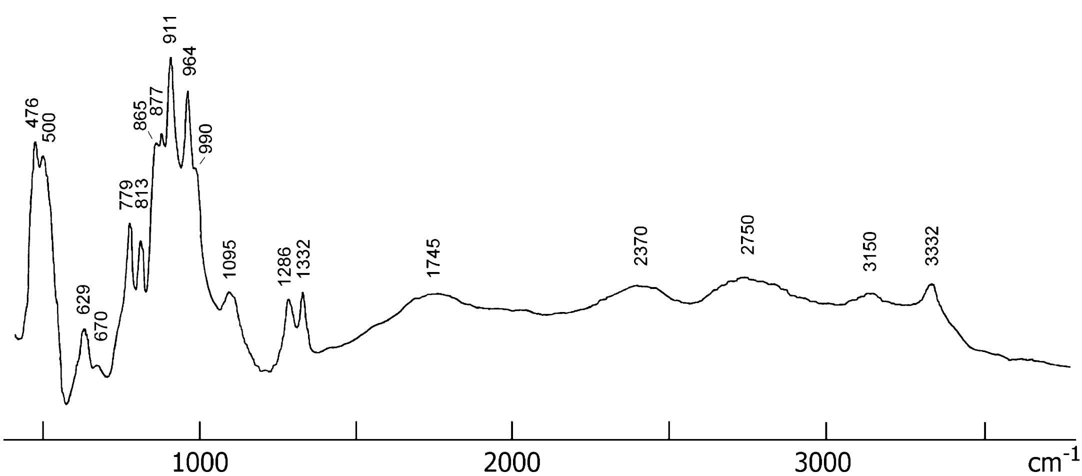


Fig. 1.16 IR spectrum of acid nesosilicate (i.e. orthosilicate) afwillite (revised formula $Ca_3[SiO_4][SiO_2(OH)_2]\cdot 2H_2O$; see Rastsvetaeva et al. 2009) from the Yoko-Dovyren massif, Northern Baikal area

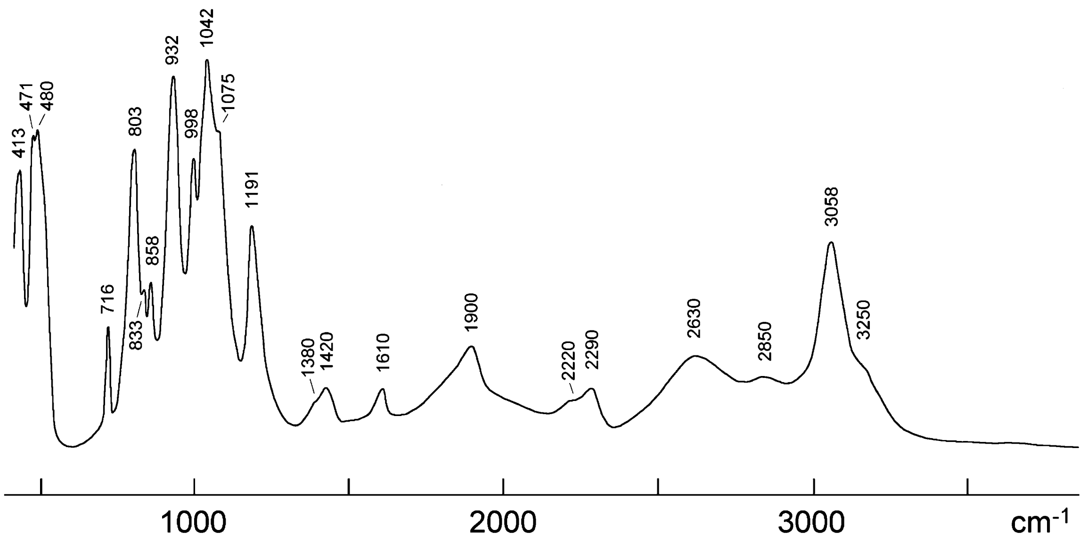


Fig. 1.17 IR spectrum of acid sorosilicate (i.e. diorthosilicate) suolunite $Ca_2[Si_2O_5(OH)_2]{\cdot}H_2O$ from the Yoko-Dovyren massif, Northern Baikal area

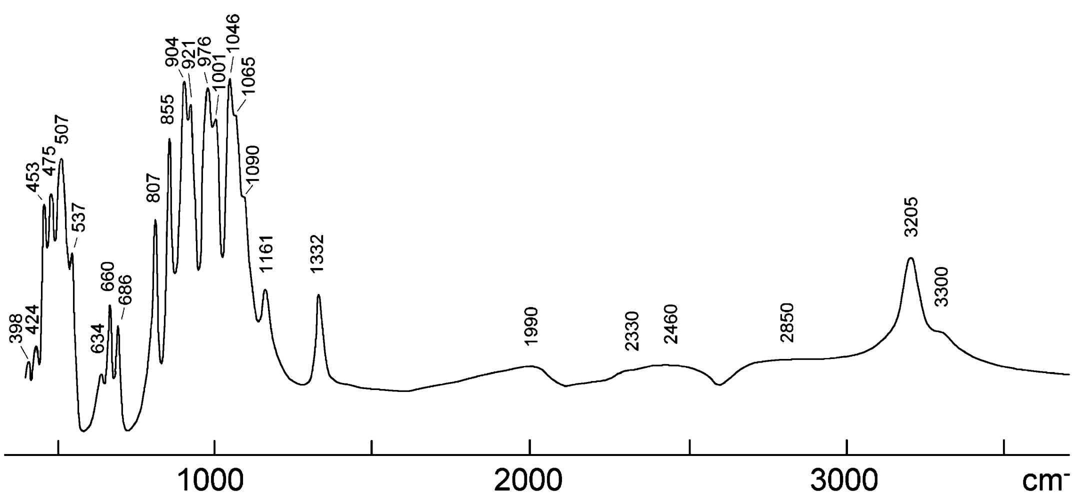


Fig. 1.18 IR spectrum of acid triorthosilicate rosenhahnite $HCa_3(HSi_3O_{10})$ from the Bazhenovskoye deposit, Middle Urals

observed in the range 1,700–3,200 cm^{-1} (Figs. 1.16, 1.17, and 1.18). These bands indicate the presence of multiple states of hydrogen with different O–H-bond strengths (Chukanov and Pekov 2012).

Analogous bands in the range 1,700–3,200 cm^{-1}, as well as bands in the range 1,250–1,500 cm^{-1}, are present in IR spectra of some hydrous acid cyclosilicates (e.g. megacyclite), but as a rule they are not observed in IR spectra of anhydrous acid cyclosilicates, e.g. anhydrous lovozerite-group minerals bearing silanol groups (Chukanov and Pekov 2012). In other words, hydrogen bonding with water molecules results in the polarization and the dissociation of silanol groups.

Vibrational spectra of *hydronium cation* H_3O^+ and hydronium–water clusters (*Zundel cation* $H_5O_2{}^+$, *Eigen cation* $H_9O_4{}^+$ and other forms of

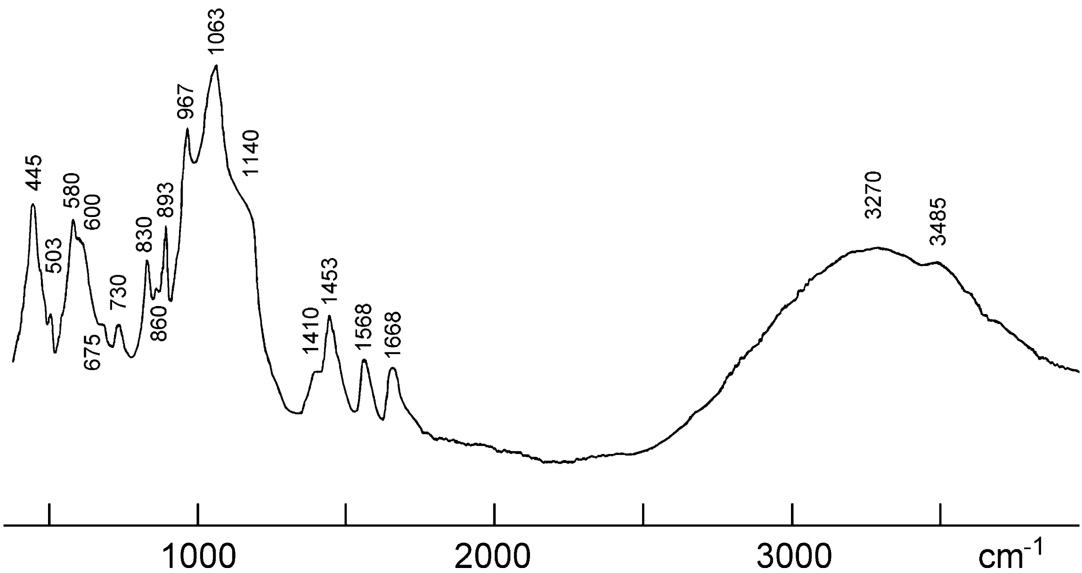


Fig. 1.19 IR spectrum of hydrous acid inosilicate yegorovite $Na_4[Si_2O_4(OH)_2]_2{\cdot}7H_2O$ from the Palitra pegmatite, Lovozero massif, Kola peninsula

hydrated proton) in solids and liquids are discussed in numerous publications (Yukhnevich 1973; Wilkins et al. 1974; Muguet 1996; Kim et al. 2002; Sobolewski and Domcke 2002; Christie 2004; Ortega et al. 2005; Park et al. 2007; Stoyanov et al. 2010; Jianqing Xu et al. 2011). Available experimental data and theoretical studies (including ab initio calculations) demonstrate wide variations of band positions in vibrational spectra of these groups, depending on their configuration and hydrogen bonding. In most cases, a series of broad bands is present in the range 1,100–3,600 cm^{-1}. Characteristic bands of the cation $H_{13}O_6$ present in aqueous solutions of different acids are observed at 3,134 ± 12, 2,816 ± 40, 1,746 ± 11, 1,202 ± 4 and 654 ± 12 cm^{-1}, along with a continuous broad absorption from 600 to 3,400 cm^{-1} (Stoyanov et al. 2010). The presence of the band in the range 1,700–1,800 cm^{-1} in IR spectra of hydronium cation and its aqueous complexes is noted also in other publications (Yukhnevich 1973; Muguet 1996; Kim et al. 2002; Asmis et al. 2003; Headrick et al. 2004; Hammer et al. 2005; Park et al. 2007). Apparently this band could be considered as one of the most reliable indications of the presence of hydrated proton.

There are few valid mineral species, in which hydronium cation is considered as a species-defining component. Among them, there are aqualite, larisaite, chernikovite, trögerite (“hydrogen uranospinite”), hydroniumjarosite and schlossmacherite. In most cases IR spectra of these minerals contain bands (at least weak ones or shoulders) in the range 1,700–1,800 cm^{-1}. For example, for trögerite [“hydrogen uranospinite”, $(H_3O)(UO_2)(AsO_4){\cdot}3H_2O$], the IR absorption band at 1,740 cm^{-1} is indicated by Wilkins et al. (1974). However, there are exceptions from this rule. One of them is minerals of the alunite-jarosite group. Their general formula is $DG_3(TO_4)_2X_6$, where species-defining components are $T = S^{6+}$, P^{5+} or As^{5+}; $G = Al^{3+}$, Fe^{3+}, V^{3+}, Ga^{3+}, Cu^{2+} or Zn^{2+}; $D = K^+$, Na^+, Tl^+, Ag^+, NH_4^+, H_3O^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}, REE^{3+}, Bi^{3+}, Th^{4+}, H_2O or vacancy; X are usually OH^- anions.

The nature of hydroniumjarosite and “hydroniumalunite” (schlossmacherite) has been discussed repeatedly in connection with specific features of IR spectra of these minerals and their synthetic analogues. Hydroniumjarosite and schlossmacherite are considered as H_3O-dominant members of the alunite-jarosite group with idealized formulae $(H_3O)Fe_3(SO_4)_2(OH)_6$

and $(H_3O,Ca_{0.5})Al_3(SO_4)_2(OH)_6$, respectively. Members of solid solutions with the general formula $(K,Na,H_3O,Pb,Ca)(Fe,Al,Zn)_3(SO_4)_2(OH)_3$ are considered to be typical minerals of oxidation zones of sulphide ore deposits. However, in IR spectra of synthetic "hydroniumjarosite" and "hydroniumalunite", as well as (Na,K)-deficient alunite-jarosite group minerals, characteristic bands of H_3O^+ cations are usually absent. Instead of this, bands of HOH bending vibrations are often observed in the range 1,575–1,650 cm^{-1} (Wilkins et al. 1974; Majzlan et al. 2004; Basciano 2008; this book, Chap. 2). It means that the acid–base equilibrium $H_3O^+ + OH^- \leftrightarrow H_2O + H_2O$ (Wilkins et al. 1974) in these minerals is strongly shifted to the right side, corresponding to the presence of H_2O molecules in two sites (one in D and another one in X). Note that already in one in the first publications on this subject (Hendricks 1937), for a synthetic compound with jarosite-type structure, but without large cations, the following formula was suggested: $H_2O{\cdot}Fe^{3+}{}_3(SO_4)_2(OH)_5{\cdot}H_2O$.

The single-crystal X-ray study of synthetic analogue of hydroniumjarosite (Majzlan et al. 2004) did not reveal the position of the H atoms that could belong to the H_3O^+ group, despite the position of H atoms of the OH^-group was readily located in the difference Fourier maps. The presence of two IR bands of HOH bending vibrations in the range 1,575–1,650 cm^{-1} of the IR spectrum of this sample indicates the presence of H_2O molecules in two different sites. Based on these facts, one can suppose that H_2O molecules were not located in synthetic analogue of hydroniumjarosite because they do not conform to R-3 m symmetry.

In IR spectrum of synthetic analogue of ammoniojarosite, a band at 1,743 cm^{-1} was detected (Basciano 2008) that could be an indication of the admixture of H_3O^+ cations. Taking into account this observation, the existence of hydroniumjarosite *s.s.* (as a metastable phase with the predominance of H_3O^+ cations in D site) cannot be ruled out.

In IR spectra of some samples of synthetic H_2O-bearing analogue of hydroniumjarosite, a band of acid sulphate groups $HSO_4^-$is present in the range 1,900–2,000 cm^{-1} (Basciano and Peterson 2008). Note that partial *protonation of tetrahedral anionic groups* in nominally neutral (i.e. not acid) sulphates, arsenates and phosphates is a common phenomenon. In IR spectra of such compounds and minerals, weak bands that cannot be assigned to overtones or mixed modes (two-quantum excitation) are present in the range 1,800–2,500 cm^{-1}.

1.5 Solid-Solution Series

One can distinguish between three kinds of substitutions resulting in the formation of solid-solution series of minerals within the same structural motif:

1. Substitutions between monoatomic ions. Such substitutions can be isovalent (e.g. involving groups of cations $K^+ \leftrightarrow Na^+$, $Fe^{2+} \leftrightarrow Mg^{2+} \leftrightarrow Mn^{2+}$ or anions $F^- \leftrightarrow Cl^-$) or heterovalent (the typical examples are $Ca^{2+} \leftrightarrow Na^+$, $Ba^{2+} \leftrightarrow K^+$, $O^{2-} \leftrightarrow F^-$). In the latter case, charge compensation is required in another site of the structure. As a rule, substitutions between monoatomic ions result in linear dependences of the positions of IR bands on the contents of impurities in a given site.
2. Substitutions between polyatomic groups with covalent interatomic bonds (the typical examples are $CO_3{}^{2-} \leftrightarrow SO_4{}^{2-} \leftrightarrow PO_4{}^{3-} \leftrightarrow AsO_4{}^{3-} \leftrightarrow VO_4{}^{3-} \leftrightarrow SiO_4{}^{4-}$). Such substitutions can be also isovalent or heterovalent and result in the shifts of some IR bands. In addition, each polyatomic impurity group gives additional characteristic bands in the IR spectrum.
3. Substitutions between blocks or clusters including several ions and groups. In particular, such solid solutions are typical for heterophyllosilicates and minerals of labuntsovite and eudialyte groups.

In cases of two-component solid solutions, their compositions can be easily estimated from IR spectra after preliminary calibration using samples with known compositions. The case of multicomponent solid solutions is more complicated (see, e.g. Fig. 1.20). For example, as it was shown by Chukanov and Stepanov (1989),

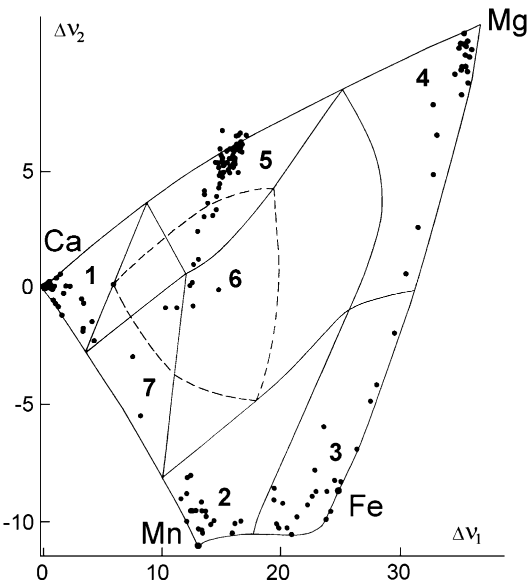


Fig. 1.20 Diagram in coordinates of shifts (cm^{-1}) of the bands of in-plane (ν_1) and out-of-plane (ν_2) vibrations of calcite- and dolomite-group carbonates (Ca,Mn,Mg,Fe)(CO_3) with respect to corresponding bands of pure $CaCO_3$. The figures correspond to the areas of calcite (*1*), rhodochrosite (*2*), siderite (*3*), magnesite (*4*), dolomite (*5*), ankerite (*6*) and kutnohorite (*7*)

formula coefficients for Ca-free carbonates $Mg_yFe_zMn_t(CO_3)$ can be calculated from the following equations:

$$y = 0.0667\Delta\nu_1 - 0.0138\Delta\nu_2 + 0.914.$$

$$t = 1.97 + 1.16y - 0.080\Delta\nu_1.$$

$$z = 1 - y - t.$$

Violations from linear correlations between band shifts and contents of impurities are possible in cases of resonance with other modes or lattice straining due to strong differences between radii of ions present in the same site. Asymmetric broadening of IR bands is an indication of lattice straining caused by strong differences of the sizes of replaced and replacing ions or groups (see Berlyand et al. 1991; Fig. 1.21a, b).

1.6 Force Parameters of Cations in Silicates

In the harmonic approximation, the potential part of the vibrational energy per unit cell can be expressed as $U = \Sigma k_{ij}q_iq_j$, where $1 < i, j < N$; N is the number of vibrational degrees of

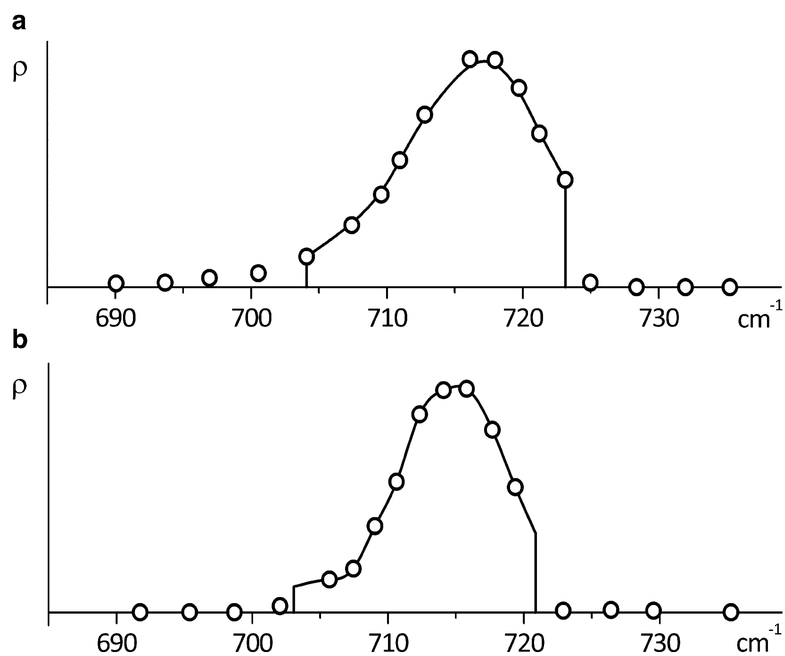


Fig. 1.21 Calculated from the IR spectra (*circles*) and theoretical (Berlyand et al. 1991, *curves*) frequency distribution densities for samples of Fe-bearing calcite with the formulae (**a**) $Ca_{0.92}Fe_{0.08}(CO_3)$ and (**b**) $Ca_{0.85}Fe_{0.15}(CO_3)$

Table 1.1 Characteristics of some cation in silicates

Cation type	Coordination number	Ranges of ionic radii, Å	Examples of cations	Ranges of stretching frequencies, cm^{-1}
H^a	2	$\ll 0.1$	H^+	2,000–3,700
T	4	0.2–0.5	Si^{4+}, Al^{3+}, P^{5+}, B^{3+}	800–1,200
M^b	6	0.6–0.7	Ti^{4+}, Nb^{5+}, Zr^{4+}, Al^{3+}, Fe^{3+}, Y^{3+}, Mn^{3+}, Sn^{4+}, W^{6+}	500–750
D^c	6	0.7–1.0	Mn^{2+}, Fe^{2+}, Mg^{2+}, Zn^{2+}, Ca^{2+}	400–500
A	> 6	1.1–1.5	Na^+, K^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Pb^{2+}	<400

[a]Hydrogen atom forming one covalent bond and one hydrogen bond
[b]High-force-strength octahedral cations with charges >2
[c]Medium-force-strength bivalent octahedral cations

freedom per unit cell and q_i and q_j are deviations of local coordinates (i.e. lengths of chemical bonds and angles between them) from their equilibrium values. The values k_{ij} with $i = j$ are usually much higher than that with $i \neq j$, and therefore, the parameter $k_{ii} = \left|\partial^2 U / \partial q_i^2\right|$ can be considered as a proper force characteristic of the ith bond. Generally speaking, the frequencies of absorption bands in the IR spectra of crystalline substances correspond to lattice modes and are related to collective vibrations of a large number of atoms within the region of coherent vibrations. However, in real periodic structures collective vibrations of each kind involve mainly chemical bonds of a certain type, and, as a result, frequencies of normal vibrations are determined by local force parameters of these bonds (see, e.g. Loghinov et al. 1979; Chukanov and Kumpanenko 1988). Thus, with a certain degree of approximation, the frequency ν_i of a spectral band of stretching vibrations involving chemical bonds of a given type is connected with the force parameter k_{ii} of these bonds according the equation $k_{ii} = 4\pi^2 \mu \nu_i^2$, where μ is the reduced mass of corresponding normal oscillator (for cations with atomic numbers >12 coordinated by oxygen, the value of μ varies from 10 to 16).

The values k_{ij} of the bonds formed by cations with oxygen (and consequently the frequencies of corresponding stretching normal vibrations ν_i) depend on the cation charge, the cation coordination number and the mean cation–anion distance. With a definite degree of conditionality, one can divide cations in silicates in five types in accordance with their force and spectroscopic characteristics (Table 1.1).

In the so-called amphoterosilicates containing high-force-strength amphoteric cations of the M type (heteroframework silicates, heterophyllosilicates, etc.), all types of cations can be present in the same structure showing different properties (Chukanov and Pekov 2005). For example, A cations in low-density structures show trend to substitutions by other cations, site splitting and the presence of vacancies in A sites. For D sites vacancies and substitutions (but not splitting) are also typical. For M and T sites vacancies and splitting are nontypical, but isovalent and heterovalent substitution is a common occurrence. Some examples of general formulae of some "amphoterosilicates" with grouping of cations in accordance with their force characteristics are given below:

Labuntsovite group (monoclinic members): $A1_4A2_4A3_4D_2M_8(T_4O_{12})_4(OH,O)_8{\cdot}nH_2O$.

Lovozerite group: $A1_3A2_3D_2MT_6O_{12}O_{6-x}(OH)_x{\cdot}nH_2O$.

Kukisvumite group: $A_6DM_4(T_2O_6)_4O_4{\cdot}4H_2O$.

Note that this classification of cations in accordance with their force characteristics reflects more general crystal-chemical relationships. In particular, wide mutual substitutions between cations belonging to the same type are common in minerals. For cations from different groups, mutual substitutions are usually restricted.

Two low-charge cations with small radii, Li^+ and Be^{2+}, present special cases. A.S. Povarennykh (1978) indicates frequency ranges 380–470 and 700–855 cm^{-1} for stretching vibrations of LiO_4 and BeO_4 tetrahedra, respectively. However, the presence of distinct bands in the range 540–600 cm^{-1} of IR spectra of some Li-bearing amphiboles, pyroxenes and micas and the absence of such bands in their Li-free counterparts indicate that for the tetrahedra LiO_4 the frequency range of stretching vibrations should be widened.

It is important to note that frequencies of stretching vibrations of coordination polyhedra with oxygen-bearing ligands depend not only on force characteristics of cations, but also on the character of polymerization of the polyhedra (see Sect. 2.3). In silicates with polymerized SiO_4 tetrahedra, the position of the most high-frequency Si–O-stretching band, $\nu_{Si\text{–}O}$(max) depends on the value of *the greatest Si–O–Si angle*, φ_{SiOSi}. At $\varphi_{SiOSi} = 180°$ the value $\nu_{Si\text{–}O}$(max) is close to 1,200 cm^{-1} in Al-free silicates and lowers with the substitution of Si with Al. For example, in the IR spectrum of xonotlite (with $\varphi_{SiOSi} = 180°$ at the stacking of wollastonite-type chains; see Kudoh and Takeuchi 1979) $\nu_{Si\text{–}O}$(max) is equal to 1,203 cm^{-1}. The crystal structure of tobermorite is also based on xonotlite-type bands with $\varphi_{SiOSi} \approx 180°$. For Al-free tobermorite $Ca_{4\text{–}5}[Si_6(O,OH)_{17}]{\cdot}5H_2O$, the value $\nu_{Si\text{–}O}$(max) is equal to 1,203 cm^{-1}. The substitution of Si for Al in tobermorite results in the lowering of $\nu_{Si\text{–}O}$(max) (up to 1,173 cm^{-1} at 0.5 apfu Al and up to 1,150 cm^{-1} at 1 apfu Al). In IR spectra of minerals belonging to the palygorskite and the sepiolite groups and structurally related minerals ("palysepioles", with $\varphi_{SiOSi} \approx 180°$ at the stacking of tetrahedral bands, see Cámara et al. 2002; Ferraris and Gula 2005; Chukanov et al. 2012), the value $\nu_{Si\text{–}O}$(max) varies from 1,160 to 1,212 cm^{-1} (the lowest values correspond to the samples with Si partly substituted by Al or Fe^{3+}). Another example is suolunite $Ca_2[Si_2O_5(OH)_2]{\cdot}H_2O$ (Ma et al. 1999) with $\varphi_{SiOSi} = 180°$, $\nu_{Si\text{–}O}(max) = 1{,}191$ cm^{-1}. In contrast to these examples, for cuspidine $Ca_8(Si_2O_7)_2F_4$ (Saburi et al. 1977) $\varphi_{SiOSi} = 155.4°$, $\nu_{Si\text{–}O}(max) = 1{,}057$ cm^{-1}; for kilchoanite $Ca_6(Si_3O_{10})(SiO_4)$ (Taylor 1971) $\varphi_{SiOSi} = 117°$, $\nu_{Si\text{–}O}(max) = 1{,}047$ cm^{-1}.

2 IR Spectra of Minerals and Reference Samples Data

This chapter contains figures of transmittance IR spectra of mineral species accompanied with the descriptions of reference samples given in the form of extended figure captions. The Sects. 2.1, 2.2, and 2.3, etc., are arranged in ascending order of the atomic number Z_a of the main species-defining element for a given class of minerals: first for borate minerals (with $Z_a = 5$ for boron), than for carbides, carbonates and organic substances (with $Z_a = 6$ for carbon); for ammino-complexes, nitrates and sulfato-nitrates (with $Z_a = 7$ for nitrogen); for oxides and hydroxides (with $Z_a = 8$ for oxygen) and so on.

IR spectra presented in this chapter have been recorded mainly in the period from 1989 to 2013. In order to obtain absorbance or transmittance infrared spectra, powdered mineral samples have been mixed with anhydrous KBr, pelletized and analysed using different spectrophotometers (Specord 75 IR or Specord M80, Carl Zeiss, Jena, Germany), Perkin Elmer 1600 Series FT IR spectrometer or ALPHA FT IR spectrometer (Bruker Optics, Ettlingen, Germany). IR spectrum of a pure KBr disc was subtracted from the overall spectrum. Samples unstable in air due to rapid hydration, dehydration or oxidation have been dispersed in mineral oil (nuyol). In these cases, the absorption spectrum of the oil has been subtracted from the spectrum of the mineral suspension in nuyol.

It is important to note that reflectance mode IR spectra, IR spectra obtained without immersion medium (e.g. KBr), as well as IR spectra of single crystals, coarse-grained or textured aggregates cannot be considered as stable and reliable diagnostic characteristics of mineral species due to specific effects induced by orientation, polarization, scattering and reflection conditions. For example, in case of a single crystal, bands corresponding to normal vibrations with polarization vector parallel to the direction of propagation of IR radiation are absent in the spectrum. However, these bands can be observed at another orientation of the crystal. For the above reasons, *only transmittance or absorbance IR spectrum of a pulverized sample dispersed in an immersion medium is a stable characteristic of a mineral and can be used as a diagnostic tool.*

For each reference sample, its origin (the locality) is indicated. Additional information includes general appearance, associated minerals, methods of the mineral species identification and the list of wavenumbers of absorption bands with the indication of strong bands, weak bands and shoulders. IR spectroscopy itself can be considered as an adequate identification method if IR spectrum is unique for a given mineral and coincides with IR spectrum of a well-investigated sample.

For most samples, empirical formulae are given, or authors of their investigations are indicated. For more than 250 samples (mainly for holotypes of mineral species), a more detailed information is given including unit-cell dimensions, symmetry, strongest reflections of the powder X-ray diffraction pattern, empirical formula, optical data and density.

N.V. Chukanov, *Infrared spectra of mineral species: Extended library*,
Springer Geochemistry/Mineralogy, DOI 10.1007/978-94-007-7128-4_2,

The following *abbreviations* are used in this chapter:

Mt.	mountain
Co.	county
IR	infrared
D	density
D_{meas}	measured density
D_{calc}	calculated density
Apfu	atoms per formula unit
Z	the number of formula units per unit cell
α, β, γ	refractive indices for biaxial minerals
ω, ε	refractive indices for uniaxial minerals
n	refractive index for isotropic minerals
2*V*	angle between optic axes
d	interplanar spacing
I	relative intensity of a line in the powder X-ray diffraction pattern
REE	rare earth elements
Ln	lanthanides
s	strong band
w	weak band
sh	shoulder (inflection point of the spectral curve)

For the numeration of samples, double letter-figure symbols are used. The same numeration is used in figure captions for Chap. 1. The meaning of letter parts of the symbols is explained in Table 2.1. Note that these designations are conventional and not unambiguous. For example, carbokentbrooksite $(Na,\square)_{12}(Na,Ce)_3Ca_6Mn^{2+}{}_3Zr_3Nb(Si_{25}O_{73})(OH)_3(CO_3)\cdot 2H_2O$ can be classified as cyclosilicate, as zirconosilicate or as carbonatosilicate.

Table 2.1 The meaning of letter symbols used in the numbering of reference samples

Symbol	Meaning of the symbol	Symbol	Meaning of the symbol
B	Borates	Sif	Tectosilicates (aluminosilicates with 3d frameworks formed by SiO_4 and AlO_4 tetrahedra), except zeolites
Bo	Borates with isolated orthogroups BO_3	Sif_Z	Zeolites
BAs	Arsenato-borates	Siod	Silicates containing both orthogroups SiO_4 and diorthogroups Si_2O_7
BC	Carbonato-borates	Sir	Cyclosilicates (“r” means “ring”)
C	Carbonates	Sit	Triorthosilicates with groups Si_3O_{10}
Org	Organic compounds and salts of organic acids	SSi	Sulfato-silicates
Crbd	Carbides	TiSi	Titanosilicates and related zircono-, niobo- and stannosilicates (except heterophyllosilicates and minerals belonging to the labuntsovite and the eudialyte groups)
N	Minerals with NO_3^- groups	USi	Silicates with uranyl groups UO_2^{2+} (except nesosilicates)
Am	Ammino-complexes	VSi	Vanadato-silicates
O	Oxides and hydroxides	P	Phosphates
F	Fluorides	S	Sulfates
Si	Silicates with unknown or complex structures	SC	Carbonato-sulfates
Sio	Nesosilicates (i.e. silicates with orthogroups SiO_4)	SP	Phosphato-sulfates
Sil	Phyllosilicates (with layers formed by SiO_4 and AlO_4 tetrahedra)	Cl	Chlorides and hydroxychlorides
AsSi	Arsenato-silicates	V	Vanadates, V oxides and hydroxides

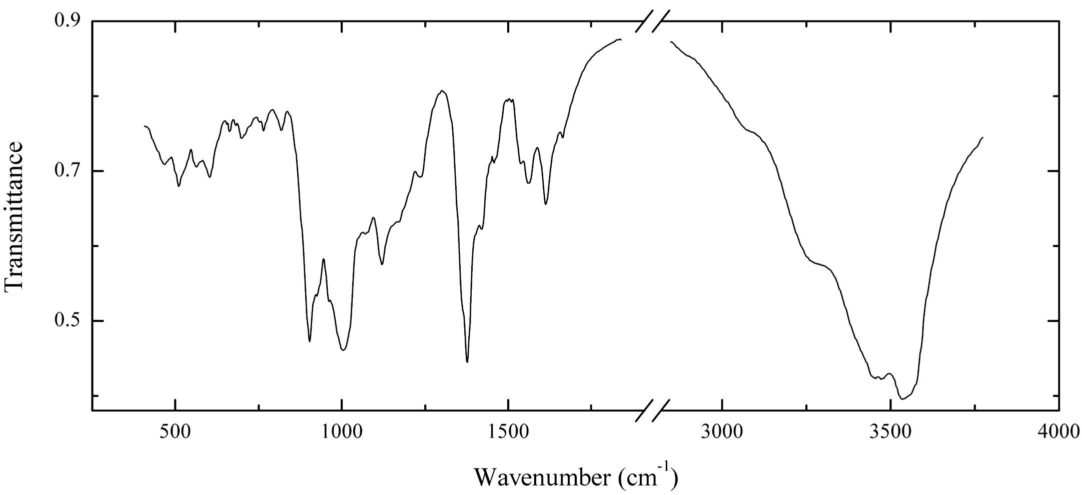
(continued)

Table 2.1 (continued)

Symbol	Meaning of the symbol	Symbol	Meaning of the symbol
BeSi	Beryllosilicates	Cr	Chromates
BSi	Borosilicates and borato-silicates	As	Arsenates and arsenites
CSi	Carbonato-silicates	UAs	Uranyl arsenates
PSi	Phosphato-silicates	AsS	Sulfato-arsenates
Sia	Amorphous silicates	Se	Selenites
Sib	Inosilicates with bands formed by SiO_4 and AlO_4 tetrahedra	Mo	Molybdates, Mo oxides and hydroxides
Sic	Inosilicates with chains formed by SiO_4 and AlO_4 tetrahedra	Te	Tellurates and tellurites
Sid	Sorosilicates (i. e. silicates with diorthogroups Si_2O_7 or $SiAlO_7$)	W	Wolframates, W oxides and hydroxides

2.1 Borates, Including Sulfato-Borates and Arsenato-Borates

B1 Hydrochlorborite $Ca_2B_4O_4(OH)_7Cl·7H_2O$

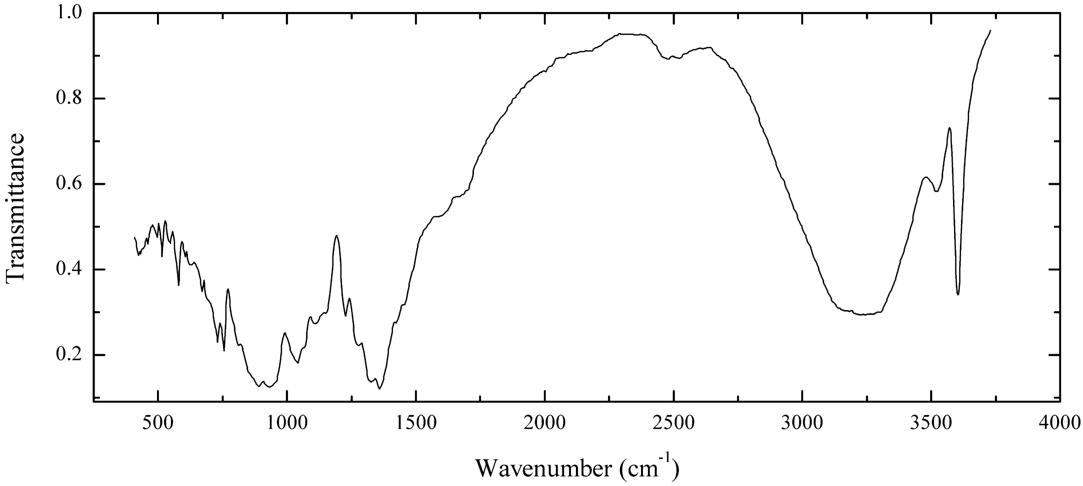


Locality: Salar de Carcote deposit, El Loa province, Antofagasta, Chile.

Description: Colourless crystal from the association with halite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3525s, 3455s, 3260sh, 3070sh, 1667w, 1619, 1570, 1544, 1465sh, 1424, 1378s, 1365sh, 1240, 1170sh, 1124, 1078, 1009s, 967, 925, 904s, 822w, 764w, 703w, 664w, 603, 567, 510, 460.

B2 Colemanite $CaB_3O_4(OH)_3 \cdot H_2O$

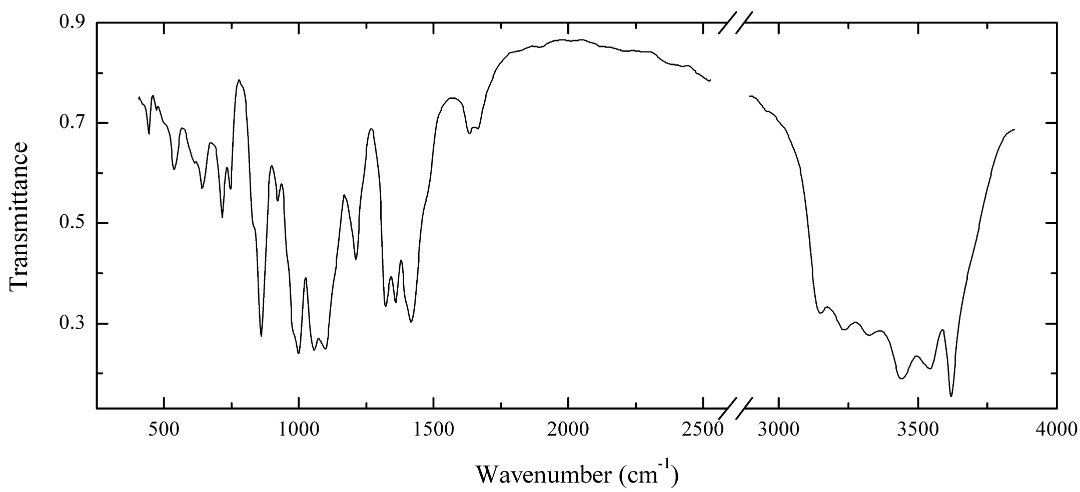


Locality: Boron Open Pit, Boron, Kern Co., California, USA.

Description: Colourless crystal from the association with ulexite and kernite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3608, 3525, 3245s, 1675sh, 1590sh, 1460sh, 1363s, 1330s, 1282, 1229, 1154, 1117, 1065sh, 1044s, 935s, 893s, 865sh, 813, 758, 732, 695sh, 669, 629, 603w, 578, 546w, 513, 495w, 422.

B3 Ulexite $NaCaB_5O_6(OH)_6 \cdot 5H_2O$

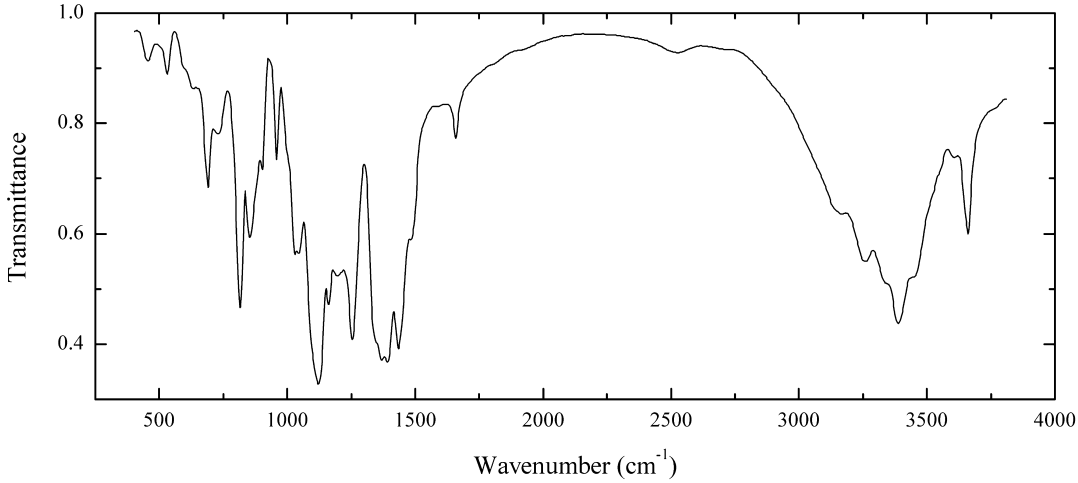


Locality: Bulganak area of mud volcanos, Kerch peninsula, Crimea, Ukraine.

Description: White soft concretion. Specimen No. 37869 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Identified by IR spectrum.

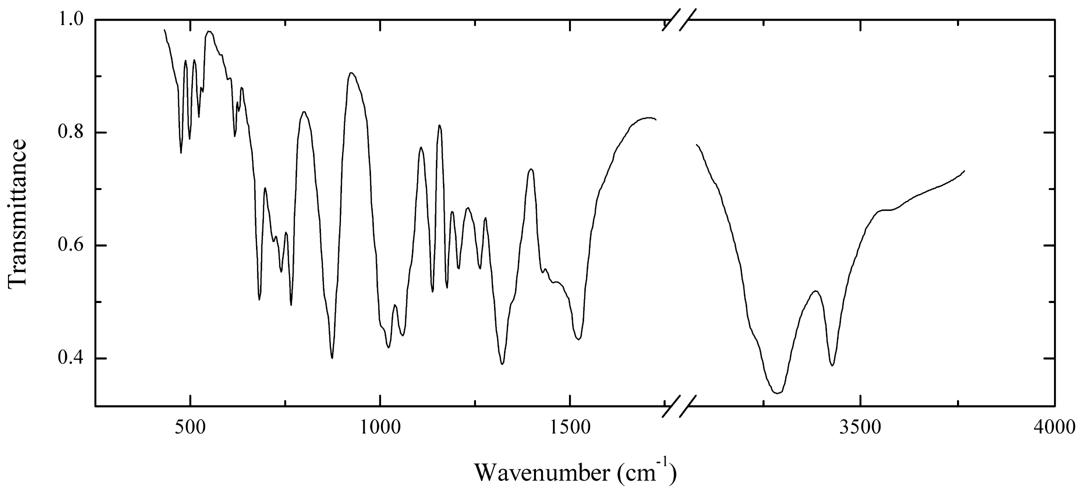
Wavenumbers (cm^{-1}): 3600, 3520, 3420, 3305, 3220, 3125, 1667, 1631, 1470sh, 1413, 1395sh, 1355, 1319, 1211, 1190sh, 1099s, 1058s, 1001s, 980sh, 960sh, 921, 860s, 837, 747, 716, 643, 611, 538, 505sh, 471w, 445.

B4 Aksaite $MgB_6O_7(OH)_6{\cdot}2H_2O$



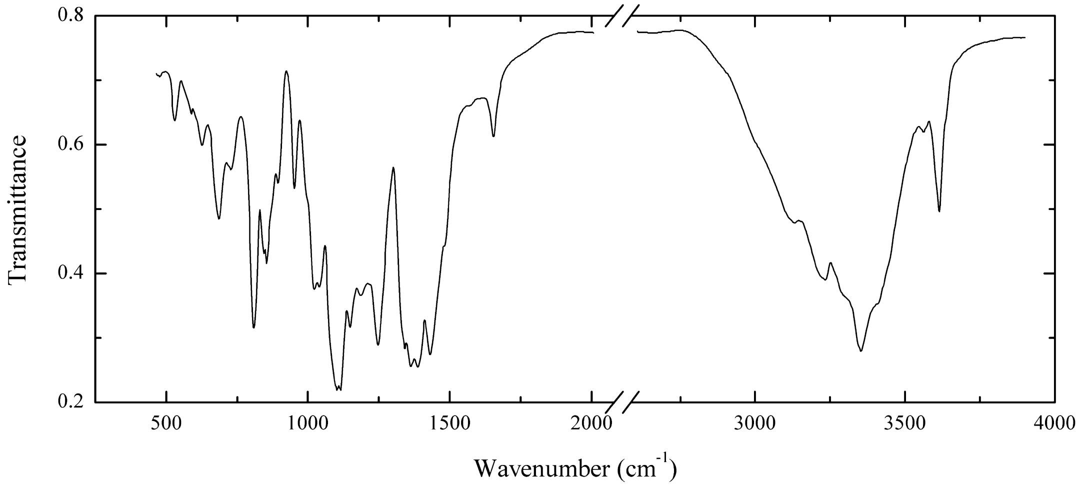
Locality: Chelkar salt dome, Aksai Valley, Aktobe region, Kazakhstan (type locality).
Description: Colourless crystals from granular aggregate of halite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3620, 3560w, 3410sh, 3350, 3310sh, 3215, 3120, 2490w, 1656, 1482, 1431s, 1388s, 1365s, 1344s, 1248s, 1198, 1158, 1121s, 1045, 1028, 1005sh, 957, 902, 856, 816, 735, 690, 637w, 600sh, 532w, 457w.

B5 Ameghinite $NaB_3O_3(OH)_4$



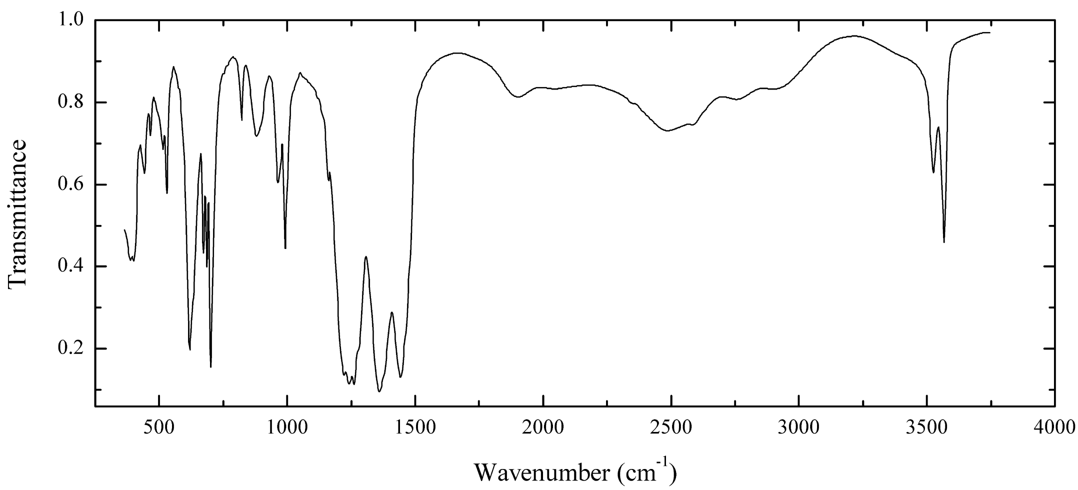
Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta province, Argentina (type locality).
Description: Colourless grains. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3405, 3265s, 1530s, 1467, 1431, 1355, 1324s, 1264, 1210, 1178, 1139, 1061s, 1024s, 1004sh, 985sh, 875s, 855sh, 766s, 739, 721, 683s, 630w, 618, 531w, 523, 500, 477.

B6 Aksaite $MgB_6O_7(OH)_6{\cdot}2H_2O$



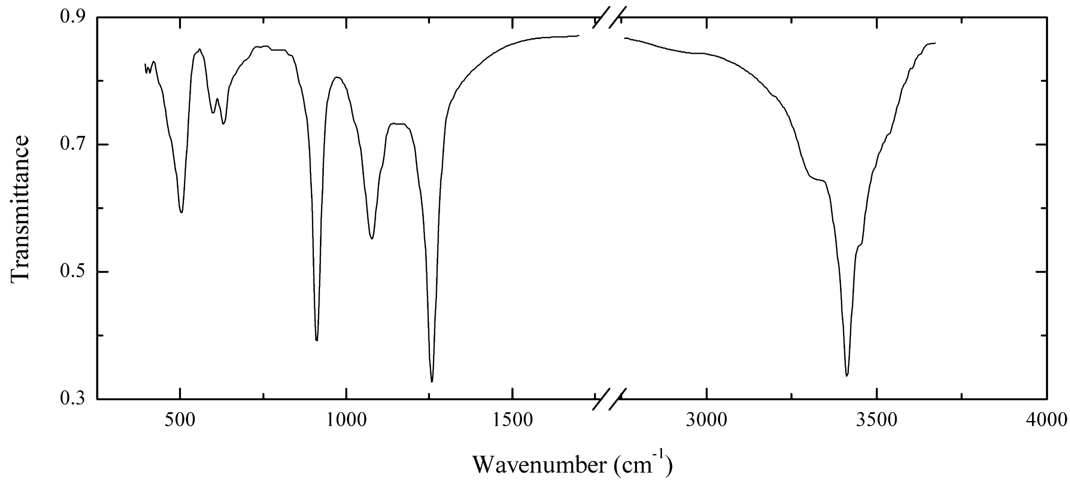
Locality: Chelkar salt dome, Aksai Valley, Aktobe region, Kazakhstan (type locality).
Description: Colourless crystals from massive halite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3610, 3550w, 3400sh, 3345, 3300sh, 3215, 3115, 1654, 1484, 1433s, 1391s, 1367s, 1347s, 1251s, 1195, 1159, 1123s, 1115s, 1046, 1028, 1000sh, 957, 903, 855, 846, 816s, 733, 690, 629, 597w, 533.

B7 Sussexite $Mn^{2+}BO_2(OH)$



Locality: Franklin, Sussex Co., New Jersey, USA (type locality).
Description: Pink massive aggregate from the association with willemite and Mn carbonates. Identified by IR spectrum. Mg-rich variety. The empirical formula is (electron microprobe) $Mn_{0.59}Mg_{0.36}Zn_{0.04}Fe_{0.01}BO_2(OH)$.
Wavenumbers (cm^{-1}): 3560, 3515, 2890w, 2770w, 2585w, 2490, 2355sh, 2015w, 1895w, 1461sh, 1443s, 1361s, 1275sh, 1261s, 1241s, 1225s, 993, 967, 883, 826, 702s, 688, 674, 620s, 530, 514, 467w, 441, 401, 380.

B9 Bandylite $CuB(OH)_4F$

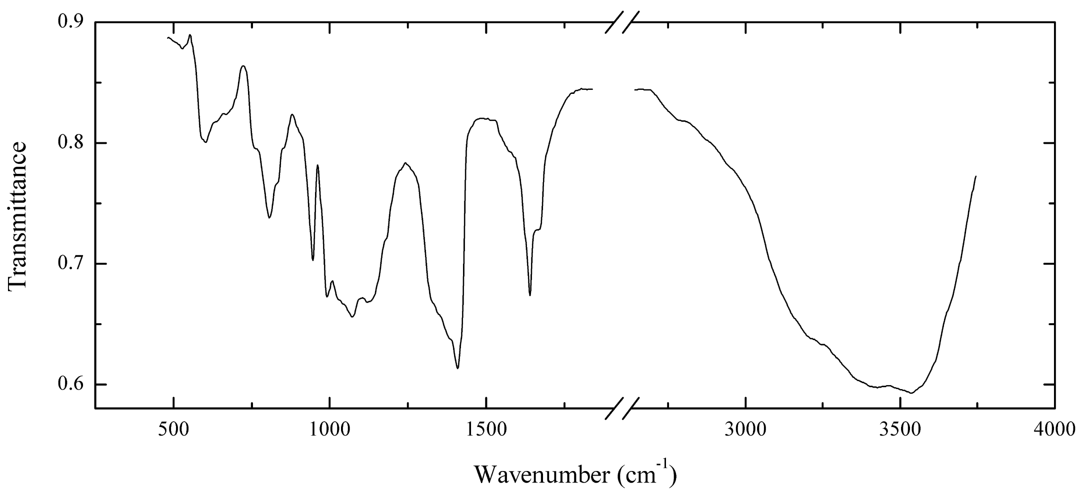


Locality: Palestina, Atacama, Chile.

Description: Blue crystals from the association with a betpakdalite group mineral. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3430sh, 3395s, 3310sh, 1257s, 1078, 912s, 636, 601, 504, 402w.

B10 Borax $Na_2B_4O_5(OH)_4·8H_2O$

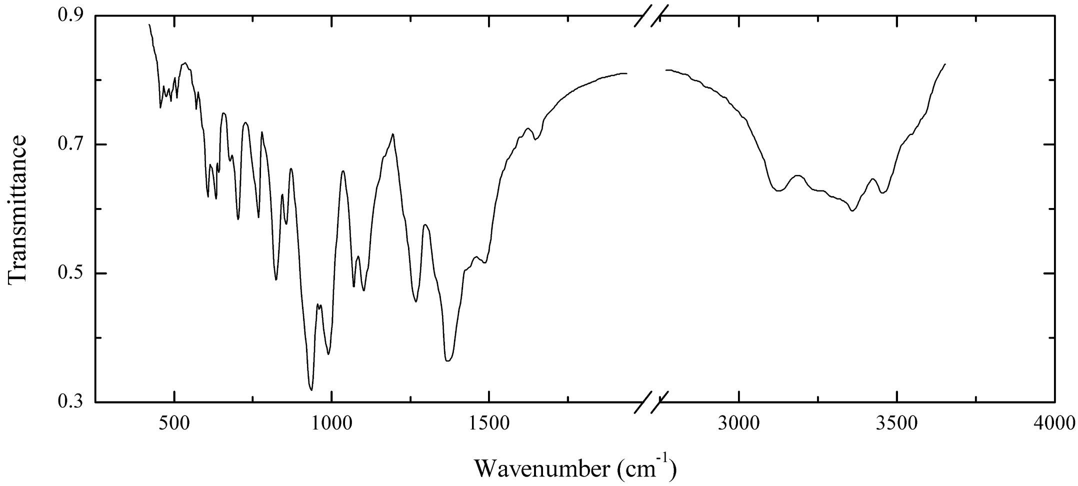


Locality: An unknown locality in Siberia, Russia.

Description: Colourless crystal. IR spectrum was obtained using a suspension in vaseline oil. The spectrum of vaseline oil is subtracted.

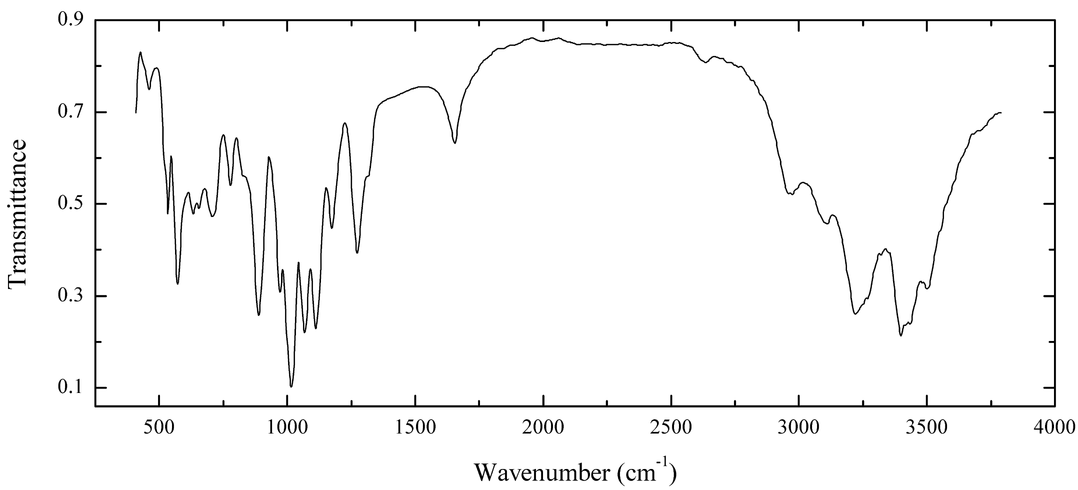
Wavenumbers (cm^{-1}): 3510s, 3410s, 3200sh, 1660sh, 1640, 1413s, 1385sh, 1330sh, 1180sh, 1127, 1070s, 1025sh, 994, 855sh, 830sh, 807, 760sh, 687sh, 652sh, 610.

B11 Veatchite $Sr_2[B_5O_8(OH)]_2B(OH)_3{\cdot}H_2O$



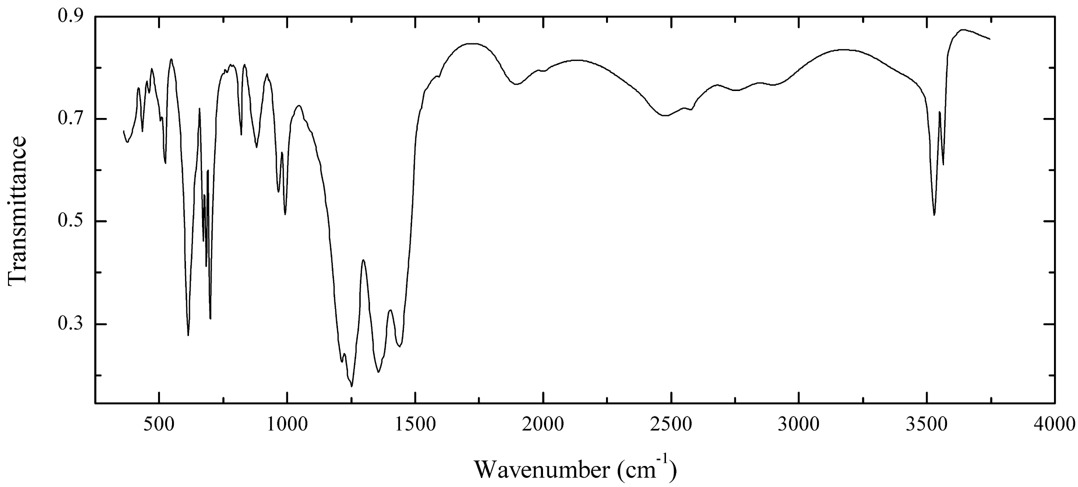
Locality: Inder boron deposit, Atyrau region, Kazakhstan.
Description: White fibrous aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3440, 3340, 3280sh, 3230sh, 3105, 1650w, 1490, 1435sh, 1372s, 1265s, 1102s, 1071s, 992s, 962, 936s, 857, 823s, 769, 703, 677w, 641w, 631, 606, 570w, 506w, 489w, 478w, 460w.

B12 Lüneburgite $Mg_3B_2(PO_4)_2(OH)_6{\cdot}6H_2O$



Locality: Bulganak area of mud volcanos, Kerch peninsula Crimea, Ukraine.
Description: White fine-grained aggregate from the association with tincalconite and gypsum. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mg_{2.83}Fe_{0.08}Mn_{0.04}B_2(PO_4)_{1.95}(SO_4)_{0.05}(OH)_6{\cdot}6H_2O$.
Wavenumbers (cm^{-1}): 3495, 3440, 3390s, 3250sh, 3215, 3100, 2965, 2625w, 1665, 1325sh, 1283, 1185, 1122s, 1075s, 1020s, 973, 891s, 830sh, 783, 712, 664, 638, 576, 537, 520sh, 462w.

B13 Sussexite $Mn^{2+}BO_2(OH)$

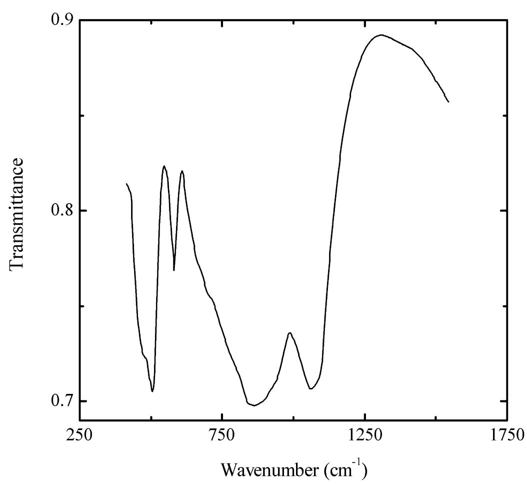


Locality: Gonzen mine, Sargans, St. Gallen, Switzerland.

Description: Pink fibrous aggregate from the association with Mn carbonates. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mn_{0.81}Mg_{0.19}BO_2(OH)$.

Wavenumbers (cm^{-1}): 3555, 3520, 2900w, 2760w, 2575w, 2470, 2000w, 1900w, 1590sh, 1442s, 1362s, 1257s, 1245sh, 1218s, 993, 969, 884, 822, 701s, 686, 673, 648, 616s, 525, 509w, 460w, 436w, 370.

B14 Schiavinatoite $(Nb,Ta)BO_4$

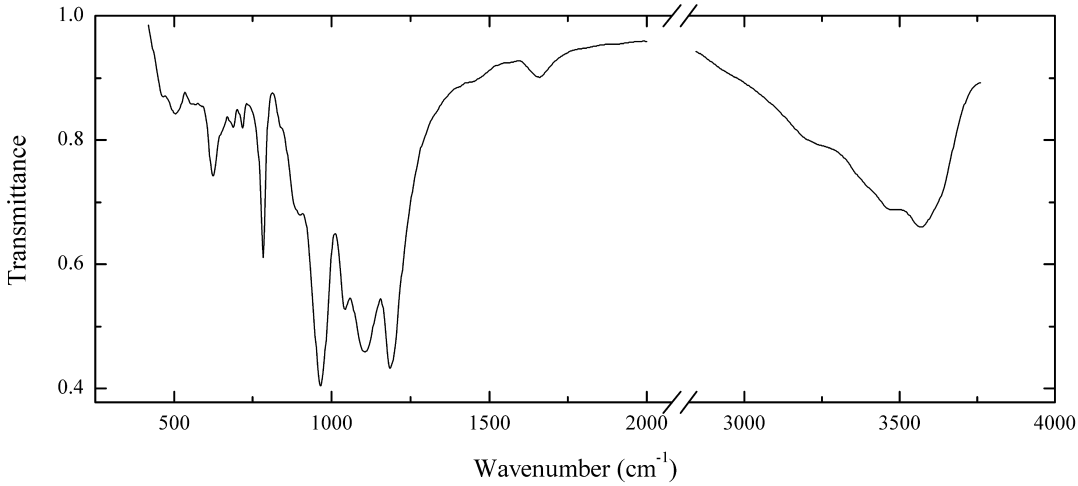


Locality: Ampanodiana North pegmatite, Tetezantsio-Andoabatokely Pegmatite Field, Andrembesoa Commune, Betafo District, Vakinankaratra Region, Antananarivo Province, Madagascar.

Description: Grey grains from the association with rynersonite.

Wavenumbers (cm^{-1}): 3260w, 1062s, 920sh, 865s, 581, 504s, 470sh.

B15 Vitimite $Ca_6B_{14}O_{19}[SO_4](OH)_{14}{\cdot}5H_2O$

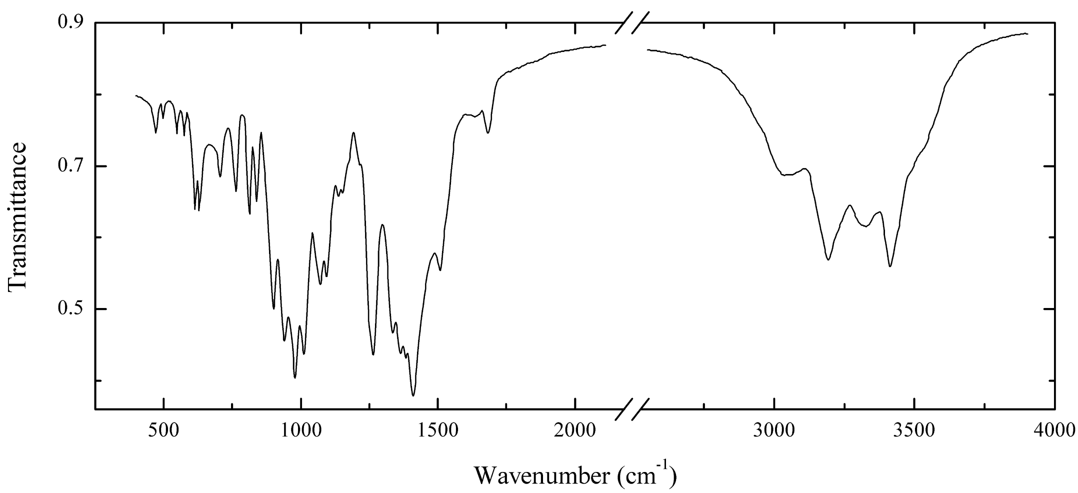


Locality: Borehole (depth 129.4 m) at the Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia (type locality).

Description: Veinlet in fedorovskite, in the association with calcite, priceite, kurchatovite, ludwigite, magnetite, sphalerite and pyrite. Holotype sample. Monoclinic, pseudohexagonal, space group *P*2/*m*, *P*2 *or Pm*; $a = 14.10(2)$, $b = 19.53(1)$, $c = 14.05(2)$ Å, $\beta \approx 120°$; $Z = 4$. The empirical formula is $Ca_{6.23}B_{13.98}O_{19.24}(SO_4)(OH)_{13.91}{\cdot}4.78H_2O$. Optically biaxial (−), $\alpha = 1.532(3)$, $\beta = 1.537(1)$, $\gamma = 1.540(1)$. $D_{calc} = 2.24(3)$ g/cm^3, $D_{meas} = 2.29(3)$ g/cm^3. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 12.2 (100), 3.45 (50), 3.036 (60), 2.720 (70), 1.992 (50).

Wavenumbers (cm^{-1}): 3570sh, 3535, 3435, 3220sh, 1650w, 1185s, 1103s, 1041s, 964s, 898. 835sh, 782, 716w, 686w, 621, 549w, 538w, 500w, 465sh.

B16 Volkovskite $KCa_4B_{22}O_{32}(OH)_{10}Cl{\cdot}4H_2O$

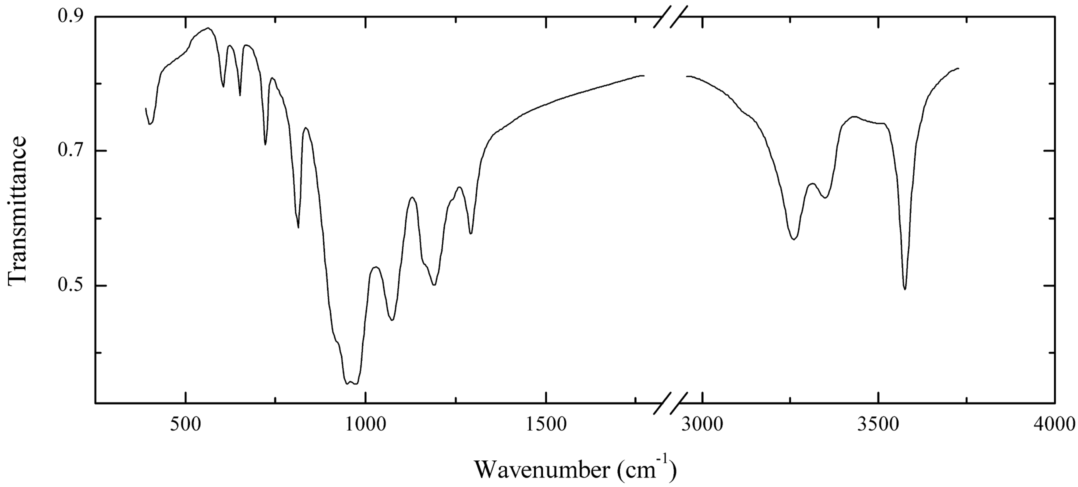


Locality: Satimola salt dome, Western Kazakhstan region, Kazakhstan.

Description: Colourless platy crystals from massive halite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3400, 3300, 3175, 3020, 1685w, 1640w, 1510, 1410s, 1386s, 1366s, 1338s, 1266s, 1250sh, 1215w, 1175sh, 1156, 1137, 1099, 1068, 1015s, 982s, 936s, 903s, 840, 812, 763, 704, 626, 610, 572w, 548w, 494w, 475w.

B17 Vimsite $CaB_2O_2(OH)_4$

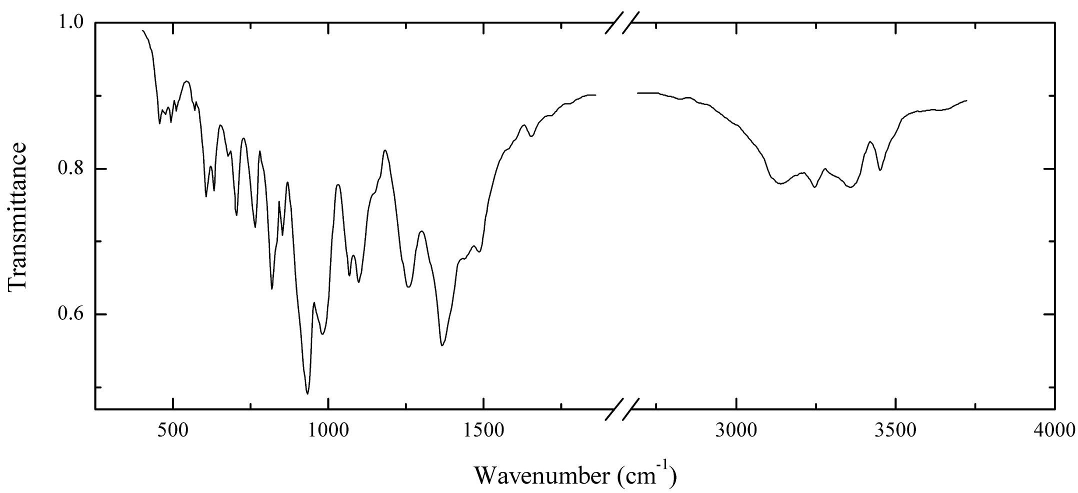


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: Colourless crystals from the association with calcite, kurchatovite, sakhaite, frolovite, ludvigite and magnetite. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3560s, 3340, 3250, 1291, 1240sh, 1191, 1160sh, 1072s, 968s, 944s, 920sh, 807, 718, 646, 602, 500sh, 401.

B18 Veatchite $Sr_2[B_5O_8(OH)]_2B(OH)_3{\cdot}H_2O$

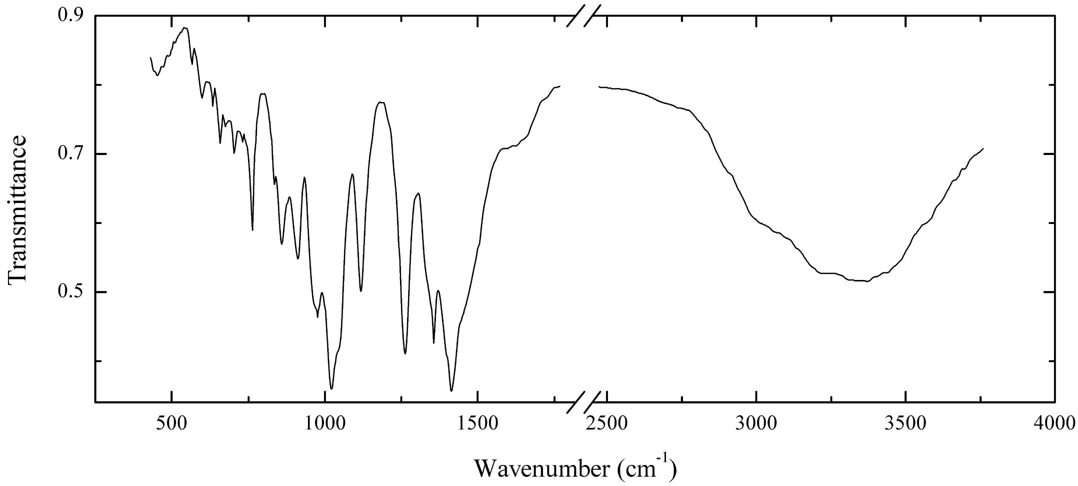


Locality: Billie mine, Death Valley, California, USA.

Description: White platelets with pearly lustre. The polytype “p-veatchite”. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3435, 3350, 3235, 3130, 1654w, 1485, 1437, 1367s, 1265, 1170sh, 1150sh, 1100, 1070, 990s, 933s, 855, 820, 767, 704, 679w, 631, 607, 567w, 509w, 491w, 477w, 460w.

B19 Gowerite $CaB_6O_{10}\cdot5H_2O$

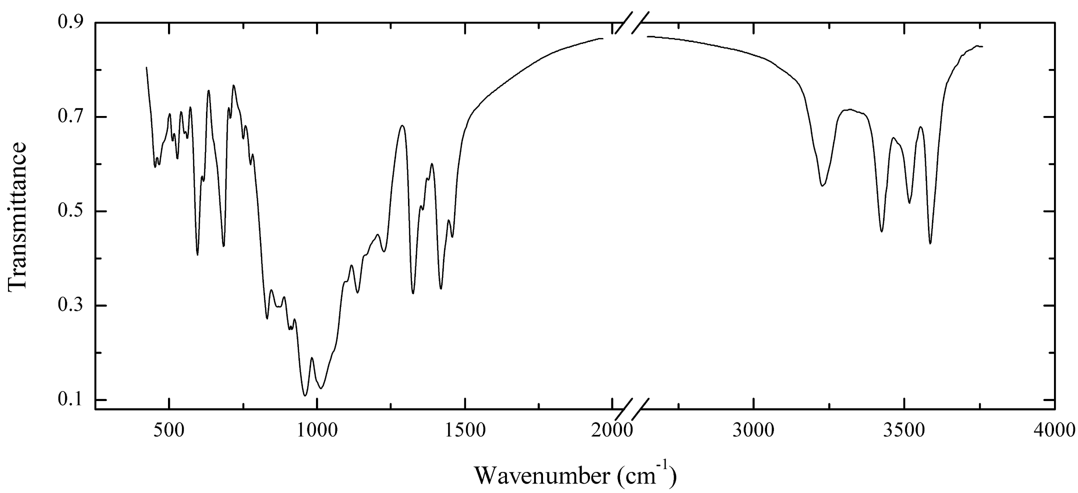


Locality: Death Valley, California, USA.

Description: White fibrous aggregate. Specimen No. 77795 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 3325, 3210sh, 3010sh, 1620sh, 1450sh, 1415s, 1355s, 1258s, 1116, 1045sh, 1021s, 977s, 965s, 912, 861, 837w, 763, 732w, 707w, 679w, 661w, 635w, 602w, 566w, 497w, 478w, 456w.

B20 Howlite $Ca_2SiB_5O_9(OH)_5$

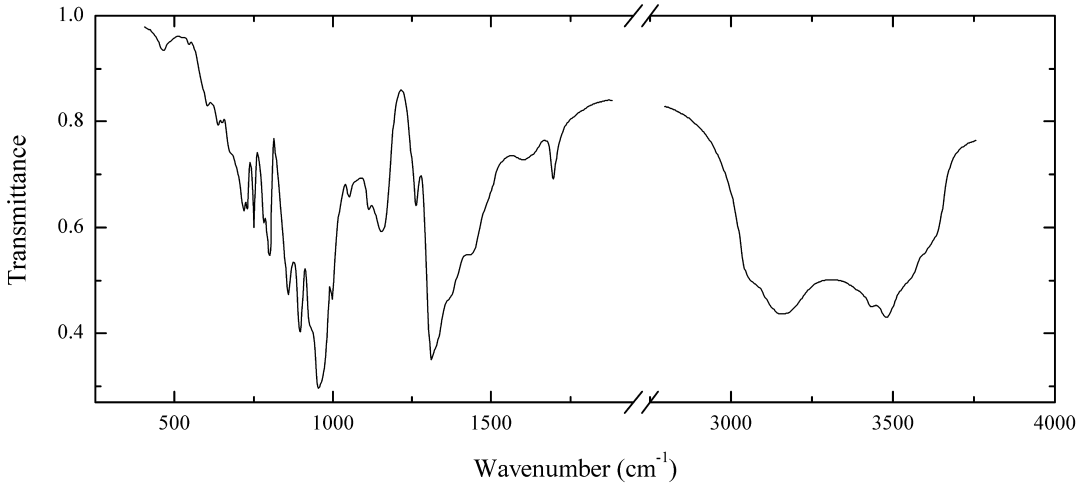


Locality: Piskanya boron deposit, near Baljevac town, 60 km southern of Kraljevo, Serbia.

Description: White-grained aggregate from the association with colemanite, ulexite, veatchite and studenitsite. Investigated by S.V. Malinko.

Wavenumbers (cm^{-1}): 3460, 3492, 3404, 3212, 1455, 1435, 1410, 1379w, 1359, 1324, 1223, 1163, 1136, 1104, 1055sh, 1014s, 959s, 915s, 906s, 875, 761, 831s, 775, 750w, 707w, 682, 617, 595, 563w, 551w, 527, 511w, 466, 451.

B21 Halurgite $Mg_2[B_4O_5(OH)_4] \cdot H_2O$

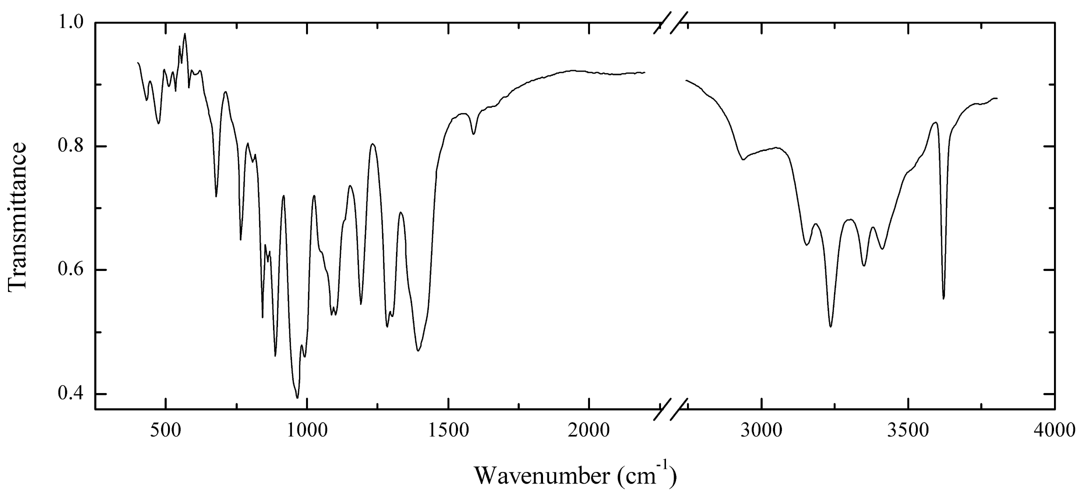


Locality: Kungar salt deposit, Chelkar salt dome, Aksai Valley, Aktobe region, Kazakhstan (type locality).

Description: White-grained aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3600sh, 3550sh, 3475, 3425, 3155, 3060sh, 1696, 1610w, 1442, 1375sh, 1325sh, 1310s, 1262, 1154, 1113, 1052, 996, 956s, 930sh, 897s, 859, 807, 794, 762, 731, 720, 675sh, 650w, 635w, 605w, 546w, 465w.

B22 Hydroboracite $CaMgB_6O_8(OH)_6 \cdot 3H_2O$

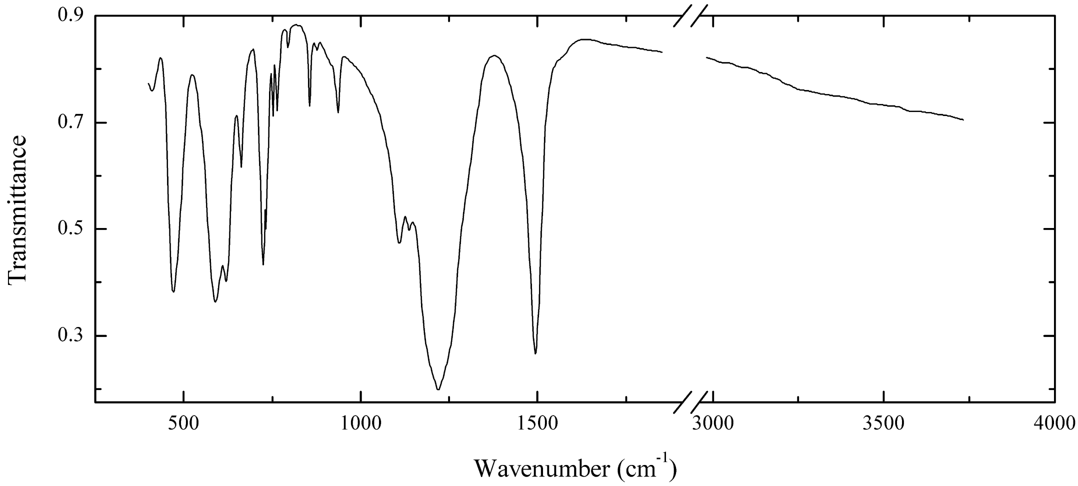


Locality: District # 99, underground mine, Inder boron deposit, Atyrau region, Kazakhstan.

Description: Yellow transparent crystal from the association with görgeyite. Identified by IR spectrum.

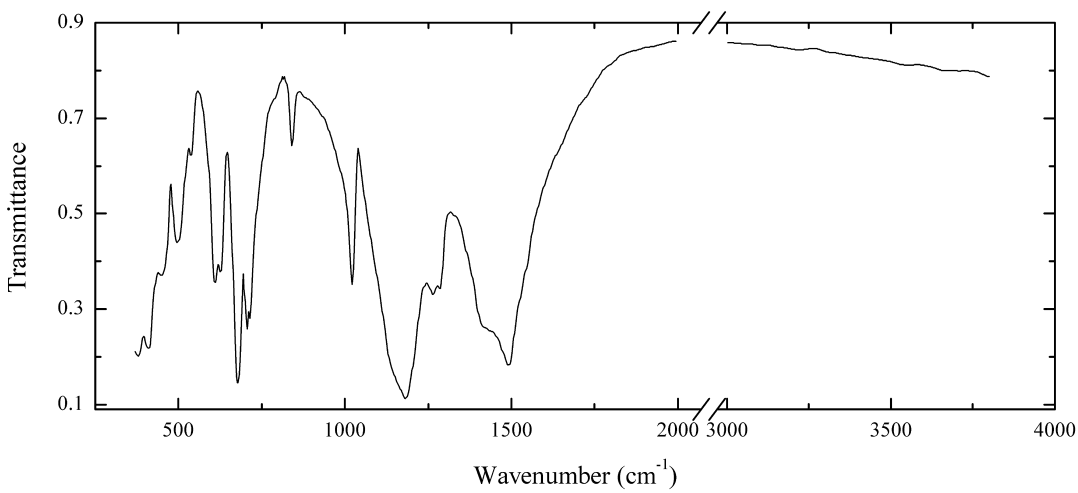
Wavenumbers (cm^{-1}): 3600s, 3500sh, 3395, 3335, 3220s, 3140, 2925, 1660sh, 1592w, 1420sh, 1395s, 1301, 1281, 1190, 1135sh, 1100, 1084, 1060sh, 1050sh, 992s, 966s, 955sh, 887s, 858, 839, 802w, 764, 730sh, 677, 660sh, 603w, 578w, 552w, 540sh, 530w, 507w, 470w, 427w.

B23 Gaudefroyite $Ca_4Mn^{2+}{}_3O_3(BO_3)_3(CO_3)$



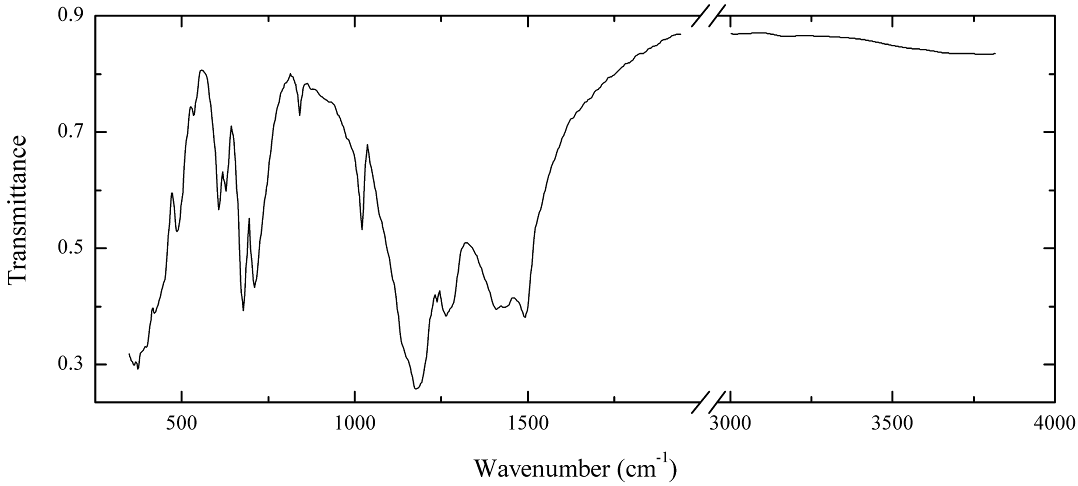
Locality: Tachgagalt manganese mine, near Ouarzazate, Morocco (type locality).
Description: Black crystals in rock. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ca_{4.3}Mn_{2.8}O_3(BO_3)_3(CO_3)$.
Wavenumbers (cm^{-1}): 1494s, 1219s, 1138, 1110, 937, 878w, 856, 795w, 764, 752w, 735sh, 724s, 663, 621s, 591s, 550sh, 470s, 408w.

B24 Suanite $Mg_2B_2O_5$



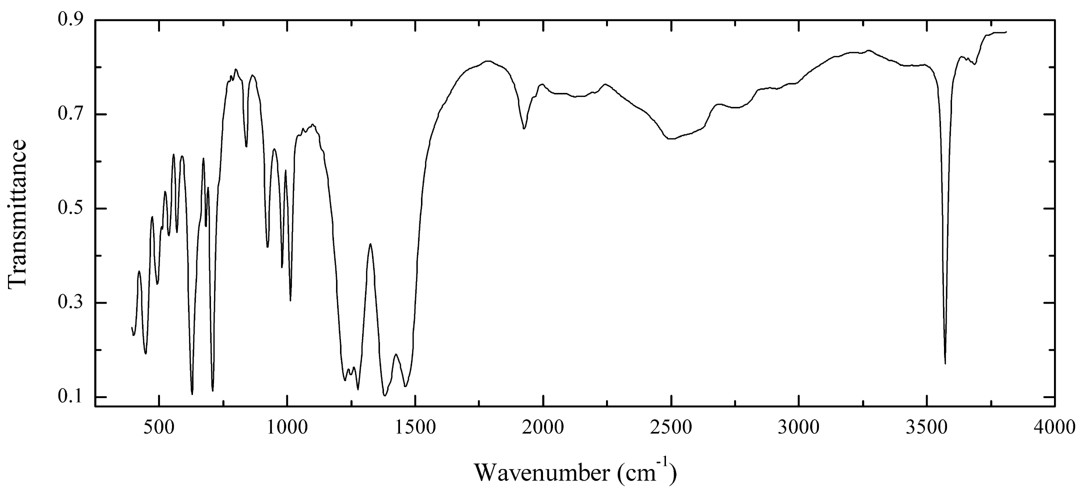
Locality: Ore body No. 9′, Nalednoe deposit, upper reaches of Jana river, Sakha Republic, Russia.
Description: Dull columnar aggregate from the association with clinokurchatovite, kurchatovite, szaibélyite, kotoite, ludwigite and calcite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1494s, 1450sh, 1425sh, 1285, 1265, 1186s, 1150sh, 1025, 840w, 713, 705s, 678s, 670sh, 626, 608, 536w, 495, 453, 405s, 387s.

B25 Suanite $Mg_2B_2O_5$



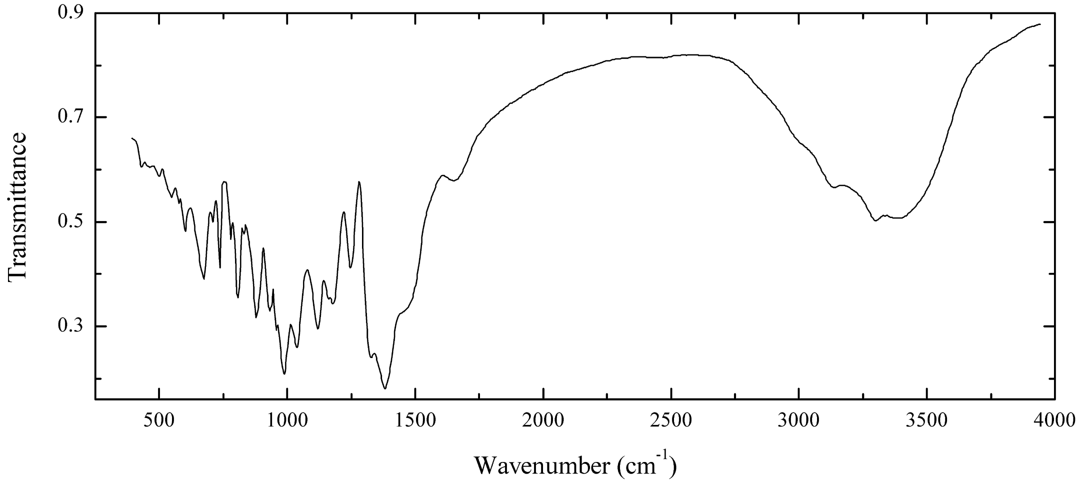
Locality: Nalednoe boron deposit, upper reaches of Jana river, Sakha Republic, Russia.
Description: Prismatic single-crystal grain. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 1495s, 1443s, 1417s, 1280sh, 1266s, 1240, 1194s, 1024, 841w, 714, 679s, 629, 609, 533w, 488, 445sh, 420sh, 400sh, 388s.

B26 Szaibélyite $MgBO_2(OH)$



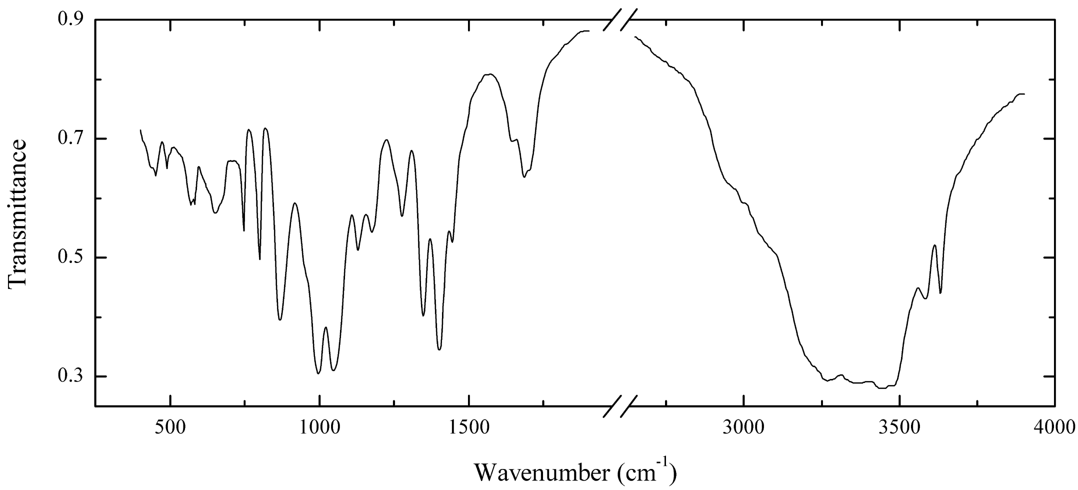
Locality: Kebiriin'ya boron deposit, upper reaches of Jana (Yana) river, Sakha Republic, Russia.
Description: White crystals from marble. Associated minerals are fluoborite, magnetite, serpentine and chlorite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3690w, 3560, 2975w, 2900w, 2760w, 2620sh, 2560w, 2495, 2030w, 1925, 1825w, 1465s, 1405sh, 1388s, 1274s, 1245s, 1223s, 1014, 981, 923, 841, 703s, 679, 623s, 563, 533, 508, 486, 440s, 400s.

B27 Ginorite $Ca_2B_{14}O_{20}(OH)_6{\cdot}5H_2O$



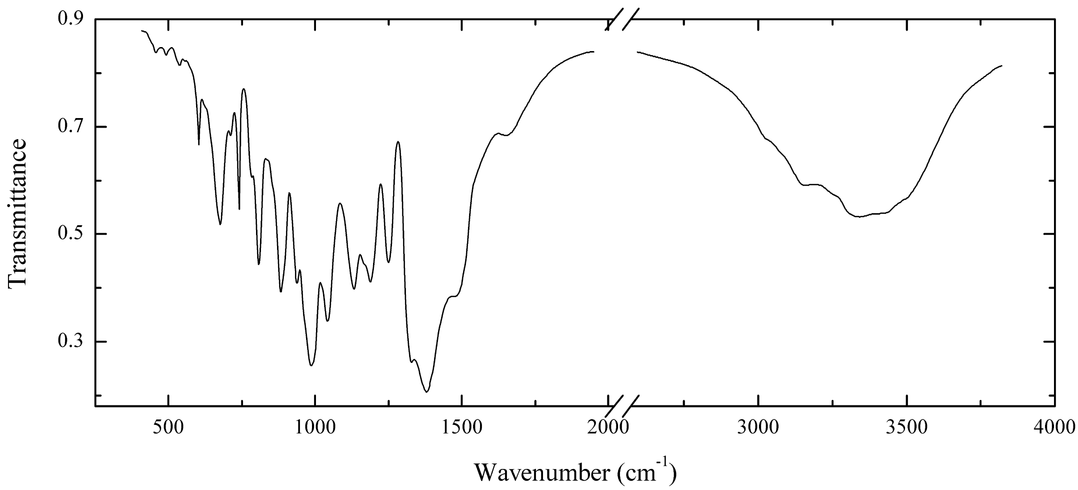
Locality: Chelkar salt dome, Aksai Valley, Aktobe region, Kazakhstan.
Description: Colourless crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3370, 3280, 3125, 3000sh, 1650, 1460sh, 1396s, 1339s, 1259, 1191, 1170, 1129s, 1045s, 997s, 965sh, 940, 884, 834w, 810, 783w, 741, 714w, 676, 667, 602w, 554w, 538w, 504w, 460w, 438w.

B28 Inderite $MgB_3O_3(OH)_5{\cdot}5H_2O$



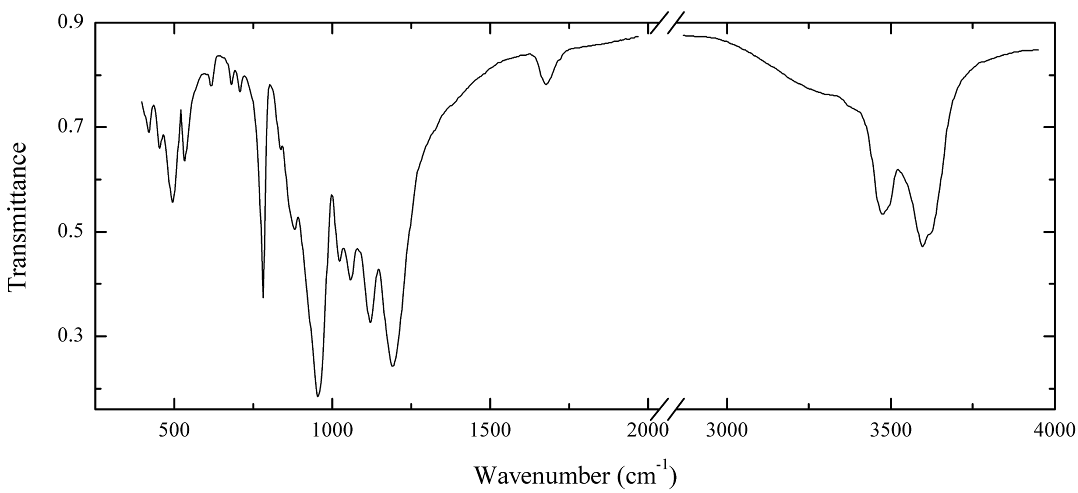
Locality: Boron Open Pit, Boron, California, USA.
Description: Colourless prismatic crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3625, 3580, 3470s, 3435s, 3360s, 3260s, 3060sh, 2940sh, 1705sh, 1685, 1650w, 1449, 1405s, 1350s, 1280, 1260sh, 1179, 1134, 1047s, 999s, 870s, 802, 748, 675sh, 657, 620sh, 583, 568, 487w, 347w.

B29 Ginorite $Ca_2B_{14}O_{20}(OH)_6{\cdot}5H_2O$



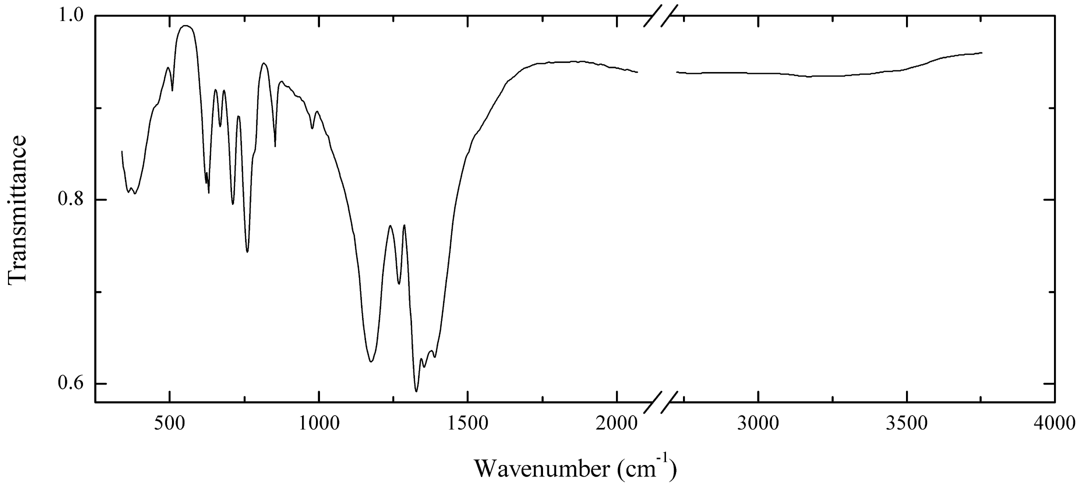
Locality: Mott open cut, Furnace creek, Death Valley, California, USA.
Description: White-grained aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3480sh, 3420sh, 3330, 3140, 3020sh, 1655w, 1480sh, 1381s, 1329s, 1250, 1189, 1165sh, 1132, 1042s, 991s, 941, 882, 808, 783w, 742, 715w, 678, 623sh, 605, 539w, 498w.

B30 Ekaterinite $Ca_2B_4O_7(Cl,OH)_2{\cdot}2H_2O$



Locality: Borehole at the Korshunovskoe iron deposit, Irkutsk region, Siberia, Russia.
Description: Rose-foliated aggregate from the association with dolomite, shabynite, hydromagnesite, korshunovskite, halite, iowaite and serpentine. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3570sh, 3550, 3420, 1660w, 1193s, 1123s, 1062s, 1026, 958s, 882, 837w, 784s, 711w, 683w, 620w, 540, 499, 457, 426.

B31 Clinokurchatovite $CaMgB_2O_5$

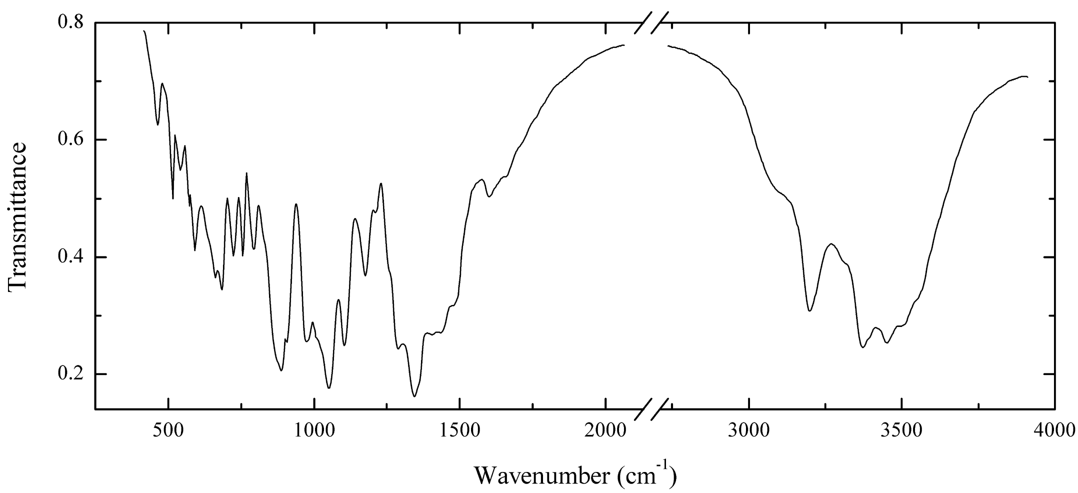


Locality: Sayak-IV deposit, Balkhash lake area, Karagandy region, Kazakhstan (type locality).

Description: Light grey grains with perfect cleavage in boron ore. Identified by IR spectrum and optical data. Bands with wavenumbers above 1,400 cm^{-1} are not observed in the IR spectrum.

Wavenumbers (cm^{-1}): 1389s, 1353s, 1325s, 1269, 1180s, 979w, 856, 785sh, 759, 711, 669, 625, 617, 507w, 406, 389.

B32 Kaliborite $KHMg_2B_{12}O_{16}(OH)_{10}{\cdot}4H_2O$

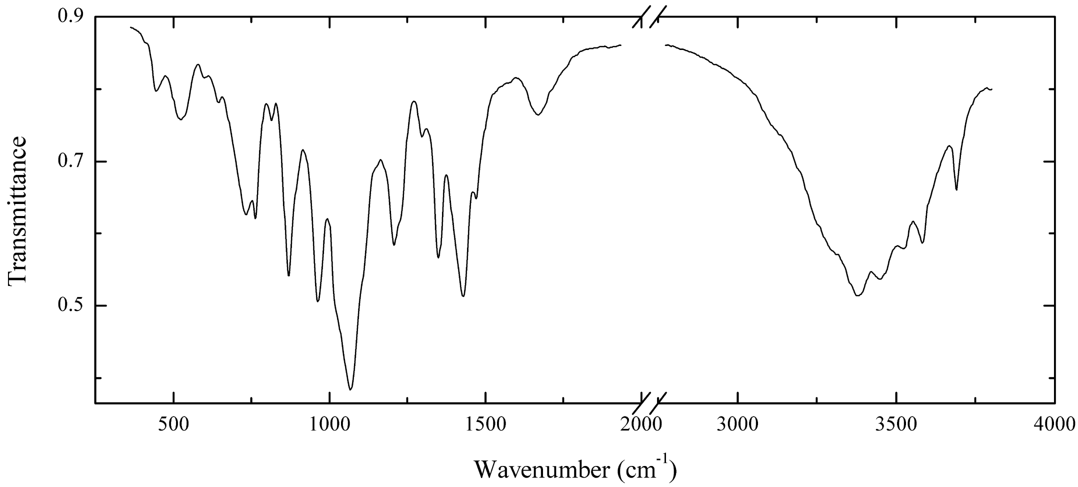


Locality: Inder boron deposit, Atyrau region, Kazakhstan.

Description: Coarse-grained aggregate. Investigated by I.V. Pekov. Identified by powder X-ray diffraction pattern. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3530sh, 3480sh, 3420, 3350, 3300sh, 3180, 3050sh, 1660sh, 1605w, 1480sh, 1427, 1407, 1338s, 1284s, 1260sh, 1206w, 1174, 1104s, 1051s, 1010sh, 975s, 905sh, 886s, 792, 753, 722, 681, 659, 590, 569, 539, 513, 464.

B33 Inderborite $CaMg[B_3O_3(OH)_5]_2 \cdot 6H_2O$

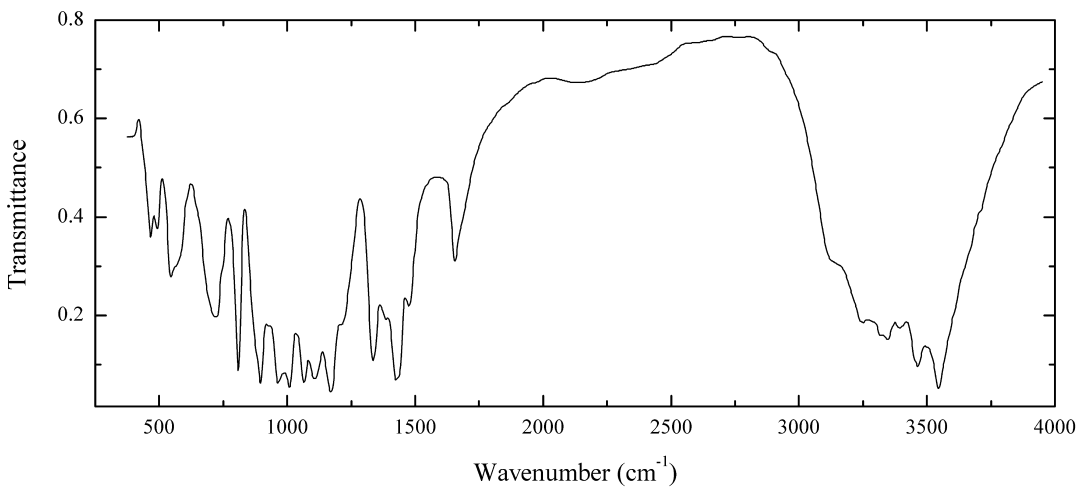


Locality: Inder boron deposit, Atyrau region, Kazakhstan (type locality).

Description: Colourless crystal. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3655, 3550, 3495, 3420s, 3355s, 3240sh, 3100sh, 1650, 1462, 1423s, 1344, 1294w, 1220sh, 1203, 1100sh, 1064s, 1020sh, 961s, 867s, 814w, 759, 729, 643w, 600w, 530, 445, 410sh.

B34 Inyoite $CaB_3O_3(OH)_5 \cdot 4H_2O$

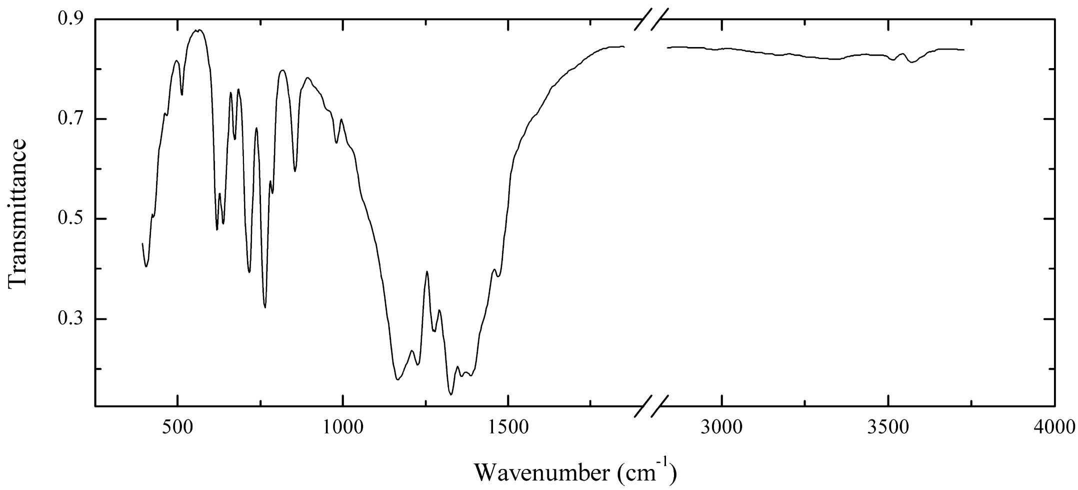


Locality: Inder boron deposit, Atyrau region, Kazakhstan.

Description: Colourless crystal. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3530s, 3440, 3325, 3225, 3120sh, 1650, 1600, 1480, 1433s, 1395, 1345, 1222, 1171s, 1109s, 1067s, 1009s, 963s, 895s, 808s, 750sh, 718, 570sh, 543, 486, 464.

B36 Kurchatovite $CaMgB_2O_5$

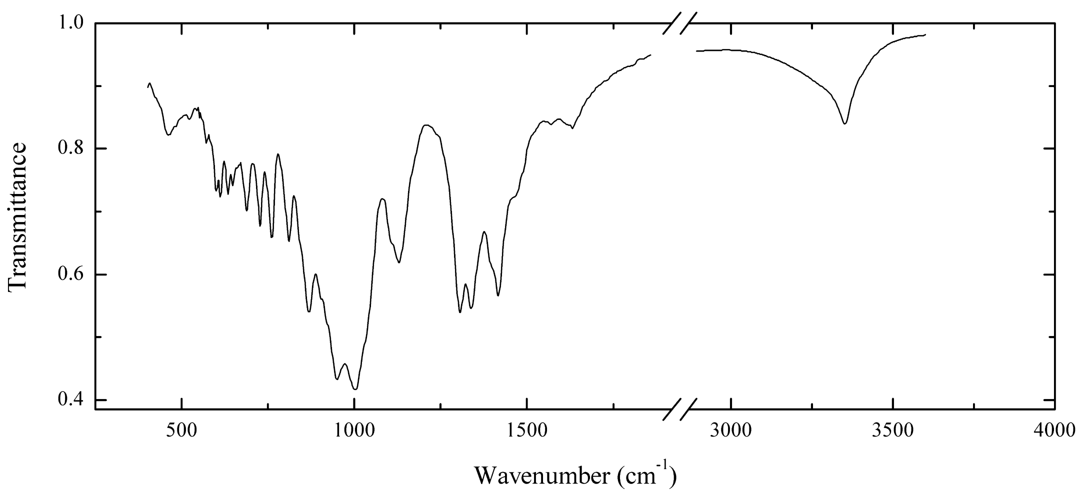


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia (type locality).

Description: Light grey grain with perfect cleavage in sakhaite-kurchatovite boron ore. Identified by IR spectrum and optical data. The empirical formula is (electron microprobe) $Ca_{0.94}Mg_{0.84}Fe_{0.11}Mn_{0.11}B_2O_5$.

Wavenumbers (cm^{-1}): 3550w, 3495w, 1469, 1440sh, 1387s, 1356s, 1323s, 1277, 1270, 1223s, 1170sh, 1159s, 984w, 977w, 856, 787, 761, 713, 669, 633, 614, 509, 462, 422, 405.

B37 Kurgantaite $CaSr(B_5O_9)Cl{\cdot}H_2O$

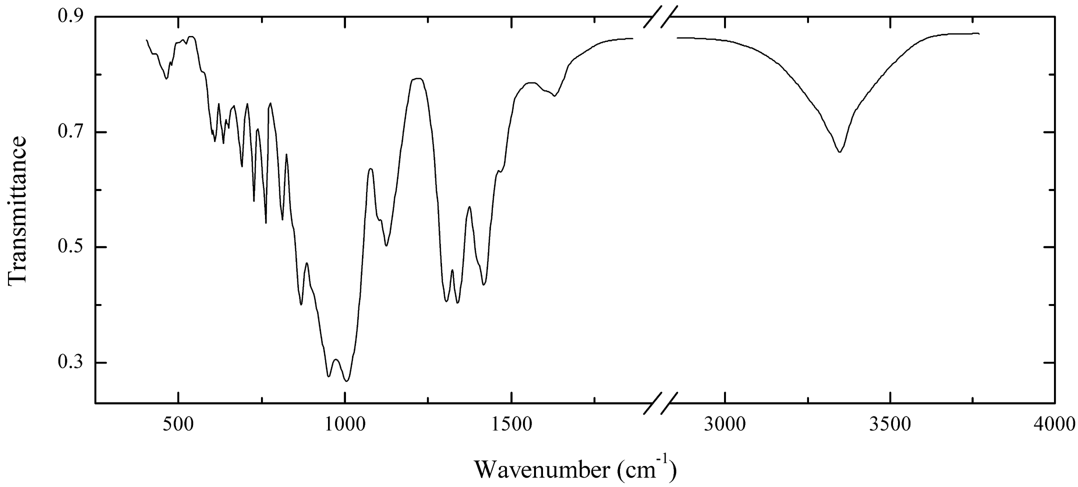


Locality: Nepskoe K salt deposit, Nepa river basin, Irkutsk region, Eastern Siberia, Russia.

Description: Colourless crystals from massive sylvite. Neotype sample. Associated minerals are halite, boracite, anhydrite, magnesite and quartz. The empirical formula is $Ca_{1.04}Sr_{0.98}B_{4.99}O_9Cl_{1.01}{\cdot}H_2O$.

Wavenumbers (cm^{-1}): 3345, 1640w, 1590w, 1475sh, 1422s, 1400sh, 1341s, 1308s, 1132, 1106, 1040sh, 1004s, 953s, 905, 870s, 845sh, 811, 762, 727, 689, 647w, 634, 612, 599, 571w, 522w, 482.

B38 Kurgantaite $CaSr(B_5O_9)Cl·H_2O$

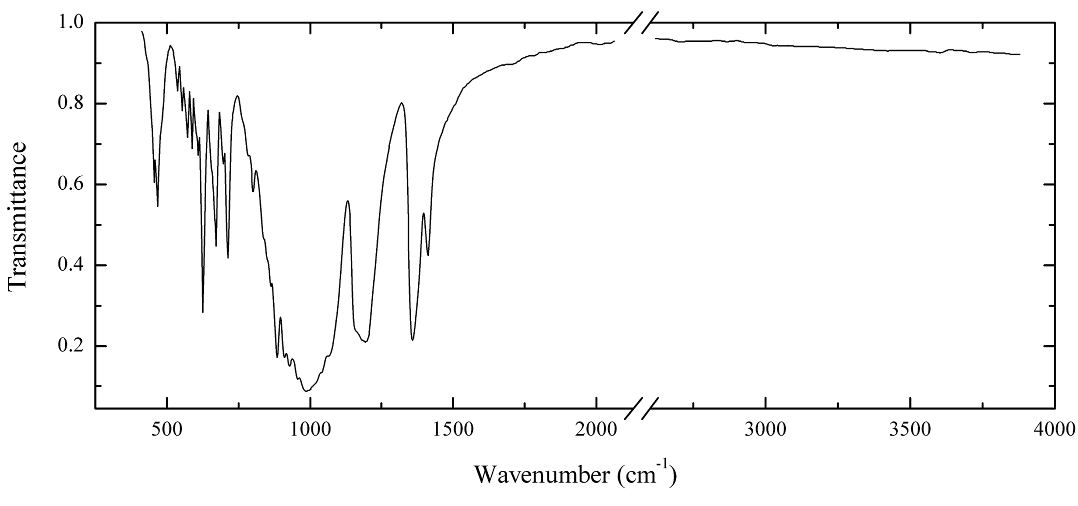


Locality: Borehole at the Korshunovskoe iron deposit, Irkutsk region, Siberia, Russia.

Description: Pink radial aggregates from the association with ekaterinite, anhydrite and calcite. The empirical formula is $Ca_{1.2}Sr_{0.8}B_5O_9Cl_{1.0}·H_2O$.

Wavenumbers (cm^{-1}): 3345, 1635w, 1600w, 1470, 1419s, 1400sh, 1342s, 1308s, 1132, 1107, 1008s, 953s, 910sh, 871s, 812, 763, 728, 690, 648, 634, 611, 605, 571w, 527w, 482w, 460w.

B39 Boracite $Mg_3B_7O_{13}Cl$

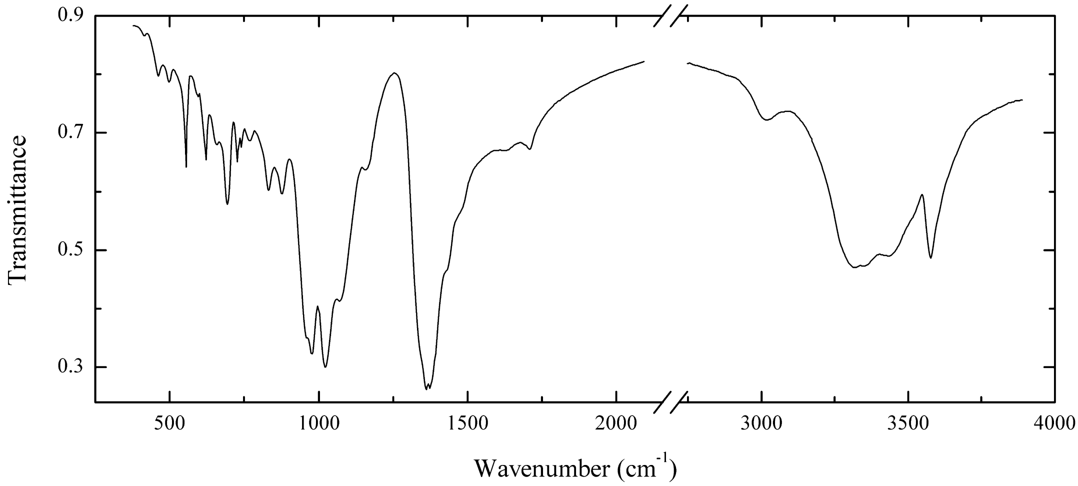


Locality: Wandsleben, Saxony-Anhalt, Germany.

Description: White to beige fine-grained aggregate ("staßfurtite"). Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1416, 1359s, 1201s, 1185sh, 1165sh, 1067s, 1040sh, 1020sh, 993s, 959s, 929s, 910s, 887s, 862, 849, 837, 803, 782, 731w, 711, 695w, 670, 655w, 630sh, 623, 607w, 600w, 584w, 569w, 551w, 534w, 483w, 474w, 465, 451.

B40 Kernite $Na_2B_4O_6(OH)_2{\cdot}3H_2O$

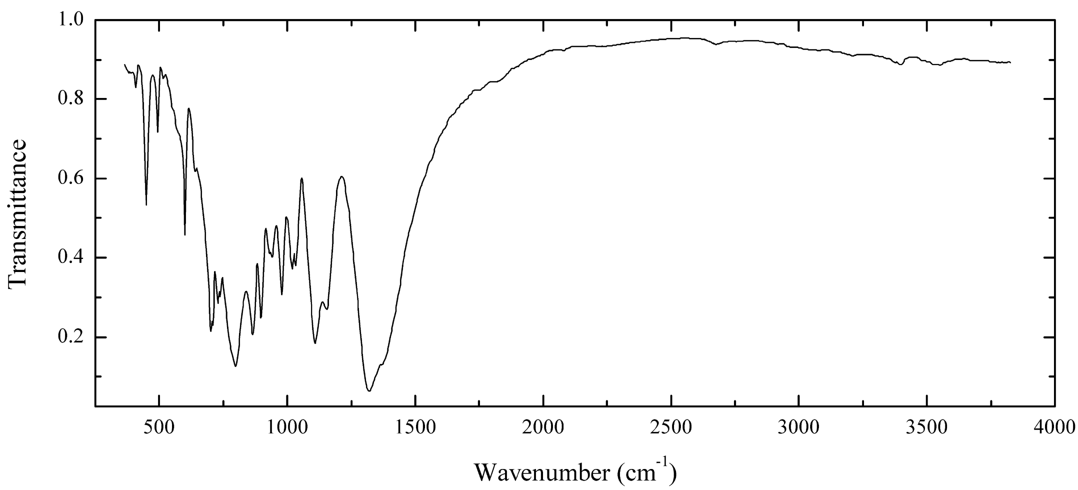


Locality: Kramer borate district, Kern Co., California, USA (type locality).

Description: Colourless crystal. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3550, 3480sh, 3420, 3350, 3300, 2990, 1710w, 1625w, 1470sh, 1425sh, 1374s, 1356s, 1340sh, 1160, 1070, 1015s, 974s, 957s, 875, 828, 763w, 739w, 724, 690, 655w, 617, 583w, 550, 494w, 454w, 416w.

B41 Calciborite CaB_2O_4

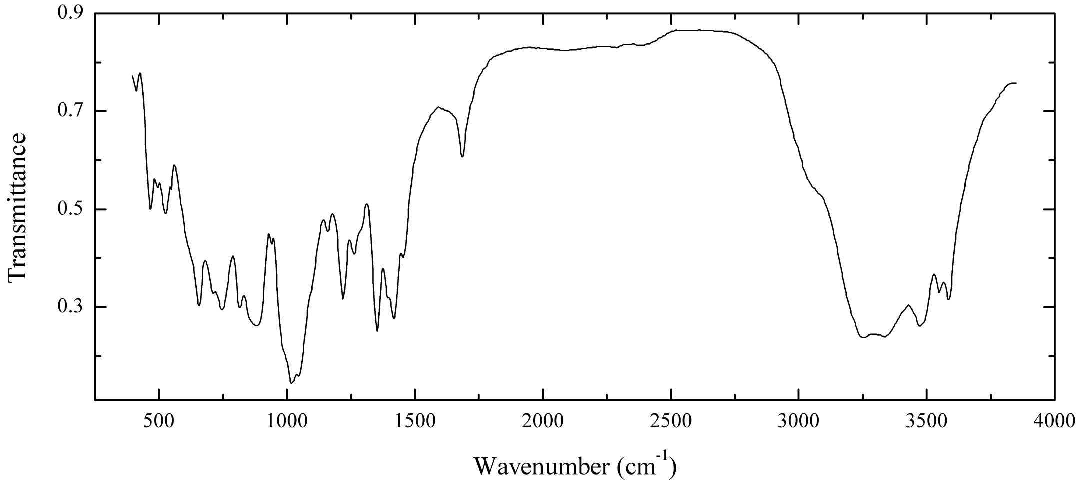


Locality: Novofrolovskoye copper deposit, near Krasnotur'insk, Northern Ural Mts., Russia (type locality).

Description: Colourless grains from marble, from the association with sibirskite. Identified by IR spectrum, powder X-ray diffraction pattern and optical data.

Wavenumbers (cm^{-1}): 3550w, 3400w, 2680w, 1376s, 1330s, 1162, 1118s, 1040, 1026, 985, 946, 933, 901s, 870s, 800s, 740, 728s, 708s, 700s, 641w, 602, 590sh, 575sh, 515w, 492w, 447, 406w.

B42 Kurnakovite $MgB_3O_3(OH)_5 \cdot 5H_2O$

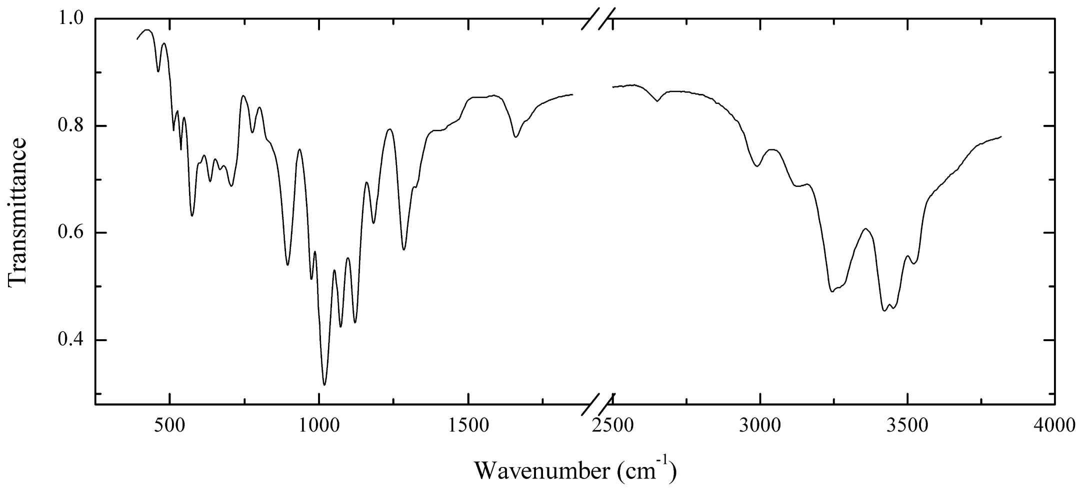


Locality: Inder boron deposit, Atyrau region, Kazakhstan (type locality).

Description: Colourless crystals from the association with pinnoite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3565s, 3530, 3460s, 3330s, 3240s, 3060sh, 1685, 1452, 1413, 1390, 1349s, 1285, 1262, 1216, 1160, 1090sh, 1043s, 1015s, 985sh, 940, 877s, 815, 746, 715, 656, 630sh, 580sh, 546w, 524, 490w, 466, 404w.

B43 Lüneburgite $Mg_3B_2(PO_4)_2(OH)_6 \cdot 6H_2O$

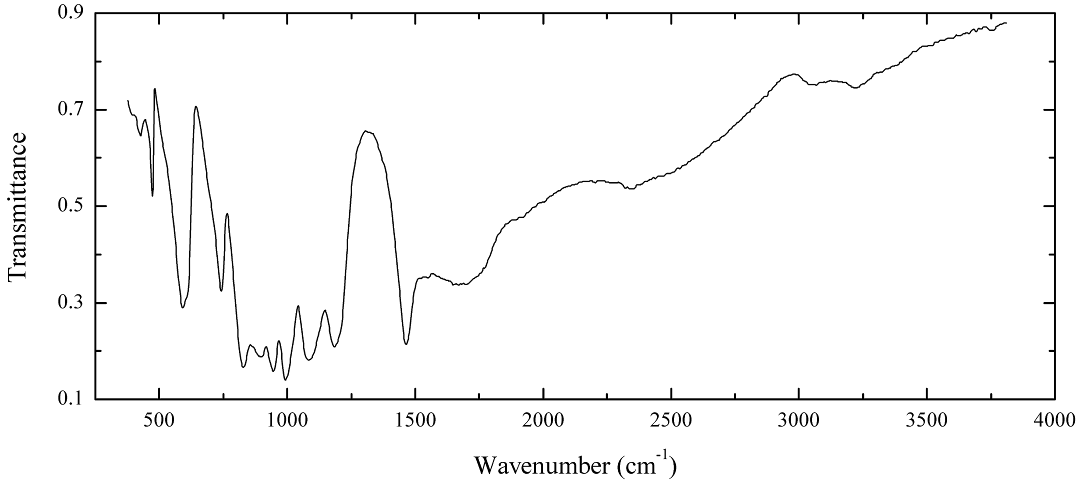


Locality: Lüneburger Kalkberg, Lüneburg, Lower Saxony, Germany (type locality).

Description: White fibrous aggregate. Identified by IR spectrum.

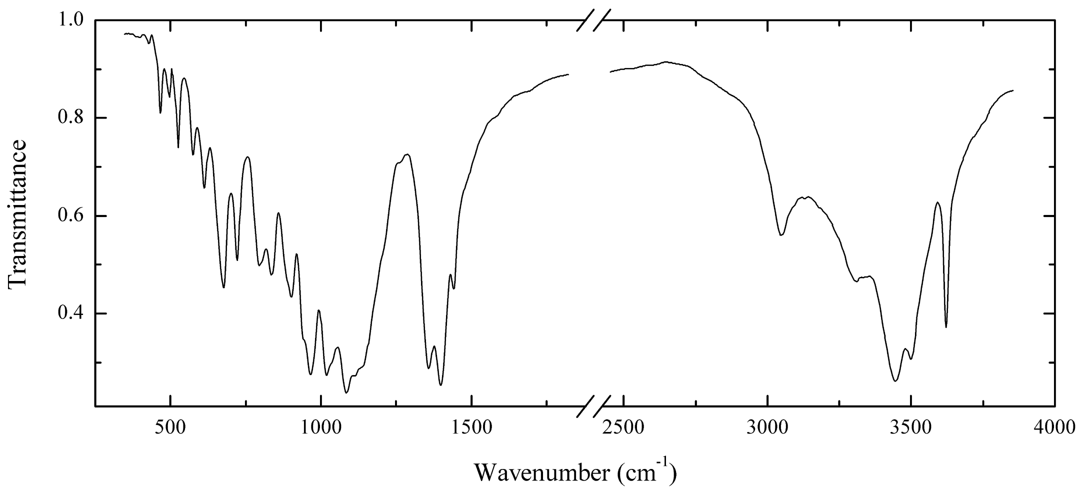
Wavenumbers (cm^{-1}): 3490, 3420s, 3390s, 3250sh, 3220, 3100, 2965, 2630w, 1653w, 1460sh, 1415w, 1333, 1284, 1185, 1121s, 1074s, 1020s, 975, 896, 830sh, 786w, 710, 667, 638, 604w, 575, 537, 521, 465w.

B44 Metaborite HBO_2



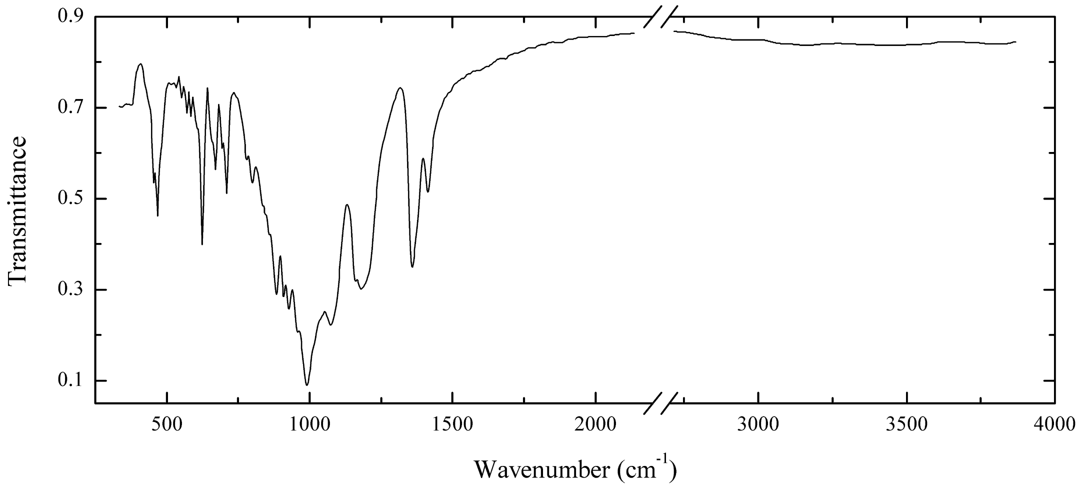
Locality: Chelkar salt dome, Aksai Valley, Aktobe region, Kazakhstan.
Description: Colourless crystal. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3210w, 3050w, 2345, 1670, 1467s, 1187s, 1090s, 996s, 948s, 900s, 831s, 746, 605sh, 595, 474, 431w.

B45 Meyerhofferite $Ca_2B_6O_6(OH)_{10}{\cdot}2H_2O$



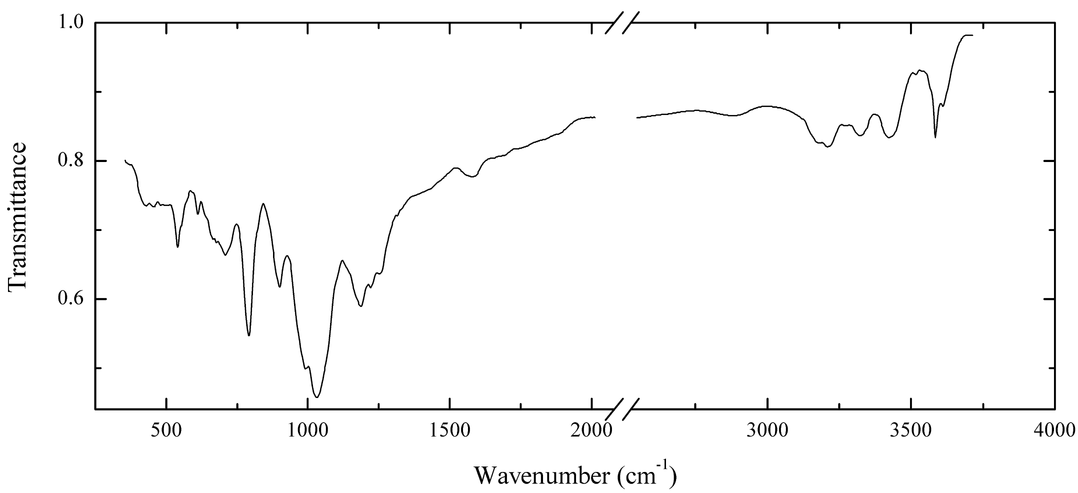
Locality: 10-mile canyon, Death Valley, California, USA.
Description: White columnar aggregate. Pseudomorph after inyoite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3605, 3485, 3425s, 3305, 3040, 1443, 1399s, 1359s, 1180sh, 1140sh, 1120sh, 1087s, 1040sh, 1022s, 966s, 950sh, 905, 890sh, 842, 801, 726, 679, 616, 579, 529, 497w, 470, 430w.

B46 Boracite $Mg_3B_7O_{13}Cl$



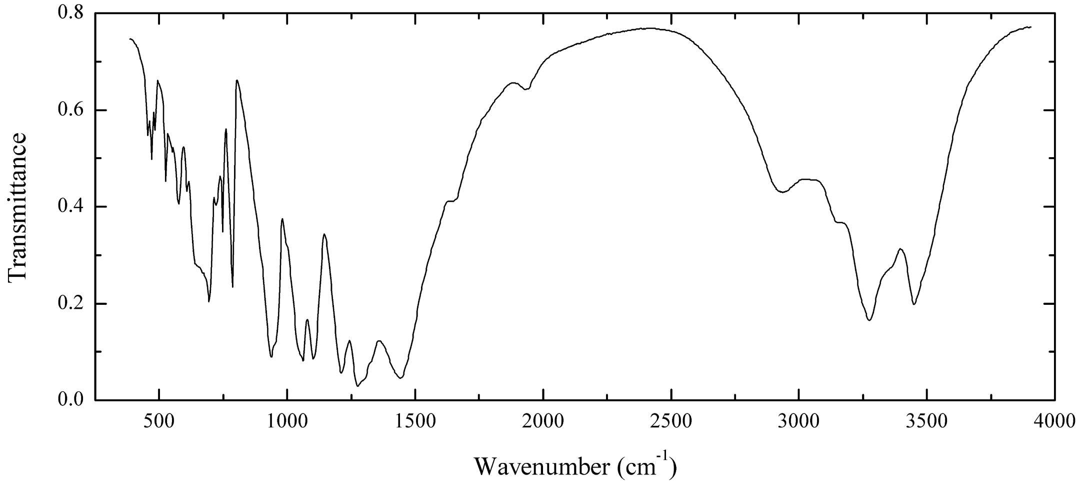
Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta Province, Argentina.
Description: Colourless crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1416, 1359s, 1210sh, 1184, 1162, 1077s, 1040sh, 1020sh, 992s, 958s, 929s, 912s, 886s, 861, 847, 837, 802, 782, 710, 695w, 670, 660w, 624, 605w, 600w, 584w, 568w, 550w, 533w, 485sh, 474w, 465, 453, 390w.

B47 Nifontovite $Ca_3B_6O_6(OH)_{12}{\cdot}2H_2O$



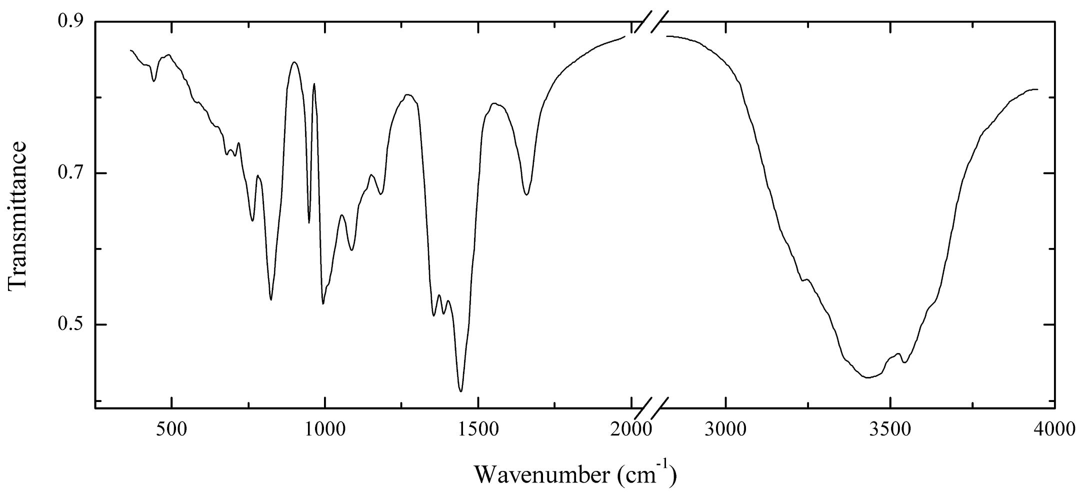
Locality: Novofrolovskoye copper deposit, near Krasnotur'insk, Northern Ural Mts., Russia (type locality).
Description: Colourless grain from the association with grossular-andradite garnet, szaibélyite, sibirskite, calciborite, dolomite and calcite. Holotype sample. Monoclinic, $a = 13.102, b = 13.473, c = 9.507$ Å, $\beta = 118.43°$. Contains admixture of Mg (0.51 wt.% MgO). Optically biaxial (+), $\alpha = 1.575(1)$, $\beta = 1.578(1)$, $\gamma = 1.584(1)$. $D_{meas} = 2.36$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 2.41 (100), 7.04 (80), 2.21 (80), 3.79 (70), 3.66 (70), 3.02 (70), 2.05 (70).
Wavenumbers (cm^{-1}): 3600, 3572, 3415, 3315, 3200, 3170, 2880w, 1590w, 1255, 1222, 1186, 1065sh, 1034s, 995s, 903, 825sh, 793s, 709, 660sh, 612w, 555sh, 540, 436w.

B48 Larderellite $(NH_4)B_5O_7(OH)_2 \cdot H_2O$



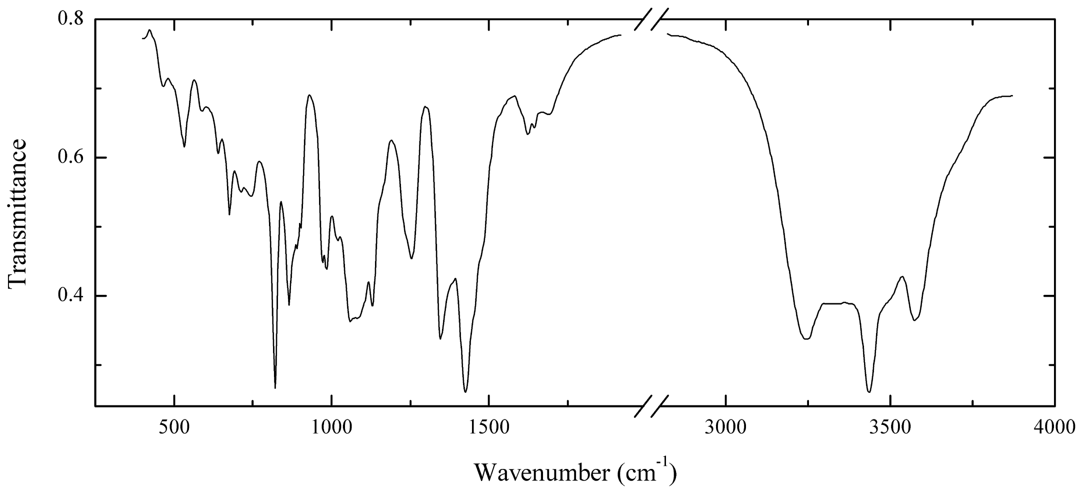
Locality: Larderello, Val di Cecina, Tuscany, Italy (type locality).
Description: White powdery aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3420, 3330sh, 3255s, 3130, 2915, 1925w, 1640, 1448s, 1325sh, 1300sh, 1275s, 1208s, 1097s, 1060s, 1045sh, 990sh, 950sh, 935s, 895sh, 875sh, 781, 745, 718w, 689, 670sh, 655sh, 645sh, 608w, 570, 547w, 525, 480w, 468w, 456w.

B49 Mcallisterite $Mg_2[B_6O_7(OH)_6]_2 \cdot 9H_2O$



Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta Province, Argentina.
Description: White-grained aggregate. Specimen No. 78652 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.
Wavenumbers (cm^{-1}): 3580sh, 3500s, 3400s, 3325sh, 3195, 1655, 1439s, 1393s, 1350s, 1180, 1088, 1010sh, 995s, 947, 824s, 765, 708w, 683w, 650sh, 585sh, 450w.

B50 Hungchaoite $MgB_4O_5(OH)_4 \cdot 7H_2O$

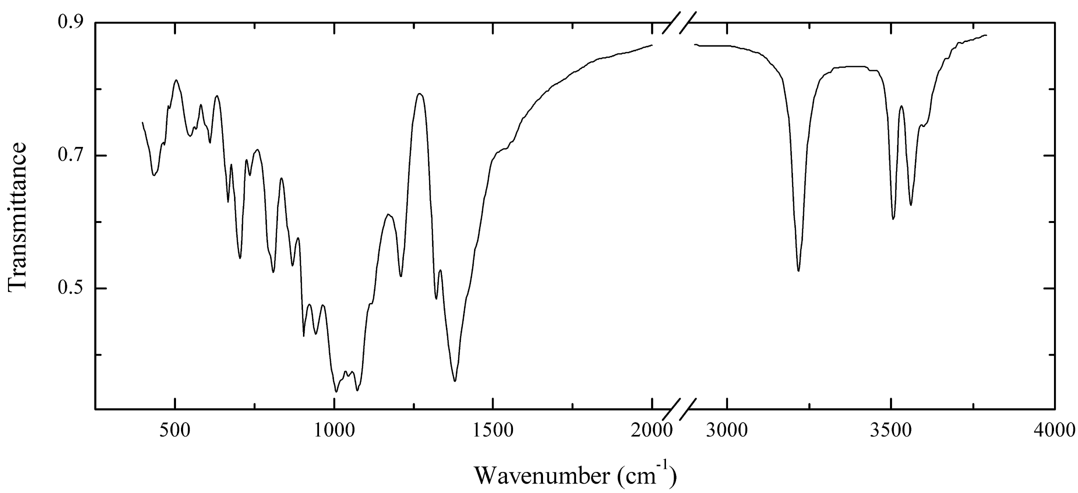


Locality: Inder boron deposit, Atyrau region, Kazakhstan.

Description: Colourless grains from the association with kurnakovite. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3540, 3450sh, 3395s, 3215, a683w, 1638w, 1618w, 1460sh, 1440sh, 1417s, 1341s, 1250, 1235sh, 1160sh, 1125, 1074s, 1056s, 1017, 980, 967, 895, 880, 860, 817s, 740, 713, 674, 639, 586w, 540sh, 532, 468w.

B51 Preobrazhenskite $Mg_3B_{11}O_{15}(OH)_9$

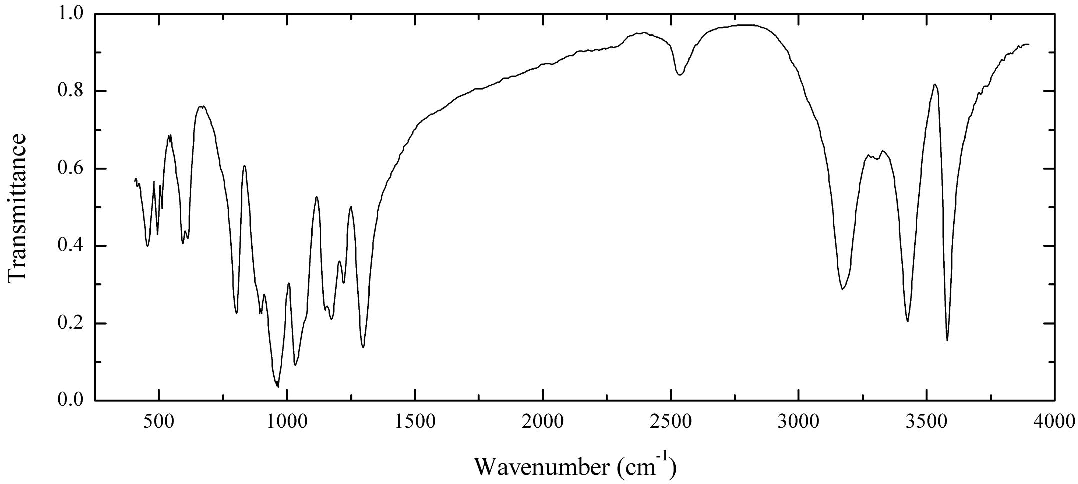


Locality: Inder boron deposit, Atyrau region, Kazakhstan (type locality).

Description: Colourless crystal from the association with kaliborite, halite, polyhalite and inyoite. Identified by powder X-ray diffraction pattern.

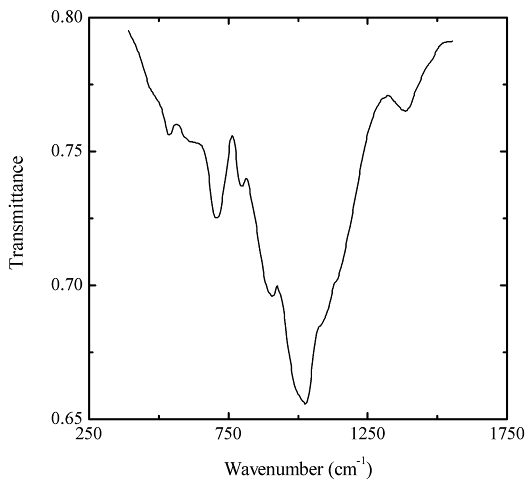
Wavenumbers (cm^{-1}): 3580, 3540, 3488, 3200, 1530sh, 1420sh, 1382s, 1321, 1210, 1120sh, 1077s, 1050s, 1025sh, 1007s, 942s, 908s, 871, 811, 795sh, 751w, 737, 708, 669, 610, 595sh, 566w, 550w, 491w, 470w, 450, 437.

B52 Pinnoite $MgB_2O(OH)_6$



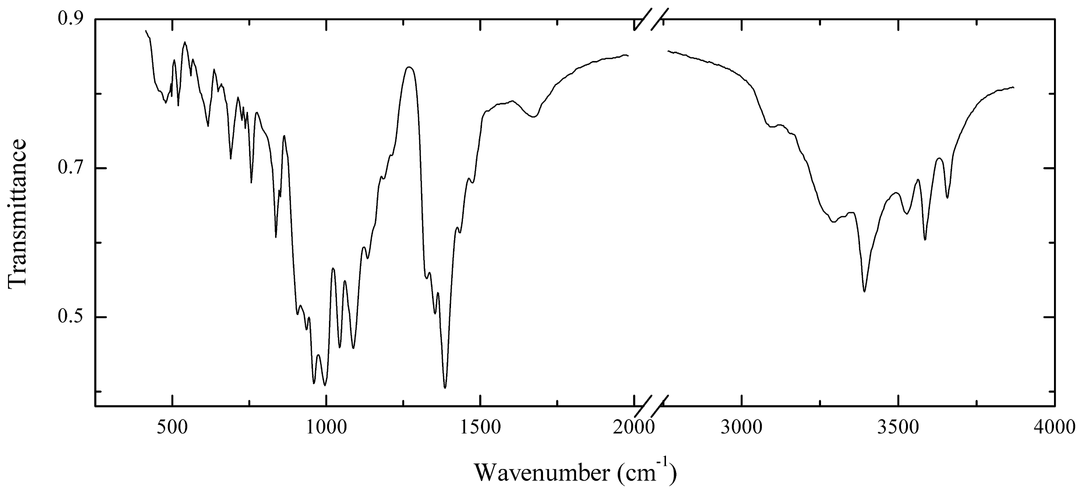
Locality: Inder boron deposit, Atyrau region, Kazakhstan.
Description: Colourless crystal from the association with kurnakovite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3575s, 3420s, 3305, 3173, 2535w, 1296s, 1221, 1176s, 1151, 1070sh, 1033s, 959s, 895, 880sh, 798s, 608, 588, 506w, 487, 447.

B53 Peprossiite-(Ce) $(Ce,La)(Al_3O)_{2/3}B_4O_{10}$



Locality: Viterbo, Lazio region, Italy.
Description: Canary-yellow platy crystals. Identified by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1380w, 1140sh, 1080sh, 1025s, 908, 795, 707, 535.

B54 Probertite $NaCaB_5O_7(OH)_4{\cdot}3H_2O$

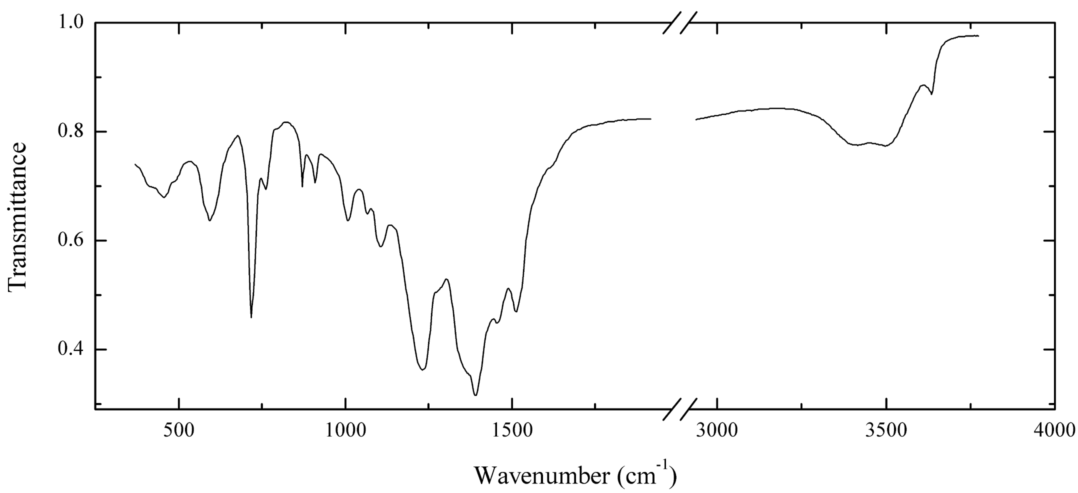


Locality: Bandirma (Pandirma), Balikesir province, Turkey.

Description: Grey radial aggregate. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3635, 3565, 3505, 3370, 3290, 3085w, 1670w, 1473, 1431, 1382s, 1351, 1300, 1210w, 1187, 1152, 1133, 1086s, 1041s, 994s, 959s, 934, 905, 850, 835, 800sh, 754, 724w, 714w, 687, 652w, 614, 605sh, 555w, 517, 478.

B55 Parasibirskite $Ca_2B_2O_5{\cdot}H_2O$

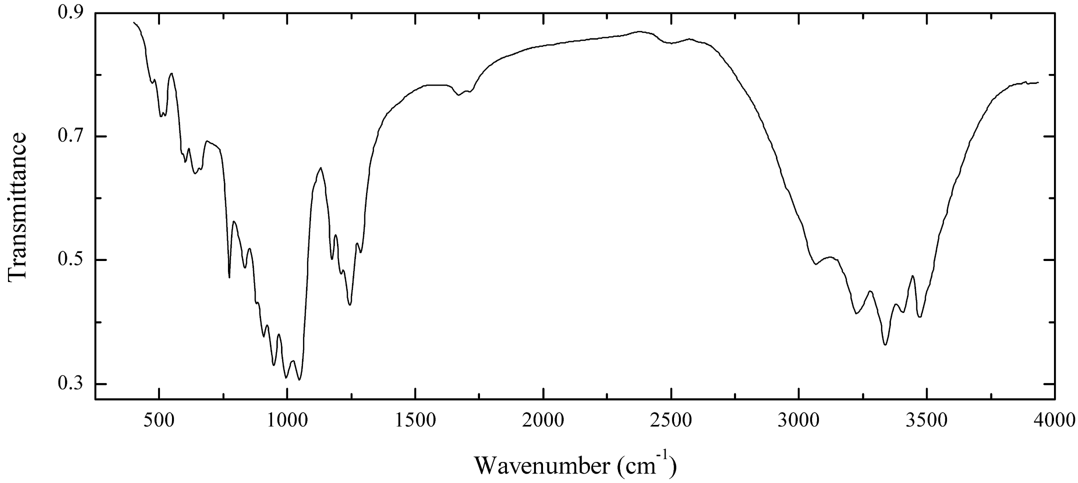


Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan (type locality).

Description: White granular aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3610, 3470, 3390, 1530sh, 1512, 1462, 1391s, 1360sh, 1280sh, 1233s, 1108, 1068w, 1007, 911, 871, 753, 719, 605sh, 592, 580sh, 490sh, 458, 410sh.

B56 Pentahydroborite $CaB_2O(OH)_6 \cdot 2H_2O$

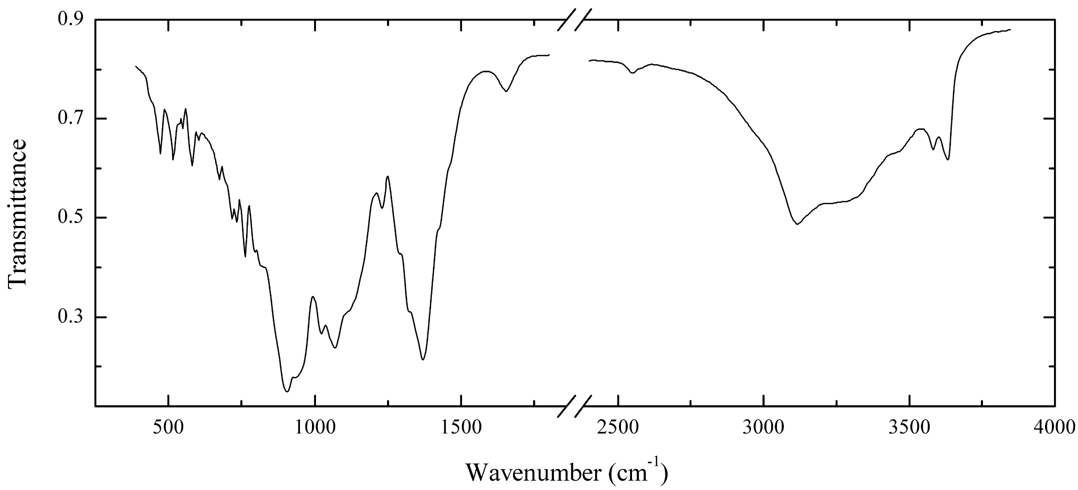


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: Colourless grains forming veinlet in kurchatovite–sakhaite boron ore. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3450s, 3385, 3315s, 3210, 3050, 2490w, 1705w, 1660w, 1289, 1245, 1210, 1175, 1047s, 990s, 947s, 906s, 883, 834, 773, 660, 637, 601, 583w, 522w, 506w, 471w.

B57 Priceite $Ca_4B_{10}O_{19} \cdot 7H_2O$

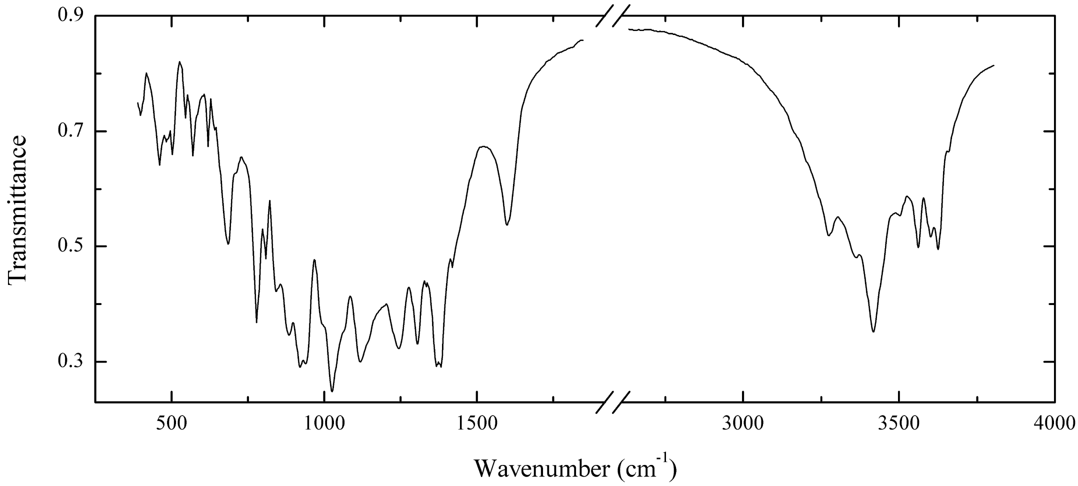


Locality: Death Valley, California, USA.

Description: White fine-grained aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3608, 3560, 3430sh, 3250sh, 3095, 2530w, 1650w, 1455sh, 1425sh, 1368s, 1316s, 1286, 1227, 1105sh, 1067s, 1017s, 933s, 902s, 870sh, 815sh, 797, 760, 731, 715, 672w, 603w, 580w, 548w, 530w, 515w, 471w, 435sh.

B58 Solongoite $Ca_2B_3O_4(OH)_4Cl$

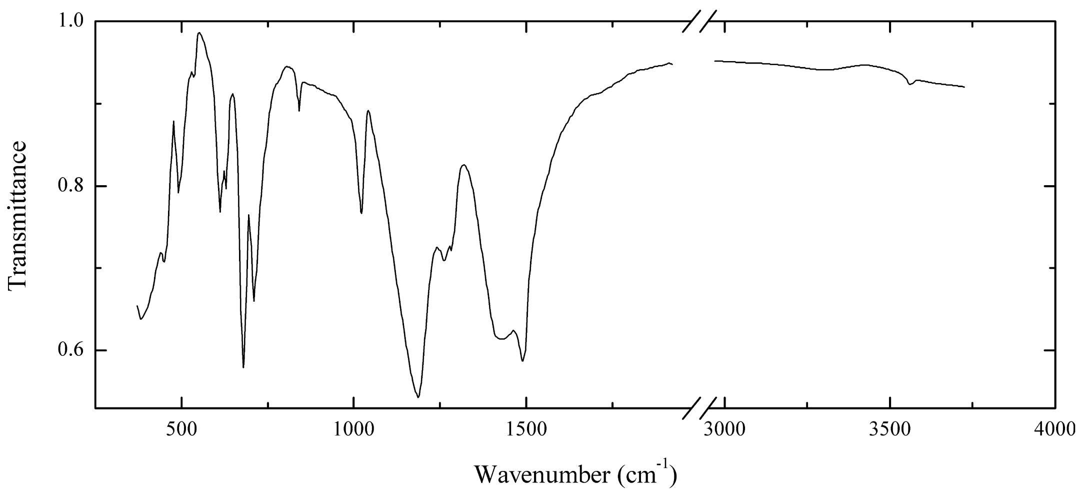


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia (type locality).

Description: Colourless grains from kurchatovite–sakhaite boron ore. Identified by powder X-ray diffraction pattern and optical data.

Wavenumbers (cm^{-1}): 3650w, 3620, 3585, 3545, 3488, 3405s, 3337, 3263, 1602, 1421, 1382s, 1368s, 1305s, 1243s, 1180sh, 1145sh, 1118s, 1065sh, 1026s, 997sh, 943s, 922s, 887s, 847, 811, 781, 715w, 690, 643w, 620, 586w, 571, 545w, 503, 488, 460, 397w.

B59 Suanite $Mg_2B_2O_5$

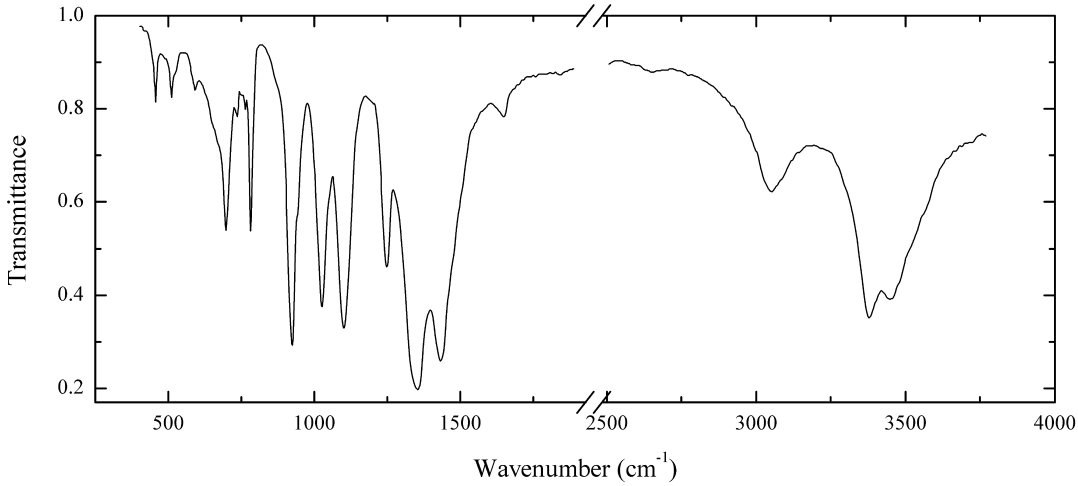


Locality: Nalednoe deposit, upper reaches of Jana (Yana) river, Sakha Republic, Russia.

Description: Columnar aggregate from the association with szaibélyite and kotoite. Identified by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Mg_{1.93}Fe_{0.04}Ca_{0.02}Mn_{0.01}B_2O_5$.

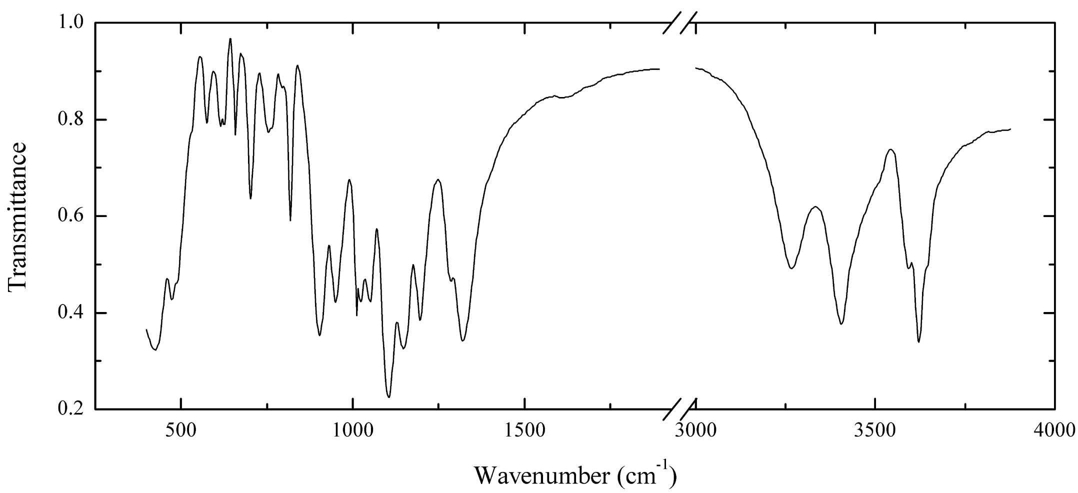
Wavenumbers (cm^{-1}): 1496s, 1442s, 1284, 1265, 1188s, 1024, 841, 712s, 680s, 629, 610, 533w, 490, 450, 403s.

B60 Santite $KB_5O_6(OH)_4 \cdot 2H_2O$



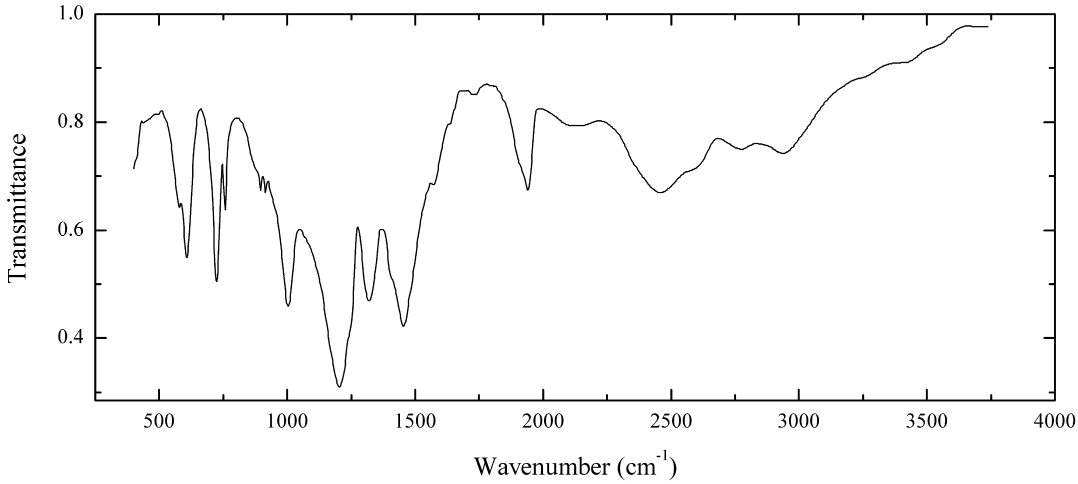
Locality: Synthetic.
Description: Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3445, 3375, 3050, 2650w, 1657w, 1436s, 1357s, 1251, 1104s, 1026s, 945, 926s, 783, 766w, 752w, 735w, 697, 670sh, 650sh, 591w, 520sh, 508w, 453w.

B61 Sulfoborite $Mg_3B_2(SO_4)(OH)_8(OH,F)_2$



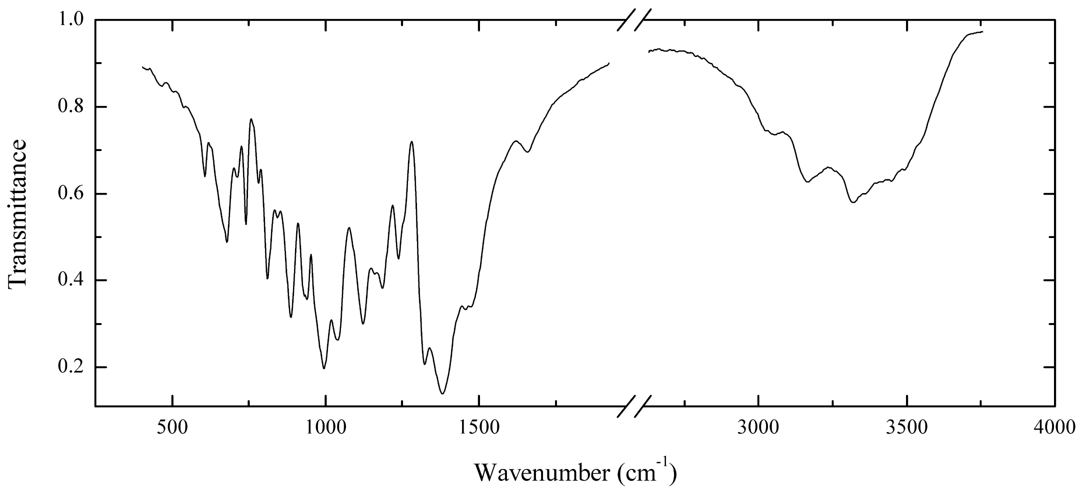
Locality: Inder boron deposit, Atyrau region, Kazakhstan.
Description: Colourless crystal. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3620, 3590s, 3565, 3377s, 3242, 1620w, 1317s, 1283, 1195s, 1146s, 1104s, 1052, 1023, 1011, 949, 903s, 817, 792w, 760sh, 749, 700, 654, 625, 612, 573, 529, 486, 471, 422s.

B62 Sibirskite $CaHBO_3$



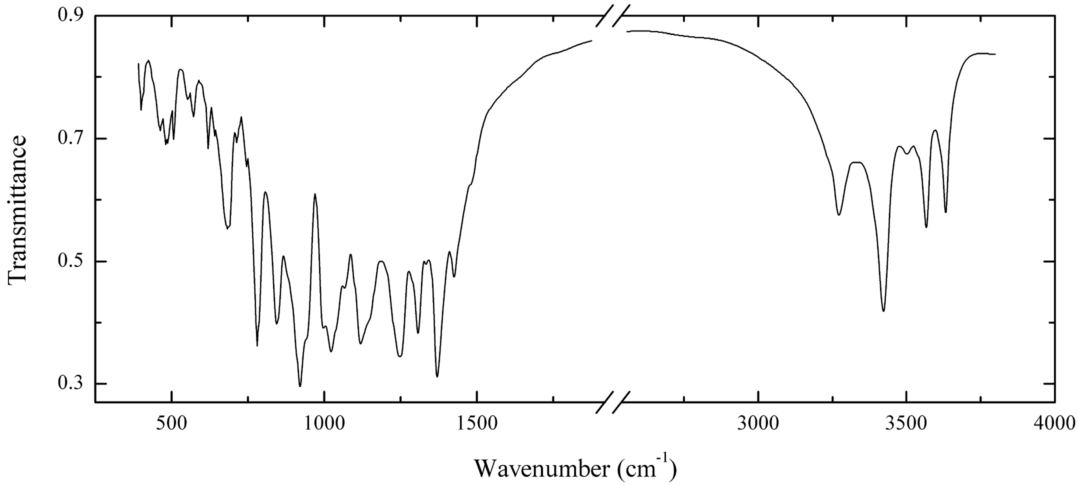
Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.
Description: Veinlet in kurchatovite–sakhaite boron ore. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3550sh, 3410w, 2930, 2770, 2570sh, 2450, 2140, 1943, 1730w, 1570, 1456s, 1405sh, 1324s, 1207s, 1006s, 918w, 898w, 757, 723s, 607, 576, 450w.

B63 Strontioginorite $(Sr,Ca)_2B_{14}O_{23}·8H_2O$



Locality: Kohnstein Quarry, Niedersachswerfen, Nordhausen, Harz, Thuringia, Germany.
Description: White crystals on anhydrite. Investigated by I.V. Pekov. Confirmed by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3490sh, 3455, 3325, 3165, 3060, 1660w, 1474, 1457, 1380s, 1321s, 1255sh, 1236, 1191, 1165, 1126, 1041s, 995s, 970sh, 939, 930, 888, 843, 811, 781w, 740, 712w, 678, 665sh, 605.

B64 Solongoite $Ca_2B_3O_4(OH)_4Cl$

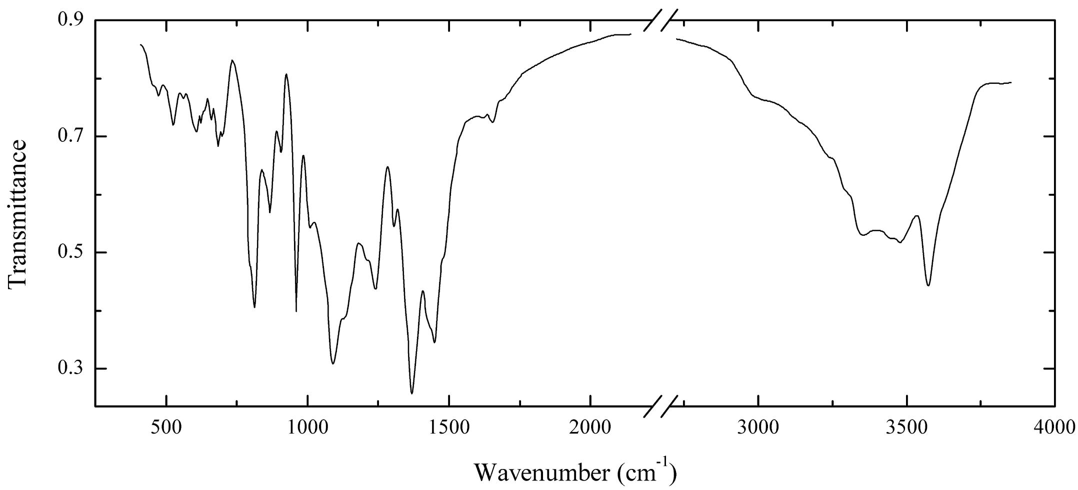


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia (type locality).

Description: Granular aggregates in szaibélyite veinlet crossing kurchatovite–sakhaite boron ore. Holotype sample. Monoclinic, space group $P2_1/c$; $a = 7.976$, $b = 7.237$, $c = 12.571$ Å, $\beta = 93.86°$. The empirical formula is $Ca_{1.92}Mg_{0.03}B_{3.02}O_4Cl_{0.58}(OH)_{4.66}$. Optically biaxial (+), $\alpha \approx \beta = 1.510$, $\gamma = 1.545$. $D_{calc} = 2.58$ g/cm^3, $D_{meas} = 2.514$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 2.196 (100), 7.84 (90), 1.734 (90), 2.61 (80), 2.54 (80), 1.911 (80), 2.74 (70).

Wavenumbers (cm^{-1}): 3610, 3545, 3482w, 3405, 3250, 1475sh, 1425, 1369s, 1334, 1305s, 1248s, 1150sh, 1120s, 1069, 1025s, 999s, 945sh, 920s, 845s, 780s, 742w, 711w, 683, 642w, 619, 569w, 553w, 504, 487, 482, 460w, 400w.

B65 Rivadavite $Na_6MgB_{24}O_{40}{\cdot}22H_2O$

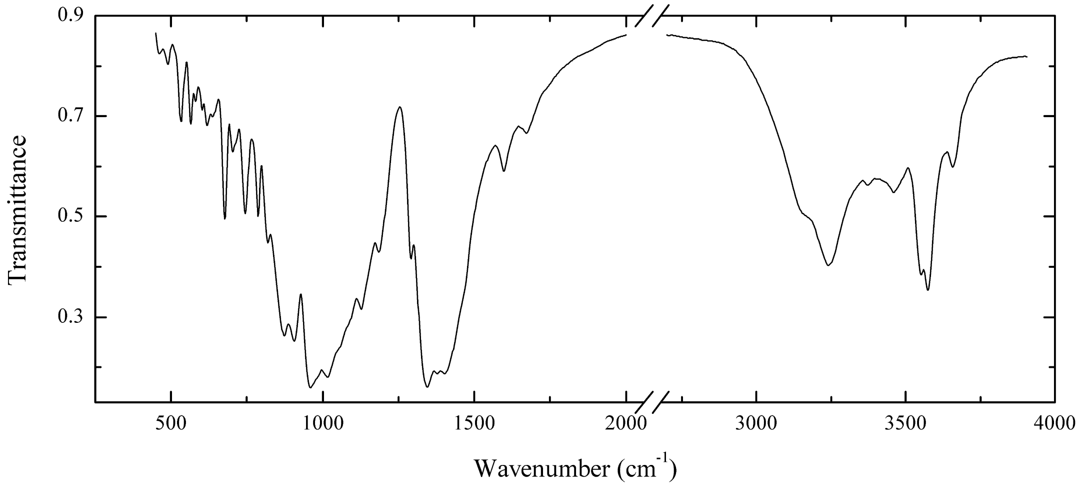


Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta province, Argentina (type locality).

Description: Colourless grains. Specimen No. 37869 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 3550, 3455, 3435sh, 3330, 3270sh, 3225sh, 3000sh, 1660w, 1620w, 1480sh, 1448s, 1430sh, 1369s, 1306, 1240, 1215sh, 1134s, 1091s, 1010, 961s, 912, 869, 813s, 798, 699w, 686, 658w, 638w, 623w, 600w, 559w, 525w, 479w.

B67 Studenitsite $NaCa_2B_9O_{14}(OH)_4 \cdot 2H_2O$

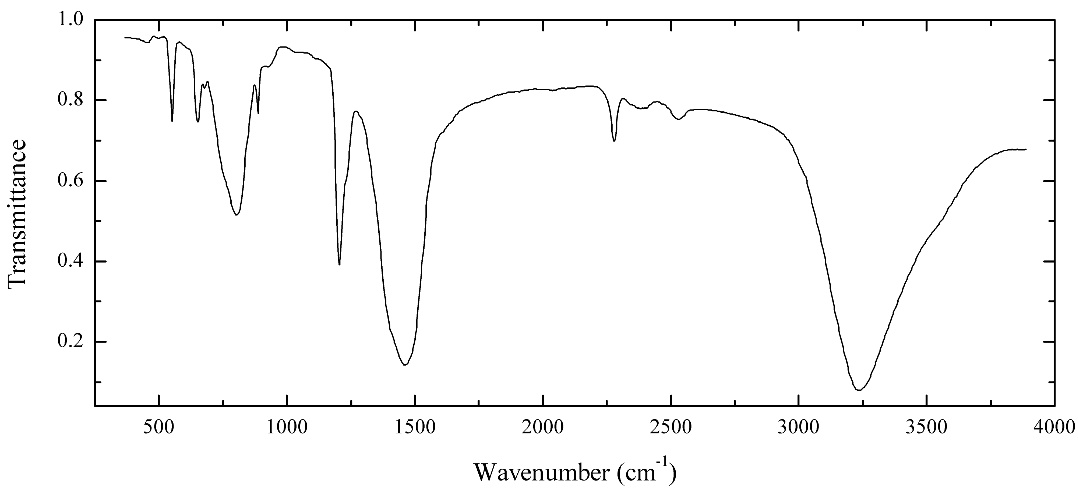


Locality: Peskaya deposit, Balevats, Jarandol basin, Serbia (type locality).

Description: White granular aggregate from the association with colemanite, howlite, ulexite and pentahydroborite. Holotype sample. Monoclinic, space group $P2_1/c$; a = 11.499, b = 12.588, c = 10.530 Å, β = 99.42°. Optically biaxial (+), α = 1.532, β = 1.538, γ = 1.564. D_{calc} = 2.34 g/cm^3, D_{meas} = 2.29 g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 3.04 (100), 3.35 (89), 5.41 (66), 3.27 (59), 2.210 (59), 5.20 (57), 4.20 (56).

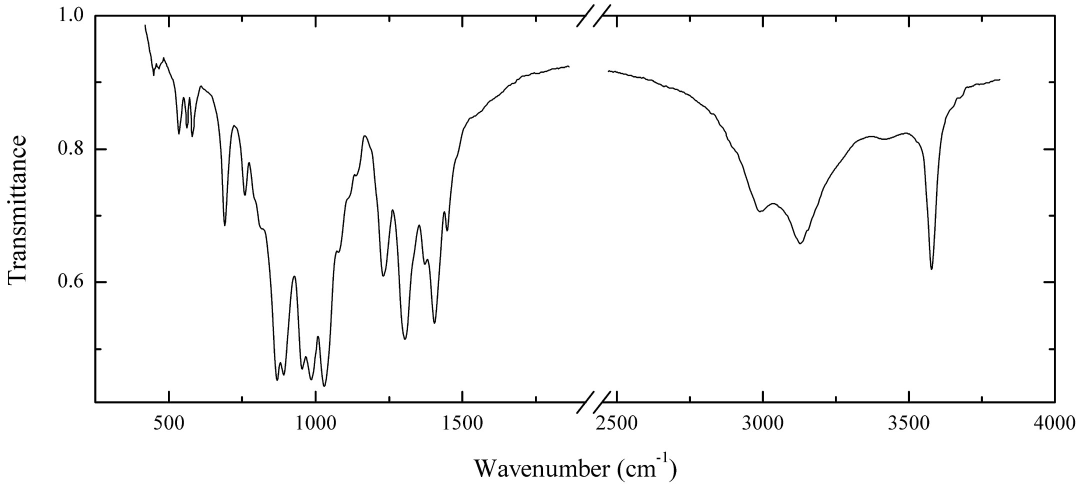
Wavenumbers (cm^{-1}): 3662, 3569, 3544, 3455, 3375, 3242, 3160sh, 1688w, 1598, 1460sh, 1401s, 1376s, 1341s, 1290, 1183, 1122, 1085sh, 1060sh, 1014s, 957s, 903s, 869s, 815, 783, 743, 709, 697, 671, 635w, 611w, 597w, 573w, 559, 538w, 526, 482w, 450w.

B68 Sassolite H_3BO_3



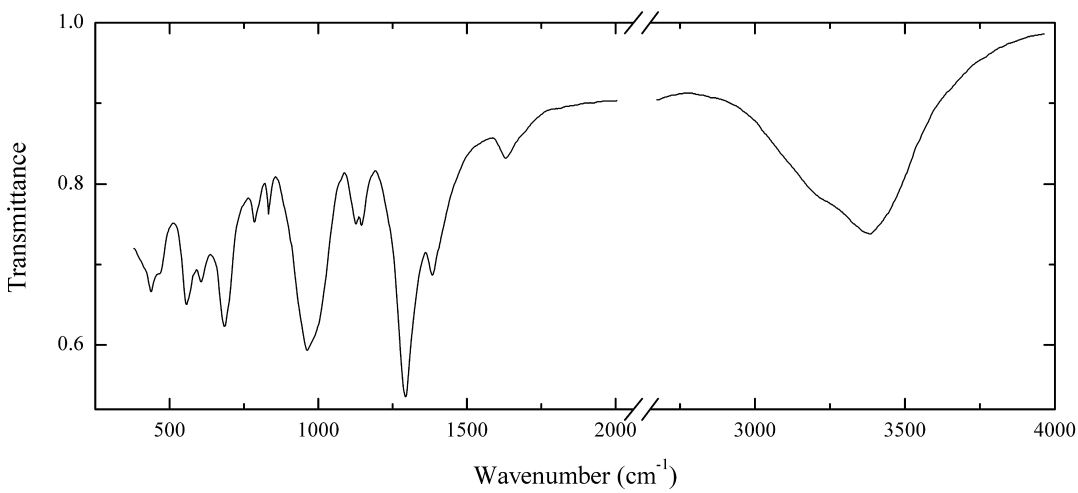
Locality: Vesuvius volcanic complex, Campania, Italy.
Description: Soft scaly aggregate. Associated mineral is ferruccite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3212s, 2512w, 2365w, 2265, 1456s, 1230sh, 1200s, 926w, 884, 800, 675w, 649, 547, 510w, 470w.

B69 Jarandolite $CaB_3O_4(OH)_3$



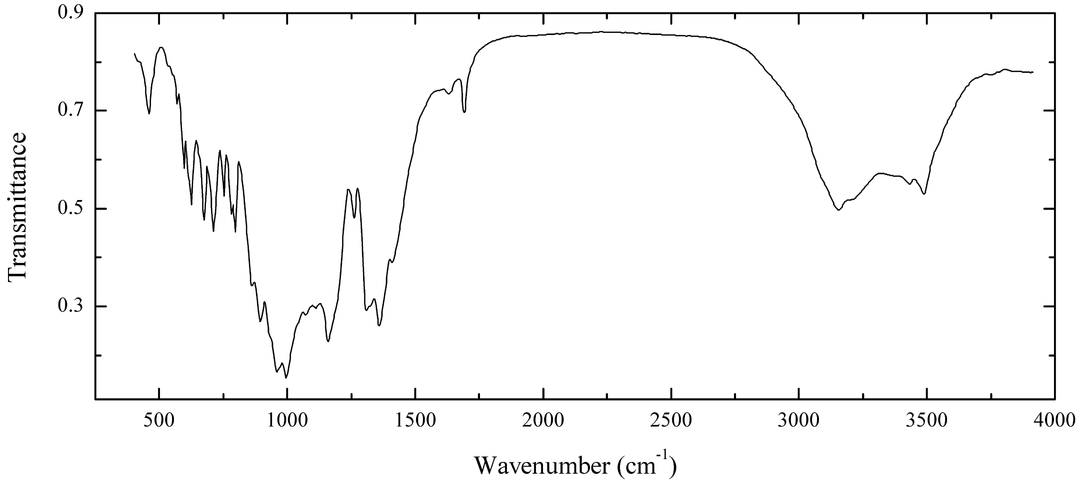
Locality: Peskaya deposit, Balevats, Jarandol basin, Serbia (type locality).
Description: Subparallel growth of colourless rough prismatic crystals from the association with colemanite, howlite, ulexite, veatchite, pentahydroborite, studenitsite and montmorillonite. Holotype sample. Monoclinic, space group $P2_1/a$; $a = 8.386(3)$, $b = 8.142(4)$, $c = 7.249(3)$ Å, $\beta = 98.33(3)°$. The empirical formula is $Ca_{1.03}(B_{3.02}Si_{0.01})O_{4.17}(OH)_{2.81}Cl_{0.01}$. Optically biaxial (+), $\alpha = 1.573(2)$, $\beta = 1.586(2)$, $\gamma = 1.626(2)$. $D_{calc} = 2.57$ g/cm^3, $D_{meas} = 2.49$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 4.32 (57), 3.39 (100), 3.13 (50), 2.93 (23), 2.606 (25), 1.849 (25).
Wavenumbers (cm^{-1}): 3550, 3390w, 3115, 2980, 1447, 1402, 1369, 1300, 1226, 1135sh, 1110sh, 1075, 1026s, 983s, 953s, 889s, 867s, 810, 795sh, 756, 687, 595sh, 577w, 560w, 533w, 444w, 419w.

B70 Satimolite $KNa_2Al_4B_6O_{15}Cl_3 \cdot 13H_2O$



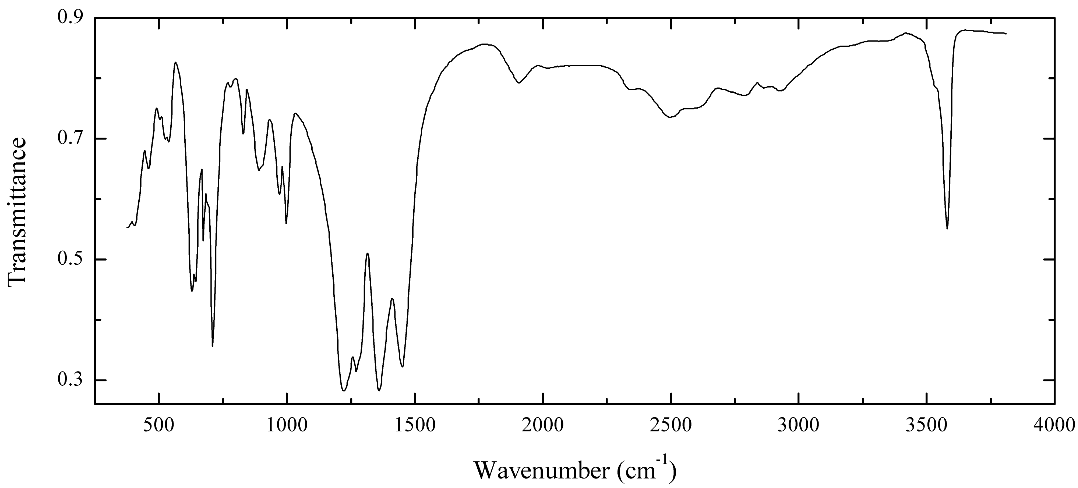
Locality: Satimola salt dome, North Caspian region, Kazakhstan (type locality).
Description: Fine-grained aggregate from the association with halite, kaliborite, boracite, kieserite and magnesite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3390, 3240sh, 1638, 1386, 1298s, 1156, 1136, 990sh, 972s, 838, 793, 696, 614, 570, 476, 444.

B71 Strontioborite $SrB_8O_{11}(OH)_4$



Locality: Chelkar salt dome, Aksai Valley, Aktobe (Aqtöbe) region, Kazakhstan (type locality).
Description: White scaly aggregate from the association with halite, ginorite, boracite, halurgite, kieserite, anhydrite, preobrazhenskite, boracite, aksaite and metaborite. Holotype sample. Monoclinic, space group $P2_1$, $a = 9.909(5)$, $b = 8.130(10)$, $c = 7.623(1)$ Å, $\beta = 108.4(2)°$. Optically biaxial (+) or (−), $\alpha = 1.470(2)$, $\beta = 1.510(2)$, $\gamma = 1.579(2)$. $D_{calc} = 2.38$ g/cm^3, $D_{meas} = 2.40$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 7.33 (100), 4.09 (80), 3.50 (70), 3.32 (70), 3.06 (60), 2.033 (60), 7.77 (40).
Wavenumbers (cm^{-1}): 3483, 3417, 3190sh, 3143, 1691w, 1630w, 1414, 1357s, 1328s, 1308s, 1262, 1161s, 1116s, 1074s, 996s, 958s, 930sh, 894s, 862, 795, 782, 752, 720sh, 710, 674, 623, 613, 594, 567w, 464w.

B72 Szaibélyite $MgBO_2(OH)$

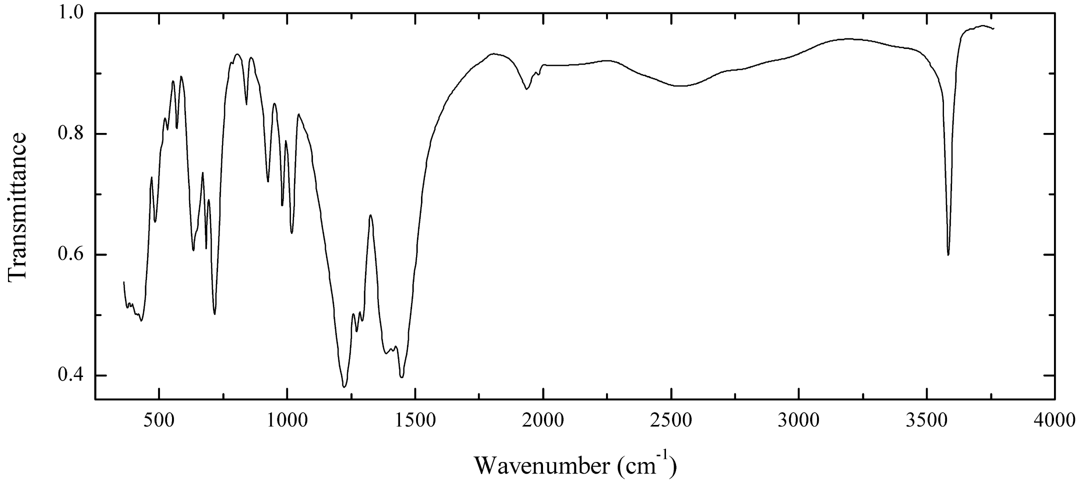


Locality: Franklin, Sussex Co., New Jersey, USA.

Description: Pink massive. Identified by IR spectrum. Mn-rich variety. The empirical formula is (electron microprobe; qualitative analysis for F) $Mg_{0.59}Mn_{0.39}Zn_{0.03}BO_2(OH,F)$.

Wavenumbers (cm^{-1}): 3552, 3504w, 3330w, 3180w, 2920w, 2860w, 2775w, 2590w, 2495, 2340w, 2005w, 1905w, 1448s, 1359s, 1285sh, 1266s, 1240sh, 1220s, 998, 970, 905sh, 892, 830, 777w, 707s, 673, 641, 626, 539, 522, 501w, 400.

B73 Szaibélyite $MgBO_2(OH)$

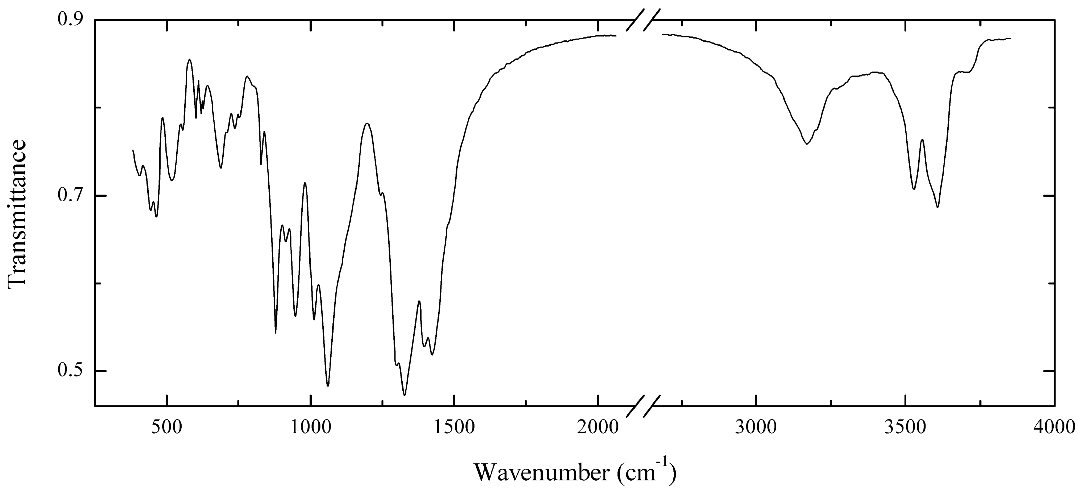


Locality: Liaoning Province, China.

Description: Pseudomorph after suanite from the association with ludwigite. Identified by IR spectrum. The empirical formula is (electrom microprobe) $Mg_{0.95}Fe_{0.03}Mn_{0.01}Ca_{0.01}BO_2(OH)$.

Wavenumbers (cm^{-1}): 3557, 3515sh, 2880w, 2775w, 2580sh, 2510, 2370sh, 2100sh, 1975w, 1930, 1447s, 1410s, 1385s, 1289s, 1268s, 1222s, 1015, 979, 922, 840, 713s, 678, 640sh, 628, 564, 530w, 505sh, 481, 445sh, 432s, 400.

B74 Roweite $Ca_2Mn^{2+}{}_2B_4O_7(OH)_6$

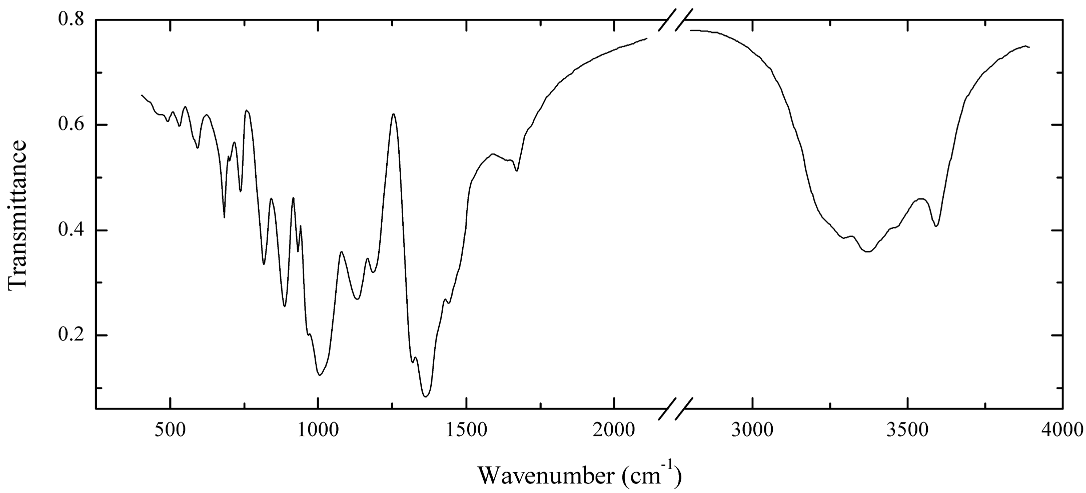


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: Brown granular aggregate from the association with frolovite, kurchatovite, sakhaite and ludwigite. Identified by IR spectrum. Mg-rich variety. The empirical formula is (electrom microprobe) $Ca_{1.97}Mn_{1.04}Mg_{0.88}Fe_{0.11}B_4O_7(OH)_6$.

Wavenumbers (cm^{-1}): 3675w, 3580, 3560sh, 3500, 3155, 1470sh, 1425s, 1395s, 1326s, 1300s, 1250, 1110sh, 1058s, 1010, 946, 913, 876s, 827, 757w, 733w, 698, 616w, 596w, 522w, 510, 458, 440, 400.

B75 Tunellite $SrB_6O_9(OH)_2{\cdot}3H_2O$

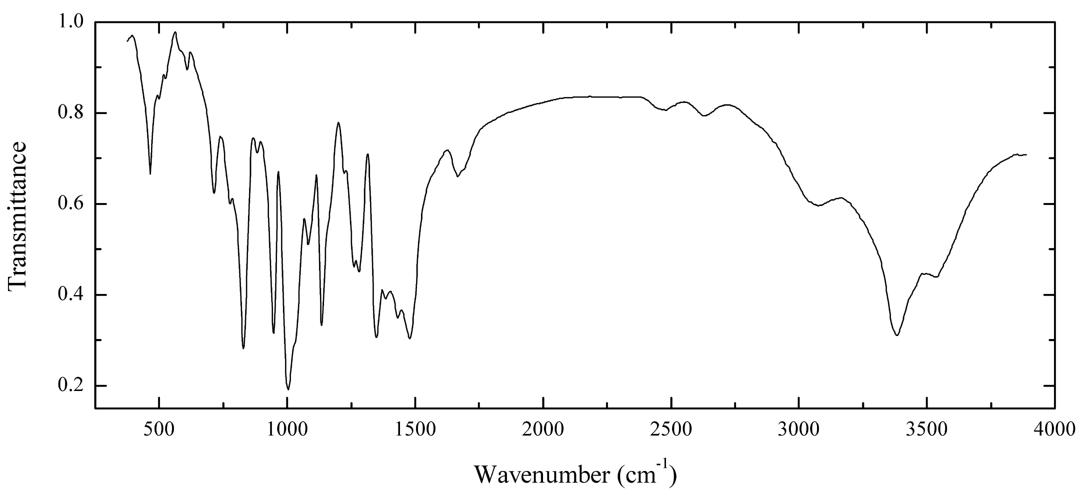


Locality: Boron Open Pit, Boron, Kern Co., California, USA.

Description: Colourless crystal. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3585, 3450sh, 3365, 3290, 1676w, 1636w, 1438, 1362s, 1318s, 1186, 1133s, 1030sh, 1003s, 965s, 932, 883s, 813, 735, 697w, 681, 593w, 580sh, 530w, 491w, 450w.

B76 Tincalconite $Na_2B_4O_5(OH)_4{\cdot}3H_2O$

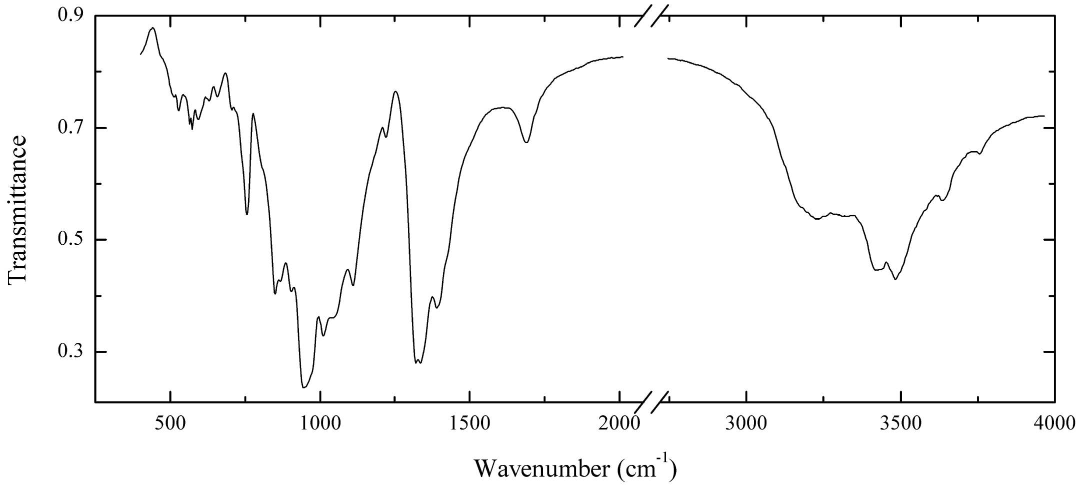


Locality: An unknown locality in Siberia, Russia.

Description: White fine-grained aggregate. Pseudomorph after borax. Identified by IR spectrum.

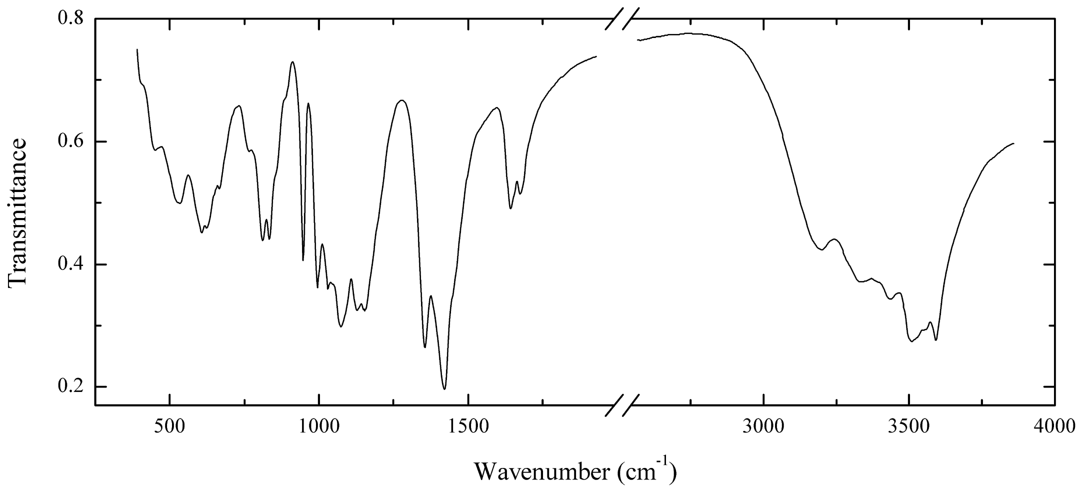
Wavenumbers (cm^{-1}): 3510, 3375s, 3070, 2625w, 2460w, 1680sh, 1660w, 1477s, 1430s, 1380, 1346s, 1280, 1260, 1225w, 1160sh, 1134s, 1090, 1028sh, 1004s, 947s, 882w, 826s, 773, 708, 605w, 590sh, 520w, 494w, 461.

B77 Tuzlaite $NaCaB_5O_8(OH)_2 \cdot 3H_2O$



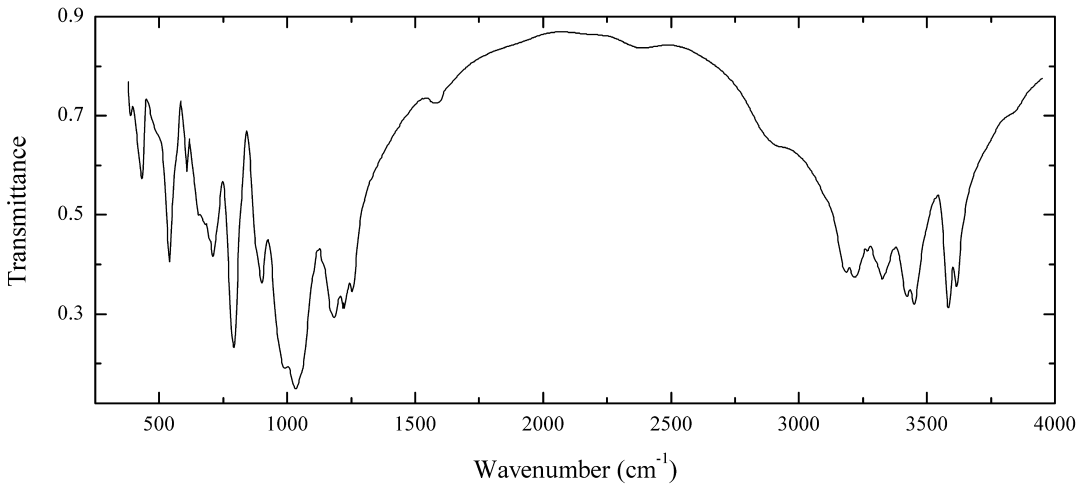
Locality: Tuzla salt mine, near Tuzla, Bosnia and Hercegovina (type locality).
Description: White parallel-fibrous aggregate. Vein in dolomite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3730w, 3620, 3470, 3415, 3220, 1685w, 1390sh, 1385, 1336s, 1319s, 1220w, 1109, 1043s, 1010s, 945s, 903, 869, 847, 752, 735sh, 701w, 655w, 630w, 600sh, 588w, 572, 562w, 549w, 523w, 510sh.

B78 Borax $Na_2B_4O_5(OH)_4 \cdot 8H_2O$



Locality: Kramer borate deposit, Boron, Kern Co., California, USA.
Description: Colourless crystal.
Wavenumbers (cm^{-1}): 3570s, 3495s, 3410, 3317, 3190, 1670, 1640, 1420s, 1314s, 1152s, 1130s, 1075s, 1027, 995, 946, 855sh, 835, 810, 763, 675sh, 625, 610, 531, 450.

B79 Nifontovite $Ca_3B_6O_6(OH)_{12}{\cdot}2H_2O$

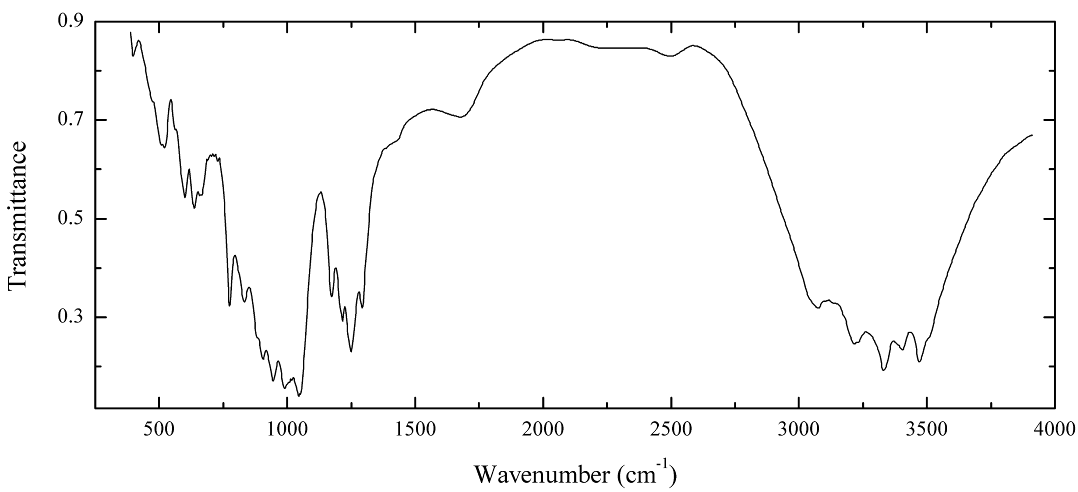


Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan.

Description: Grey granular aggregate from the association with pentahydroborite and calcite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3605, 3570s, 3435s, 3410s, 3310, 3205, 3170, 2875, 2380w, 1585w, 1252, 1220, 1185s, 1065sh, 1034s, 994s, 903, 892s, 710, 670sh, 650sh, 614w, 541, 434, 385w.

B80 Pentahydroborite $CaB_2O(OH)_6{\cdot}2H_2O$

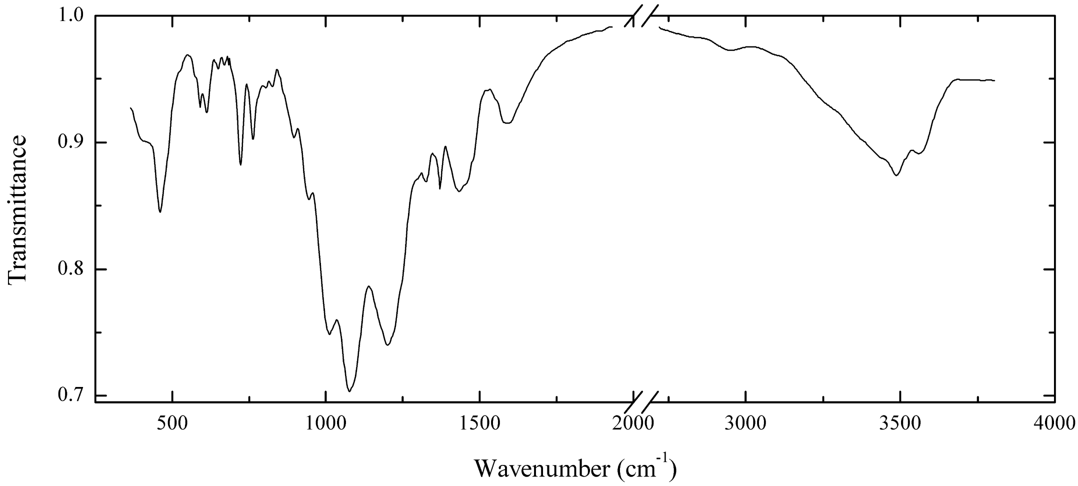


Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan.

Description: White granular aggregate from the association with nifontovite, parasibirskite and calcite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3450s, 3390, 3315s, 3210, 3055, 2495w, 2250w, 1695w, 1655w, 1420sh, 1290, 1247, 1215, 1176, 1048s, 988s, 945s, 905s, 885, 832, 772, 660, 637, 600, 583w, 522w, 505w, 470sh.

B81 Uralborite $CaB_2O_2(OH)_4$

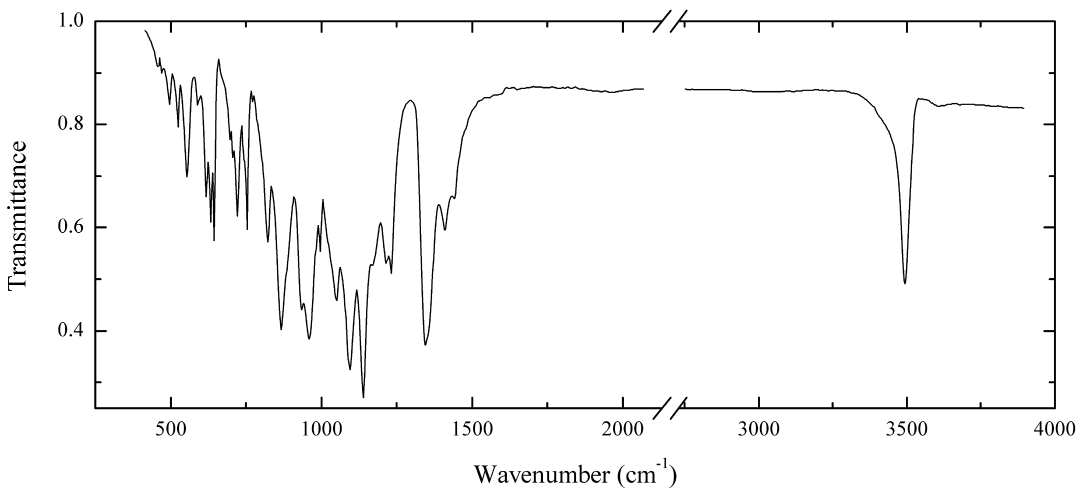


Locality: Novofrolovskoye copper deposit, near Krasnotur'insk, Northern Ural Mts., Russia (type locality).

Description: White grains from the association with frolovite. Specimen No. 64944 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 3550, 3470, 1595, 1452, 1372, 1325, 1220sh, 1201s, 1180sh, 1083s, 1016s, 949, 898, 808w, 782w, 761, 722, 674w, 650w, 611, 591, 464, 410sh.

B82 Heidornite $Na_2Ca_3B_5O_8(SO_4)_2Cl(OH)_2$

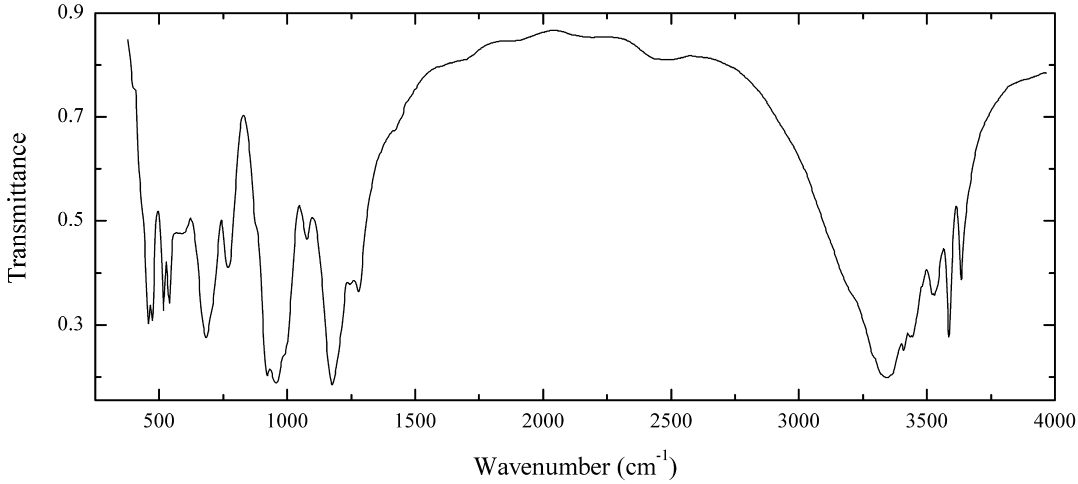


Locality: Nordhorn, near Hanover, Lower Saxony, Germany (type locality).

Description: Colourless crystal from the association with anhydrite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3475, 1447, 1413, 1355sh, 1344s, 1231, 1216, 1173, 1141s, 1096s, 1055, 997, 964s, 936, 869s, 825, 754, 744w, 722, 707w, 697w, 645, 633, 618, 690w, 556, 525w, 499w, 470w.

B83 Henmilite $Ca_2Cu^{2+}[B(OH)_4]_2(OH)_4$

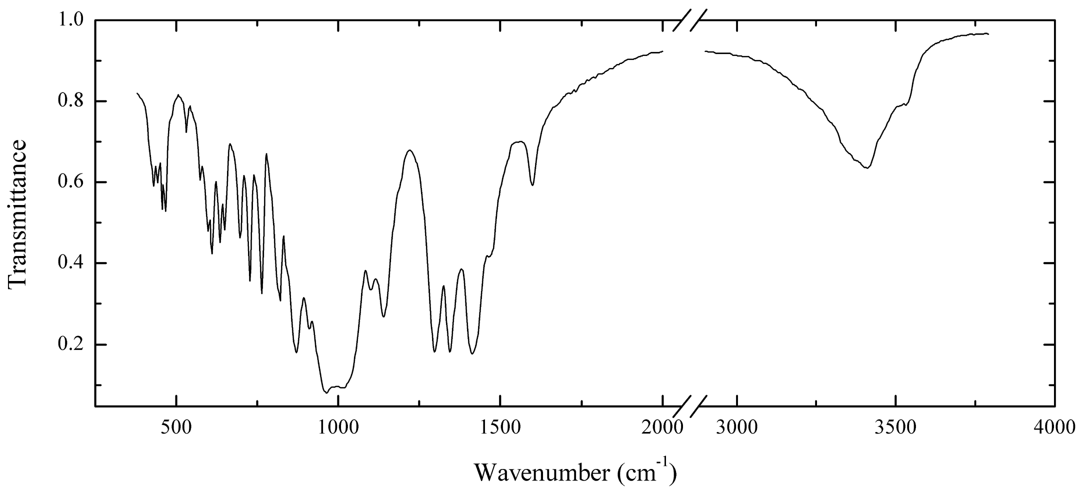


Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan (type locality).

Description: Violet-blue crystals to 2 mm from the association with calcite, pentahydroborite, nifontovite, inyoite and apophyllite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3607, 3560s, 3500, 3415s, 3385s, 3320s, 3170sh, 2460w, 1415sh, 1280, 1248, 1175s, 1077, 987s, 959s, 921s, 769, 705sh, 686s, 592, 540, 517, 474s, 457s, 435sh, 400sh.

B84 Hilgardite $Ca_2(B_5O_9)Cl{\cdot}H_2O$

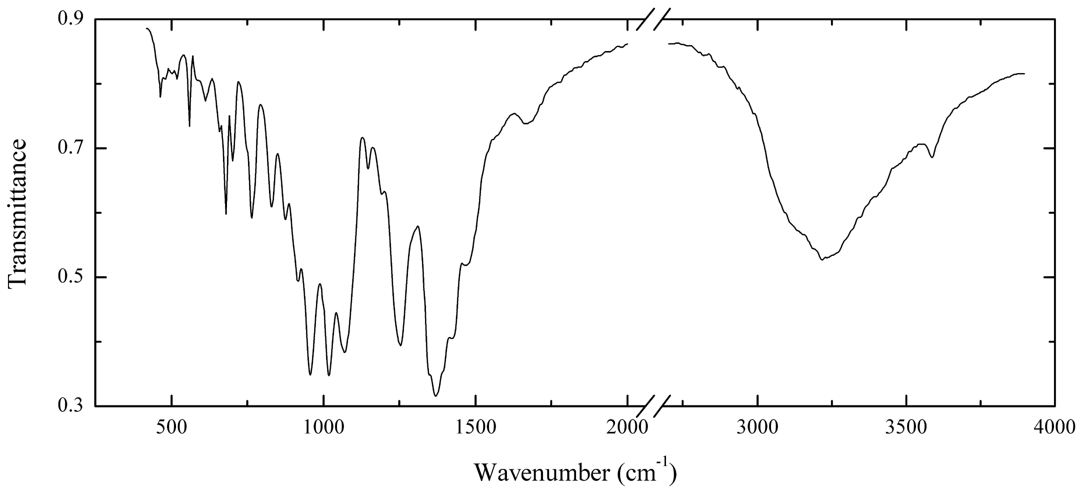


Locality: Chelkar salt dome, Aksai Valley, Aktobe region, Kazakhstan.

Description: Colourless. Identified by IR spectrum and semiquantitative electron microprobe analysis. Close to calcium endmember.

Wavenumbers (cm^{-1}): 3525sh, 3405, 1601w, 1469, 1414s, 1342s, 1297s, 1141, 1103, 1016s, 961s, 909s, 870s, 840sh, 819, 763, 725, 695, 650, 633, 610, 598, 571w, 529w, 483w, 464, 455, 440w, 430w.

B85 Ezcurrite $Na_2B_5O_7(OH)_3{\cdot}2H_2O$

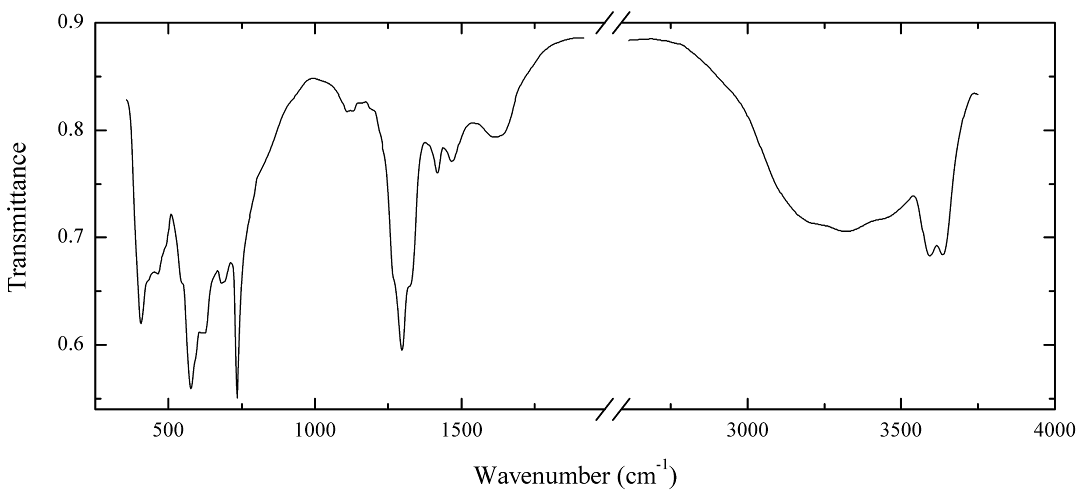


Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta province, Argentina (type locality).

Description: Colourless crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3575w, 3380sh, 3215, 3125sh, 1670w, 1477, 1431, 1400s, 1377s, 1351s, 1254s, 1197, 1151, 1074s, 1019s, 959s, 917, 876, 831, 773, 764, 747w, 700w, 677, 658w, 610w, 585sh, 556w, 513w, 497w, 477w, 463w.

B86 Shabynite $Mg_5BO_3(Cl,OH)_2(OH)_5{\cdot}4H_2O$

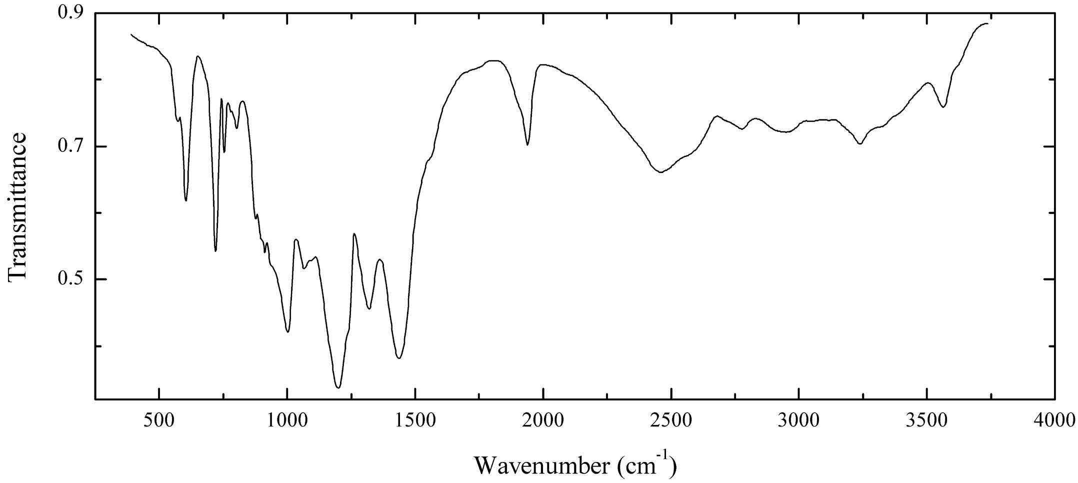


Locality: Borehole at the Korshunovskoe iron deposit, Irkutsk region, Siberia, Russia.

Description: White soft fibrous aggregate from the association with dolomite, korshunovskite, ekaterinite, dashkovaite, iowaite and halite. Holotype sample. Monoclinic (?). The empirical formula is $Mg_{5.05}(BO_3)_{0.94}Cl_{1.49}(OH)_{5.79}{\cdot}3.90H_2O$. Optically biaxial (−), $\alpha = 1.543(2)$, $\beta = 1.571(3)$, $\gamma = 1.577(2)$. $D_{meas} = 2.32(3)$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 9.27 (100), 2.439 (80), 3.69 (70), 5.47 (60), 2.377 (60), 4.21 (50), 1.798 (50).

Wavenumbers (cm^{-1}): 3640, 3595, 3340, 3220sh, 1625w, 1475w, 1425w, 1325sh, 1302s, 1270sh, 1125w, 732s, 685, 625s, 590sh, 576s, 545sh, 465, 425sh, 402.

B87 Sibirskite $CaHBO_3$

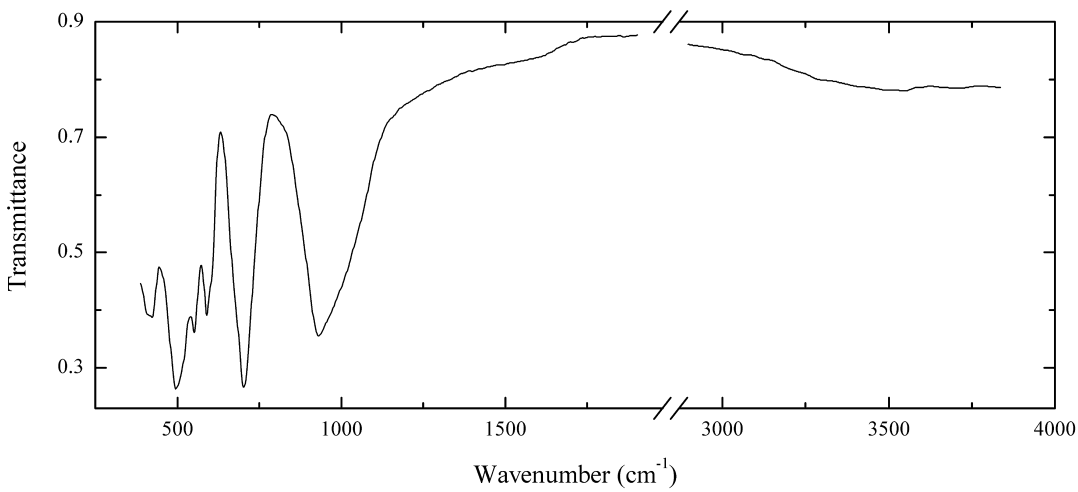


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: White veinlet in marble in the association with sakhaite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3555w, 3310sh, 3240w, 2940w, 2750w, 2460, 1943w, 1905sh, 1550sh, 1453s, 1325s, 1245sh, 1204s, 1085sh, 1072, 1005s, 950sh, 917, 907w, 897w, 874w, 807w, 784w, 756w, 721, 606, 574w.

B88 Sinhalite $MgAlBO_4$

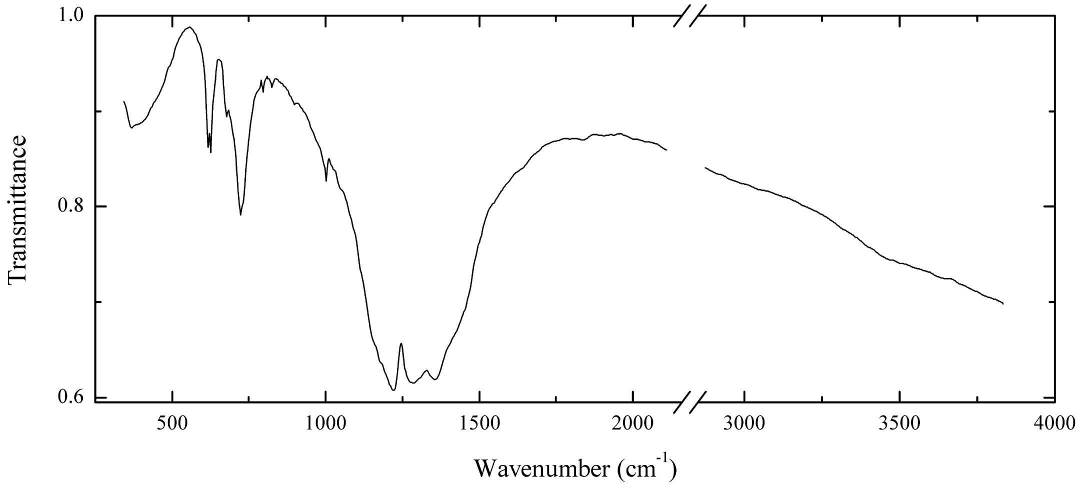


Locality: Tayozhnoe deposit, Aldan shield, Eastern Siberia, Russia.

Description: Greenish crusts around spinel grains. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mg_{0.90}Fe_{0.12}Al_{0.98}BO_4$.

Wavenumbers (cm^{-1}): 930s, 699s, 595sh, 585, 550s, 497s, 422, 412.

B89 Takedaite $Ca_3B_2O_6$

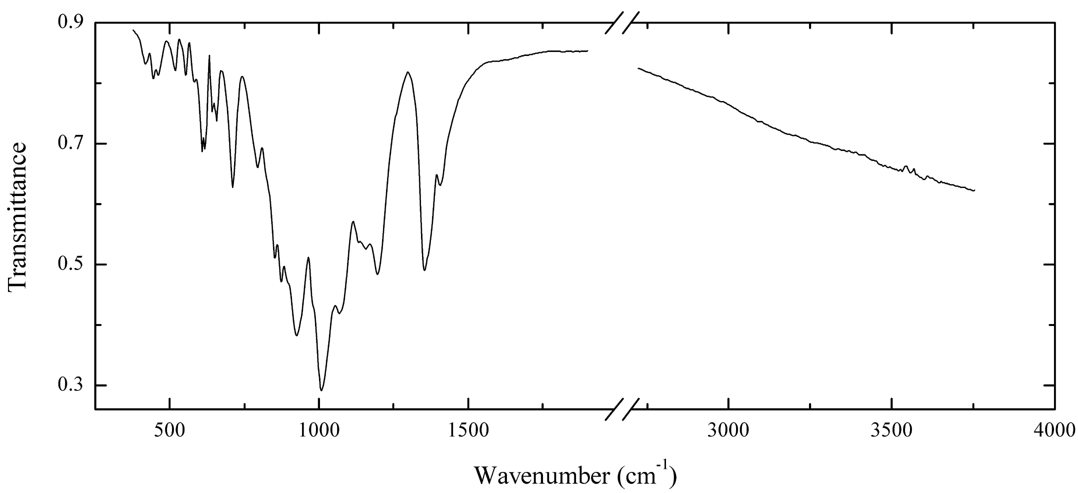


Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan (type locality).

Description: Light grey granular aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1400sh, 1354s, 1287s, 1219s, 1160sh, 1002, 730sh, 720, 678w, 627, 618, 460sh, 400sh, 370.

B90 Ericaite $(Fe^{2+},Mg,Mn)_3 B_7O_{13}Cl$

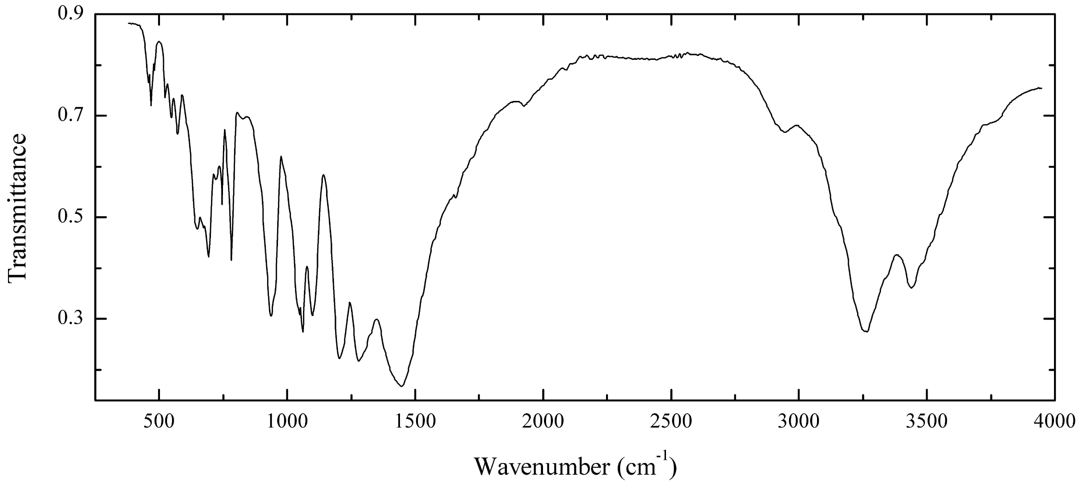


Locality: Verkhnekamskoe K deposit, Solikamsk, Perm Krai, Middle Urals, Russia.

Description: Green tetrahedral crystals. The empirical formula is (electron microprobe) $Fe_{1.5}Mn_{1.3}Mg_{0.2}B_7O_{13}Cl$.

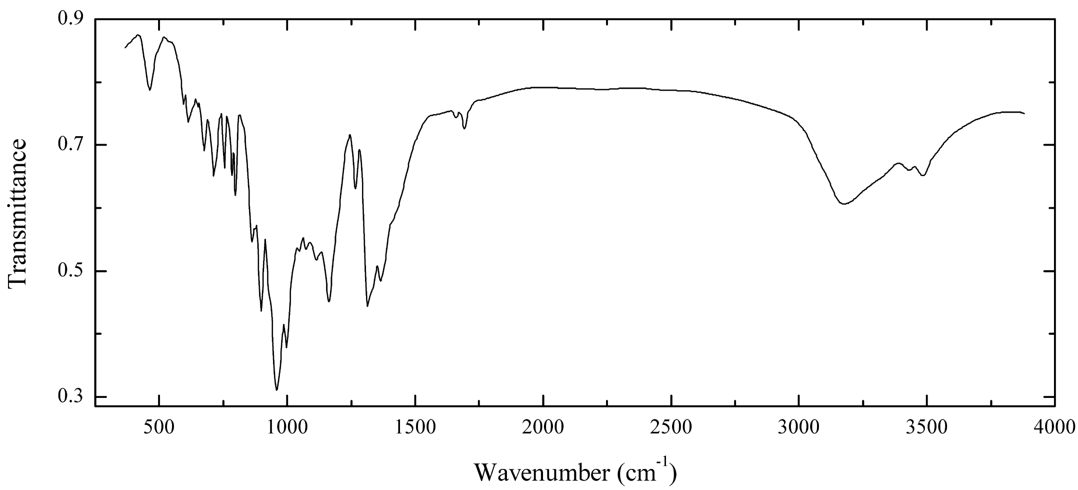
Wavenumbers (cm^{-1}): 1400, 1349s, 1192s, 1157, 1133, 1069s, 1007s, 980sh, 926s, 900sh, 873s, 850s, 793, 711, 661, 645, 618, 607, 583w, 557w, 521w, 447w, 424w, 416w.

B91 Larderellite $(NH_4)B_5O_7(OH)_2{\cdot}H_2O$



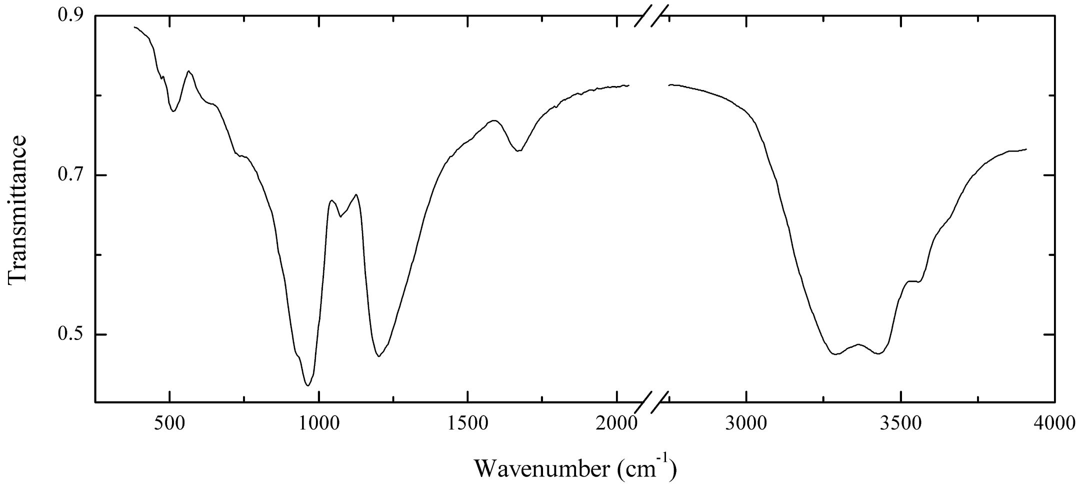
Locality: Larderello, Val di Cecina, Tuscany, Italy (type locality).
Description: White massive. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3720sh, 3412 m 3240s, 3120sh, 2925w, 1923w, 1444s, 1425sh, 1325sh, 1300sh, 1276s, 1202s, 1095s, 1059s, 1040sh, 1010sh, 950sh, 936, 895sh, 870sh, 828w, 782, 746, 721w, 692, 672, 645, 610sh, 573w, 547w, 527w, 482w, 470w, 457w.

B92 Strontioborite $SrB_8O_{11}(OH)_4$



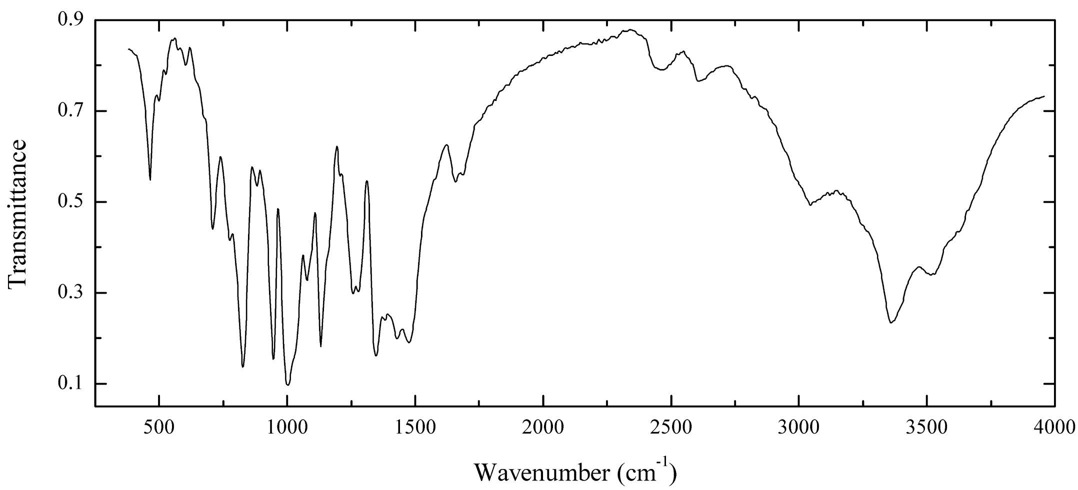
Locality: Chelkar salt dome, Aksai Valley, Aktobe region, Kazakhstan (type locality).
Description: White scaly aggregate from the association with halite, ginorite and anhydrite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3460w, 3405w, 3150, 1690w, 1655w, 1410sh, 1362, 1335sh, 1309s, 1265, 1161s, 1114, 1074, 1047, 995s, 959s, 930sh, 896s, 861, 797, 785, 753, 711, 675, 617w, 594w, 464w.

B93 Hexahydroborite $Ca[B(OH)_4]_2{\cdot}2H_2O$



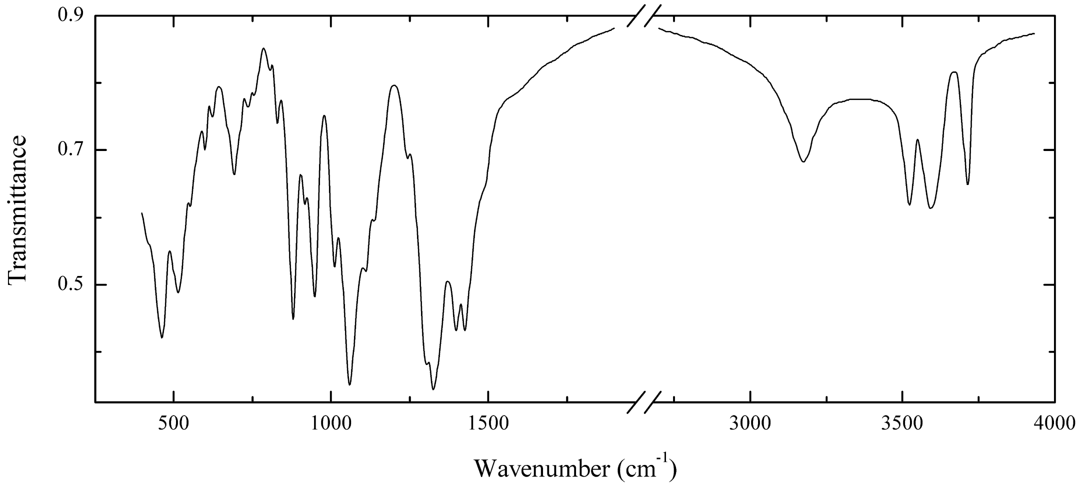
Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan.
Description: White fine-grained aggregate. Pseudomorph after takedaite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3600sh, 3525, 3390, 3255, 1662w, 1195s, 1073, 965s, 925sh, 740, 635sh, 518, 485sh.

B94 Tincalconite $Na_2B_4O_5(OH)_4{\cdot}3H_2O$



Locality: Unknown locality in Australia.
Description: White fine-grained aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3515, 3355s, 3035, 2610w, 2460w, 1695w, 1665w, 1475s, 1437s, 1385, 1346s, 1276, 1252, 1224w, 1160sh, 1130s, 1100sh, 1078, 1025sh, 1002s, 945s, 880w, 824s, 773, 709, 675sh, 650sh, 606w, 574w, 522w, 496w, 461.

B95 Fedorovskite $Ca_2Mg_2B_4O_7(OH)_6$

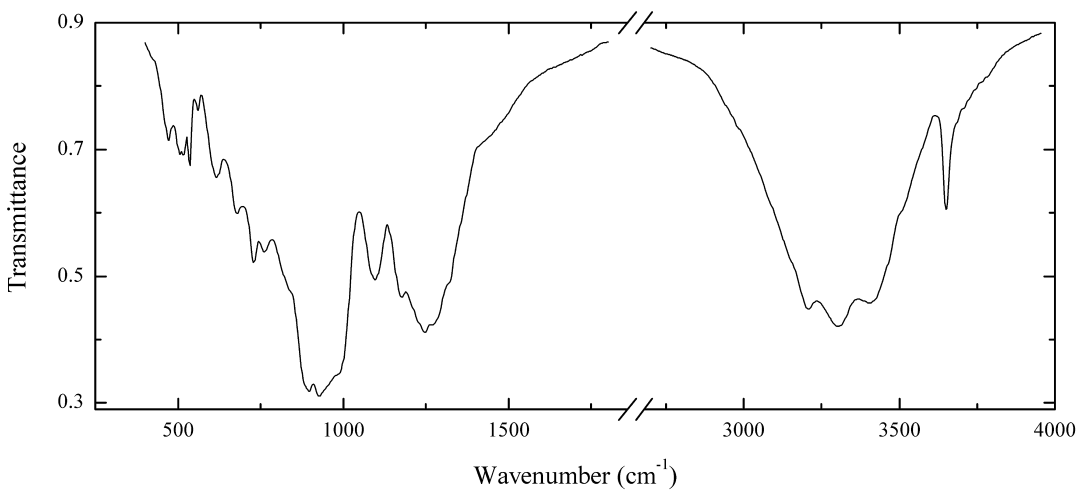


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia (type locality).

Description: Brownish-yellow granular aggregate from the association with frolovite, kurchatovite, sakhaite and ludwigite. Identified by IR spectrum. The empirical formula is (electrom microprobe) $Ca_{1.95}Mg_{1.78}Mn_{0.20}Fe_{0.07}B_4O_7(OH)_6$.

Wavenumbers (cm^{-1}): 3695, 3570, 3500, 3160, 1490sh, 1424s, 1395s, 1326s, 1300s, 1250, 1131, 1108, 1056s, 1008, 946s, 914, 876s, 827w, 798w, 754w, 733w, 705sh, 688, 665sh, 617w, 597w, 552, 510, 462s, 410sh.

B96 Frolovite $Ca[B(OH)_4]_2$

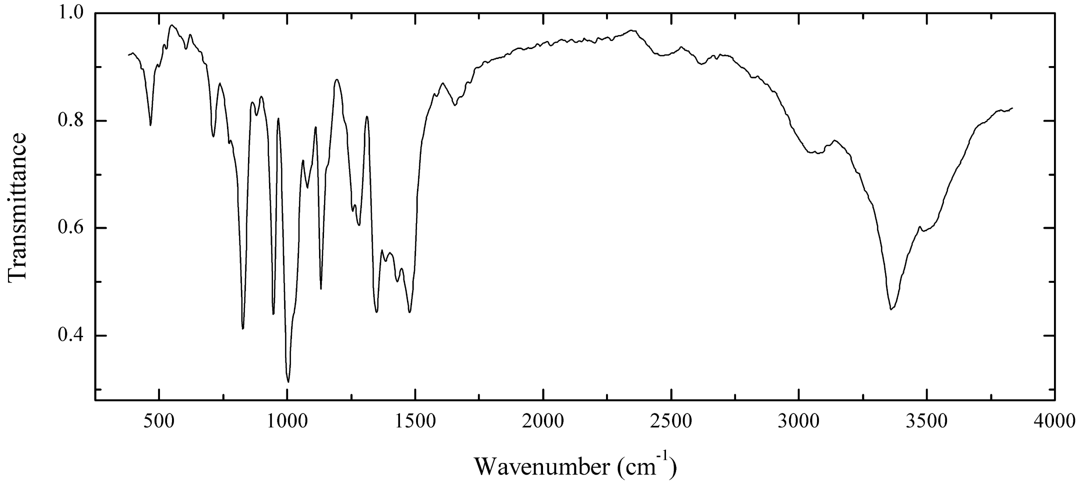


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: White veinlet in kurchatovite–sakhaite boron ore. Identified by powder X-ray diffraction pattern.

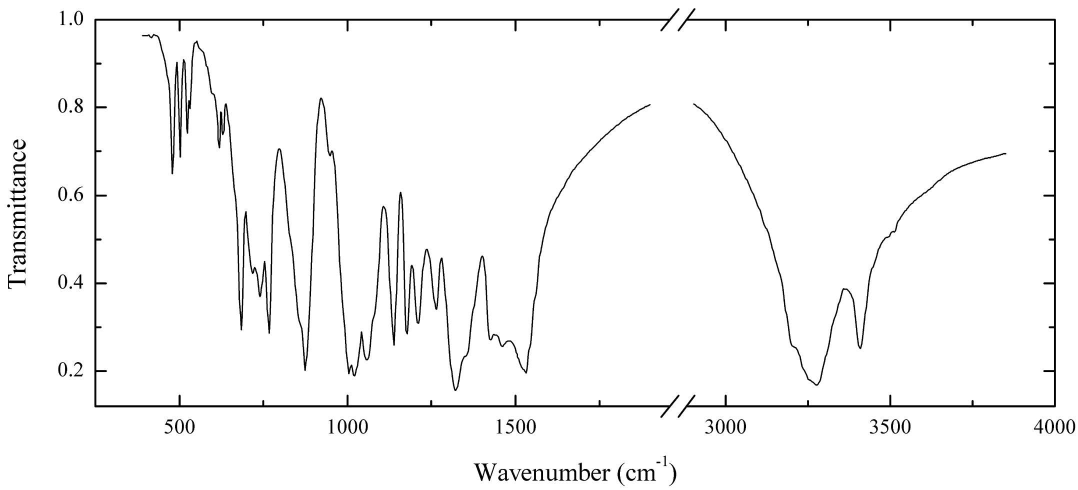
Wavenumbers (cm^{-1}): 3620, 3480sh, 3380, 3260s, 3180, 1315sh, 1270s, 1244s, 1175s, 1095, 985sh, 955sh, 927s, 892s, 760, 725, 670, 610, 560w, 535, 518, 507, 470.

B97 Tincalconite $Na_2B_4O_5(OH)_4{\cdot}3H_2O$



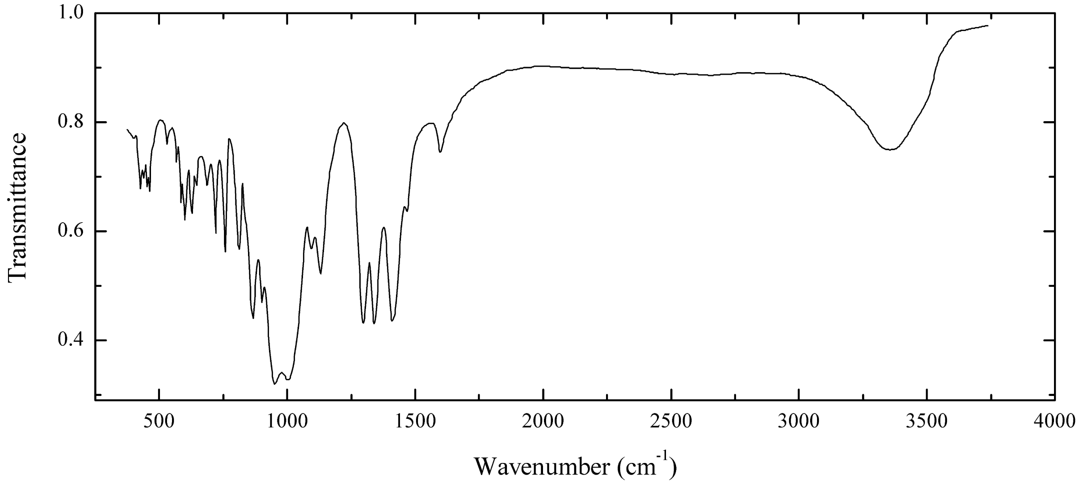
Locality: Searles Lake, San Bernardino Co., California, USA (type locality).
Description: White powdery aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3475, 335os, 3050, 2610w, 2460w, 1725w, 1685w, 1657w, 1480s, 1430, 1386, 1348s, 1279, 1258, 1160sh, 1131s, 1095sh, 1080w, 1025sh, 1003s, 946s, 878w, 827s, 774w, 711w, 607w, 522w, 496w, 460w.

B98 Ameghinite $NaB_3O_3(OH)_4$



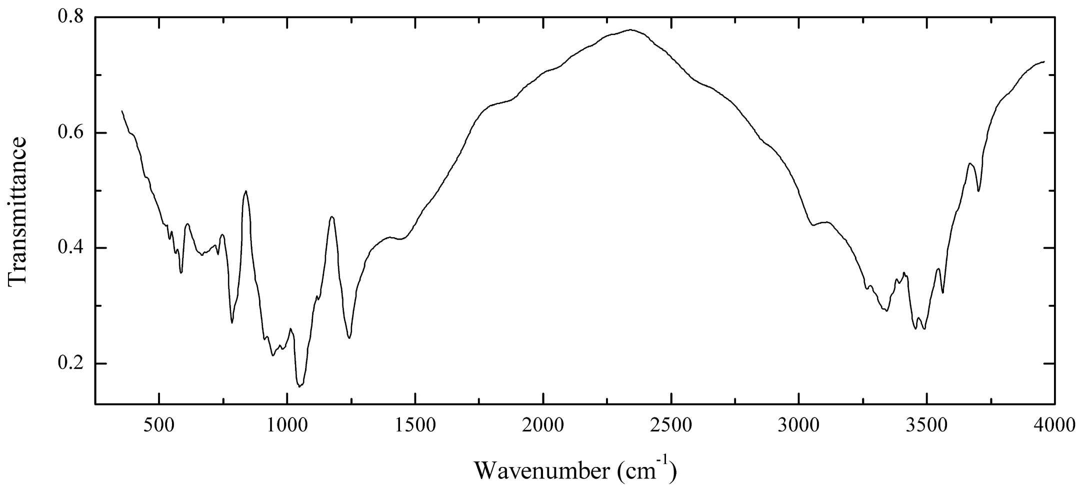
Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta province, Argentina (type locality).
Description: White fine-grained aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3640sh, 3570sh, 3405, 3270s, 3200sh, 1533s, 1520sh, 1468, 1430, 1356s, 1324s, 1265, 1212, 1178, 1139, 1062s, 1022s, 1004s, 985sh, 875s, 855sh, 766s, 739, 720, 682s, 630w, 618, 597w, 531w, 524, 501, 477.

B99 Hilgardite $Ca_2(B_5O_9)Cl·H_2O$



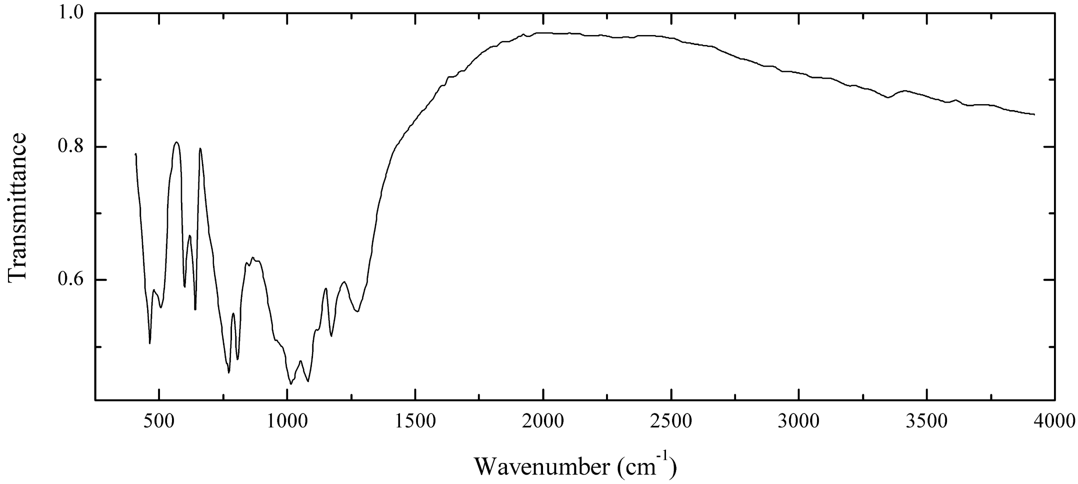
Locality: Nepskoe K salt deposit, Nepa river basin, Irkutsk region, Eastern Siberia, Russia.
Description: White concretion. Identified by IR spectrum. Sr-rich variety. The empirical formula is (electrom microprobe) $Ca_{1.7}Sr_{0.3}(B_5O_9)Cl_{0.9}(OH)_{0.1}·H_2O$.
Wavenumbers (cm^{-1}): 3490sh, 3350, 1610w, 1429s, 1354s, 1310s, 1140, 1102, 1017s, 958s, 909, 870s, 818, 763, 725, 694w, 649w, 633, 608, 598, 571w, 529w, 462, 453, 439, 429, 408w.

B100 Olshanskyite $Ca_3B_4(OH)_{18}$



Locality: Titovskoe boron deposit, Tas-Khayakhtakh range, Sakha Republic (Yakutia), Eastern Siberia, Russia.
Description: White cross-fibre veinlet in massive sakhaite. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3703w, 3553, 3482s, 3447s, 3325, 3270, 3060, 1455, 1295sh, 1239, 1127, 1057s, 989s, 950s, 919s, 805sh, 788, 693, 663w, 650sh, 605sh, 588, 565w, 542w, 528w, 470sh, 425sh.

B101 Johachidolite $CaAlB_3O_7$

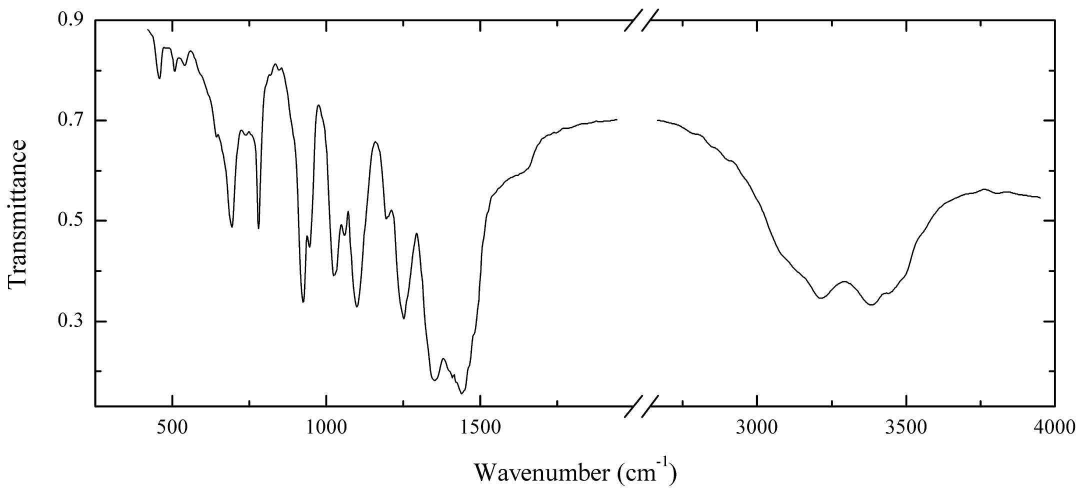


Locality: Near Mogok township, Pyin Oo Lwin district, Mandalay division, Myanmar.

Description: Colourless crystal from the association with sodalite, phlogopite, a humite-group mineral and zircon. Identified by powder X-ray diffraction pattern and semiquantitative electron microprobe analysis (Ca:Al ≈ 1:1 in atomic proportion).

Wavenumbers (cm^{-1}): 3335w, 1275, 1174, 1122, 1080s, 1015s, 957, 854w, 805s, 769s, 755sh, 642, 599, 507, 466.

B102 "Santite-(NH$_4$)" $(NH_4)B_5O_6(OH)_4{\cdot}2H_2O$

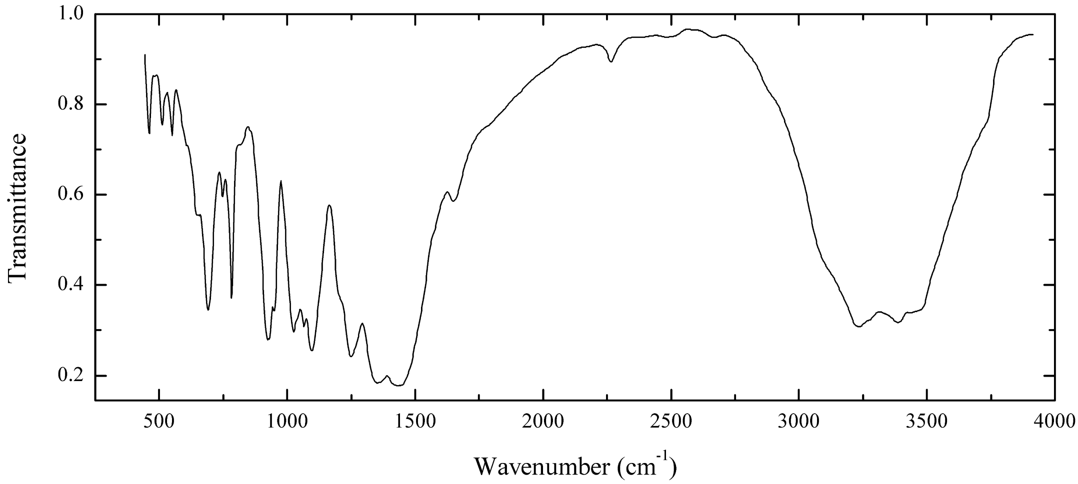


Locality: Larderello, Val di Cecina, Tuscany, Italy (type locality of santite).

Description: White fine-grained aggregate. Ammonium analogue of santite. Close to the IR spectrum of synthetic santite but contains bands of ammonium cations at 3,190 and 1,440 cm^{-1}. Electron microprobe analysis shows only trace amounts of elements with atomic numbers >10. Note that first description of santite, $KB_5O_6(OH)_4{\cdot}2H_2O$, was made without complete chemical data, by analogy with synthetic $KB_5O_6(OH)_4{\cdot}2H_2O$. It is possible that correct formula of santite is $(NH_4)B_5O_6(OH)_4{\cdot}2H_2O$.

Wavenumbers (cm^{-1}): 3460sh, 3420, 3355, 3190, 3065sh, 1620sh, 1440s, 1350s, 1252s, 1195, 1000s, 1058, 1025, 943, 925s, 778, 738w, 692, 644w, 542w, 508w, 456w.

B103 "Santite-(NH_4)" $(NH_4)B_5O_6(OH)_4 \cdot 2H_2O$

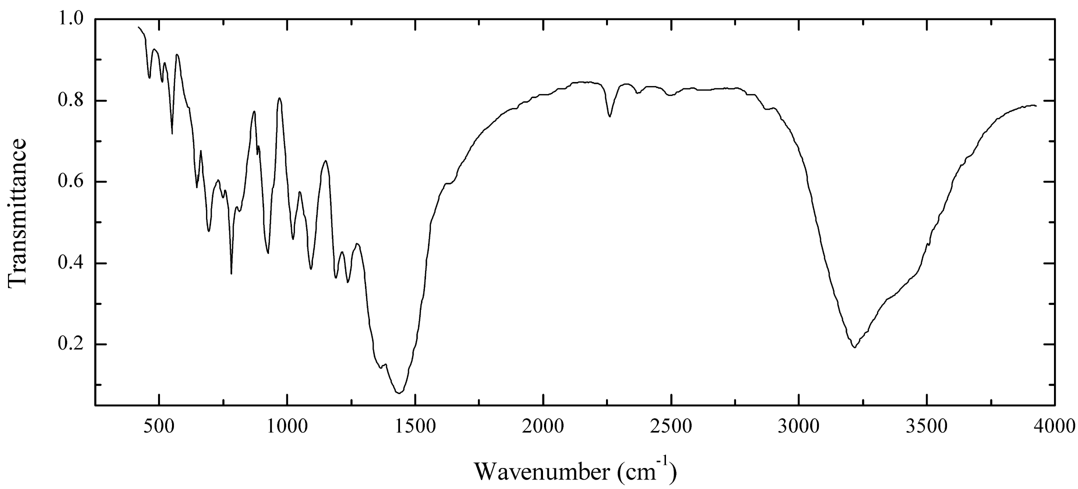


Locality: Larderello, Val di Cecina, Tuscany, Italy (type locality of santite).

Description: White fine-grained aggregate. Ammonium analogue of santite. Identified by IR spectrum. Note that first description of santite, $KB_5O_6(OH)_4 \cdot 2H_2O$, was made without complete chemical data, by analogy with synthetic $KB_5O_6(OH)_4 \cdot 2H_2O$.

Wavenumbers (cm^{-1}): 3700sh, 3440sh, 3415, 3360s, 3210s, 3075sh, 2655w, 2475w, 2255w, 1640w, 1440s, 1350s, 1250s, 1205sh, 1095s, 1062, 1023, 946, 923s, 781, 746w, 689, 648w, 605w, 547w, 509w, 460w.

B104 Ammonioborite $(NH_4)_3B_{15}O_{20}(OH)_8 \cdot 4H_2O$

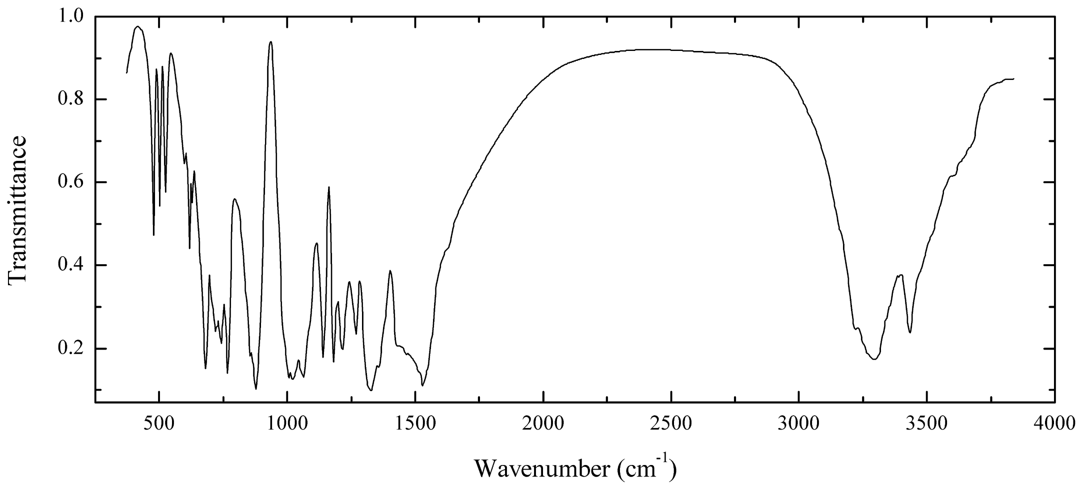


Locality: Larderello, Val di Cecina, Tuscany, Italy (type locality).

Description: White fine-grained aggregate from the association with "santite-(NH_4)". Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3420sh, 3330sh, 3203s, 2875w, 2500w, 2370w, 2260w, 1640w, 1440s, 1367s, 1240, 1190, 1093, 1065sh, 1024, 996w, 925, 910sh, 884w, 816w, 782, 750w, 693, 648w, 549w, 511w, 460w.

B105 Ameghinite $NaB_3O_3(OH)_4$

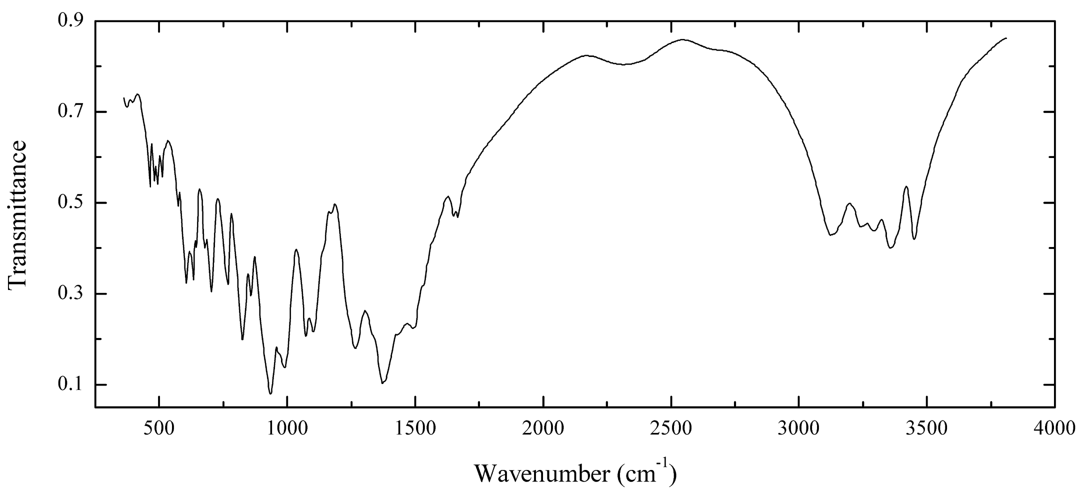


Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta province, Argentina (type locality).

Description: White granular aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3640sh, 3570sh, 3405, 3270s, 3200, 1620sh, 1535s, 1520sh, 1470, 1430sh, 1357s, 1324s, 1265, 1213, 1178, 1139, 1062s, 1022s, 1004s, 875s, 855sh, 766, 739, 719, 682, 630w, 618, 597w, 530sh, 524w, 501w, 477.

B106 Veatchite $Sr_2[B_5O_8(OH)]_2B(OH)_3{\cdot}H_2O$

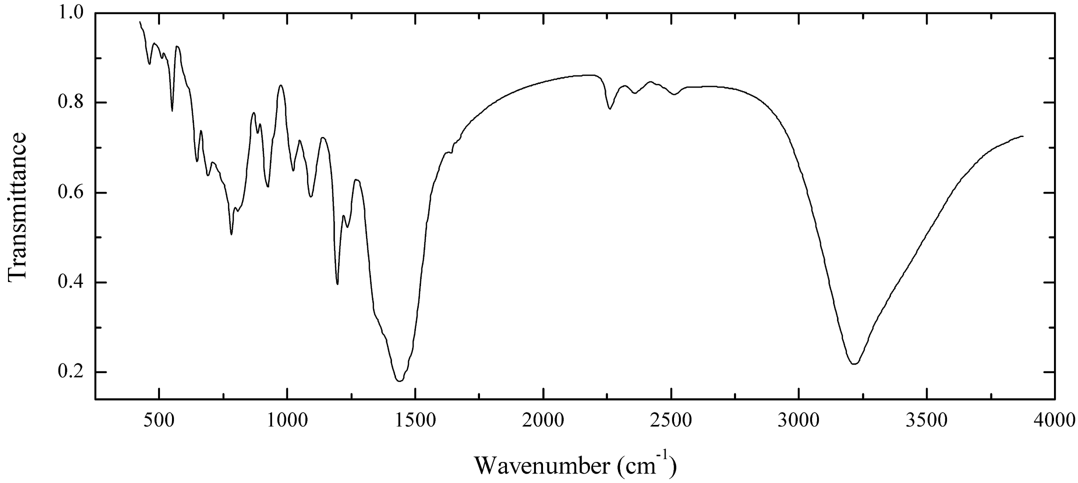


Locality: Shoktybay Salt Dome, Western Kazakhstan region, Kazakhstan.

Description: Colourless grains with perfect cleavage. Identified by IR spectrum. Single-crystal unit-cell parameters are $a = 6.615(5)$, $b = 11.724(6)$, $c = 20.67(3)$ Å, $\beta = 92.31(8)°$.

Wavenumbers (cm^{-1}): 3440, 3340, 3275, 3225, 3115, 2320w, 1665w, 1648w, 1492s, 1430sh, 1372s, 1266s, 1170w, 1101s, 1071s, 990s, 934s, 857, 824s, 768, 704, 678w, 643w, 632, 605, 571w, 507w, 491w, 479w, 462w.

B108 Ammonioborite $(NH_4)_3B_{15}O_{20}(OH)_8{\cdot}4H_2O$

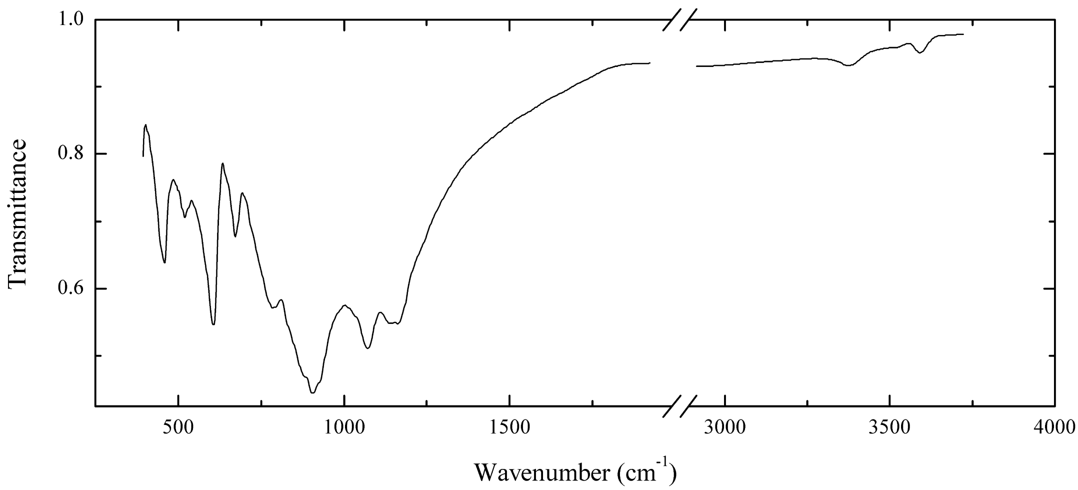


Locality: Larderello, Val di Cecina, Tuscany, Italy (type locality).

Description: White fine-grained aggregate from the association with "santite-(NH_4)". Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3205s, 2510w, 2370w, 2260w, 1660sh, 1640sh, 1443s, 1370sh, 1240, 1193s, 1093, 1024, 924, 885w, 820sh, 808, 782s, 693, 647, 550w, 511w, 460w.

B109 Londonite (Cs,K,□,H_2O)(Al,Li)$_4$(Be,Li,Al,□)$_4$(B,Be)$_{12}$[O_{28-x}(OH,F)$_x$]

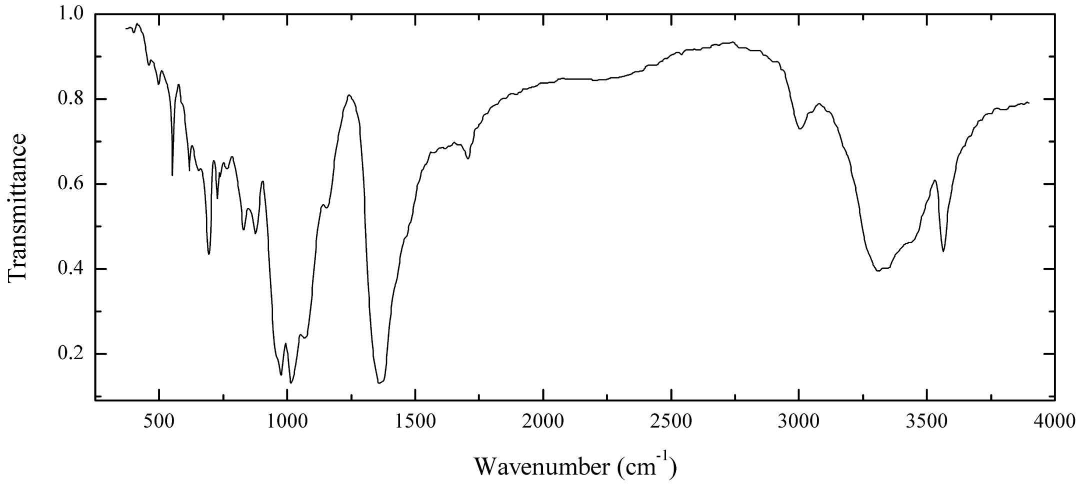


Locality: Ministerskaya Yama Pit, Sarapulka pegmatite field (near Sarapulka village), Murzinka district, Middle Urals, Russia.

Description: Colourless rhombic dodecahedron from the association with potassic feldspar and tourmaline. Identified by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3580w, 3385w, 1152s, 1071s, 925sh, 906s, 885sh, 785s, 671, 605s, 517, 458.

B110 Kernite $Na_2B_4O_6(OH)_2 \cdot 3H_2O$

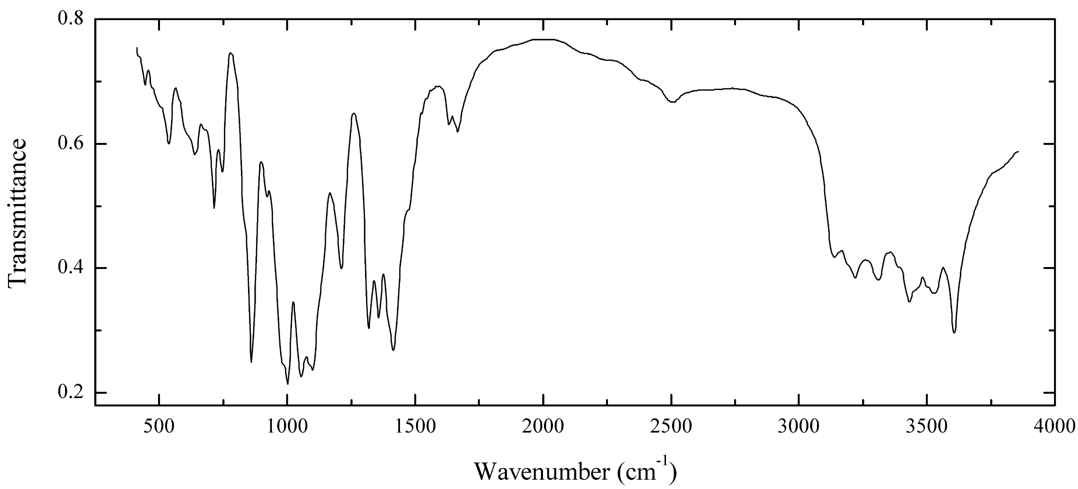


Locality: Larderello, Val di Cecina, Tuscany, Italy.

Description: Colourless acicular crystals from the association with ulexite, orpiment and realgar. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3577, 3415sh, 3325sh, 3300, 2996w, 2200w, 1708w, 1465sh, 1375sh, 1357s, 1158, 1068s, 1016s, 975s, 958, 875, 828, 764w, 739w, 725w, 691, 655w, 618w, 585w, 552w, 496w, 456w, 400w.

B111 Ulexite $NaCaB_5O_6(OH)_6 \cdot 5H_2O$

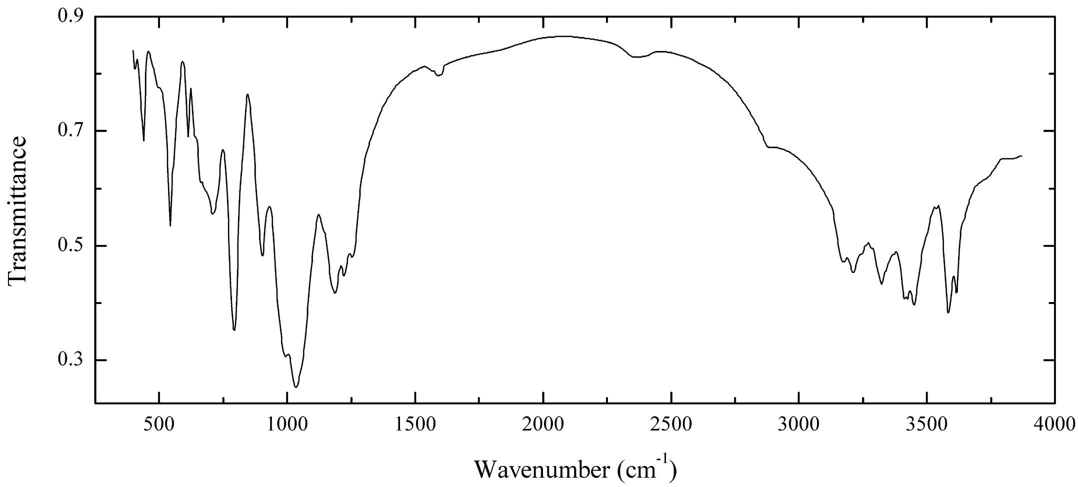


Locality: Larderello, Val di Cecina, Tuscany, Italy.

Description: Colourless crystals from the association with kernite, orpiment and realgar. Identified by IR spectrum.

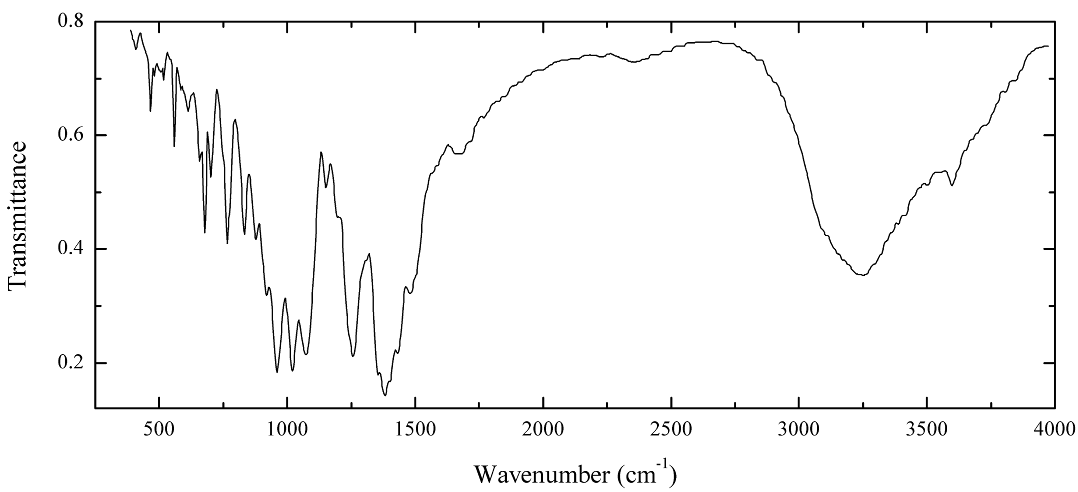
Wavenumbers (cm^{-1}): 3595s, 3515, 3415, 3300, 3215, 3125, 2500w, 1665w, 1633w, 1415s, 1357s, 1318s, 1211, 1099s, 1057s, 1001s, 970sh, 920w, 860s, 835sh, 746w, 715, 640w, 610sh, 537w, 505sh, 444w.

B112 Nifontovite $Ca_3B_6O_6(OH)_{12}{\cdot}2H_2O$



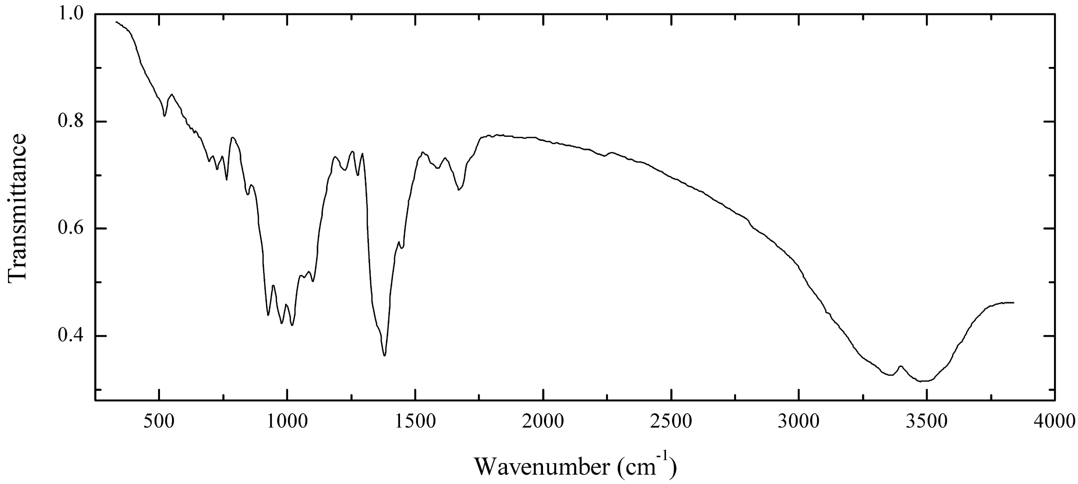
Locality: Charcas, San Luis Potosí, Mexico.
Description: Colourless crystal from the association with wollastonite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3604, 3570s, 3435s, 3405, 3310, 3200, 3160, 2885w, 2360w, 1595w, 1257, 1222, 1187s, 1035s, 995s, 904, 895s, 710, 660sh, 645sh, 613w, 555sh, 541, 500sh, 438w, 400w.

B113 Ezcurrite $Na_2B_5O_7(OH)_3{\cdot}2H_2O$



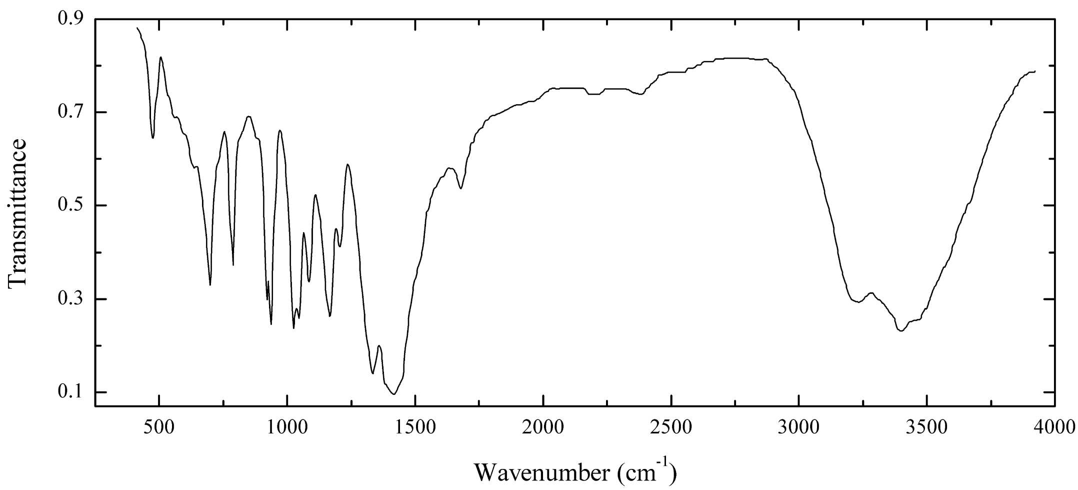
Locality: Tincalayu borax deposit, Salar del Hombre Muerto, Salta province, Argentina (type locality).
Description: Colourless grain. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3573, 3225, 2350w, 1670w, 1480, 1432s, 1400sh, 1380s, 1354s, 1255s, 1197, 1151, 1074s, 1020s, 959s, 918, 877, 832, 775sh, 765, 700, 678, 659, 611w, 557, 515w, 465w.

B114 Tertschite $Ca_2B_{10}O_{19}{\cdot}20H_2O$



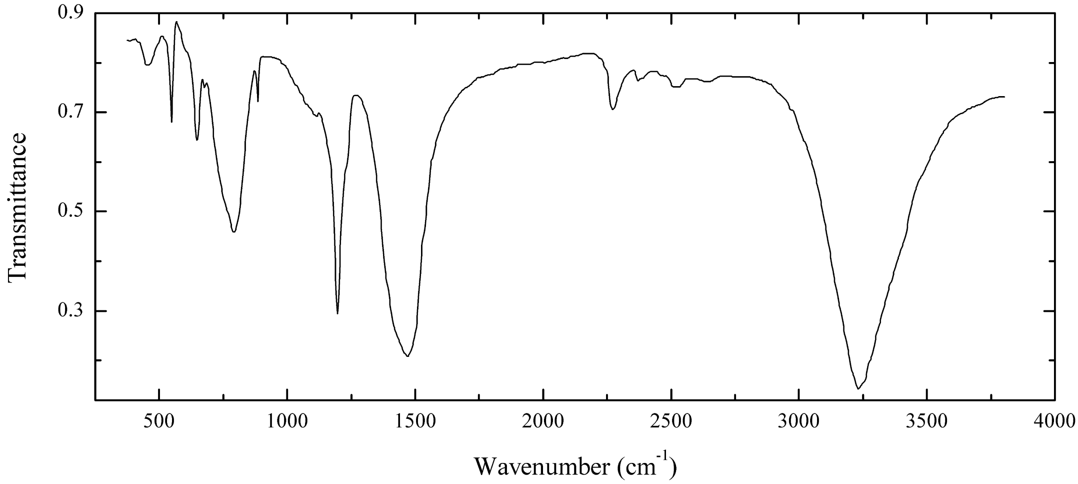
Locality: Kurtpinari mine, Bigadiç district, western Anatolia, Turkey (type locality).
Description: White fibrous aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3450s, 3340s, 1670, 1585w, 1447, 1378s, 1350sh, 1277, 1226, 1101, 1065, 1018s, 977s, 925s, 846, 765, 726, 695, 521.

B115 Sborgite $NaB_5O_6(OH)_4{\cdot}3H_2O$



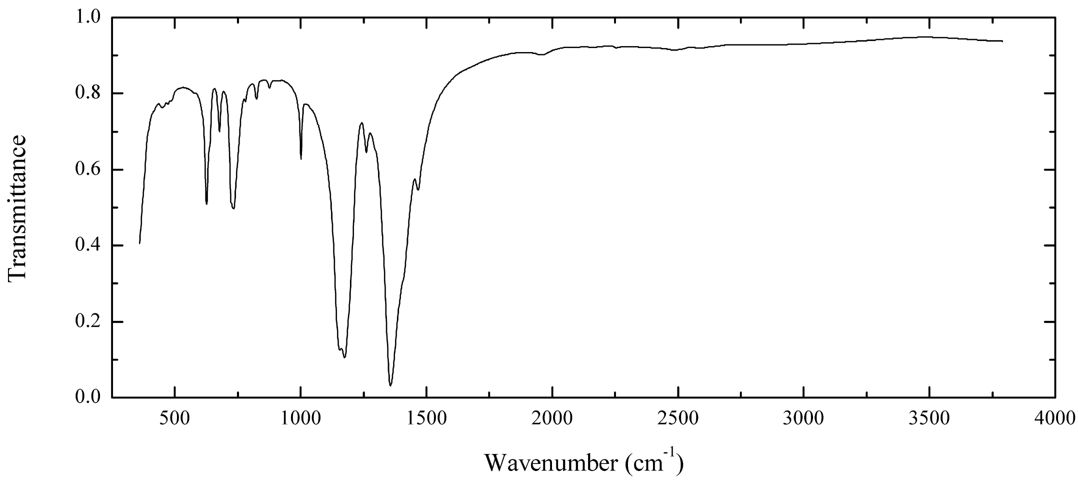
Locality: Larderello, Val di Cecina, Tuscany, Italy.
Description: White granular aggregate. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3595s, 3515, 3415, 3300, 3215, 3125, 2500w, 1665w, 1633w, 1415s, 1357s, 1318s, 1211, 1099s, 1057s, 1001s, 970sh, 920w, 860s, 835sh, 746w, 715, 640w, 610sh, 537w, 505sh, 444w.

B116 Sassolite H_3BO_3



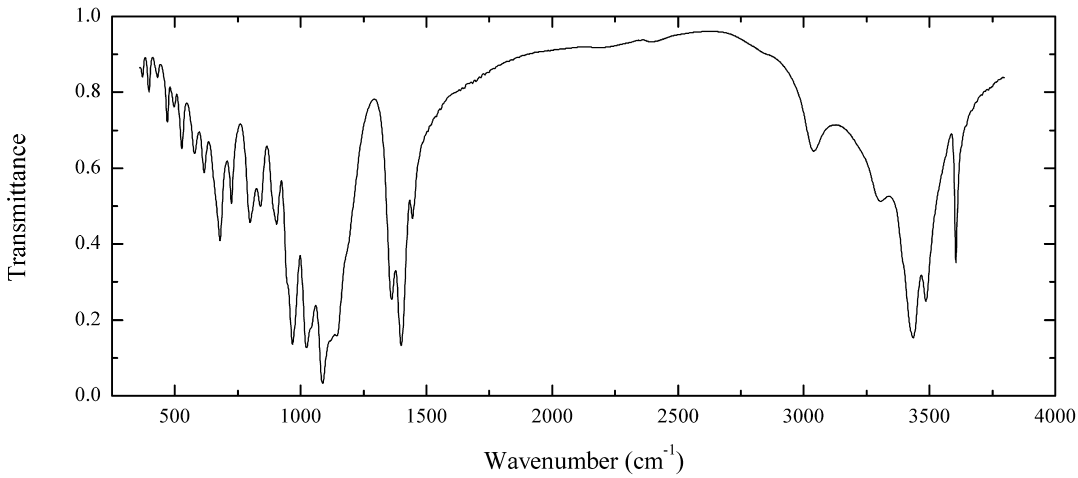
Locality: La Fossa crater, Vulcano Island, Eolie Islands, Messina province, Sicily, Italy.
Description: White platy crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3214s, 2640w, 2519w, 2362w, 2262w, 1456s, 1195s, 1118, 884, 807s, 675w, 648, 548, 472w.

B117 Shimazakiite $Ca_4B_{2-x}O_{5-3x}(OH)_{3x}$ ($x = 0$–0.06)



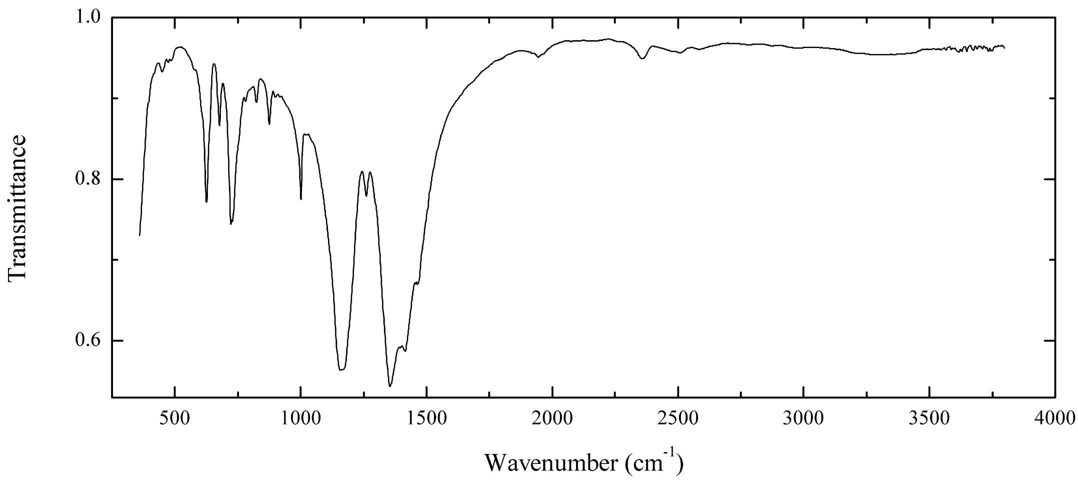
Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan (type locality).
Description: White granular aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 2587w, 2490w, 2258w, 1960w, 1466, 1405sh, 1357s, 1261, 1175s, 1159s, 1102, 876w, 824, 780, 734, 677, 626, 485w, 471w, 453.

B118 Meyerhofferite $Ca_2B_6O_6(OH)_{10}·2H_2O$



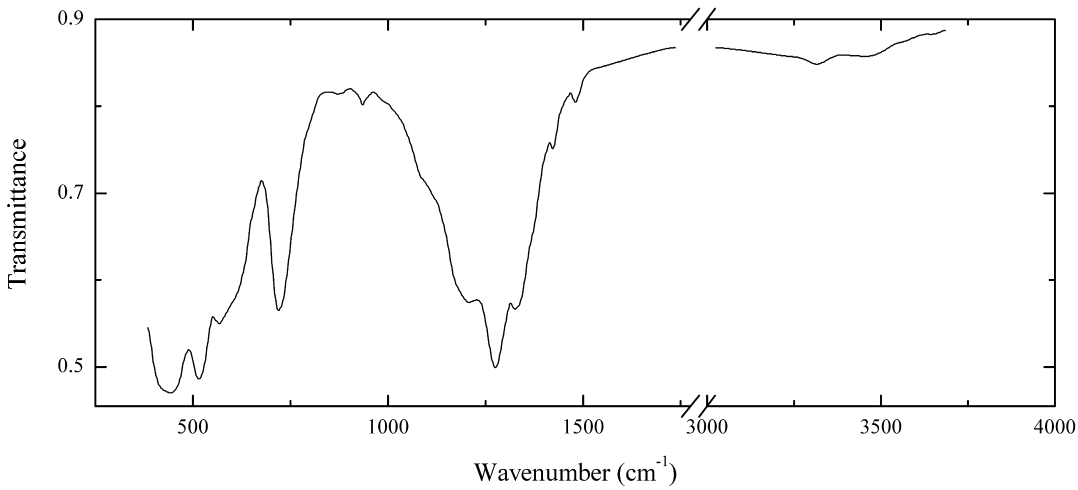
Locality: Faras mine, Bigadic, Marmara region, Turkey.
Description: White twinned prismatic crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3505, 3486, 3435s, 3307, 3040, 2395w, 2185w, 1445, 1400s, 1362, 1144s, 1120sh, 1087s, 1035sh, 1023s, 967s, 950sh, 904, 840, 799, 725, 679, 616, 578, 528, 497, 470, 431w, 398, 371w.

B119 Shimazakiite $Ca_4B_{2-x}O_{5-3x}(OH)_{3x}$ (x = 0–0.06)



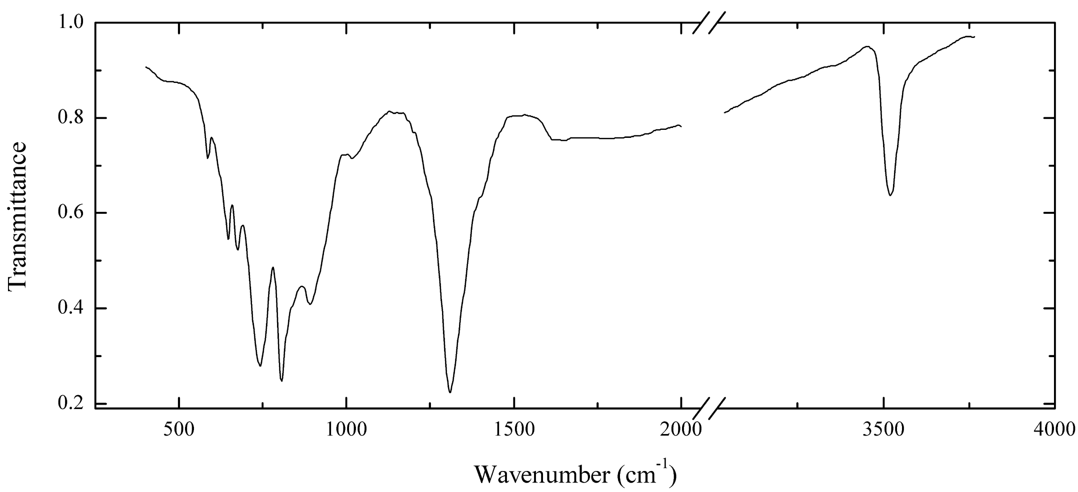
Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan (type locality).
Description: White granular aggregate. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3308w, 2588w, 2509w, 1943w, 1462, 2416s, 1395, 1355s, 1261, 1170sh, 1158s, 1001, 904w, 875, 824w, 783w, 760sh, 740sh, 722, 677, 626, 580sh, 485w, 475w, 449w.

Bo1 Azoproite $(Mg,Fe^{2+})_2(Fe^{3+},Ti,Mg)(BO_3)O_2$



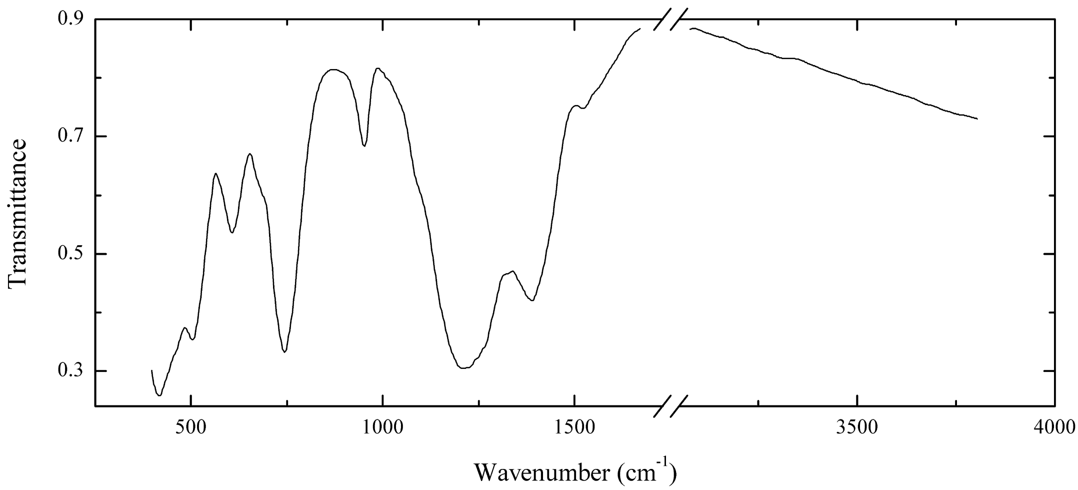
Locality: Tazheran alkaline massif, Baikal area, Siberia, Russia (type locality).
Description: Black prismatic crystals in carbonate.
Wavenumbers (cm^{-1}): 3450w, 3310w, 1575w, 1483w, 1422w, 1370sh, 1329, 1278s, 1220, 1090sh, 935w, 870w, 722, 620sh, 569, 515s, 451s, 425sh.

Bo2 Berborite-1*T* $Be_2(BO_3)(OH,F)\cdot H_2O$



Locality: Lupikko deposit, near Pitkäranta, Ladoga lake, Karelia, Russia (type locality).
Description: Colourless crystals in skarn. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3495, 1650w, 1610w, 1307s, 1021w, 895, 806s, 744s, 677, 649, 586w.

Bo3 Warwickite $Mg(Ti,Fe^{3+},Mg,Al)(BO_3)O$

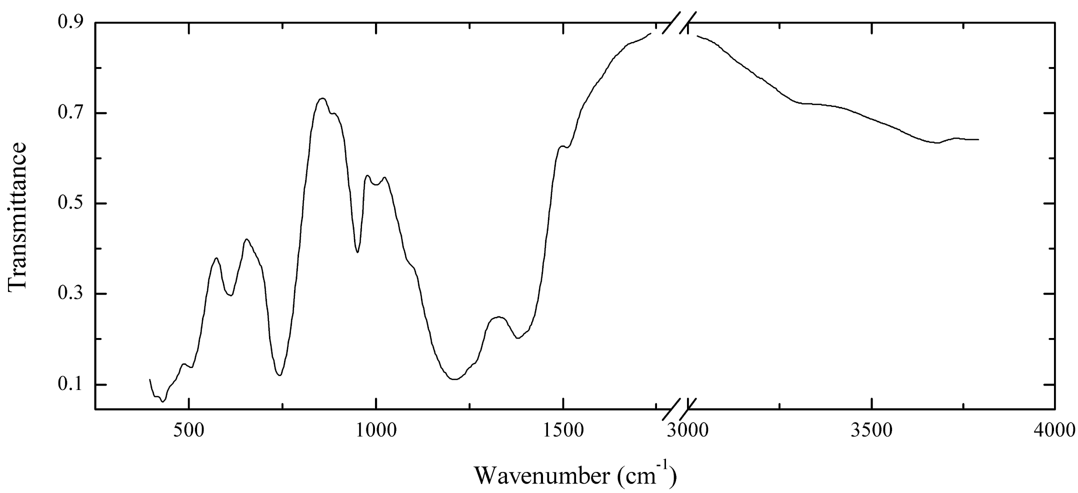


Locality: Mramornyi district, Aldan shield, Sakha Republic, Siberia, Russia.

Description: Dark brown grains from calciphyre. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Mg(Ti_{0.34}Mg_{0.32}Fe_{0.25}Ale_{0.09})(BO_3)O$.

Wavenumbers (cm^{-1}): 1523w, 1386, 1215s, 957, 744s, 685sh, 607, 503, 418s.

Bo4 "Warwickite-(Mg)" $Mg(Mg,Ti,Fe^{3+},Al)(BO_3)O$

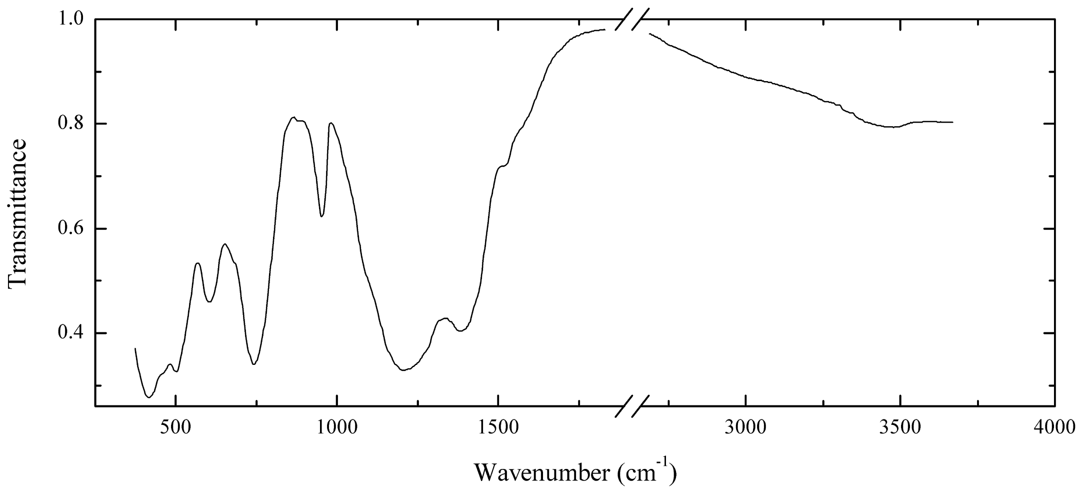


Locality: Hol Kol Mine (?), North Korea.

Description: Dark brown grains. Mg-rich variety or analogue of warwickite. The formula based on chemical and structural data is $(Mg_{0.84}Fe_{0.08}Al_{0.06}Ti_{0.02})(Mg_{0.50}Ti_{0.36}Fe_{0.07}Al_{0.06})(BO_3)O$.

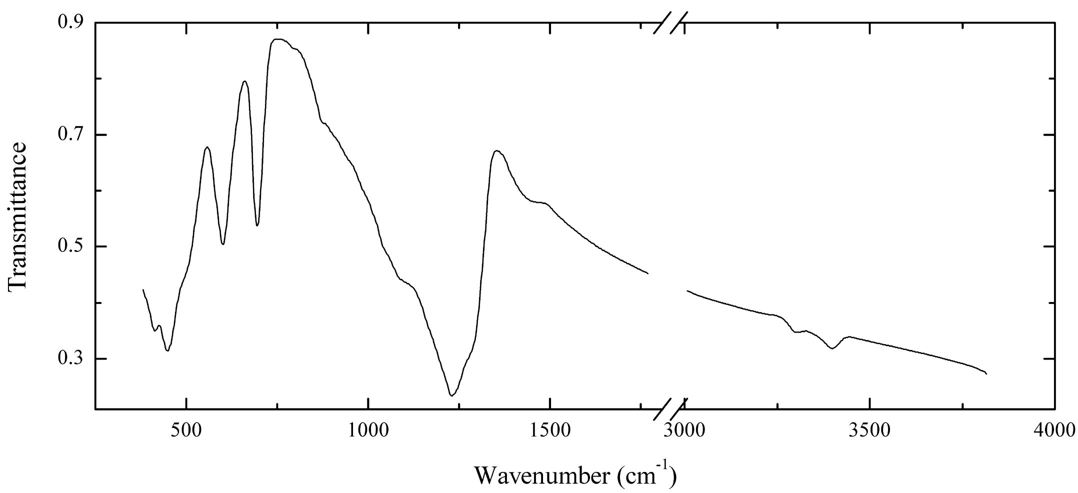
Wavenumbers (cm^{-1}): 3675w, 3320w, 1514w, 1389, 1210s, 1095sh, 1004w, 954, 887w, 744s, 607, 506, 430sh, 416s, 405sh.

Bo5 Yuanfuliite $(Mg,Fe^{2+})(Fe^{3+},Mg,Ti,Al)(BO_3)O$



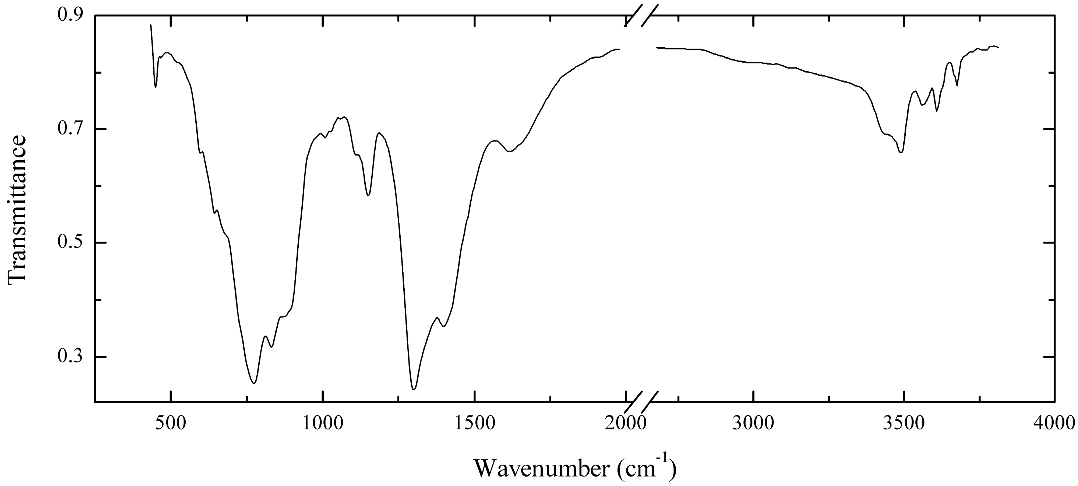
Locality: Taezhnoe iron-ore deposit, Neryungri ulus, Sakha Republic, Siberia, Russia.
Description: Dark brown grains from the association with calcite, ludwigite and magnetite. The empirical formula is (electron microprobe) $Mg(Fe_{0.6}Mg_{0.1}Ti_{0.2}Al_{0.1})(BO_3)O$.
Wavenumbers (cm^{-1}): 3450w, 1510w, 1380, 1206s, 949, 750s, 605, 499s, 410s.

Bo6 Vonsenite $(Fe^{2+},Mg)_2Fe^{3+}(BO_3)O_2$



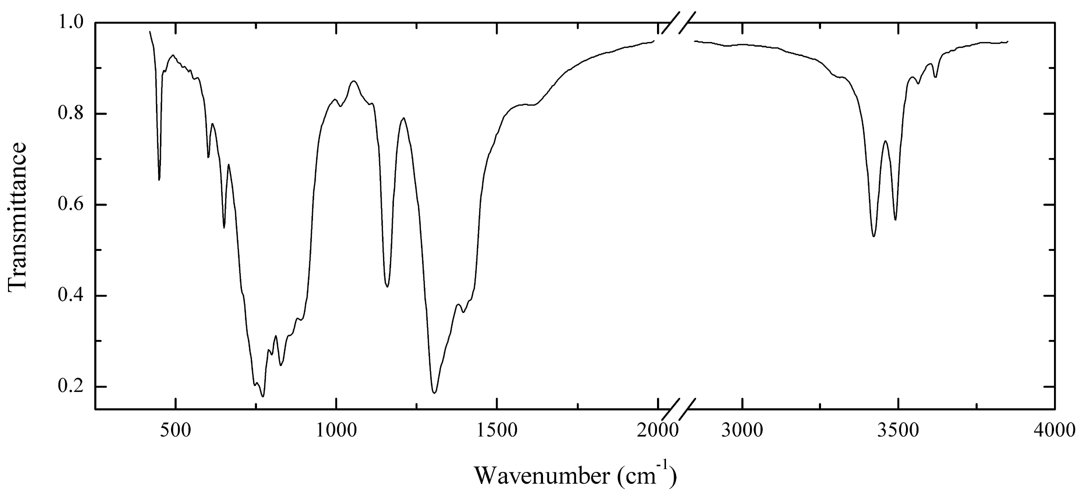
Locality: Taezhnoe iron-ore deposit, Neryungri ulus, Sakha Republic, Siberia, Russia.
Description: Black prismatic crystal. Identified by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3390w, 3295w, 1455w, 1285sh, 1238s, 1105sh, 1050sh, 880w, 800w, 700, 606, 500sh, 452s, 422s.

Bo7 Hambergite $Be_2(BO_3)(OH,F)$



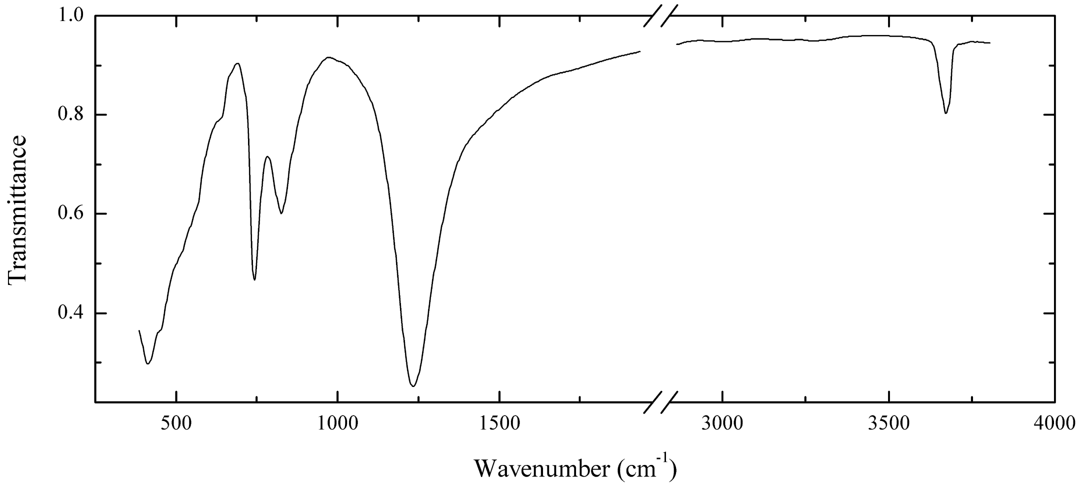
Locality: Fantaziya (Fantasy) pegmatite, Kukurt river, Eastern Pamir, Tajikistan.
Description: Colourless prismatic crystal. H_2O-bearing F-rich variety. Identified by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3667, 3600, 3549, 3480, 3420, 1620, 1420sh, 1398s, 1300s, 1150, 1109, 1060w, 1027w, 1006w, 890sh, 870sh, 830s, 773s, 725sh, 677, 639, 591, 665w, 444.

Bo8 Hambergite $Be_2(BO_3)(OH)$



Locality: Malkhan pegmatite field, Chita region, Transbaikal area, Eastern Siberia, Russia.
Description: Colourless prismatic crystal from the association with quartz, albite, lepidolite and elbaite. Investigated by I.V. Pekov. H_2O-bearing F-poor variety (the content of F is between 0.7 and 1.1 wt.%). Identified by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3598w, 3543w, 3470, 3401, 3280w, 1615w, 1420sh, 1395, 1303s, 1155, 1105w, 1022w, 1011w, 889, 857, 826s, 799s, 770s, 743s, 722, 706, 648, 601, 560w, 470w, 448, 441.

Bo9 Hydroxylborite $Mg_3(BO_3)(OH,F)_3$

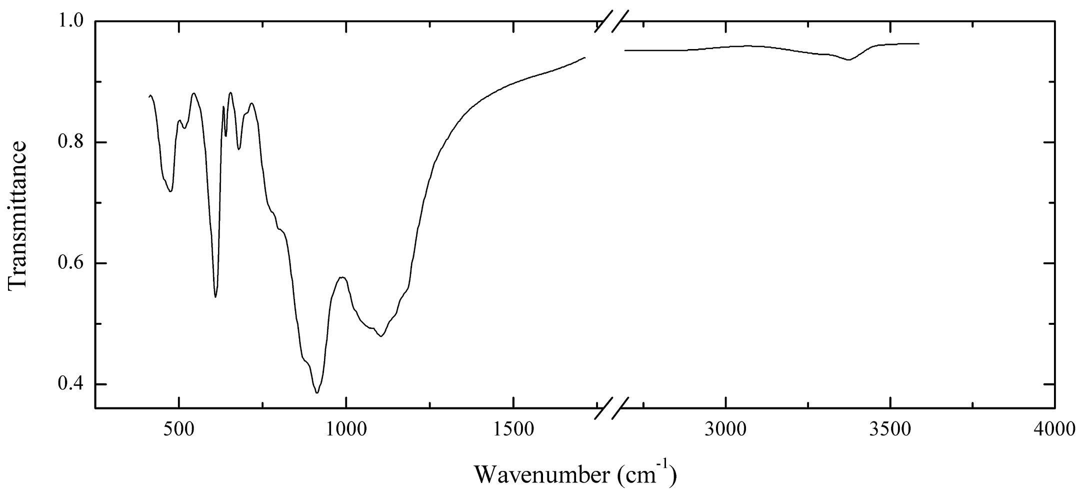


Locality: Titovskoe deposit, Chersky range, basin of the river Dogdo, Sakha Republic (Yakutia), Russia (type locality).

Description: Colourless long-prismatic crystals in the association with calcite, dolomite, ludwigite, kotoite, szaibelyite, clinohumite, magnetite, serpentine and chlorite. Holotype sample. Hexagonal, space group $P6_3/m$, $a = 8.912(8)$, $c = 3.112(4)$ Å. The empirical formula is $Mg_{3.03}B_{0.98}[(OH)_{2.00}F_{1.00}]O_{3.00}$. Optically uniaxial (–), $\omega = 1.566(1)$, $\varepsilon = 1.531(1)$. $D_{calc} = 2.872$ g/cm^3, $D_{meas} = 2.89(1)$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 7.69 (52), 4.45 (82), 2.573 (65), 2.422 (100), 2.128 (60).

Wavenumbers (cm^{-1}): 3668, 1233s, 824, 742, 630sh, 555sh, 500sh, 450sh, 407s.

Bo12 Londonite $(Cs,K,\square,H_2O)(Al,Li)_4(Be,Li,Al,\square)_4(B,Be)_{12}[O_{28-x}(OH,F)_x]$

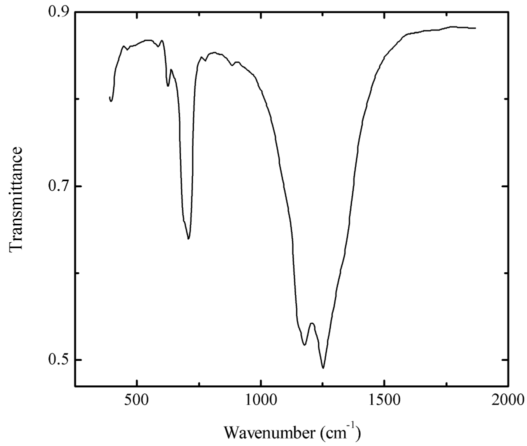


Locality: Mor's Pits, Shaitanka pegmatite field, Rezh district., Middle Urals, Russia.

Description: Colourless transparent rhombic-dodecahedral crystal from the association with potassic feldspar and elbaite. The empirical formula is $Cs_{0.7}K_{0.15}Li_{0.1}Be_{4.8}B_{10.9}Al_{4.1}[O_{27.7}(OH)_{0.3}]$.

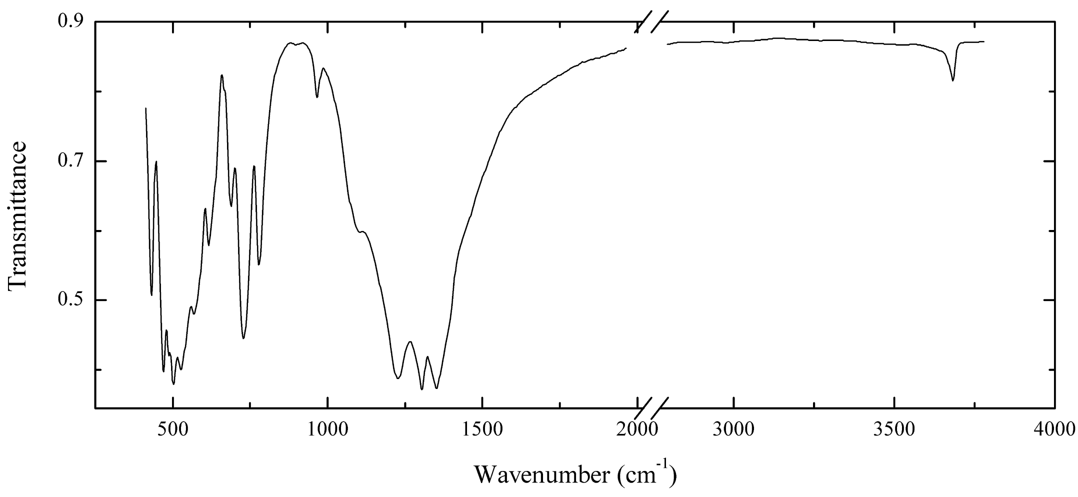
Wavenumbers (cm^{-1}): 3385w, 1595w, 1180sh, 1100s, 1075sh, 912s, 875s, 800sh, 760sh, 673, 640w, 603, 511w, 475, 450sh.

Bo13 Jimboite $Mn_3(BO_3)_2$



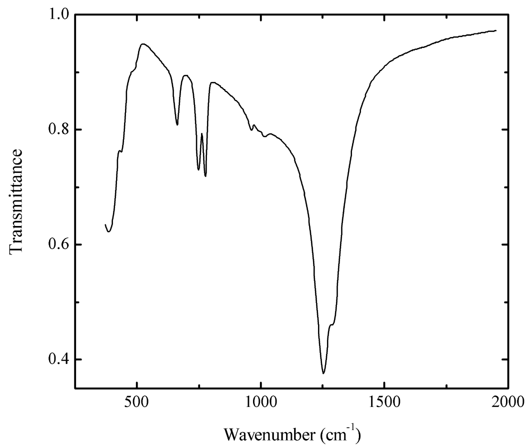
Locality: Rito mine, Azuma-mura, Seta-gun, Gunma prefecture, Honshu Island, Japan.
Description: Brown grains in the association with a manganese humite-group mineral. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1300sh, 1249s, 1181s, 890w, 685w, 710, 686, 625, 595w, ~400.

Bo14 Jeremejevite $Al_6(BO_3)_5F_3$



Locality: Fantaziya (Fantasy) pegmatite, Kukurt river, Eastern Pamir, Tajikistan.
Description: Colourless prismatic crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3675w, 1390sh, 1354s, 1305s, 1224s, (1086), 961, 773, 722, 680, 661w, 605, 560, 518s, 492, 479, 460s, 424.

Bo15 Nordenskiöldine $CaSn(BO_3)_2$

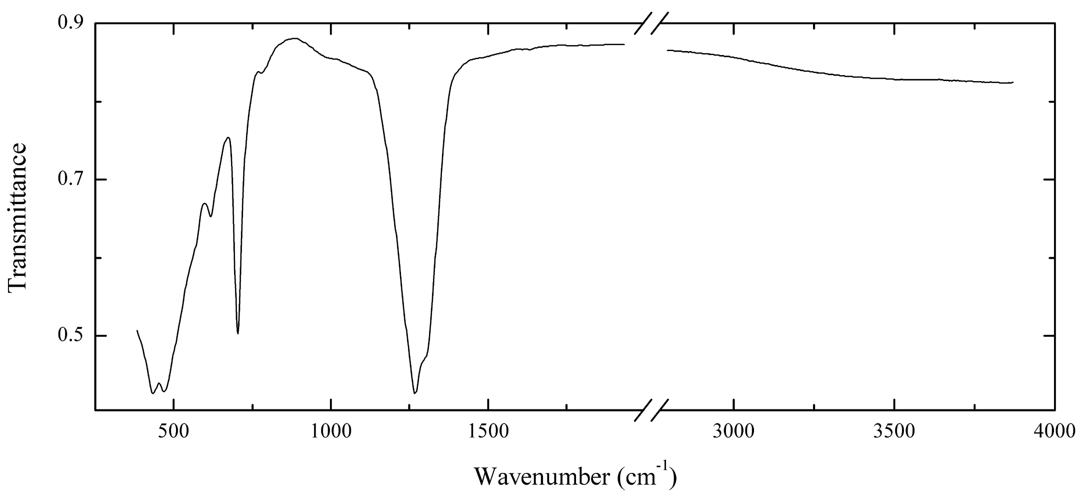


Locality: Ear Mt., York range, Seward peninsula, Nome Borough, Alaska, USA.

Description: Light-coloured grains. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1276s, 1246s, 1020w, 990w, 960w, 772, 750, 666, 500sh, 436, ~390.

Bo16 Magnesiohulsite $(Mg,Fe^{2+})_2(Fe^{3+},Sn,Mg)(BO_3)O_2$

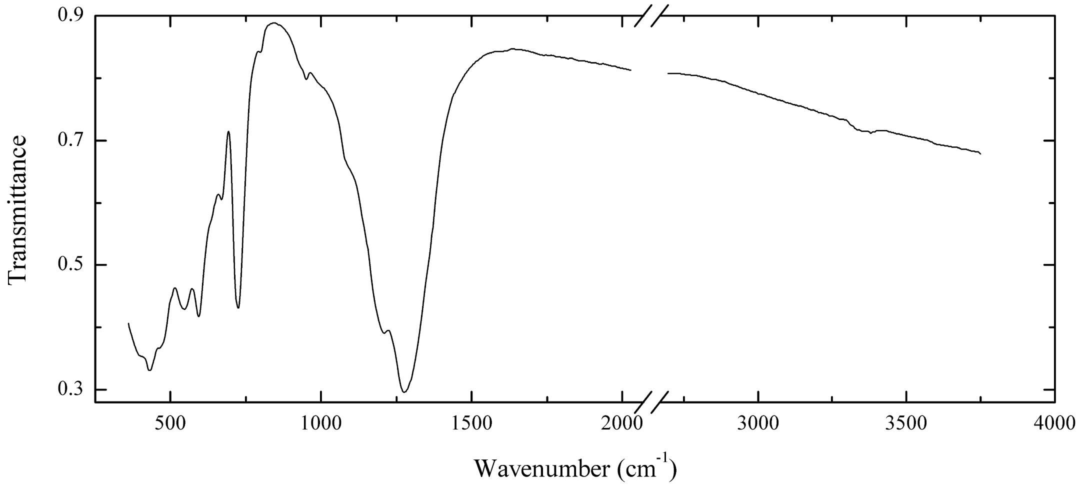


Locality: Iten'yurginskoe deposit, Chukchi peninsula, Russia.

Description: Greenish-black granular aggregate. The empirical formula is $Mg_{1.72}Fe_{1.11}Sn_{0.11}Al_{0.06}(BO_3)O_2$.

Wavenumbers (cm^{-1}): 1310sh, 1278s, 777w, 705, 622, 560sh, 472s, 435s.

Bo17 Pinakiolite $(Mg,Mn^{2+})_2Mn^{3+}(BO_3)O_2$

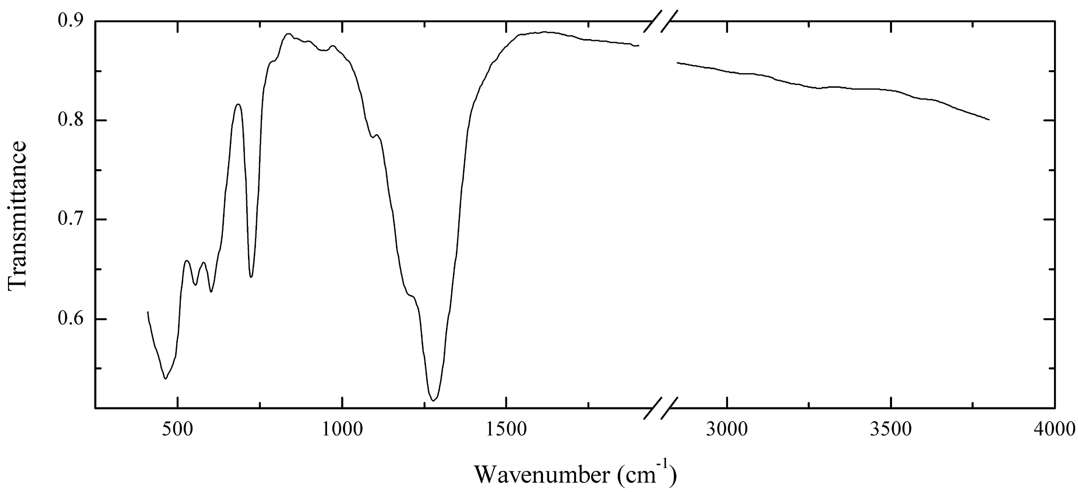


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Black prismatic crystals from the association with dolomite, phlogopite and hausmannite. The empirical formula is (electron microprobe) $Mg_{1.8}Mn_{0.9}Sb_{0.1}Al_{0.1}Fe_{0.1}(BO_3)O_2$.

Wavenumbers (cm^{-1}): 3310w, 1273s, 1205s, 1095sh, 949w, 798w, 723, 670, 591, 541, 467s, 432s, 415sh.

Bo18 Orthopinakiolite $(Mg,Mn^{2+})_2(Mn^{3+},Fe^{3+})(BO_3)O_2$

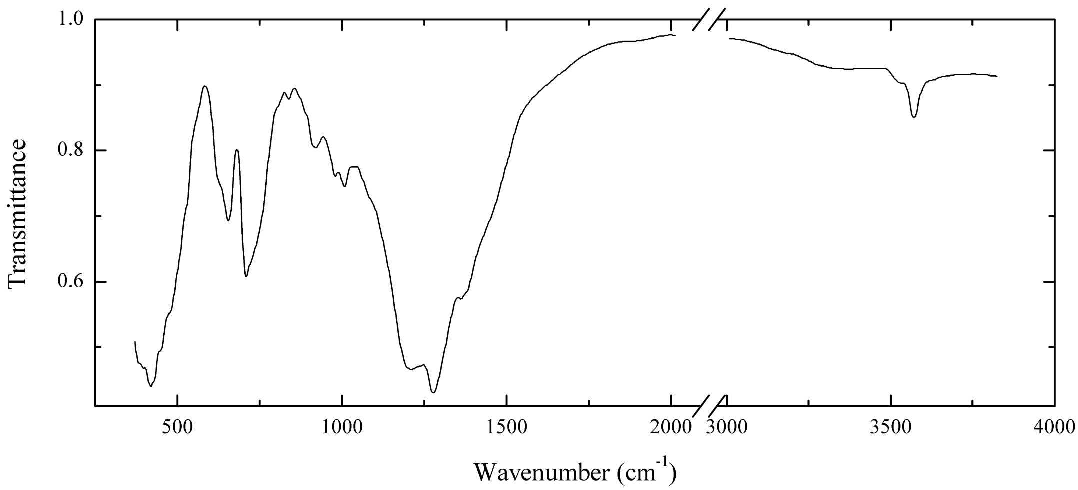


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Black prismatic crystals from the association with dolomite, phlogopite and hausmannite. Identified by single-crystal X-ray diffraction data.

Wavenumbers (cm^{-1}): 1282s, 1210sh, 1100, 798w, 726, 603, 551, 485sh, 465s, 420sh.

Bo19 Kotoite $Mg_3(BO_3)_2$

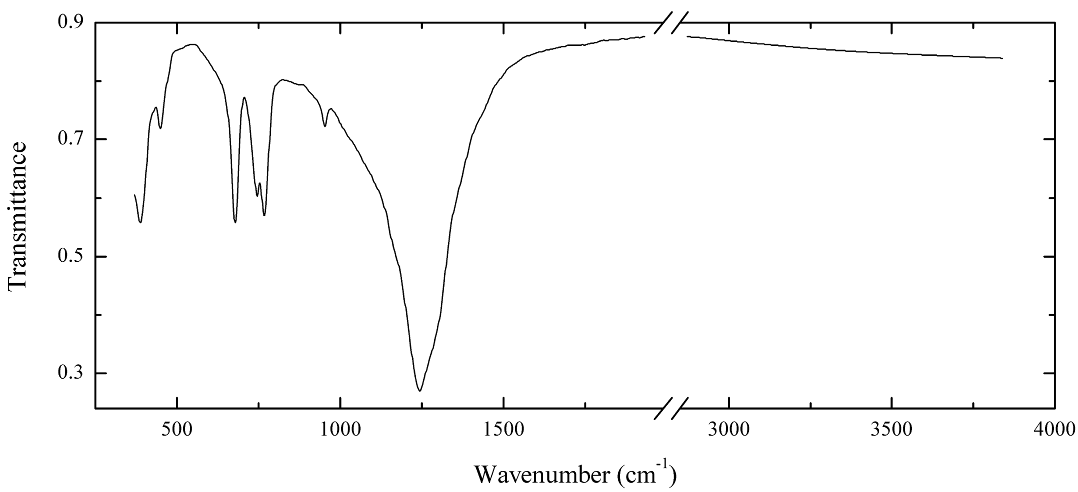


Locality: Molodyozhnoe deposit, Aldan shield, Sakha Republic, Siberia, Russia.

Description: White granular aggregate. Identified by IR spectrum. Contains admixture of szaibélyite (weak bands at 3555 and from 837 to 1,011 cm^{-1}; shoulders at 1,450 and 1,335 cm^{-1}).

Wavenumbers (cm^{-1}): 3555w, 1450sh, 1335sh, 1280s, 1210s, 1011w, 980w, 921w, 837w, 730sh, 705, 656, 520sh, 495sh, 422s, 398s.

Bo20 Tusionite $Mn^{2+}Sn^{4+}(BO_3)_2$

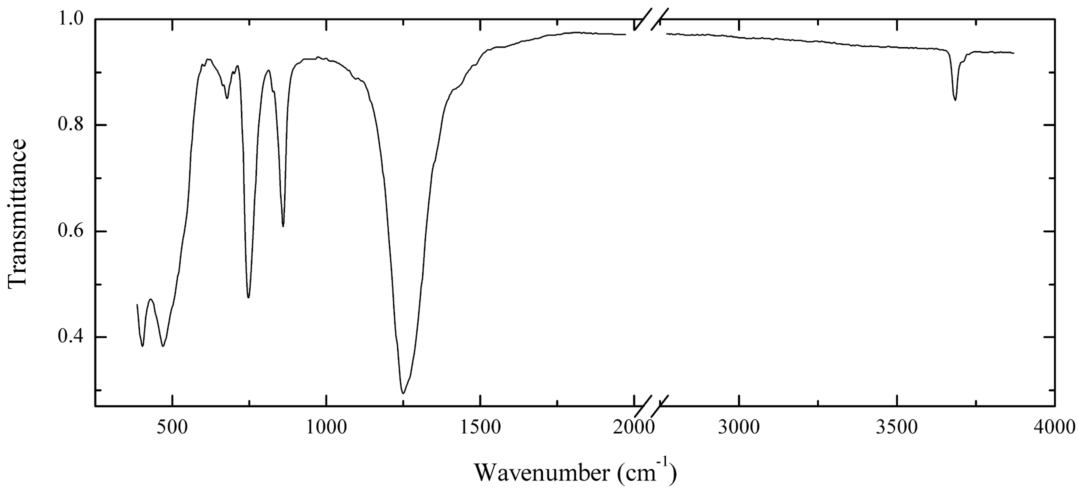


Locality: Tusion River valley, Pamir Mts., Tajikistan (type locality).

Description: Brown crystal. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mn_{0.77}Fe_{0.19}Mg_{0.09}Sn_{0.95}(BO_3)_2$.

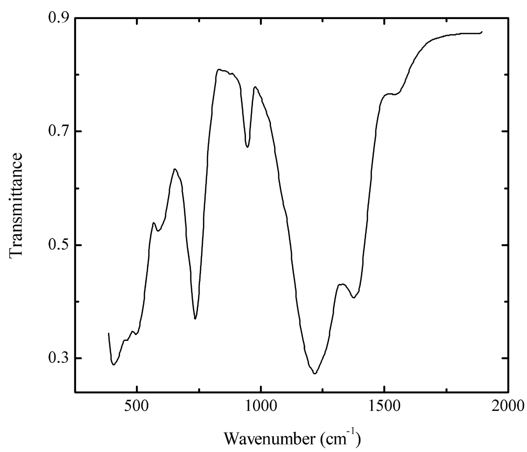
Wavenumbers (cm^{-1}): 1300sh, 1239s, 949w, 764, 742, 674, 446w, 380.

Bo21 Fluoborite $Mg_3(BO_3)(F,OH)_3$



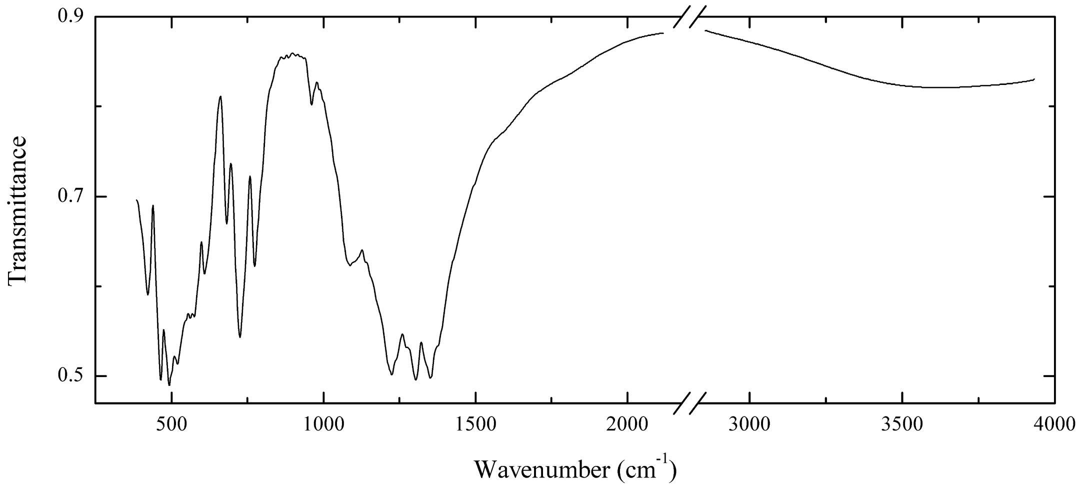
Locality: Franklin, New Jersey, USA.
Description: Pale yellow transparent crystals in the association with norbergite and magnetite. The empirical formula is (electron microprobe) $Mg_{2.95}Fe_{0.05}(BO_3)[F_{2.4}(OH)_{0.6}]$.
Wavenumbers (cm^{-1}): 3645sh, 3640w, 1241s, 1095sh, 857, 823w, 743, 699w, 676w, 655sh, 535sh, 500sh, 468s, 400s.

Bo22 Yuanfuliite $(Mg,Fe^{2+})(Fe^{3+},Mg,Ti,Al)(BO_3)O$



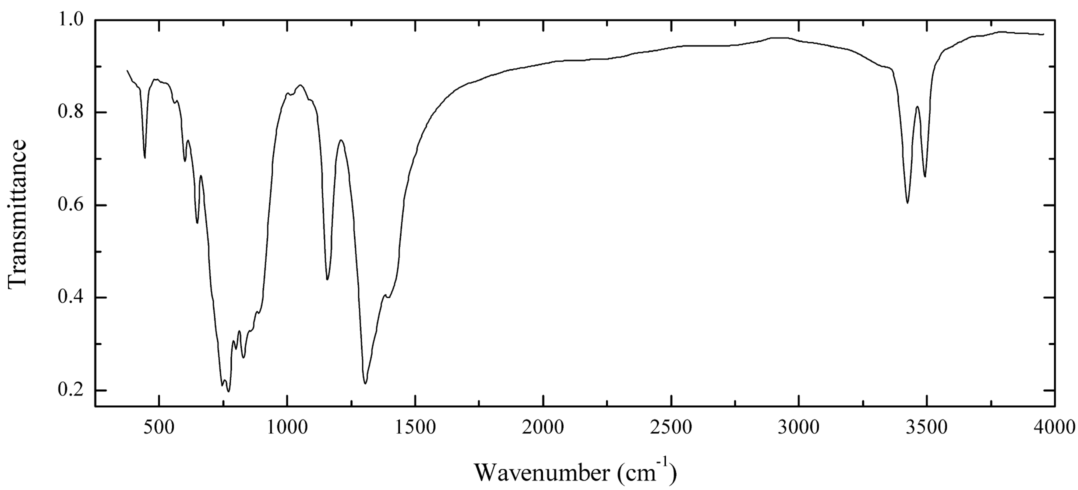
Locality: Taezhnoe iron-ore deposit, Neryungri ulus, Sakha Republic, Siberia, Russia.
Description: Dark brown grains from the association with calcite, ludwigite and magnetite. The empirical formula is (electron microprobe) $Mg(Fe_{0.60}Ti_{0.17}Al_{0.15}Mg_{0.07}Zr_{0.01})(BO_3)O$.
Wavenumbers (cm^{-1}): 1550w, 1380s, 1216s, 947, 739s, 594, 490s, 460s, 410s.

Bo23 Jeremejevite $Al_6(BO_3)_5F_3$



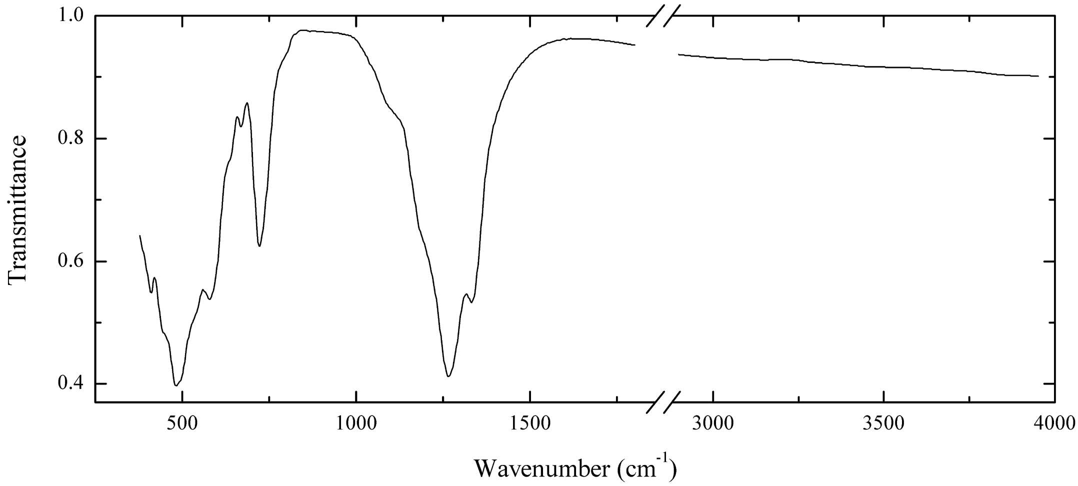
Locality: Erongo Mts., Usakos district, Namibia.
Description: Light blue prismatic crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3670w, 1357s, 1306s, 1227s, 1090, 962w, 774, 725, 681, 608, 563, 518s, 493s, 465s, 426.

Bo24 Hambergite $Be_2(BO_3)(OH)$



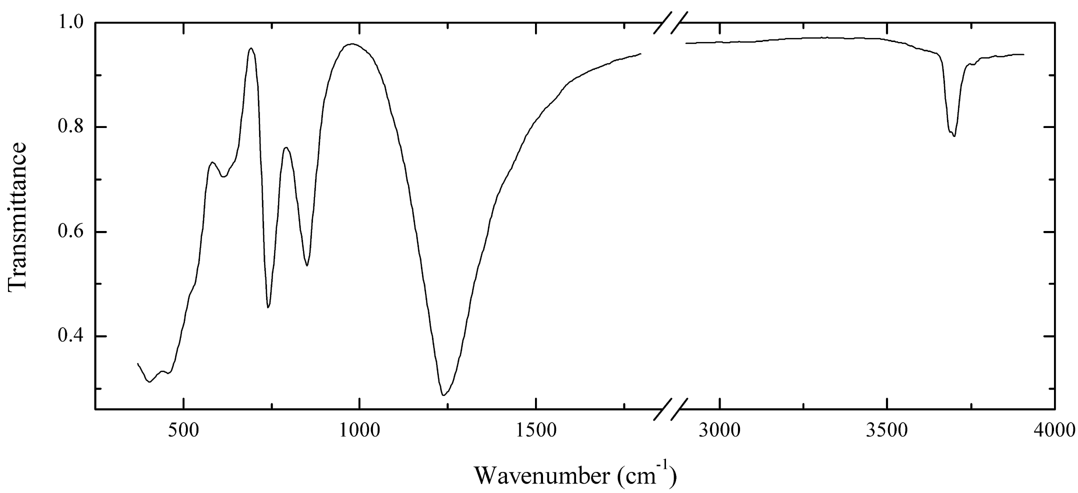
Locality: Paprok mine, Kamdesh district, Nuristan (Nurestan, Nooristan) province, Afghanistan.
Description: Pink twin. OH-rich F-poor variety. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3468, 3400, 3290sh, 1420sh, 1394, 1304s, 1155, 1090w, 1017w, 889, 857, 826s, 800s, 770s, 743s, 722, 705, 647, 601, 559w, 445.

Bo25 Fredrikssonite $Mg_2(Mn^{3+},Fe^{3+})(BO_3)O_2$



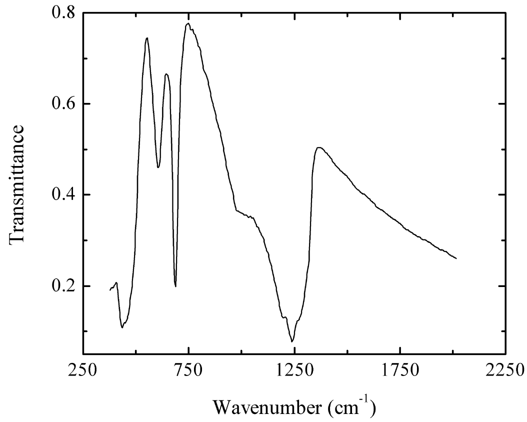
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).
Description: Dark brown prismatic crystals from the association with calcite and hausmannite.
Wavenumbers (cm^{-1}): 1325s, 1257s, 1190sh, 1100sh, 720, 668w, 630sh, 574s, 520sh, 495sh, 480s, 435sh, 412.

Bo26 Fluoborite $Mg_3(BO_3)(F,OH)_3$



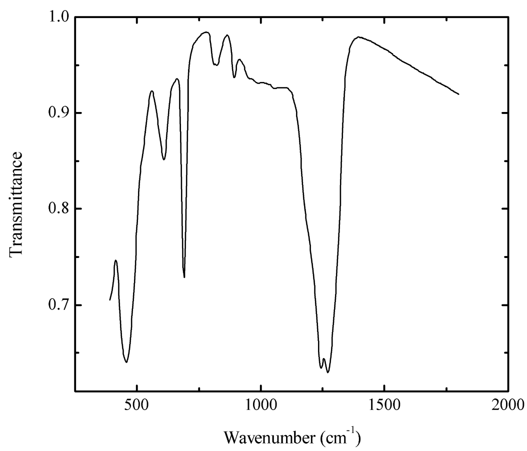
Locality: Pöhla, Schwarzenberg district, Erzgebirge, Saxony, Germany.
Description: White long-prismatic crystals in the association with ludwigite.
The empirical formula is (wet chemical analysis) $Mg_{2.98}Fe_{0.07}B_{1.00}[F_{2.01}(OH)_{1.07}]O_{3.01}$.
Wavenumbers (cm^{-1}): 3675, 3653, 1236s, 850, 739, 640sh, 613, 525sh, 457s, 397s.

Bo27 Hulsite $(Fe^{2+},Mg)_2(Fe^{3+},Sn,Mg)(BO_3)O_2$



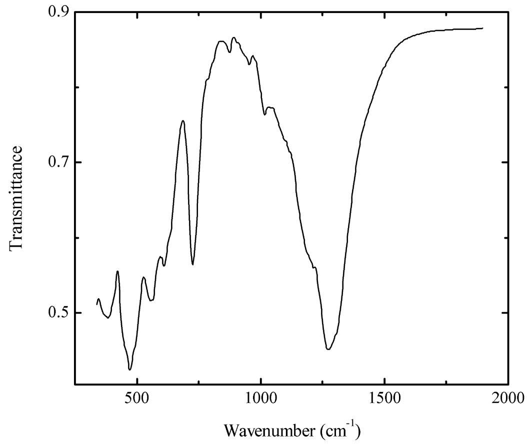
Locality: Moral'nyi district, Titovskoe boron deposit, Tas-Khayakhtakh range, Sakha Republic, Russia.
Description: Black massive. The empirical formula is (electron microprobe) $Fe_{2.81}Mg_{0.12}Sn_{0.07}(BO_3)O_2$.
Wavenumbers (cm^{-1}): 1275s, 1250s, 1200sh, 898w, 839w, 818w, 690s, 608, 510sh, 457s, 440sh.

Bo28 Hulsite $(Fe^{2+},Mg)_2(Fe^{3+},Sn,Mg)(BO_3)O_2$



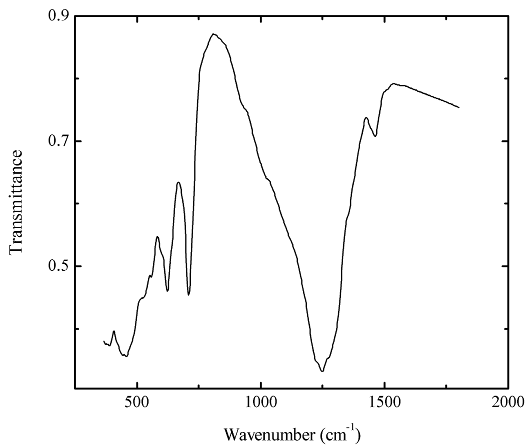
Locality: Titovskoe boron deposit, Tas-Khayakhtakh range, Sakha Republic, Russia.
Description: Black platy crystals. The empirical formula is (electron microprobe) $Fe_{2.55}Mg_{0.30}Sn_{0.12}Al_{0.03}(BO_3)O_2$.
Wavenumbers (cm^{-1}): 1275sh, 1243s, 1198s, 1000sh, 686s, 597, 440s.

Bo29 Takéuchiite $(Mg,Mn^{2+})_2(Mn^{3+},Fe^{3+})(BO_3)O_2$



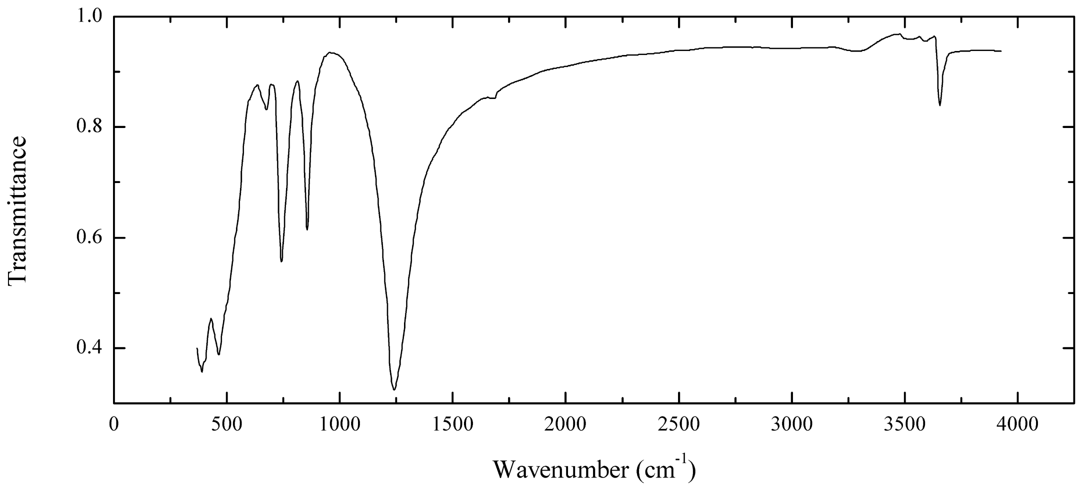
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).
Description: Black crystals.
Wavenumbers (cm^{-1}): 1277s, 1218, 1195sh, 1016w, 956w, 877w, 726, 635sh, 611, 555, 470s, 385.

Bo30 Ludwigite $(Mg,Fe^{2+})_2Fe^{3+}(BO_3)O_2$



Locality: Taezhnoe iron-ore deposit, Neryungri ulus, Sakha Republic, Siberia, Russia.
Description: Black coarse-grained aggregate. The empirical formula is (electron microprobe) $(Mg_{1.65}Fe^{2+}{}_{0.35})(Fe^{3+}{}_{0.82}Al_{0.18})(BO_3)O_2$.
Wavenumbers (cm^{-1}): 1463w, 1250s, 1010, 979w, 920w, 708, 623, 560, 520sh, 455s.

Bo31 Fluoborite $Mg_3(BO_3)(F,OH)_3$

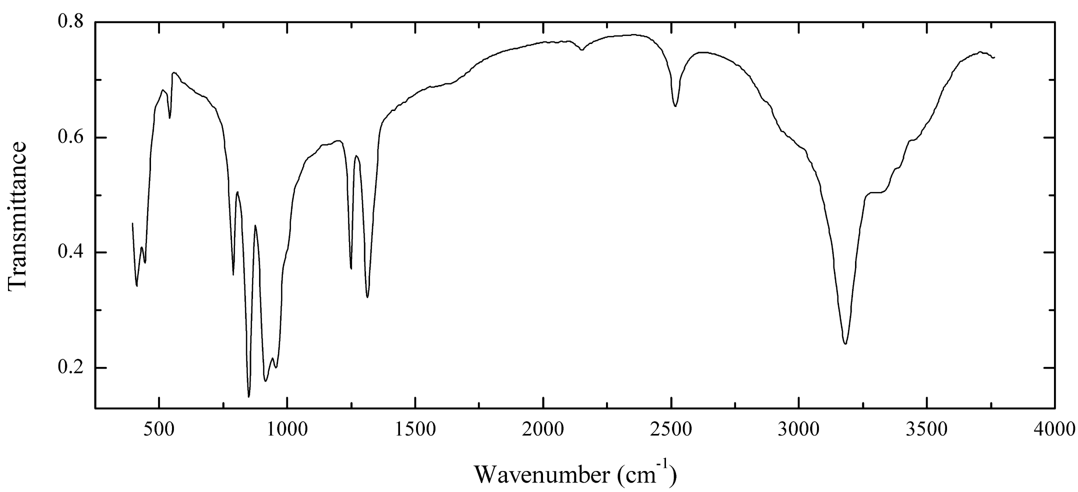


Locality: Rudville, New Jersey, USA.

Description: Yellowish grains in rock. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mg_{2.95}Fe_{0.05}(BO_3)[F_{2.4}(OH)_{0.6}]$.

Wavenumbers (cm^{-1}): 3643, 1245s, 858, 743, 677w, 466s, 390s.

BAs1 Cahnite $Ca_2B(AsO_4)(OH)_4$

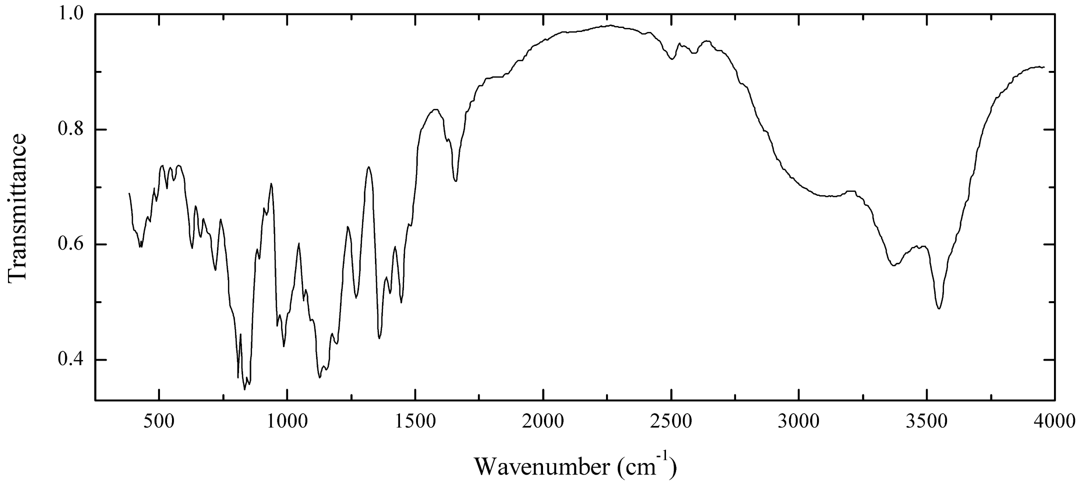


Locality: Borehole at the Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: White pseudomorph after turneaureite. Associated minerals are pentahydroborite, szaibélyite, calcite and sakhaite. Investigated by S.V. Malinko.

Wavenumbers (cm^{-1}): 3425sh, 3370sh, 3300sh, 3165s, 3000sh, 2925sh, 2860sh, 2514, 2150w, 1600sh, 1312, 1247, 990sh, 956s, 913s, 850s, 790, 541w, 441, 406.

BAs2 Teruggite $Ca_4Mg[B_6O_7(OH)_6]_2(AsO_4)_2 \cdot 12H_2O$

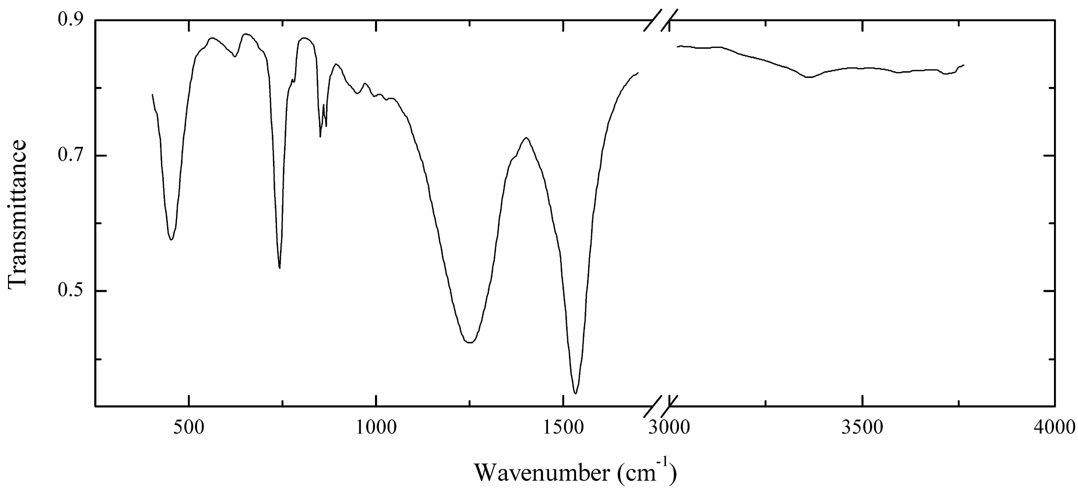


Locality: Hisarcik borate mine, near Emet, Kütahya Province, Turkey.

Description: White nodule from the association with colemanite and ulexite. Specimen No. 80107 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3522s, 3350, 3100, 2575w, 2485w, 1660, 1625w, 1482, 1446, 1401, 1358s, 1267, 1195s, 1152s, 1127s, 1095, 1064, 1030sh, 1005sh, 988s, 962, 920w, 890, 848s, 832s, 808s, 780sh, 717, 690sh, 661, 628, 553w, 525w, 488w, 462, 430, 410sh.

BC1 Sakhaite $Ca_{12}(Mg,Fe,Al)_{4+x}(BO_3)_8(CO_3)_4 \cdot n(H_2O,Cl,OH)$

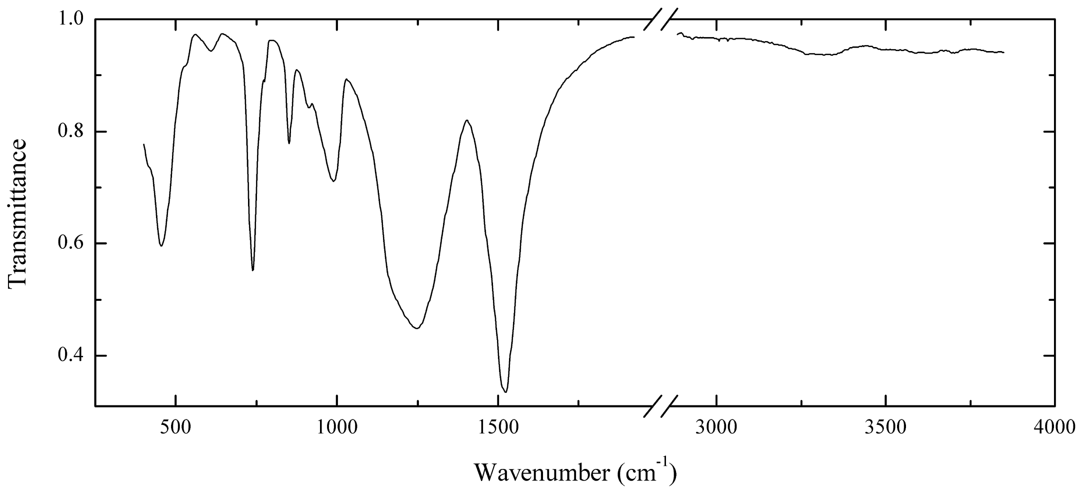


Locality: Dokuchan, Sakha Republic, Eastern Siberia, Russia.

Description: Grey massive aggregate. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ca_{12.00}Mg_{3.53}Fe_{0.44}Mn_{0.03}Al_{0.20}Si_{0.25}(BO_3)_x(CO_3)_yCl_{1.13}(OH,H_2O)_z$.

Wavenumbers (cm^{-1}): 3685w, 3555w, 3370w, 1530s, 1248s, 1030w, 993w, 945w, 920sh, 863, 850, 779w, 739s, 620, 450s.

BC2 Sakhaite $Ca_{12}(Mg,Fe,Al)_{4+x}(BO_3)_8(CO_3)_4 \cdot n(H_2O,Cl,OH)$

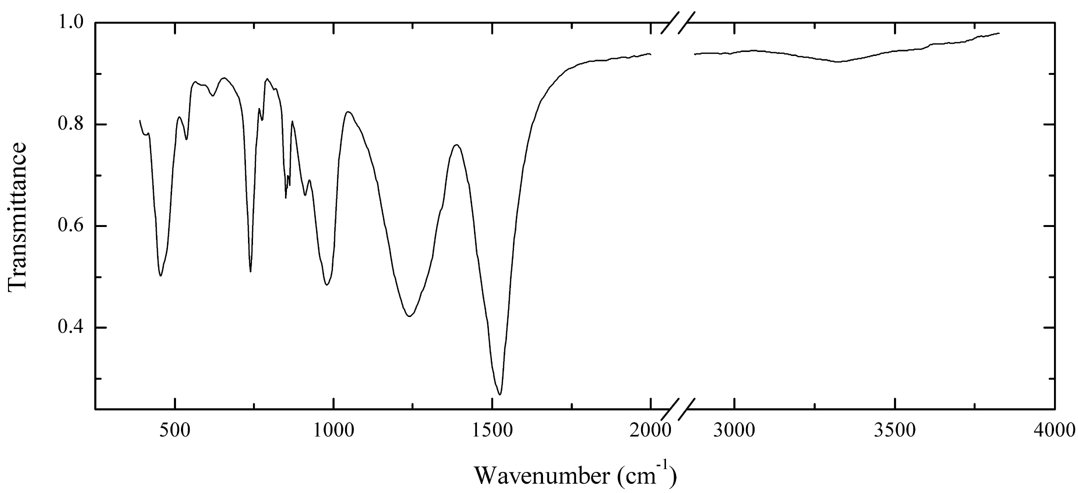


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: Brown massive aggregate from the association with kurchatovite and ludwigite. Identified by IR spectrum. Si- and Al-rich variety (transitional to harkerite). The empirical formula is (electron microprobe) $Ca_{12.00}Mg_{3.52}Fe_{0.32}Mn_{0.17}Al_{0.64}Si_{1.89}(BO_3)_x(CO_3)_yCl_{1.07}(OH,H_2O)_z$.

Wavenumbers (cm^{-1}): 1525s, 1248s, 991, 916w, 850, 776w, 736s, 617w, 535sh, 453s, 407w.

BC3 Harkerite $Ca_{12}Mg_4Al[Si(O,OH)_4]_4(BO_3)_4(CO_3)_4 \cdot n(Cl,H_2O)$

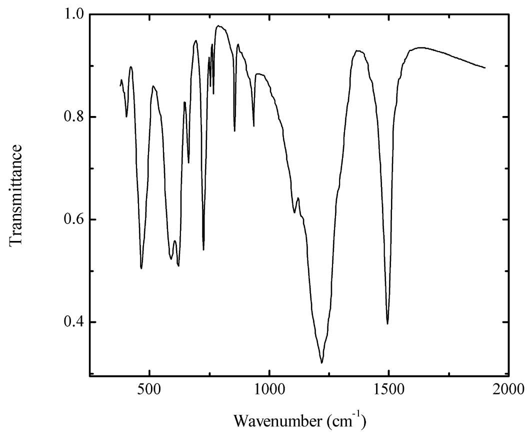


Locality: Dokuchan, Sakha Republic, Eastern Siberia, Russia.

Description: Brown massive aggregate from the association with kurchatovite and ludwigite. Identified by IR spectrum. Si-poor variety (transitional to sakhaite). The empirical formula is (electron microprobe) $Ca_{12.00}Mg_{3.59}Fe_{0.38}Mn_{0.02}Al_{1.05}Si_{2.60}(BO_3)_x(CO_3)_yCl_{1.08}(OH,H_2O)_z$.

Wavenumbers (cm^{-1}): 3560w, 3320w, 1522s, 1245s, 983s, 911, 861, 850, 814w, 777w, 738, 623w, 610sh, 538, 470sh, 456s, 403w.

BC4 Gaudefroyite $Ca_4Mn_3(BO_3)_3(CO_3)O_3$

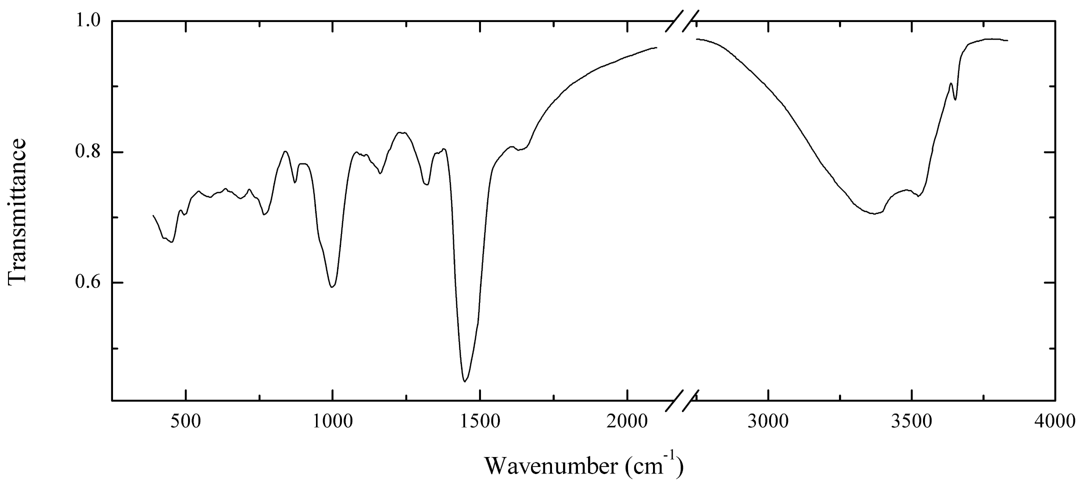


Locality: N'Chwaning II Mine, Kuruman, Kalahari manganese fields, Northern Cape province, South Africa.

Description: Black prismatic crystal from the association with barite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1496s, 1219s, 1140sh, 1108, 936, 856, 764w, 752w, 733, 724, 662, 622, 591, 469, 405w.

BC5 Canavesite $Mg_2(CO_3)(HBO_3)\cdot 5H_2O$

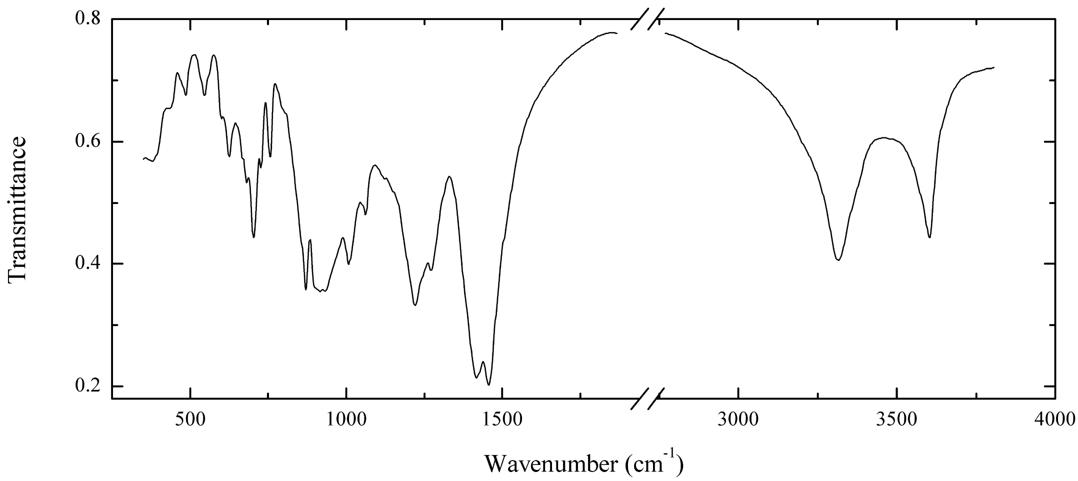


Locality: Brosso mine, Cálea, Léssolo, Canavese district, Torino province, Piedmont, Italy (type locality).

Description: White soft radial-fibrous aggregates. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3655w, 3530, 3370, 1645w, 1455s, 1319, 1165, 1001s, 965sh, 874, 774, 687, 585, 493, 448.

BC6 Borcarite $Ca_4Mg[B_4O_6(OH)_6](CO_3)_2$

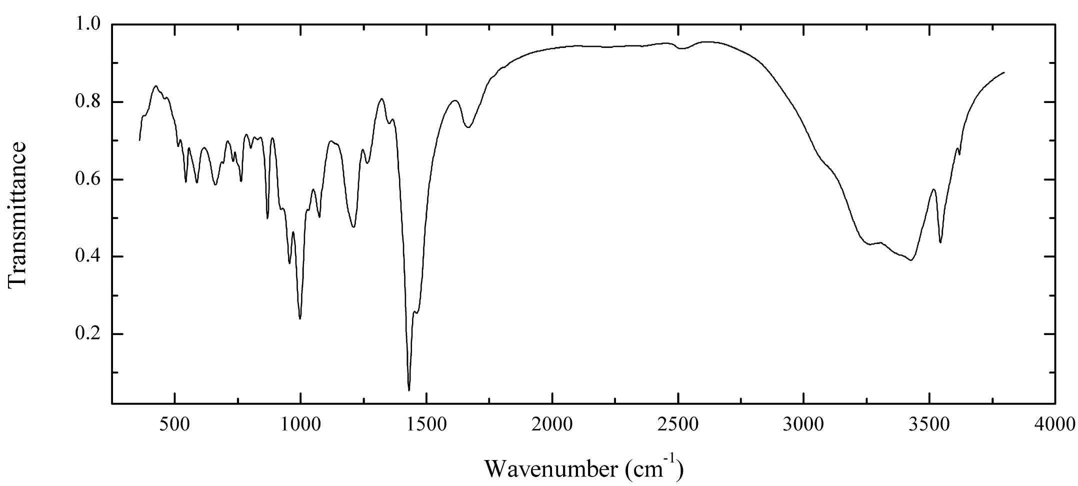


Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: White grains from the association with kurchatovite and szaibélyite. Investigated by S.V. Malinko.

Wavenumbers (cm^{-1}): 3565, 3280, 1453s, 1417s, 1271, 1224, 1130sh, 1066, 1011, 938, 924, 905sh, 876, 820sh, 759, 730, 706, 684, 670sh, 626, 602w, 560sh, 546w, 485w, 435, 385.

BC7 Carboborite $Ca_2Mg(CO_3)_2B_2(OH)_8{\cdot}4H_2O$



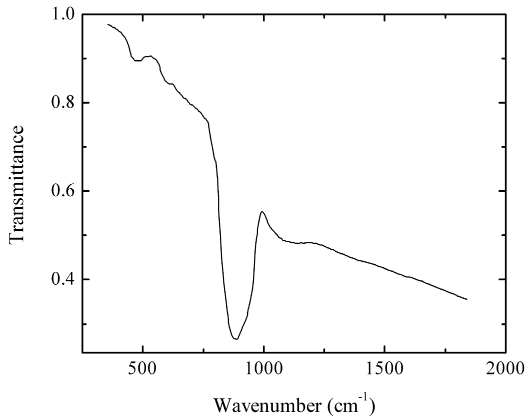
Locality: Titovskoe boron deposit, Tas-Khayakhtakh range, Sakha Republic (Yakutia), Eastern Siberia, Russia.

Description: White crystals from the association with Mg-bearing calcite, serpentine and ludwigite. Investigated by I.V. Pekov. Single-crystal unit-cell parameters are $a = 10.695(10)$, $b = 6.694(3)$, $c = 11.058(15)$ Å, $\beta = 116.55(13)°$.

Wavenumbers (cm^{-1}): 3619, 3544, 3425s, 3380sh, 3265, 3090sh, 2518w, 1667, 1462s, 1431s, 1353w, 1265, 1211, 1140sh, 1075, 1030sh, 997s, 956, 925, 868, 830w, 802, 763, 750sh, 732, 690, 661, 587, 544, 513, 465w, 380sh.

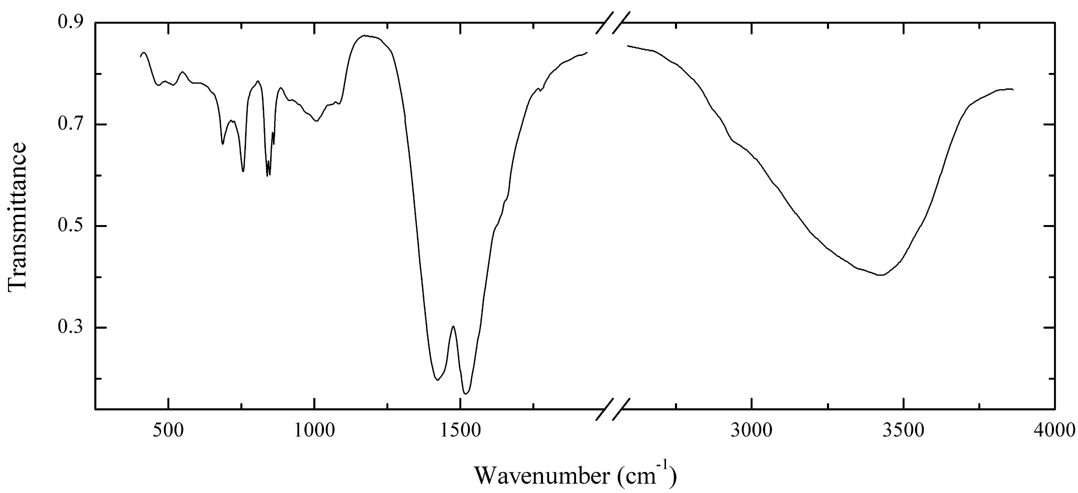
2.2 Carbides and Carbonates

Crbd1 Moissanite SiC



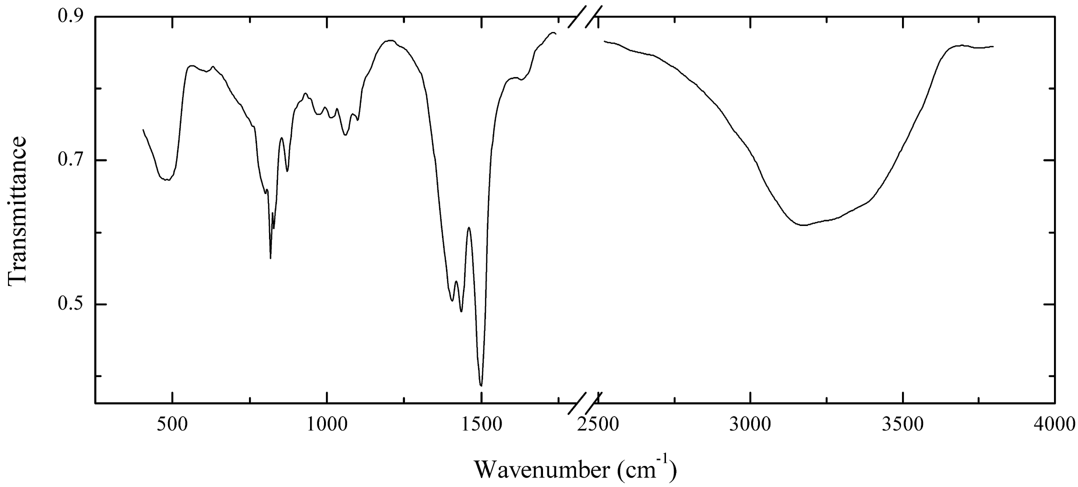
Locality: Synthetic.
Description: Green single-crystal grain.
Wavenumbers (cm^{-1}): 925sh, 880s, 795sh, 580w, 470w.

C1 Tengerite-(Y) $Y_2(CO_3)_3·2–3H_2O$



Locality: Idkerberget, Borlänge, Dalarna, Sweden.
Description: White crust. Identified by qualitative electron microprobe analysis and IR spectrum.
Wavenumbers (cm^{-1}): 3420s, 2950sh, 1775w, 1650sh, 1525s, 1423s, 1099w, 1061w, 1014, 863, 849, 839, 757, 686, 610w, 523w, 466.

C3 Claraite $(Cu,Zn)_3(CO_3)(OH)_4 \cdot 4H_2O$

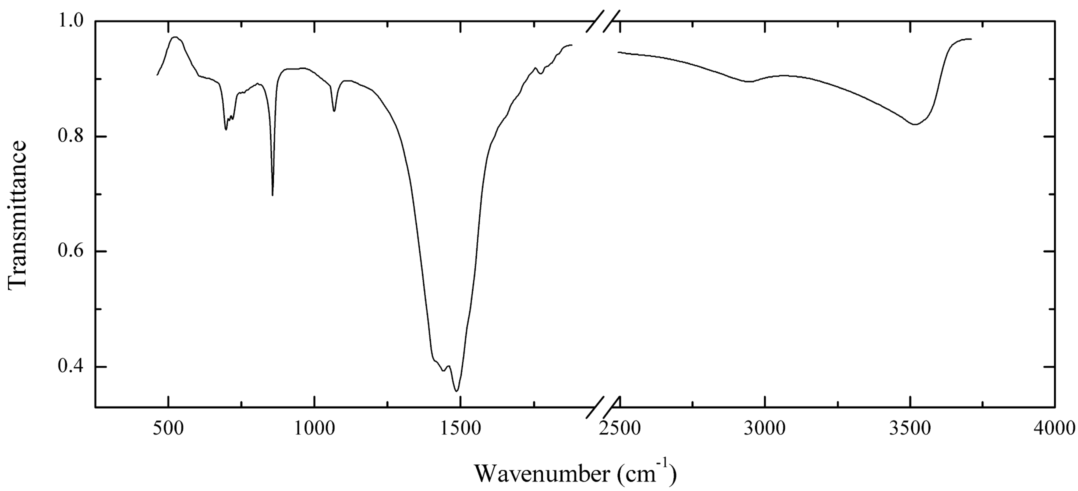


Locality: Weisser Schrofen, Ringenwechsel district, Brixlegg, Tyrol, Austria.

Description: Light blue crusts in the association with dolomite, malachite, allophane, parnauite and tyrolite. Identified by powder X-ray diffraction pattern (the strongest reflections are observed at 13.5, 7.9, 5.12, 3.73, 3.28, 2.96, 2.77 Å). The empirical formula is (electron microprobe) $Cu_{2.67}Zn_{0.33}(CO_3)(OH)_4 \cdot 4H_2O$.

Wavenumbers (cm^{-1}): 3350sh, 3250sh, 3160, 1635w, 1502s, 1437s, 1405s, 1104, 1062, 1016, 980w, 873, 832, 819s, 802, 488, 460sh.

C5 Ancylite-(Ce) $Sr(Ce.La)(CO_3)_2(OH) \cdot H_2O$

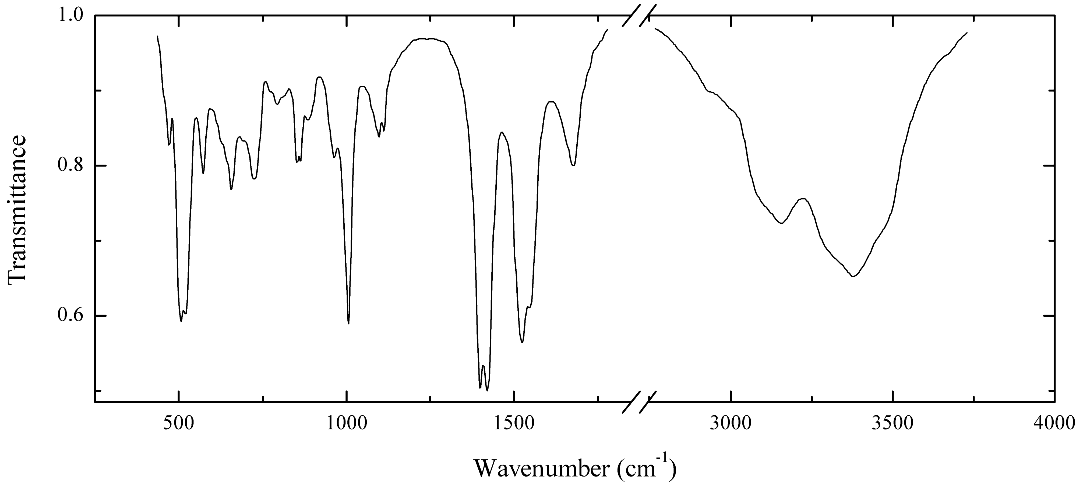


Locality: Neskevaara hill, Vuoriyarvi alkaline-ultramafic pluton, Northern Karelia, Russia.

Description: Brownish pseudomorphs after carbocernaite crystals from carbonatite. Low-symmetry variety, space group $Pmc2_1$. The empirical formula is (electron microprobe) $(Sr_{0.77}Ca_{0.16})(Ce_{0.59}La_{0.25}Nd_{0.21}Pr_{0.02})(CO_3)_2(OH,H_2O)_2$.

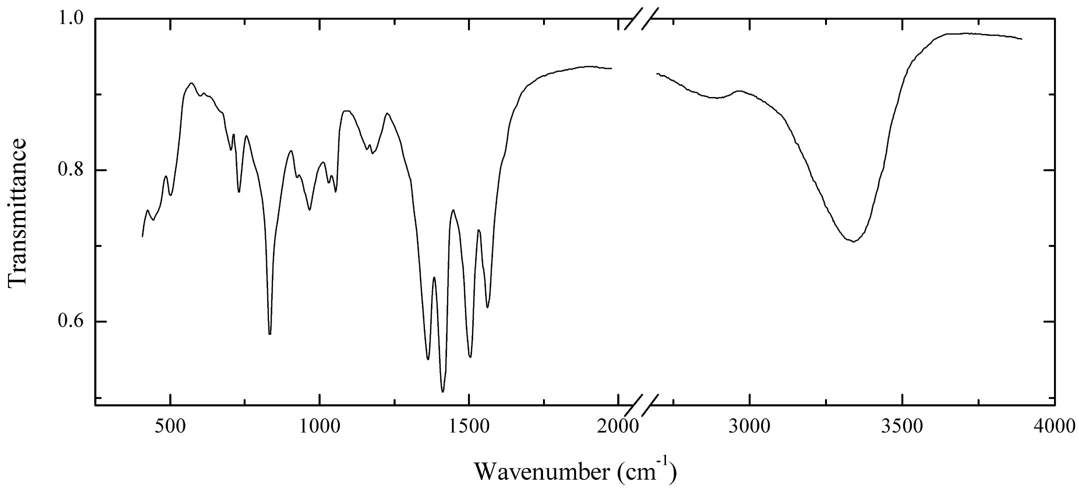
Wavenumbers (cm^{-1}): 3540sh, 3490, 3920w, 1765w, 1486s, 1438s, 1415sh, 1068, 860, 721, 707, 699.

C6 Alumohydrocalcite $CaAl_2(CO_3)_2(OH)_4{\cdot}3H_2O$



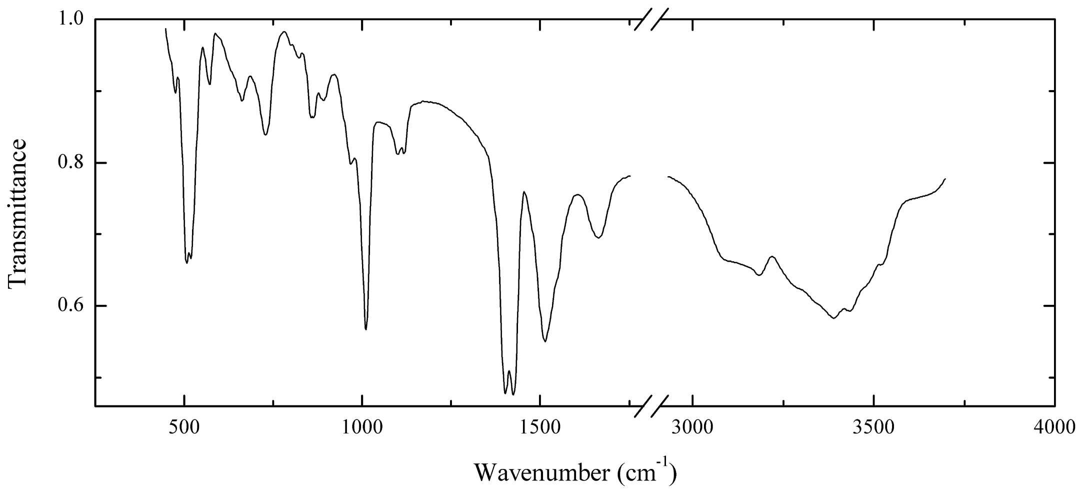
Locality: Ladomirov, Slovakia.
Description: White spherulites from the association with dawsonite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3450sh, 3355s, 3270sh, 3125, 3075sh, 1678, 1550s, 1523s, 1510sh, 1420s, 1397s, 1112, 1100, 1007s, 967, 891w, 867, 855, 797w, 726, 658, 573, 523s, 507s, 474.

C8 Aurichalcite $(Zn,Cu^{2+})_5(CO_3)_2(OH)_6$



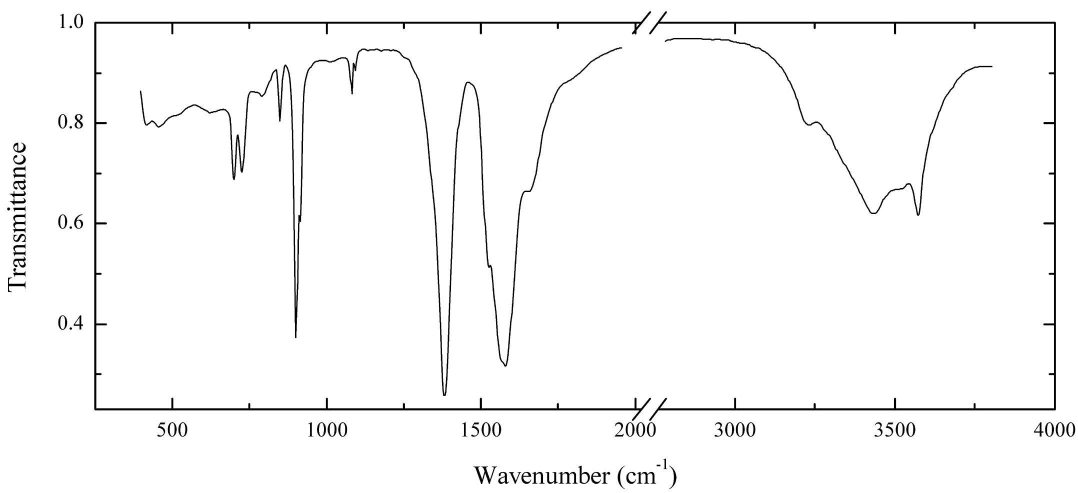
Locality: Verkhniy mine, Dal'negorskoye deposit, Primorskiy Kray, Far East, Russia.
Description: Greenish-blue radiating aggregates to 1 mm in diameter. Identified by IR spectrum. The empirical formula is (electron microprobe) $Zn_{3.2}Cu_{1.7}Mg_{0.1}(CO_3)_2(OH)_6$.
Wavenumbers (cm^{-1}): 3340, 2880w, 1610sh, 1566s, 1550sh, 1507s, 1414s, 1365s, 1188w, 1168w, 1061, 1042, 977, 936w, 840s, 734, 710w, 505, 455.

C9 Alumohydrocalcite $CaAl_2(CO_3)_2(OH)_4 \cdot 3H_2O$



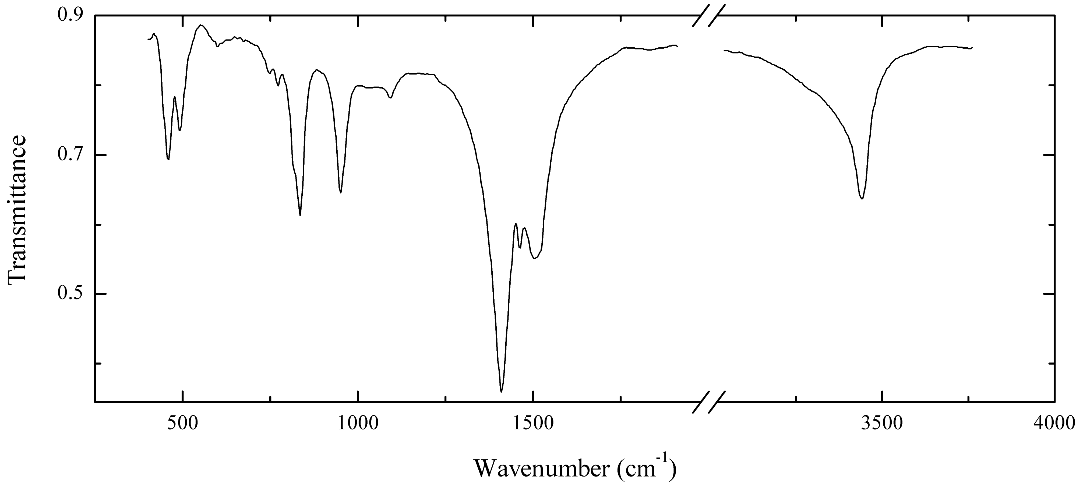
Locality: Potekhina village, 40 km NE of Sorsk, Khakassia, Siberia, Russia.
Description: Lilac fine-grained aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3495, 3405, 3365s, 3270sh, 3160, 3080sh, 1670, 1550sh, 1515s, 1417s, 1394s, 1111, 1097, 1006s, 965, 891w, 867, 855, 821w, 798w, 729, 658, 630sh, 569, 518s, 506s, 473.

C10 Andersonite $Na_2Ca(UO_2)(CO_3)_3 \cdot 6H_2O$



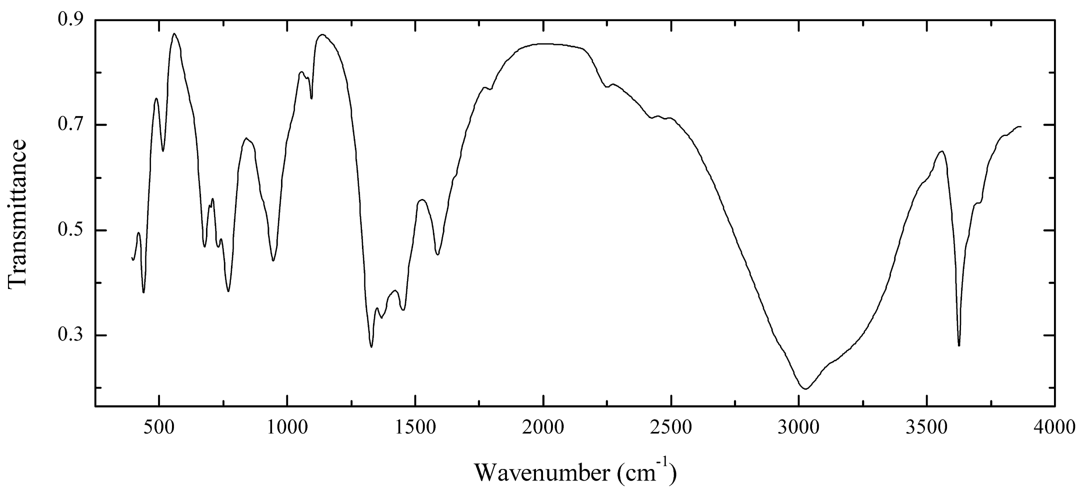
Locality: Uranium mine near Moab, Utah, USA.
Description: Yellow platy crystals. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3547, 3410, 3210, 1656, 1579s, 1565sh, 1545sh, 1523, 1358s, 1091w, 1079w, 913, 902s, 852, 847, 792w, 727, 700, 622w, 530sh, 460, 421.

C11 Azurite $Cu_3(CO_3)_2(OH)_2$



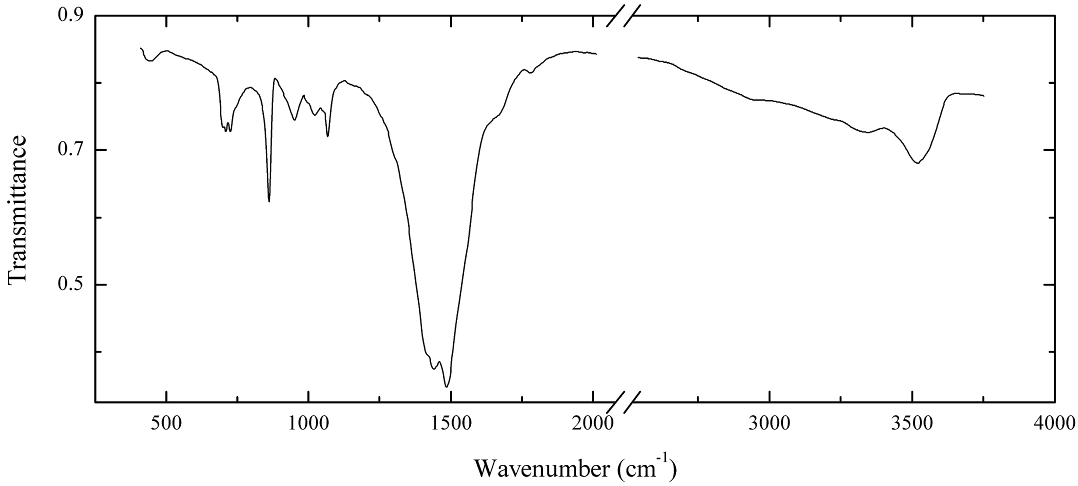
Locality: Pieski mine, Spania Dolina, near Banská Bystrica, Slovakia.
Description: Blue split crystals to 0.3 mm from the association with camerolaite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3430, 1498s, 1460s, 1415s, 1090w, 955, 837, 818, 770w, 746w, 495, 456.

C12 Artinite $Mg_2(CO_3)(OH)_2{\cdot}3H_2O$



Locality: Getchell mine, N of Golconda, Humboldt Co., Nevada, USA.
Description: White radiating aggregate of fibrous crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3690w, 3605s, 3120sh, 3015s, 2470w, 2420w, 2250w, 1790w, 1590, 1451s, 1370s, 1326s, 1094, 1075w, 947, 900sh, 747s, 724, 698, 674, 620sh, 513, 435s.

C14 Ancylite-(La) $Sr(La,Ce)(CO_3)_2(OH)\cdot H_2O$

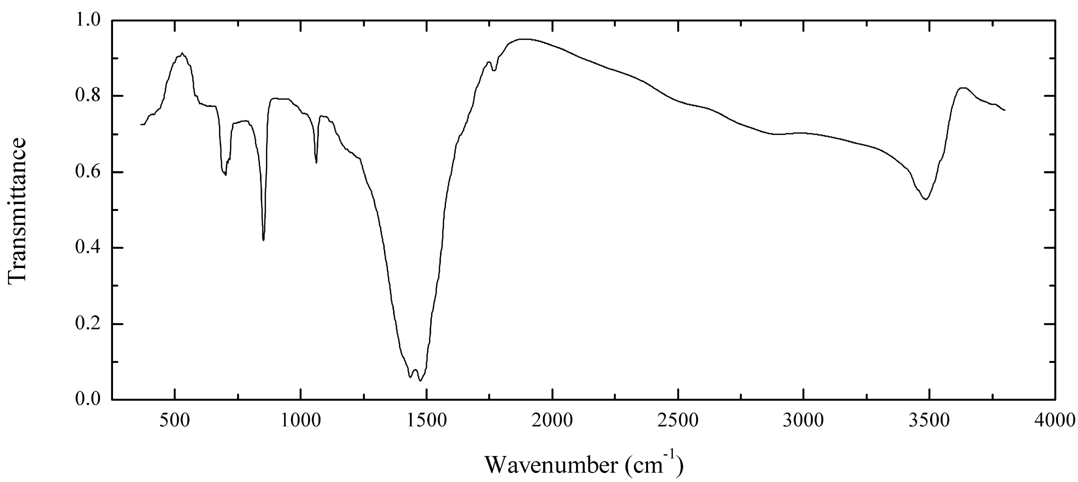


Locality: Marchenko Peak, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown crystals to 1 mm growing on microcline. Low-symmetry variety, space group *Pmc*2$_1$. The empirical formula is (electron microprobe) $(Sr_{0.73}Ca_{0.06}Ba_{0.02})(La_{0.56}Ce_{0.50}Nd_{0.09}Pr_{0.04})(CO_3)_2(OH,H_2O)_2$.

Wavenumbers (cm^{-1}): 3530sh, 3480, 3310, 2950sh, 1770w, 1650sh, 1525, 1481s, 1436s, 1410sh, 1067, 862s, 727, 711, 701.

C15 Ancylite-(Ce) $Sr(Ce,La)(CO_3)_2(OH)\cdot H_2O$

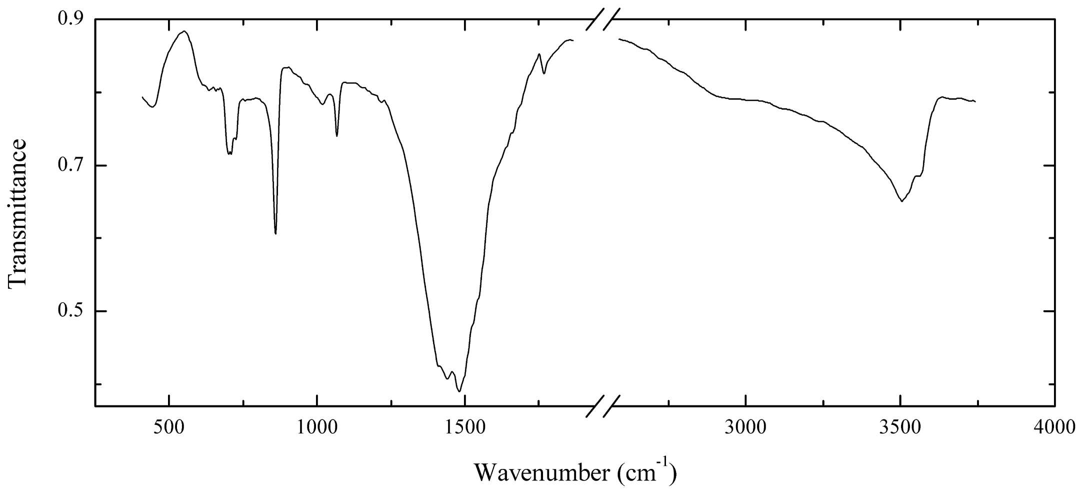


Locality: Marchenko Peak, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White prismatic crystals to 1 mm in length. Associated minerals are gonnardite, eudialyte, microcline and aegirine. Low-symmetry variety, space group *Pmc*2$_1$. The empirical formula is (electron microprobe) $(Sr_{0.71}Ca_{0.07}Ba_{0.03})(Ce_{0.61}La_{0.51}Nd_{0.05}Pr_{0.02})(CO_3)_2(OH,H_2O)_2$.

Wavenumbers (cm^{-1}): 3535sh, 3488, 2890, 2590sh, 1770w, 1640sh, 1485s, 1441s, 1410sh, 1220sh, 1068, 862, 857s, 720, 728, 711, 702, 695, 640sh.

C16 Ancylite-(Ce) $Sr(Ce,La)(CO_3)_2(OH)\cdot H_2O$

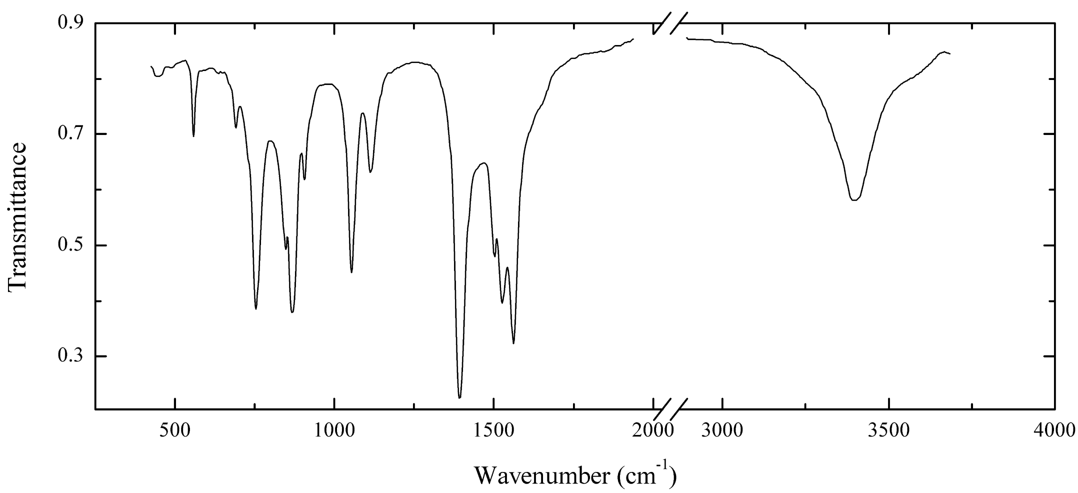


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Beige soft aggregate. Associated minerals are pyrite, natrolite, lemmleinite-Ba. Low-symmetry variety, space group $Pmc2_1$. The empirical formula is (electron microprobe) $(Sr_{0.82}Ca_{0.19}Ba_{0.03})(Ce_{0.58}La_{0.34}Nd_{0.09}Pr_{0.03})(CO_3)_2(OH,H_2O)_2$.

Wavenumbers (cm^{-1}): 3550sh, 3492, 2900sh, 1765w, 1484s, 1442s, 1410s, 1068, 860s, 722, 710, 702, 460.

C17 Niveolanite $NaBe(CO_3)(OH)\cdot 2H_2O$

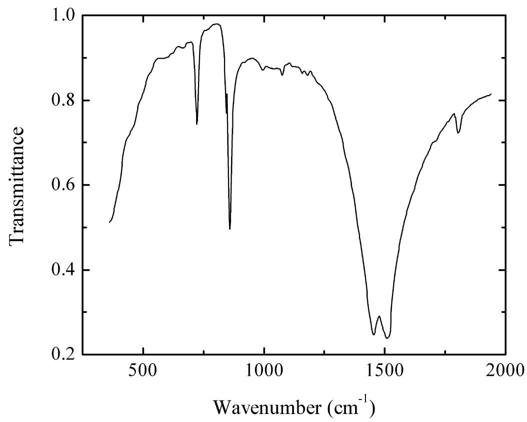


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: White soft fibrous aggregate from the association with natrolite, gonnardite, siderite, petersenite-(Ce), franconite, dawsonite, analcime, quartz, eudidymite, catapleiite, gaidonnayite, monazite-(Ce), calcite, adamsite-(Y), shomiokite-(Y), etc. Holotype sample. The crystal structure is solved. Tetragonal, space group *P*4/*mcc*, $a = 13.1304(19)$, $c = 5.4189(11)$ Å, $V = 934.3(3)$ Å^3, $Z = 8$. The empirical formula is $(Na_{0.94}Ca_{0.10})_{\Sigma1.04}Be_{0.98}(CO_3)_{1.00}(OH)_{1.10}{\cdot}1.66H_2O$. Optically uniaxial $\omega = 1.469(1)$, $\varepsilon = 1.502(1)$. $D_{meas} = 2.06$ g/cm^3. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 13.01 (100) (100), 9.20 (62) (110), 4.343 (27) (300); 3.611 (34) (320), 3.269 (22) (311), 3.256 (95) (400), 2.693 (44) (002), 2.605 (37) (430, 500), 2.489 (60) (202), 2.076 (32) (620).

Wavenumbers (cm^{-1}): 3550sh, 3380, 1780sh, 1640sh, 1567s, 1531s, 1503, 1395s, 1117, 1059, 905w, 870s, 847, 756s, 692w, 560, 450w.

C18 Brenkite $Ca_2(CO_3)F_2$

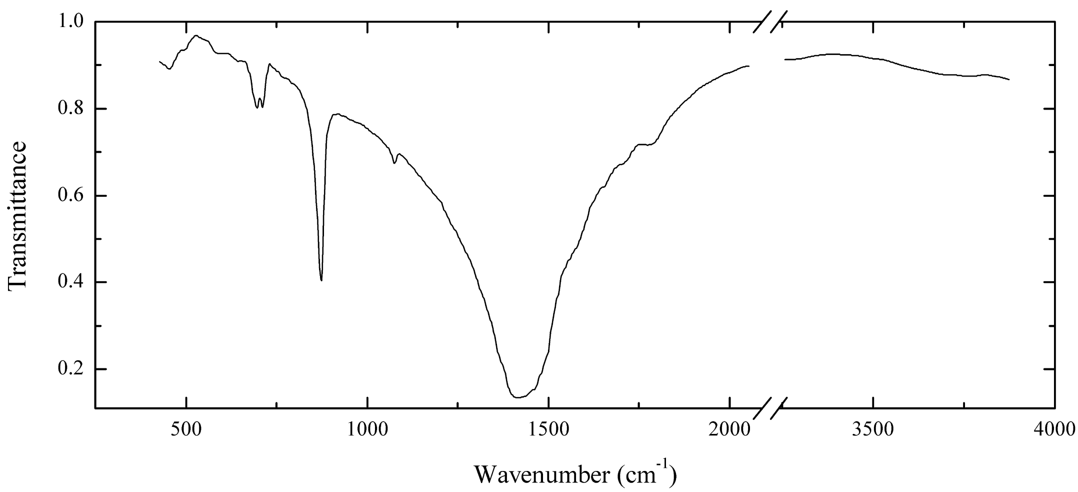


Locality: Schellkopf quarry, near Brenk, Eifel region, Germany (type locality).

Description: Radial aggregates of colourless prismatic crystals in the association with phillipsite-K. Identified by IR spectrum and electron microprobe analysis (Ca:F = 1:1). Bands of OH groups and H_2O molecules are absent in the IR spectrum.

Wavenumbers (cm^{-1}): 1803, 1518s, 1458s, 1187w, 1166w, 1085w, 1002w, 861s, 844, 724, 719.

C19 Benstonite $(Ba,Sr)_6Ca_6Mg(CO_3)_{13}$

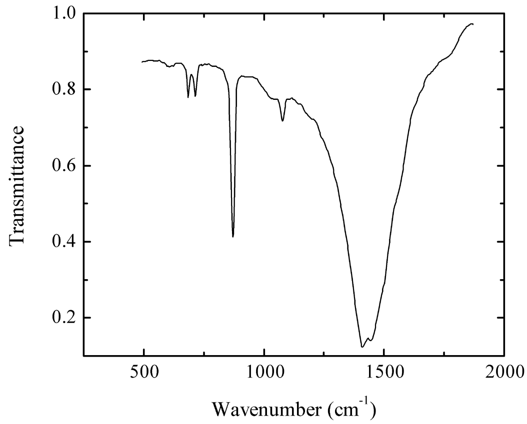


Locality: Murun massif, Sakha Republic (Yakutiya), Siberia, Russia.

Description: White massive aggregate. Disordered variety. Product of heating up to 660 °C for homogenization with the restoration of Mg-free benstonite-type protophase. Identified by powder X-ray diffraction pattern. The empirical formula is $Ba_{4.6}Sr_{2.6}Ca_{5.8}(CO_3)_{13}$.

Wavenumbers (cm^{-1}): 1772w, 1425s, 1078w, 874s, 712, 695, 687.

C20 Benstonite $(Ba,Sr)_6Ca_6Mg(CO_3)_{13}$

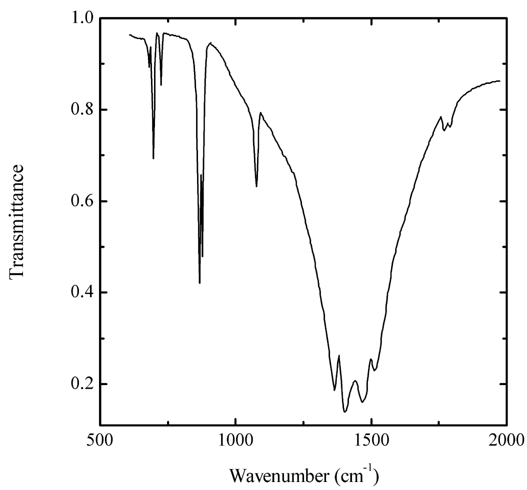


Locality: Jogipatti massif, Southern India.

Description: White massive aggregate. Identified by powder X-ray diffraction pattern. The empirical formula is $Ba_{5.1}Sr_{0.9}Ca_{6.2}Mg_{0.8}(CO_3)_{13}$.

Wavenumbers (cm^{-1}): 1760sh, 1495sh, 1445s, 1415s, 1078, 872s, 716, 686.

C22 Barytocalcite $BaCa(CO_3)_2$

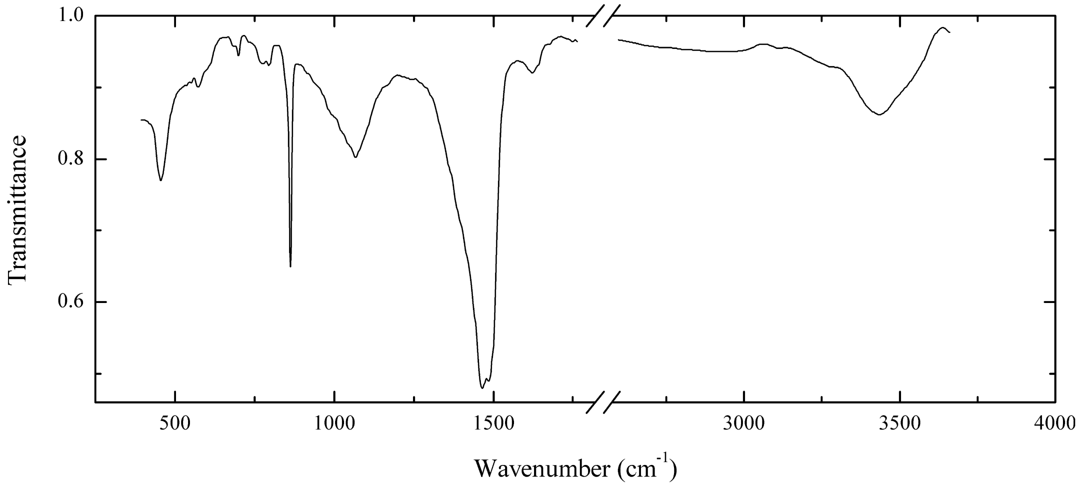


Locality: Kedrovyi massif, Murunskiy alkaline complex, Sakha Republic (Yakutiya), Siberia, Russia.

Description: White aggregate from the association with paralstonite, calcite and barite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ba_{0.94}Sr_{0.08}Ca_{0.98}(CO_3)_2$.

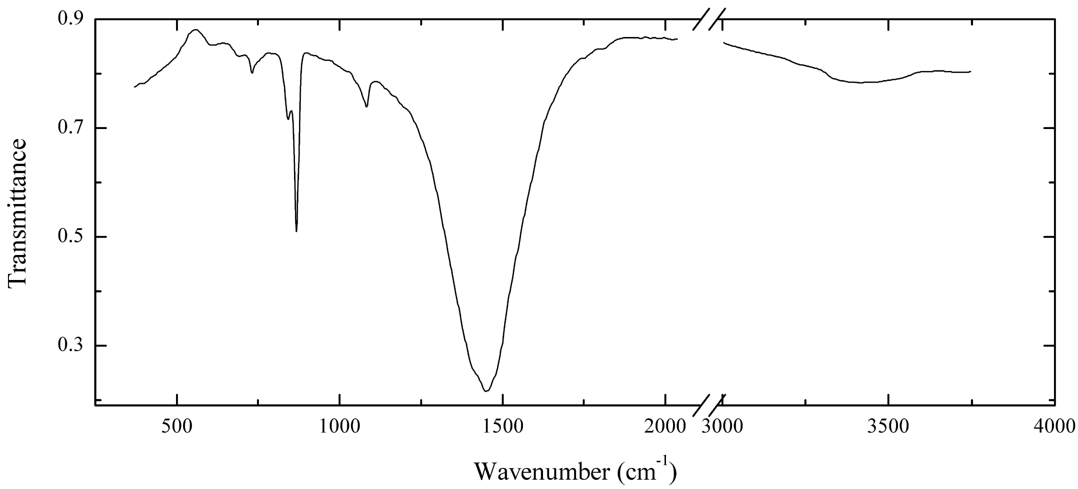
Wavenumbers (cm^{-1}): 1798w, 1775w, 1522s, 1473s, 1409s, 1370s, 1081, 878, 867s, 722, 695, 679w.

C23 Beyerite $(Ca,Pb)Bi_2(CO_3)_2O_2$



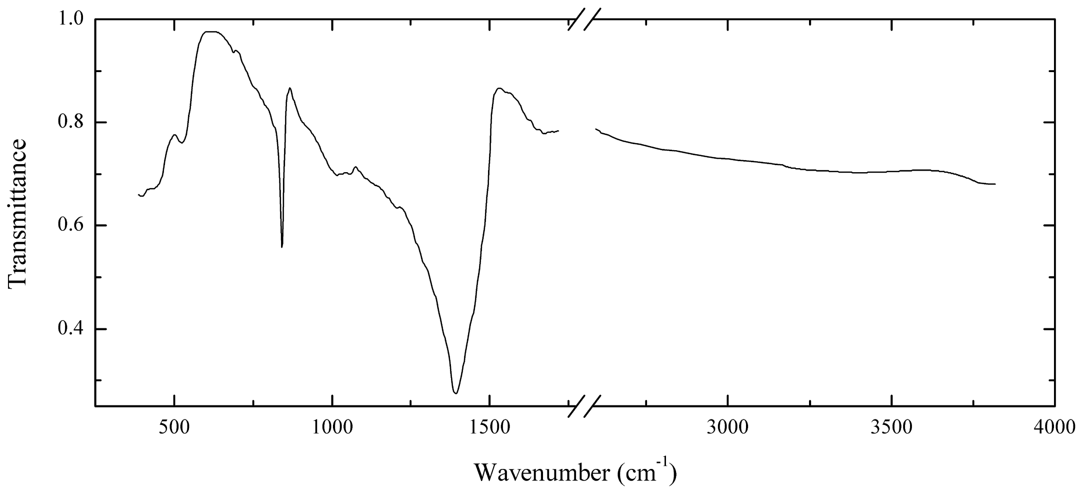
Locality: Jáchymov, Krušné Hory Mts. (Ore Mts.), Czech Republic.
Description: Yellow massive, from the association with eulytine. The empirical formula is (electron microprobe, semiquantitative analysis) $Ca_{1.15}Pb_{0.15}Bi_{1.8}(CO_3)_2O_2$. Contains impurities.
Wavenumbers (cm^{-1}): 1485s, 1465s, 1400sh, 1067, 863s, 848, 792, 777, 704, 687w, 572, 456.

C24 Bastnäsite-(Ce) $(Ce,La)(CO_3)F$



Locality: Ploskaya Mt., Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: Brown grains in pegmatite. The empirical formula is (electron microprobe) $(Ce_{0.54}La_{0.26}Nd_{0.12}Pr_{0.06}Sm_{0.01}Ca_{0.01})(CO_3)F$.
Wavenumbers (cm^{-1}): 1449s, 1417sh, 1085, 867s, 841, 729, 694w, 612w.

C26 Bismutite $(BiO)_2(CO_3)$

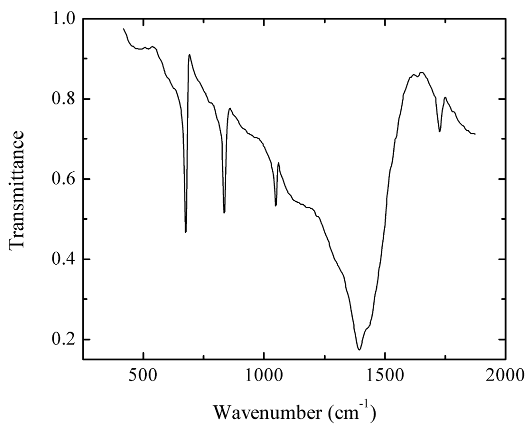


Locality: Bainazar, Kazakhstan.

Description: Yellowish-green fine-grained aggregate in quartz. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1390s, 1065w, 1015w, 846s, 689w, 533, 430sh, (400s).

C28 Cerussite $Pb(CO_3)$

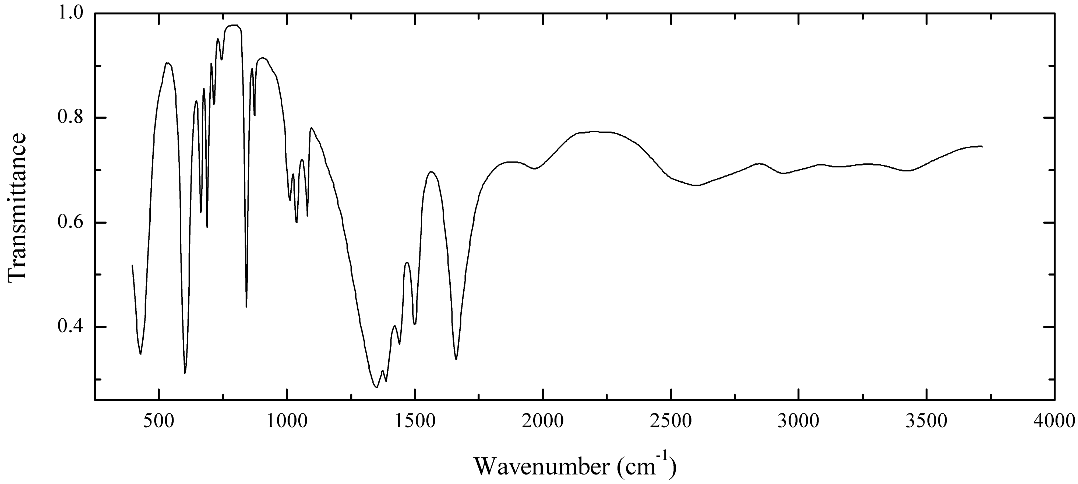


Locality: Monte Avanza mine, Forni Avoltri, Udine province, Italy.

Description: Colourless crystal from the association with secondary copper minerals. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1730, 1430sh, 1395s, 1170sh, 1051, 839, 678s, 485w.

C29 Barentsite $Na_7Al(CO_3)_2(HCO_3)_2F_4$

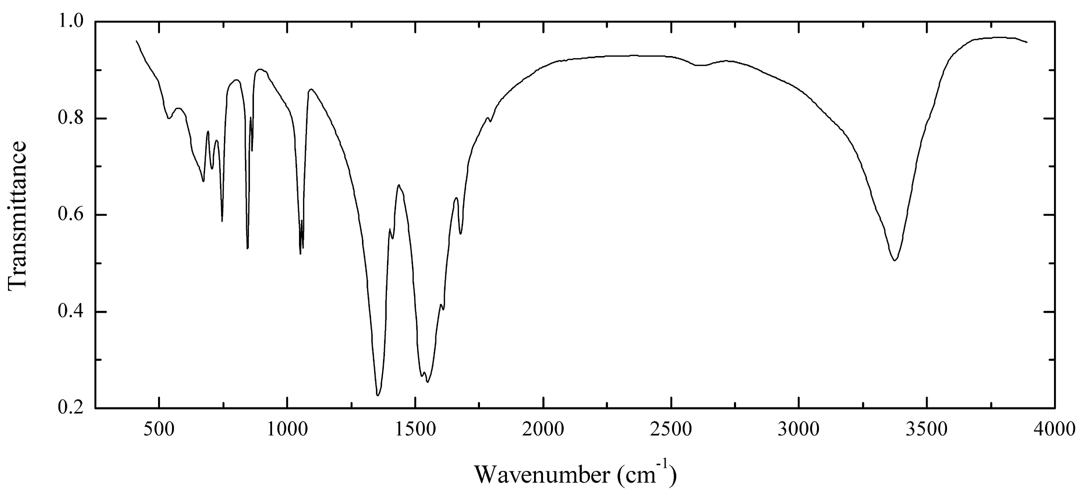


Locality: Restin'yun Mt. (drillcore, depth 600 m), Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless grains from the association with shortite, villiaumite, cryolite, neighborite, bonshtedtite, natrite and albite. Holotype sample. The empirical formula is $H_{1.96}Na_{6.99}Al_{1.01}(CO_3)_{3.51}F_{3.62}$. Optically biaxial (−), $\alpha = 1.358(2)$, $\beta = 1.479(2)$, $\gamma = 1.530(2)$. $D_{meas} = 2.56$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.778 (100), 2.658 (100), 2.887 (84), 2.169 (70), 2.316 (50), 1.870 (42), 2.543 (30).

Wavenumbers (cm^{-1}): 3400w, 3135w, 2915w, 2590, 2520sh, 1965, 1690sh, 1660, 1497, 1439s, 1382s, 1349s, 1081, 1035, 1009, 871, 839s, 742w, 711, 685, 660, 599s, 424s.

C30 Weloganite $Sr_3Na_2Zr(CO_3)_6 \cdot 3H_2O$

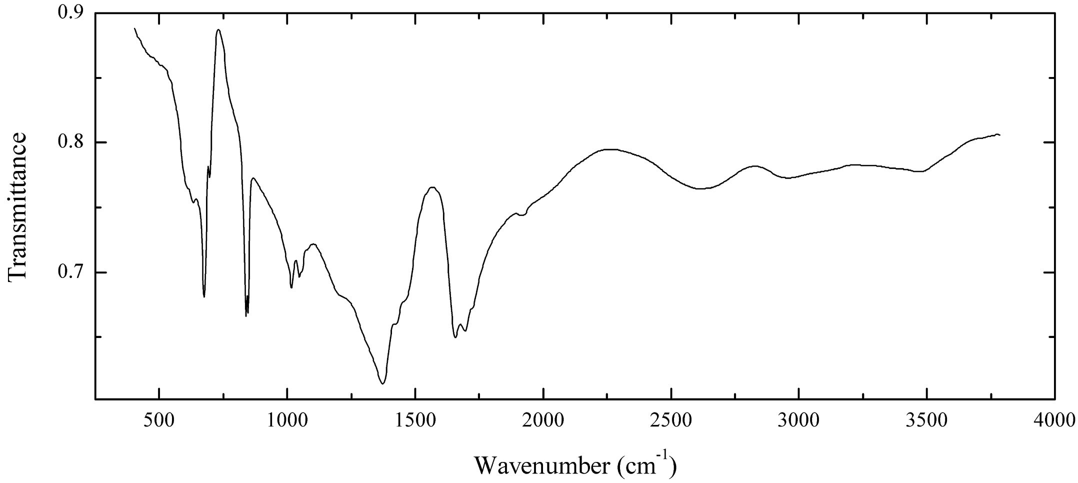


Locality: Francon quarry, Saint-Michel, Montréal, Québec, Canada (type locality).

Description: Light greenish-grey crystals. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3510sh, 3370, 2610w, 1795w, 1680, 1615s, 1560sh, 1545s, 1528s, 1415, 1356s, 1062s, 1056s, 869, 849s, 750s, 709, 677, 650sh, 549.

C31 Wegscheiderite $Na_5(CO_3)(HCO_3)_3$

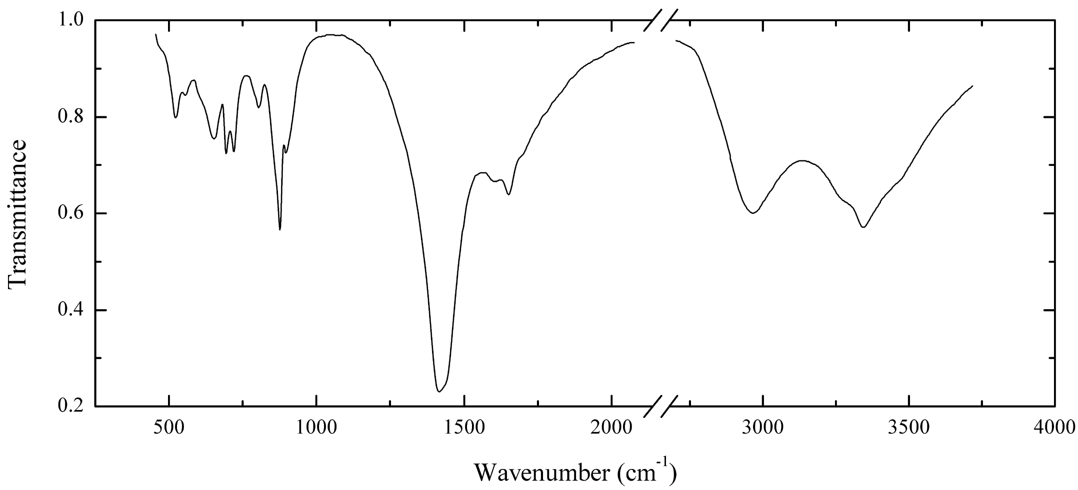


Locality: Umbozero underground mine, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light grey coarse-grained aggregate. Associated minerals are sidorenkite, kogarkoite, villiaumite, catapleiite, microcline, aegirine and sphalerite. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3450w, 2930w, 2630w, 1920w, 1725sh, 1693s, 1658s, 1455sh, 1427, 1374s, 1200sh, 1065w, 1047, 1032, 1018, 847s, 839s, 695, 674s, 637, 610sh.

C32 Gaylussite $Na_2Ca(CO_3)_2{\cdot}5H_2O$

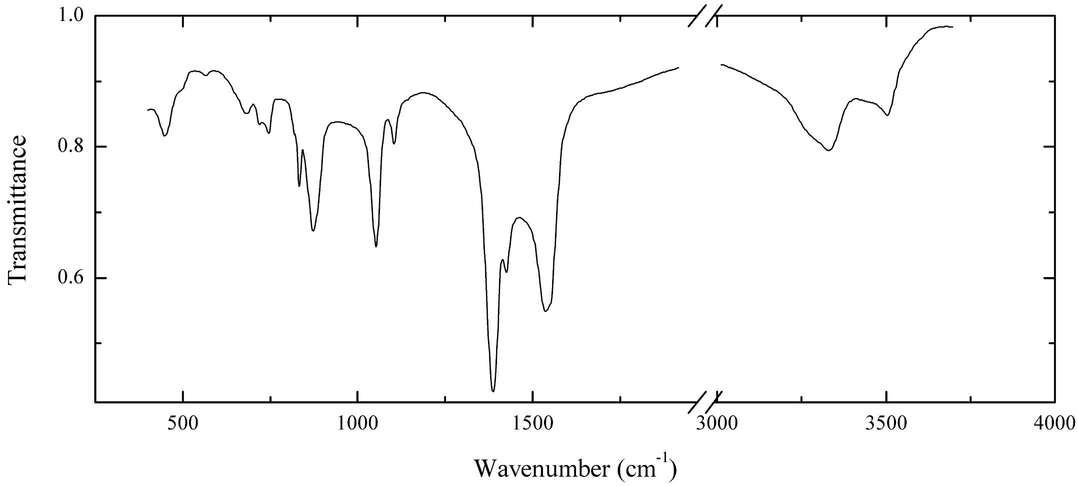


Locality: Searles Lake, San Bernardino Co., California, USA.

Description: Colourless crystal. Identified by IR spectrum and morphological features.

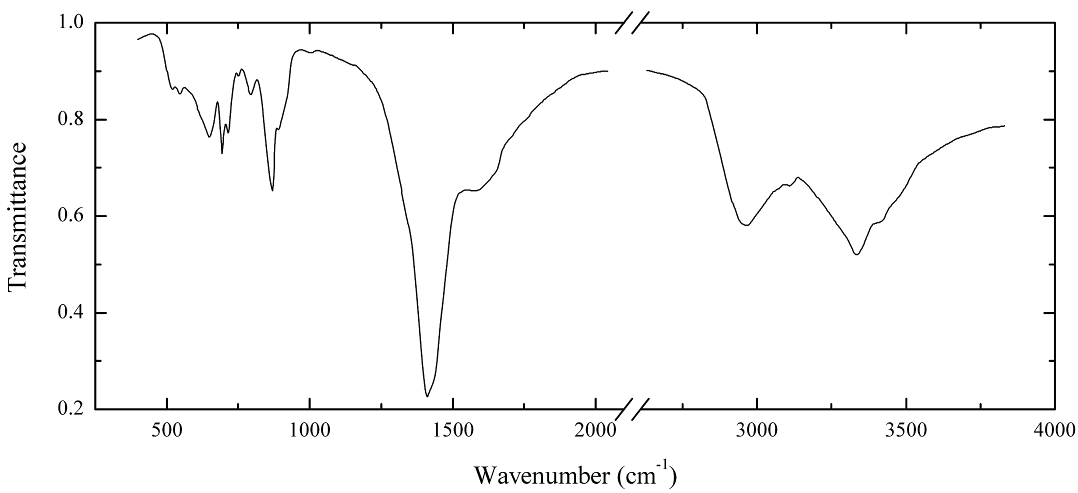
Wavenumbers (cm^{-1}): 3460sh, 3345s, 3290sh, 2965s, 1655, 1610, 1435sh, 1418s, 899, 877s, 806, 721, 693, 652, 555w, 522, 460sh.

C33 Glaukosphaerite $(Cu,Ni)_2(CO_3)_2(OH)_2$



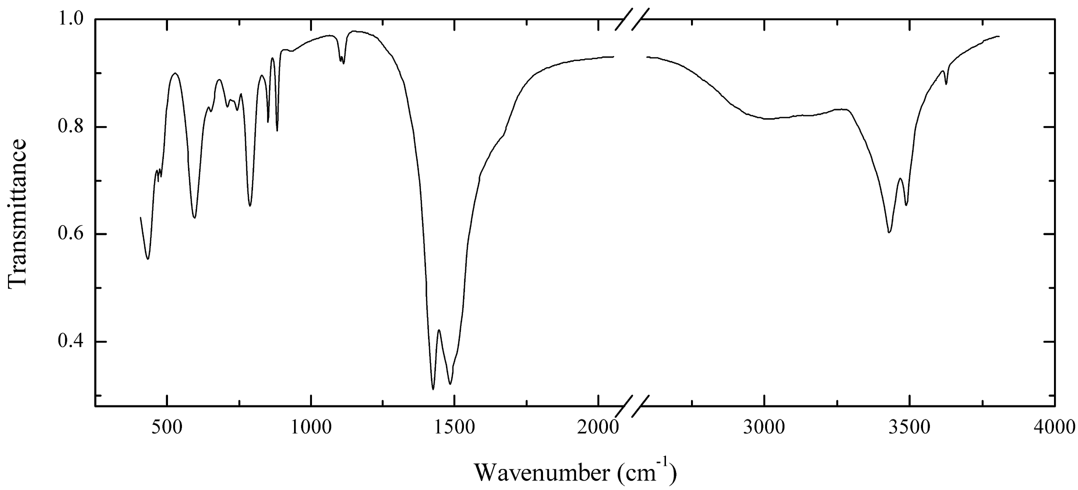
Locality: Carr Boyd mine, Western Australia.
Description: Green spherulites to 0.6 mm. The empirical formula is (electron microprobe) $(Cu_{0.9}Ni_{0.8}Mg_{0.2}Zn_{0.1})(CO_3)_2(OH)_2$.
Wavenumbers (cm^{-1}): 3480, 3305, 1536s, 1439, 1379s, 1099w, 1047, 868, 828, 815w, 743, 718w, 685w, 561w, 490sh, 444.

C34 Gaylussite $Na_2Ca(CO_3)_2{\cdot}5H_2O$



Locality: Trona, Searles Lake, San Bernardino Co., California, USA.
Description: Colourless grain. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3410sh, 3335, 3110sh, 2960, 1650sh, 1600, 1440sh, 1420s, 898, 877s, 804, 755w, 720, 693, 655, 547, 520.

C35 Hydromagnesite $Mg_5(CO_3)_4(OH)_2{\cdot}4H_2O$

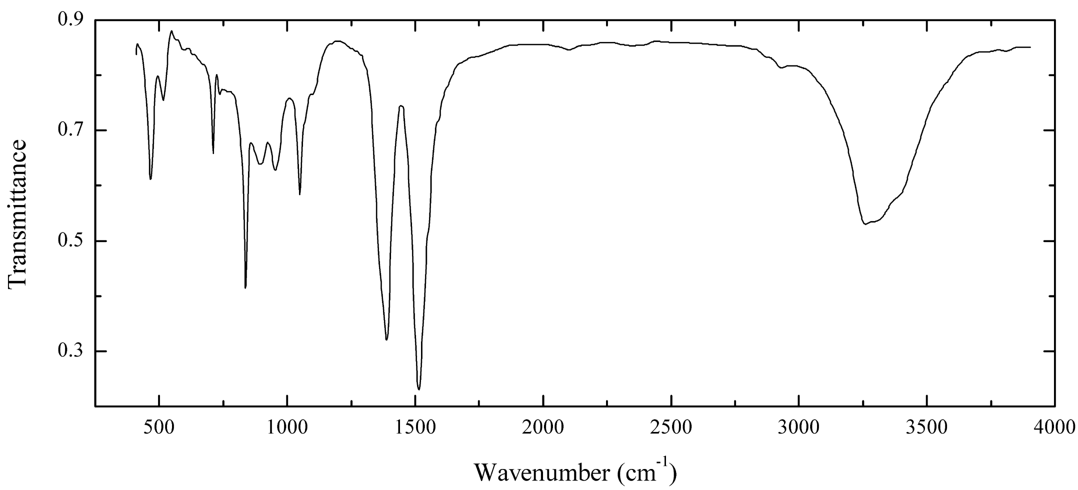


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.

Description: White radial aggregate. Associated minerals are aragonite, magnesite and chrysotile. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3645, 3505, 3445, 3000, 1660sh, 1515sh, 1484s, 1427s, 1118w, 1109w, 885, 853, 790, 744w, 714w, 660w, 593, 480, 468, 434s.

C36 Hydrozincite $Zn_5(CO_3)_2(OH)_6$

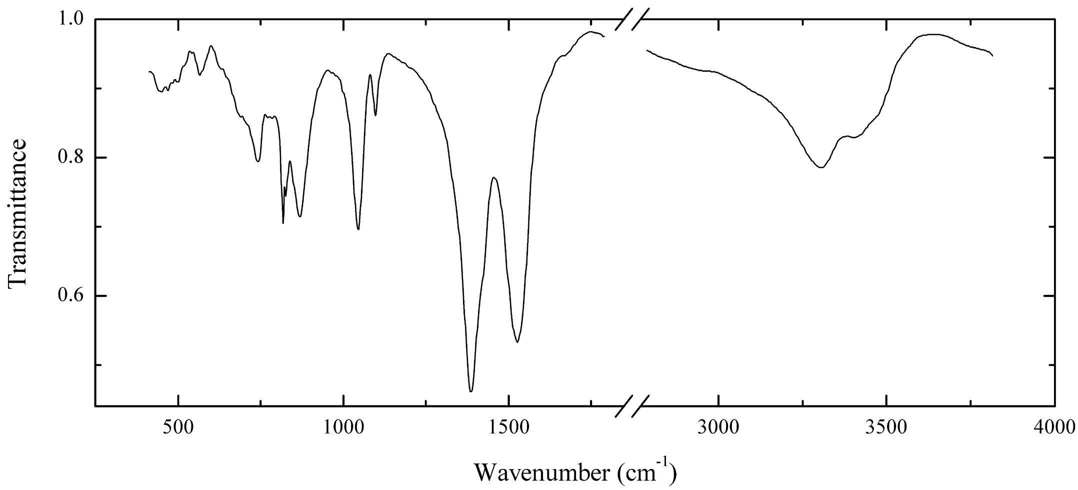


Locality: Santander, Cantabria, Spain.

Description: White spherulites. Identified by IR spectrum and qualitative electron microprobe analysis.

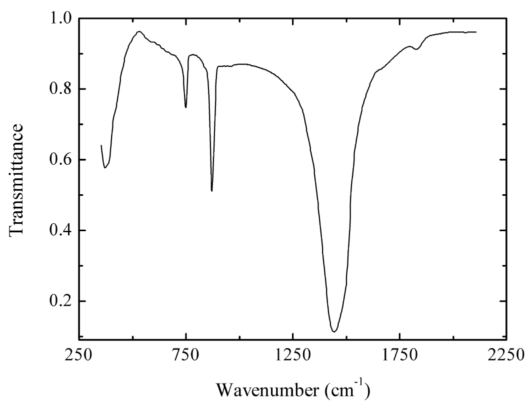
Wavenumbers (cm^{-1}): 3360sh, 3280sh, 3225, 1550sh, 1512s, 1384s, 1095sh, 1065sh, 1049, 955, 896, 837s, 737w, 710, 512, 465, 400w.

C37 Glaukosphaerite $(Cu,Ni)(CO_3)_2(OH)_2$



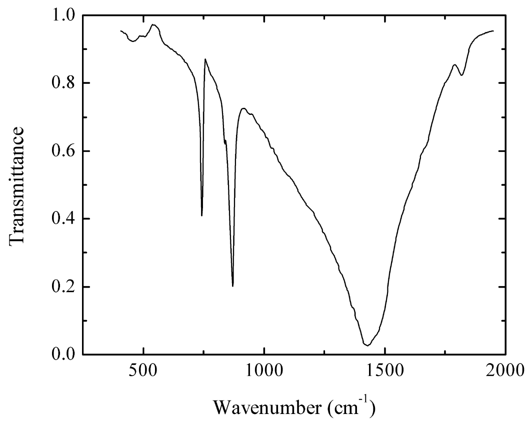
Locality: Mina el Dragon, Potosi, Bolivia.
Description: Green massive.
Wavenumbers (cm^{-1}): 3475, 3420, 3315, 1530s, 1384s, 1099, 1046s, 870s, 827, 817s, 744, 569, 455.

C38 Gaspéite $Ni(CO_3)$



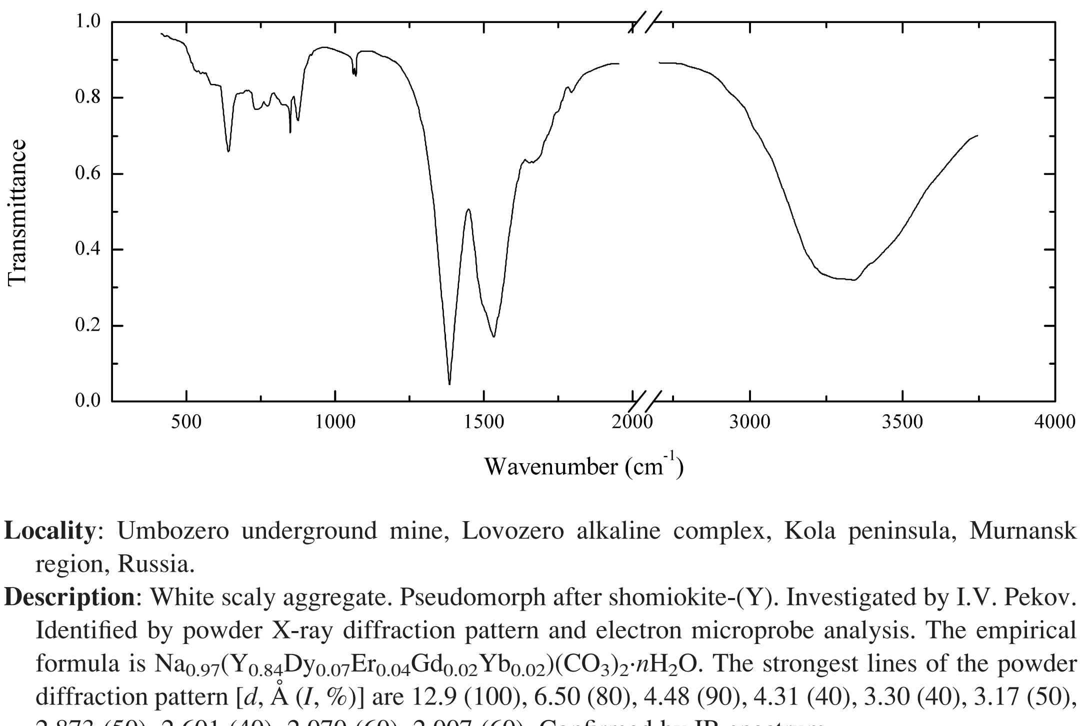
Locality: Widgiemooltha, Western Australia.
Description: Apple-green spherulite, from the association with carrboydite. The empirical formula is (electron microprobe) $Ni_{0.6}Mg_{0.35}Fe_{0.05}(CO_3)$.
Wavenumbers (cm^{-1}): 1840w, 1440s, 873s, 752, 390sh, 375.

C39 Smithsonite $Zn(CO_3)$



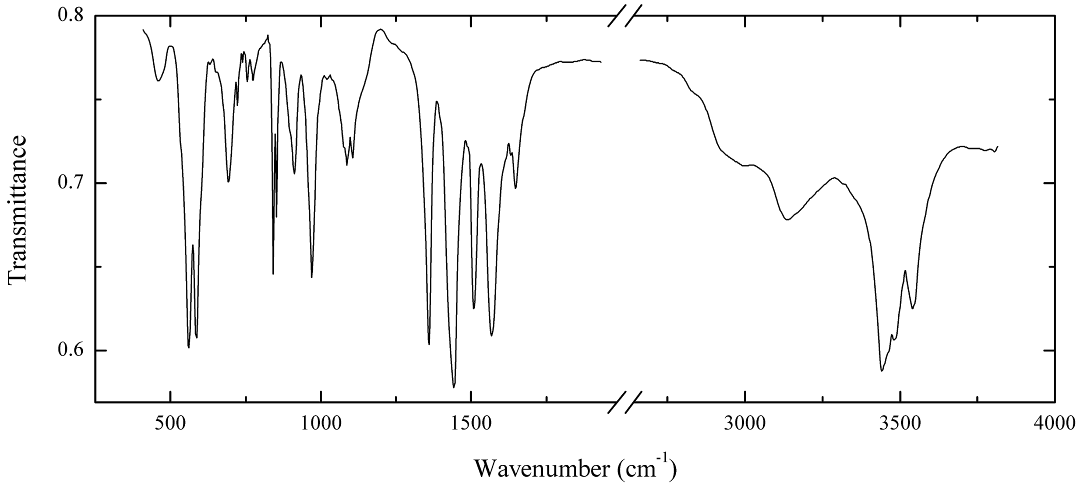
Locality: Preguiça mine, Sobral da Adiça, Moura, Beja district, Portugal.
Description: Light grey, massive. Identified by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1818w, 1425s, 871s, 842, 745s, 500w, 457w.

C40 Adamsite-(Y) $NaY(CO_3)_2{\cdot}6H_2O$



Locality: Umbozero underground mine, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White scaly aggregate. Pseudomorph after shomiokite-(Y). Investigated by I.V. Pekov. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $Na_{0.97}(Y_{0.84}Dy_{0.07}Er_{0.04}Gd_{0.02}Yb_{0.02})(CO_3)_2{\cdot}nH_2O$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %)] are 12.9 (100), 6.50 (80), 4.48 (90), 4.31 (40), 3.30 (40), 3.17 (50), 2.873 (50), 2.601 (40), 2.070 (60), 2.007 (60). Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3480sh, 3340, 3280sh, 1792w, 1660, 1531s, 1381s, 1070w, 1061w, 877, 850, 824w, 775, 741, 641, 590sh, 550w.

C41 Kochsándorite $CaAl_2(CO_3)_2(OH)_4 \cdot H_2O$

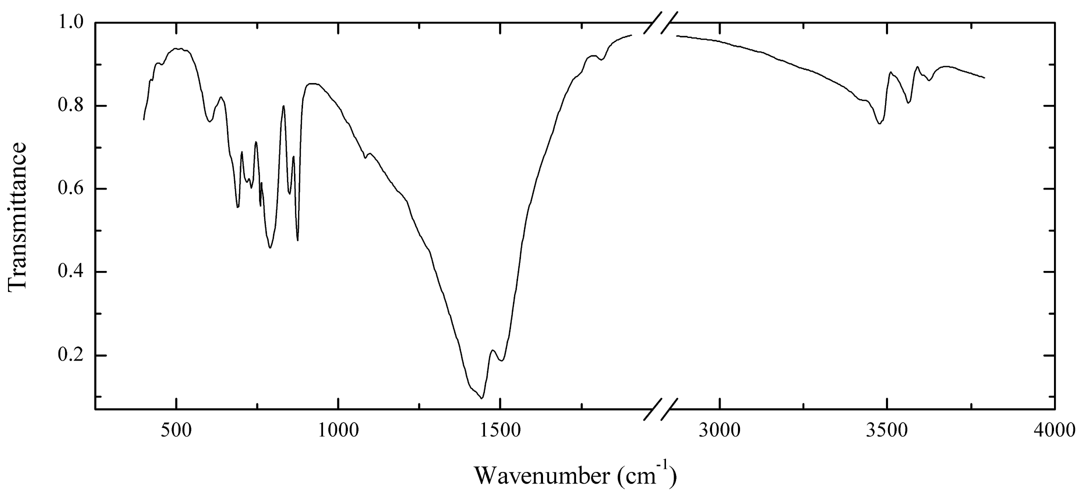


Locality: Mány, Bicske-Zsámbéki basin, Hungary.

Description: Spherical aggregates of acicular crystals in coal. Associated minerals are alumohydrocalcite and illite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3485, 3440s, 3130, 3000w, 1654, 1576s, 1518s, 1448s, 1363s, 1112, 1088, 973s, 915, 900sh, 854, 844s, 778w, 754w, 720sh, 694, 585s, 560s, 462.

C42 Hydroxylbastnäsite-(Ce) $(Ce,La)(CO_3)(OH,F)$

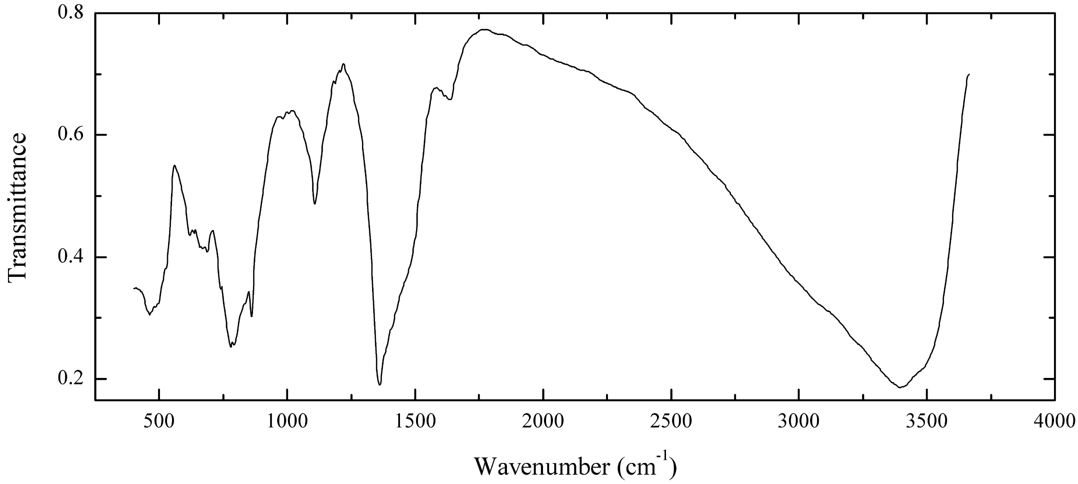


Locality: Crosetto talc mine, Level 1440, Prali, Germanasca valley, Torino province, Piedmont, Italy.

Description: Pink grains in rock. The empirical formula is (electron microprobe) $(Ce_{0.43}Nd_{0.27}La_{0.13}Pr_{0.08}Sm_{0.05}Gd_{0.03}Dy_{0.01}Ca_{0.01})(CO_3)(OH)_{0.9}F_{0.1}$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %)] are 4.97 (90), 3.57 (100), 2.896 (100), 2.070 (60), 2.028 (80), 1.904 (70), 1.583 (40), 1.305 (50).

Wavenumbers (cm^{-1}): 3608w, 3548, 3460, 3410sh, 1815w, 1506s, 1446s, 1412s, 1083w, 873s, 850, 792s, 757, 733, 717, 690, 665, 603.

C43 Reevesite $Ni_6Fe^{3+}_2(CO_3)(OH)_{16}·4H_2O$

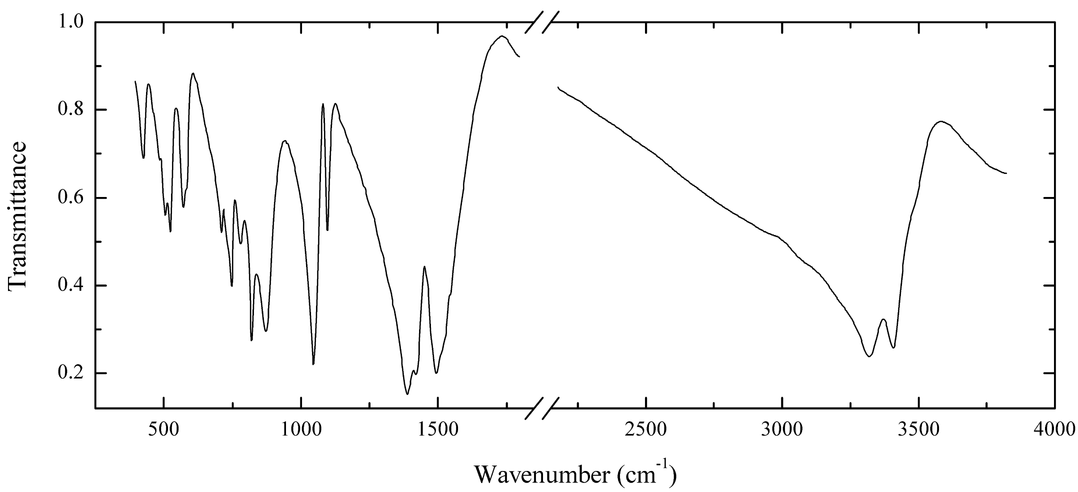


Locality: Weathered iron meteorite Dronino, Dronino village, Kasimov District, Ryazan' Oblast, Russia.

Description: Yellow fine-grained aggregate grains in rock. Associated minerals are violarite, troilite, chromite, goethite, lepidocrocite and nickelbischofite. The empirical formula is (electron microprobe, CO_3 calculated) $(Ni_{5.32}Fe^{2+}_{0.68})(Fe^{3+}_{1.95}Cr_{0.05})[(CO_3)_{0.72}(SO_4)_{0.28}](OH)_{16}·nH_2O$ (the ratio Fe^{2+}:Fe^{3+} and the content of CO_3 are calculated by stoichiometry).

Wavenumbers (cm^{-1}): 3450sh, 3380s, 3000sh, 1635w, 1450sh, 1362s, 1105, 861s, 792s, 778s, 740, 684, 660sh, 619, 520sh, 490sh, 460s.

C44 Malachite $Cu_2(CO_3)(OH)_2$

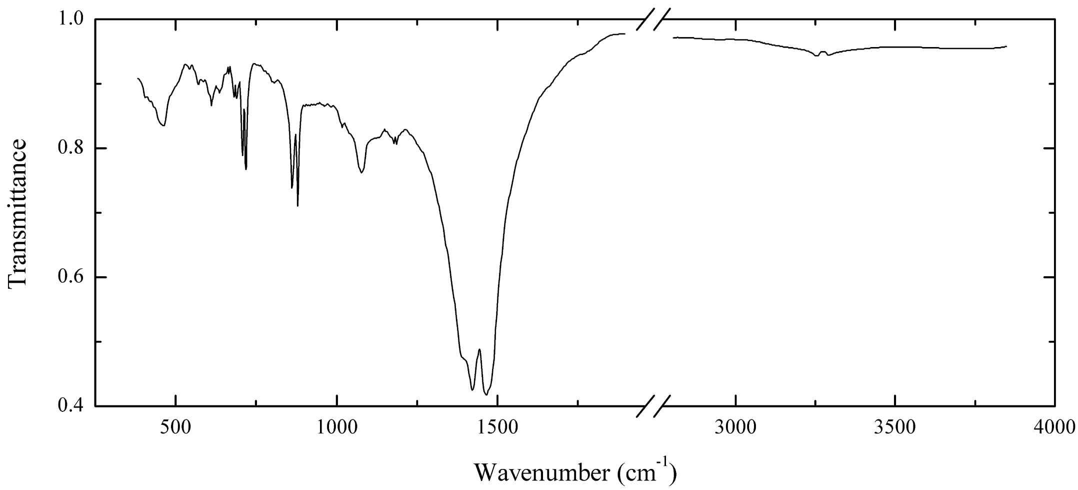


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Green crystals. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3398s, 3305s, 1520sh, 1500s, 1425s, 1392s, 1097, 1049s, 874s, 822s, 783, 751, 712, 585, 575, 524, 502, 486w, 428w.

C46 Cebaite-(Ce) $Ba_3Ce_2(CO_3)_5F_2$

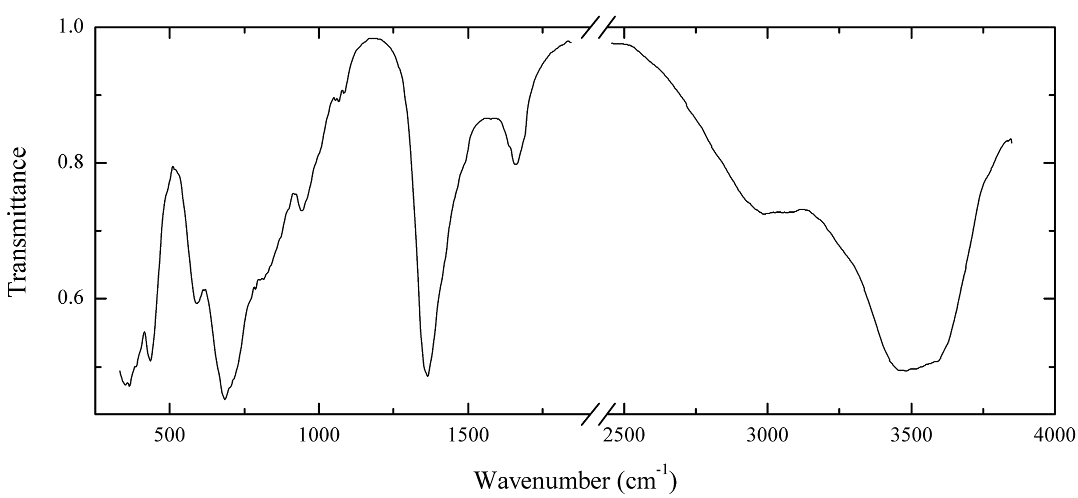


Locality: East mine, Bayan Obo, Inner Mongolia, China (type locality).

Description: Yellowish-brown grains in the association with quartz, fluorite, aegirine, fluorapatite and monazite-(Ce). Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1472s, 1426s, 1405sh, 1182w, 1085, 880, 862, 803w, 718, 707, 691w, 636w, 608w, 458.

C47 Sjögrenite $Mg_6Fe^{3+}{}_2(CO_3)(OH)_{16}·4H_2O$

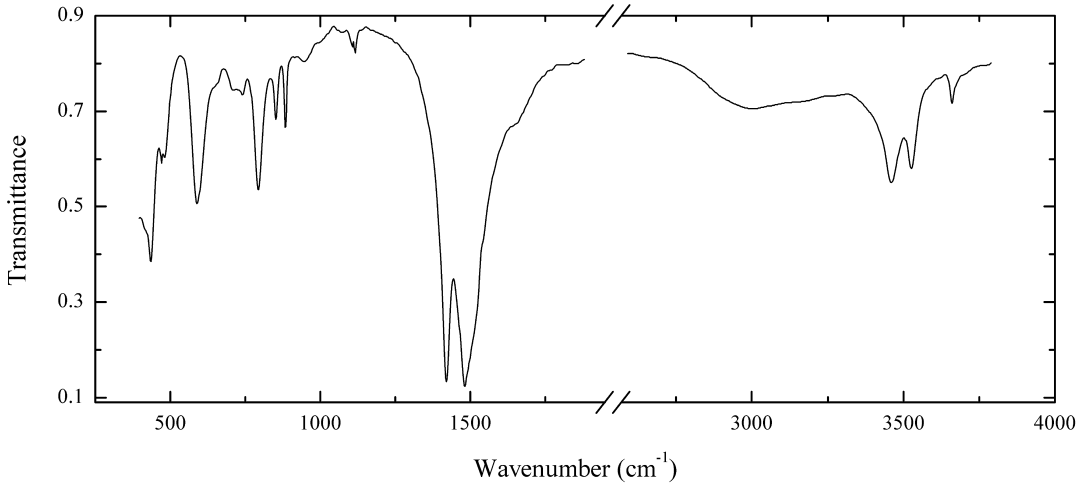


Locality: Phlogopite Mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Scaly aggregate. Associated minerals are phlogopite and dolomite. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

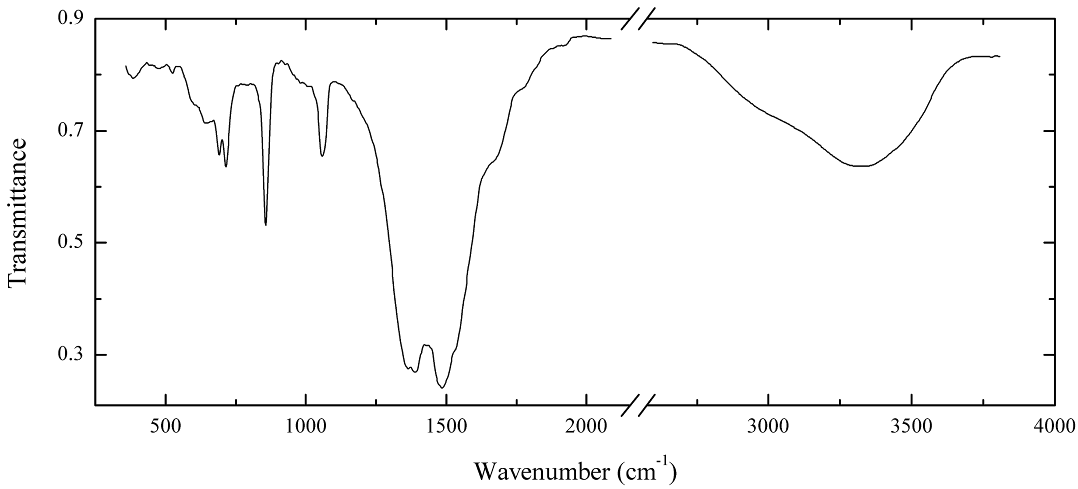
Wavenumbers (cm^{-1}): 3560sh, 3460s, 2980, 1655, 1367s, 1060sh, 944, 800sh, 683s, 586, 437s, 362s.

C48 Hydromagnesite $Mg_5(CO_3)_4(OH)_2{\cdot}4H_2O$



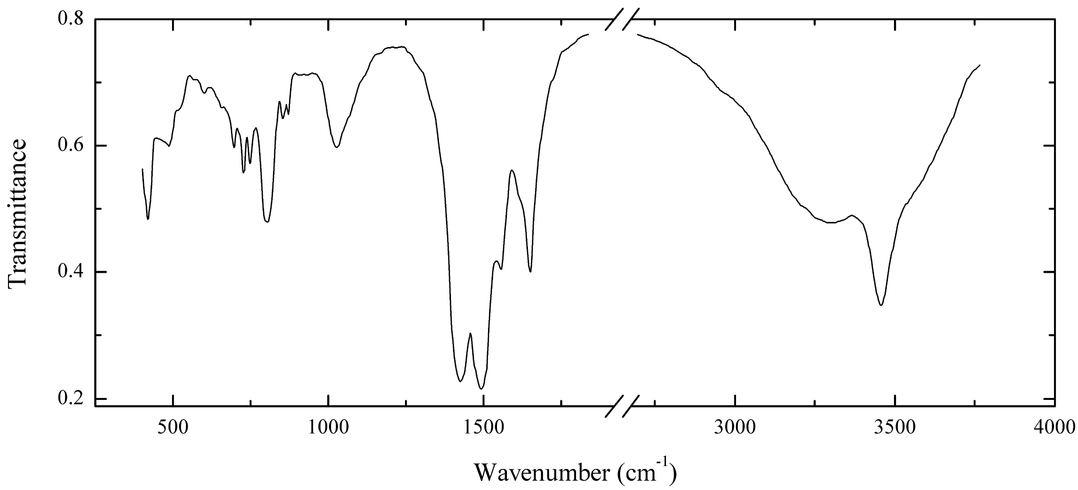
Locality: San Benito, Clear Creek Co., California, USA.
Description: White crust. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3655, 3515, 3455, 2990, 1650sh, 1515sh, 1485s, 1427s, 1118w, 1109w, 946w, 885, 853, 792, 744w, 714w, 660sh, 592, 480, 468, 434s.

C49 Donnayite-(Ce) $Sr_3NaCaCe(CO_3)_6{\cdot}3H_2O$



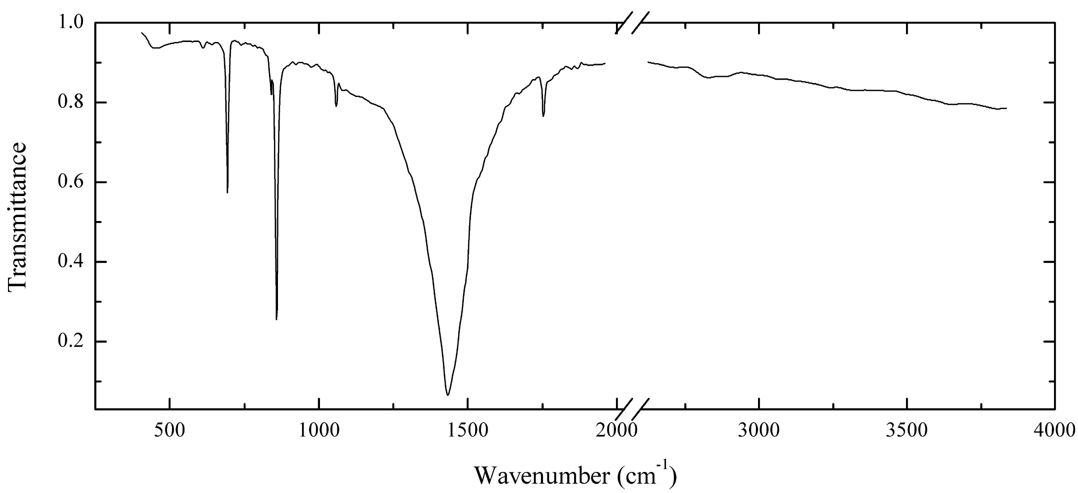
Locality: Neskevaara hill, Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.
Description: White rosette-like aggregate in the association with carbocernaite. The empirical formula is (electron microprobe) $Sr_{2.43}Ba_{0.16}Na_{0.95}Ca_{1.12}Ce_{0.68}La_{0.32}Nd_{0.15}Pr_{0.06}(CO_3)_6{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3310, 3000sh, 1760sh, 1650sh, 1540sh, 1484s, 1390s, 1363s, 1061, 859s, 717, 695, 655, 620sh, 534w, 387w.

C50 Decrespignyite-(Y) $Y_4Cu(CO_3)_4Cl(OH)_5{\cdot}2H_2O$



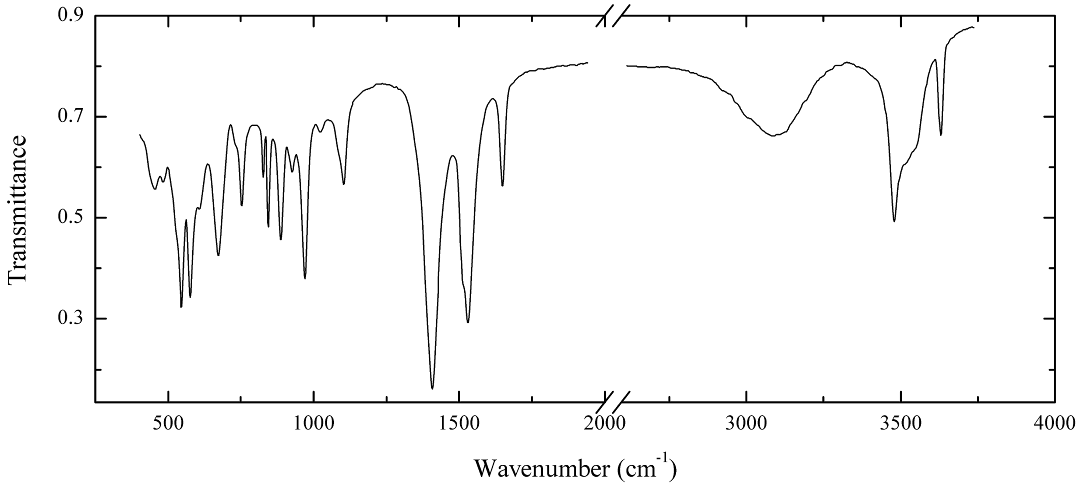
Locality: Paratoo copper deposit, Olary district, South Australia, Australia (type locality).
Description: Blue-rounded aggregates. Identified by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3520sh, 3422s, 3260, 1646s, 1549s, 1486s, 1421s, 1029, 871w, 853w, 805s, 794s, 747, 727, 695, 602w, 520sh, 494, 416s.

C51 Witherite $Ba_2(CO_3)$



Locality: Kremikovtsi iron mine, near Sofia, Bulgaria.
Description: Aggregate of brownish split and twinned crystals. Associated minerals are barite and hematite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 2875w, 2820w, 1752, 1434s, 1060, 859s, 840, 694, 610w.

C52 Dundasite $PbAl_2(CO_3)_2(OH)_4{\cdot}H_2O$

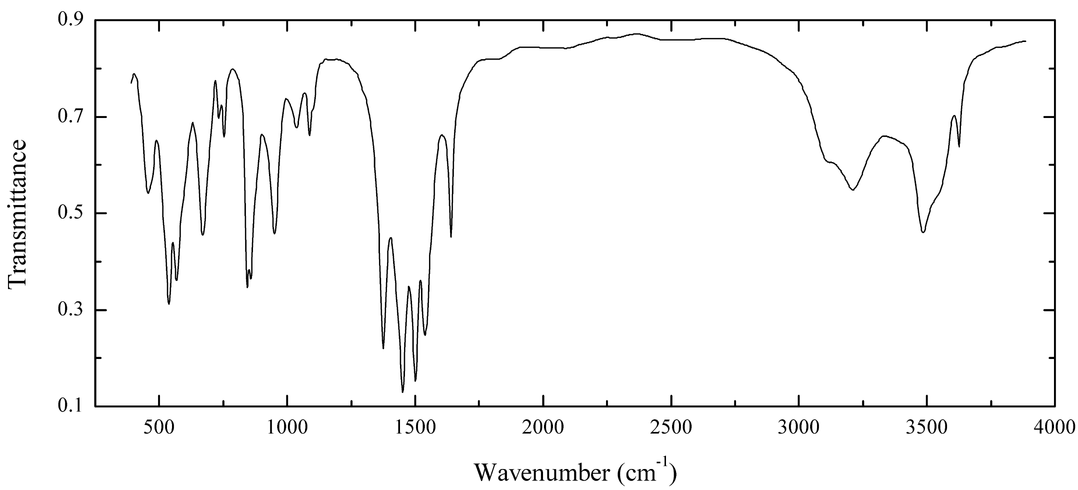


Locality: Adelaida mine, Dundas, Tasmania, Australia (type locality).

Description: White crystalline crust. The empirical formula is (electron microprobe) $Pb_{1.03}Ca_{0.04}Al_{0.92}Fe_{0.03}(CO_3)_2(OH)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3602, 3500sh, 3453, 3060, 1642, 1527s, 1510sh, 1400s, 1100, 1085sh, 1018w, 967s, 924w, 886, 844, 825w, 750, 672, 605w, 576s, 543s, 530sh, 480w, 453w.

C53 Dresserite $BaAl_2(CO_3)_2(OH)_4{\cdot}H_2O$

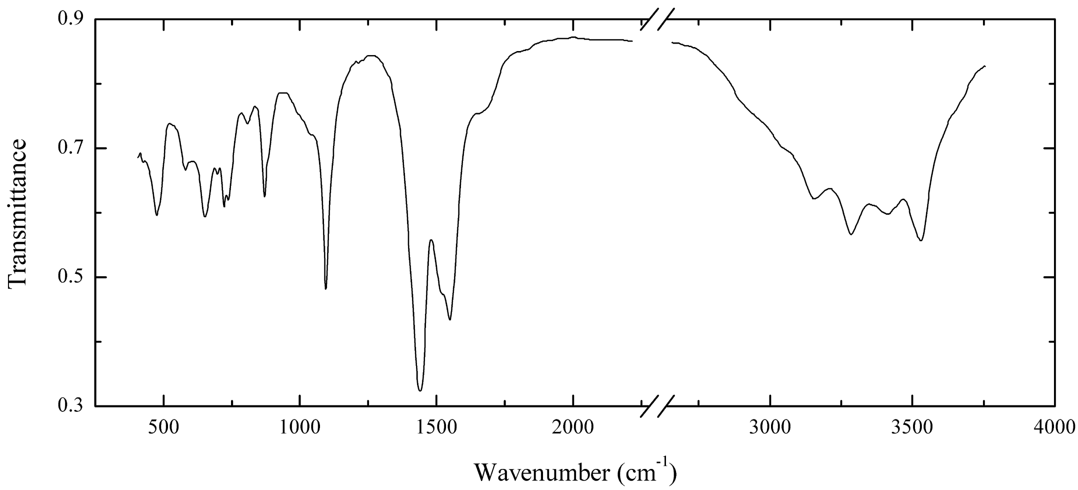


Locality: Francon quarry, Saint-Michel, Montréal, Québec, Canada (type locality).

Description: White radial aggregate. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3620, 3540sh, 3510sh, 3475, 3200, 3105, 1830w, 1645w, 1542s, 1505s, 1455s, 1377s, 1105sh, 1090, 1037, 953, 858, 843, 745, 731, 670, 556, 537, 455.

C54 Indigirite $MgAl(CO_3)_2(OH)\cdot 8H_2O$

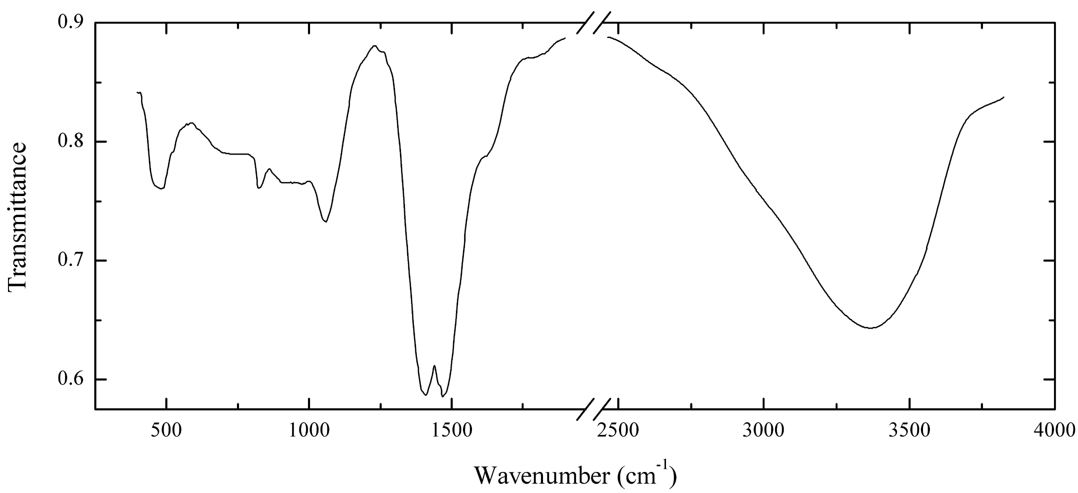


Locality: Sarylakh Au–Sb deposit, upper Indigirka River, NW Yakutia, Russia (type locality).

Description: Specimen No. 76565 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 3508s, 3390, 3260s, 3135, 3025sh, 2900sh, 1650sh, 1549s, 1513sh, 1438s, 1093s, 1040sh, 880sh, 866, 800w, 735, 717, 692w, 647, 579w, 473.

C55 Georgeite $Cu_2(CO_3)(OH)_2$

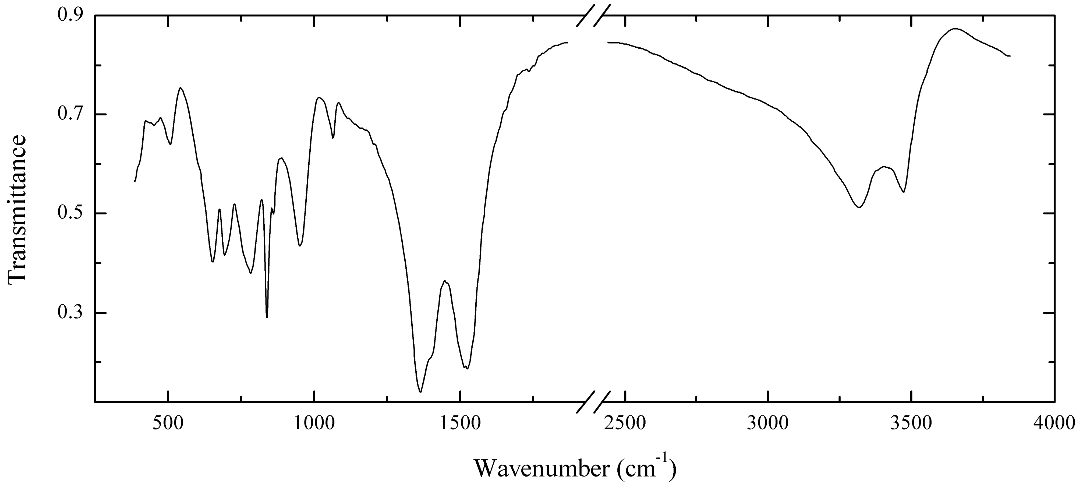


Locality: Cooper Creek, Pinal Co., Arizona, USA.

Description: Light green powdery aggregate. Amorphous. The empirical formula is (electron microprobe) $Cu_{1.96}Ca_{0.02}Zn_{0.02}(CO_3)(OH)_2$.

Wavenumbers (cm^{-1}): 3350s, 1630sh, 1475s, 1408s, 1054, 950w, 825w, 480.

C56 Chukanovite $Fe^{2+}_2(CO_3)(OH)_2$

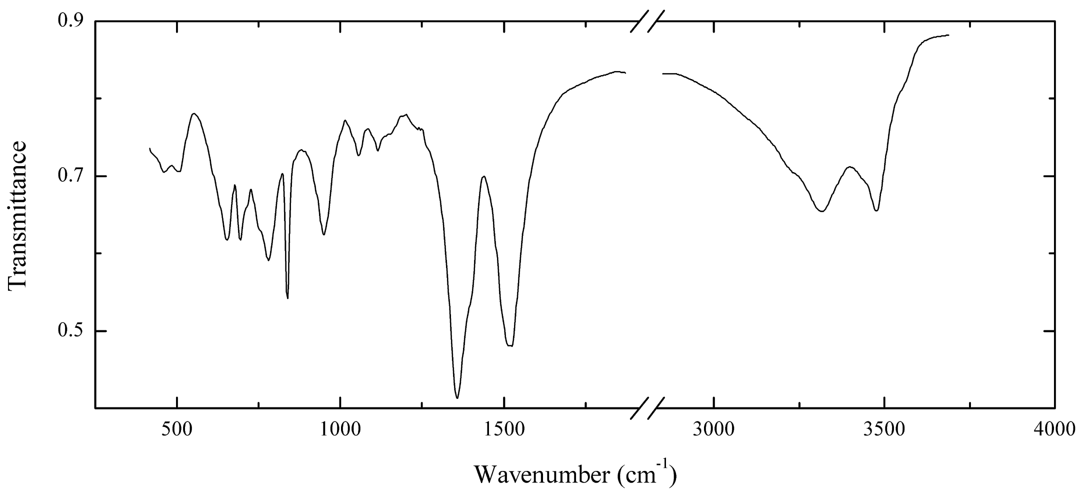


Locality: Dronino ataxite iron meteorite, Dronino village, Kasimov District, Ryazan' Oblast, Russia (type locality).

Description: Brown crusts on weathered meteorite. Associated minerals are goethite, akaganéite, hematite, hibbingite, reevesite and honessite. Cotype sample.

Wavenumbers (cm^{-1}): (3740w), 3475, 3325, 1755sh, 1521s, 1400sh, 1364s, 1069, 955, 861, 837s, 781s, 695s, 655s, 504, 452w.

C57 Chukanovite $Fe^{2+}_2(CO_3)(OH)_2$



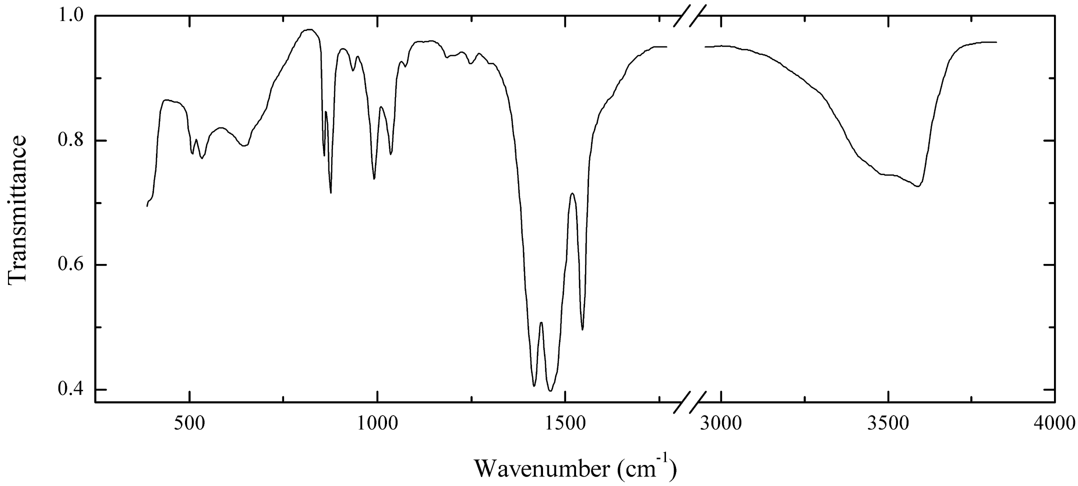
Locality: Dronino ataxite iron meteorite, Dronino village, Kasimov District, Ryazan' Oblast, Russia (type locality).

Description: Brown spherulites on weathered meteorite. Associated minerals are goethite, akaganéite, hematite, hibbingite, reevesite and honessite. Holotype sample. Monoclinic, $a = 9.639$, $b = 12.226$, $c = 6.492$ Å, $\beta = 96.06°$. The empirical formula is (electron microprobe, H_2O by modified Penfield method, CO_2 by selective sorption of annealing products) $(Fe^{2+}_{1.97}Ni_{0.02}Mg_{0.01})(CO_3)_{0.93}(OH)_{2.14}\cdot 0.18H_2O$. Optically biaxial (−), $\alpha = 1.673(3)$, $\beta = 1.770(5)$, $\gamma = 1.780(5)$.

D_{calc} = 3.60 g/cm^3. The strongest lines of the powder X-ray pattern [d, Å, (I, %)] are 6.14 (40), 5.15 (60), 3.73 (80), 2.645 (100), 2.361 (40), 2.171 (40).

Wavenumbers (cm^{-1}): 3478, 3320, 1529s, 1357s, 1145sh, 1114w, 1055w, 951, 837s, 780s, 695s, 655s, 500, 460.

C58 Defernite $Ca_6(CO_3)_2(OH)_7(Cl,OH)$

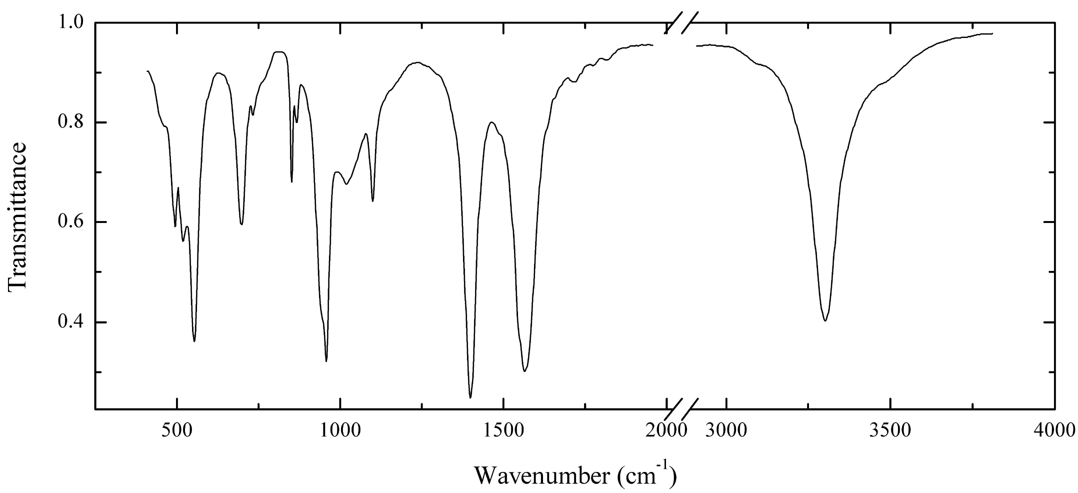


Locality: Kombat mine, Namibia.

Description: Brown slabs with perfect cleavage. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{5.82}Mn_{0.18})(CO_3)_2(OH)_7[Cl_{0.62}(OH)_{0.38}]$.

Wavenumbers (cm^{-1}): 3567s, 3480, 3400sh, 1542s, 1459s, 1414s, 1235w, 1187w, 1077w, 1037, 991, 933w, 872s, 858, 700sh, 655, 535, 506.

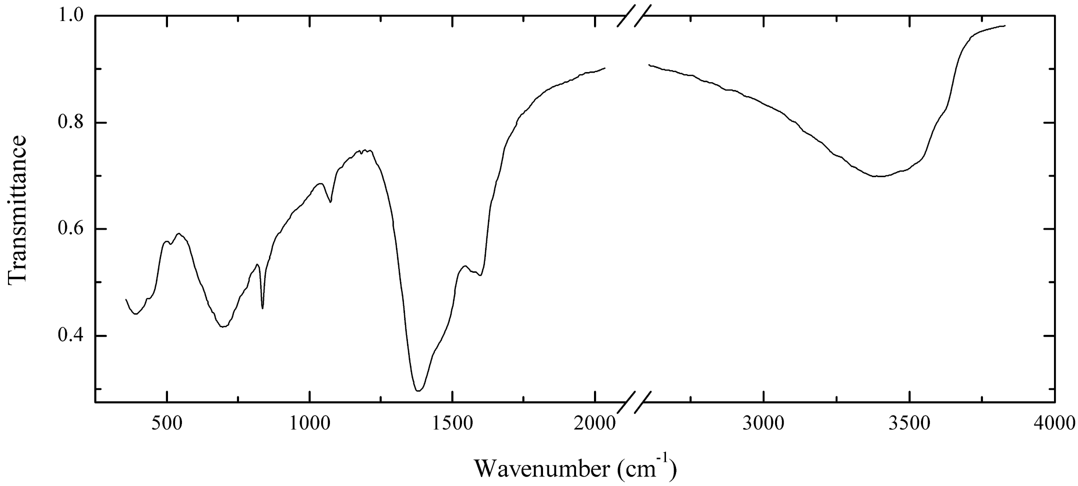
C59 Dawsonite $NaAl(CO_3)(OH)_2$



Locality: Tulilukht gulf, the eastern part of the Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

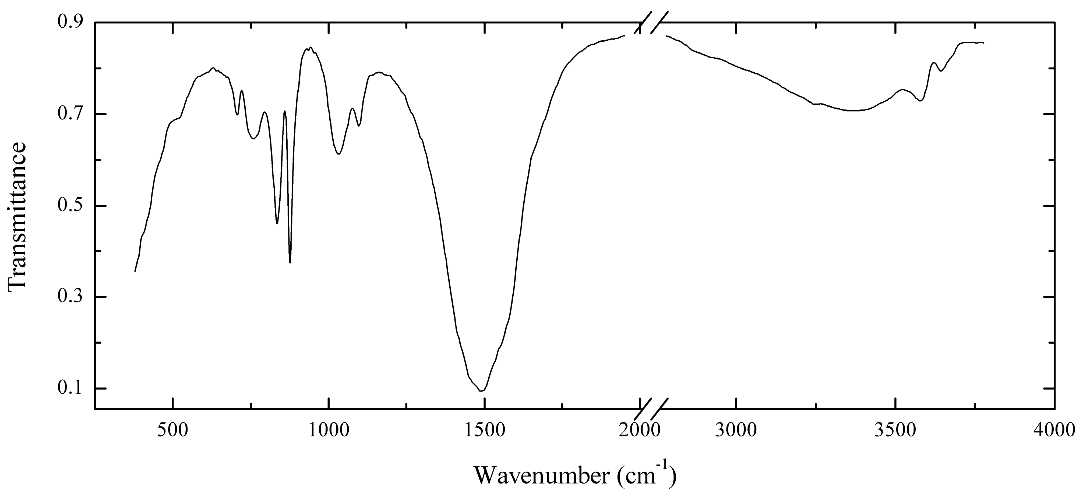
Description: White fibrous aggregate forming veinlet in carbonatite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3285s, 1820w, 1715w, 1562s, 1545sh, 1396s, 1098, 1019, 956s, 940sh, 865w, 848, 731w, 694, 549s, 514, 491, 455sh.

C61 Zaratite $Ni_3(CO_3)(OH)_4 \cdot 4H_2O$



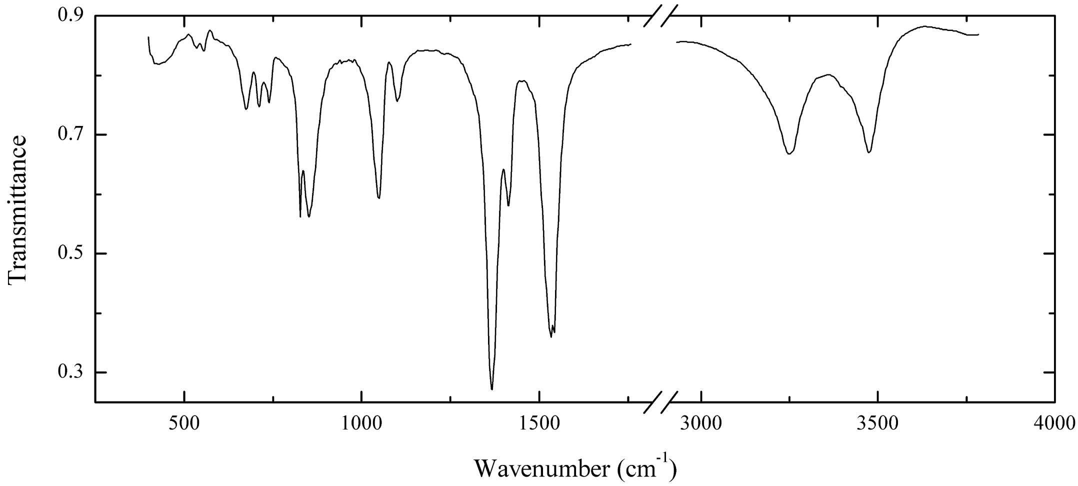
Locality: Lord Brassey mine, Heazlewood, Tasmania.
Description: Emerald-green, from the association with hellyerite and serpentine. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3610sh, 3380s, 1600, 1575sh, 1450sh, 1383s, 1070, 832, 696s, 515w, 435sh, 392s.

C62 Bastnäsite-(Y) (Y,*REE*)(CO_3)(F,OH)



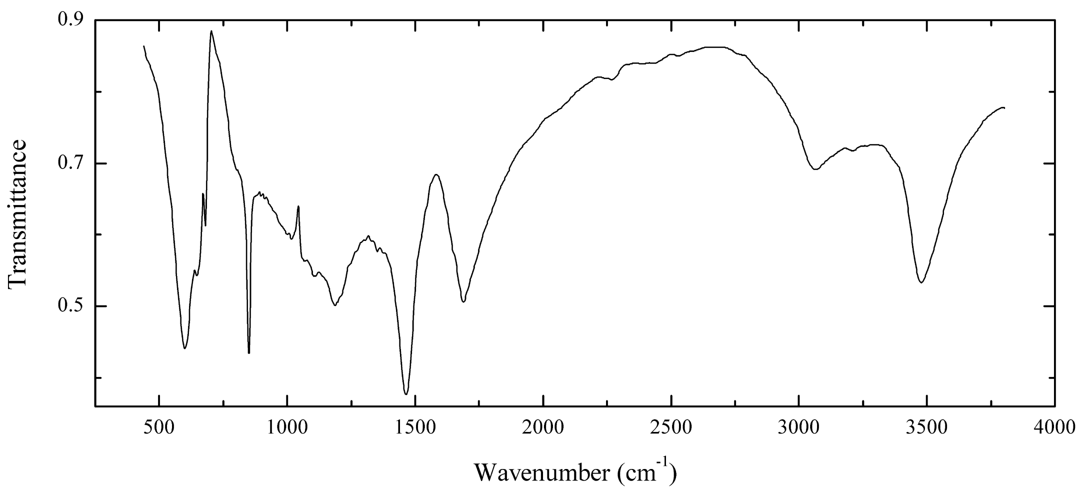
Locality: Verkhnee Espe deposit, Akzhailyautas Mts., Tarbagatai range, Eastern Kazakhstan region, Kazakhstan.
Description: Yellow pseudomorphs after gagarinite-(Y) in quartz. Investigated by I.V. Pekov. Identified by semiquantitative electron microprobe analysis. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3640w, 3575, 3375, 1535sh, 1485s, 1440sh, 1096, 1032, 875s, 832s, 760, 703, 520sh.

C63 Kolwezite $(Cu^{2+},Co)_2(CO_3)(OH)_2$



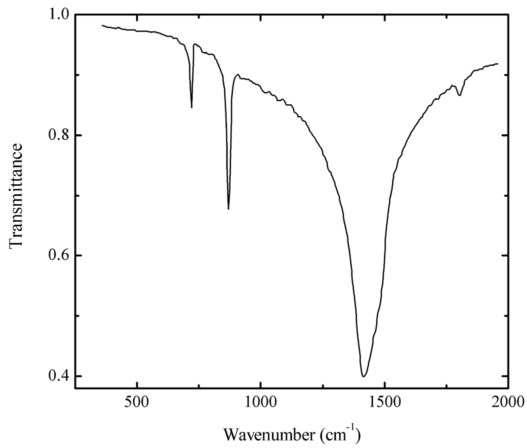
Locality: Kolwézi, southern Shaba, Zaire (type locality).
Description: Brownish-red spherulites. Identified by IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $(Cu_{1.32}Co_{0.61}Ni_{0.05}Fe_{0.02})(CO_3)(OH)_2$.
Wavenumbers (cm^{-1}): 3465s, 3240s, 1544s, 1537s, 1417, 1371s, 1103, 1050s, 853s, 827s, 740, 709, 672, 550w, 530w, 430.

C64 Trona $Na_3H(CO_3)_2{\cdot}2H_2O$



Locality: Natrum depression, Western Desert, Sahara, Egypt.
Description: Cream-coloured crystals from the association with halite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3470s, 3055, 1691s, 1465s, 1194s, 1105, 1064, 1028, 1005, 850s, 795sh, 681sh, 649, 600s, 470sh.

C65 Kutnohorite $CaMn^{2+}(CO_3)_2$

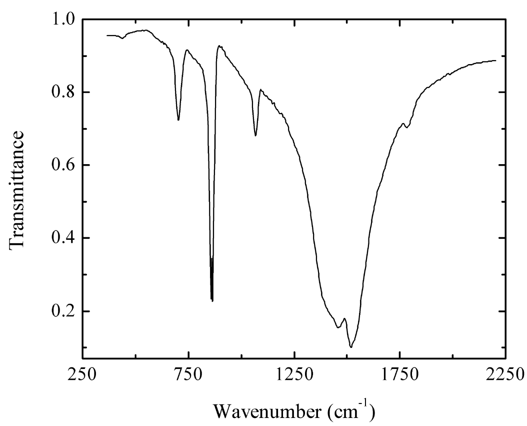


Locality: Sterling Hill mine, New Jersey, USA.

Description: Pink single-crystal fragment. The empirical formula is (electron microprobe) $(Ca_{0.96}Mn_{0.85}Mg_{0.12}Fe_{0.07})(CO_3)_2$.

Wavenumbers (cm^{-1}): 1802w, 1485sh, 1417s, 871s, 720.

C66 Calcioburbankite $Na_3(Ca,\mathit{REE},Sr)_3(CO_3)_5$

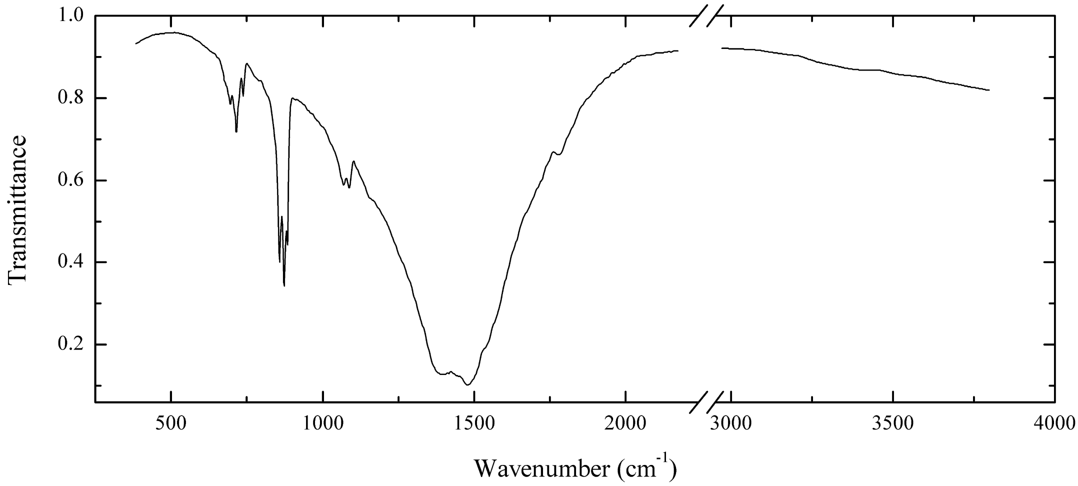


Locality: Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.

Description: Brownish-yellow, coarse-grained aggregate from the association with barytocalcite, norsethite, vaterite, strontianite, ancylite-(Ce) and franconite. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $(Na_{2.86}Ca_{0.14})(Ca_{1.14}Sr_{0.54}Ba_{0.49}\mathit{REE}_{0.82})(CO_3)_5$.

Wavenumbers (cm^{-1}): 1773w, 1514s, 1455s, 1420sh, 1390sh, 1067, 874sh, 863s, 859s, 706, 700sh.

C67 Carbocernaite (Ca,Na)(Sr,*REE*)$(CO_3)_2$

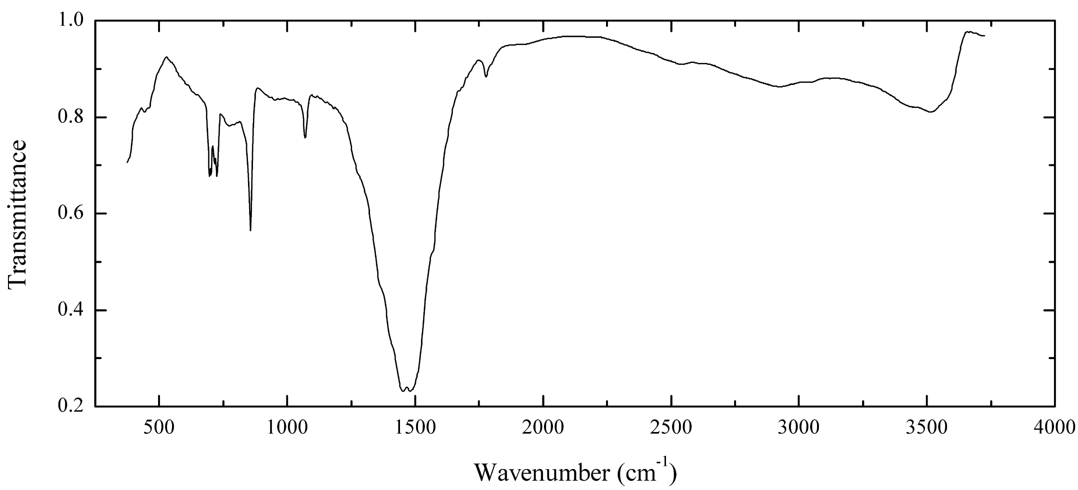


Locality: Neskevaara hill, Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia (type locality).

Description: Brownish crystal -yellow, coarse-grained aggregate from the association with dolomite, alstonite and dolomite. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $(Ca_{0.59}Na_{0.42})(Sr_{0.52}Ba_{0.04}Ce_{0.20}La_{0.16}Nd_{0.04}Pr_{0.02})(CO_3)_2$.

Wavenumbers (cm^{-1}): 1770w, 1530sh, 1480s, 1405s, 1160sh, 1088, 1069, 884, 873s, 859, 739w, 717, 695, 670sh.

C68 Calcioancylite-(Ce) $(Ca,Sr)_{4-x}(Ce,La)_x\ (CO_3)_4(OH)_x{\cdot}(4{-}x)H_2O$

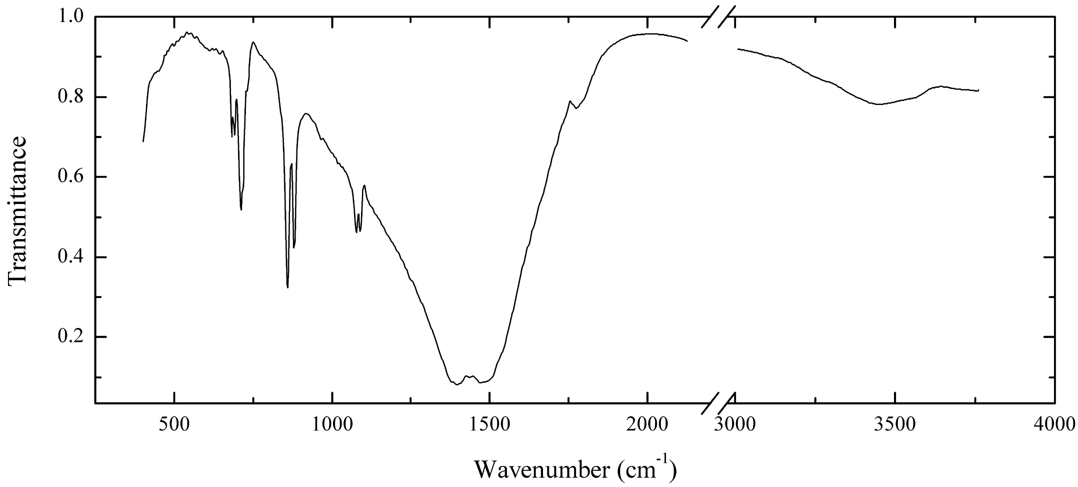


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada.

Description: Brown crystal. The empirical formula is (electron microprobe) $(Ca_{0.9}Sr_{0.4})(Ce_{1.5}La_{0.8}Nd_{0.3}Pr_{0.1})(CO_3)_4(OH)_{2.7}{\cdot}1.3H_2O$.

Wavenumbers (cm^{-1}): 3560sh, 3490, 2900w, 2540sh, 1800w, 1772w, 1560sh, 1505sh, 1483s, 1454s, 1410sh, 1370sh, 1071, 858, 774w, 726, 715, 702, 696, 459w, 385.

C69 Cordylite-(Ce) $(Na,Ca)Ba(Ce,La,Sr)_2(CO_3)_4(F,OH)$

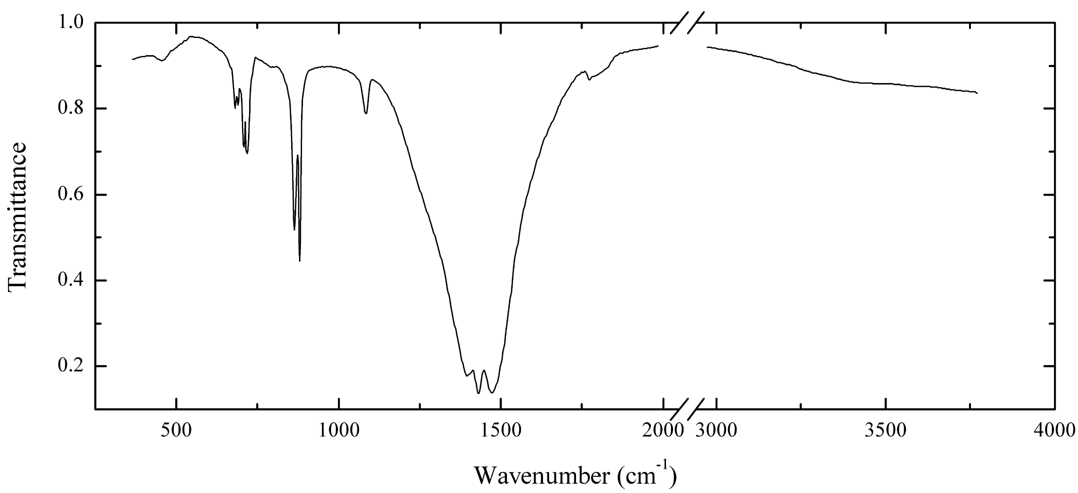


Locality: Ust'-Biraya, Biraya Fe-*REE* ore occurrence, Biraya and Biya Rivers confluence area (Chara Basin), Vitim Plateau, Irkutsk region, Eastern Siberia, Russia.

Description: Brown crystal from the association with strontianite, ancylite-(Ce), ferriallanite-(Ce), chevkinite-(Ce), pyrochlore, monazite-(Ce), *etc*. Contains Ce- and La-dominant zones. The empirical formula based on the mean electron microprobe analysis is $Na_{1.2}Ca_{0.8}Ba_{2.1}Sr_{0.9}Ce_{1.4}La_{1.4}Nd_{0.2}(CO_3)_4(F,OH)$.

Wavenumbers (cm^{-1}): 3550sh, 3455w, 1776w, 1476s, 1398s, 1092, 1080, 879s, 859s, 733sh, 718sh, 710, 689, 682.

C70 Cordylite-(Ce) $(Na,Ca)Ba(Ce,La,Sr)_2(CO_3)_4(F,OH)$

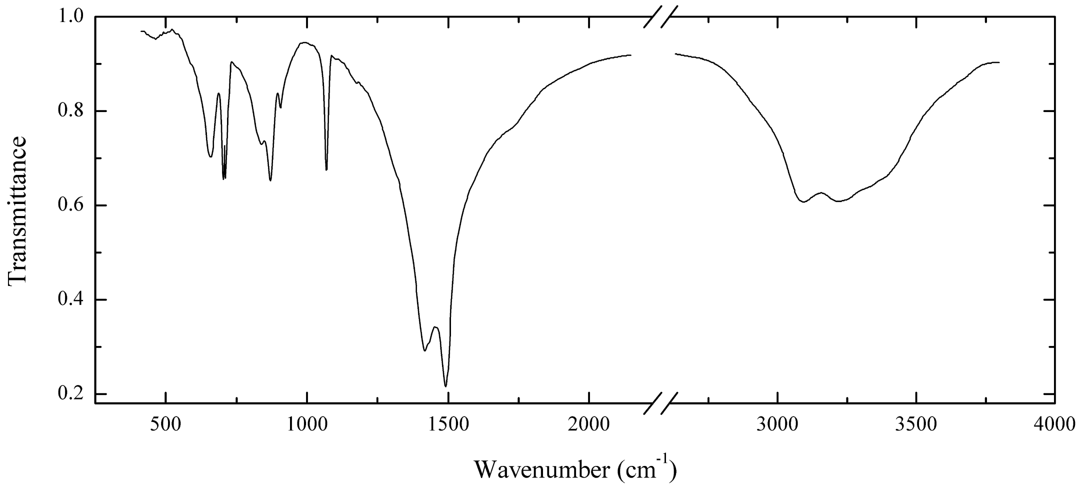


Locality: Bayun Obo Nb-Ta-*REE* ore deposit, Inner Mongolia, China.

Description: Brown crystals.

Wavenumbers (cm^{-1}): 1810sh, 1768w, 1469s, 1427s, 1392s, 1090, 880s, 864s, 730sh, 717, 714, 705, 686, 681, 669w, 470w.

C71 Pirssonite $Na_2Ca(CO_3)_2 \cdot 2H_2O$

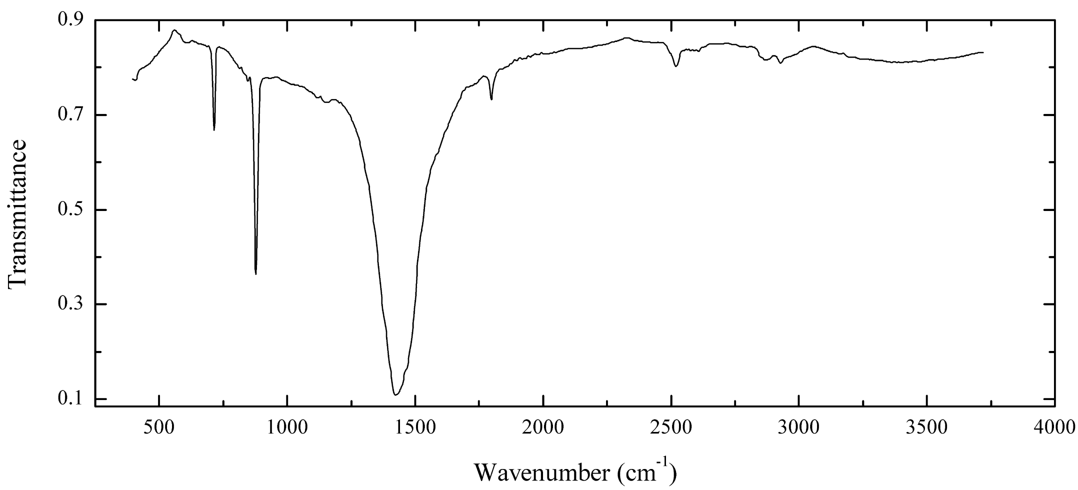


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless crystal from a peralkaline pegmatite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3360sh, 3300sh, 3195, 3070, 1700sh, 1487s, 1425sh, 1412s, 1069, 901w, 869, 836, 710, 704, 657, 460w.

C72 Calcite $Ca(CO_3)$

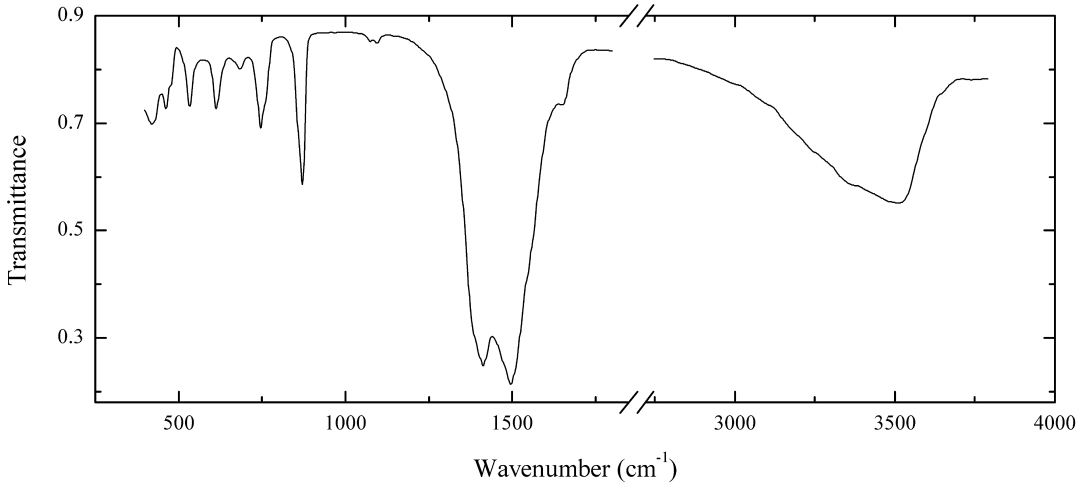


Locality: Novofrolovskoye B-Cu deposit, North Urals, Russia.

Description: Colourless grains forming veinlet in rock. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.995}Mn_{0.05})(CO_3)$.

Wavenumbers (cm^{-1}): 2920w, 2865w, 2513w, 1795, 1470sh, 1427s, 876s, 847w, 712.

C73 Kamphaugite-(Y) Ca(Y,*REE*)$(CO_3)_2(OH)\cdot H_2O$

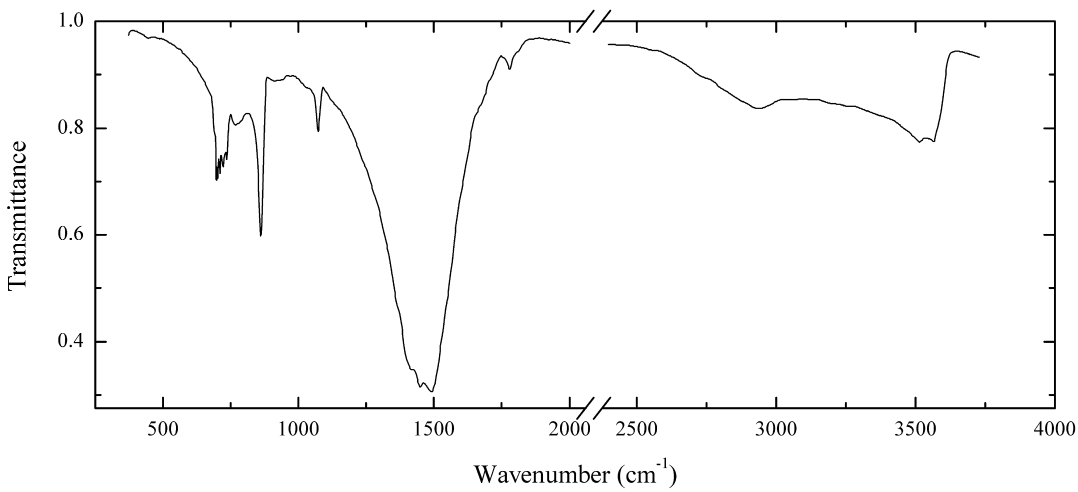


Locality: Borehole number 1978, Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: White radial aggregates forming veinlet in quartz. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ca_{1.0}(Y_{0.9}Ln_{0.2})(CO_3)_2(OH)\cdot H_2O$.

Wavenumbers (cm^{-1}): 3500s, 3360sh, 1640w, 1493s, 1411s, 1092w, 1070w, 871s, 860sh, 758sh, 744, 682w, 608, 531, 475sh, 461, 422.

C74 Calcioancylite-(Ce) $(Ca,Sr)_{4-x}(Ce,La)_x\ (CO_3)_4(OH)_x\cdot(4-x)H_2O$

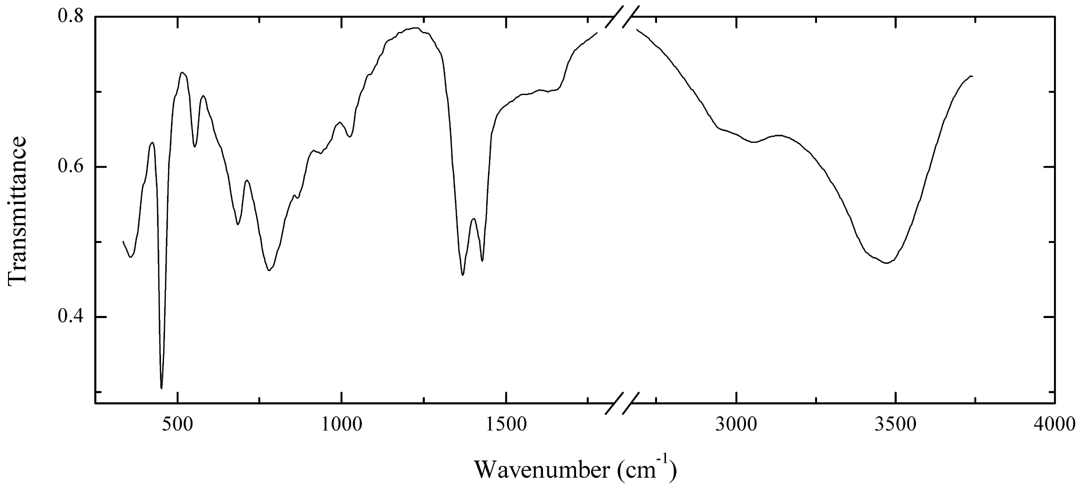


Locality: Afrikanda massif of alkaline and ultrabasic rocks, Kola peninsula, Murnansk region, Russia.

Description: Brownish crystals. Identified by IR spectrum and semiquantitative electron microprobe analysis. Contains Ca- and Sr-dominant zones.

Wavenumbers (cm^{-1}): 3545, 3490, 2920w, 1815sh, 1775w, 1486s, 1447s, 1412s, 1069, 859s, 767, 724, 712, 696.

C75 Karchevskyite $[Mg_{18}Al_9(OH)_{54}][Sr_2(CO_3,PO_4)_9(H_2O,H_3O)_{11}]$

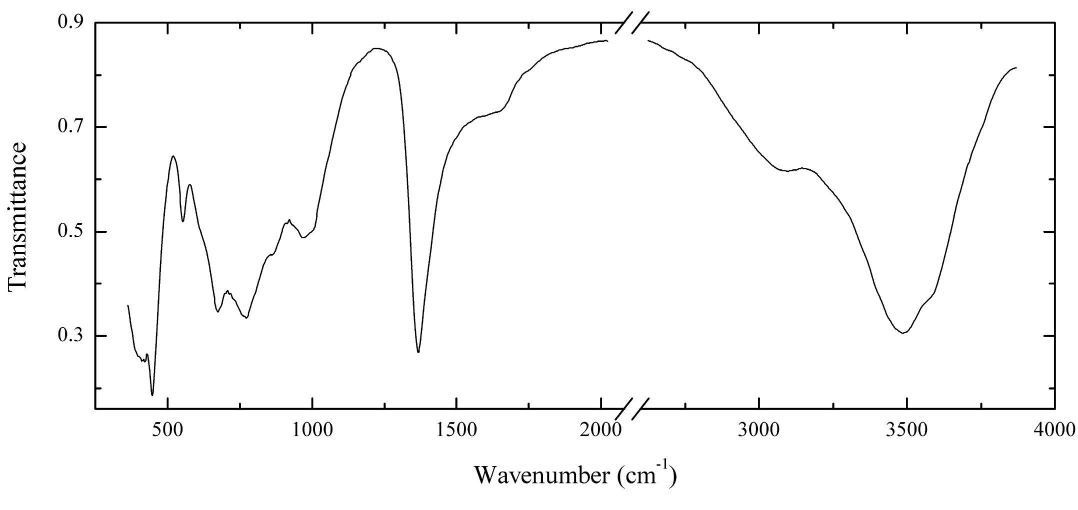


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Holotype sample. White spherulites up to 1 mm in diameter composed of thin, bent platelets. Associated minerals are magnetite, dolomite, quintinite-*3T*, strontian carbonate-fluorapatite and clinochlore. Trigonal, unit-cell parameters are $a = 16.055(6)$, $c = 25.66(1)$ Å. Uniaxial (−), $\omega = 1.542(2)$, $\varepsilon = 1.534(2)$. $D_{meas} = 2.21(2)$ g/cm^3. The empirical formula is $Mg_{18.00}Al_{9.00}(OH)_{54.00}(Sr_{1.79}Mg_{0.48}Ca_{0.09})_{\Sigma 2.36}(CO_3)_{8.26}(PO_4)_{0.46}(H_2O)_{6.54}(H_3O)_{4.18}$. The strongest lines of the powder X-ray pattern [*d*, Å (*I*, %)] are 8.52 (100), 6.41 (40), 4.27 (60), 3.665 (90), 3.547 (90), 3.081 (60).

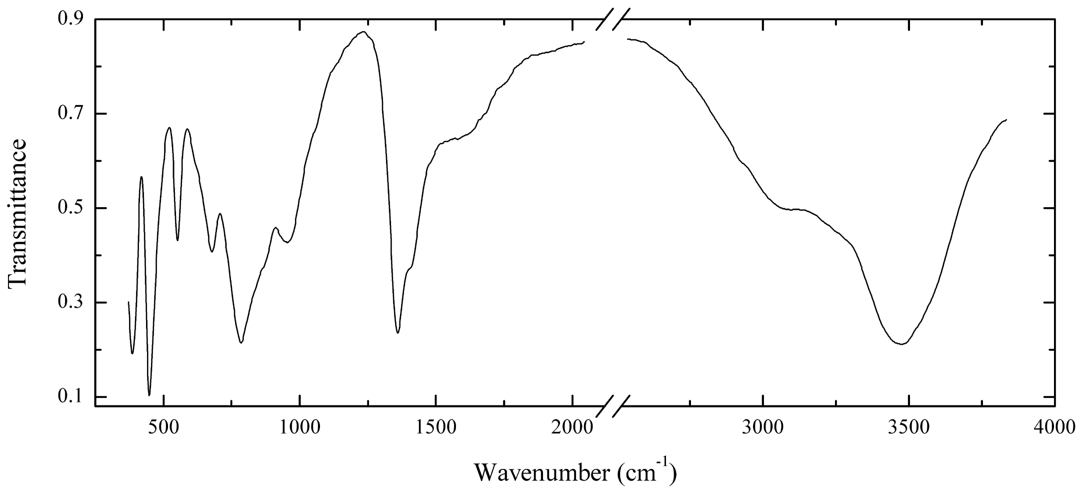
Wavenumbers (cm^{-1}): 3470s, 3420sh, 3035, 2960sh, 1650w, 1426s, 1366s, 1024, 937, 860, 779s, 678s, 615sh, 553, 449s, 386s.

C76 Quintinite-*3T* $Mg_4Al_2(CO_3)(OH)_{12}\cdot 3H_2O$



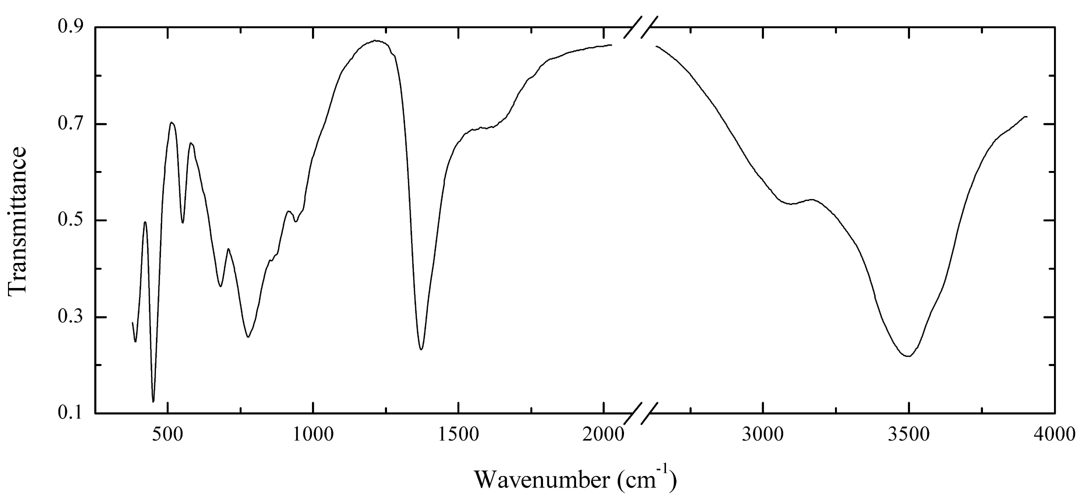
Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless crystals. The empirical formula is (electron microprobe) ($Mg_{3.9}Fe_{0.2}Al_{1.9}(CO_3)(OH)_{12}\cdot 3H_2O$).
Wavenumbers (cm^{-1}): 3575sh, 3475s, 3085, 1650sh, 1367s, 995sh, 973, 860sh, 771s, 680s, 620sh, 556, 449s, 410s, 395sh.

C77 Quintinite-2*H* $Mg_4Al_2(CO_3)(OH)_{12}\cdot 3H_2O$



Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless crystals. The empirical formula is (electron microprobe) ($Mg_{3.6}Fe_{0.5}Al_{1.9}(CO_3)(OH)_{12}\cdot 3H_2O$).
Wavenumbers (cm^{-1}): 3450s, 3075, 1580sh, 1400sh, 1354s, 958, 860sh, 783s, 678, 553, 449s, 388s.

C78 Quintinite-2*H* $Mg_4Al_2(CO_3)(OH)_{12}\cdot 3H_2O$

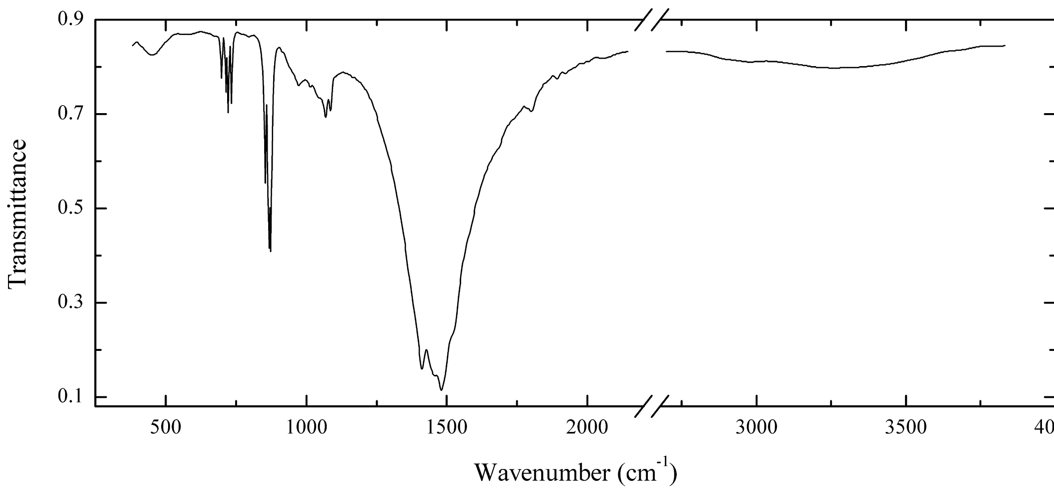


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Curved brownish platy crystals. The empirical formula is (electron microprobe) ($Mg_{3.8}Fe_{0.2}Al_{2.0}(CO_3)(OH)_{12}\cdot 3H_2O$).

Wavenumbers (cm^{-1}): 3570sh, 3470s, 3070, 1610sh, 1366s, 943, 860sh, 778s, 680s, 551, 447s, 388s.

C79 Shortite $Na_2Ca_2(CO_3)_3$

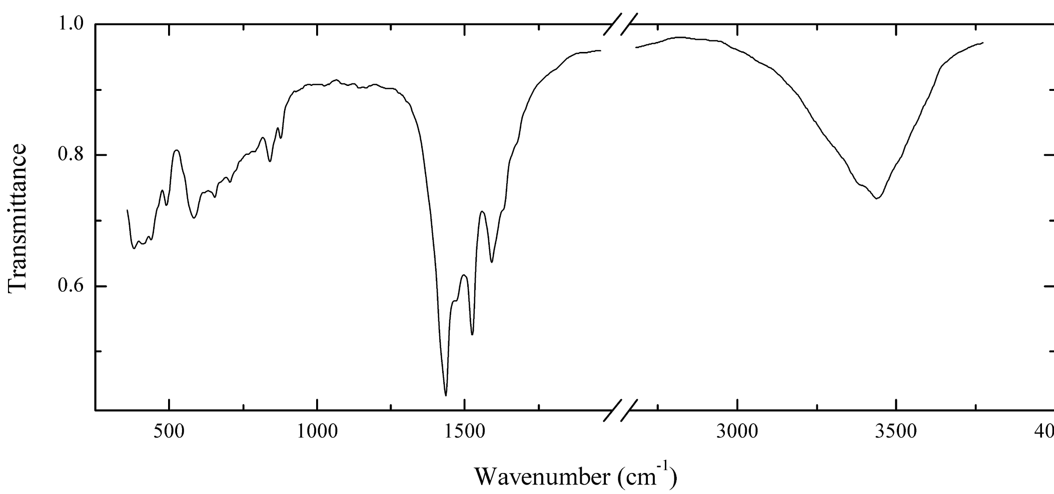


Locality: Dumps of the Umbozero mine, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pale green platy crystals from the association with calcite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1803w, 1520sh, 1480s, 1468s, 1408s, 1088, 1069, 1050sh, 1010w, 975w, 872s, 866s, 851, 731, 719, 711, 694, 450w.

C80 Chlorartinite $Mg_2(CO_3)Cl(OH)\cdot 3H_2O$

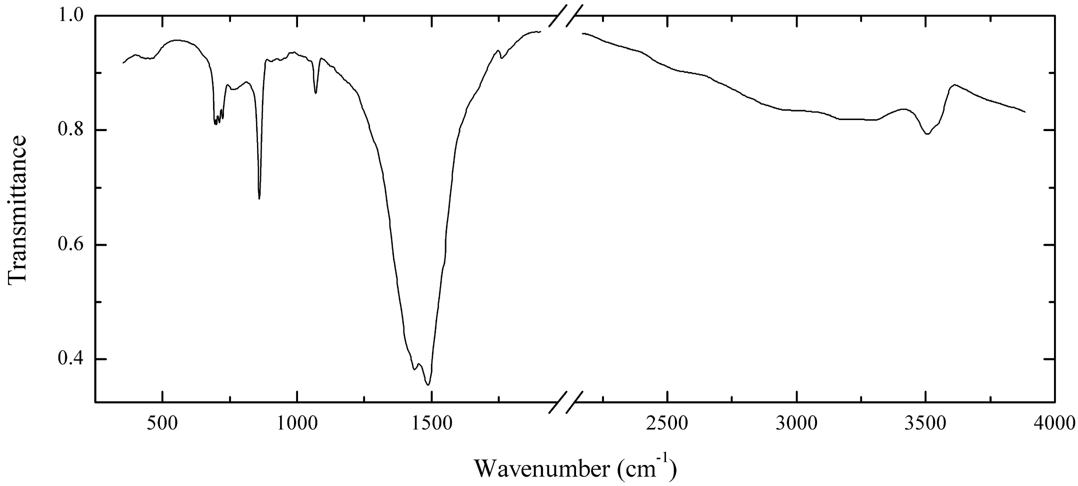


Locality: Korshunovskoye deposit, Irkutsk region, Siberia, Russia.

Description: White fibrous aggregate in dolomite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mg_{1.98}Fe_{0.02}(CO_3)Cl_{1.01}(OH)_{0.99}\cdot nH_2O$.

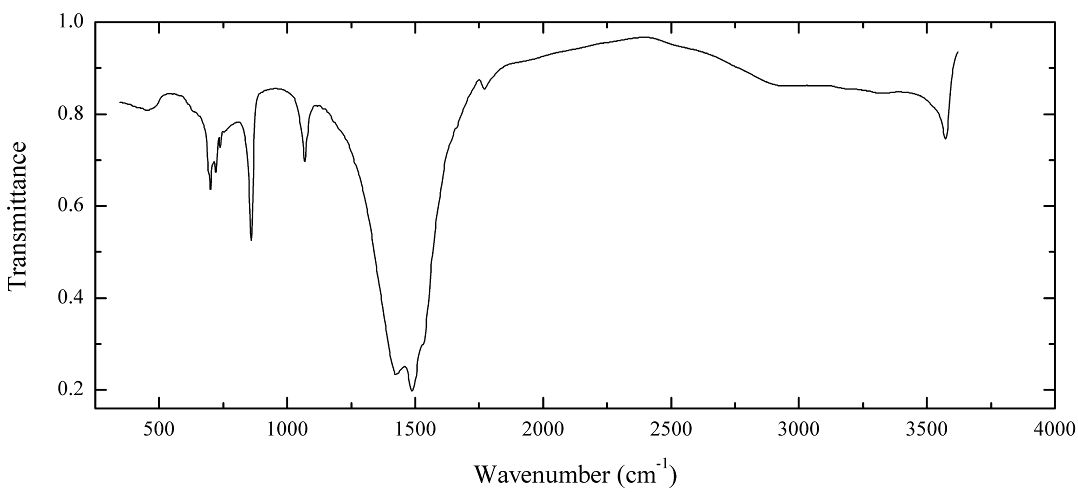
Wavenumbers (cm^{-1}): 3425, 3380sh, 1675sh, 1639sh, 1534s, 1482, 1442s, 880w, 844, 770sh, 725sh, 709, 660, 586, 494, 440, 415, 380.

C81 Ancylite-(Ce) $Sr(Ce.La)(CO_3)_2(OH){\cdot}H_2O$



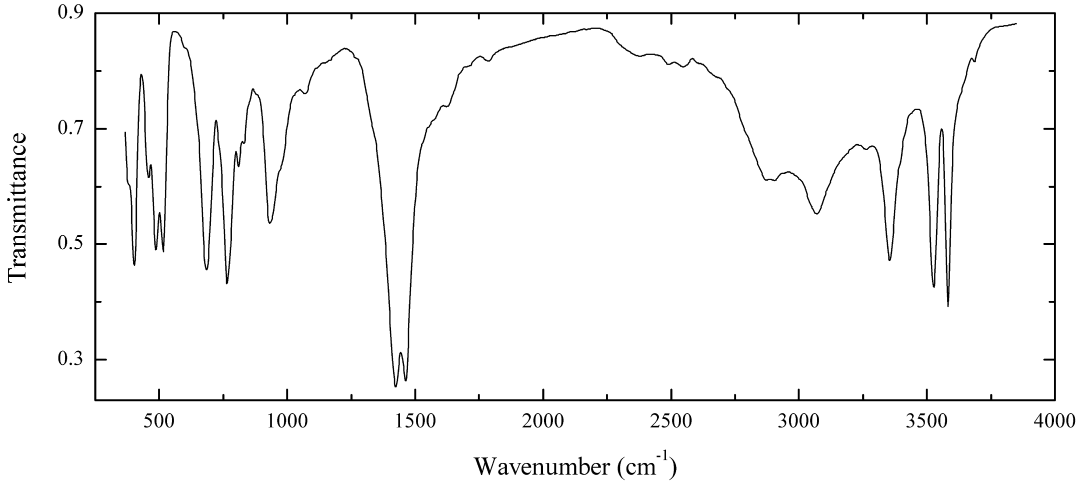
Locality: Narssârssuq pegmatite, Igaliko alkaline complex, South Greenland (type locality).
Description: Brownish grains. Low-symmetry variety, space group *Pmc*2$_1$. The empirical formula is (electron microprobe) $(Sr_{0.60}Ca_{0.19}Ba_{0.03})(Ce_{0.57}La_{0.45}Nd_{0.10}Pr_{0.04}Sm_{0.03})(CO_3)_2(OH)_{0.86}F_{0.31}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3540sh, 3498, 3275w, 3190sh, 3000sh, 2580sh, 1758w, 1485s, 1441s, 1425sh, 1069, 860s, 765w, 722, 712, 700, 195sh, 450w.

C82 Ancylite-(La) $Sr(Ce.La)(CO_3)_2(OH){\cdot}H_2O$



Locality: Seblyavr massif, Kola peninsula, Murnansk region, Russia.
Description: Pink prismatic crystals. High-symmetry variety, space group *Pmcn*. The empirical formula is (electron microprobe) $(Sr_{0.71}Ca_{0.01}Ba_{0.02})(La_{0.36}Nd_{0.35}Ce_{0.34}Pr_{0.09}Sm_{0.09})(CO_3)_2(OH,H_2O)_2$.
Wavenumbers (cm^{-1}): 3547, 3300w, 3155w, 2900sh, 1770w, 1525sh, 1484s, 1424s, 1067, 860s, 738w, 720, 712, 699, 670w.

C83 Callaghanite $Cu_2Mg_2\ (CO_3)(OH)_6{\cdot}2H_2O$

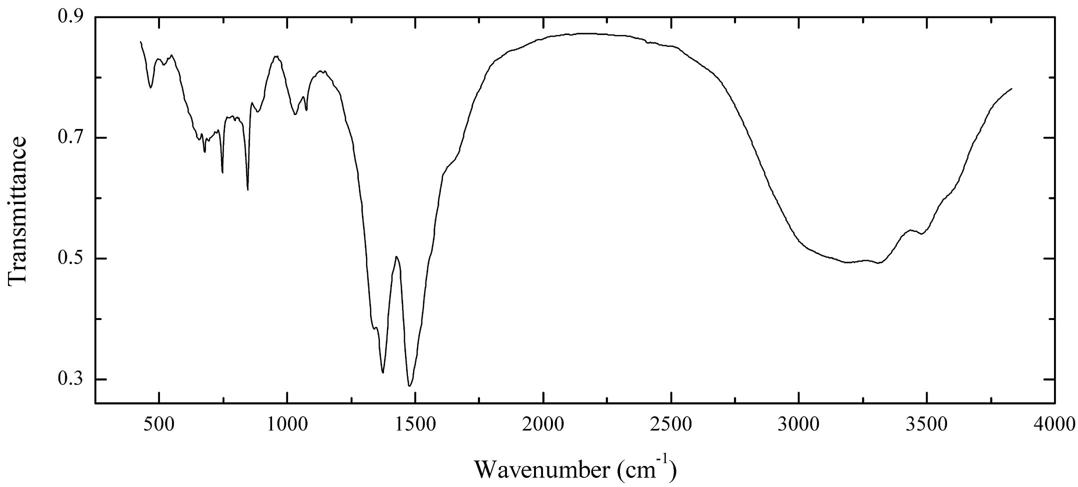


Locality: Gabbs, Gabbs district, Nye Co., Nevada, USA (type locality).

Description: Blue crust. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3665w, 3555s, 3500s, 3330, 3045, 2890, 2855, 2555w, 2485w, 2370w, 1785w, 1620w, 1462s, 1423s, 1061w, 975sh, 937, 832w, 813w, 765s, 685s, 517s, 488s, 460, 405s, 380sh.

C84 Lanthanite-(La) $(La,Nd)_2(CO_3)_3{\cdot}8H_2O$

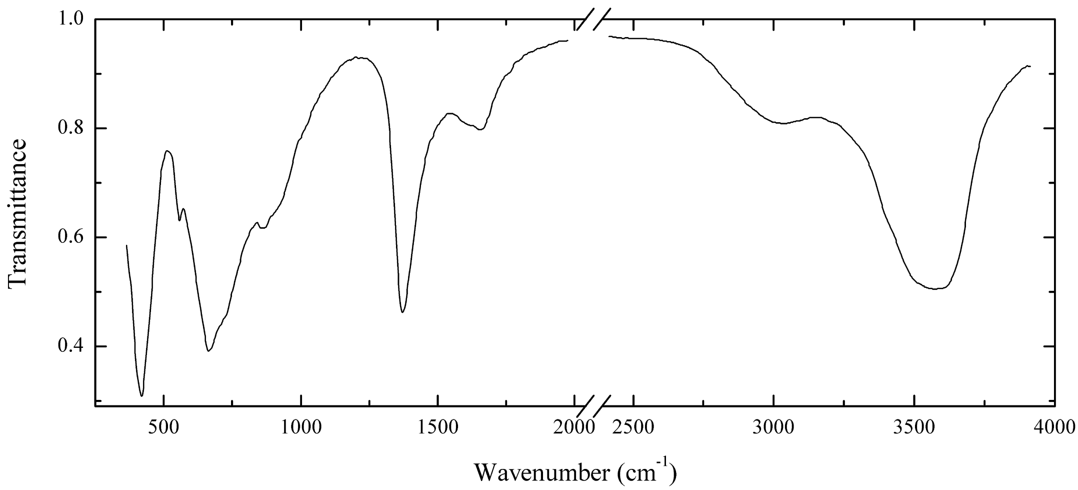


Locality: Curitiba, Paraná, Brazil (type locality).

Description: Pink platy crystals. The empirical formula is (electron microprobe) $(La_{0.86}Nd_{0.82}Pr_{0.24}Sm_{0.08})(CO_3)_3{\cdot}8H_2O$.

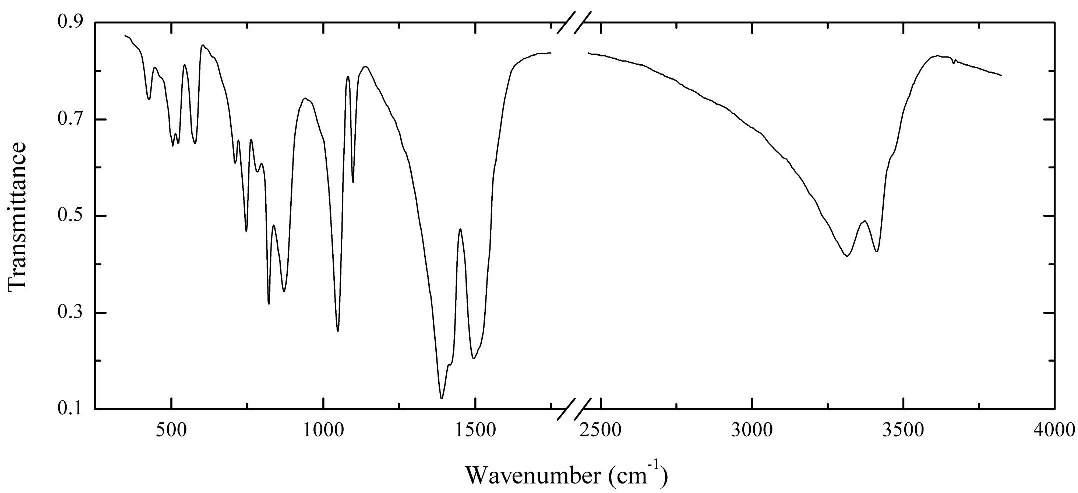
Wavenumbers (cm^{-1}): 3590sh, 3485, 3315s, 3200sh, 3100sh, 1755sh, 1640sh, 1483s, 1377s, 1341s, 1078, 1035, 886, 849, 749, 678, 657, 518w, 467.

C85 Manasseite $Mg_6Al_2(CO_3)(OH)_{16}{\cdot}4H_2O$



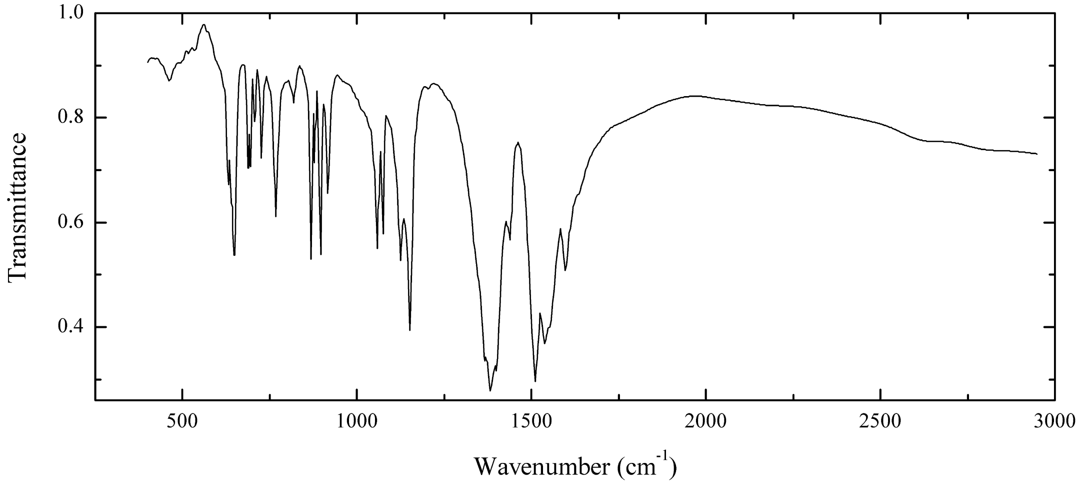
Locality: Zelentsovskaya pit, near Zlatoust, Chelyabinsk region, South Urals, Russia.
Description: Pink scaly aggregate. The empirical formula is (electron microprobe) $Mg_{5.89}Fe_{0.12}Al_{1.99}(CO_3)(OH)_{16}{\cdot}4H_2O$.
Wavenumbers (cm^{-1}): 3570s, 3020, 1655, 1620sh, 1368s, 905sh, 861, 710sh, 665s, 553, 409s.

C86 Malachite $Cu_2(CO_3)(OH)_2$



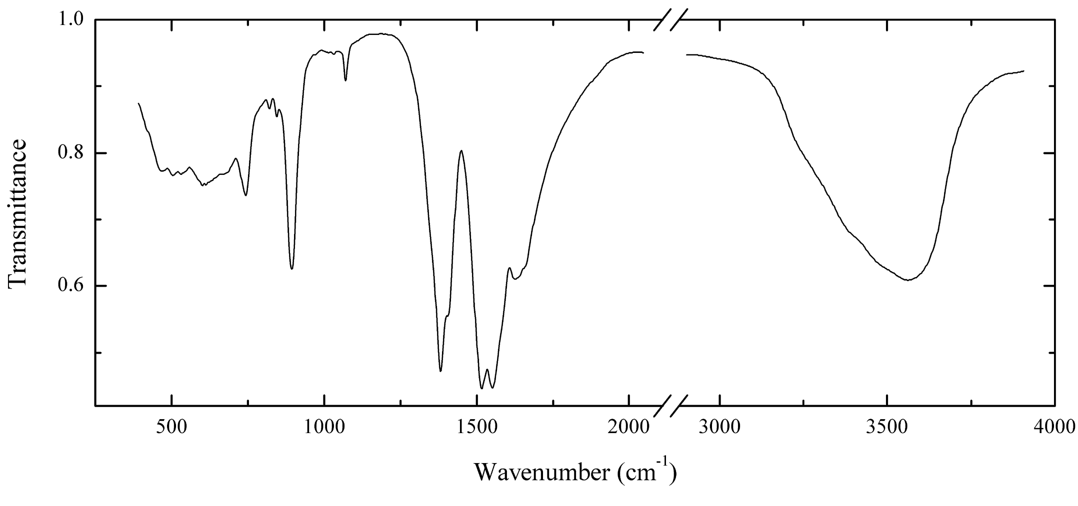
Locality: Nizhniy Tagil, Middle Urals, Russia.
Description: Green split crystals from the association with chrysocolla. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3440sh, 3393, 3298, 1510sh, 1493s, 1420sh, 1391s, 1098, 1049s, 874, 821s, 783, 748, 712, 578, 521, 501, 423w.

C87 Mineevite-(Y) $Na_{25}Ba(Y,Gd,Dy)_2(CO_3)_{11}(HCO_3)_4(SO_4)_2F_2Cl$



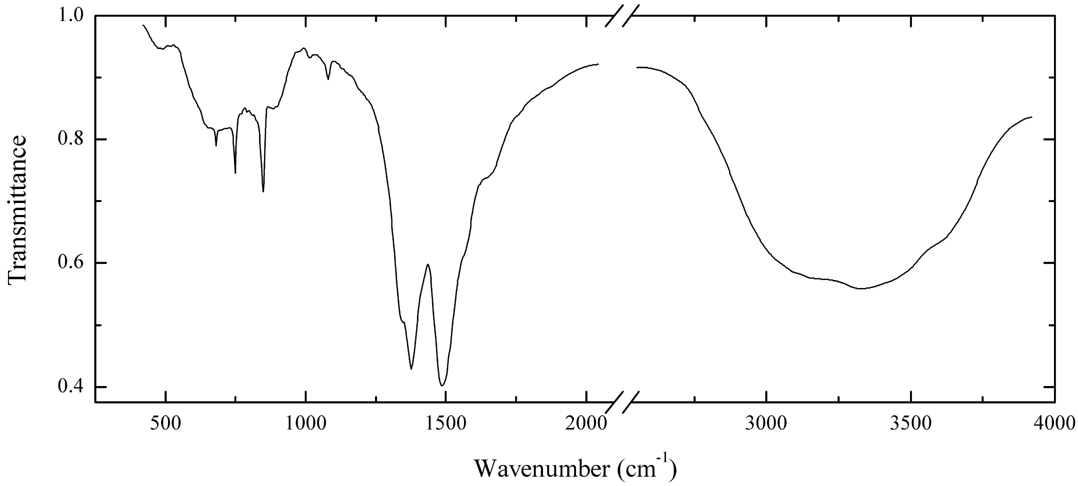
Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: Greenish grains in peralkaline pegmatite. Investigated by A.P. Khomyakov.
Wavenumbers (cm^{-1}): 3420, . . ., 2615w, 1592, 1547sh, 1534s, 1505s, 1431, 1392s, 1376s, 1360sh, 1149s, 1123, 1071, 1055, 914, 893, 877w, 866, 817w, 767, 726, 706w, 695sh, 690, 648, 633, 476w.

C88 Liebigite $Ca_2(UO_2)(CO_3)_3 \cdot 11H_2O$



Locality: Schwarzwalder mine, Golden, Jefferson Co., Colorado, USA.
Description: Yellow crust. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3545, 3220sh, 1650sh, 1628, 1549s, 1512s, 1043, 1379s, 1069, 894, 846w, 824w, 743, 650sh, 605, 520, 505, 470.

C89 Lanthanite-(Nd) $(Nd,La)_2(CO_3)_3{\cdot}8H_2O$

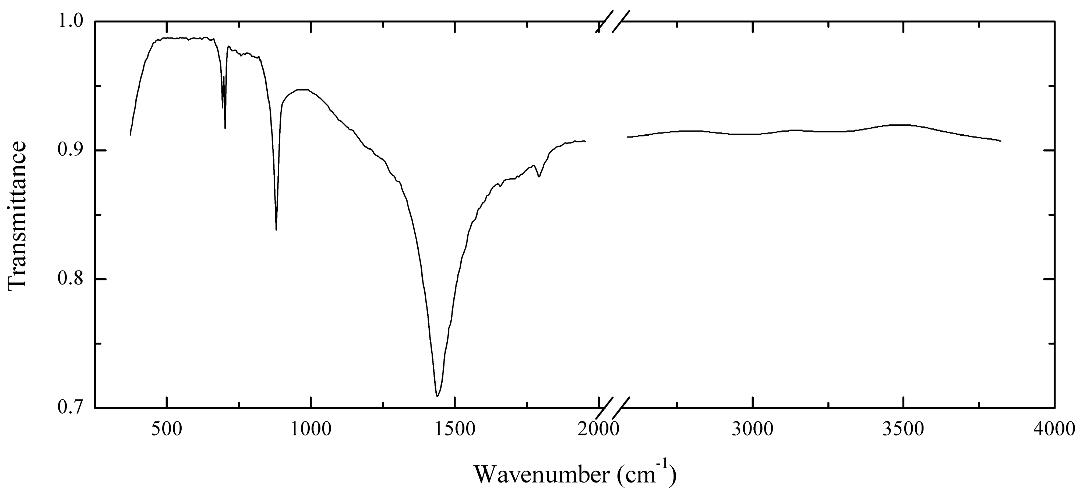


Locality: Niikoba, Hizen-cho, Karatsu, Saga prefecture, Kyushu, Japan.

Description: Pink platy crystals. The empirical formula is (electron microprobe) $(Nd_{0.92}La_{0.63}Pr_{0.23}Sm_{0.15}Gd_{0.07})(CO_3)_3{\cdot}8H_2O$.

Wavenumbers (cm^{-1}): 3570sh, 3320s, 3120sh, 1640sh, 1484s, 1374s, 1340sh, 1079w, 1015w, 885w, 849, 748, 679, 650sh, 478w.

C90 Natrite $Na_2(CO_3)$

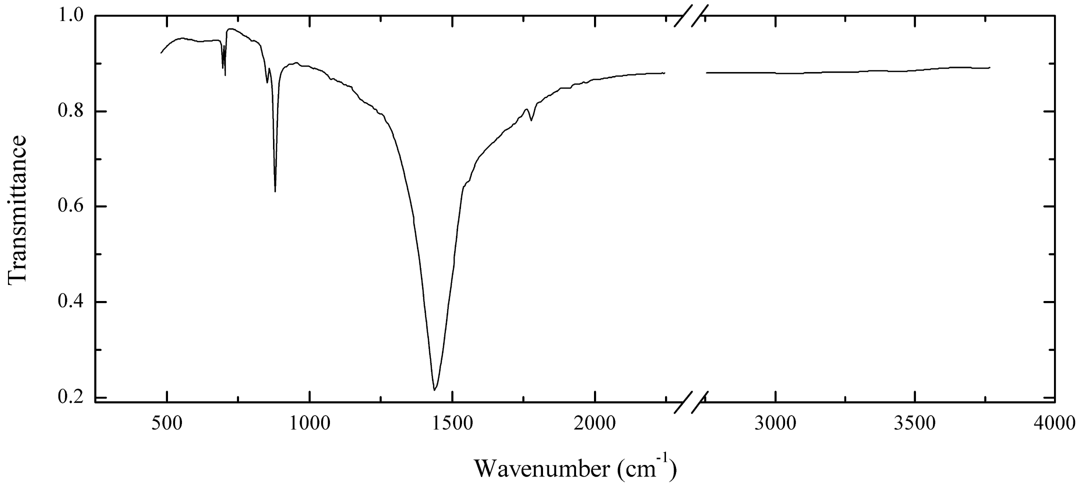


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light grey coarse-grained aggregate, from the association with villiaumite and lomonosovite. γ-modification. Identified by IR spectrum and powder X-ray diffraction pattern. The crystal structure is investigated. Unit-cell parameters are $a = 8.905(4)$, $b = 5.237(3)$, $c = 6.045(2)$Å; $\beta = 101.32(3)°$.

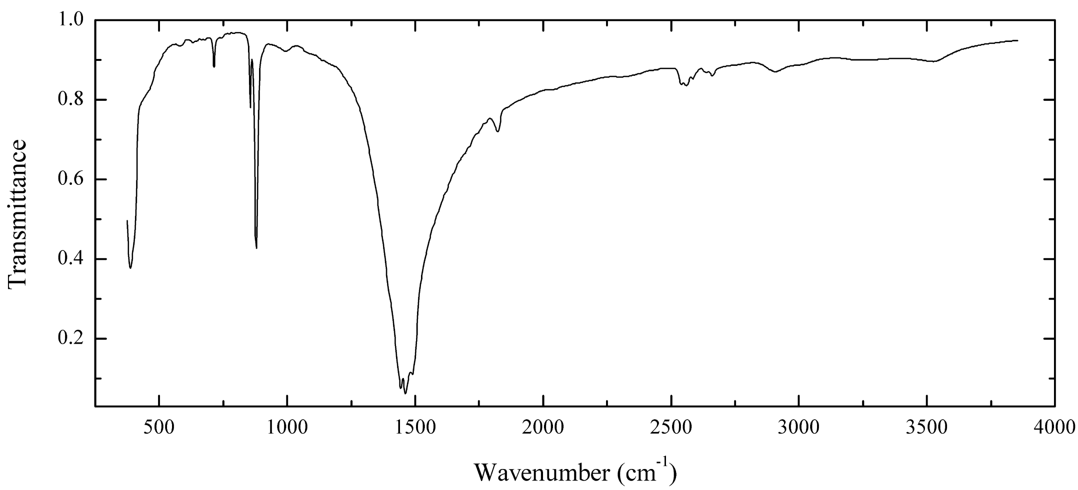
Wavenumbers (cm^{-1}): 1777w, 1437s, 880s, 702, 694.

C91 Natrite $Na_2(CO_3)$



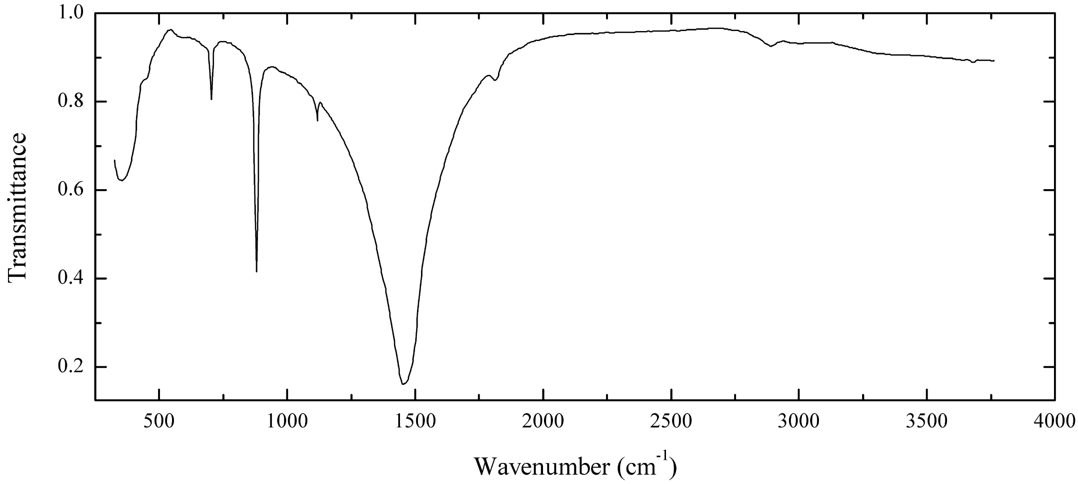
Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Light grey grained aggregate, from the association with villiaumite and lomonosovite. Orthorhombic modification. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1780w, 1540sh, 1442s, 880s, 850, 702, 695.

C92 Northupite $Na_3Mg(CO_3)_2Cl$



Locality: Searles Lake, San Bernardino Co., California, USA.
Description: Light grey crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3515w, 3000sh, 2895w, 2660w, 2633w, 2580w, 2555, 2535, 1815, 1494s, 1463s, 1449s, 990w, 880s, 857, 715, 450sh, 392s.

C93 Norsethite $BaMg(CO_3)_2$

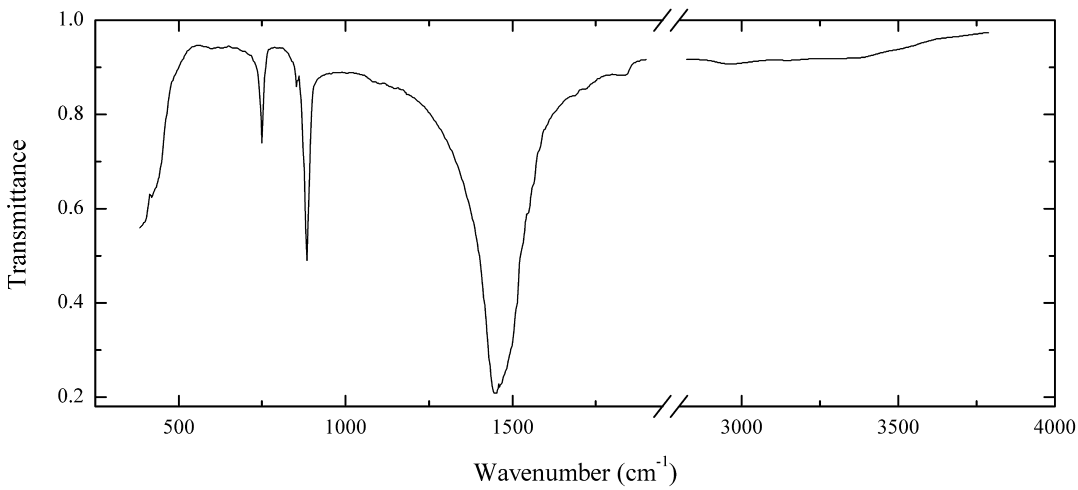


Locality: Kremikovtsi iron mine, near Sofia, Bulgaria.

Description: Beige platy crystals from the association with siderite and barite. The empirical formula is (electron microprobe) $Ba_{0.95}Sr_{0.02}Ca_{0.05}Mg_{0.76}Fe_{0.22}(CO_3)_2$.

Wavenumbers (cm^{-1}): 2873w, 1810w, 1456s, 1115, 880s, 701, 450sh, 355.

C94 Magnesite $Mg(CO_3)$

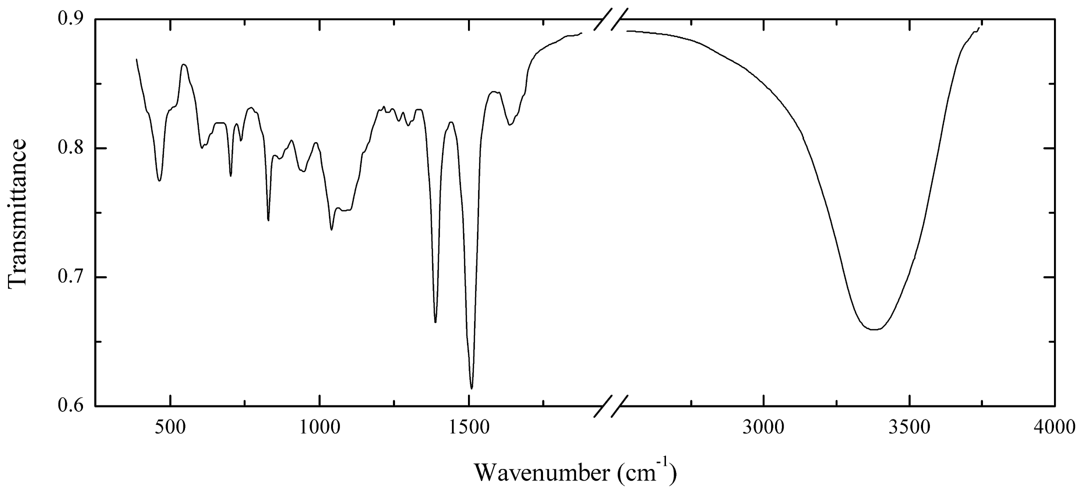


Locality: Widgiemooltha, Western Australia.

Description: Pale green spherulites from the association with carrboydite. The empirical formula is (electron microprobe) $Mg_{0.86}Ni_{0.11}Fe_{0.03}(CO_3)_2$.

Wavenumbers (cm^{-1}): 1810w, 1448s, 885s, 855w, 748, 420sh.

C95 Hydrozincite $Zn_5(CO_3)_2(OH)_6$

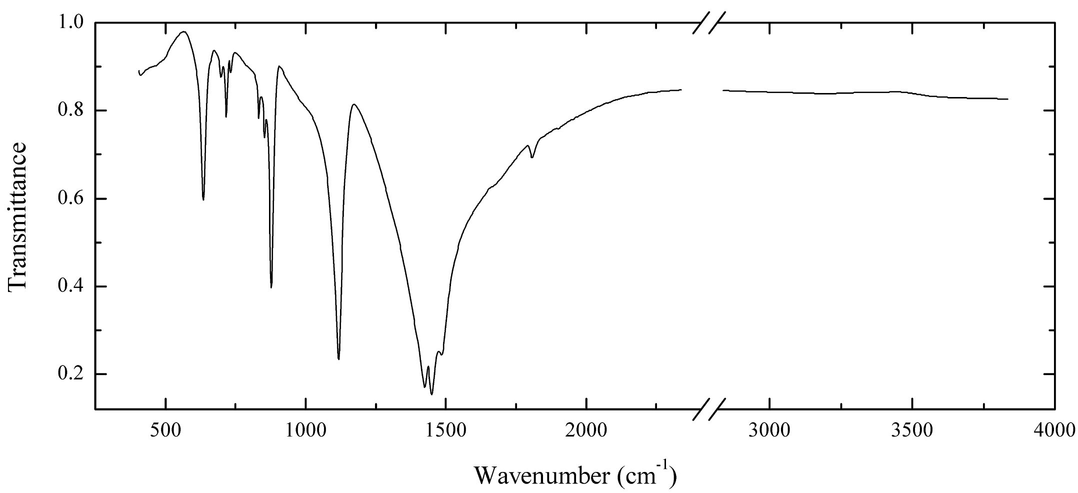


Locality: Zlatý Kopec, near Jáchymov, Krušné Hory Mts. (Ore Mts.), Czech Republic.

Description: White crust in the association with ludwigite and schoenflisite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3490sh, 3370, 1645, 1509s, 1388s, 1100, 1045, 955, 870w, 832, 739, 704, 617, 515sh, 469.

C96 Manganotychite $Na_6Mn^{2+}_2(CO_3)_4(SO_4)$

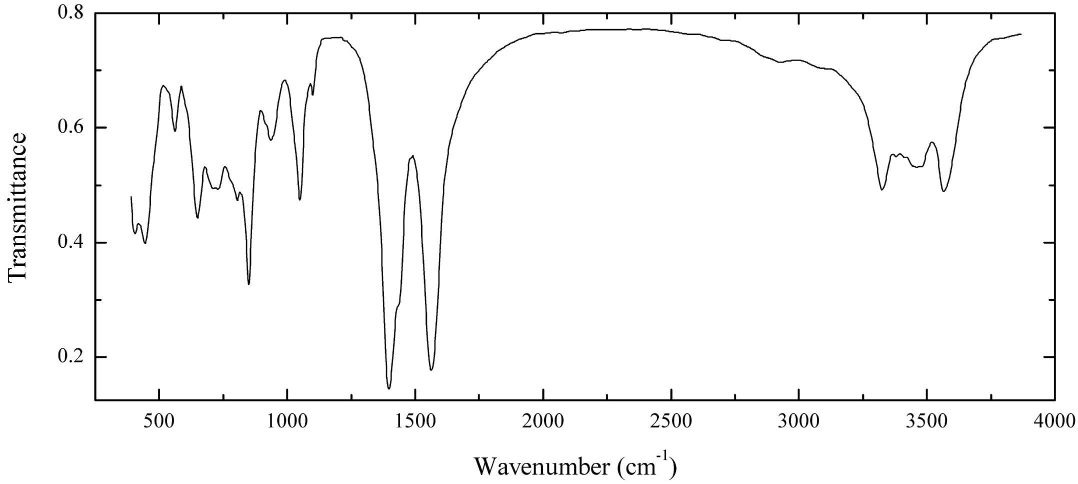


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pink grains in peralkaline pegmatite. Holotype sample. Associated minerals are shortite, pirssonite, sidorenkite and kogarkoite. The empirical formula is $Na_{5.99}Mn^{2+}_{1.22}Fe_{0.48}Mg_{0.28}(CO_3)_{4.02}(SO_4)_{1.04}$. Cubic, space group $Fd3$, $a = 13.9951(8)$ Å, Z = 8. Isotropic, $n = 1.544(2)$. $D_{meas} = 2.70(5)$ g/cm^3.

Wavenumbers (cm^{-1}): 3567s, 3480, 3400sh, 1542s, 1459s, 1414s, 1235w, 1187w, 1077w, 1037, 991, 933w, 872s, 858, 700sh, 655, 535, 506.

C97 Mcguinnessite $(Mg,Cu^{2+})_2(CO_3)(OH)_2$

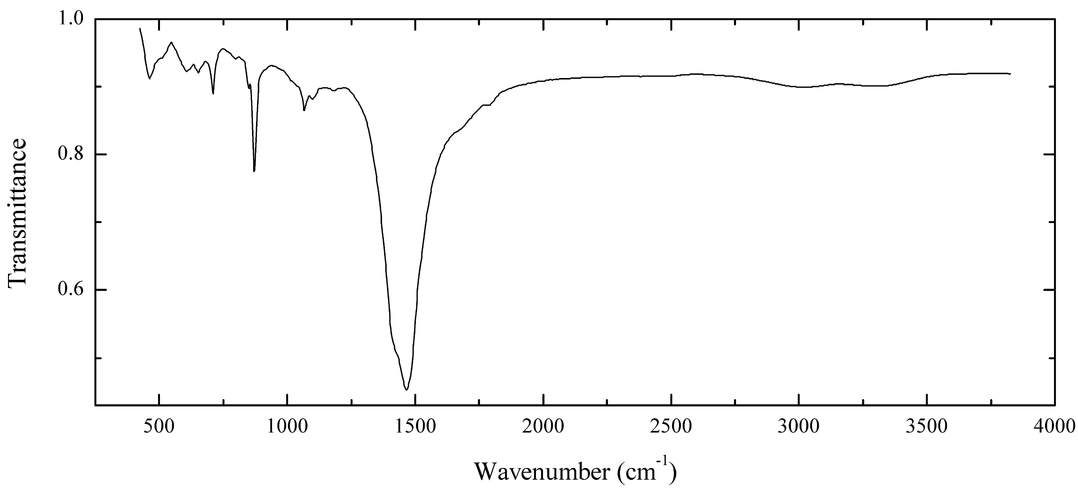


Locality: Lobminggraben, Leoben, Styria, Austria.

Description: Light blue veinlets in serpentine. The empirical formula is (electron microprobe) $Mg_{1.07}Cu_{0.90}Zn_{0.03}(CO_3)(OH)_2$.

Wavenumbers (cm^{-1}): 3350, 3450, 3310, 2915w, 1560s, 1440sh, 1397s, 1101w, 1050, 942, 850s, 805, 730, 710, 645, 559, 446, 406.

C98 Nyerereite $Na_2Ca(CO_3)_2$

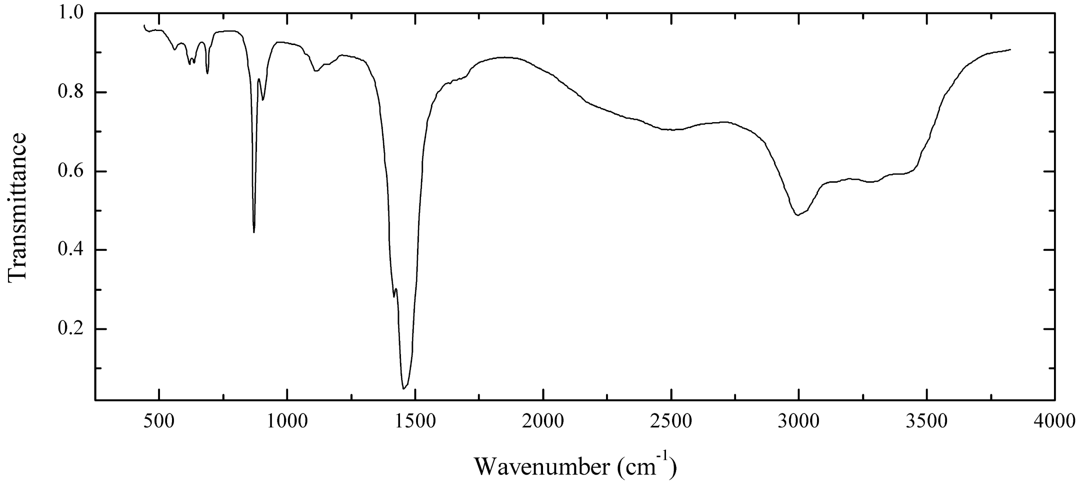


Locality: Oldoinyo Lengai volcano, Tanzania (type locality).

Description: Colourless metacrysts in carbonatite lava, in the association with gregoryite and late thaumasite. Identified by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1790w, 1467s, 1420sh, 1100w, 1070, 871s, 851w, 710, 651w, 604w, 500sh, 458.

C99 Natron $Na_2(CO_3)\cdot 10H_2O$

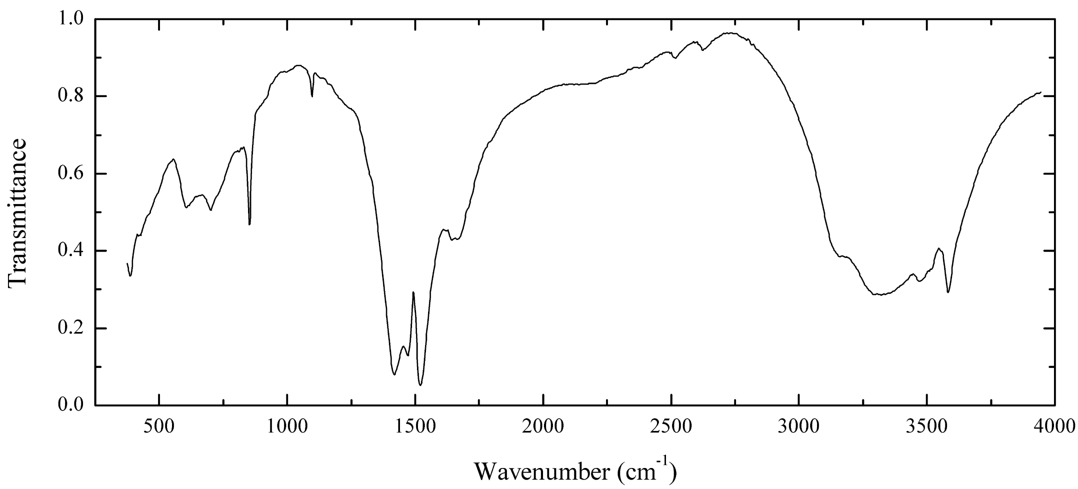


Locality: Luxemburg.

Description: White efflorescence on the wall of an old casemate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3360sh, 3250, 2965s, 2480, 1650sh, 1465sh, 1450s, 1410s, 1375sh, 1145sh, 1113w, 904, 869s, 700sh, 688, 638w, 620w, 567w, 460w.

C100 Nesquehonite $Mg(HCO_3)(OH)\cdot 2H_2O$

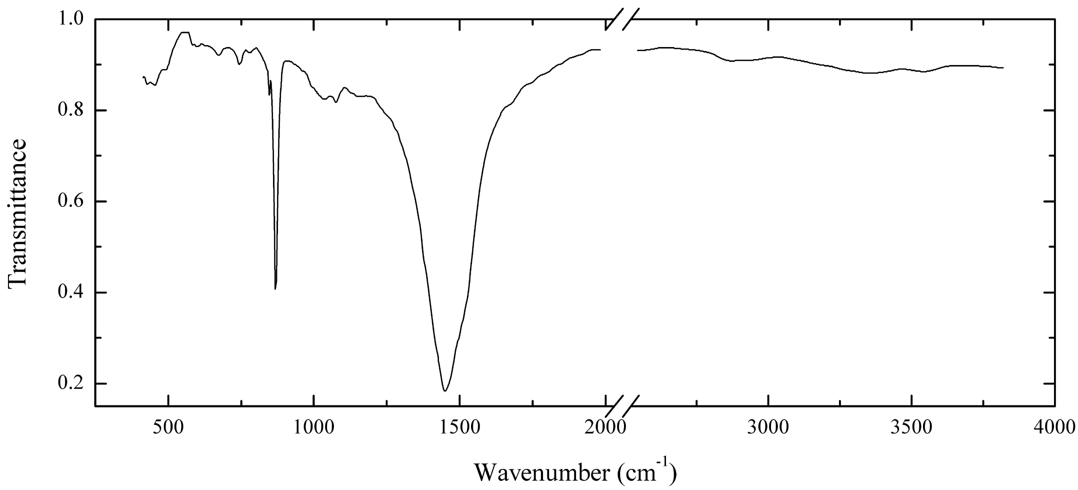


Locality: Baley Au deposit, Priiskovaya railway station, near Baley town, Zabaykalsky Kray, Siberia, Russia.

Description: White columnar aggregate, in the association with formicaite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3570s, 3460, 3300s. 3150, 2625w, 2515w, 2360w, 2270sh, 2160w, 1670, 1645, 1521s, 1472s, 1420s, 1099w, 854, 730sh, 701, 610, 425sh, 393.

C102 Synchysite-(Ce) $Ca(Ce,La)(CO_3)_2F$

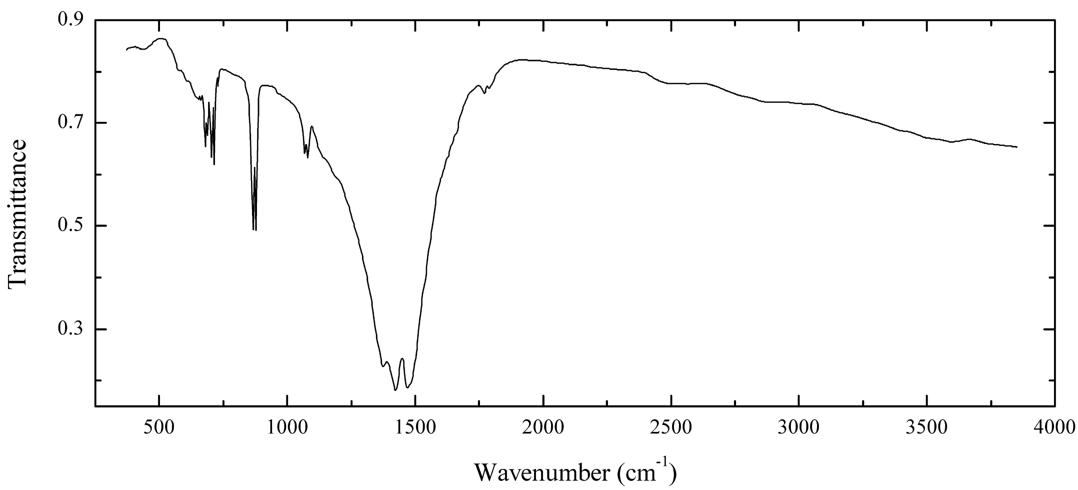


Locality: Kimzey Calcite Pit, Magnet Cove, Arkansas, USA.

Description: Light yellow grains in rock. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3525w, 3335w, 2855w, 1455s, 1075, 1040w, 870s, 846sh, 784w, 744w, 669w, 600w, 490sh, 450, 432.

C103 Kukharenkoite-(Ce) $Ba_2Ce(CO_3)_3F$

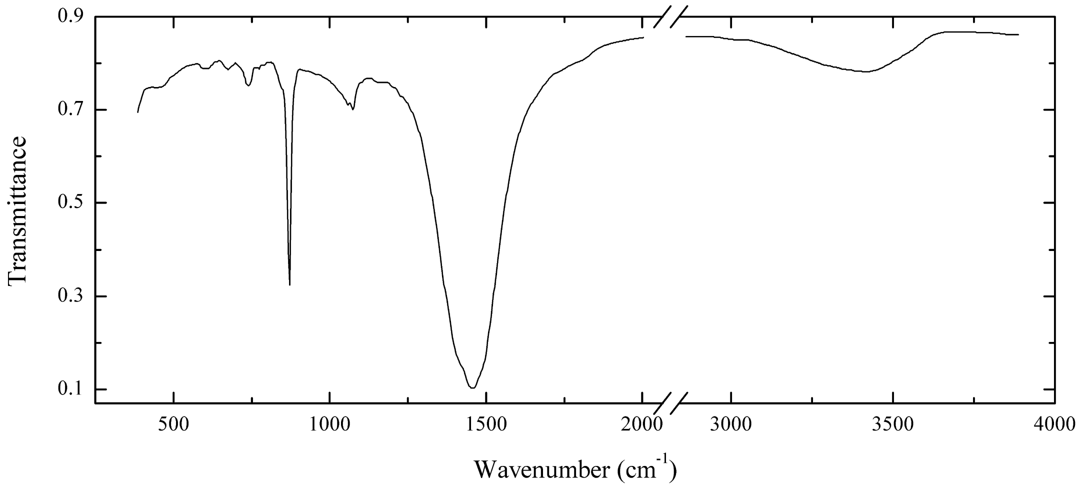


Locality: Tuliylukht bay, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow prismatic crystals from manganoan ankerite carbonatite. Holotype sample. The empirical formula is $(Ba_{1.86}Sr_{0.09}Ca_{0.04})(Ce_{0.56}La_{0.24}Nd_{0.15}Pr_{0.04}Y_{0.01})(CO_3)_{3.00}F_{1.01}$. The crystal structure solved. Monoclinic, space group $P2_1/m$; $a = 13.374(3)$, $b = 5.1011(8)$, $c = 6.653(1)$ Å, $\beta = 106.56(1)°$. $D_{meas} = 4.71$ g/cm^3.

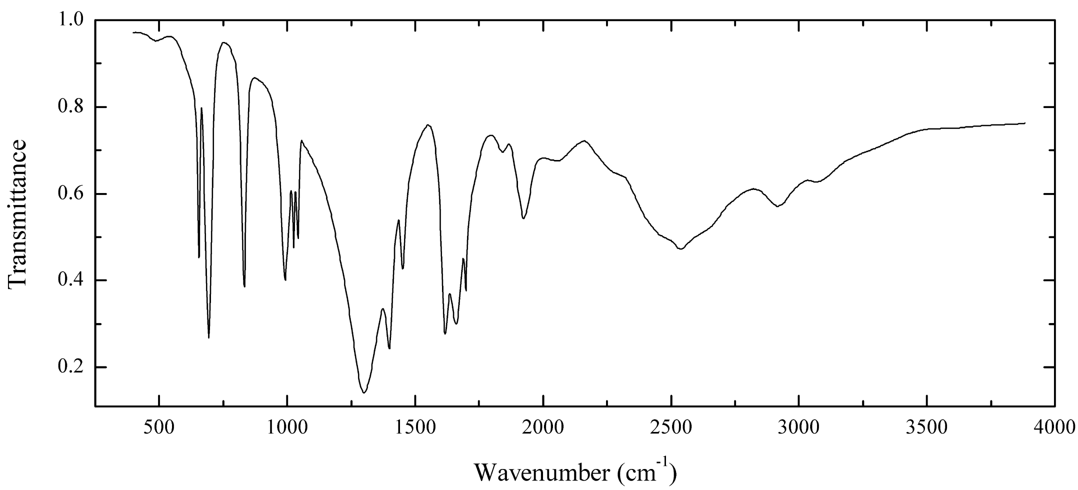
Wavenumbers (cm^{-1}): 1785w, 1765w, 1468s, 1422s, 1373s, 1080. 1068, 886s, 873s, 729w, 713, 703, 686, 678, 648w, 600sh, 575w, 445w.

C104 Synchysite-(Ce) $Ca(Ce,La)(CO_3)_2F$



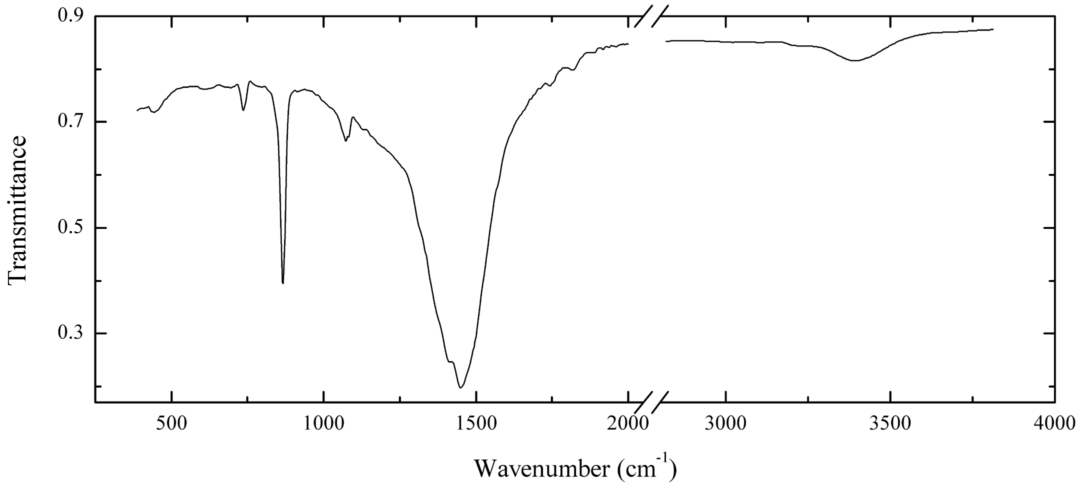
Locality: Narssârssuq pegmatite, Igaliko alkaline complex, South Greenland (type locality).
Description: Light beige semitransparent coarse crystals from the association with xenotime-(Y), aegirine and microcline. Identified by IR spectrum and qualitative electron microprobe analysis. Contains H_2O (as a result of partial alteration?).
Wavenumbers (cm^{-1}): 3400, 1815w, 1460s, 1425sh, 1080, 1070, 871s, 739, 675w, 605w, 455.

C105 Nahcolite $NaH(CO_3)$



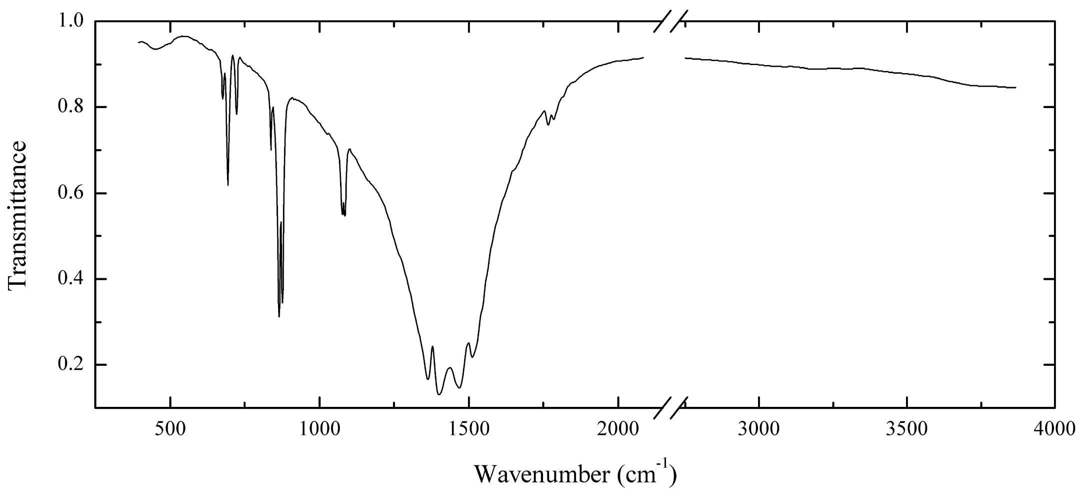
Locality: Oldoinyo Lengai volcano, Tanzania (type locality).
Description: Colourless grains in carbonatite lava, in the association with gregoryite and nyerereite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3060w, 2910, 2620sh, 2540, 2450sh, 2280sh, 2050w, 1935, 1855w, 1710, 1680s, 1625s, 1454, 1402s, 1306s, 1048, 1035, 1002, 836s, 694s, 655.

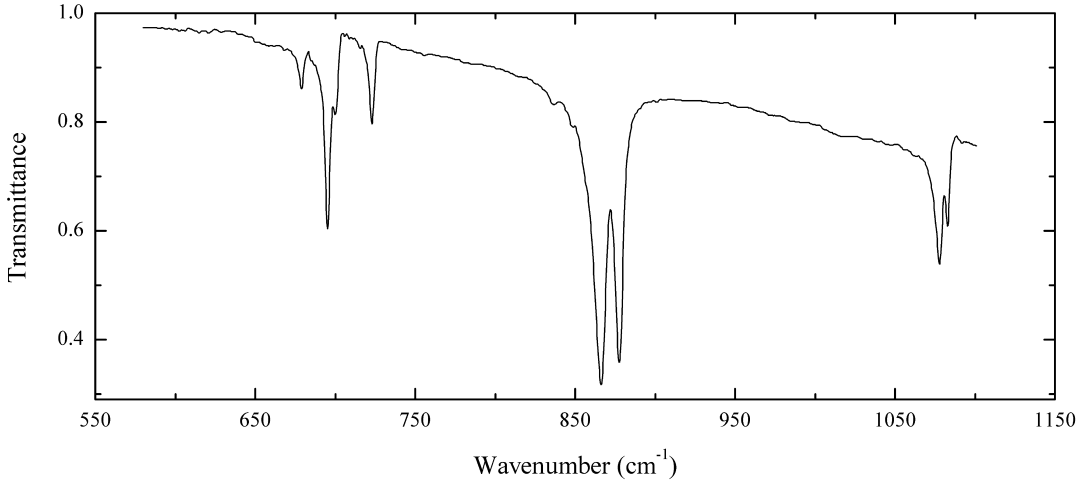
C106 Parisite-(Ce) $Ca(Ce, La)_2(CO_3)_3F_2$



Locality: Emerald deposit at Muso, 100 km north of Bogota, Colombia (type locality).
Description: Brown crystal. Identified by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3400, 1820w, 1745w, 1455s, 1418s, 1088, 1079, 871s, 867sh, 745sh, 736, 445w.

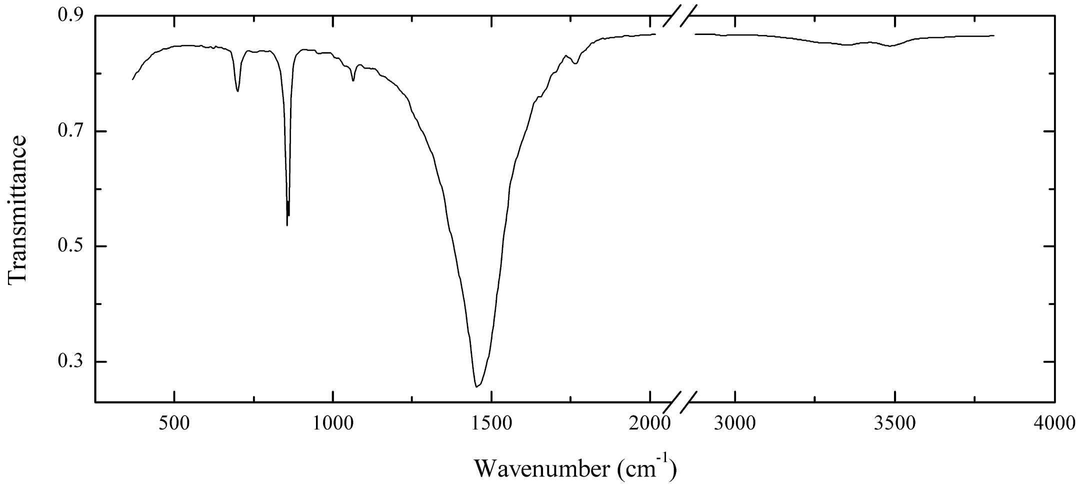
C107 Barytocalcite $BaCa(CO_3)_2$





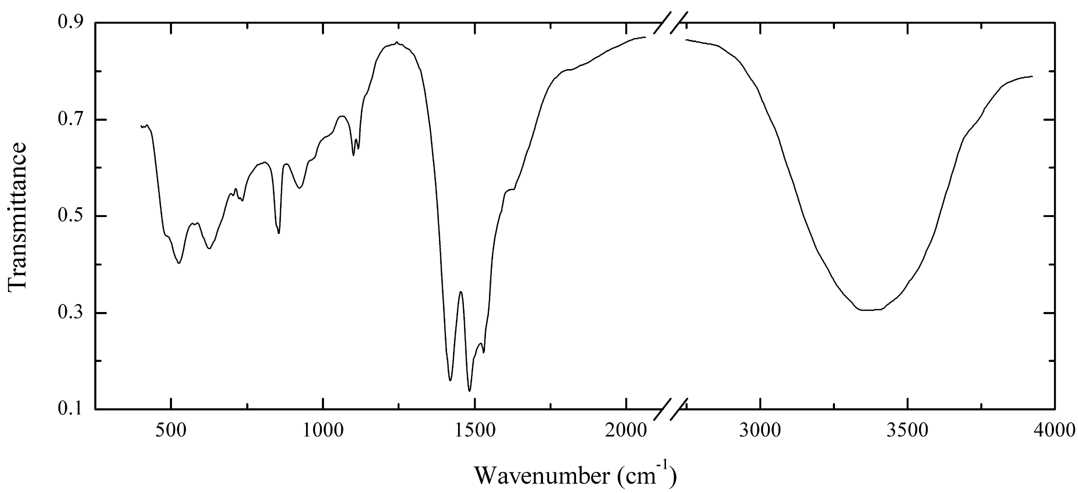
Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Pale yellow platy crystals from the association with podlesnoite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1795w, 1774w, 1521s, 1474s, 1407s, 1369s, 1085, 1079, 879s, 868s, 837w, 723, 696, 678w.

C108 Olekminskite $Sr(Sr,Ca,Ba)(CO_3)_2$



Locality: Kedrovyi massif, Murunskiy alkaline complex, Aldan shield, Siberia, Russia.
Description: White semitransparent crystals from the association with paralstonite, calcite and barite. Holotype sample. The empirical formula is $Sr_{1.41}Ca_{0.35}Ba_{0.22}Ce_{0.01}(CO_3)_{2.00}$. Trigonal, $a = 8.66(2)$, $c = 6.08(2)$ Å. Uniaxial (−), $\omega = 1.670(2)$, $\varepsilon = 1.527(2)$. $D_{meas} = 3.70(2)$ g/cm^3.
Wavenumbers (cm^{-1}): 1765w, 1455s, 1067w, 860, 855, 701, 695sh.

C109 Para-alumohydrocalcite $CaAl_2(CO_3)_2(OH)_4{\cdot}6H_2O$

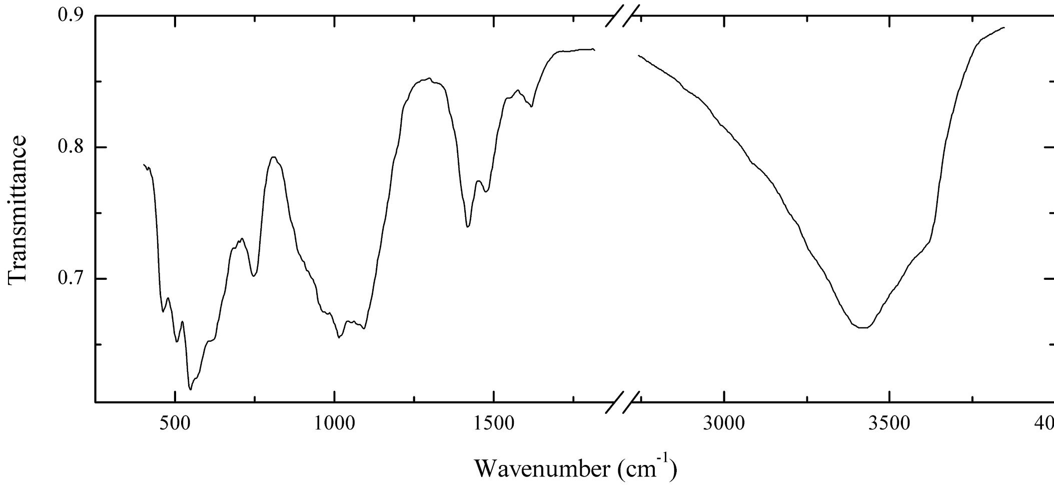


Locality: Vodino, Samara (former Kuybtshev) region, Russia (type locality).

Description: White microconcretions from the association with gypsum, calcite and halloysite. The empirical formula is (electron microprobe) $Ca_{0.92}Mg_{0.05}Fe_{0.12}Al_{1.91}(CO_3)_2(OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3330s, 1620sh, 1531s, 1486s, 1422s, 1116w, 1101, 1020sh, 970sh, 926, 856s, 850sh, 732, 723, 702w, 623s, 521s, 485sh.

C110 Scarbroite $Al_5(CO_3)(OH)_{13} \cdot 5H_2O$

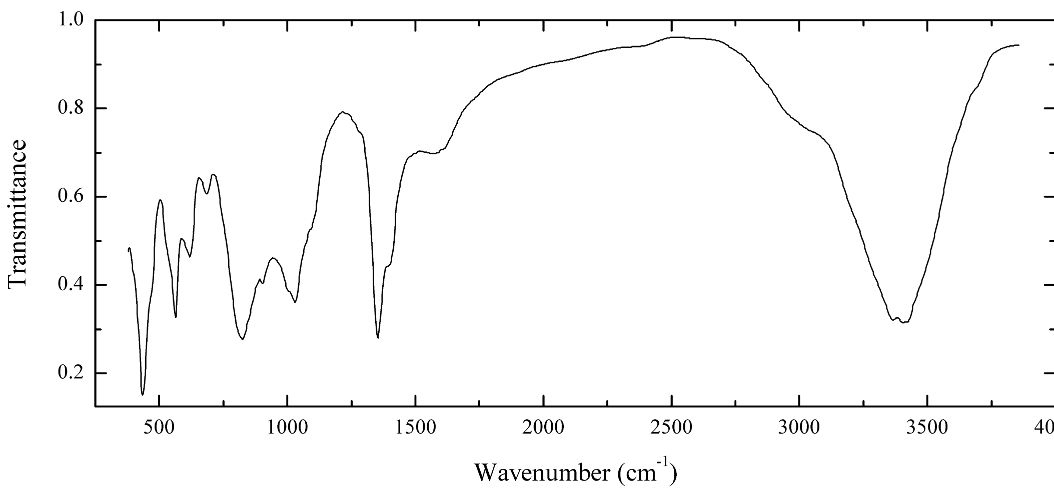


Locality: South Bay, Scarbrough, Yorkshire, England, UK (type locality).

Description: White massive, from the association with allophane. The empirical formula is (electron microprobe) $Na_{0.09}Al_{4.88}Mg_{0.08}Fe_{0.04}(CO_3)_{1.94}(SO_4)_{0.06}(OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3600sh, 3400s, 1615, 1475, 1420, 1084s, 1020s, 980sh, 925sh, 752, 645sh, 614, 570sh, 549s, 504, 460.

C112 Takovite $Ni_6Al_2(CO_3)(OH)_{16} \cdot 4H_2O$

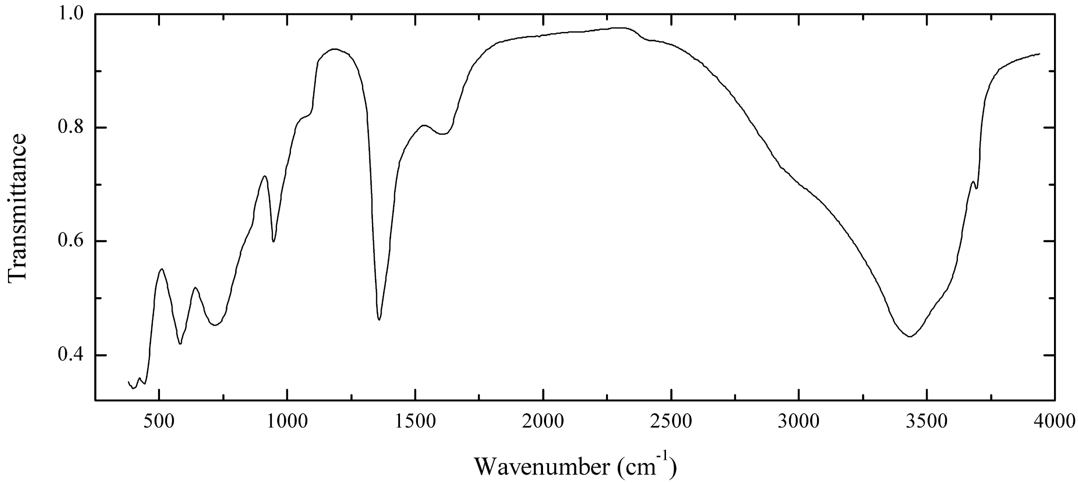


Locality: Capo Sounion, Sounion, Attica, Greece.

Description: Light blue friable. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3395s, 3352s, 3040sh, 2960sh, 1570, 1397, 1353s, 1090sh, 1030, 1003, 902, 826s, 684, 620, 565s, 434s.

C113 Pyroaurite $Mg_6Fe^{3+}{}_2(CO_3)(OH)_{16}{\cdot}4H_2O$

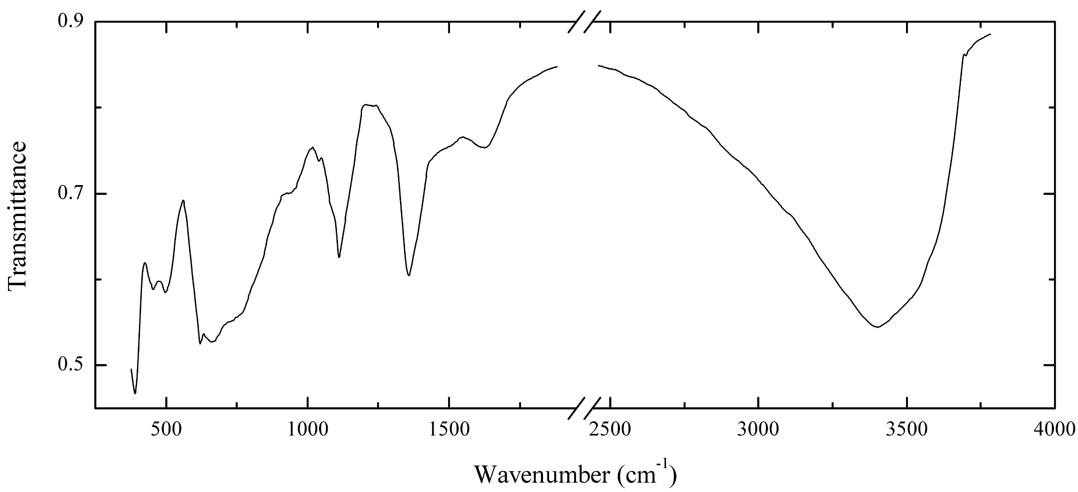


Locality: Solov'yova Gora, Middle Urals, Russia.

Description: Yellow-brown scaly aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3690, 3550sh, 3430s, 3000sh, 2440sh, 1615, 1362s, 1084sh, 944, 723s, 580s, 442s, 395s.

C114 Reevesite $Ni_6Fe^{3+}{}_2(CO_3)(OH)_{16}{\cdot}4H_2O$

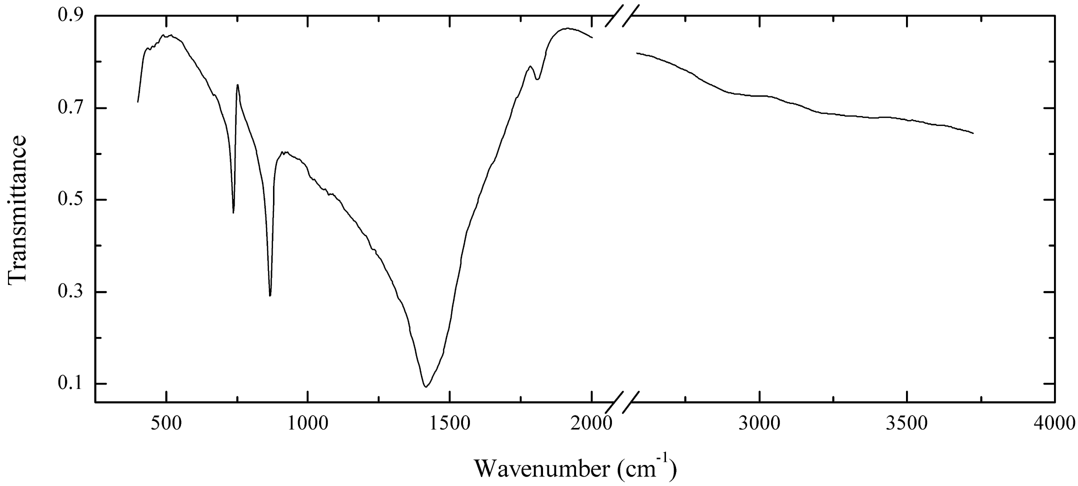


Locality: Lord Brassey mine, Heazlewood, Tasmania, Australia.

Description: Greenish-yellow friable aggregate. SO_4-rich variety. The empirical formula is (electron microprobe) $Ni_{6.0}(Fe_{1.7}Ni_{0.3})(CO_3)_{0.6}(SO_4)_{0.4}(OH)_{16}{\cdot}nH_2O$.

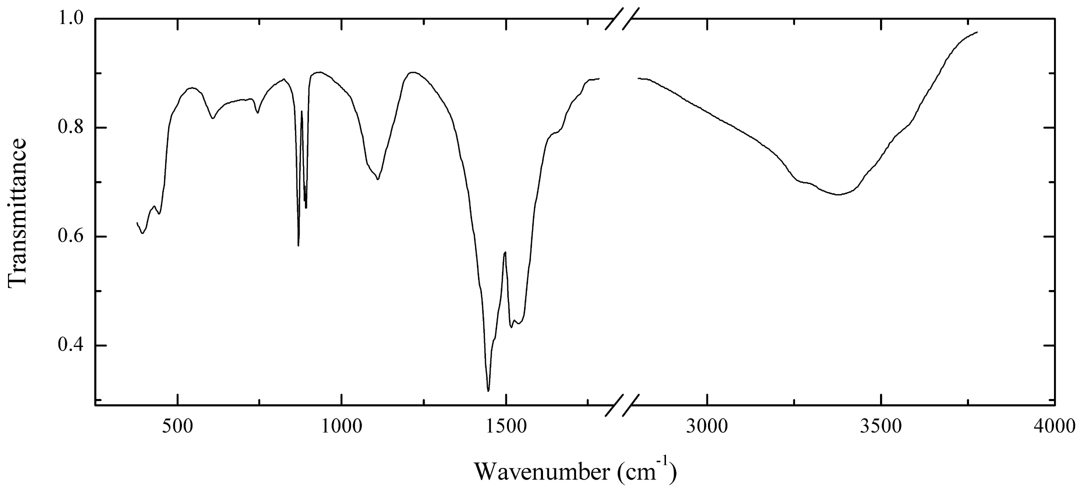
Wavenumbers (cm^{-1}): 3500sh, 3390s, 1615, 1357s, 1107, 1080sh, 1040w, 930sh, 750sh, 650s, 619s, 493, 457, 370s.

C115 Siderite $Fe^{2+}(CO_3)$



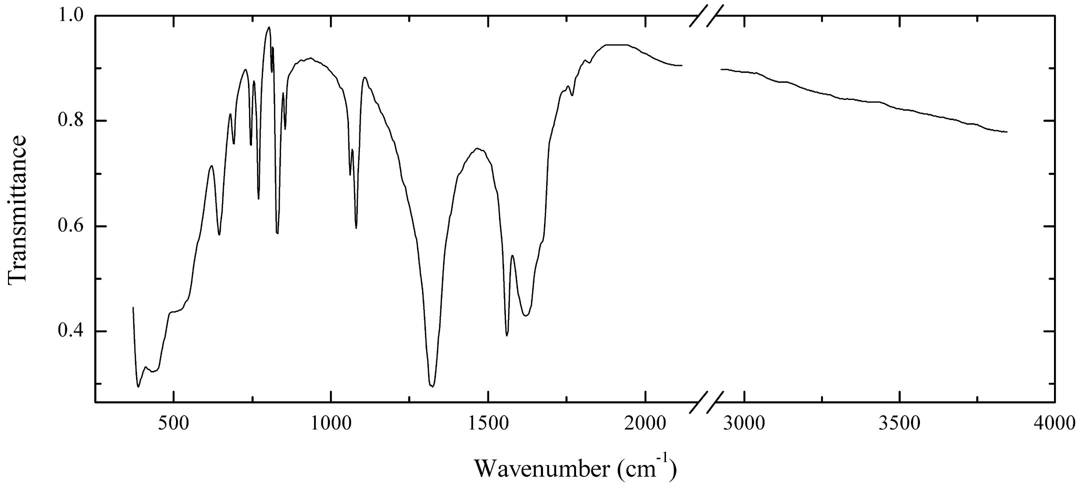
Locality: Chernomorskiy quarry, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.
Description: Brown spherulites. The empirical formula is (electron microprobe) $(Fe_{0.83}Mn_{0.09}Ca_{0.04}Mg_{0.04})(CO_3)$.
Wavenumbers (cm^{-1}): 1810w, 1415s, 865s, 736.

C117 Sergeevite $Ca_2Mg_{11}(CO_3)_{13-x}(HCO_3)_x(OH)_x{\cdot}(10\text{-}x)H_2O$



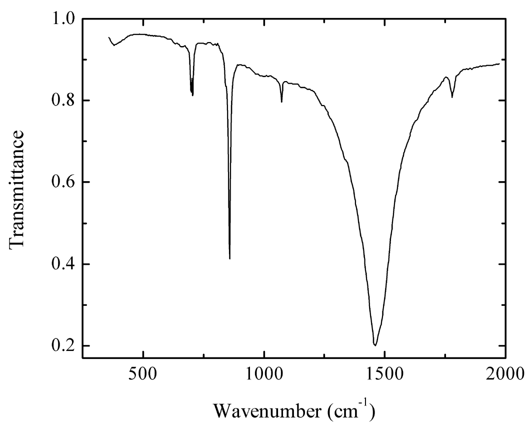
Locality: Tyrnyauz W-Mo deposit, Kabardino-Balkaria, Russia (type locality).
Description: White fine-grained aggregate. Specimen No. 82947 from the Mineralogical museum of the Russian Academy of Sciences, Moscow. Very close to the IR spectrum of holotype sergeevite. Questionable mineral species (probably a mixture of huntite with a hydrous Mg sulfate).
Wavenumbers (cm^{-1}): 3645sh, 3350, 3260sh, 1650sh, 1546s, 1511s, 1480sh, 1460s, 1442s, 1111, 1090sh, 891, 887, 869, 744w, 617w, 443, 401.

C118 Sabinaite $Na_4Zr_2TiO_4(CO_3)_4$



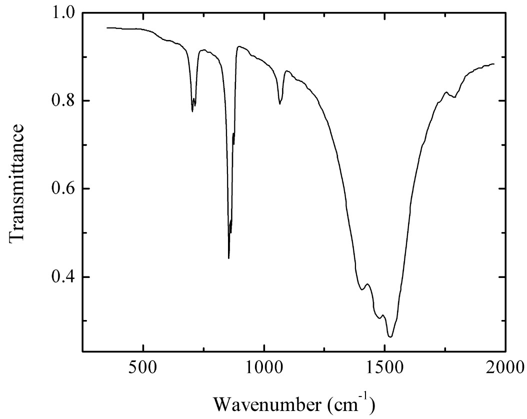
Locality: Poudrette quarry, Mont St. Hilaire, Rouville Co., Québec, Canada.
Description: White crystals from the association with calcite and weloganite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1770w, 1675sh, 1632s, 1567s, 1330s, 1319s, 1084, 1064, 857, 832s, 811w, 770, 747, 690, 646, 525sh, 438s, 394s.

C119 Strontianite $Sr(CO_3)$



Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Radial aggregate from the association with edingtonite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1775, 1458s, 1071, 858s, 843w, 707, 700, 383w.

C120 Remondite-(Ce) $Na_3(Ce,La,Ca,Na,Sr)_3(CO_3)_5$

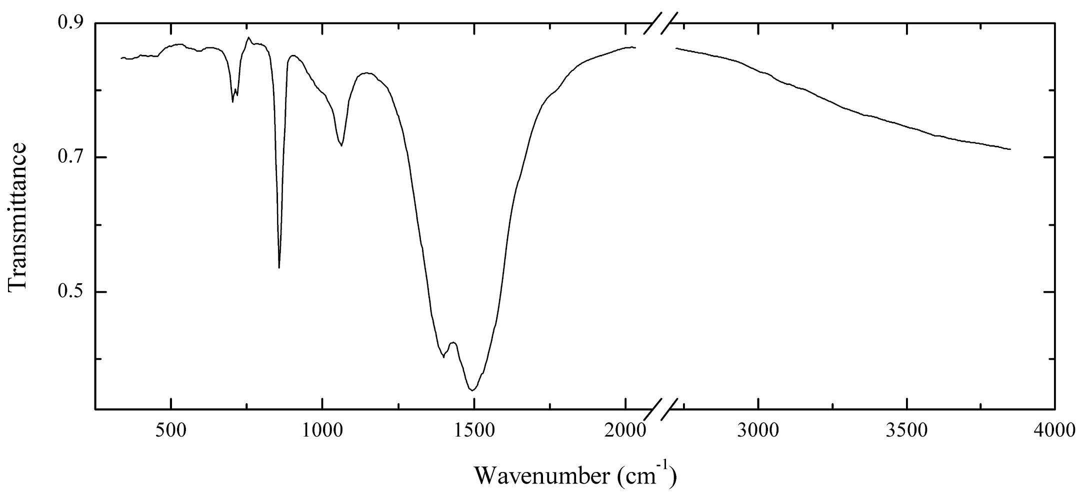


Locality: Ebounja, near Kribi, Cameroon (type locality).

Description: Orange-red crystal. The empirical formula is (electron microprobe) $Na_{3.0}(Ce_{1.1}La_{0.3}Nd_{0.1}Pr_{0.1}Na_{0.6}Ca_{0.5}Sr_{0.3})(CO_3)_5$.

Wavenumbers (cm^{-1}): 1780w, 1545sh, 1525s, 1479s, 1406s, 1070sh, 1065, 876, 864, 857s, 715, 704.

C121 Remondite-(La) $Na_3(La,Ce,Ca,Na,Sr)_3(CO_3)_5$

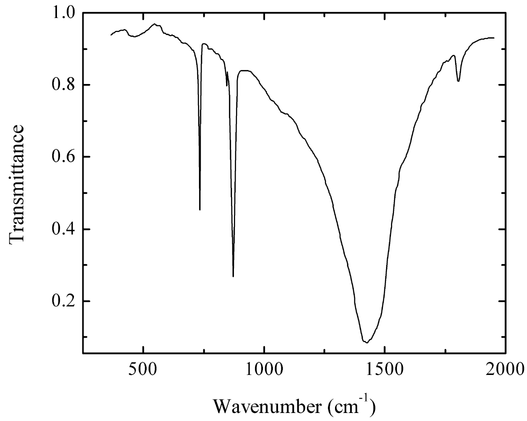


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Aggregate of orange crystals from the association with cancrisilite, villiaumite, natrolite and lomonosovite. The empirical formula is $Na_{2.9}(La_{0.8}Ce_{0.7}Ca_{0.6}Na_{0.5}Sr_{0.2}Nd_{0.1}K_{0.1})(CO_3)_5$.

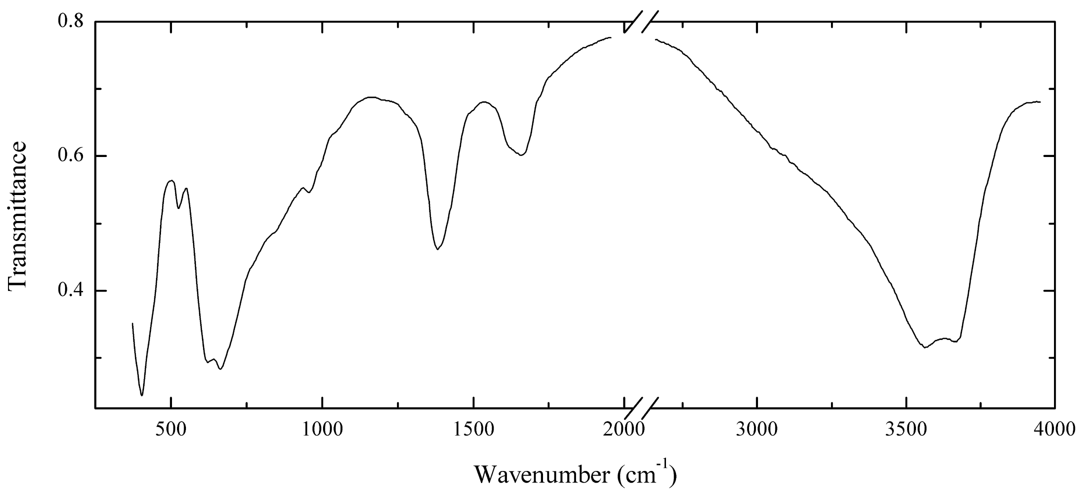
Wavenumbers (cm^{-1}): 1511s, 1401s, 1061, 870sh, 855s, 713, 702, 590w.

C122 Rhodochrosite $Mn(CO_3)$



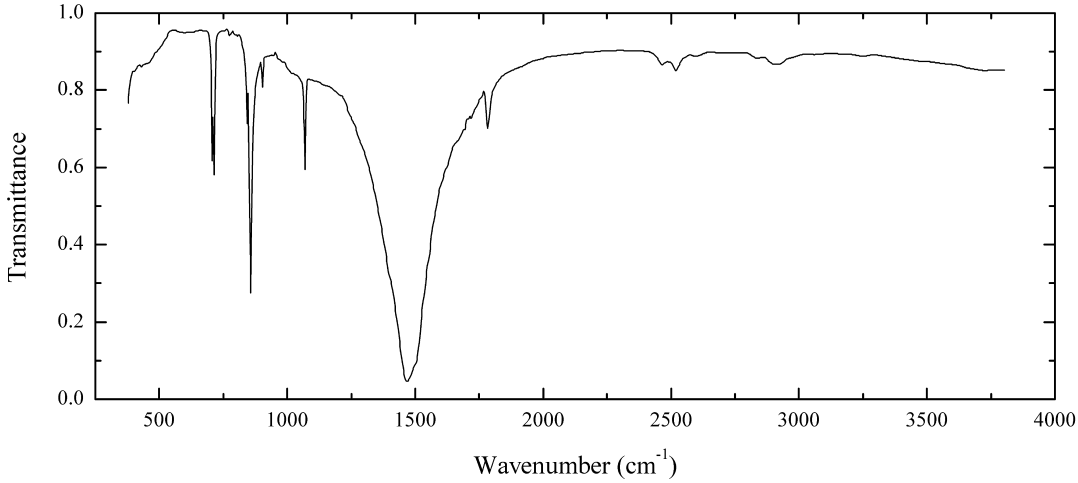
Locality: N'Chwaning II Mine, Kuruman, Kalahari, South Africa.
Description: Pink transparent crystals. The empirical formula is $Mn_{0.99}Fe_{0.01}(CO_3)$.
Wavenumbers (cm^{-1}): 1804, 1416s, 865s, 837w, 726.

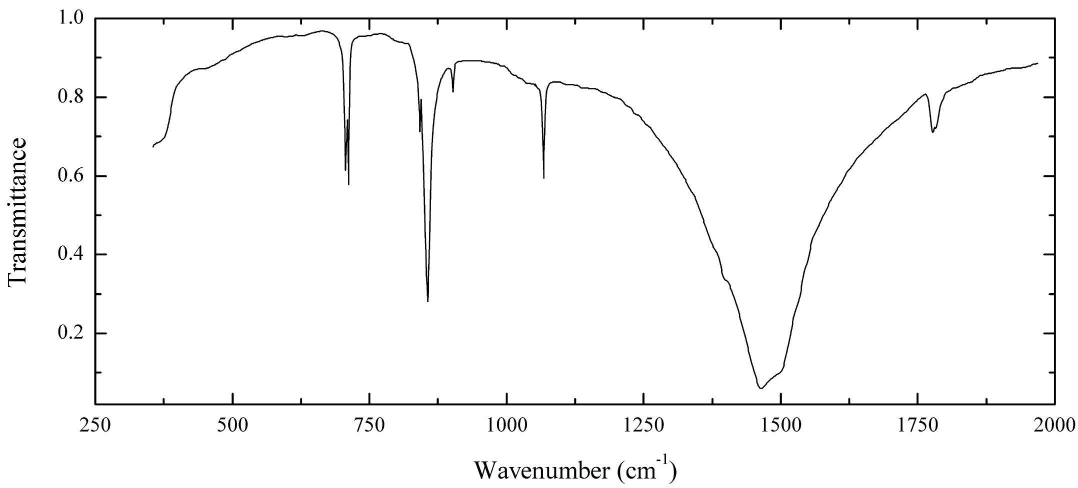
C124 Stichtite $Mg_6Cr_2(CO_3)(OH)_{16}{\cdot}4H_2O$



Locality: Serpentine Hill, North Dundas, Zeehan district, Tasmania, Australia
Description: Lilac scaly aggregate in serpentine. The empirical formula is (electron microprobe) $(Mg_{5.9}Fe_{0.1})(Cr_{1.3}Fe_{0.4}Al_{0.3})(CO_3)(OH)_{16}{\cdot}4H_2O$.
Wavenumbers (cm^{-1}): 3625s, 3550s, 3150sh, 1650, 1620sh, 1377, 952, 850sh, 730sh, 661s, 621s, 523, 430sh, 395s.

C125 Podlesnoite $Ca_2Ba(CO_3)_2F_2$



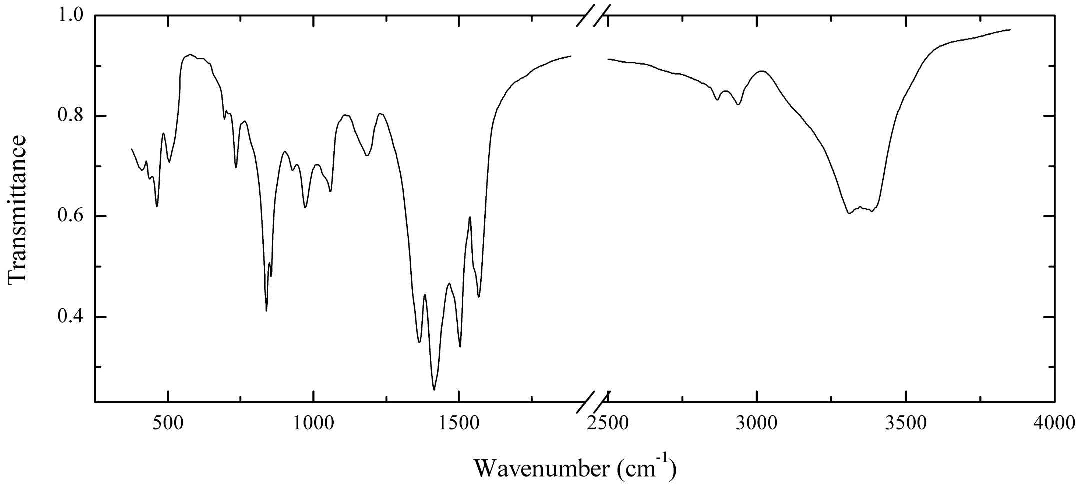


Locality: Kirovskiy underground apatite mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless prismatic crystals in the association with natrolite, biotite, ilmenite, aegirine, lorenzenite, barytocalcite, calcite, fluorite, astrophyllite, burbankite, *etc*. Holotype sample. The empirical formula is $Ba_{1.02}(Ca_{1.98}Fe_{0.01}Na_{0.01}Sr_{0.005})_{\Sigma 2.005}C_{1.99}O_6F_{2.00}$. Optically biaxial (−), $\alpha = 1.500(2)$, $\beta = 1.612(2)$, $\gamma = 1.614(2)$, $2V_{meas} = 10(5)°$. $D_{meas} = 3.62(1)$, $D_{calc} = 3.63$ g/cm^3. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 5.303 (21), 3.527 (100), 3.397 (71), 2.609 (20), 2.313 (43), 2.302 (22), 2.211 (20), 1.948 (39), 1.940 (40).

Wavenumbers (cm^{-1}): 2900w, 2830w, 2510w, 2455w, 1782sh, 1776, 1500sh, 1464s, 1395sh, 1067.5, 901.5w, 855s, 842, 710, 705.

C127 Aurichalcite $(Zn,Cu^{2+})_5(CO_3)_2(OH)_6$

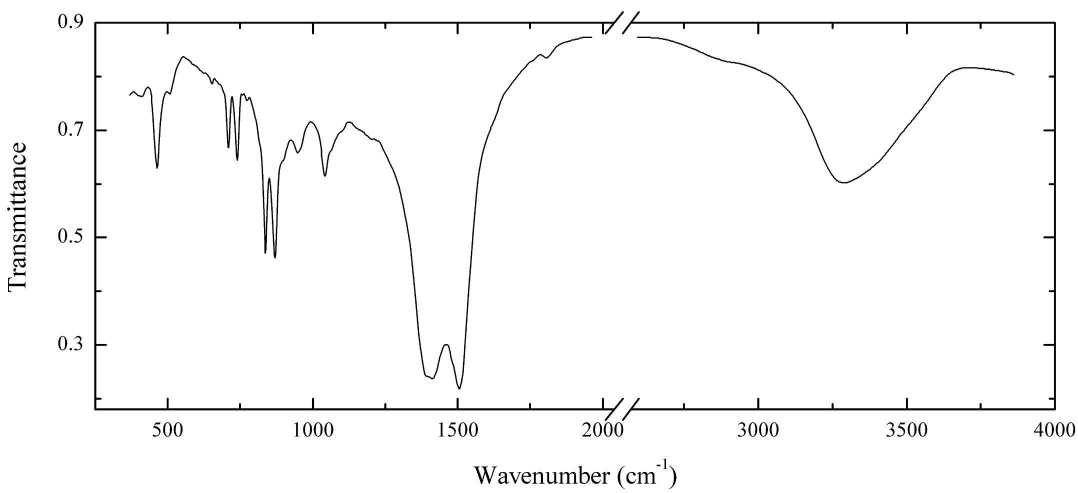


Locality: Kipushi mine, Congo.

Description: Blue acicular crystals. The empirical formula is (electron microprobe) $(Zn_{3.4}Cu_{1.6})(CO_3)_2(OH)_6$.

Wavenumbers (cm^{-1}): 3360, 3285, 2915w, 2848w, 1567s, 1550sh, 1505s, 1413s, 1366s, 1183, 1060, 1040sh, 974, 930, 857, 840s, 733, 698w, 505, 464, 445, 415.

C128 Hydrozincite $Zn_5(CO_3)_2(OH)_6$

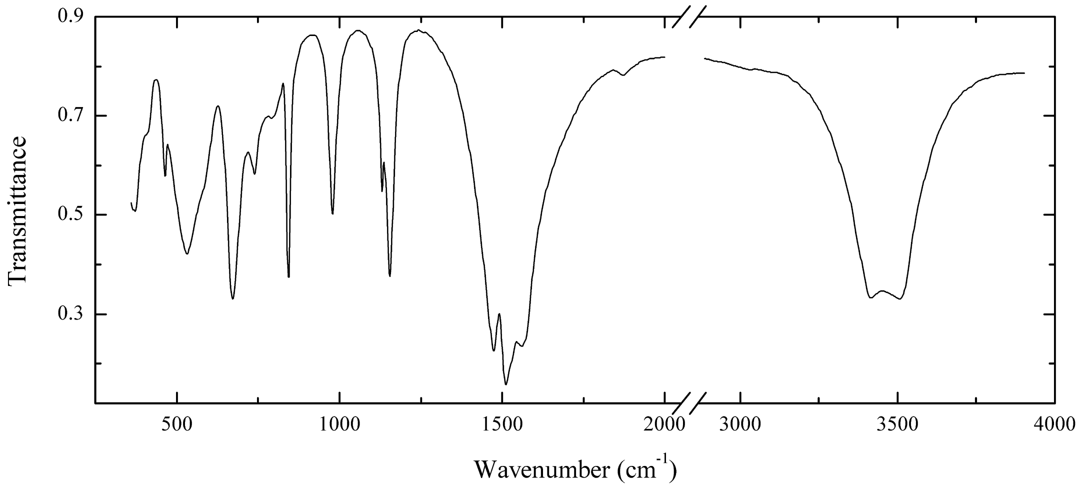


Locality: Stephanie mine, Bleiberg, Austria.

Description: White crust. Identified by IR spectrum and qualitative electron microprobe analysis.

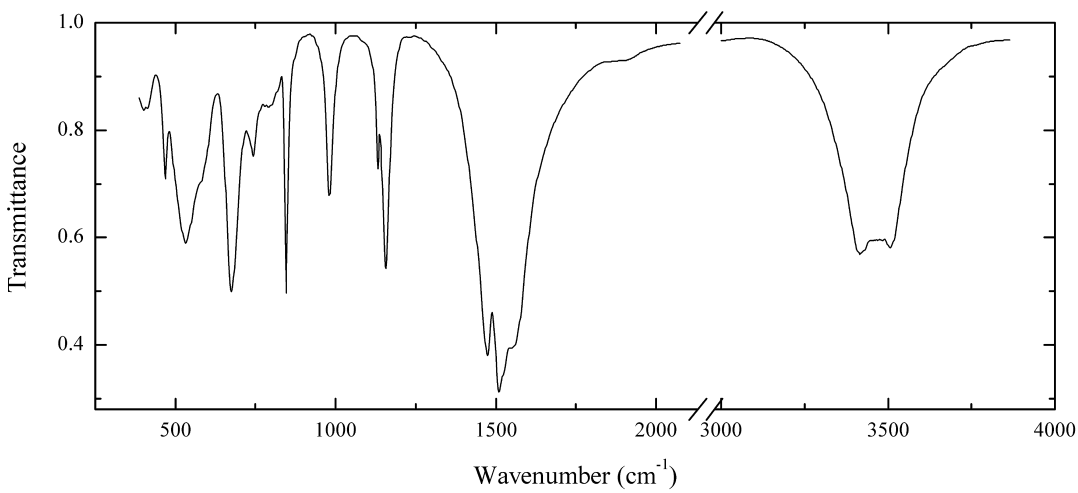
Wavenumbers (cm^{-1}): 3250, 1505s, 1410s, 1390sh, 1045, 947, 872s, 838s, 741, 709, 650w, 507w, 468, 410w.

C129 Tunisite $NaCa_2Al_4(CO_3)_4(OH)_8Cl$



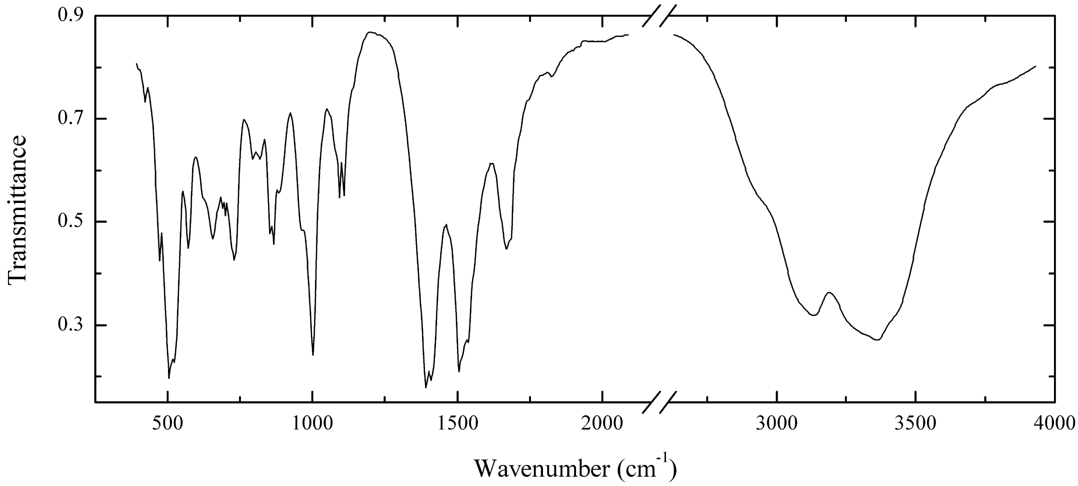
Locality: Condorcet, Nyons, Drôme, Rhône-Alpes, France.
Description: Colourless crystals. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3485s, 3390s, 1815w, 1560s, 1512s, 1475s, 1155s, 1132, 981, 844s, 794w, 741, 671s, 570sh, 532s, 466, 405sh, 370.

C130 Tunisite $NaCa_2Al_4(CO_3)_4(OH)_8Cl$



Locality: Condorcet, Nyons, Drôme, Rhône-Alpes, France.
Description: Colourless crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3490s, 3400s, 1557s, 1513s, 1475s, 1155s, 1131, 980, 844s, 790w, 740, 580sh, 531s, 466, 411w.

C131 Alumohydrocalcite $CaAl_2(CO_3)_2(OH)_4{\cdot}3H_2O$

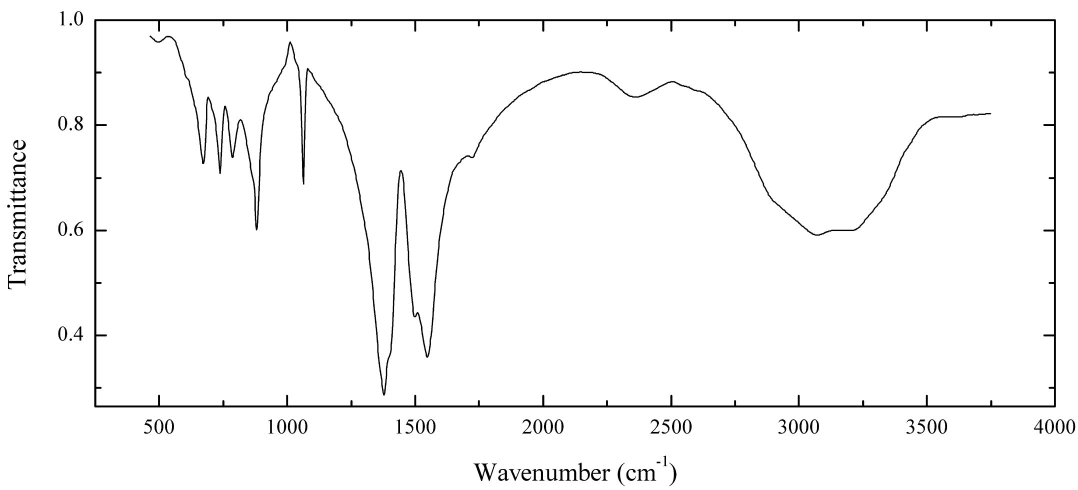


Locality: Schneeberg, Saxony, Germany.

Description: Pink fibrous, in the association with quartz and arsenate minerals. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ca_{0.86}Mn_{0.07}Fe_{0.10}Al_{1.94}Cr_{0.03}(CO_3)_2(OH)_4{\cdot}3H_2O$.

Wavenumbers (cm^{-1}): 3335s, 3125, 3080sh, 2940sh, 1830w, 1678, 1545sh, 1512s, 1420s, 1400s, 1110, 1095, 1002s, 965sh, 885, 867, 853, 818w, 794w, 730, 656, 573, 525sh, 502s, 473, 419w.

C132 Shomiokite-(Y) $Na_3Y(CO_3)_3{\cdot}3H_2O$

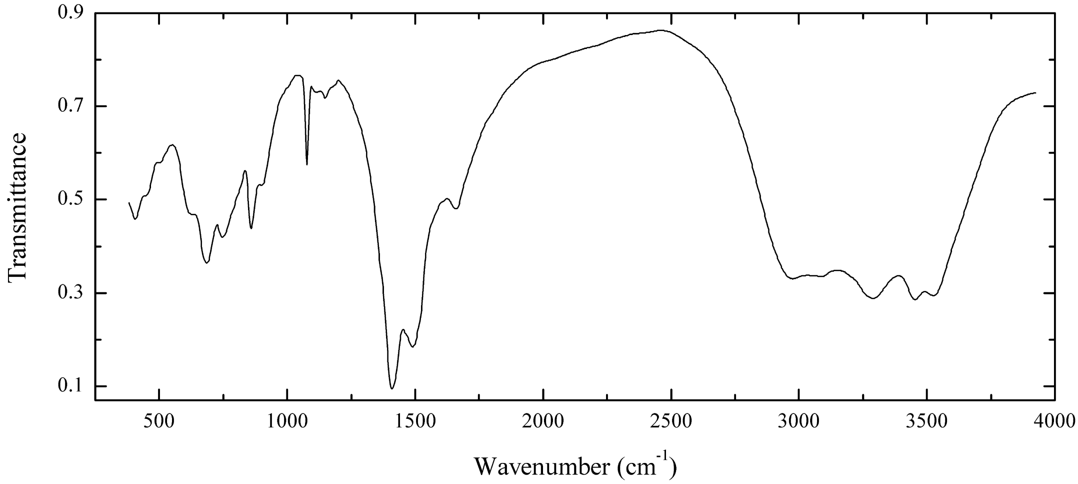


Locality: Umbozero mine, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pinkish-grey prismatic crystals up to 3 cm in length from the association with albite, aegirine, elpidite, natron, natroxalate, trona, sidorenkite, siderite and sphalerite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{2.91}Y_{0.83}Gd_{0.07}Er_{0.05}Yb_{0.03}Ho_{0.02}Eu_{0.02}Nd_{0.01}(CO_3)_3{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3160, 3055, 2900sh, 2360w, 1720w, 1549s, 1499s, 1398sh, 1378s, 1062, 880, 860sh, 786, 737, 672, 500w.

C133 "Shelkovite" $Mg_6Ca(CO_3)_5(OH)_4{\cdot}24H_2O$

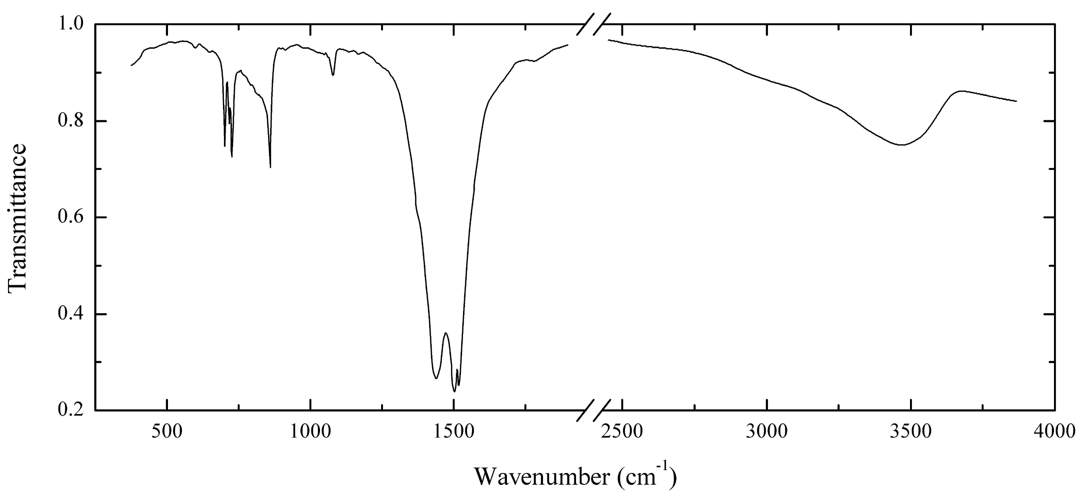


Locality: Burned dump of the shaft number 47, Kopeysk, Chelyabinsk coal basin, South Urals, Russia.

Description: White scaly aggregate from the association with dypingite. Technogenetic substance. Investigated by B.V. Chesnokov. Optically biaxial (−), $\alpha = 1.454$, $\beta = 1.482$, $\gamma = 1.502$. The empirical formula is $Mg_{6.1}Ca_{0.9}(CO_3)_{4.9}(SO_4)_{0.2}(OH)_{3.8}{\cdot}24.3H_2O$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %)] are 7.53 (100), 5.77 (80), 3.73 (57), 3.47 (32), 2.80 (37), 2.491 (30).

Wavenumbers (cm^{-1}): 3510s, 3430s, 3275s, 3080s, 2960s. 1659, 1493s, 1408s, 1185sh, 1155w, 1117w, 1098, 903, 862, 753, 690s, 530sh, 505sh, 450sh, 405.

C134 Kozoite-(Nd) $Nd(CO_3)(OH)$

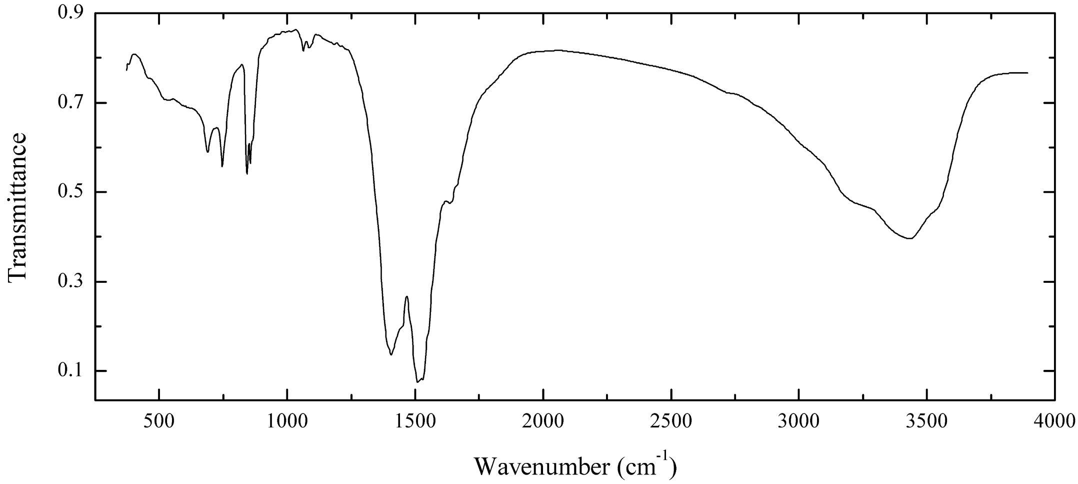


Locality: Mitsukoshi, Hizen-cho, near Karatsu, Saga prefecture, Japan.

Description: Pink massive aggregates in basalt, in the association with kimuraite-(Y), lokkaite-(Y), kozoite-(La), lanthanite-(Nd) and aragonite. The empirical formula is (electron microprobe) $Nd_{0.40}La_{0.33}Pr_{0.12}Sm_{0.05}Gd_{0.04}Eu_{0.03}Y_{0.02}Ce_{0.01}(CO_3)(OH)$.

Wavenumbers (cm^{-1}): 3540sh, 3440, 1780w, 1512s, 1500s, 1433s, 1079w, 860, 825sh, 726, 717w, 700.

C135 Kimuraite-(Y) $CaY_2(CO_3)_4{\cdot}6H_2O$

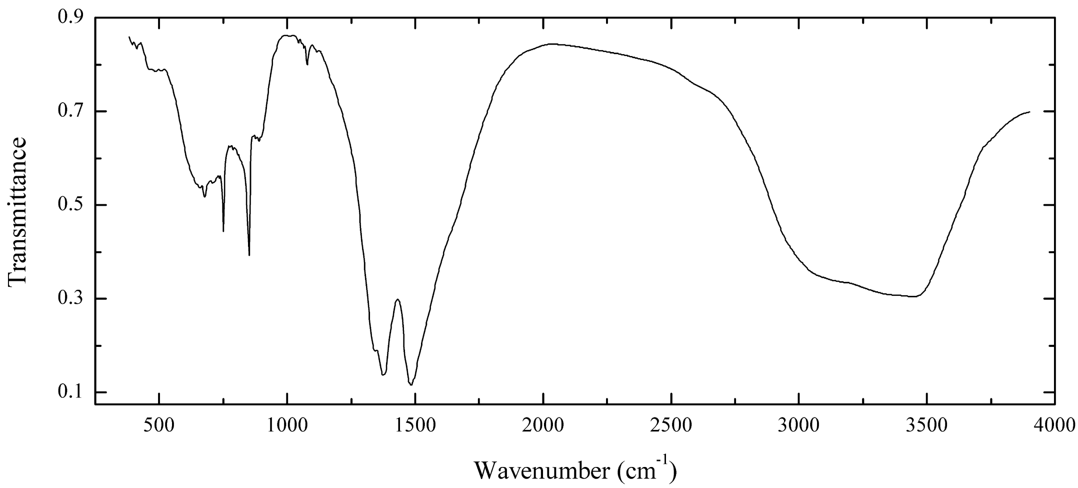


Locality: Mitsukoshi, Hizen-cho, near Karatsu, Saga prefecture, Japan.

Description: Pink aggregates in basalt, in the association with lokkaite-(Y), kozoite-(La), kozoite-(Nd), kozoite-(La), lanthanite-(Nd) and aragonite. The empirical formula is (electron microprobe) $Ca_{1.05}Y_{1.47}Nd_{0.26}Gd_{0.10}Dy_{0.07}Er_{0.04}Y_{0.02}Ce_{0.01}(CO_3)(OH)$.

Wavenumbers (cm^{-1}): 3500sh, 3405s, 3350sh, 3240sh, 1630, 1525s, 1507s, 1440sh, 1404s, 1085w, 1062w, 865sh, 856, 842, 747, 686, 620sh, 533, 450sh.

C136 Lanthanite-(Nd) $(Nd,La)_2(CO_3)_3{\cdot}8H_2O$

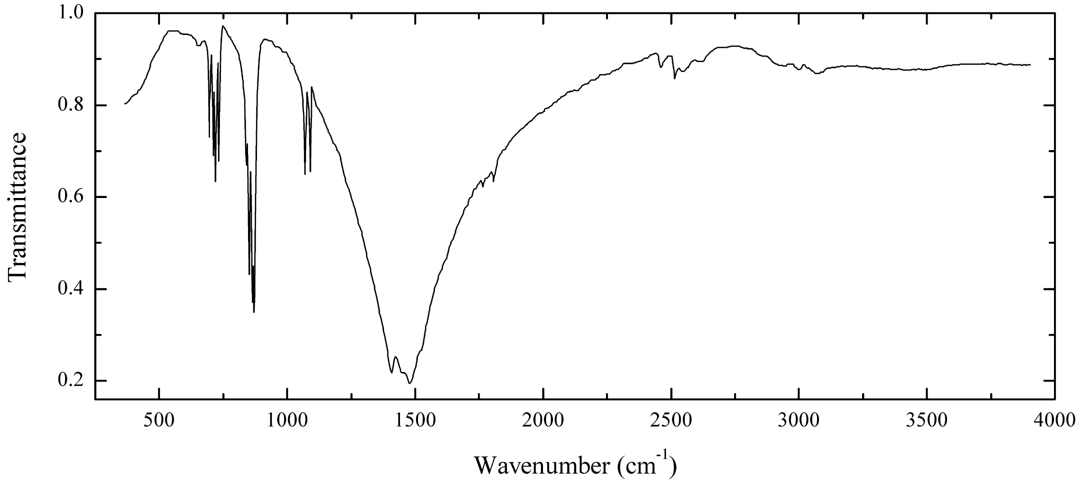


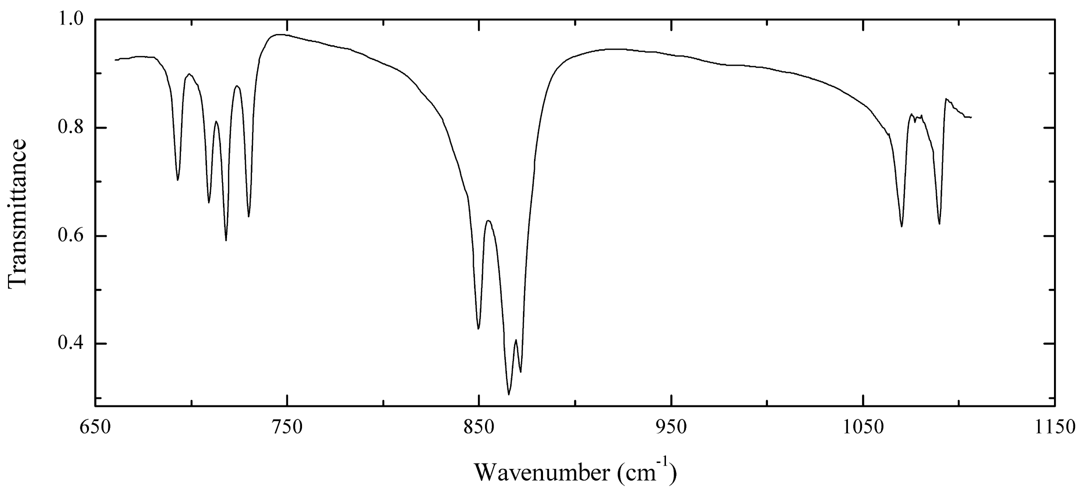
Locality: Mitsukoshi, Hizen-cho, near Karatsu, Saga prefecture, Japan.

Description: Pink platy crystals in basalt, in the association with kimuraite-(Y), lokkaite-(Y), kozoite-(La), kozoite-(Nd) and aragonite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3450s, 3350sh, 3150sh, 1765w, 1640sh, 1488s, 1375s, 1340s, 1077w, 885, 850, 748, 678, 655sh, 480sh, 410w.

C137 Shortite $Na_2Ca_2(CO_3)_3$



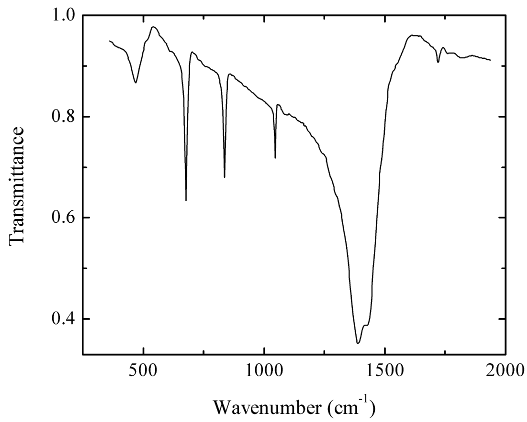


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Imperfect green crystals from the association with microcline, natrolite, pirssonite, villiaumite and thermonatrite. Identified by IR spectrum.

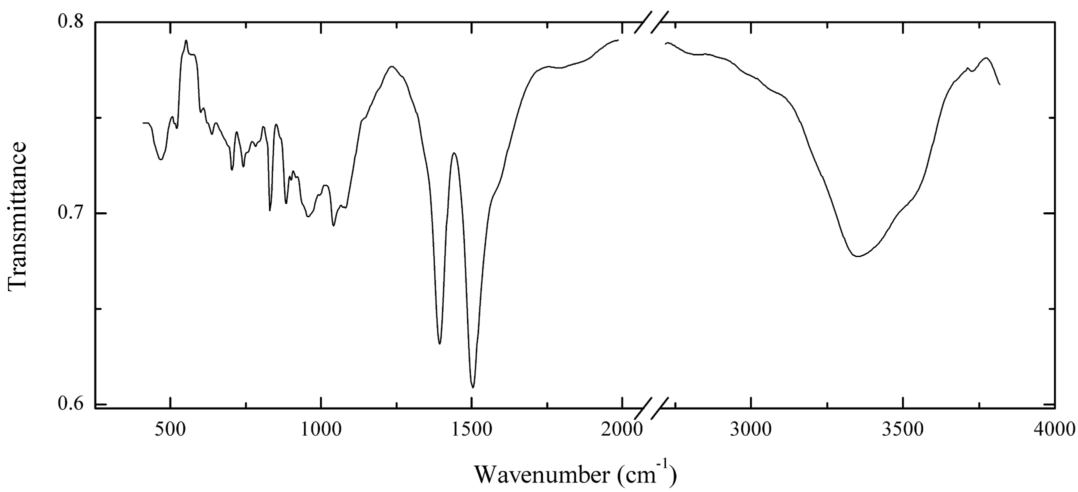
Wavenumbers (cm^{-1}): 3065w, 2995w, 2945w, 2610w, 2540w, 2505w, 2450w, 1805w, 1760w, 1525sh, 1480s, 1460sh, 1407s, 1090, 1070, 871, 865s, 850, 841w, 730, 718, 709, 693, 652w.

C139 Cerussite $Pb(CO_3)$



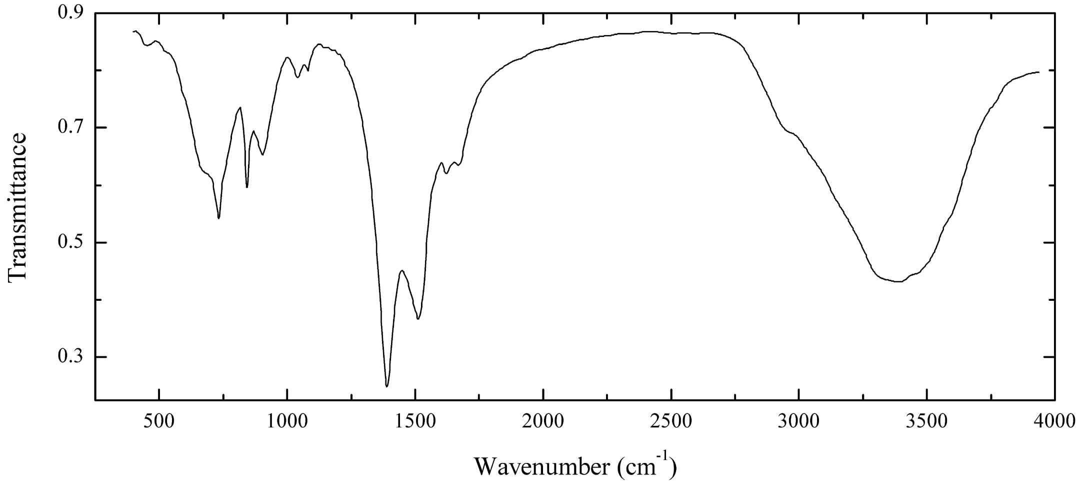
Locality: Belmont mine, Tonopah, Osborn district, Big Horn Mts., Arizona, USA.
Description: White veinlet. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1730w, 1433s, 1497s, 1051, 839, 678s, 470.

C140 Znucalite $CaZn_{11}(UO_2)(CO_3)_3(OH)_2 \cdot 4H_2O$



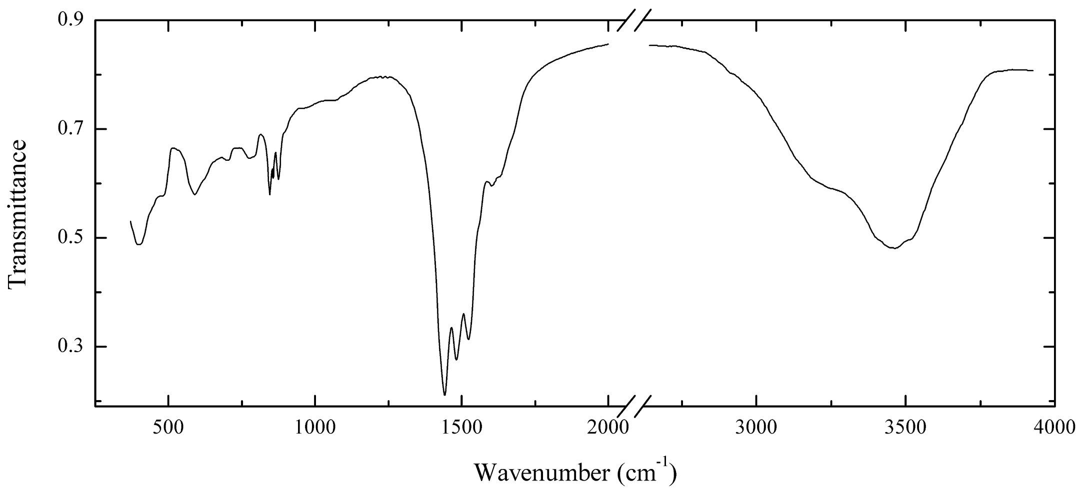
Locality: Bärenhecke, Saxony, Germany.
Description: Pale yellow spherulites. The empirical formula is (electron microprobe) $Ca_{0.54}Zn_{11.76}(UO_2)_{0.70}(CO_3)_3(OH)_2 \cdot 4H_2O$.
Wavenumbers (cm^{-1}): 3500sh, 3340s, 1580sh, 1506s, 1394s, 1083, 1048, 960, 890, 834, 741, 706, 635, 620, 510, 470.

C141 Hellyerite $Ni(CO_3)·6H_2O$



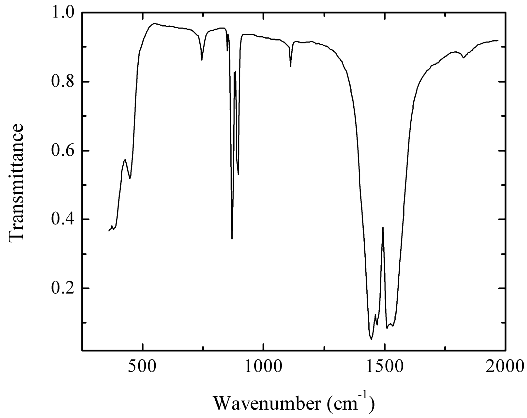
Locality: Lord Brassey nickel mine, Heazlewood district, Tasmania, Australia (type locality).
Description: Blue massive, from the association with zaratite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3570sh, 3430sh, 3360s, 2950sh, 1650, 1620, 1500s, 1386s, 1083w, 1040w, 903, 842, 732s, 700sh, 660sh, 458w.

C142 Chlorartinite $Mg_2(CO_3)Cl(OH)·3H_2O$



Locality: The third cone of the Northern Breakthrough of the Main Tolbachik fracture eruption (1975–1976), Kamchatka, Russia (type locality).
Description: White crust. Associated minerals are halite, gypsum, aragonite and nesquehonite. The empirical formula is (electron microprobe) $Mg_{1.9}Ca_{0.1}(CO_3)Cl_{1.2}(OH)_{0.8}·nH_2O$. Probably contains admixture of aragonite (the bands at 1482 and 856 cm^{-1}).
Wavenumbers (cm^{-1}): 3480sh, 3430s, 3220sh, 1630sh, 1600sh, 1520s, 1482s, 1450s, 1080w, 895sh, 876, 856, 874, 798, 783, 712, 603, 487, 404.

C143 Huntite $CaMg_3(CO_3)_4$

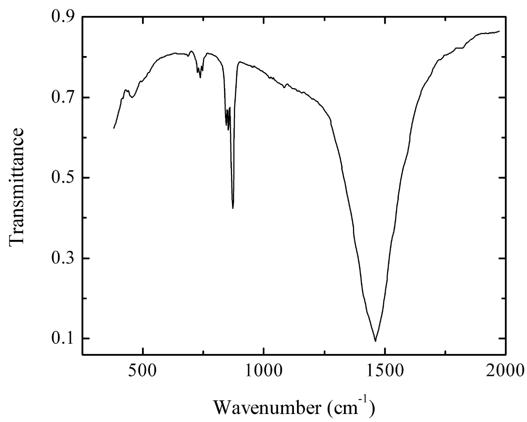


Locality: Promezhutok cave, Kugitang-Tau ridge, Turkmenistan.

Description: White powdery. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 1825w, 1545sh, 1530s, 1512s, 1475sh, 1466s, 1445s, 1114w, 892s, 879, 869s, 847w, 742, 443.

C144 Sahamalite-(Ce) $MgCe_2(CO_3)_4$

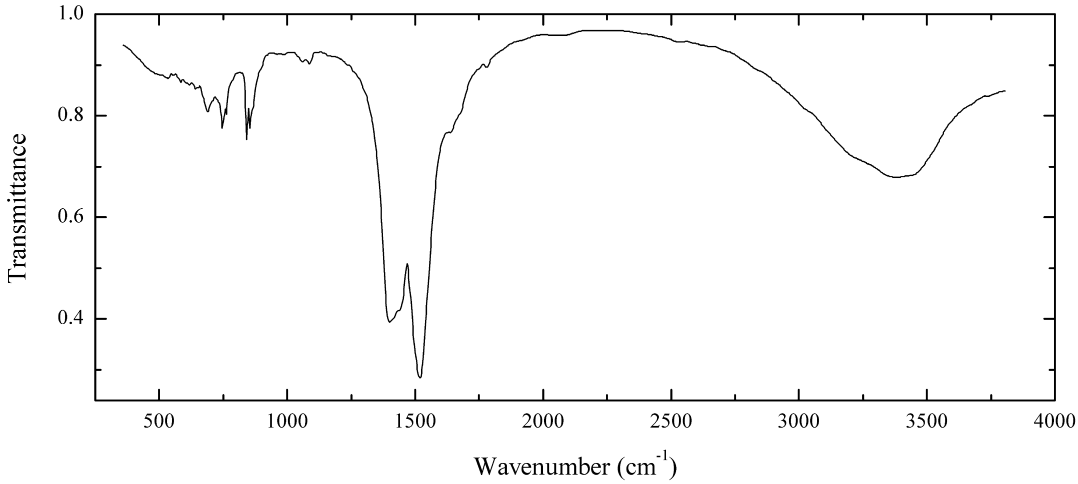


Locality: Sulfide Queen deposit, Mountain Pass mine, San Bernardino Co., California, USA (type locality).

Description: Mustard-yellow grains from coarse-grained calcite carbonatite, from the association with synchysite-(Ce), calcite, barite and witherite. Investigated by I.V. Pekov. Identified by electron microprobe analysis and powder X-ray diffraction pattern.

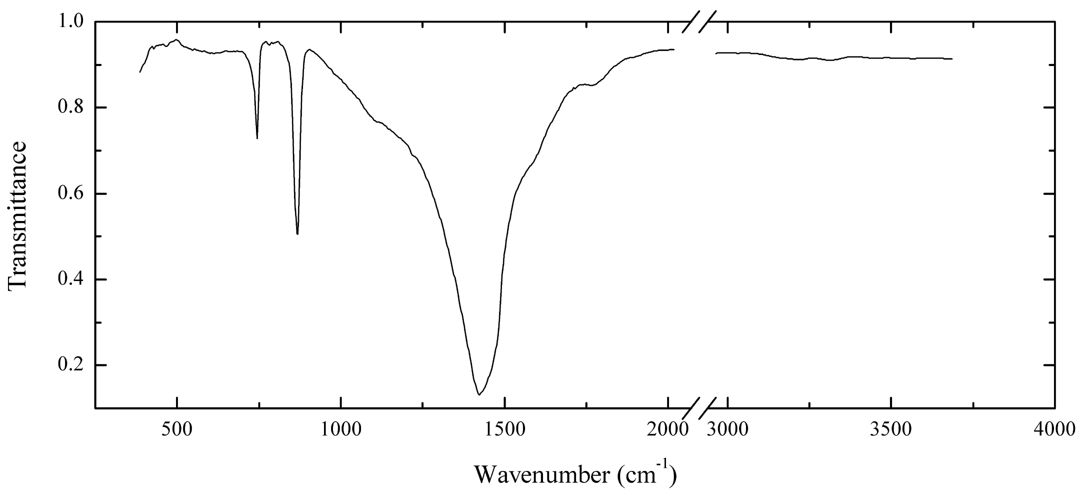
Wavenumbers (cm^{-1}): 1820w, 1457s, 872s, 853, 845, 746w, 738, 730w, 692w, 465.

C145 Lokkaite-(Y) $CaY_4(CO_3)_7 \cdot 9H_2O$



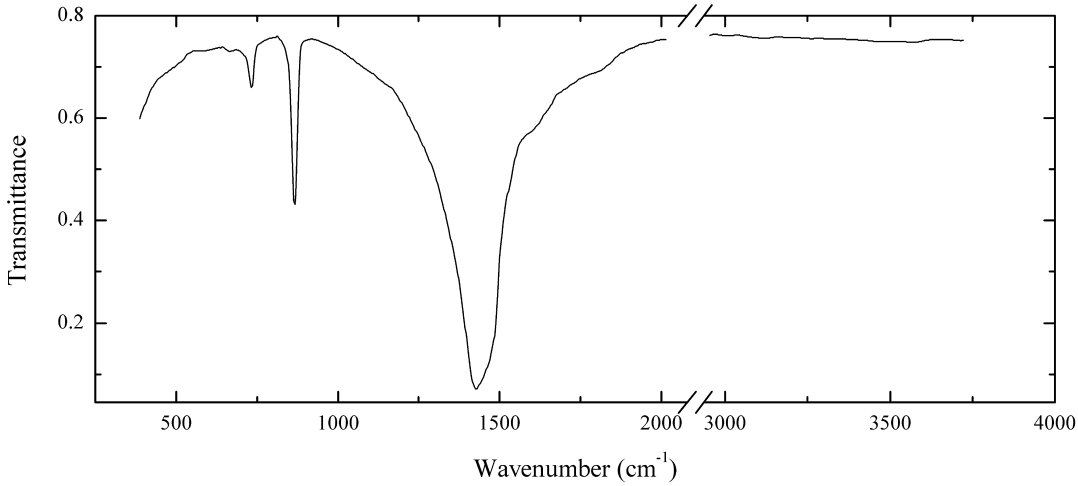
Locality: Karatsu area, Higashi-Matsuura peninsula, Saga prefecture, Kyushu, Japan.
Description: Pinkish scaly aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3370, 3250sh, 1776w, 1670sh, 1630sh, 1535sh, 1515s, 1435sh, 1400s, 1088w, 1060w, 865sh, 854, 841, 760sh, 747, 687.

C146 Smithsonite $Zn(CO_3)$



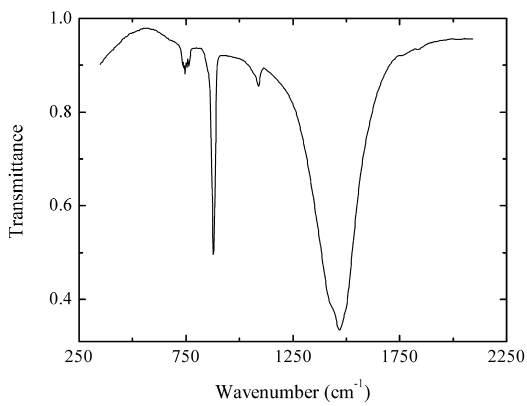
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.
Description: Colourless crystals. The empirical formula is (electron microprobe) $Zn_{0.96}Mg_{0.02}Fe_{0.01}Ca_{0.01}$.
Wavenumbers (cm^{-1}): 1810w, 1550sh, 1422s, 1080sh, 871s, 744.

C147 Spherocobaltite $Co(CO_3)$



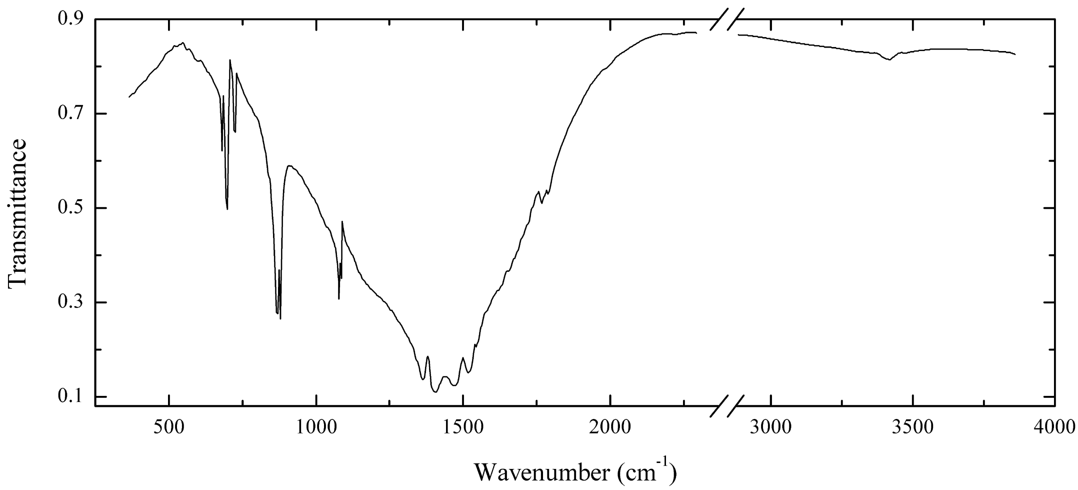
Locality: Siegen, Siegerland, North Rhine-Westphalia, Germany.
Description: Sample number 48944 from the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow. Confirmed by the IR spectrum.
Wavenumbers (cm^{-1}): 1422s, 871s, 740.

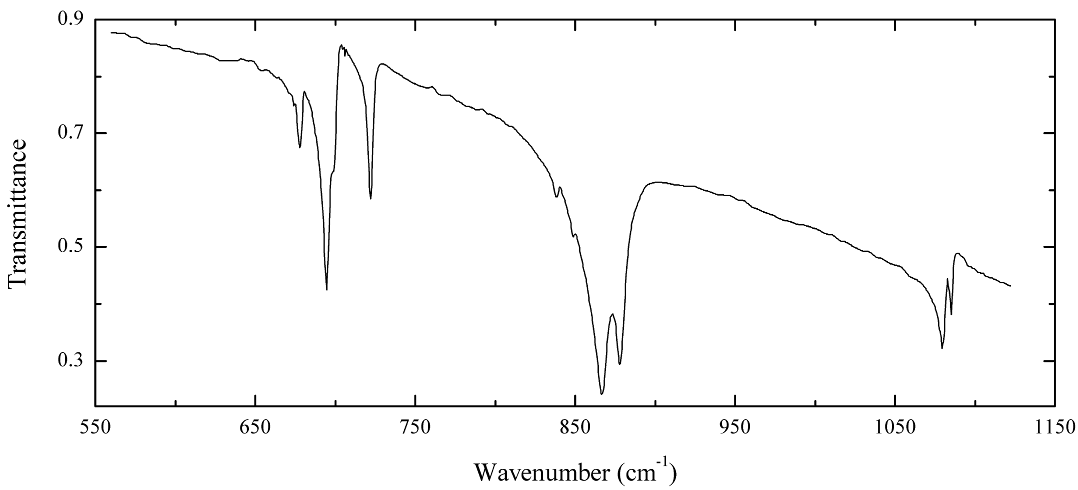
C148 Synchysite-(Ce) $Ca(Ce,La)(CO_3)_2F$



Locality: Narssârssuq pegmatite, Igaliko alkaline complex, South Greenland (type locality).
Description: Brownish crystals.
Wavenumbers (cm^{-1}): 1490sh, 1455s, 1420sh, 1080, 1070sh, 871s, 845sh, 746w, 740w, 735.

C149 Barytocalcite $BaCa(CO_3)_2$



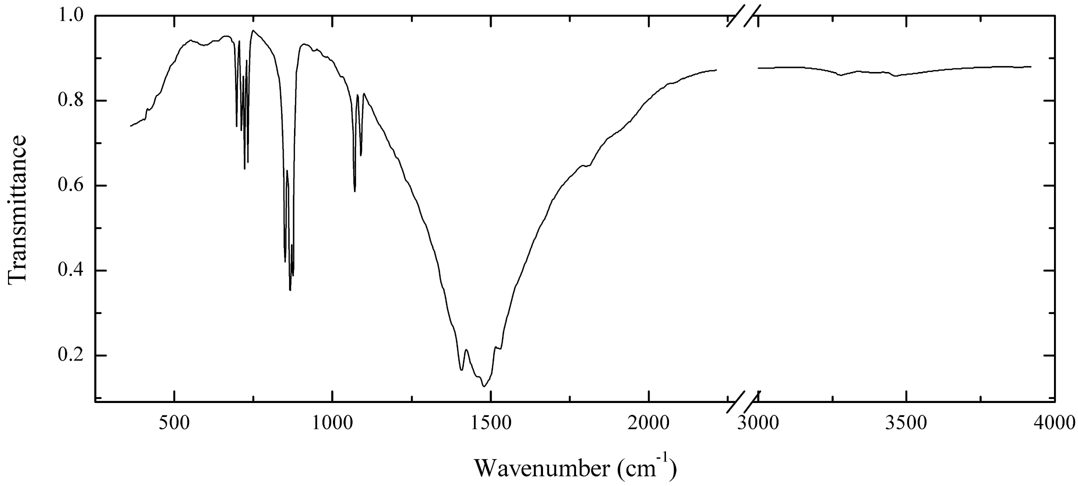


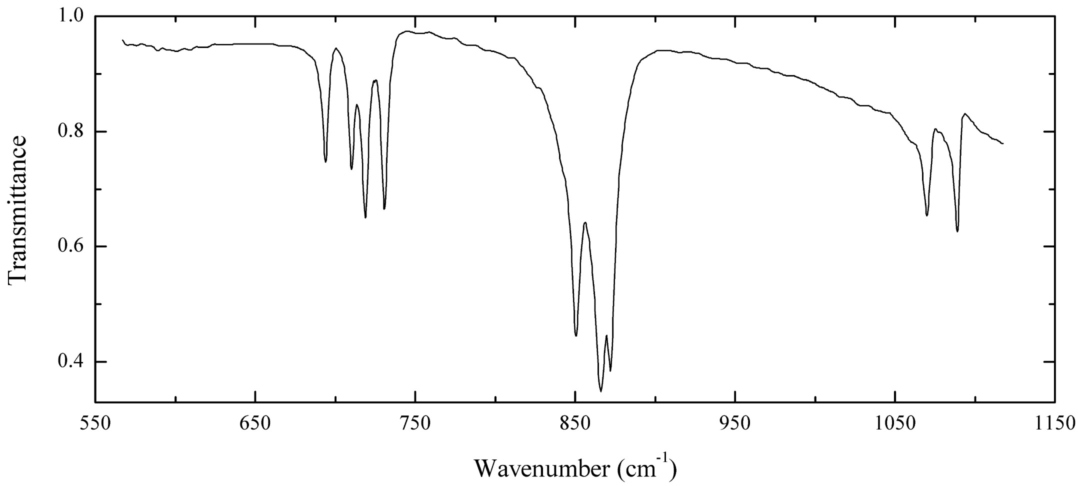
Locality: Kirovskiy apatite mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White fine-grained aggregate from the association with podlesnoite, natrolite, biotite, ilmenite, aegirine, lorenzenite, calcite, fluorite, astrophyllite and burbankite. Investigated by I.V. Pekov. Identified by electron microprobe analysis. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1795w, 1774w, 1600sh, 1520s, 1473s, 1408s, 1368s, 1200sh, 1085, 1079, 879s, 867s, 850sh, 830sh, 723, 695, 678w.

C150 Shortite $Na_2Ca_2(CO_3)_3$



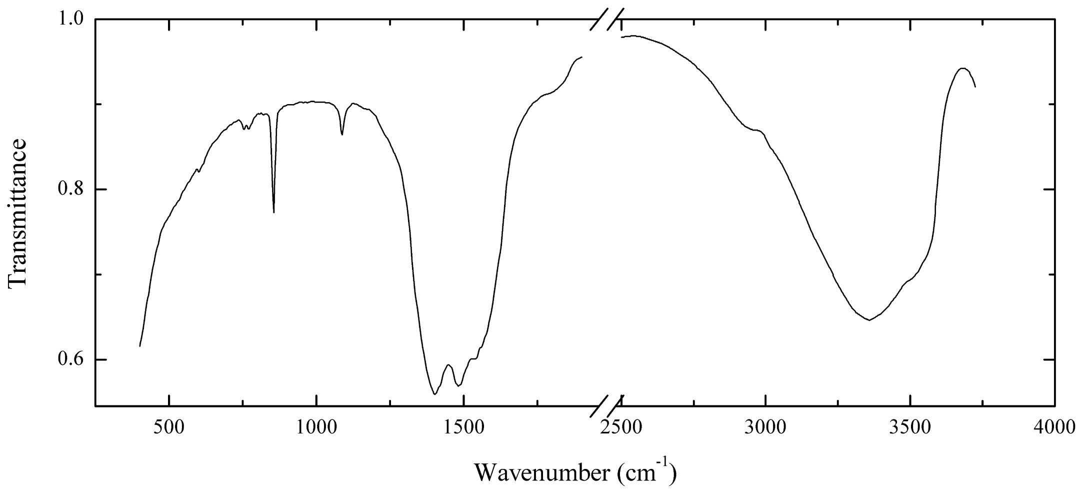


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless grains from the association with potassic feldspar, nepheline, biotite, aegirine, villiaumite, chlorbartonite and thermonatrite. Identified by IR spectrum.

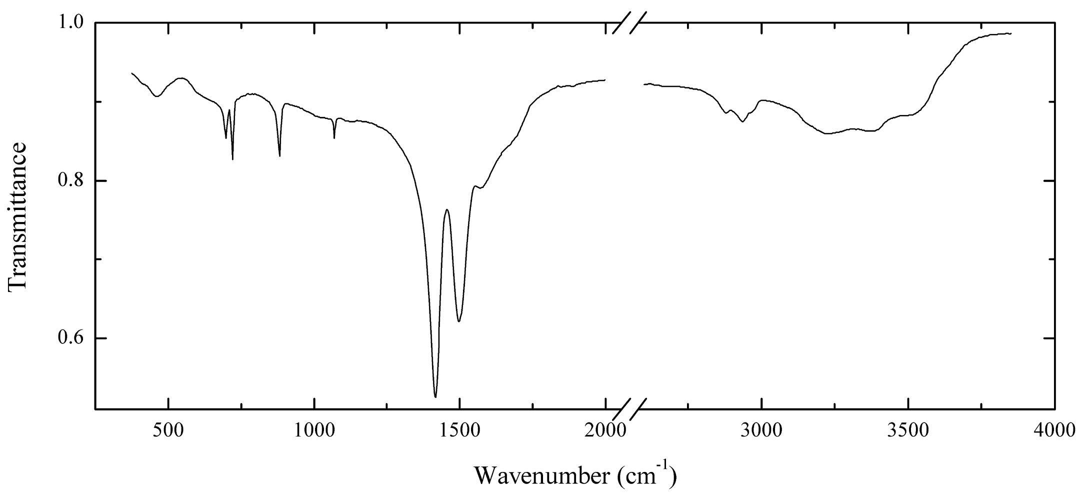
Wavenumbers (cm^{-1}): 1803w, 1550sh, 1527s, 1480s, 1467s, 1408s, 1089. 1070, 872s, 866s, 851s, 845sh, 825w, 731, 719, 710, 694, 595w.

C151 Thorbastnäsite $Th(Ca,\mathit{REE})(CO_3)_2F_2{\cdot}3H_2O$



Locality: Pichekhol' massif, Sangilenskoye upland, Tuva Republic, Russia (type locality).
Description: Brown massive from albitite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3490sh, 3340s, 1650sh, 1560sh, 1505s, 1410s, 1083, 865, 760w, 741w.

C152 Tuliokite $BaNa_6Th(CO_3)_6{\cdot}6H_2O$

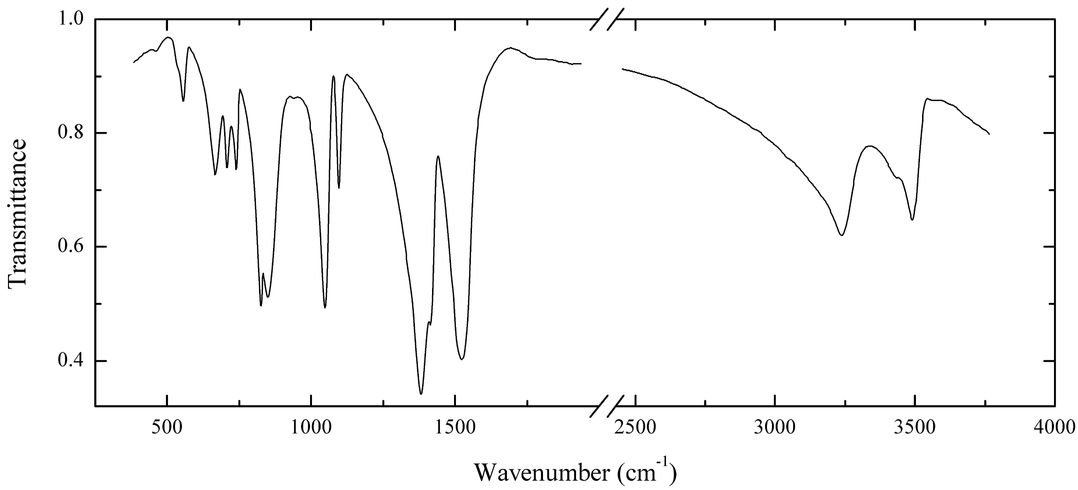


Locality: Kirovskiy apatite mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Dark brown grained aggregate from the association with sidorenkite, vinogradovite, villiaumite and microcline. Holotype sample. The empirical formula is $Ba_{0.99}Ca_{0.02}Na_{5.99}Th_{0.95}Fe_{0.05}(CO_3)_{6.01}\cdot 8.06H_2O$. Trigonal, sp. gr. *R*-3, $a = 14.175(7)$, $c = 8.605(4)$ Å. Uniaxial (+), $\omega = 1.574(2)$, $\varepsilon = 1.587(2)$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (I, %)] are 2.354 (100), 2.674 (90), 7.03 (85), 3.15 (80), 1.959 (65), 4.07 (60), 2.039 (60). Contains admixture of an organic substance (the bands at 2,950, 2,920, 2,865 and 1,560 cm^{-1}).

Wavenumbers (cm^{-1}): 3490, 3350, 3200, 2950sh, 2920, 2865, 1660sh, 1560, 1493s, 1408s, 1065, 872, 712, 690.

C153 Rosasite $(Cu^{2+},Zn)_2(CO_3)(OH)_2$

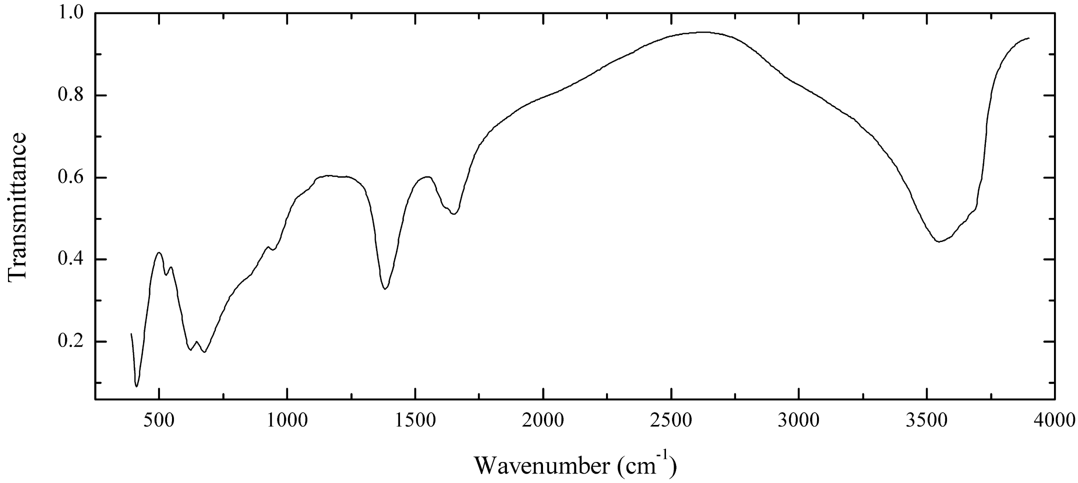


Locality: Ojuela mine, Mapimi, Durango, Mexico.

Description: Radial bluish-green aggregates. The empirical formula is (electron microprobe) $Cu_{1.24}Zn_{0.76}(CO_3)(OH)_2$.

Wavenumbers (cm^{-1}): 3490, 3425w, 3235, 1528s, 1416s, 1382s, 1099, 1049s, 851s, 827s, 737, 705, 667, 553, 535sh.

C154 Stichtite $Mg_6Cr_2(CO_3)(OH)_{16}·4H_2O$

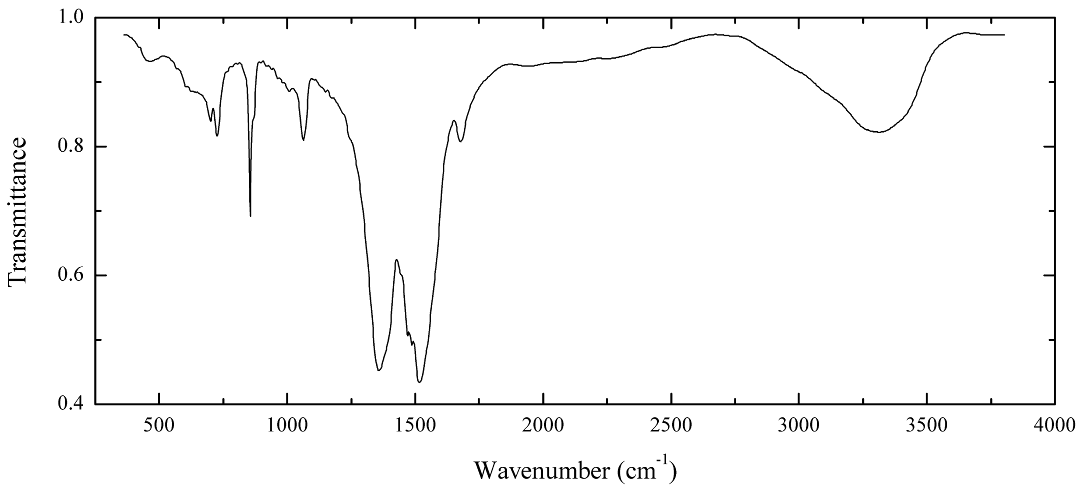


Locality: Dundas, Zeehan district, Tasmania, Australia

Description: Lilac scaly aggregate in serpentine, in the association with chromite. The empirical formula is (electron microprobe) $(Mg_{5.7}Fe_{0.3})(Cr_{1.2}Fe_{0.7}Al_{0.1})(CO_3)(OH)_{16}·4H_2O$.

Wavenumbers (cm^{-1}): 3650sh, 3525s, 1645, 1610sh, 1380, 1082sh, 952, 850sh, 663s, 616s, 522, 400s.

C155 Donnayite-(Y) $Sr_3NaCaY(CO_3)_6·3H_2O$

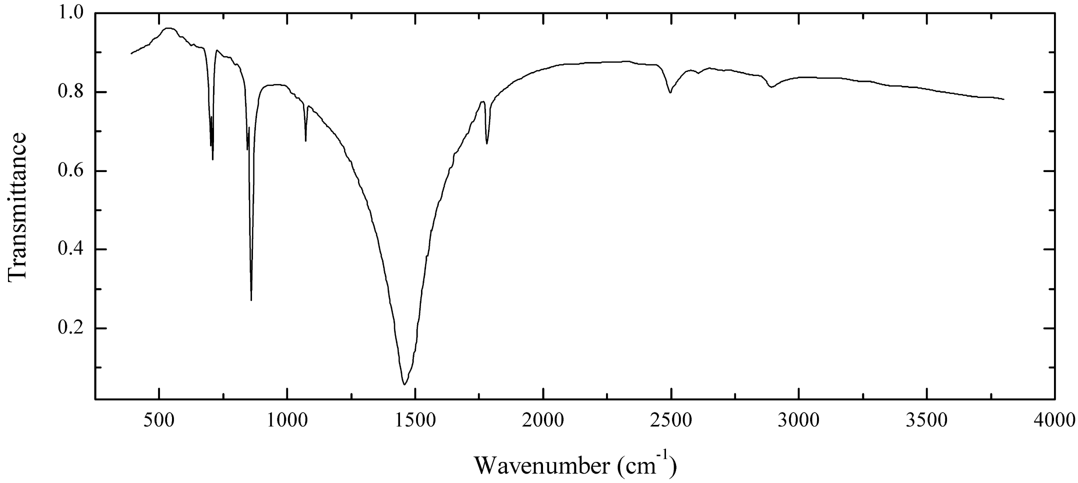


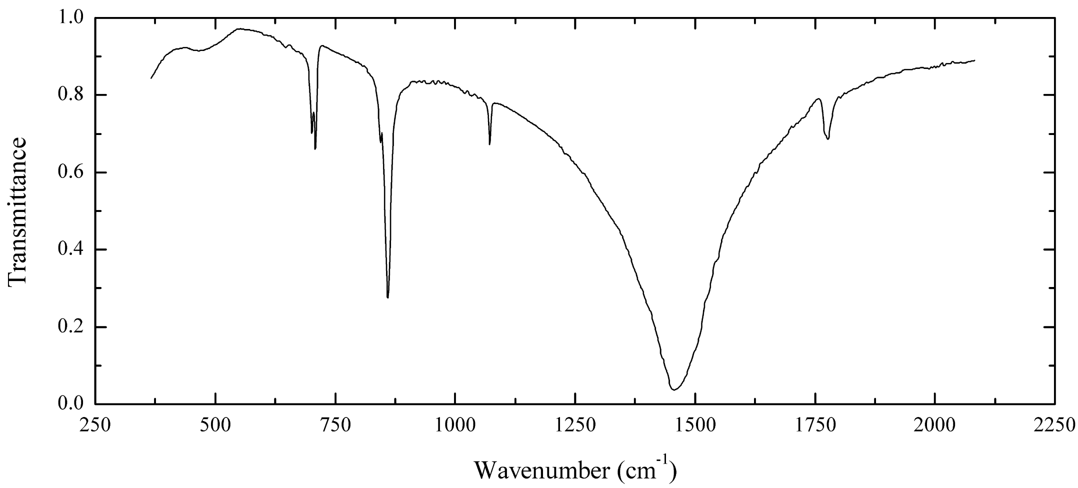
Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Greenish-grey spherulites from the association with analcime, albite and bitumen. The empirical formula is (electron microprobe) $Sr_{2.8}Ba_{0.2}Na_{0.9}Ca_{1.2}Y_{0.8}\mathit{REE}_{0.1}(CO_3)_6·nH_2O$.

Wavenumbers (cm^{-1}): 3290, 1682, 1545sh, 1520s, 1492s, 1472s, 1364s, 1064, 870sh, 857, 725, 699, 650sh, 470w.

C156 Strontianite $Sr(CO_3)$



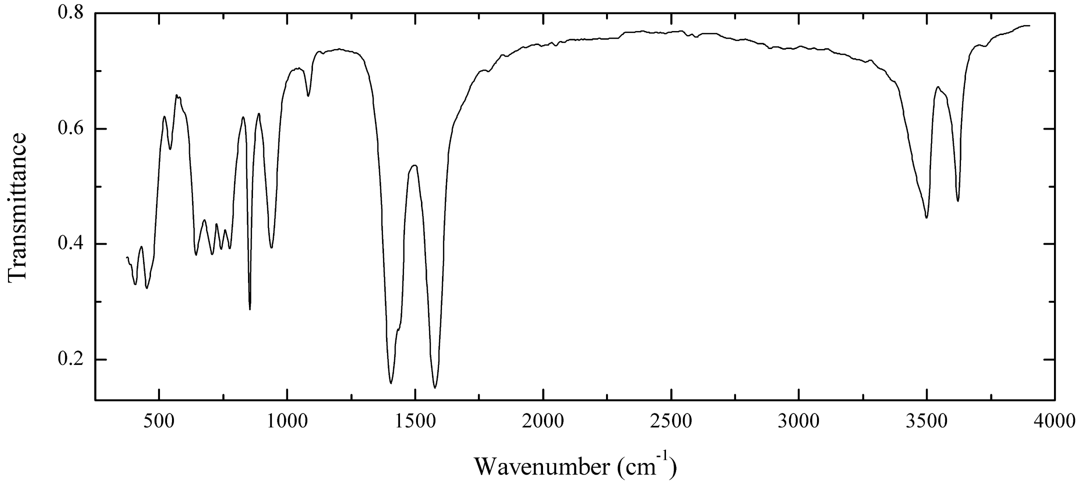


Locality: Kapitalnaya mine, Vishnevye Mts., South Urals, Russia.

Description: Light green cluster of acicular crystals from the association with microcline, aegirine, biotite and calcite. The empirical formula is (electron microprobe) $Sr_{0.96}Ca_{0.03}Ba_{0.01}(CO_3)$.

Wavenumbers (cm^{-1}): 2870w, 2500sh, 2480w, 1778, 1458s, 1072, 859s, 843, 707, 700.

C157 Pokrovskite $Mg_2(CO_3)(OH)_2{\cdot}0.5H_2O$



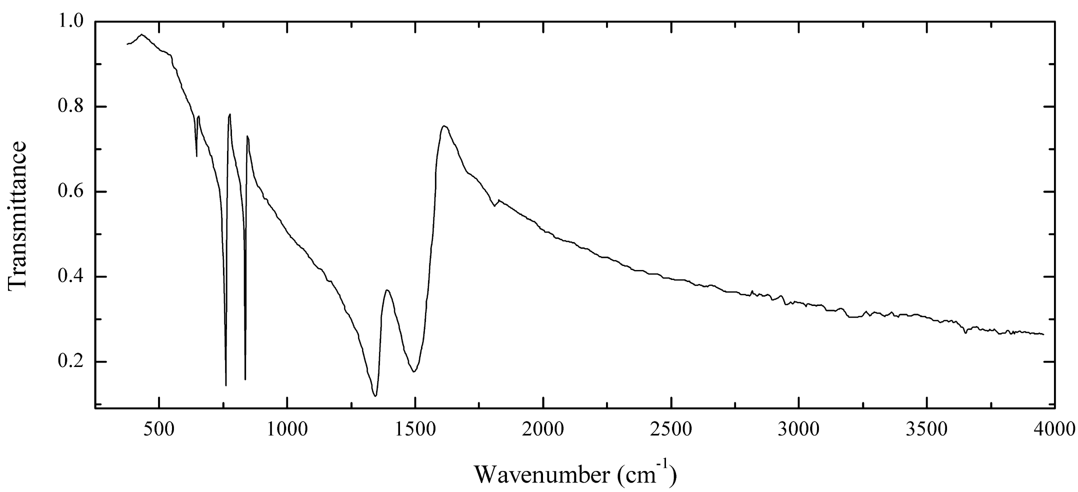
Locality: Borehole number 93, Zlatogorsk ultramafic intrusive, near Zlatogorsk, north Kazakhstan (type locality).

Description: White radial aggregates from the association with Dolomite, magnesite and sjögrenite. Holotype sample. The empirical formula is $Mg_{1.93}Fe_{0.04}Mn_{0.02}(CO_3)(OH)_2{\cdot}0.42H_2O$.

Monoclinic, space group $P2_1/a$ (?); $a = 9.43(1)$, $b = 12.27(1)$, $c = 3.395(3)$ Å, $\beta = 96.60(9)°$. Biaxial (−), $\alpha = 1.537$, $\beta = 1.619$, $\gamma = 1.619$. $D_{meas} = 2.51–2.52$ g/cm^3. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.60 (100), 2.17 (90), 6.10 (70), 4.70 (70), 3.73 (70), 1.661 (70), 1.385 (50).

Wavenumbers (cm^{-1}): 3610, 3490, 3465sh, 1795w, (1660sh), 1576s, 1440sh, 1404s, 1086w, 939, 852s, 775, 740, 705, 643, 540w, 450, 405.

C158 Phosgenite $Pb_2(CO_3)Cl_2$

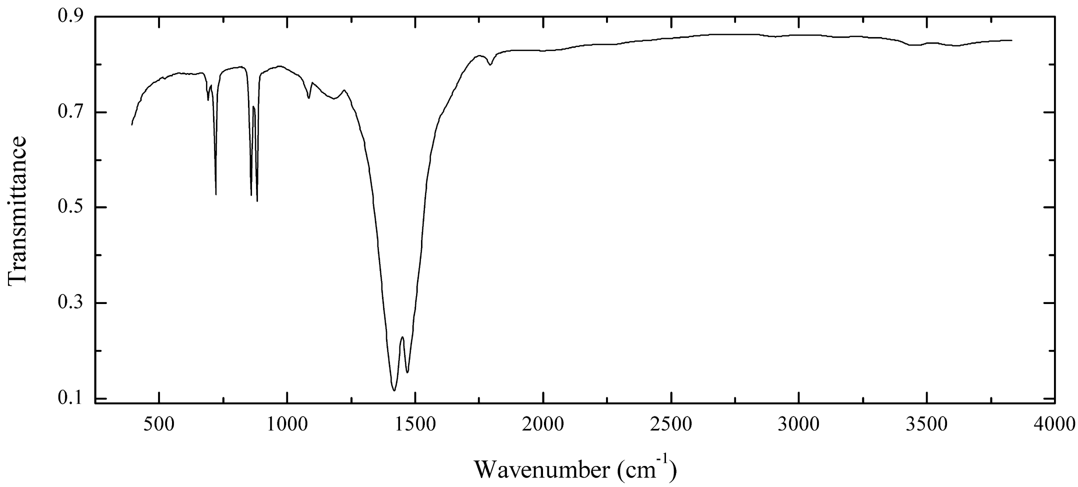


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Yellow transparent crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3625w, 1820w, 1505s, 1344s, 836s, 758s, 647, 600sh.

C159 Huanghoite-(Ce) $BaCe(CO_3)_2F$

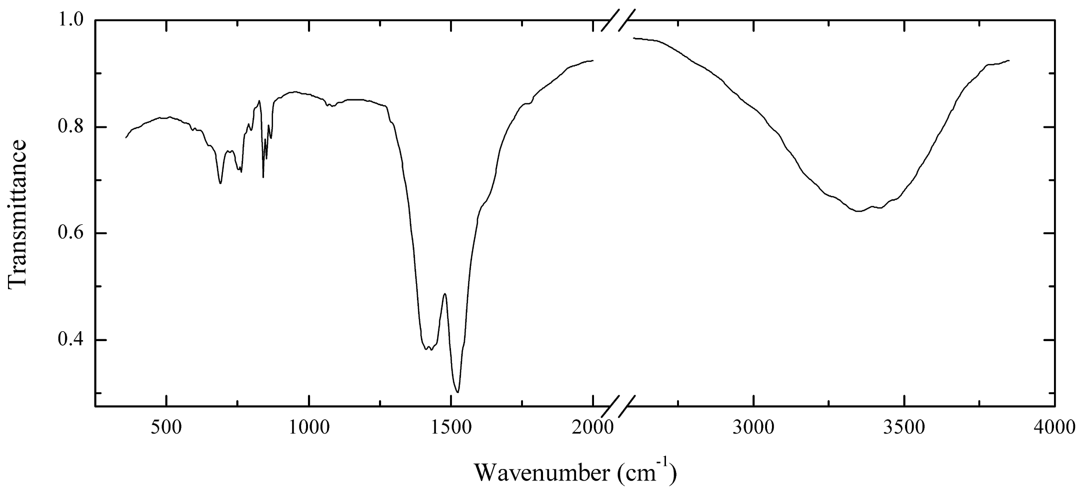


Locality: Bayan Obo, Inner Mongolia, China (type locality).

Description: Honey-yellow grains from the association with aegirine, fluorite, monazite and bastnäsite-(Ce). Investigated by V.I. Stepanov.

Wavenumbers (cm^{-1}): 1800w, 1475s, 1418s, 1185w, 1093w, 882, 859, 718, 692w.

C160 Lokkaite-(Y) $CaY_4(CO_3)_7{\cdot}9H_2O$

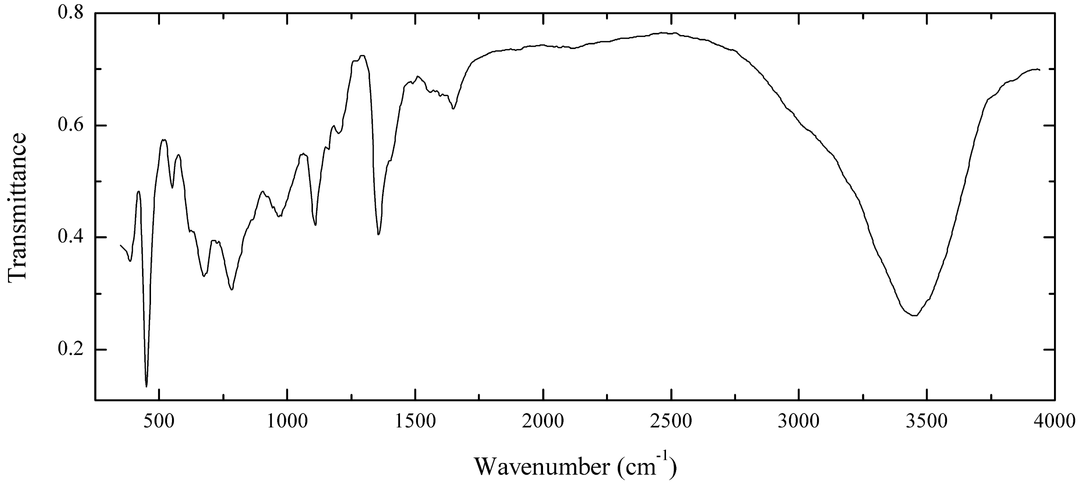


Locality: Pyörönmaa quarry, Kangasala, Finland (type locality).

Description: Colourless platy crystals from the association with fergusonite-(Y). The empirical formula is (electron microprobe) $Ca_{0.95}(Y_{3.66}Dy_{0.21}Gd_{0.16})(CO_3)_7{\cdot}9H_2O$.

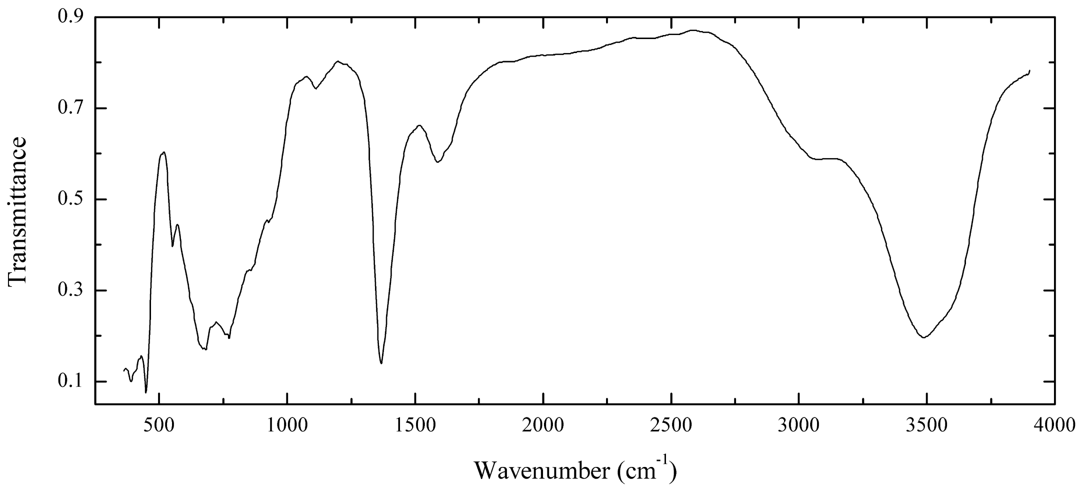
Wavenumbers (cm^{-1}): 3350s, 1770sh, 1625sh, 1524s, 1427s, 1085w, 1063w, 865, 851, 838, 797w, 764, 750, 698.

C161 Motukoreaite $Na_2Mg_{38}Al_{24}(CO_3)_{13}(SO_4)_8(OH)_{108}·56H_2O$



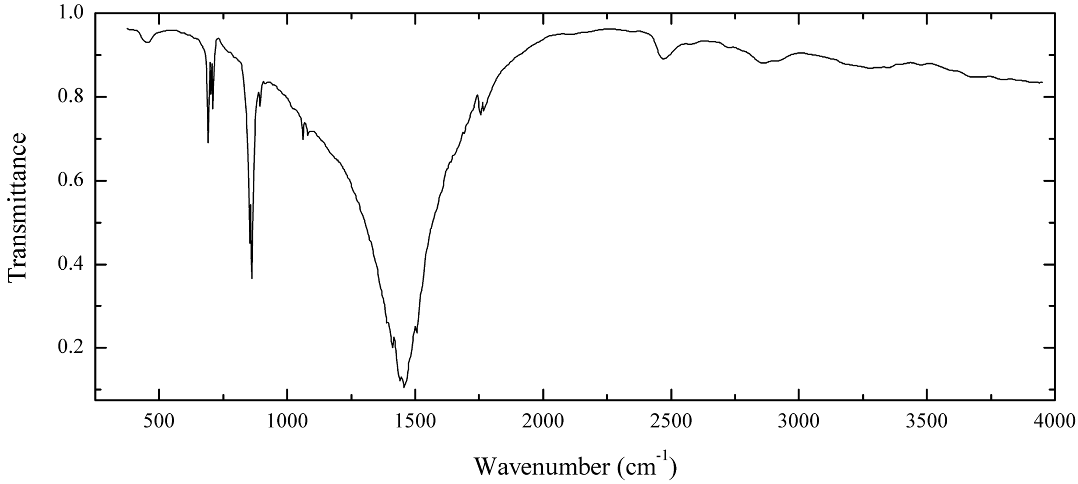
Locality: Brown's island (Motukorea), Waitemata Harbor, Auckland, New Zealand (type locality).
Description: Massive aggregate from the association with calcite, gypsum, barite, hisingerite and zeolites. The empirical formula is $Na_{9.3}(Mg_{33.8}Fe_{3.4}Mn_{0.7}Al_{24.1})(CO_3)_{6.5}Cl_{4.5}(SO_4)_{2.8}(OH,H_2O)_{164}$.
Wavenumbers (cm^{-1}): 3440s, 1650, 1605w, 1560w, 1400sh, 1362, 1204w, 1160w, 1108, 970, 860sh, 783s, 676s, 620, 550, 448s, 386.

C162 Quintinite-3*T* $Mg_4Al_2(CO_3)(OH)_{12}·3H_2O$



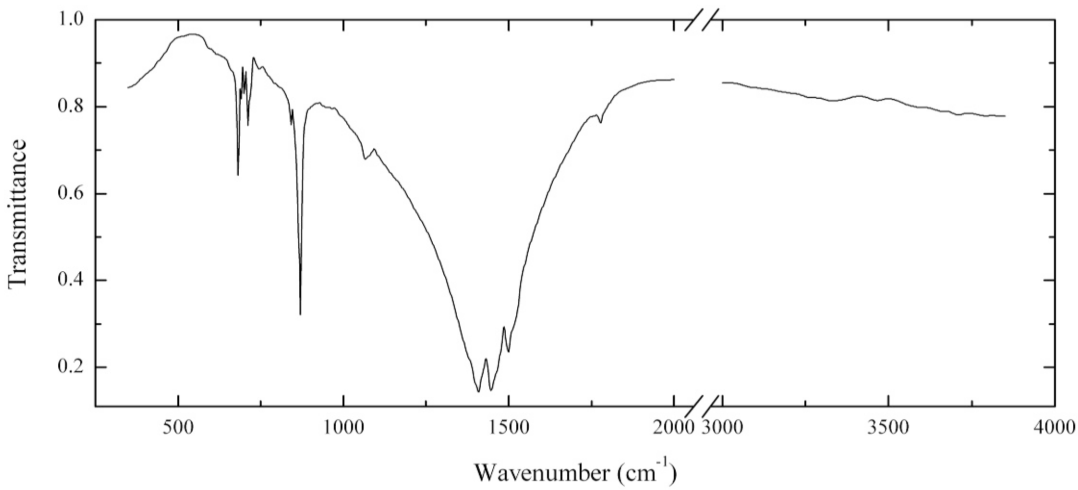
Locality: Kuh-i Lal ruby spinel deposit, SW Pamir Mts., Tajikistan.
Description: Pink scaly aggregate. SO_4-bearing variety.
Wavenumbers (cm^{-1}): 3560sh, 3475s, 3060, 1630sh, 1595, 1372s, 1112w, 1025sh, 850sh, 760s, 673s, 550, 457s, 387s.

C163 Alstonite $BaCa(CO_3)_2$



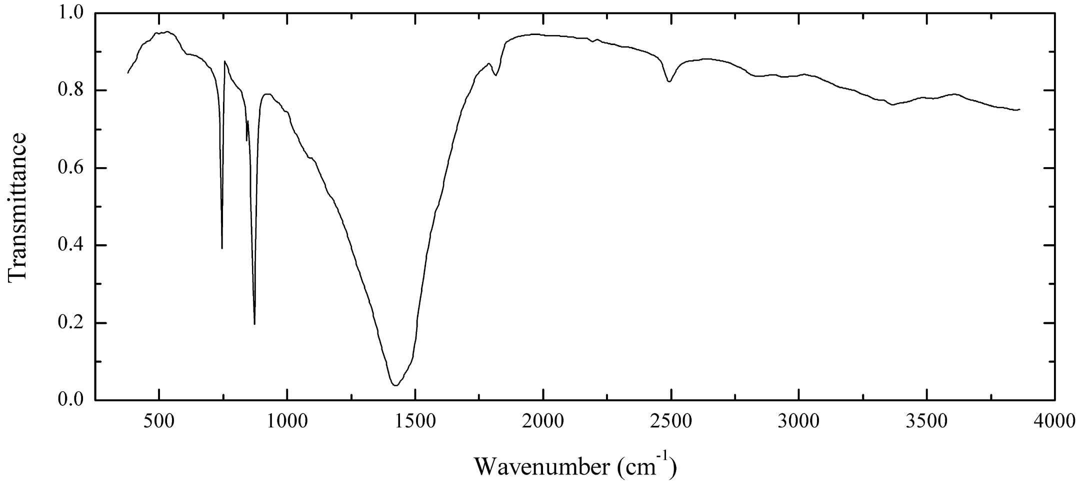
Locality: Fallowfield Mine, Acomb, Hexham, Tyne Valley, Northumberland, England, UK.
Description: Grey-grained aggregate, from the association with barite, aragonite and witherite. The empirical formula is (electron microprobe) $Ba_{0.85}Sr_{0.13}Ca_{1.02}(CO_3)_2$.
Wavenumbers (cm^{-1}): 3290w, 2905w, 2850w, 2485w, 1755w, 1502s, 1458s, 1439s, 1410s, 1390sh, 1080w, 1059w, 894w, 862s, 854, 715sh, 709, 702, 691.

C164 Benstonite $(Ba,Sr)_6Ca_6Mg(CO_3)_{13}$



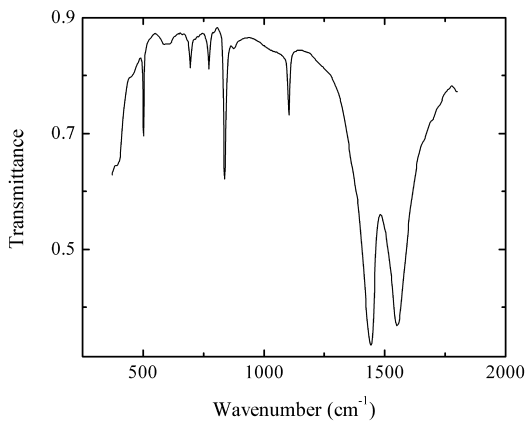
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: White grained aggregate from the association with britvinite. Pb-bearing variety. The empirical formula is $Ba_{5.48}Pb_{0.58}Ca_{5.78}Sr_{0.03}Mg_{1.12}(CO_3)_{13}$.
Wavenumbers (cm^{-1}): 2900w, 1782w, 1502s, 1450s, 1412s, 1080sh, 1068w, 871s, 845w, 744w, 720, 712, 701w, 691, 684.

C165 Smithsonite $Zn(CO_3)$



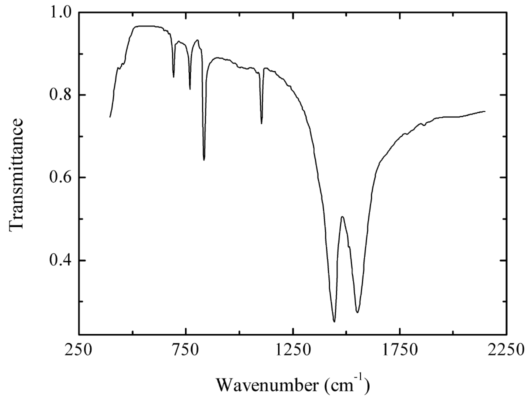
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.
Description: Light greenish-blue. Cu-bearing variety.
Wavenumbers (cm^{-1}): 3350w, 2928w, 2832w, 2480w, 1814w, 1425s, 869s, 839, 743.

C166 Horváthite-(Y) $NaY(CO_3)F_2$



Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).
Description: White prismatic crystals from the association with microcline, aegirine, dawsonite, natrolite and albite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1795w, 1553s, 1440s, 1105, 836, 770, 693.

C167 Horváthite-(Y) $NaY(CO_3)F_2$

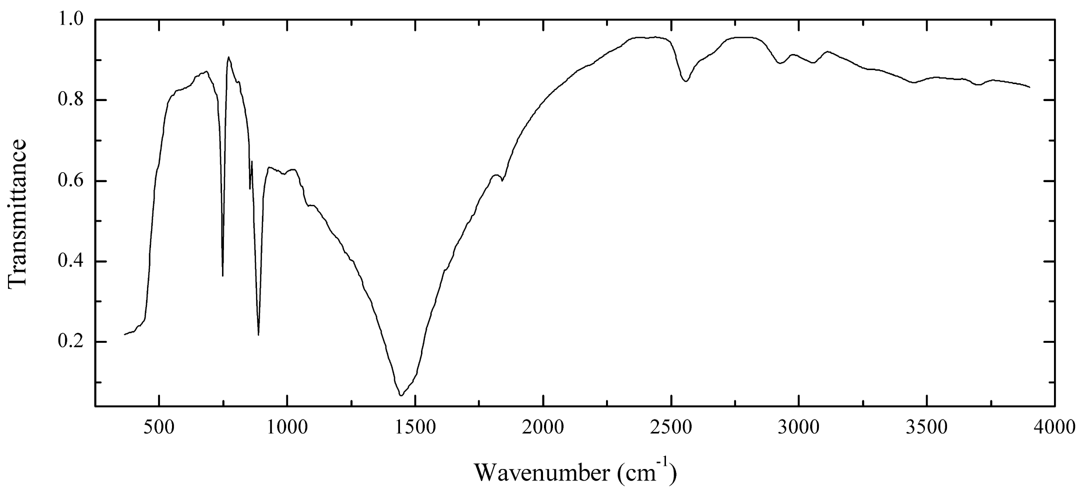


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: White prismatic crystals. Specimen No. 89060 from the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1870w, 1790w, 1550s, 1441s, 1103, 837, 771, 694.

C168 Magnesite $Mg(CO_3)$

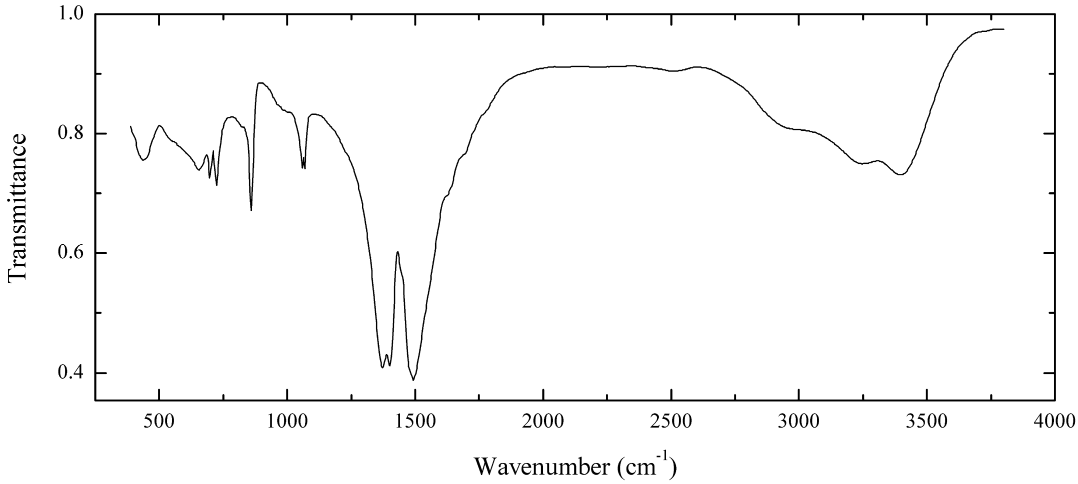


Locality: Inder boron deposit, Kazakhstan.

Description: Colourless tabular crystals from the association with sulfoborite. Identified by IR spectrum. Close to $Mg(CO_3)$ endmember.

Wavenumbers (cm^{-1}): 3665w, 3415w, 3035w, 2900w, 2650w, 2590w, 2525, 1834, 1445s, 1075sh, 985w, 887s, 855, 748, 425sh.

C170 Ewaldite $Ba(Ca,Y,Na,K)(CO_3)_2 \cdot nH_2O$

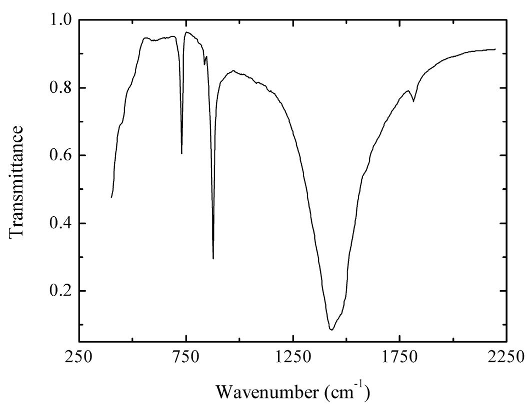


Locality: Kirovskiy apatite mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Beige crystals from the association with natrolite, calcite and vinogradovite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3390, 3250, 2950sh, 1690sh, 1620sh, 1494s, 1485sh, 1397s, 1367s, 1072, 1063, 859, 722, 696, 660, 440.

C171 Dolomite $CaMg(CO_3)_2$

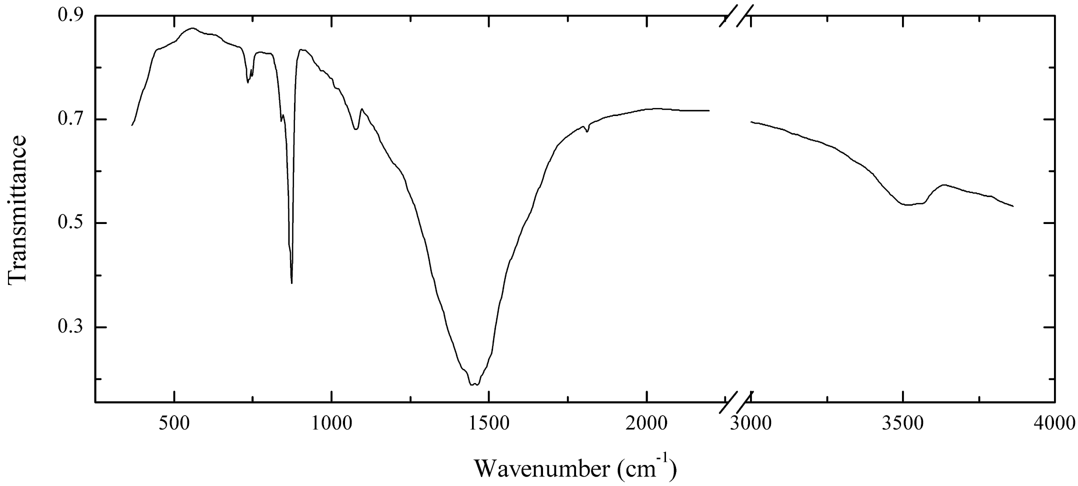


Locality: Bayan Obo, Inner Mongolia, China.

Description: Brown grains from the association with fluorite and fluorapatite. The empirical formula is (electron microprobe) $Ca_{0.99}(Ce_{1.12}Nd_{0.53}La_{0.36})(CO_3)_3F_{1.78}(OH)_{0.22}$.

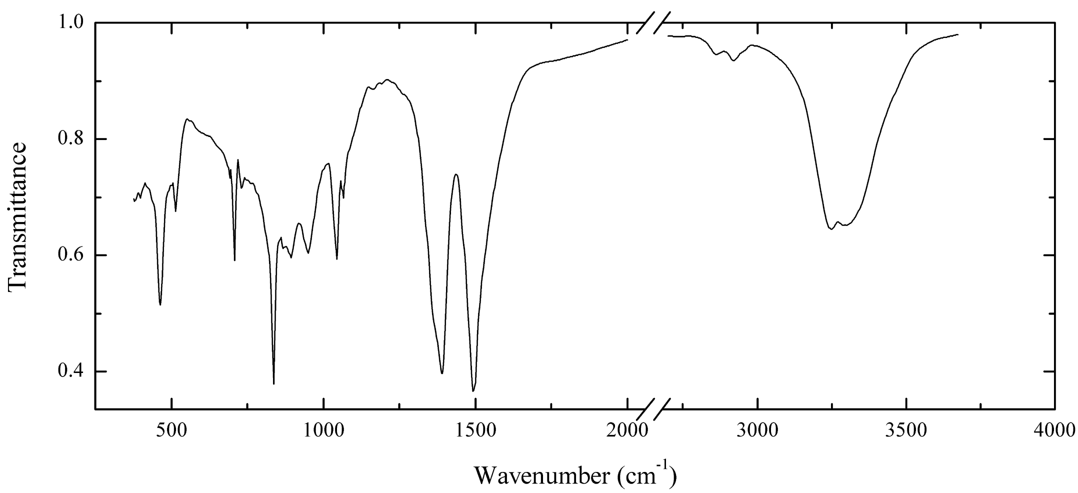
Wavenumbers (cm^{-1}): 1810w, 1458s, 1420sh, 1075, 870s, 865sh, 842, 743sh, 732.

C173 Parisite-(Ce) $CaCe_2(CO_3)_3F_2$



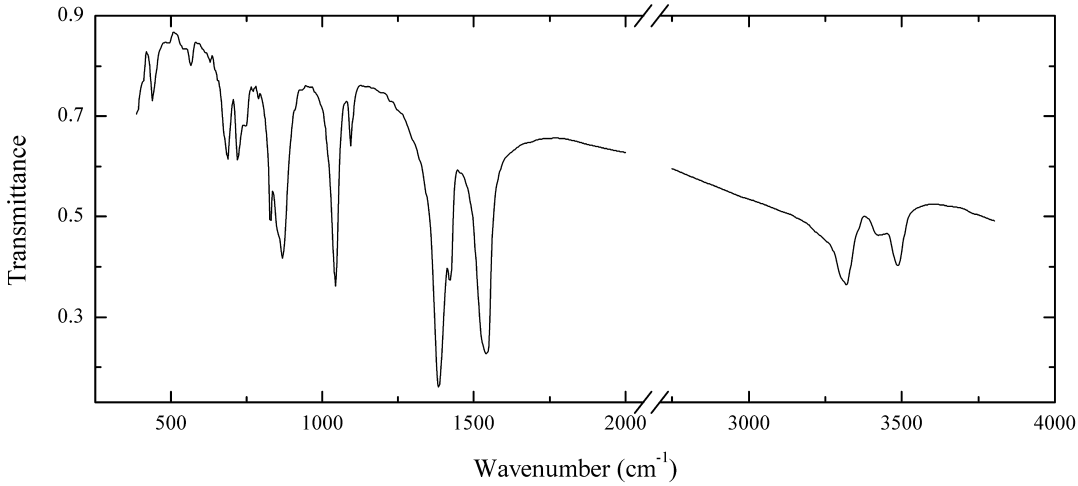
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: Cream-coloured grained aggregate. The empirical formula is (electron microprobe) $Ca_{0.96}Mg_{0.74}Mn_{0.20}Fe_{0.10}(CO_3)_2$.
Wavenumbers (cm^{-1}): 1820w, 1480sh, 1436s, 882s, 853w, 729.5.

C174 Hydrozincite $Zn_5(CO_3)_2(OH)_6$



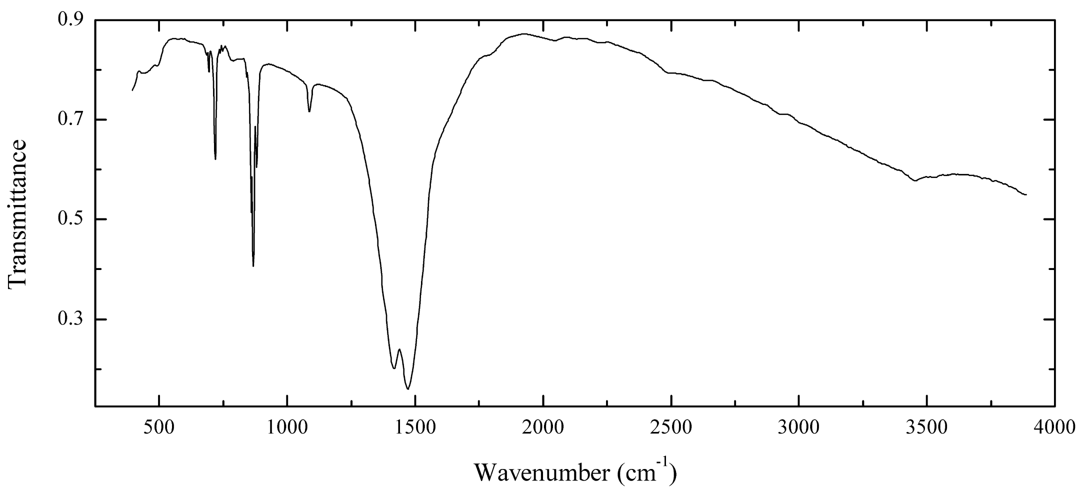
Locality: Taylor's Cave, Las Piedras, Comayagua, Honduras.
Description: White massive. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3275, 3230, 1499s, 1390s, 1064, 1046, 950, 892, 834s, 706, 515, 468.

C176 Glaukosphaerite $(Cu,Ni)_2(CO_3)(OH)_2$



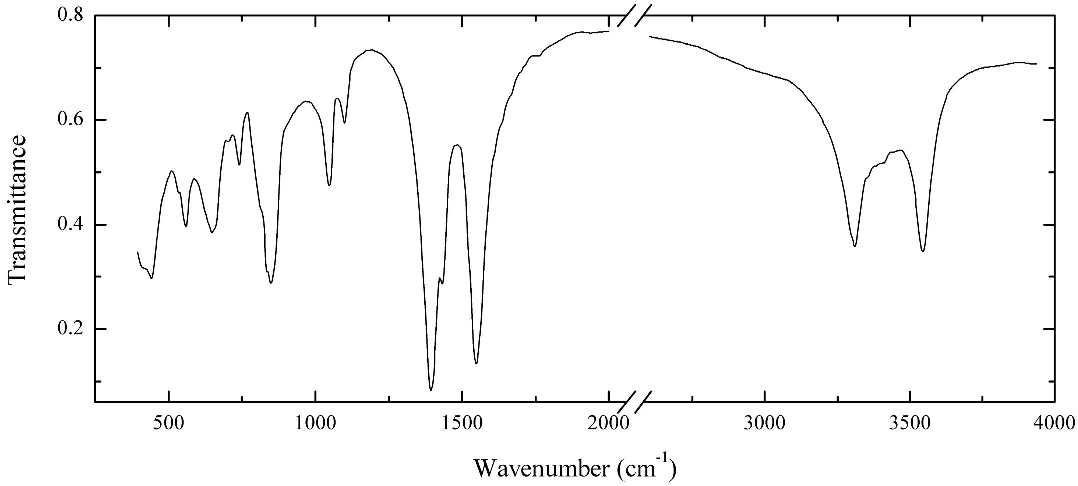
Locality: #132 North mine, 4 km SW of Widgiemooltha, W. Australia.
Description: Green spherulites from the association with gillardite. The empirical formula is (electron microprobe) $Cu_{0.96}Ni_{0.86}Mg_{0.09}Zn_{0.06}Fe_{0.03}(CO_3)(OH)_2$.
Wavenumbers (cm^{-1}): 3478, 3415w, 3305, 1543s, 1427s, 1386s, 1093, 1042s, 867s, 828s, 747, 718, 686, 564w, 540w, 440.

C177 Zhonghuacerite-(Ce) $Ba_2Ce(CO_3)_3F$



Locality: Bayan Obo, Inner Mongolia, China (type locality).
Description: Brown-grained aggregate from the association with fluorite, parisite-(Ce) and barite. The empirical formula is (electron microprobe) $Ba_{2.1}(Ce_{0.6}La_{0.2}Nd_{0.1})(CO_3)_{2.9}F_{1.1}$.
Wavenumbers (cm^{-1}): 3460w, 2600w, 1800w, 1477s, 1424s, 1085, 881, 867, 860, 792w, 718, 692w, 490w.

C178 Mcguinnessite $(Mg,Cu^{2+})_2(CO_3)(OH)_2$

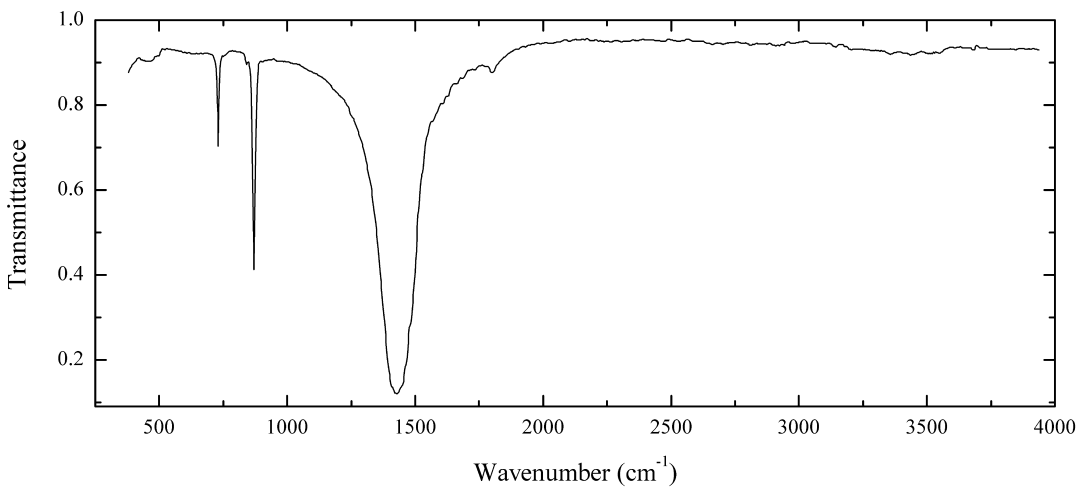


Locality: Railway station Mauk, Chelyaninsk region, South Urals, Russia.

Description: Bluish-green veinlet in serpentinite. The empirical formula is (electron microprobe) $Mg_{1.05}Cu_{0.84}Zn_{0.08}Fe_{0.03}(CO_3)(OH)_2$.

Wavenumbers (cm^{-1}): 3345s, 3310s, 1555s, 1440s, 1395s, 1098, 1047, 848s, 833, 810sh, 738, 703w, 648, 558, 533w, 446s, 415sh.

C179 Rhodochrosite $Mn(CO_3)$

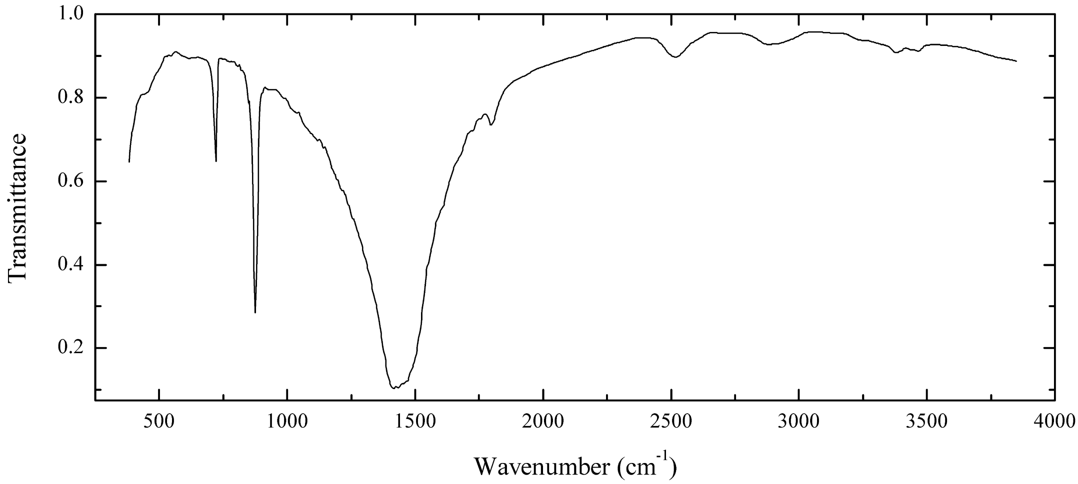


Locality: Railway station Mauk, Chelyaninsk region, South Urals, Russia.

Description: White conchoidal aggregate from the association with calcite and barite. The empirical formula is (electron microprobe) $Mn_{0.78}Fe_{0.13}Ca_{0.06}Mg_{0.03}(CO_3)$.

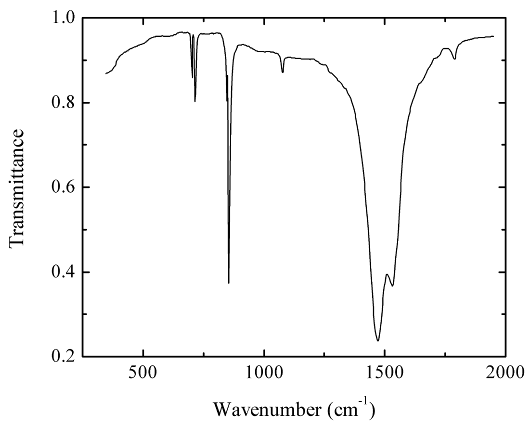
Wavenumbers (cm^{-1}): 1800w, 1429s, 868.5s, 842w, 728.

C181 Calcite $Ca(CO_3)$



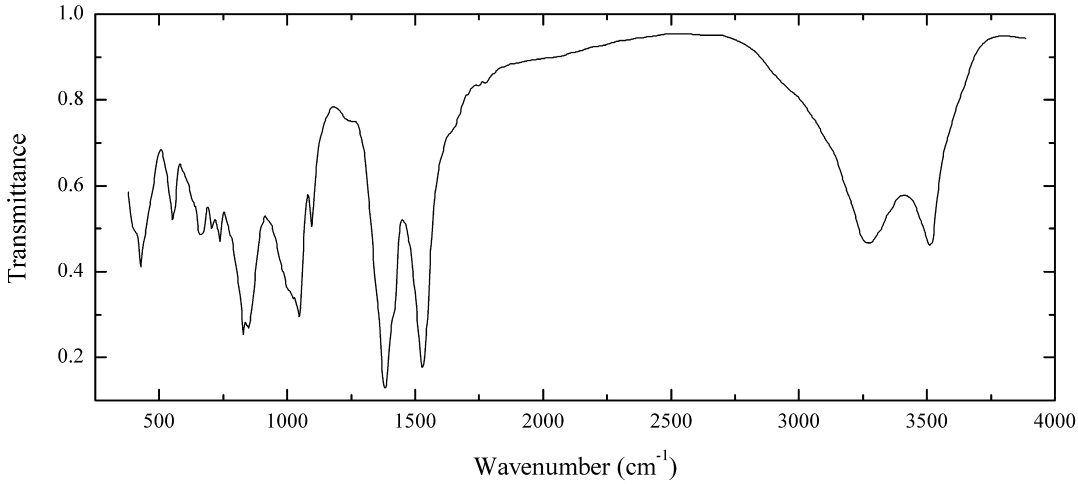
Locality: Sasa mine, Probistip, Macedonia.
Description: White fine-grained aggregate. Mn-rich variety. The empirical formula is (electron microprobe) $Ca_{0.7}Mn_{0.3}(CO_3)$.
Wavenumbers (cm^{-1}): 3435w, 3350w, 2870w, 2500w, 1795, 1420s, 874s, 848w, 720.

C182 Aragonite $Ca(CO_3)$



Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.
Description: White acicular crystals. Identified by IR spectrum. Confirmed by electron microprobe analysis. The contents of Mg, Mn, Fe and Sr are below their detection limits.
Wavenumbers (cm^{-1}): 1785w, 1533s, 1470s, 1083w, 854.5s, 844, 713, 700.

C184 Zincrosasite $(Zn,Cu^{2+})_2(CO_3)(OH)_2$

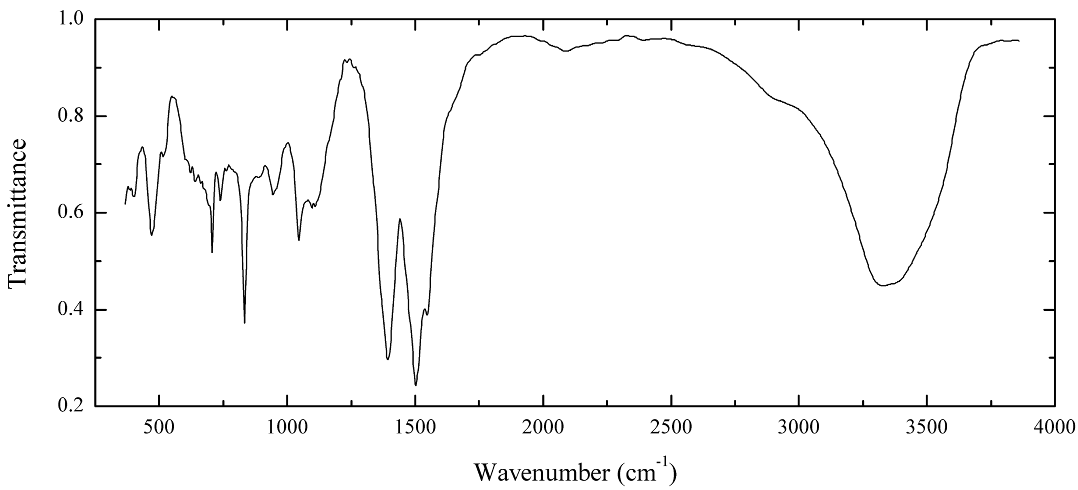


Locality: Remšnik mine, Radlje ob Dravi, Slovenia.

Description: Light green fibrous. The empirical formula is (electron microprobe) $Zn_{0.98}Cu_{0.96}Fe_{0.06}(CO_3)(OH)_2$.

Wavenumbers (cm^{-1}): 3495s, 3255s, 1640sh, 1530s, 1420sh, 1385s, 1250w, 1098, 1048s, 1020sh, 849s, 828s, 738, 705, 665, 553, 428, 410sh.

C185 Brianyoungite $Zn_3(CO_3,SO_4)(OH)_4$

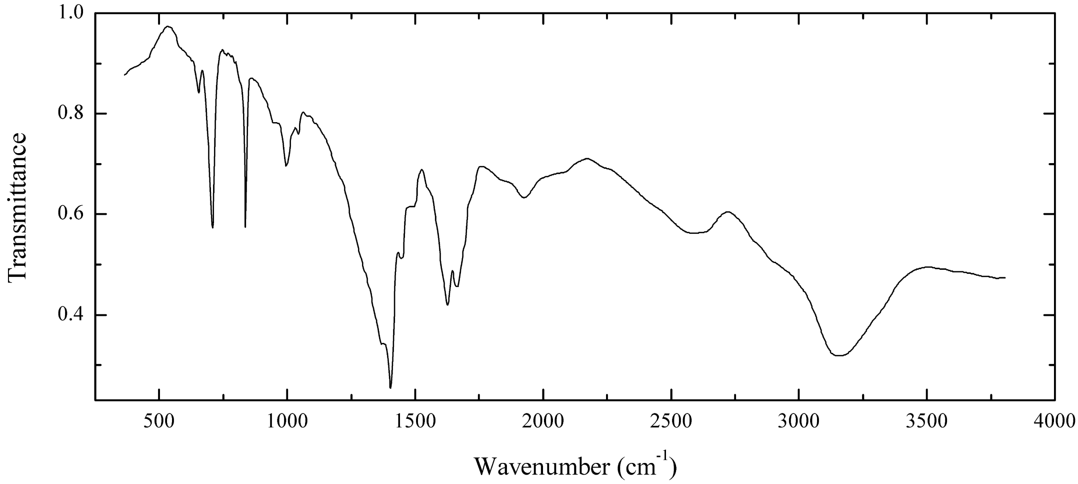


Locality: Lill mine, Příbram, Central Bohemia region, Czech Republic.

Description: White crust. S-deficient variety. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3375s, 3310s, 2950sh, 2090w, 1550s, 1505s, 1398s, 1102, 1047, 945, 890w, 835s, 739, 709, 640w, 512w, 470, 400.

C186 Teschemacherite $(NH_4)(HCO_3)$

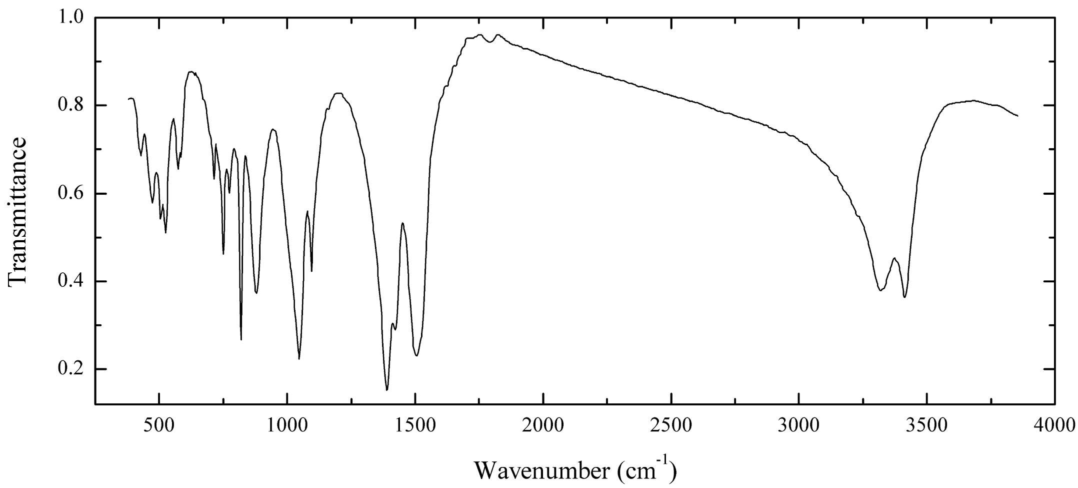


Locality: Chincha islands, Peru.

Description: White powdery from Guano. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3135s, 2590, 2420sh, 2070sh, 1920, 1662, 1623s, 1490sh, 1445, 1402s, 1365s, 1042w, 996, 950w, 837s, 707s, 650.

C187 Malachite $Cu_2(CO_3)(OH)_2$

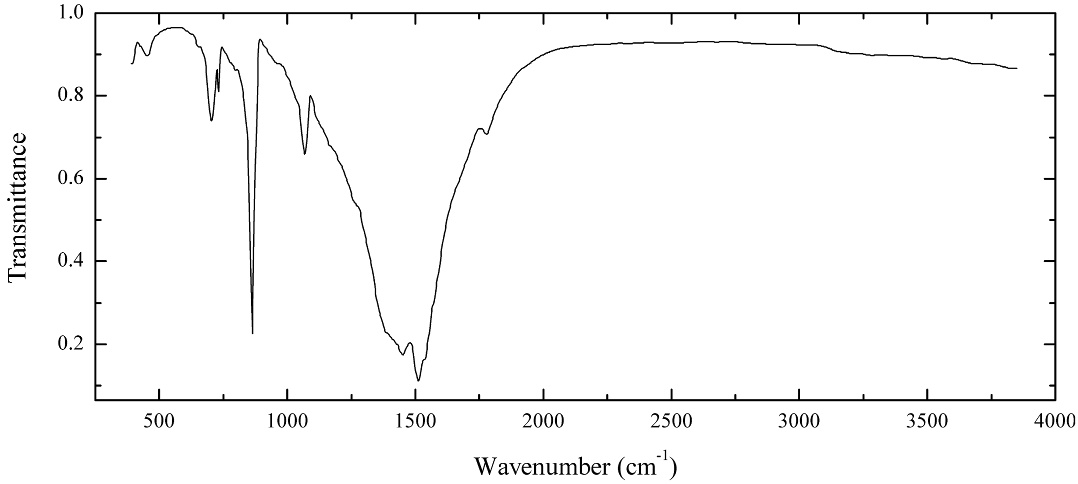


Locality: Northern Jezkazgan mine, Jezkazgan, Kazakhstan.

Description: Pseudomorph after azurite concretion. Identified by IR spectrum and electron microprobe analysis. Very close to the $Cu_2(CO_3)(OH)_2$ endmember.

Wavenumbers (cm^{-1}): 3400s, 3310s, 1700w, 1530sh, 1508s, 1425s, 1394s, 1097, 1048s, 880, 821s, 783, 750, 712, 585, 574, 526, 501, 472, 429.

C188 Burbankite $(Na,Ca)_3(Sr,Ba,Ca,REE)_3(CO_3)_5$

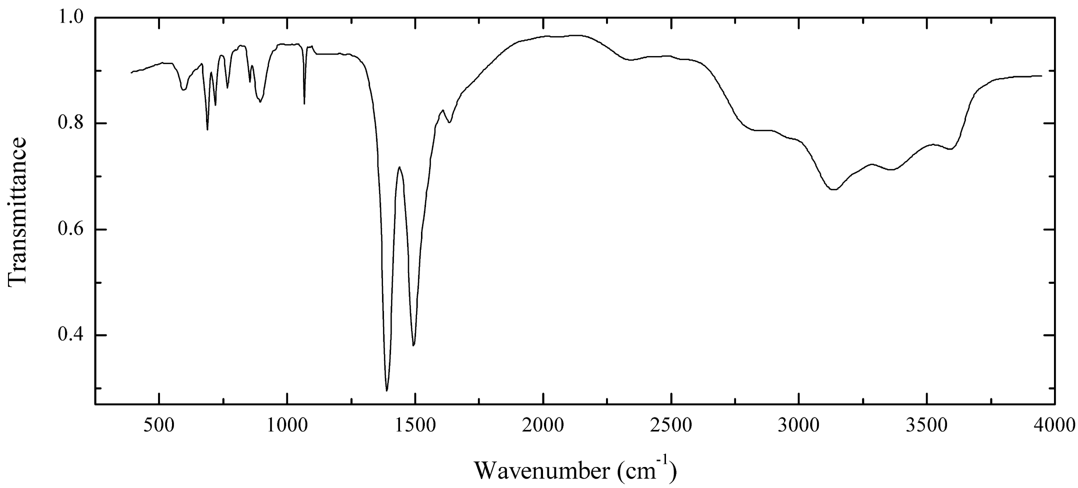


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Greenish-yellow grains. The empirical formula is (electron microprobe) $Na_{2.9}Ca_{0.1}Sr_{2.0}Ba_{0.1}Ce_{0.5}La_{0.3}Nd_{0.1}(CO_3)_5$.

Wavenumbers (cm^{-1}): 1773, 1530sh, 1506s, 1452s, 1395sh, 1068, 862s, 730w, 700, 452w.

C189 Lecoqite-(Y) $Na_3Y(CO_3)_3 \cdot 6H_2O$

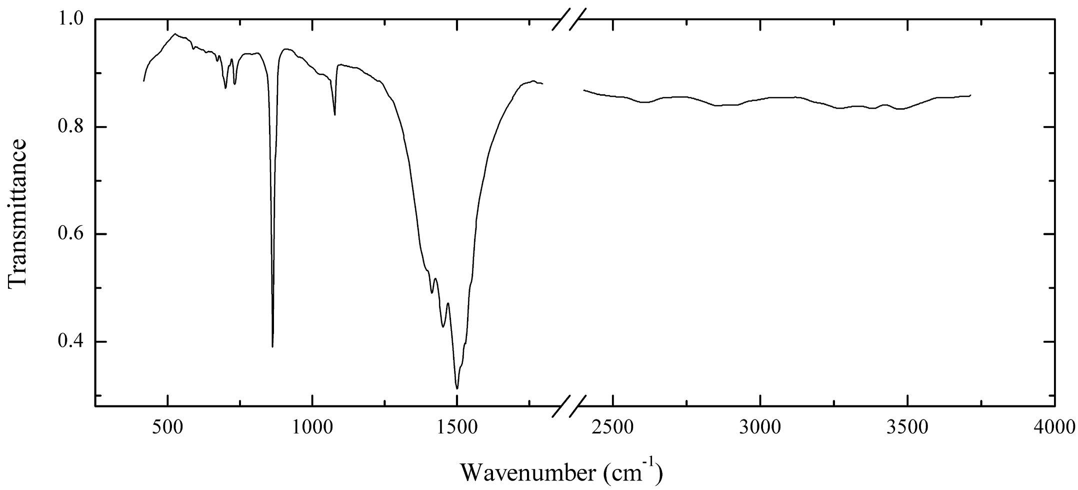


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: White radiating spray-like aggregates in the association with microcline, albite, natrolite, gonnardite, aegirine, siderite, elpidite, gaidonnayite, zircon, franconite, dawsonite, rhodochrosite, cryolite, *etc*. Holotype sample. Hexagonal, sp. gr. $P6_3$, $a = 11.316(4)$, $c = 5.931(2)$ Å. The empirical formula is (electron microprobe, H_2O and CO_2 by selective sorption of gaseous combustion products) $Na_{2.94}H_{0.32}(Y_{0.75}Dy_{0.08}Er_{0.080}Yb_{0.04}Ho_{0.03}Gd_{0.02}Nd_{0.015}Sm_{0.01})C_{2.91}O_9 \cdot 6H_2O$.

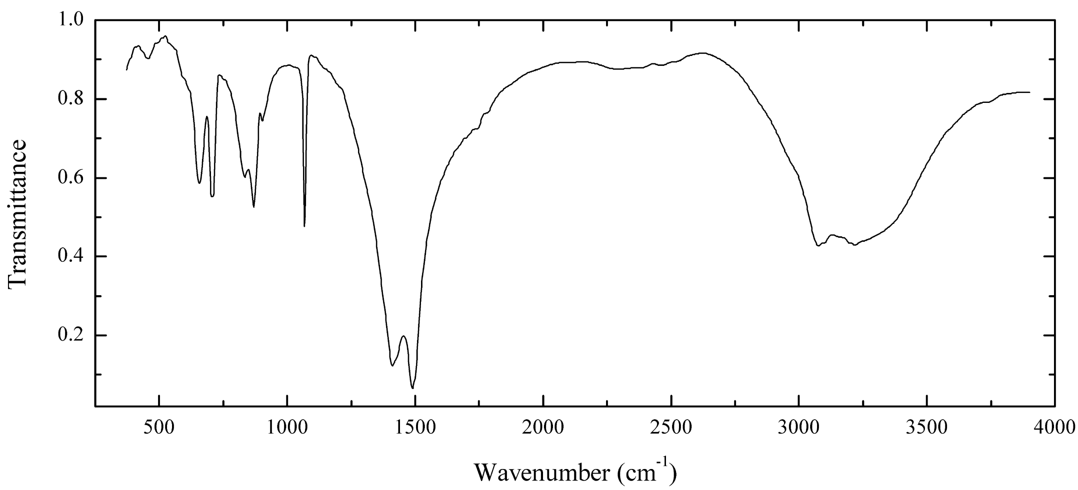
Optically uniaxial (−), $\omega = 1.521(3)$, $\varepsilon = 1.497(3)$. $D_{calc} = 2.358$ g/cm^3. The strongest lines of the powder X-ray pattern [*d*, Å (*I*, %)] are 9.82 (57), 5.081 (100), 3.779 (39), 2.627 (39), 2.471 (37).
Wavenumbers (cm^{-1}): 3585, 3350, 3125s, 2950sh, 2810, 2330w, 1638w, 1495s, 1389s, 1067, 900, 849, 764, 714, 685, 595.

C191 Burbankite $(Na,Ca)_3(Sr,Ba,Ca,REE)_3(CO_3)_5$



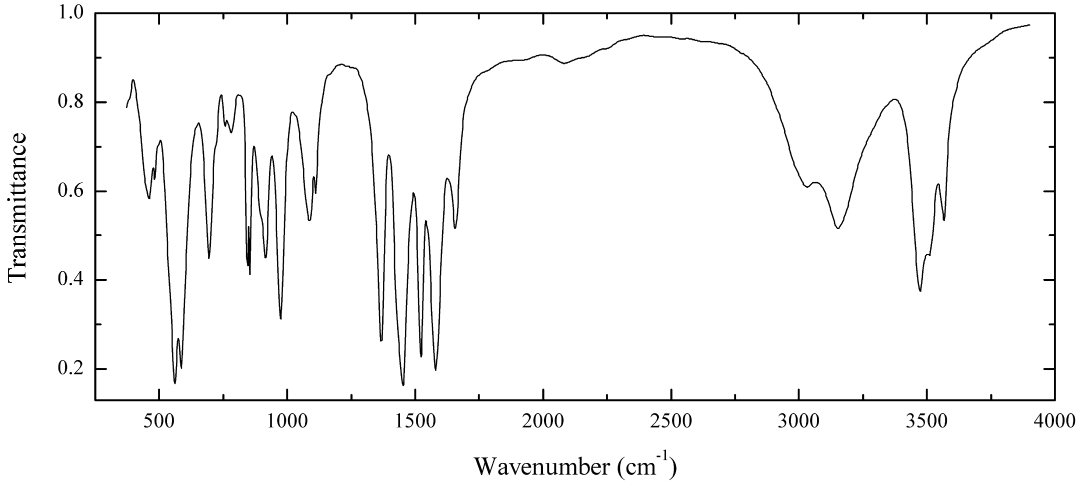
Locality: Azgir salt dome, near Caspian Sea, Kazakhstan.
Description: White fibrous aggregate. *REE*-free variety. The empirical formula is (electron microprobe) $Na_{2.0}Ca_{1.5}Sr_{2.5}(CO_3)_5$.
Wavenumbers (cm^{-1}): 1520sh, 1503s, 1466s, 1415s, 1077, 875w, 862.5s, 730w, 699.5w, 690sh.

C192 Pirssonite $Na_2Ca(CO_3)_2 \cdot 2H_2O$



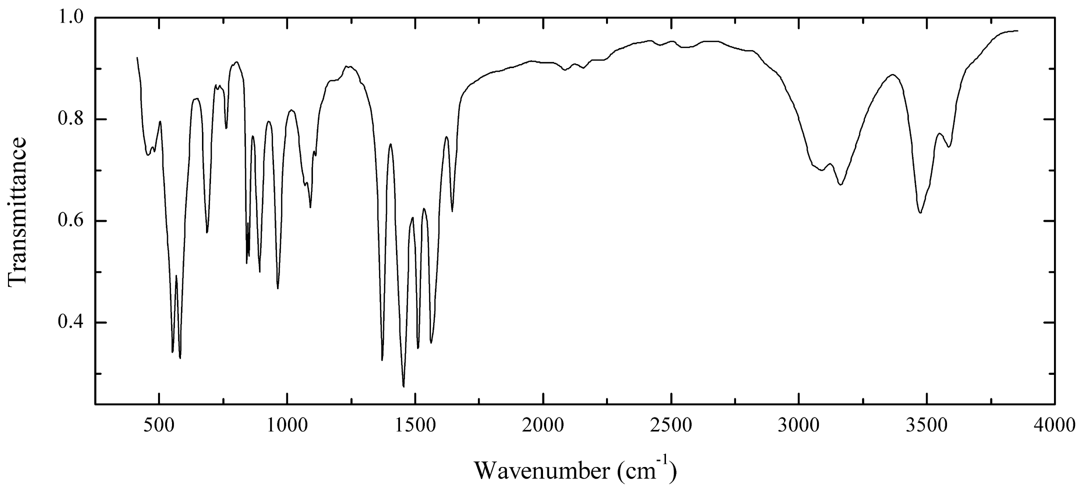
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Massive, cream-coloured. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3360sh, 3195, 3065, 2510w, 2450w, 2380w, 2290w, 1720sh, 1485s, 1412s, 1069, 901w, 870, 835, 707, 657, 460w.

C193 Kochsándorite $CaAl_2(CO_3)_2(OH)_4{\cdot}H_2O$



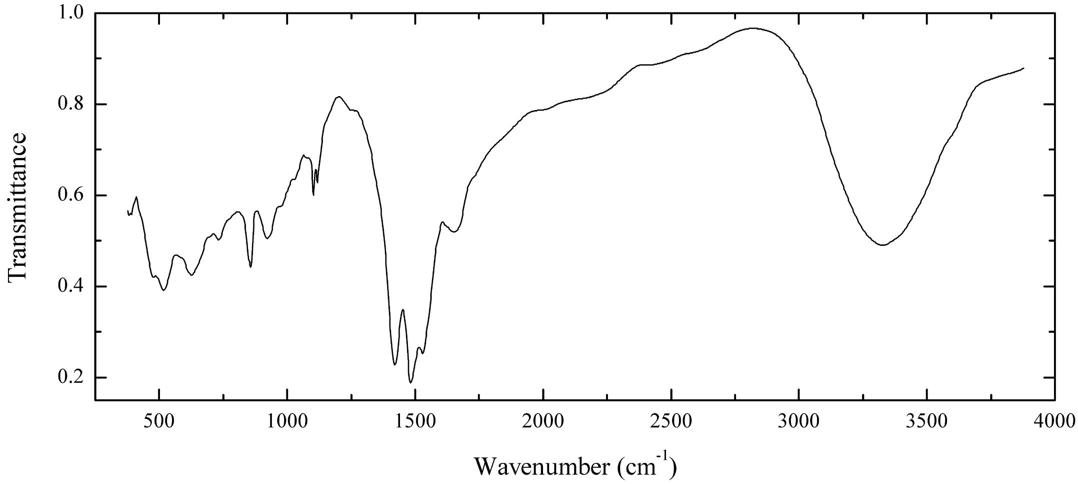
Locality: Mány coal deposit, Tatabánya, Hungary (type locality).
Description: White fibrous aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3540, 3485, 3447s, 3127, 3010, 2075w, 1650, 1577s, 1518s, 1448s, 1365s, 1111, 1085, 973, 915, 900sh, 855, 844, 780w, 755w, 720sh, 694, 585s, 559s, 484, 460.

C194 Strontiodresserite $SrAl_2(CO_3)_2(OH)_4{\cdot}H_2O$



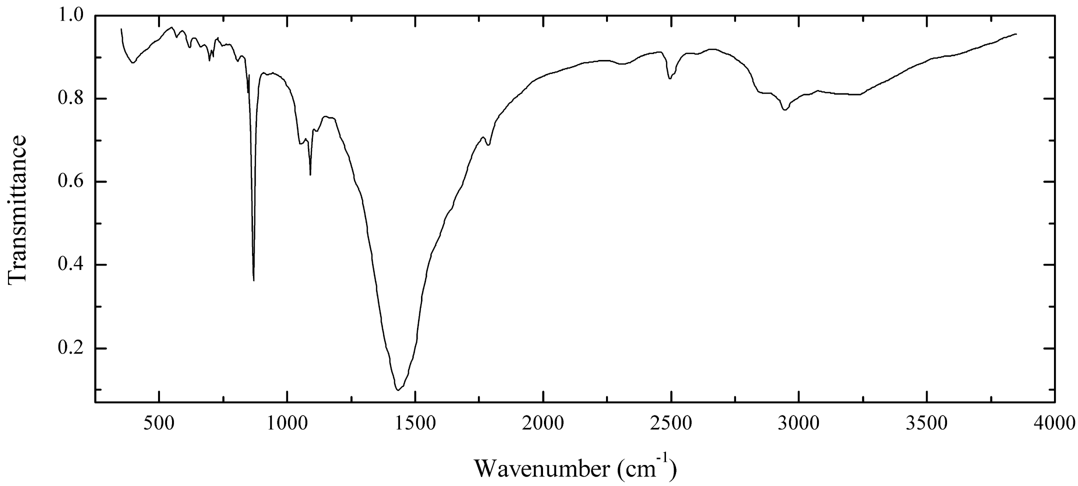
Locality: Condorcet, Nyons, Drôme, Rhône-Alpes, France.
Description: White radiated fibrous aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3570, 3480sh, 3455, 3148, 3070, 2550w, 2155w, 2090w, 1649, 1566s, 1511s, 1460sh, 1453s, 1370s, 1180sh, 1109, 1089, 1069, 963, 890, 850, 842, 760, 684, 577s, 550s, 530sh, 481, 455.

C195 Para-alumohydrocalcite $CaAl_2(CO_3)_2(OH)_4 \cdot 6H_2O$



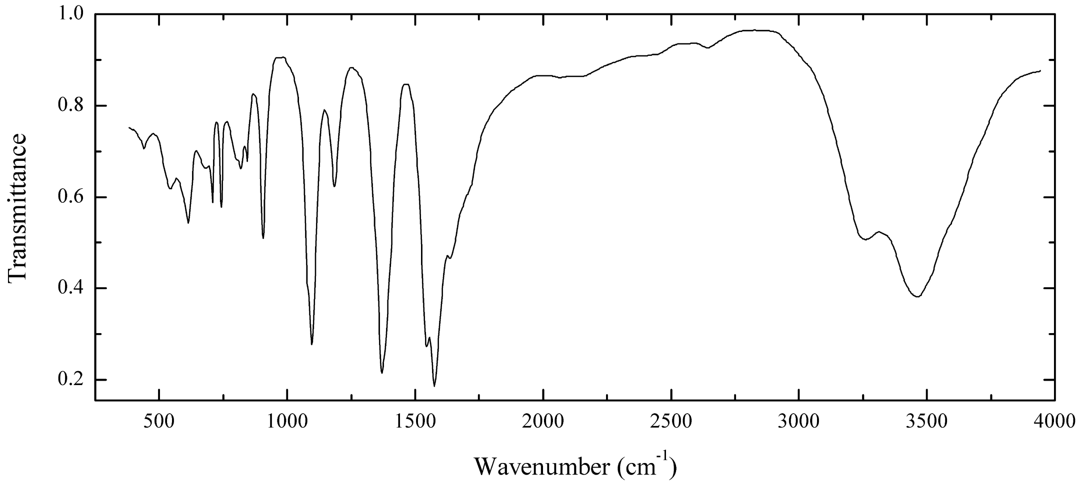
Locality: Şaru Dornei, Suceava Co., Romania.
Description: White radiated fibrous aggregate from the association with calcite, realgar and allophane. The empirical formula is (electron microprobe) $Ca_{0.95}Mg_{0.05}Fe_{0.02}Al_{1.98}(CO_3)_2(OH)_4 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3320s, 2100sh, 1645, 1530s, 1487s, 1421s, 1118w, 1103, 1027w, 970sh, 924, 857, 850sh, 730, 623, 521s, 481.

C196 Bütschliite $K_2Ca(CO_3)_2$



Locality: Grand Canyon, Arizona, USA.
Description: Grey crusts. Identified by IR spectrum. Contains impurities (weak bands at 1,112, 1,052, 808, 753, 663 and 565 cm^{-1}).
Wavenumbers (cm^{-1}): 3190w, 2920, 2850w, 2480, 2310, 1882, 1434s, 1112w, 1088, 1052w, 866s, 844, 808w, 753w, 707w, 692w, 663w, 617w, 565w, 390w.

C197 Schröckingerite $NaCa_3(UO_2)(CO_3)_3(SO_4)F{\cdot}10H_2O$

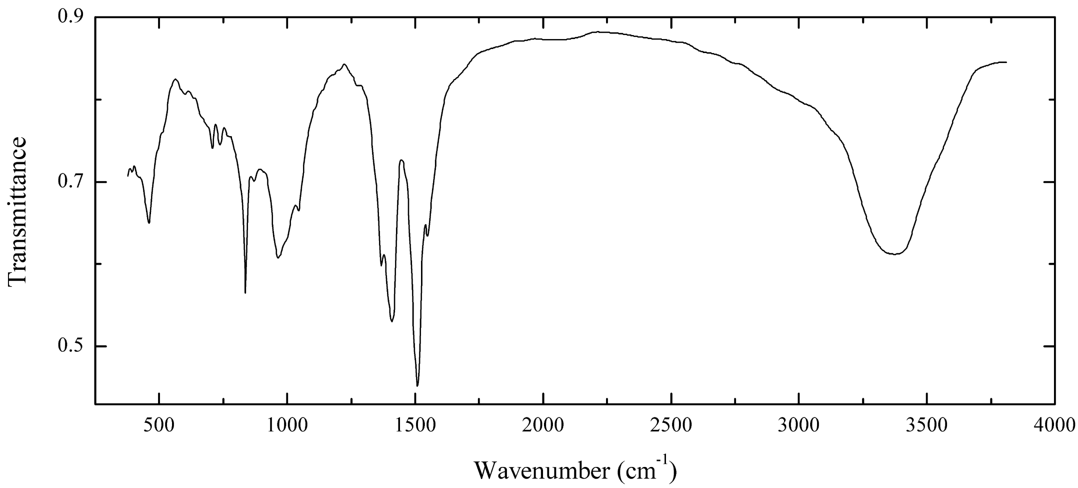


Locality: Belorechenskoe deposit, Adygei Republic, Northern Caucasus, Russia.

Description: Greenish yellow. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{0.52}Ca_{3.18}Fe_{0.19}(UO_2)_{1.08}(CO_3)_3(SO_4)_{1.00}F_{0.80}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3585sh, 3450s, 3250, 2640w, 2400w, 2100w, 1820sh, 1710sh, 1643, 1580s, 1554s, 1374s, 1186, 1098s, 1082, 907, 844, 817, 800sh, 741, 706, 680, 611, 541, 438.

C198 Hydrozincite $Zn_5(CO_3)_2(OH)_6$

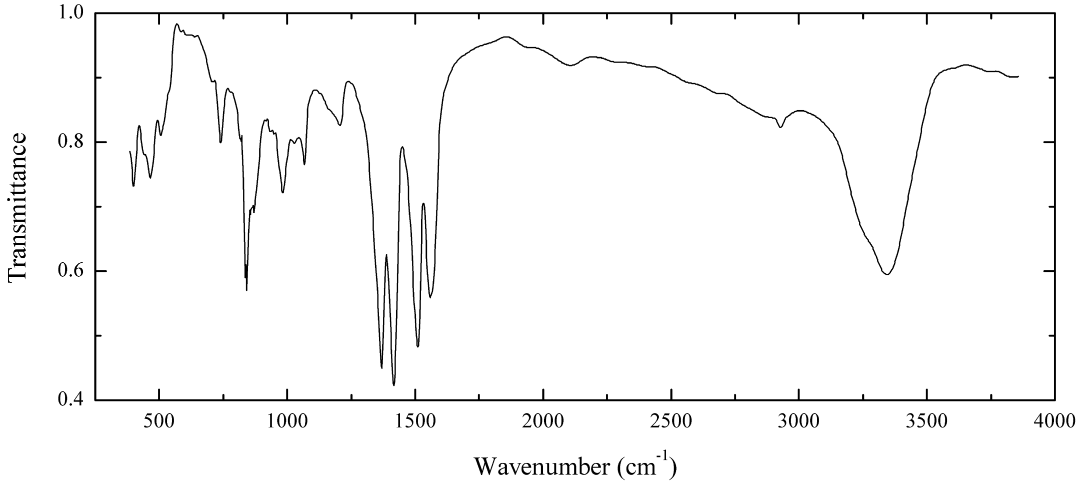


Locality: Hilarion mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: White radial aggregates. Identified by IR spectrum. The empirical formula is (electron microprobe) $Zn_{4.26}Cu_{0.34}Mg_{0.23}Fe_{0.17}(CO_3)_2(OH)_6$.

Wavenumbers (cm^{-1}): 3330s, 1547, 1507s, 1409s, 1365s, 1043, 005sh, 964s, 869, 837s, 736, 705, 510sh, 460.

C199 Aurichalcite $(Zn,Cu^{2+})_5(CO_3)_2(OH)_6$

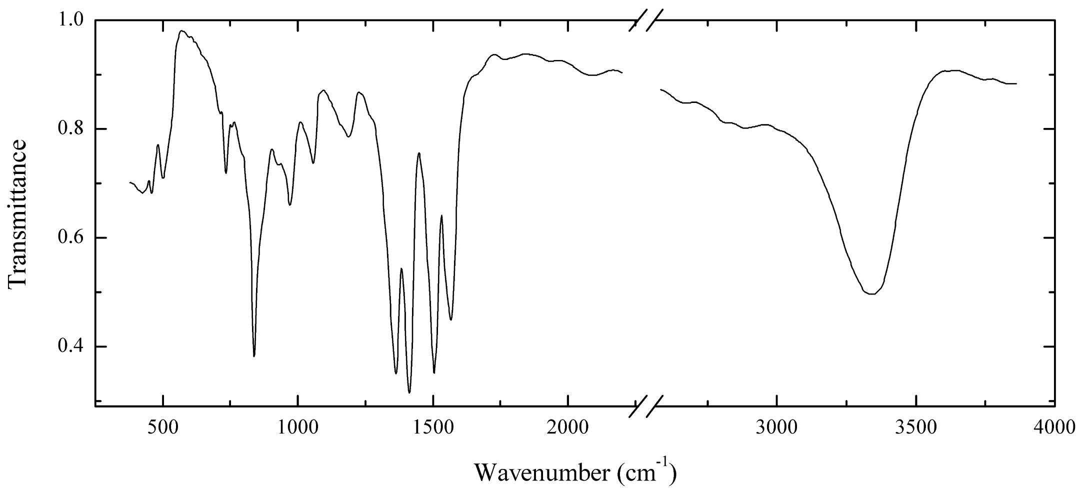


Locality: Hilarion mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Blue aggregates of soft elongated platelets. Identified by IR spectrum. The empirical formula is (electron microprobe) $Zn_{3.25}Cu_{1.61}Fe_{0.12}Ni_{0.02}(CO_3)_2(OH)_6$.

Wavenumbers (cm^{-1}): 3325s, 3250sh, 2915w, 2600w, 1562s, 1510s, 1417s, 1368s, 1203, 1068, 1026, 982, 860sh, 843s, 834s, 815sh, 738, 705w, 535sh, 504, 463, 445sh, 398.

C200 Aurichalcite $(Zn,Cu^{2+})_5(CO_3)_2(OH)_6$

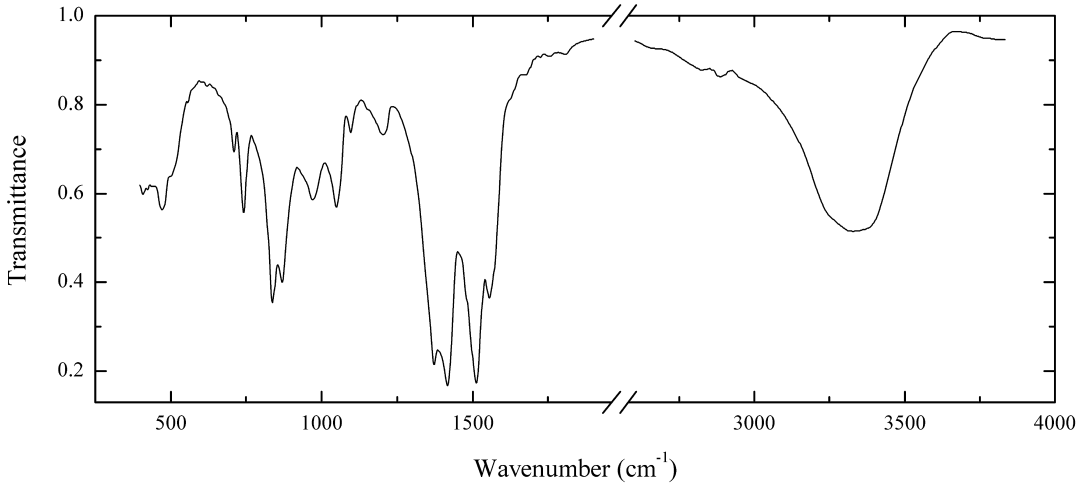


Locality: Esperanza mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Greenish-blue aggregates of platy crystals. Identified by IR spectrum. The empirical formula is (electron microprobe) $Zn_{3.60}Cu_{1.32}Fe_{0.082}(CO_3)_2(OH)_6$.

Wavenumbers (cm^{-1}): 3320s, 2865w, 2800w, 2660w, 2090w, 1927w, 1750w, 1640sh, 1569s, 1507s, 1414s, 1365s, 1187, 1160sh, 1059, 974, 860sh, 840s, 733, 710w, 503, 460, 435.

C201 Aurichalcite $(Zn,Cu^{2+})_5(CO_3)_2(OH)_6$

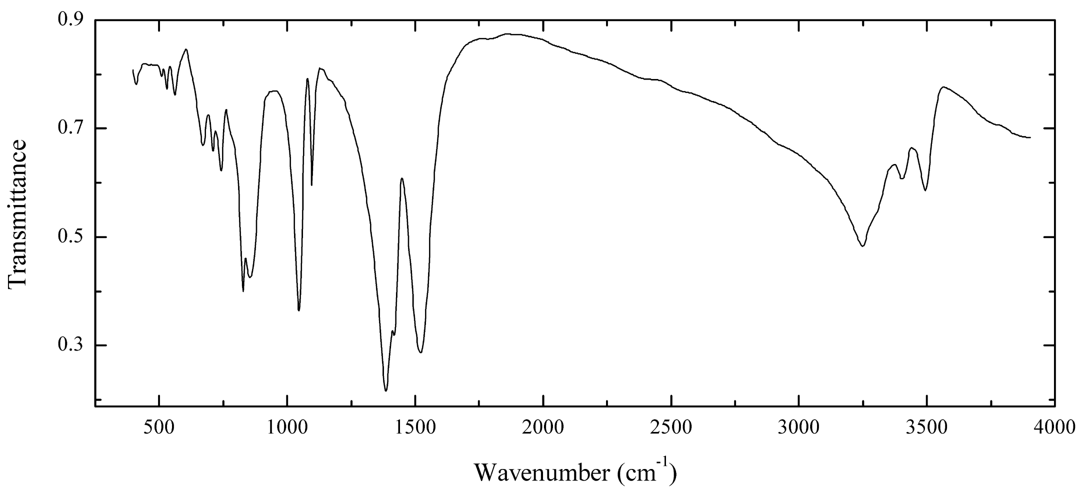


Locality: Hilarion mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Greenish-blue aggregates of platy crystals. Identified by IR spectrum. The empirical formula is (electron microprobe) $Zn_{3.08}Cu_{1.64}Fe_{0.18}Mg_{0.10}(CO_3)_2(OH)_6$.

Wavenumbers (cm^{-1}): 3320s, 2870w, 2805w, 1800w, 1560s, 1512s, 1417s, 1374s, 1202, 1095, 1050, 970, 870s, 837s, 743, 710, 500sh, 472, 410.

C202 Rosasite $(Cu^{2+},Zn)_2(CO_3)(OH)_2$

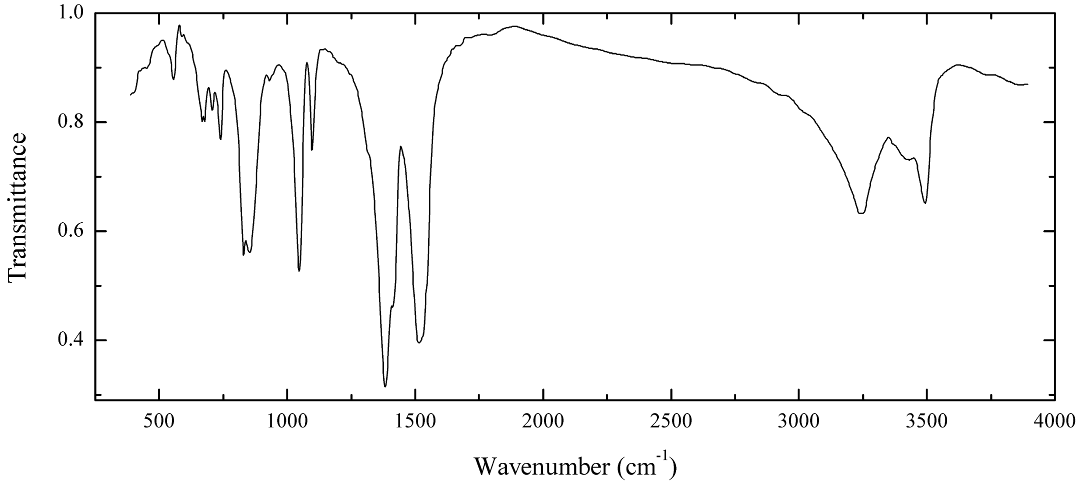


Locality: Hilarion mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Bluish-green crystals from the association with smithsonite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Cu_{1.10}Zn_{0.79}Mg_{0.08}Fe_{0.03}(CO_3)(OH)_2$.

Wavenumbers (cm^{-1}): 3492, 3398, 3245, 1525s, 1412s, 1388s, 1098, 1047s, 852s, 827s, 739, 705, 667, 557, 526, 503w, 405.

C203 Rosasite $(Cu^{2+}, Zn)_2(CO_3)(OH)_2$

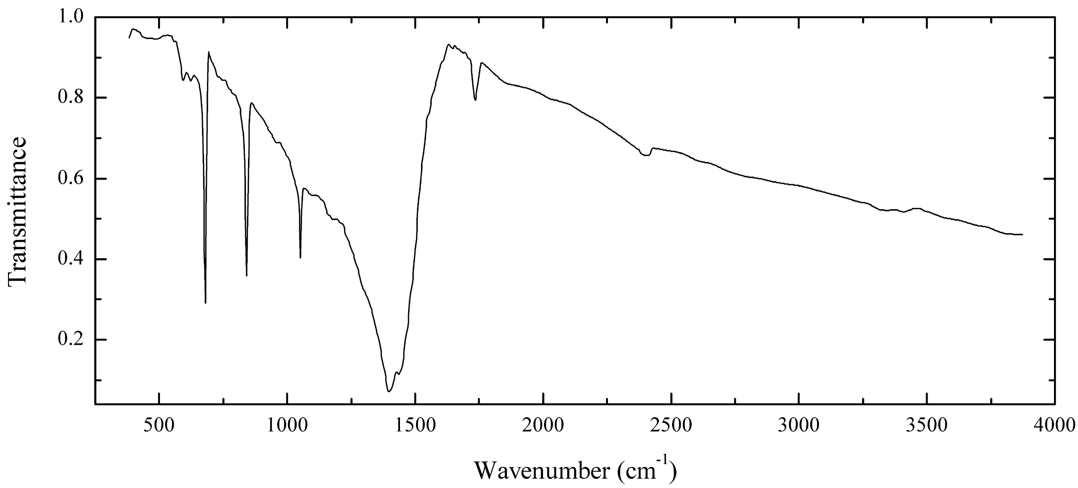


Locality: Esperanza mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light blue spherulites. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3490, 3420, 3235, 1522s, 1417s, 1387s, 1099, 1049s, 930w, 852s, 830s, 738, 705, 671, 553, 447.

C204 Cerussite $Pb(CO_3)$

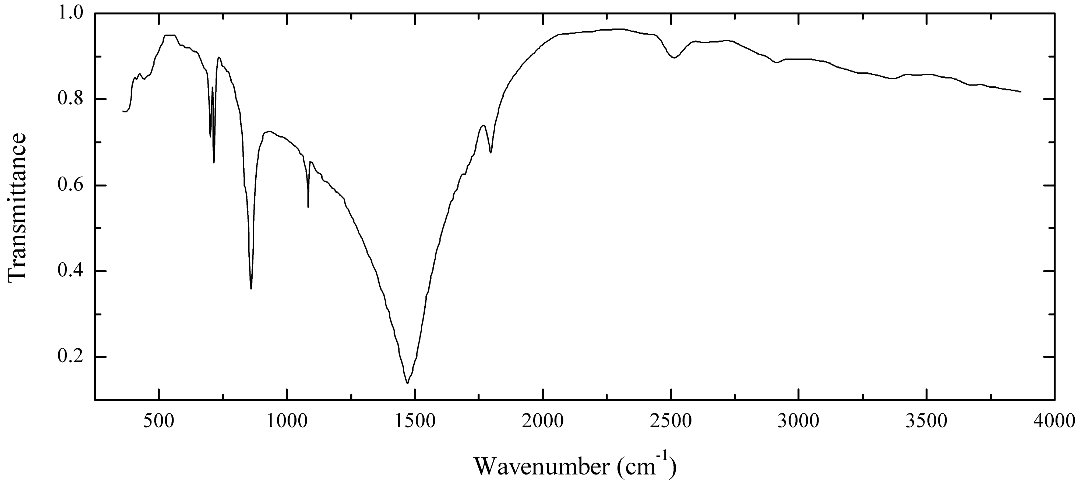


Locality: Esperanza mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Grey with adamantine lustre, from the association with rosasite and galena. Identified by IR spectrum. Contains admixture of anglesite (weak bands at 623 and 593 cm^{-1}).

Wavenumbers (cm^{-1}): 3350w, 2390w, 1730, 1432, 1394s, 1170sh, 1051, 840, 679s, 623w, 593w.

C205 Aragonite $Ca(CO_3)$

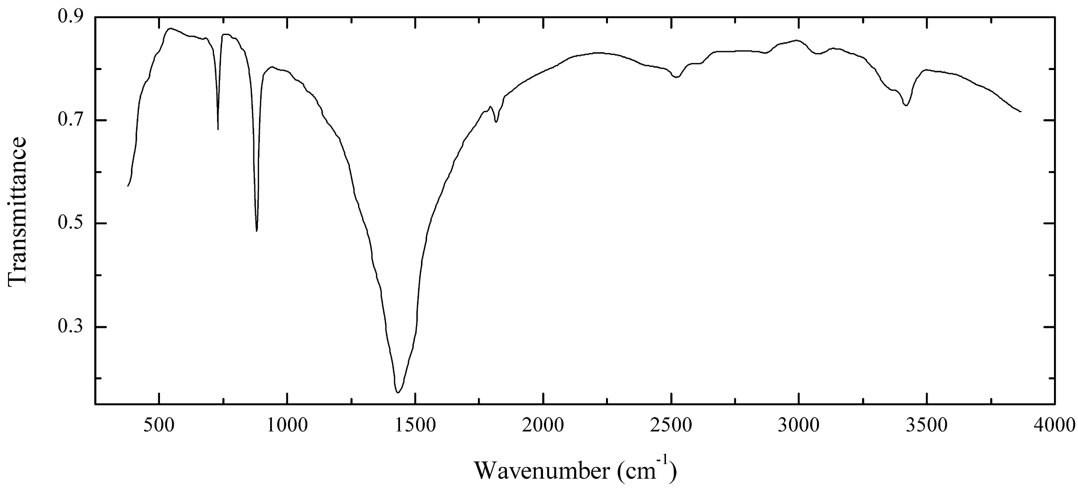


Locality: Ancient marine slag dump at Pacha Limani (Passa Limani), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Cluster of colourless prismatic crystals from the association with laurionite. Pb-bearing variety. Single-crystal unit-cell parameters are $a = 5.06$, $b = 8.04$, $c = 5.80$ Å.

Wavenumbers (cm^{-1}): 3340w, 2885w, 2490w, 1790, 1470, 1183, 858s, 835sh, 713, 699, 440w.

C207 Dolomite $CaMg(CO_3)_2$

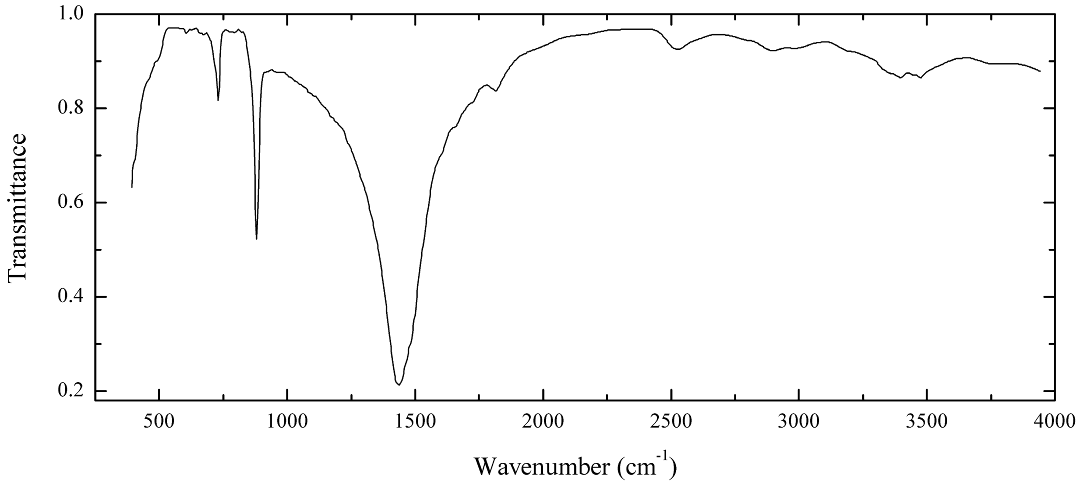


Locality: Bou Azzer, Morocco.

Description: Rose-coloured crystals on calcite. Identified by IR spectrum. Co-bearing variety. The empirical formula is (electron microprobe) $Ca_{1.02}(Mg_{0.79}Co_{0.10}Fe_{0.07}Mn_{0.05})(CO_3)_2$.

Wavenumbers (cm^{-1}): 3390, 3330w, 3035w, 2860w, 2600w, 2510w, 2450w, 1715w, 1431s, 880s, 728.

C208 Dolomite $CaMg(CO_3)_2$

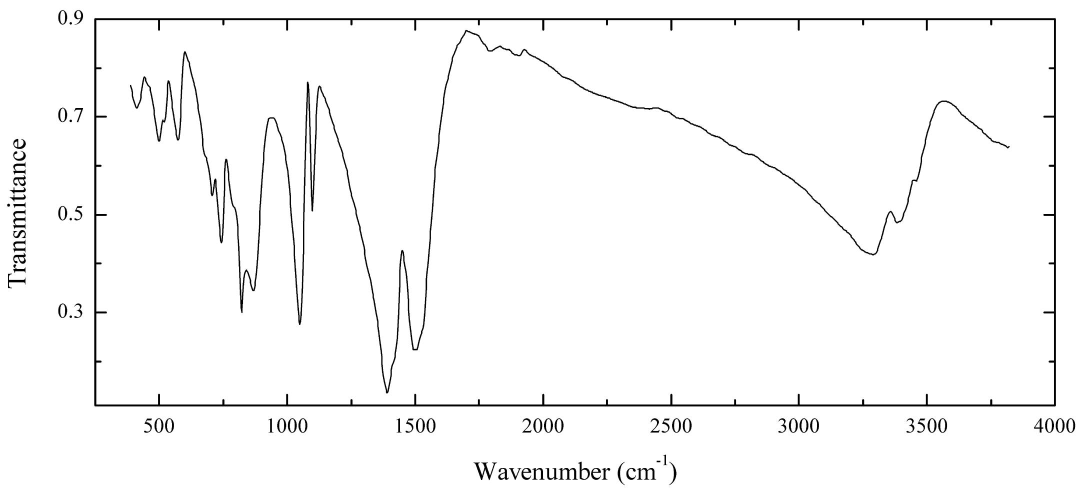


Locality: Archived Km-3 Mine, Lavrion Mines, Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Green crust, from the association with annabergite. Identified by IR spectrum. Ni-bearing variety. The empirical formula is (electron microprobe) $Ca_{1.04}(Mg_{0.79}Ni_{0.11}Fe_{0.06})(CO_3)_2$.

Wavenumbers (cm^{-1}): 3450w, 3375w, 3175w, 2975w, 2875w, 2515w, 1815w, 1436s, 882s, 730, 715sh.

C209 Malachite $Cu_2(CO_3)(OH)_2$

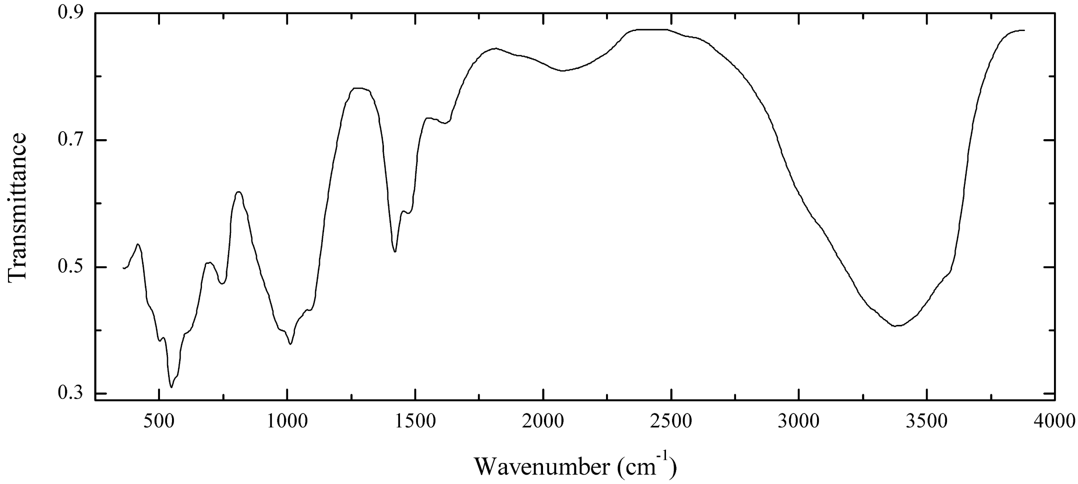


Locality: Esperanza mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Green clusters of acicular crystals. Zn-bearing variety. The empirical formula is (electron microprobe) $(Ca_{1.71}Zn_{0.23}Fe_{0.03}Mg_{0.02}Ni_{0.01})(CO_3)(OH)_2$.

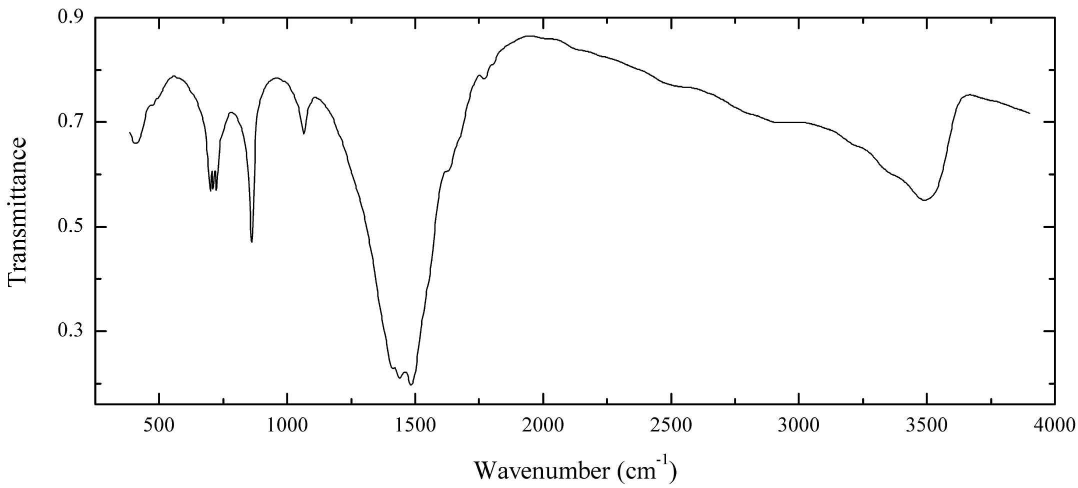
Wavenumbers (cm^{-1}): 3445, 3375, 3270, 1900w, 1800w, 1530sh, 1504s, 1392s, 1098, 1049s, 867s. 821s, 789, 744, 707, 680sh, 572, 520, 499, 413.

C211 Scarbroite $Al_5(OH)_{13}(CO_3)\cdot 5H_2O$



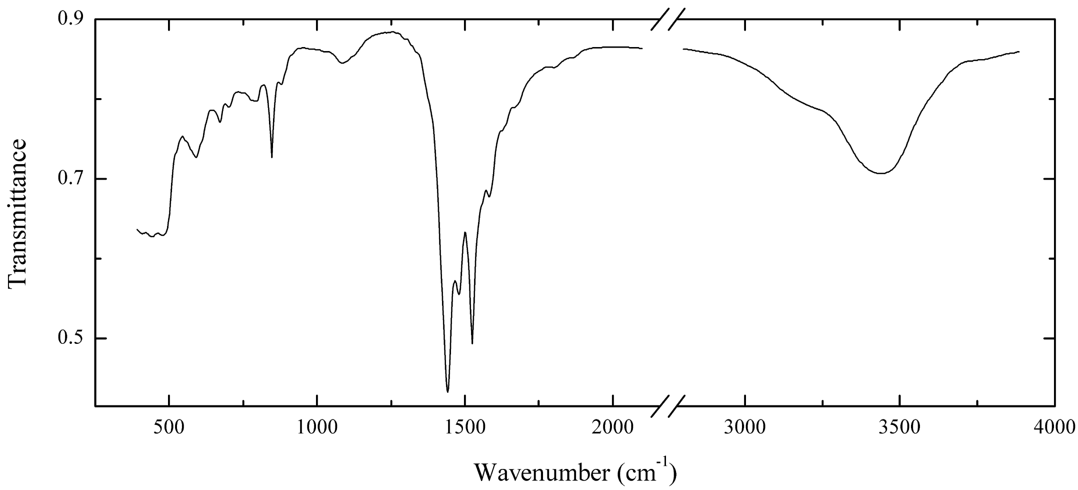
Locality: South Bay, Scarbrough, Yorkshire, England, UK (type locality).
Description: White powdery. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3600sh, 3380s, 3080sh, 2075w, 1625w, 1475, 1419, 1088, 1017s, 980sh, 750, 615sh, 570s, 547s, 503, 470sh.

C212 Ancylite-(La) $Sr(La,Ce)(CO_3)_2(OH)\cdot H_2O$



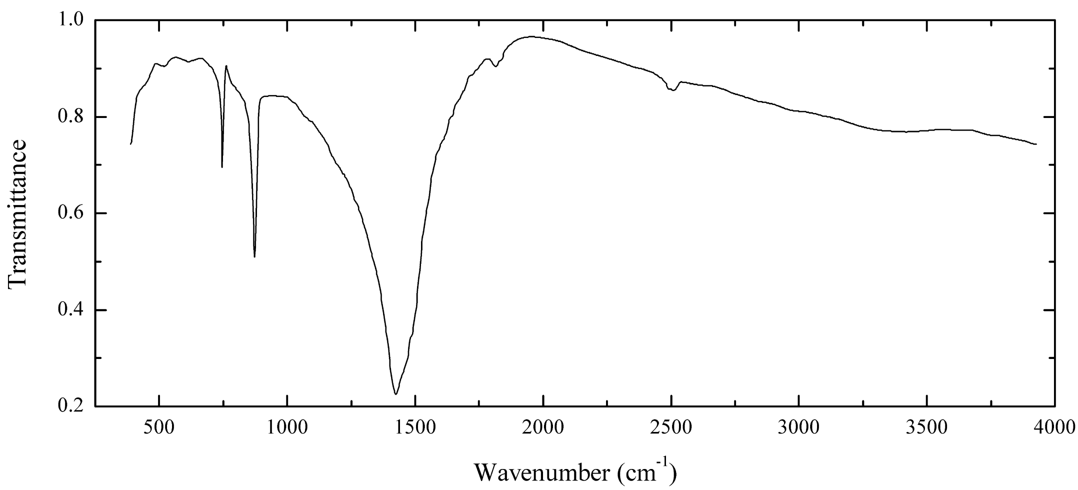
Locality: Marchenko Peak, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Brown crystals from the association with aegirine, astrophyllite, donnayite-(Y), belovite-(Ce), catapleiite, fluorapatite and calcite. Low-symmetry variety, space group *Pmc*2$_1$. The empirical formula is (electron microprobe) $(Sr_{0.85}Ca_{0.14})(La_{0.58}Ce_{0.33}Nd_{0.08}Pr_{0.02})(CO_3)_2(OH,H_2O)_2$.
Wavenumbers (cm^{-1}): 3530sh, 3477, 3320sh, 2940sh, 1800sh, 1770w, 1640sh, 1481s, 1435s, 1410sh, 1068, 862s, 727, 711, 701, 405.

C214 Chlorartinite $Mg_2(CO_3)Cl(OH)\cdot 3H_2O$



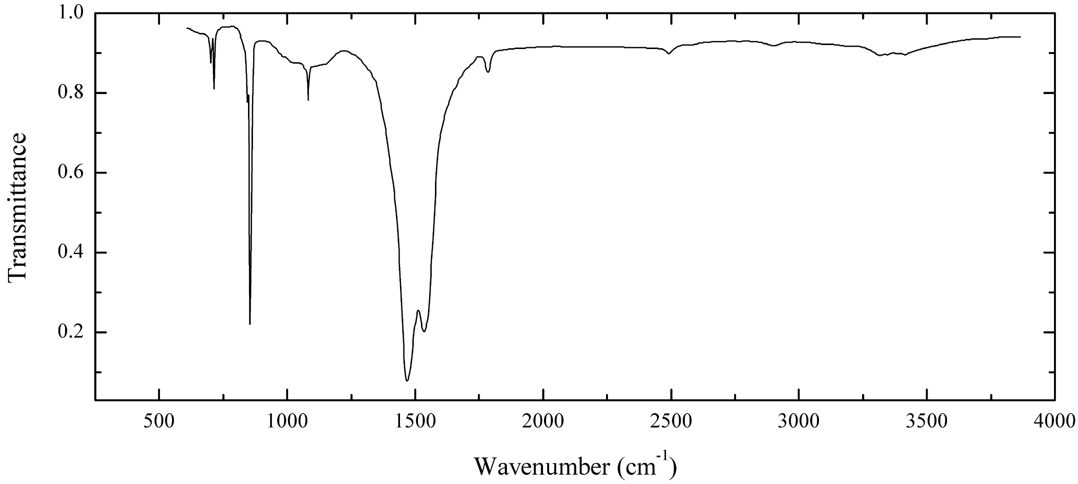
Locality: Tolbachik volcano, Kamchatka, Russia (type locality).
Description: White crust. Associated minerals are halite and aragonite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3430, 3230sh, 1670sh, 1630sh, 1588, 1527s, 1483s, 1444s, 1095w, 880w, 845, 792w, 700w, 670, 584, 483,447, 410.

C215 Spherocobaltite $Co(CO_3)$



Locality: Agoudal quarry, Bou Azzer District, Tazenakht, Morocco.
Description: Deep rose-red split rhombohedral crystals from the association with erythrite. The empirical formula is (electron microprobe) $Co_{0.86}Mg_{0.05}Ca_{0.04}Fe_{0.04}Zn_{0.01}(CO_3)$.
Wavenumbers (cm^{-1}): 2490w, 1809w, 1422s, 873s, 738.

C216 Aragonite $Ca(CO_3)$

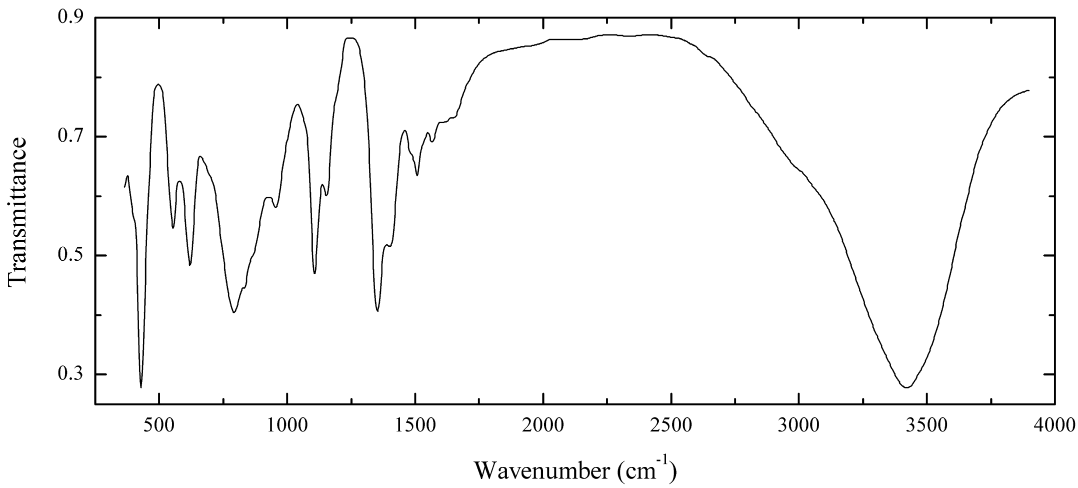


Locality: Hatrurim formation, west of the Dead Sea, Israel.

Description: White grained aggregate. Identified by IR spectrum. Confirmed by electron microprobe analysis. The contents of Mg, Mn, Fe, Sr are below their detection limits.

Wavenumbers (cm^{-1}): 3300w, 2890w, 2480w, 1786, 1534s, 1471s, 1083, 856s, 845, 713, 701.

C217 Zaccagnaite $Zn_4Al_2(OH)_{12}(CO_3)\cdot 3H_2O$

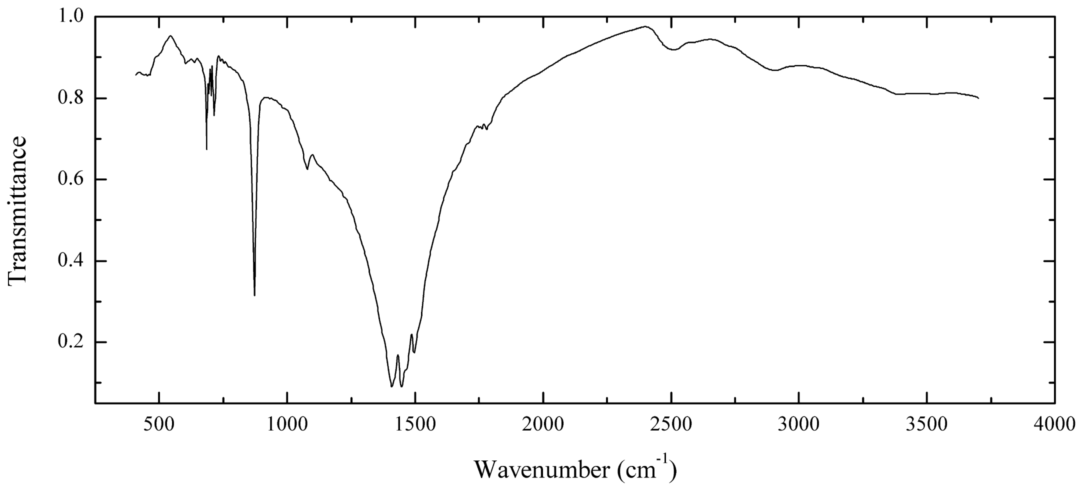


Locality: Christiana mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light blue soft spherulitic crust. Identified by IR spectrum. SO_4-rich variety. The empirical formula is (electron microprobe, CO_3 calculated) $(Zn_{3.43}Cu_{0.40}Fe_{0.10}Mg_{0.04})Al_{2.02}(OH)_{12}[(CO_3)_{0.57}(SO_4)_{0.42}Cl_{0.02}]\cdot nH_2O$.

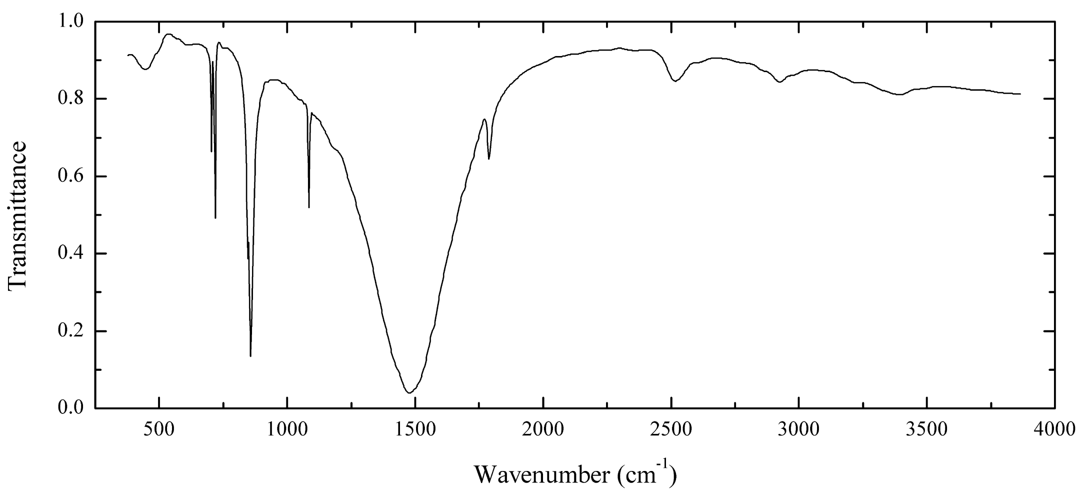
Wavenumbers (cm^{-1}): 3423s, 3000sh, 1630sh, 1575w, 1509, 1485sh, 1400, 1351s, 1157, 1109s, 960, 865sh, 835sh, 790s, 619, 553, 426s.

C218 Benstonite $(Ba,Sr)_6Ca_6Mg(CO_3)_{13}$



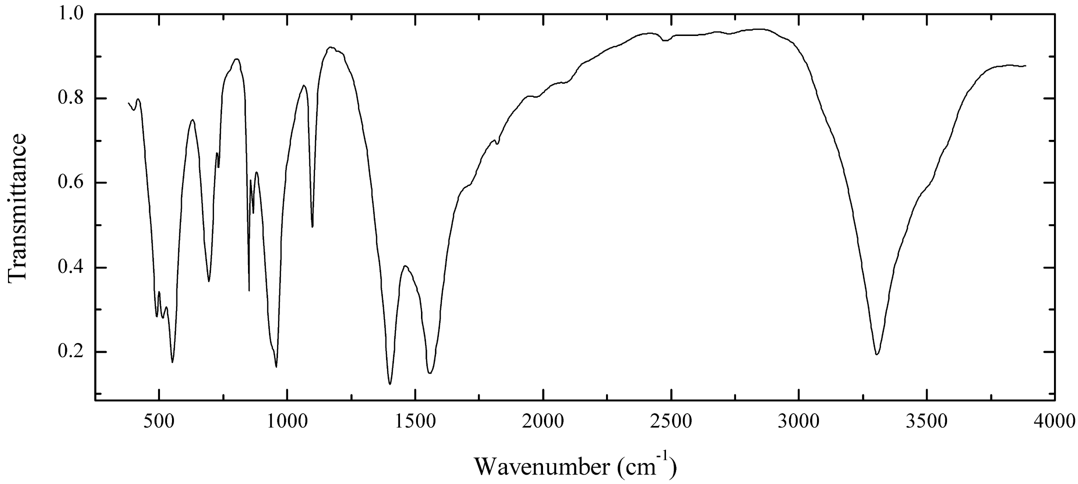
Locality: Caselor valley, Brosteni, Bistriţa Mts, East Carpathians, Romania.
Description: White massive aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3390w, 2903w, 2570w, 2502w, 2475w, 1783w, 1763w, 1515sh, 1495s, 1465sh, 1446s, 1420sh, 1408s, 1081, 877sh, 871s, 718, 712, 699, 690, 683, 632w, 608w.

C220 Aragonite $Ca(CO_3)$



Locality: Udachnaya-West kimberlite pipe, Sakha Republic, Siberia, Russia.
Description: White fibrous aggregate from the association with halite.
Wavenumbers (cm^{-1}): 3375w, 3200w, 2960sh, 2907w, 2840w, 2515w, 2490w, 1787, 1475s, 1082, 854s, 844, 714, 700, 450w.

C221 Dawsonite $NaAl(CO_3)(OH)_2$

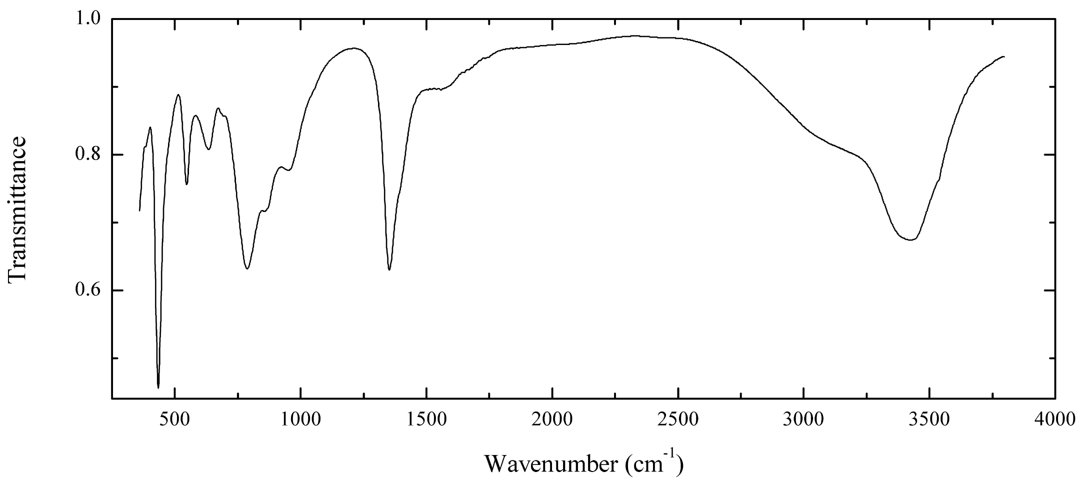


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada.

Description: Light blue massive aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3475sh, 3283s, 2465w, 2080w, 1962w, 1818w, 1715, 1559s, 1397s, 1097, 955s, 940sh, 864, 847, 731, 692, 552s, 513s, 490s, 400w.

C222 Caresite-3*T* $Fe_4Al_2(OH)_{12}(CO_3){\cdot}3H_2O$

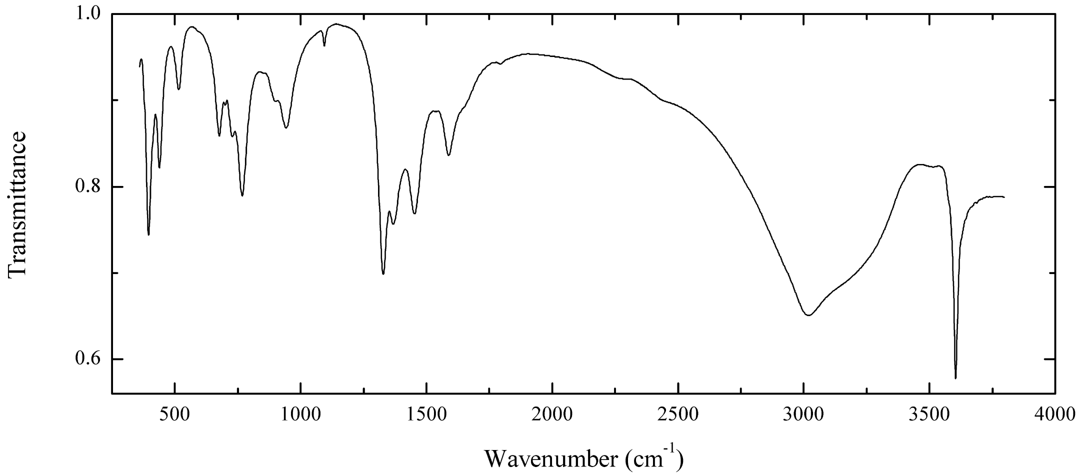


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada.

Description: Brown tabular crystal. Confirmed by IR spectrum.

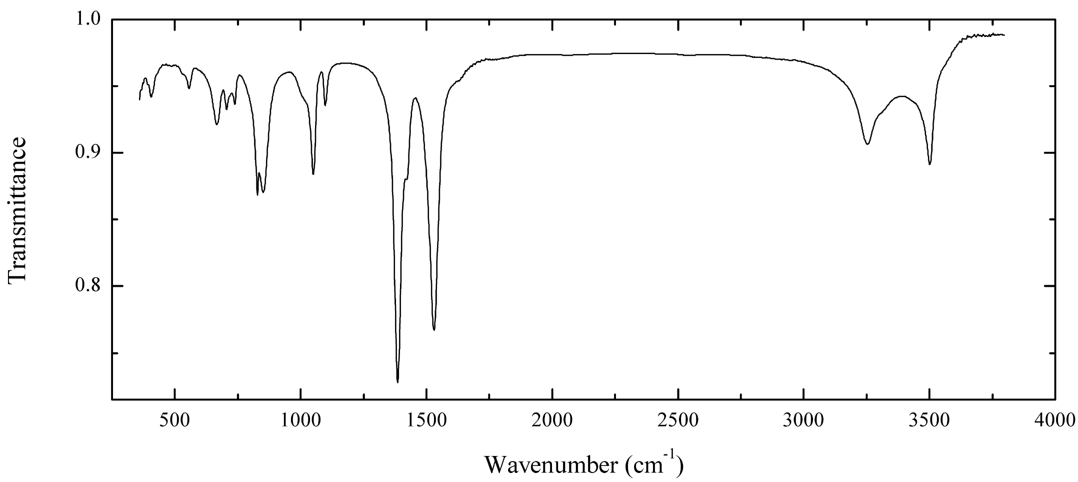
Wavenumbers (cm^{-1}): 3530sh, 3426s, 3165sh, 2430w, 2050sh, 1655sh, 1556w, 1380sh, 1353s, 952, 856, 787s, 700sh, 634, 547, 434s, 385sh.

C223 Artinite $Mg_2(CO_3)(OH)_2 \cdot 3H_2O$



Locality: New Idria mine, New Idria district, Diablo range, San Benito Co., California, USA.
Description: White radiating aggregate of fibrous crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3604s, 3505w, 3150sh, 3020s, 2420sh, 1794w, 1640sh, 1588, 1454s, 1368s, 1328s, 1094w, 942, 904, 768s, 733, 700w, 676, 515, 439, 398s.

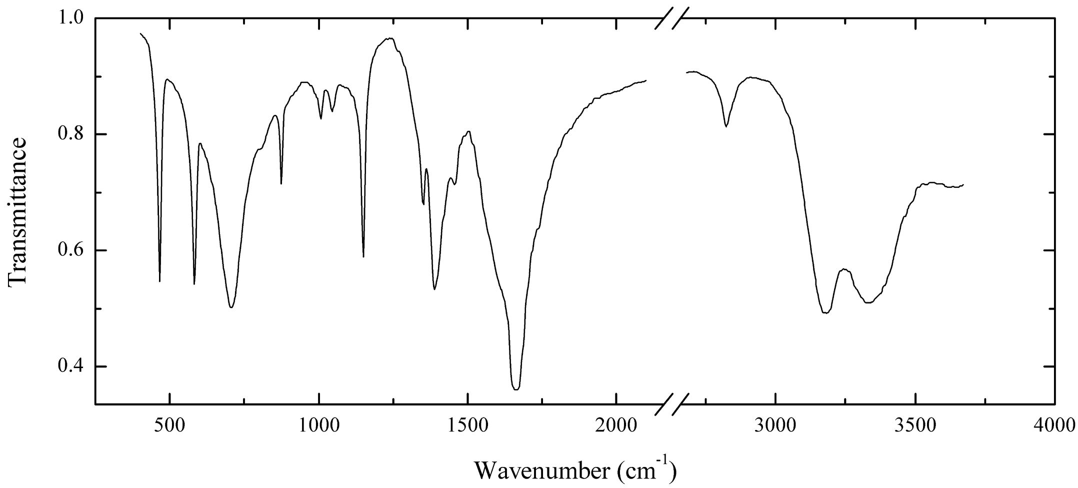
C224 Zincrosasite $(Zn,Cu^{2+})_2(CO_3)(OH)_2$



Locality: Rubtsovskoe base-metal deposit, Rubtsovsk ore district, northwest Altai Mts., Siberia, Russia.
Description: Greenish-blue massive from the association with cerussite, kaolinite, azurite and malachite. Investigated by I.V. Pekov. The empirical formula is (electron microprobe, CO_3 calculated) $(Zn_{1.24}Cu_{0.76})(CO_3)_{1.00}(OH)_2$. Confirmed by powder X-ray diffraction pattern and IR spectrum.
Wavenumbers (cm^{-1}): 3502. 3300sh, 3253, 1620sh, 1530s, 1420sh, 1386s, 1098, 1051, 1015sh, 851, 828, 738, 705, 666, 556, 535sh, 406.

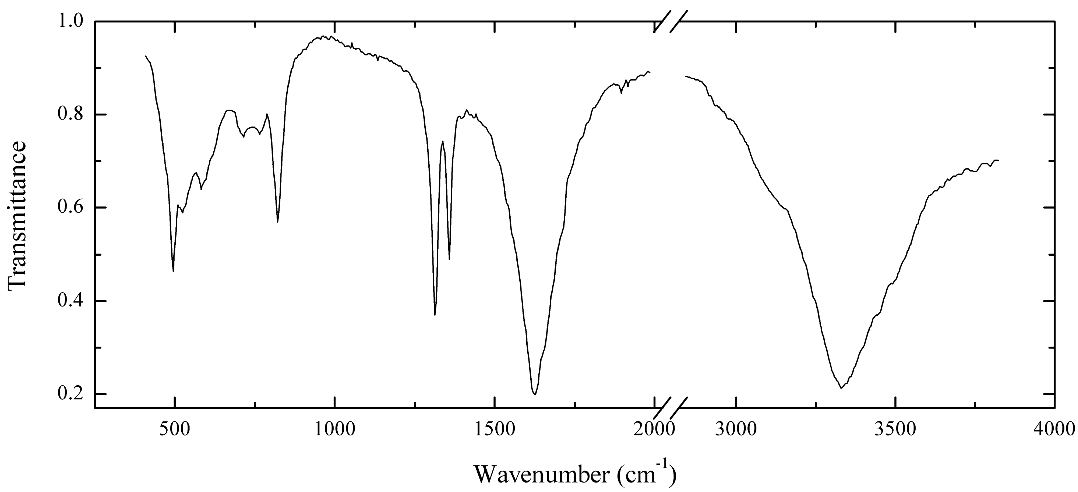
2.3 Organic Compounds and Salts of Organic Acids

Org1 Acetamide CH_3CONH_2



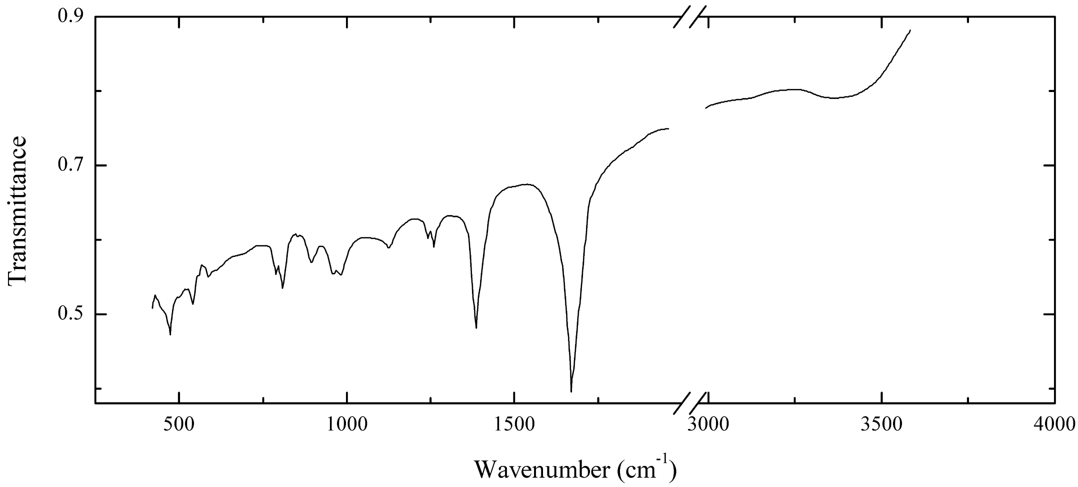
Locality: Coal shaft dumps near Chervonograd, L'vov-Volynskiy coal basin, Ukraine (type locality).
Description: Colourless grains from the association with salammoniac. Holotype sample. Trigonal, space group *R*3*c*; $a = 11.44(3)$, $c = 13.50(3)$ Å, $Z = 18$. Optically uniaxial (−), $\omega = 1.495(2)$, $\varepsilon = 1.460(2)$. $D_{calc} = 1.15$ g/cm^3, $D_{meas} = 1.17$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 5.7 (100), 3.54 (91), 2.86 (78), 3.32 (30), 2.17 (14), 3.98 (9), 3.83 (9).
Wavenumbers (cm^{-1}): 3325s, 3170s, 2810, 1677s, 1461, 1394s, 1354, 1150s, 1047w, 1007w, 875, 800sh, 708s, 582s, 465s.

Org2 Humboldtine $Fe^{2+}C_2O_4 \cdot 2H_2O$



Locality: Open pit brown coal mine Lomnice, Sokolov, Karlovy Vary region, Bohemia, Czech Republic.
Description: Yellow nodule. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3495sh, 3440sh, 3335s, 3150sh, 1907w, 1630s, 1361s, 1317s, 823, 769, 717, 523, 493s.

Org4 Minguzzite $K_3Fe^{3+}(C_2O_4)_3{\cdot}3H_2O$

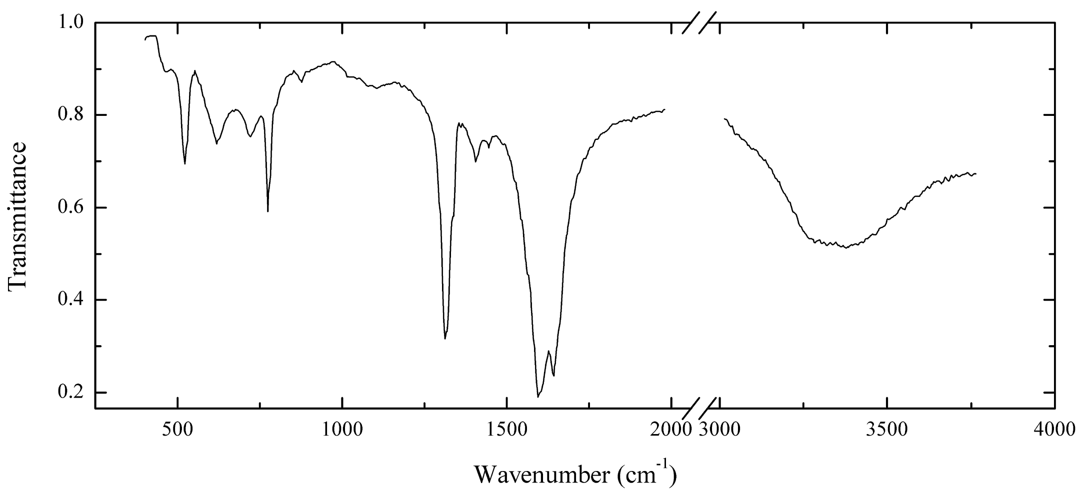


Locality: Capo Calamita, Elba Island, Italy (type locality).

Description: Yellow-green fine-grained aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3400, 1682s, 1391s, 1264, 1247w, 1134, 989, 964, 891, 801, 781, 610sh, 590w, 535, 475.

Org5 "Vertushkovite" $K_2(C_2O_4){\cdot}H_2O$

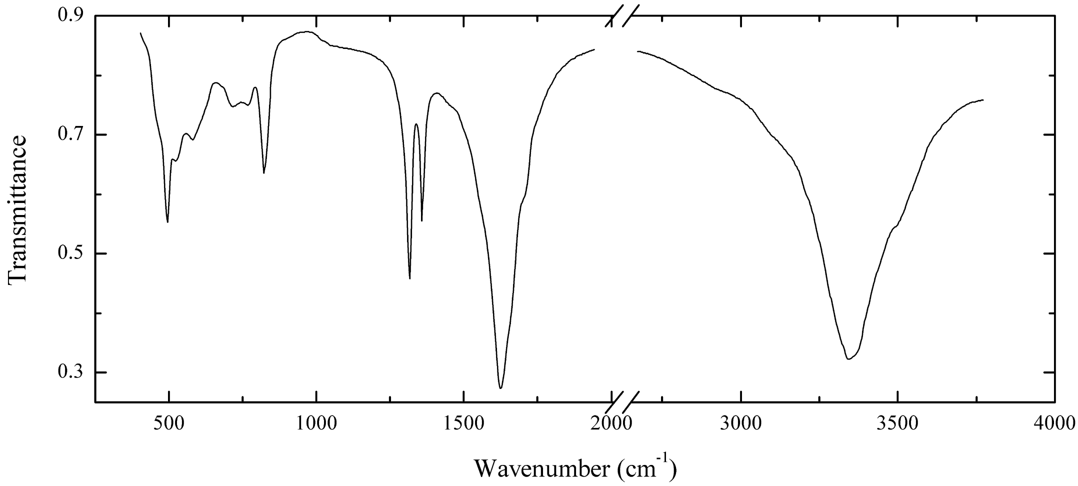


Locality: Biogenetic (from a birch polypore), Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: White crystals. Investigated and named by B.V. Chesnokov. $D_{calc} = 2.14$ g/cm^3, $D_{meas} = 2.13$ g/cm^3. Optically biaxial (+), $\alpha = 1.432$, $\beta = 1.491$, $\gamma = 1.557$. Dissolves in water.

Wavenumbers (cm^{-1}): 3360, 3310sh, 1643s, 1599s, 1448w, 1408w, 1338, 1319s, 1312s, 1100w, 1077w, 1030sh, 875w, 779, 723, 623, 524, 470w.

Org6 Humboldtine $Fe^{2+}C_2O_4{\cdot}2H_2O$

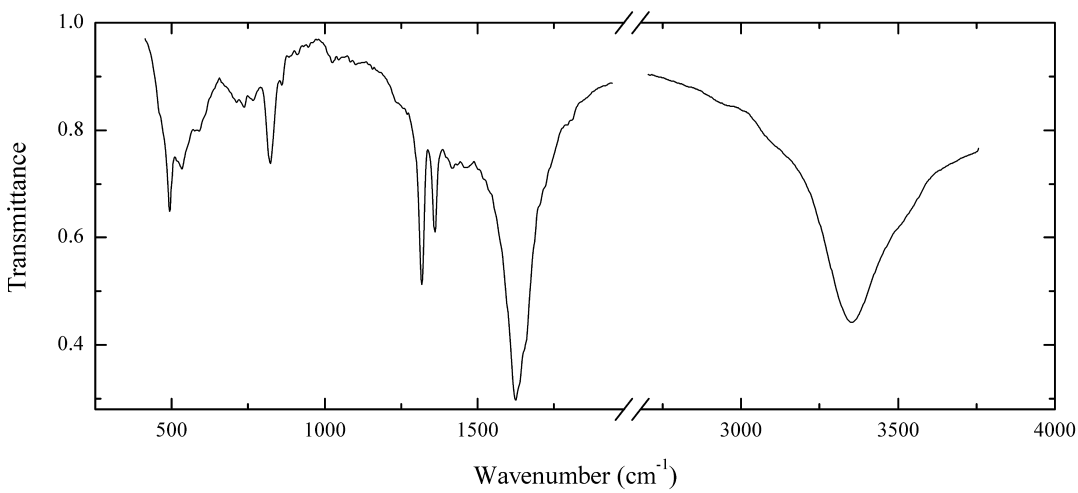


Locality: Open pit brown coal mine Lomnice, Sokolov, Karlovy Vary region, Bohemia, Czech Republic.

Description: Yellow crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3490sh, 3345s, 1710sh, 1629s, 1360s, 1316s, 821, 767, 721, 581, 520, 491s.

Org7 Humboldtine $Fe^{2+}C_2O_4{\cdot}2H_2O$

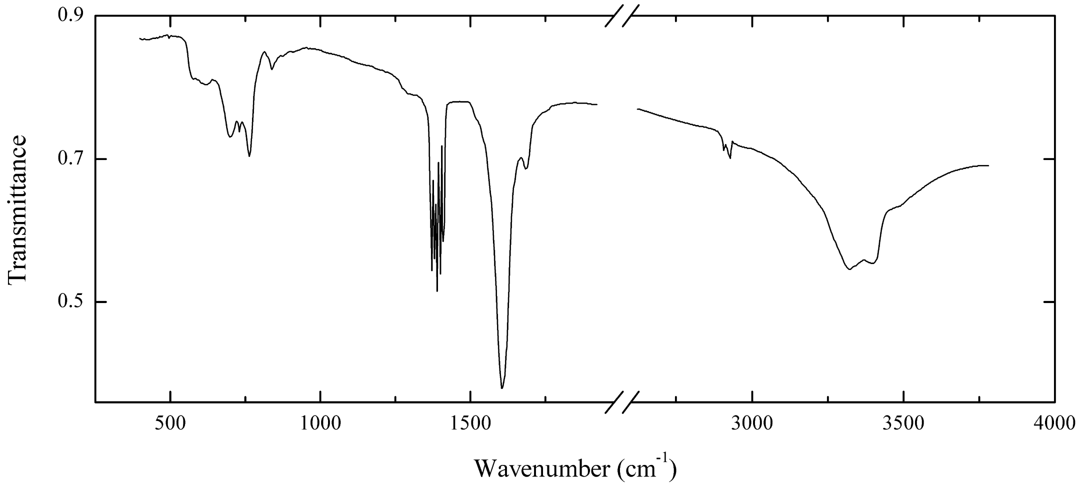


Locality: Southern Madagascar.

Description: Yellow crystals on dinosaur coprolite, from the association with siderite. Identified by IR spectrum and qualitative electron microprobe analysis. Weak bands at 1,445, 860 and 737 cm^{-1} correspond to the admixture of siderite.

Wavenumbers (cm^{-1}): 3490sh, 3340s, 1631s, 1445w, 1363s, 1318s, 860w, 822, 763w, 737w, 737w, 582, 531, 493s, 470sh.

Org8 Dashkovaite $Mg(HCO_3)_2 \cdot 2H_2O$

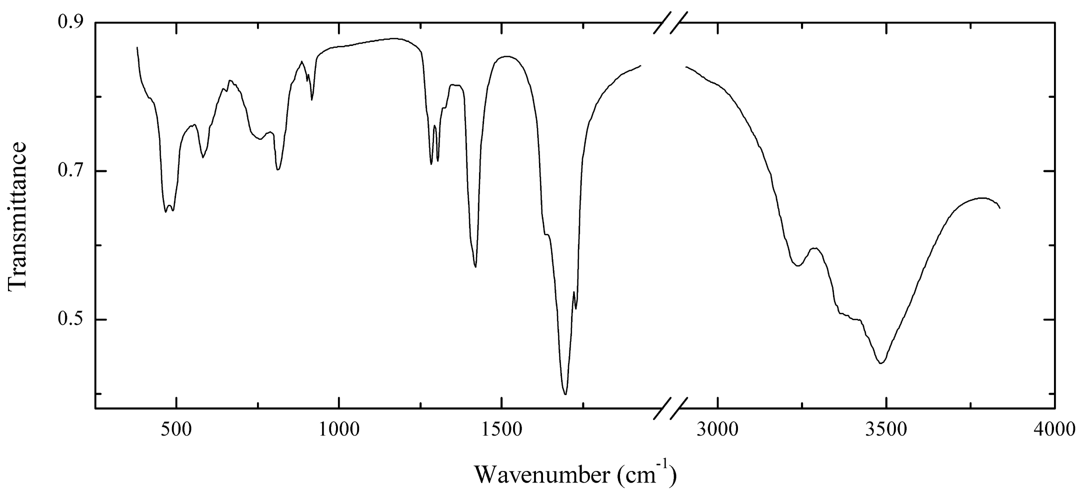


Locality: Korshunovskoye boron deposit, Irkutsk region, Siberia, Russia (type locality).

Description: White fibron aggregates in dolomite marble from the association with shabynite, iowaite, ekaterinite, korshunovskite, halite, hydromagnesite and serpentine. Holotype sample. Monoclinic, space group $P2_1/c$, $a = 8.64(1)$, $b = 7.15(1)$, $c = 9.38(1)$ Å, $\beta = 98.0(1)°$, V = 574(2) Å^3, Z = 4. The empirical formula is $Mg_{1.00}Mn_{0.01}H_{5.74}C_{2.00}O_{5.87}$. $D_{calc} = 1.74$ g/cm^3. Optically biaxial (+), $\alpha = 1.465(3)$, $\beta = 1.486(3)$, $\gamma = 1.516(3)$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 4.90 (90) (11-1), 4.64 (80) (002), 4.56 (40) (111), 4.30 (70) (200), 3.68 (80) (210), 3.40 (100) (112), 3.05 (40) (21-2), 2.67 (40) (12-2), 2.60 (40) (20-3).

Wavenumbers (cm^{-1}): 3380, 3295, 2905w, 2890w, 1684, 1604s, 1405s, 1395s, 1390, 1383s, 1375s, 1365s, 840w, 763, 731, 700, 620, 586.

Org9 Zhemchuzhnikovite $NaMg(Al,Fe^{3+})(C_2O_4)_3 \cdot 8–9H_2O$

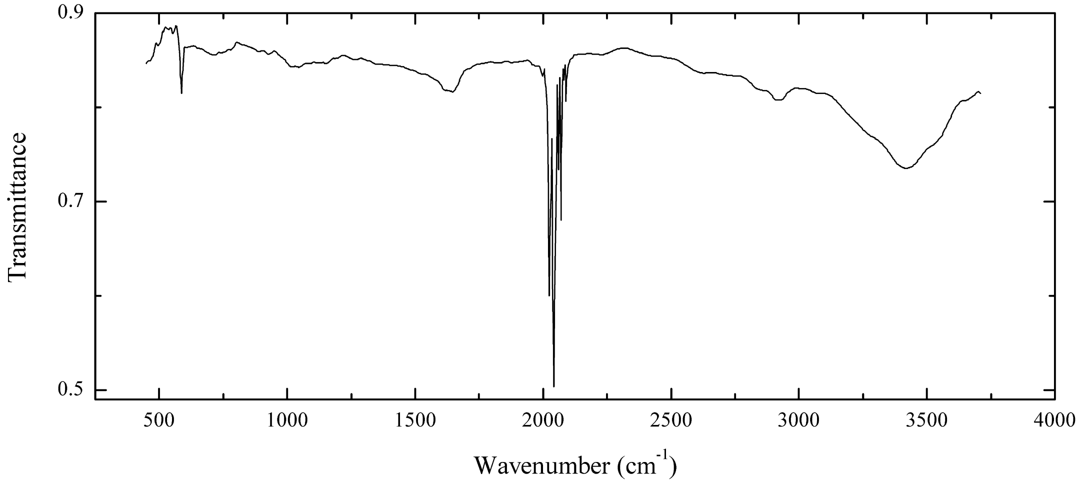


Locality: Chai-Tumus coal deposit, 200 km S of the Lena River estuary, Balun district, Sakha (Yakutia) Republic, Russia (type locality).

Description: Greenish-grey grains from the association with calcite, dolomite and stepanovite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3450s, 3350sh, 3205, 1721s, 1691s, 1631, 1416s, 1405, 1322, 1299, 1278, 916, 901w, 812, 760, 655w, 583, 490, 467.

Org10 Kafehydrocyanite $K_4Fe^{2+}(CN)_6·3H_2O$

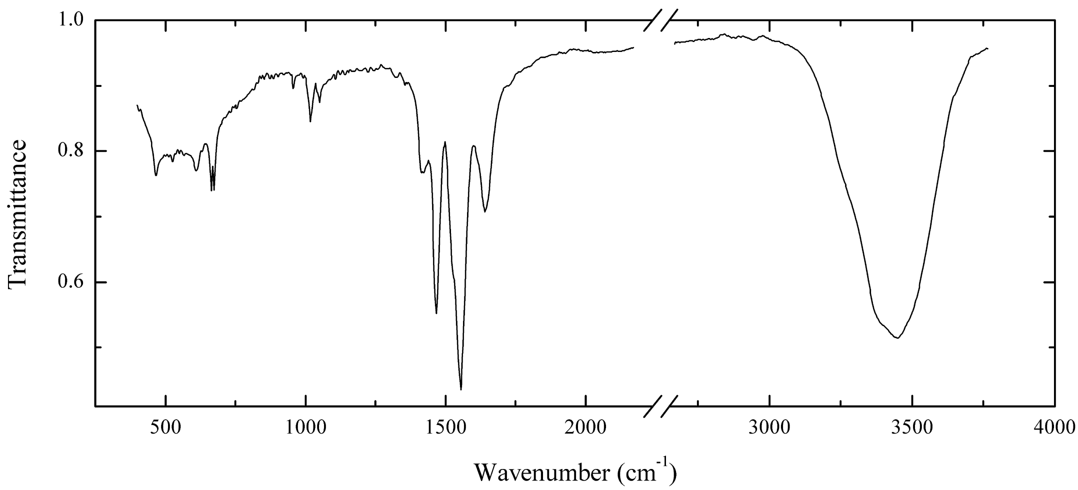


Locality: Medvezhii Log gold mine, East Sayan Mts., Krasnoyarsk region, Siberia, Russia (type locality).

Description: Yellow stalactites. Confirmed by IR spectrum. Potassium hexacyanoferrate(II) hydrate. Natural origin is questionable.

Wavenumbers (cm^{-1}): 3530sh, 3425, 3300sh, 2920w, 2845w, 2095w, 2074, 2064, 2051s, 2044s, 2031s, 2026s, 1645, 586, 500w.

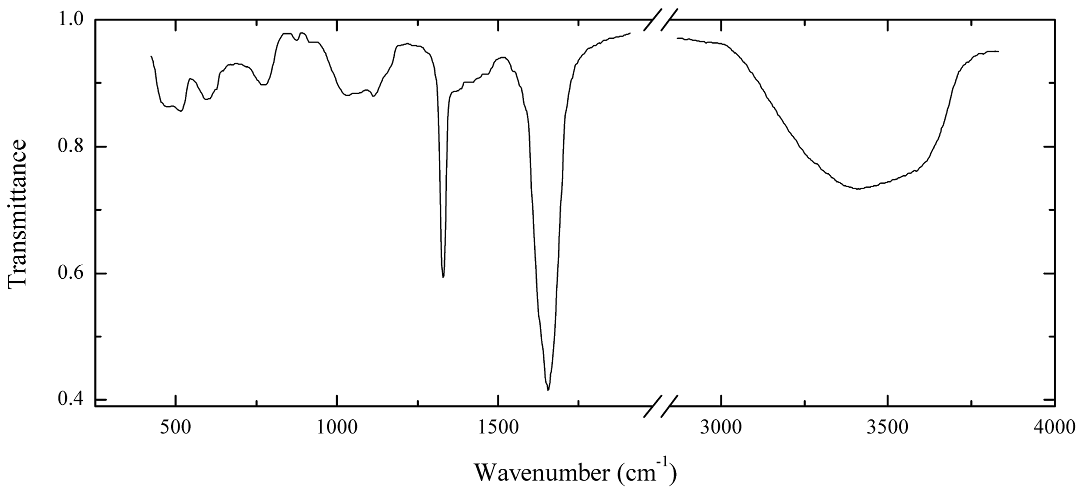
Org11 Calclacite $Ca(CH_3COO)Cl·5H_2O$



Locality: Royal Museum of Natural History of Belgium, Brussels, Belgium (type locality).

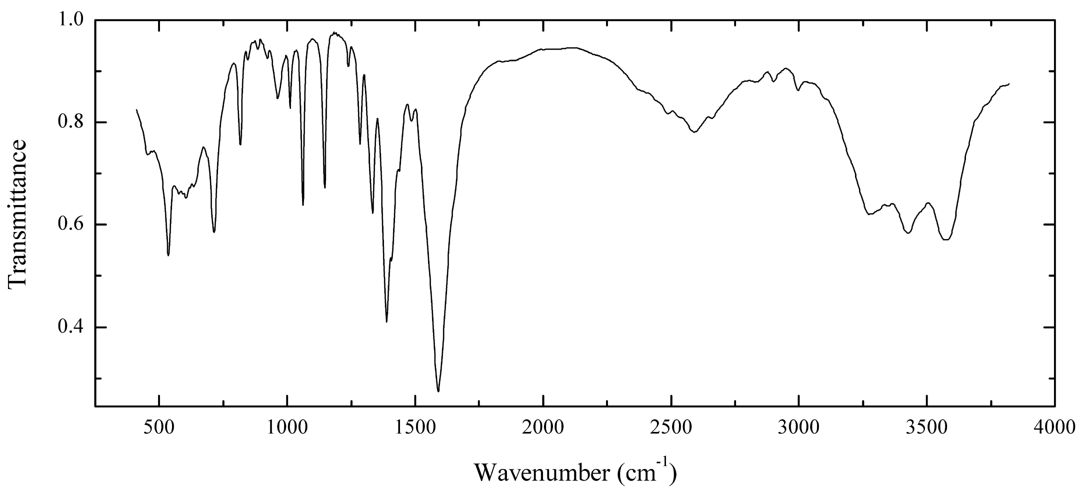
Description: White acicular crystals. Anthropogenic, due to the action of acetic acid derived from oak storage cabinets. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 8.19 (80), about 5.1 (halo), 4.15 (30), 3.33 (100), 3.00 (80), 2.40 (80), 2.24 (40), 2.03 (30).
Wavenumbers (cm^{-1}): 3440s, 3400sh, 1640, 1551s, 1465s, 1417, 1073w, 1021, 959w, 672, 665, 614, 465.

Org12 Caoxite $Ca(C_2O_4)·3H_2O$



Locality: Cerchiara mine, near Faggiona, Val di Vara, La Spezia, Liguria, Italy (type locality).
Description: White powdery crust on limestone. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3520sh, 3410, 1651s, 1625sh, 1323s, 1160sh, 1114, 1060sh, 1030, 915w, 870w, 776, 607, 520, 470.

Org13 Calcium wine stone $Ca(C_4O_6H_4)·nH_2O$

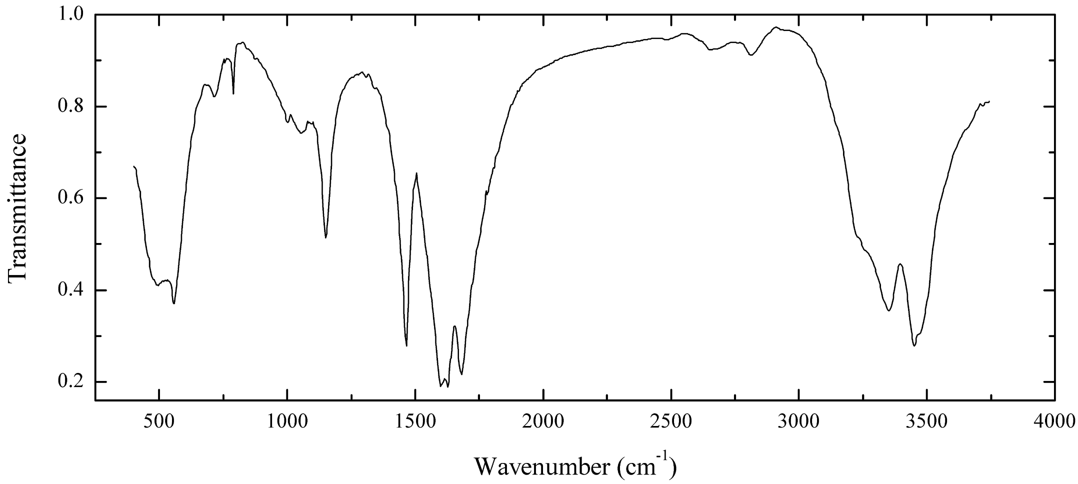


Locality: By-product of wine industry. Cabernet Sauvignon "Menada", Bulgaria, harvest of 2004.

Description: Colourless crystals. Identified by IR spectrum (as a tartrate) and by electron microprobe analysis (as a Ca salt). The empirical formula is $H_{0.4}Ca_{0.8}(C_4O_6H_4)\cdot nH_2O$. The band at 2,580 cm^{-1} indicates the presence of acid groups.

Wavenumbers (cm^{-1}): 3560, 3415, 3270, 2980w, 2883w, 2820w, 2580, 2585w, 1590s, 1506w, 1437, 1406, 1386s, 1332, 1320sh, 1283, 1238w, 1148, 1062, 1011, 964, 923w, 885w, 858w, 816, 713, 625sh, 605, 580sh, 533, 457.

Org14 Urea $CO(NH_2)_2$

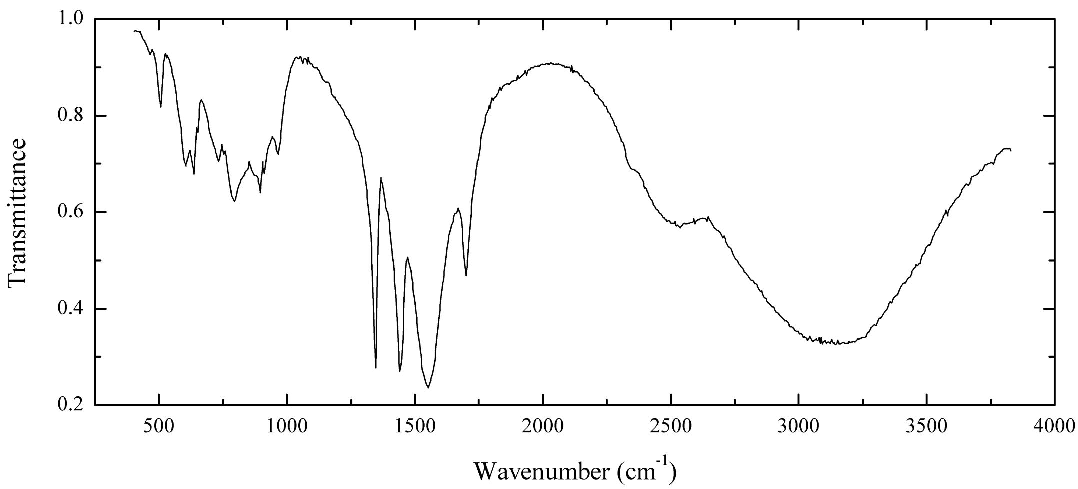


Locality: Synthetic.

Description: Colourless crystals.

Wavenumbers (cm^{-1}): 3460sh, 3440s, 3345s, 3250sh, 2810w, 2660w, 2470w, 1680s, 1628s, 1600s, 1467s, 1150, 1055w, 1002w, 790w, 716w, 557, 494, 475sh.

Org15 Mellite $Al_2[C_6(COO)_6]\cdot 16H_2O$

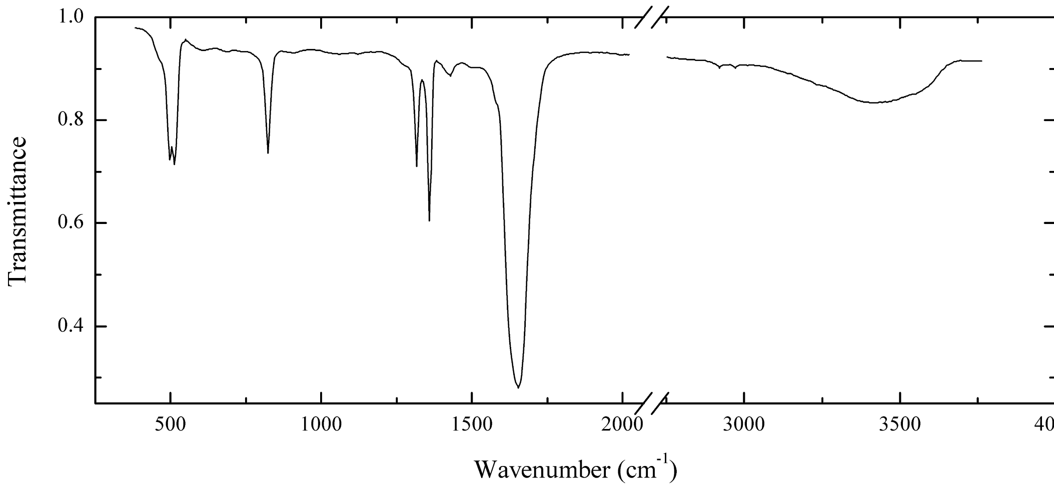


Locality: Csordakút coal mine, near Bicske, Fejér Co., Hungary.

Description: Yellowish-brown crystal from the association with humboldtine. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3150s, 3050sh, 2530, 2350sh, 1697, 1546s, 1437s, 1340s, 965, 911, 897, 870sh, 815sh, 796, 753w, 733, 635, 603, 503, 460w.

Org16 Moolooite $Cu^{2+}(C_2O_4)\cdot nH_2O$ ($n < 1$)

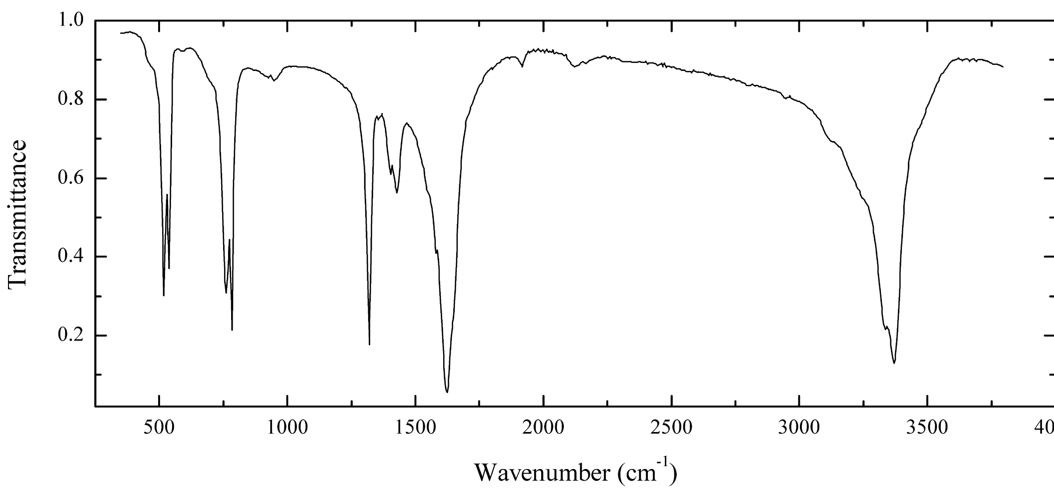


Locality: Sarbay Fe deposit, Kostanay region, Kazakhstan.

Description: Light blue crust from the association with pseudomalachite, malachite, gypsum, chrysocolla and native copper. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.87 (100), 2.48 (20), 2.31 (20), 1.77 (30). Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3550sh, 3440, 1658s, 1520w, 1436w, 1364s, 1320, 824, 506, 493.

Org17 Novgorodovaite $Ca_2(C_2O_4)Cl_2\cdot 2H_2O$

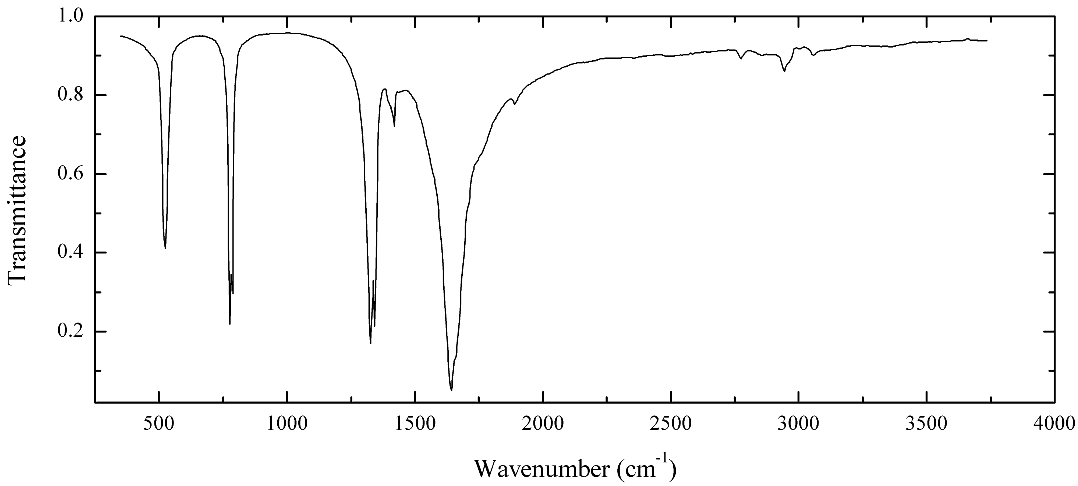


Locality: Chelkar salt dome, Aksai valley, Aktobe region, western Kazakhstan (type locality).

Description: Colourless grains from the association with anhydrite, gypsum, halite, bischofite, magnesite and hilgardite. Holotype sample. The crystal structure is solved. Monoclinic, space group $I2/m$, $a = 6.936(3)$, $b = 7.382(3)$, $c = 7.443(3)$ Å, $\beta = 94.3(1)°$, $V = 380.0(2)$ Å^3, $Z = 2$. The empirical formula is $Ca_{2.00}(C_2O_4)_{0.97}Cl_{1.89}(OH)_{0.17}$ 2.17 H_2O. $D_{meas} = 2.38(1)$ g/cm^3, $D_{calc} = 2.40(2)$ g/cm^3. Optically biaxial (–), $\alpha = 1.565(2)$, $\beta = 1.645(2)$, $\gamma = 1.725(4)$, $2V_{meas} = -88(10)°$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 5.062 (70) (110), 4.812 (50) (101), 4.323 (70) (11-1), 4.063 (70) (111), 3.644 (50) (020), 2.956 (80) (21-1), 2.917 (100) (112).

Wavenumbers (cm^{-1}): 3357s, 3325s, 3235sh, 3120sh, 2160w, 2120w, 1915w, 1645sh, 1621s, 1583, 1545sh, 1428, 1403, 1319s, 953w, 922w, 783s, 762, 700sh, 590w, 538, 518, 470sh.

Org18 Natroxalate $Na_2(C_2O_4)$

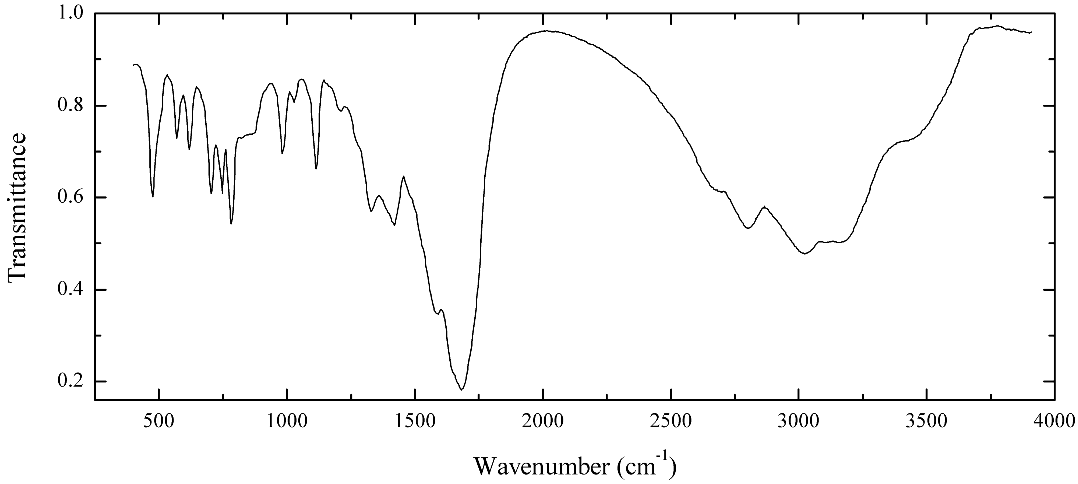


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description Colourless prismatic crystals from the association with aegirine, albite, elpidite, natron, nenadkevichite, taeniolite, sphalerite, pyrite and galena. Holotype sample. Monoclinic, space group $p2_2/a$, $a = 10.426(9)$, $b = 5.255(5)$, $c = 3.479(3)$ Å, $\beta = 93.14(8)°$, Z = 2. $D_{meas} = 2.32(3)$ g/cm^3, $D_{calc} = 2.338$ g/cm^3. Optically biaxial (–), $\alpha = 1.415(2)$, $\beta = 1.524(2)$, $\gamma = 1.592(2)$, $2V_{meas} = -72(1)°$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 2.826 (100), 2.602 (56), 2.334 (33), 2.898 (27), 2.041 (14), 5.203 (13), 2.117 (13).

Wavenumbers (cm^{-1}): 3042w, 2930w, 2755w, 1890w, 1765sh, 1655sh, 1642s, 1418, 1400sh, 1339s, 1322s, 782, 776s, 521.

Org19 "Tinnunkulite" $C_{10}H_{12}N_8O_8$ (?)

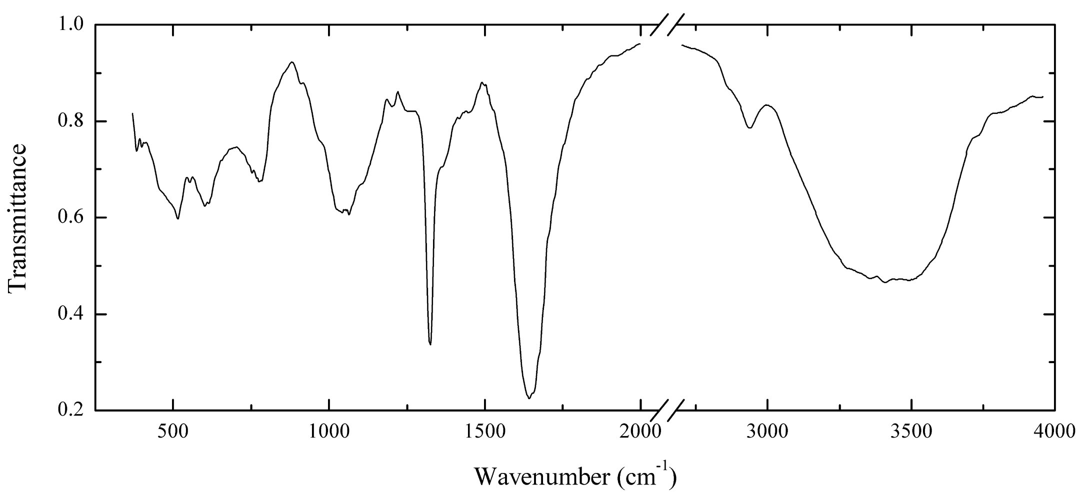


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Yellowish powdery aggregate. Presumably product of uric acid dimerization in the reaction of hot gases from a burning coal dump with excrement from European falcon (*Falco tinnunculus*). Investigated and named by B.V. Chesnokov. Orthorhombic, a = 15.08(1), b = 12.56(1), c = 34.64(10) Å. The empirical formula is $C_{9.88}H_{12.16}N_{7.98}O_{7.98}$. D_{meas} = 1.73(1) g/cm^3. Optically biaxial, n_{mean} = 1.523. NMR ^{1}H spectrum is obtained.

Wavenumbers (cm^{-1}): 3400sh, 3150, 3090, 3015s, 2790, 2700sh, 1683s, 1645sh, 1586s, 1421, 1332, 1210w, 1115, 1028w, 984, 870sh, 848, 784, 749, 704, 620, 572, 495sh, 475.

Org20 Caoxite $Ca(C_2O_4){\cdot}3H_2O$

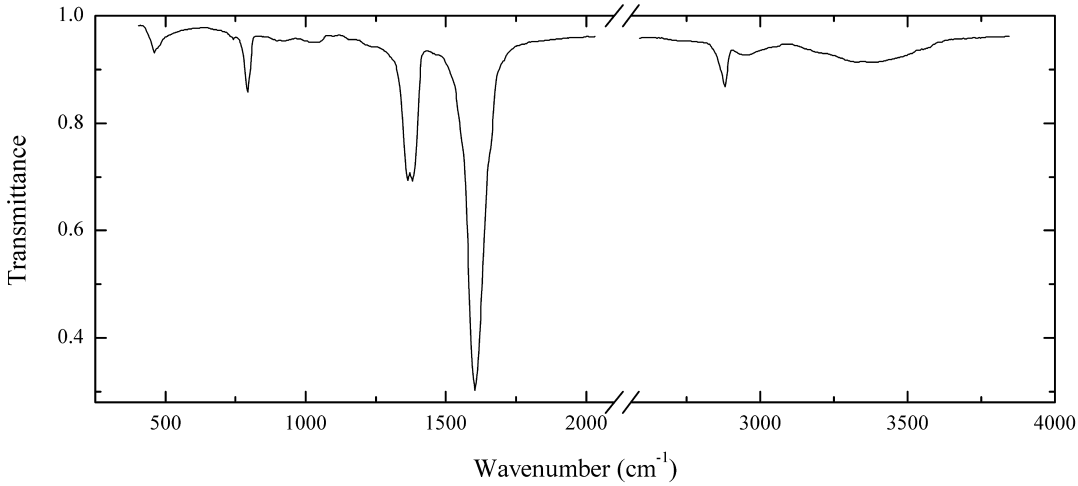


Locality: Cerchiara mine, near Faggiona, Val di Vara, La Spezia, Liguria, Italy (type locality).

Description: White powdery. Identified by IR spectrum. Contains admixture of weddellite.

Wavenumbers (cm^{-1}): 3420s, 2932, 2850sh, 1650s, 1450sh, 1360sh, 1323s, 1270sh, 1215w, 1100sh, 1062, 1035, 975sh, 910w, 777, 607, 555w, 518, 470sh.

Org21 Formicaite $Ca(HCO_2)_2$

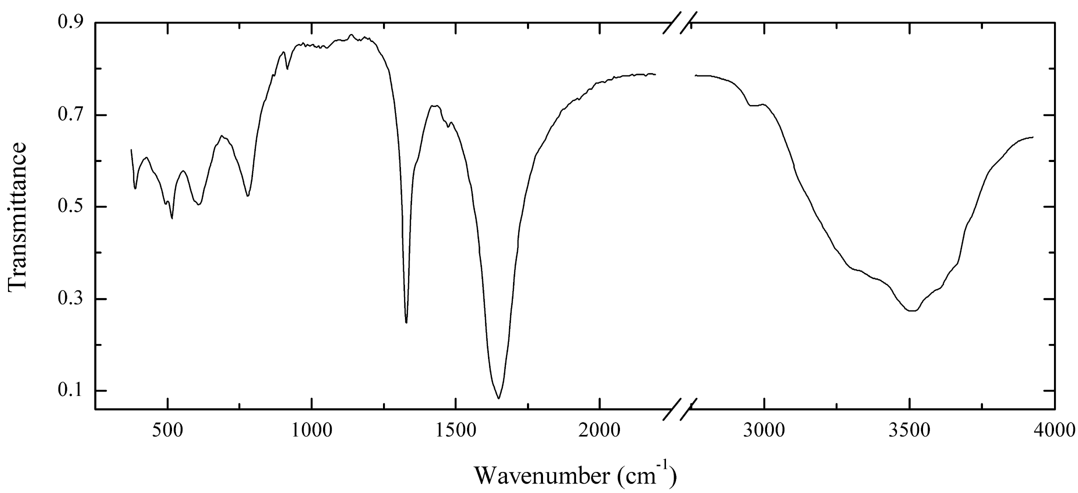


Locality: Solondo boron deposit, Vitim plateau, Buryatia Republic, Transbaikal area, Eastern Siberia, Russia (type locality).

Description: Light blue aggregate of tabular crystals (up to 30 × 30 ×5 μm) from the association with pentahydroborite, frolovite, fedorovskite, calcite, solongoite, turneaureite and johnbaumite. Holotype sample. Tetragonal, space group $P4_12_12$, $a = 6.77$ (1) Å, $c = 9.46$ (1) Å, $V = 434$ (1) Å ^{3}, $Z = 4$. The empirical formula is $(Ca_{0.88}Na_{0.01}H_{0.23})(HCO_2)_2$. $D_{meas} = 1.9$ (1) g/cm^3, $D_{calc} = 1.93$ (2) g/cm^3. Optically uniaxial (+), $\omega = 1.553$ (2), $\varepsilon = 1.573$ (2). The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.54 (90) (011), 3.40 (100) (200), 3.19 (60) (021), 2.859 (80) (013), 2.196 (70) (031), 2.046 (50) (032), 1.947(60) (132).

Wavenumbers (cm^{-1}): 3360w, 2925w, 2870, 1650sh, 1603s, 1560sh, 1380s, 1364s, 791, 740w, 464.

Org22 Weddellite $Ca(C_2O_4)\cdot 2H_2O$

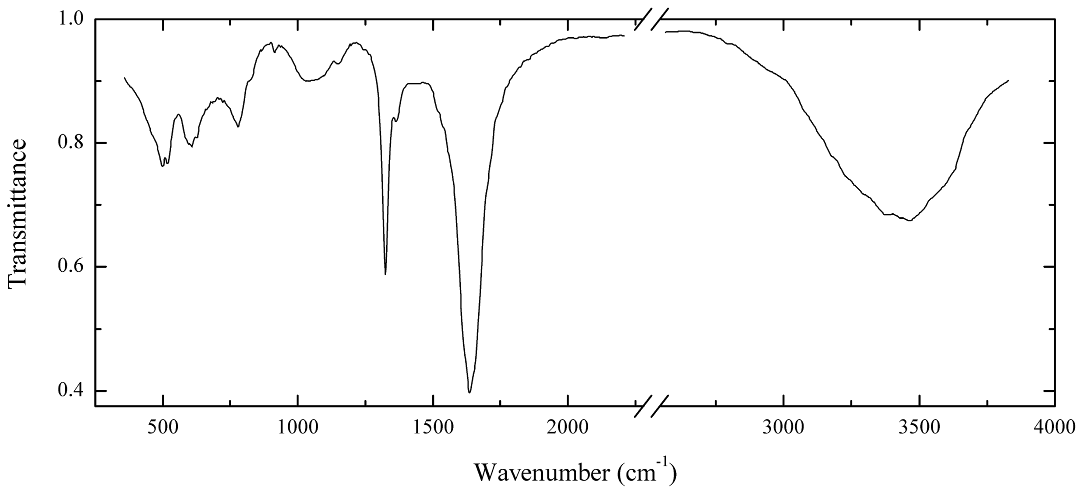


Locality: Biogenetic (from a kidney stone of the mineralogist Prof. I.V. Pekov, Moscow, Russia).

Description: Cream-coloured crystals on the aggregate of whewellite. Identified by IR spectrum.

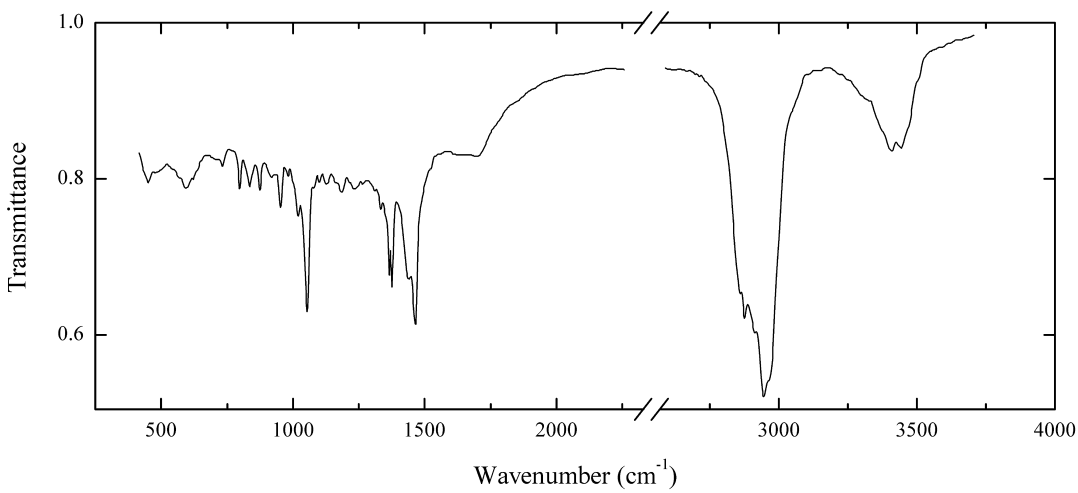
Wavenumbers (cm^{-1}): 3580sh, 3485s, 3360sh, 3300sh, 2950w, 2915w, 1645s, 1470w, 1370sh, 1325s, 916w, 779, 611, 516, 397, 400.

Org23 Weddellite $Ca(C_2O_4)\cdot 2H_2O$



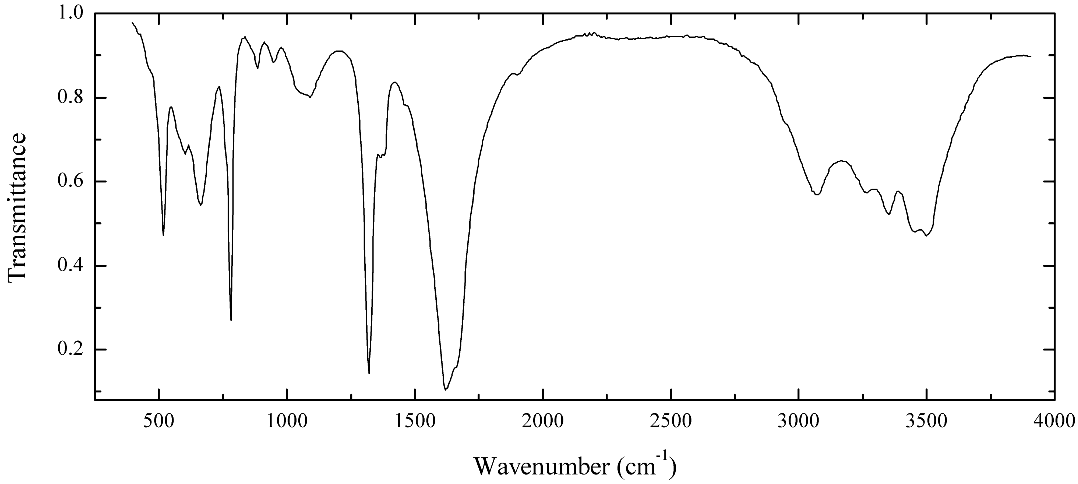
Locality: Maricopa, Maricopa Co., Arizona, USA. Biogenetic (from the dead saguaro cactus).
Description: White spherulites from the association with glushinskite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3590sh, 3460s, 3380sh, 1660sh, 1644s, 1525sh, 1371, 1325s, 1160w, 1060, 916w, 820sh, 779, 602, 519, 500.

Org24 Cholesterol $C_{27}H_{46}O\cdot nH_2O$



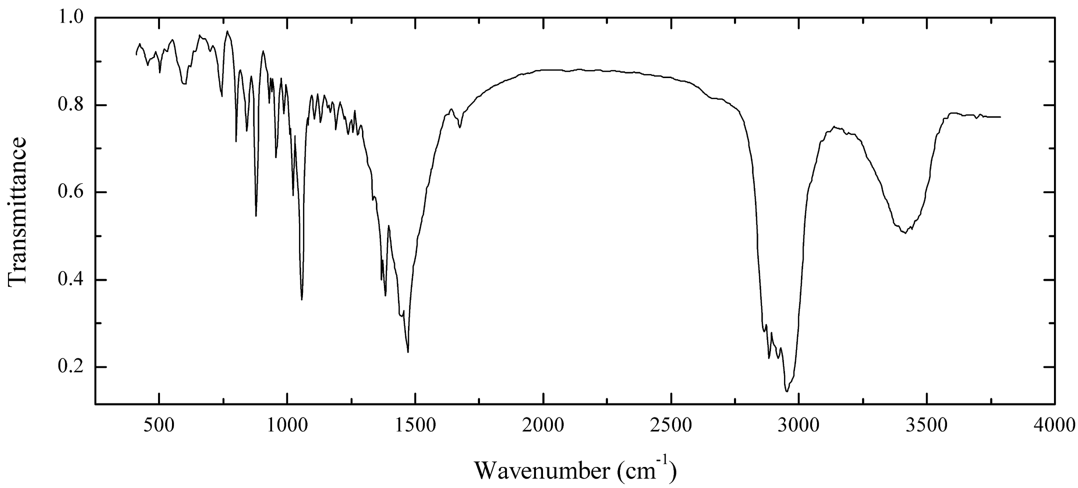
Locality: Biogenetic (gallstone).
Description: Brownish concretion. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3390, 2950sh, 2933s, 2900s, 2860s, 2845s, 1690, 1467s, 1445, 1378, 1365, 1334, 1275w, 1257w, 1236w, 1190w, 1130w, 1105w, 1080w, 1056s, 1022, 1010sh, 986w, 955, 937w, 926w, 977, 840, 800, 741w, 597, 501w, 455.

Org26 Whewellite $Ca(C_2O_4)\cdot H_2O$



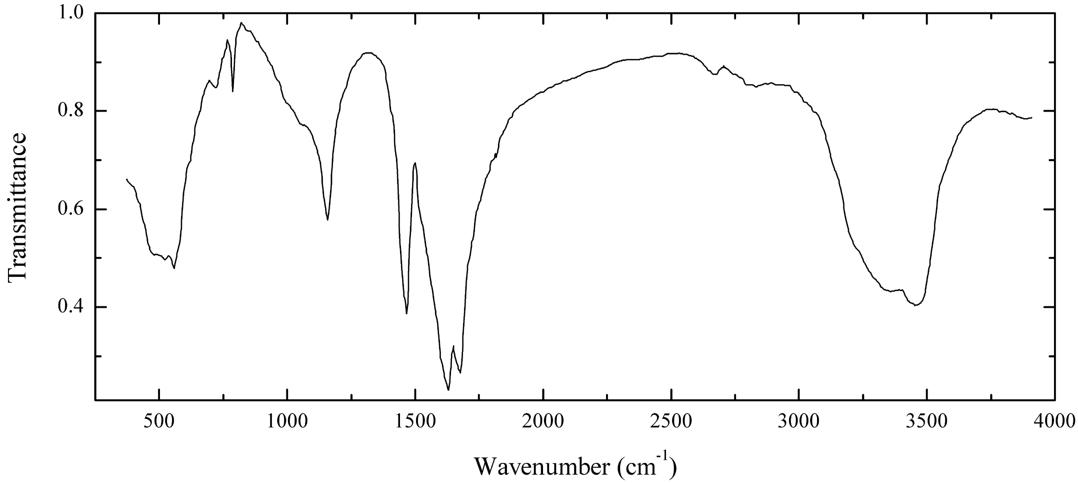
Locality: Biogenetic (from a kidney stone).
Description: Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3475, 3425, 3325, 3240, 3055, 2935sh, 1900w, 1660sh, 1620s, 1460sh, 1382, 1364, 1315s, 1091, 1045sh, 950w, 885w, 781s, 663, 602, 519.

Org27 Cholesterol $C_{27}H_{46}O\cdot nH_2O$



Locality: Biogenetic (human gallstone).
Description: Brownish concretion. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3390, 2950sh, 2934s, 2899s, 2864s, 2843s, 1675w, 1472s, 1446s, 1381s, 1368, 1333, 1275w, 1257w, 1236w, 1222w, 1188w, 1172w, 1127w, 1103w, 1075w, 1055s, 1022, 985, 956, 937w, 926w, 878, 842, 799, 740, 696w, 644w, 627w, 598, 542w, 501w, 468w.

Org28 Urea $CO(NH_2)_2$

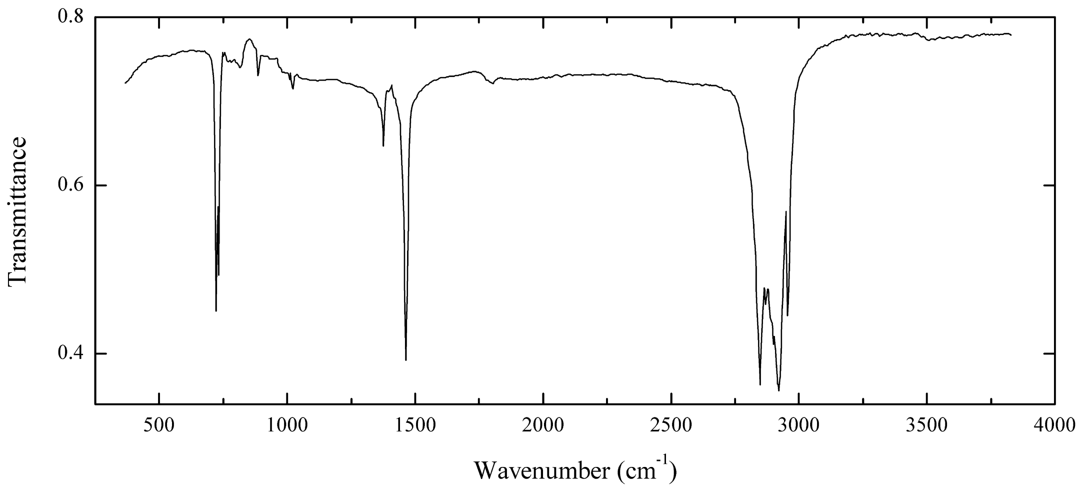


Locality: Wilgie Mia cave, Weld range, Western Australia.

Description: White acicular crystals from the association with aphthitalite and biphosphammite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3435s, 3335s, 3205sh, 2810w, 2650w, 1675s, 1627s, 1600sh, 1464s, 1156, 1060sh, 1000sh, 788, 719, 557, 523, 477.

Org29 Evenkite C_nH_{2n+2} (n = 19–28)

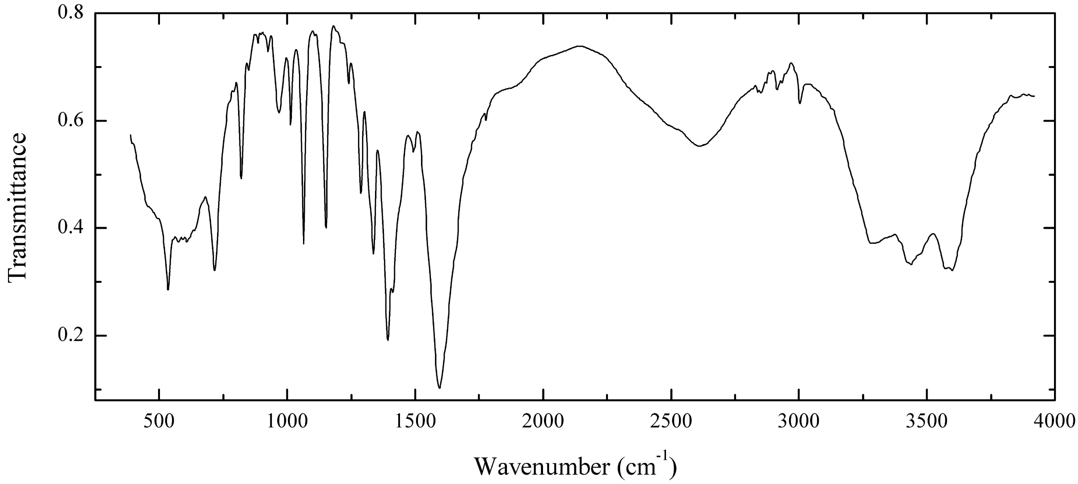


Locality: Khavokiperskiye Rocks, Lower Tunguska River, Evenki autonomous area, Siberia, Russia (type locality).

Description: Colourless tabular crystal from the association with quartz, chalcedony, pyrite, pyrrhotite, sphalerite, galena, chalcopyrite and calcite. Holotype sample. Orthorhombic, a = 7.52, b = 4.98, c = 32.50 Å. Contains 85.43 wt. % C and 14.99 wt.% H. D_{meas} = 0.92 g/cm^3. Optically uniaxial (+), ω = 1.553 (2), ε = 1.573 (2). The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 4.18 (100), 3.74 (90), 2.25 (80), 2.52 (70), 2.12 (60), 1.751 (60), 3.02 (50).

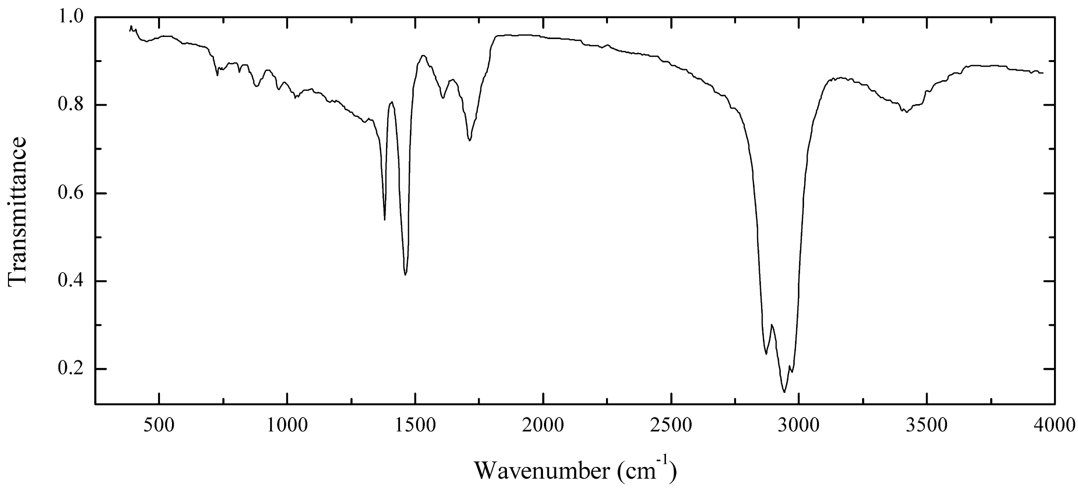
Wavenumbers (cm^{-1}): 2954, 2915s, 2867, 2845s, 1470s, 1382, 1023w, 885w, 815w, 730, 720.

Org30 Calcium wine stone $Ca(C_4O_6H_4){\cdot}nH_2O$



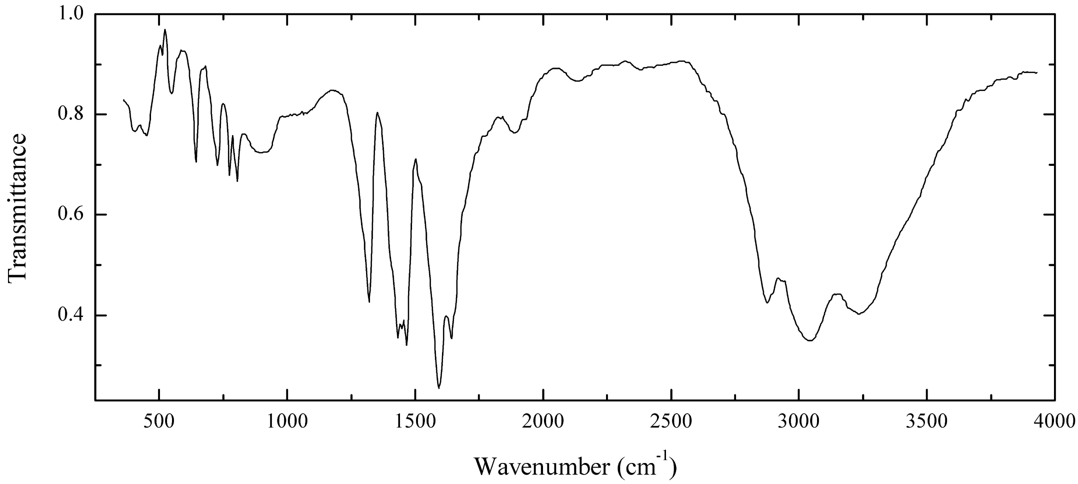
Locality: By-product of wine industry.
Description: Colourless crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3560, 3410, 3265, 2980w, 2890w, 2825w, 2590, 1850sh, 1592s, 1502w, 1408, 1390s, 1335, 1285, 1239w, 1148, 1062, 1011, 965, 923w, 885w, 858w, 817, 713, 600. 533, 460sh.

Org31 Asphaltite Bituminous matter with the predominance of aliphatic hydrocarbons



Locality: Glasberget pegmatite, Sweden.
Description: Black massive from granitic pegmatite. Investigated by V.V. Gordienko.
Wavenumbers (cm^{-1}): 3400, 2953s, 2923s, 2952s, 1770sh, 1714, 1608, 1463, 1382, 1305w, 1165w, 1034w, 967w, 880w, 810w, 748w, 725w, 450w.

Org32 Oxammite $(NH_2)_2(C_2O_4)\cdot H_2O$

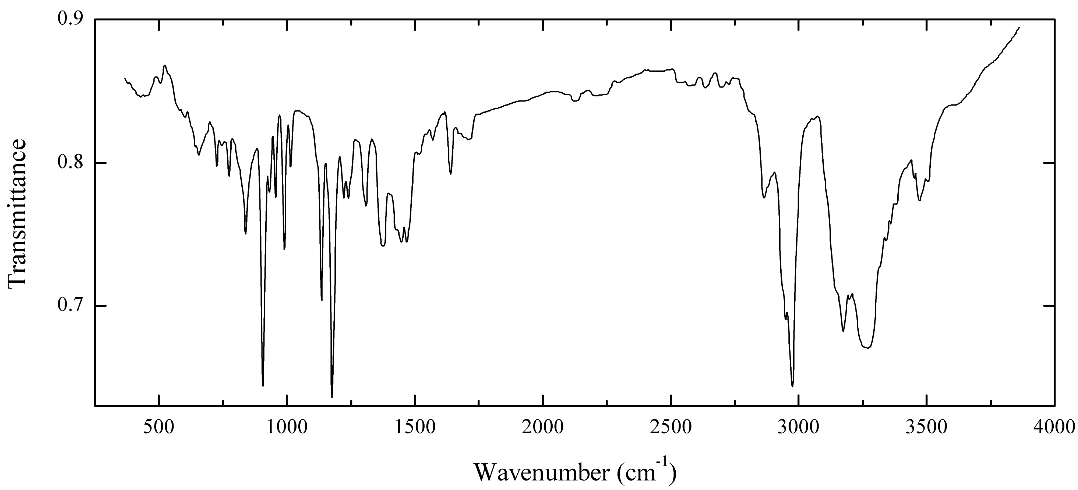


Locality: Guañape island, Trujillo province, La Liberdad department, Peru (type locality).

Description: Beige imperfect crystals. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3220s, 3030s, 2865s, 2375w, 2125w, 1890w, 1645s, 1595s, 1472s, 1453, 1435s, 1325s, 1050sh, 905, 806, 775, 728, 645, 578, 515w, 452, 412.

Org33 Flagstaffite $C_{10}H_{20}O_2\cdot H_2O$

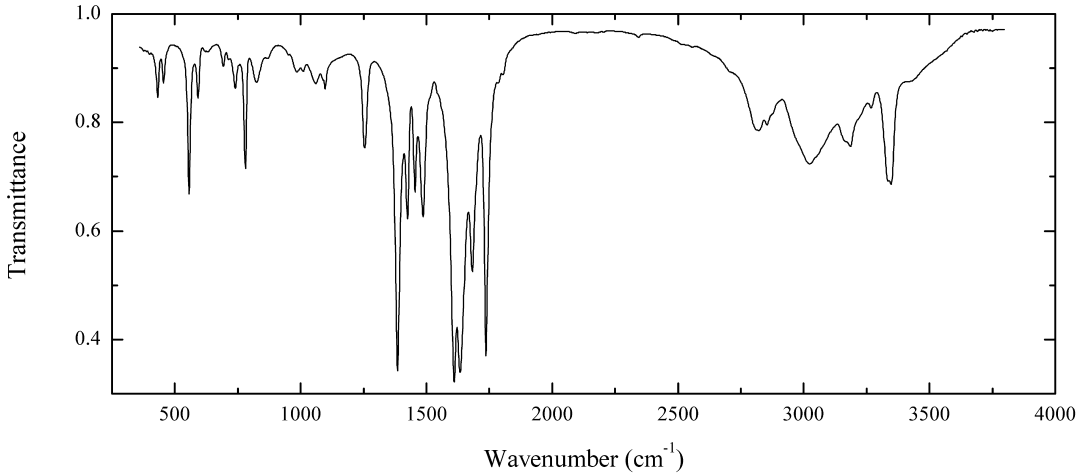


Locality: San Francisco Mts., north of Flagstaff, Coconino Co., Arizona, USA (type locality).

Description: Colourless crystals. Cis-terpin hydrate. Confirmed by IR spectrum.

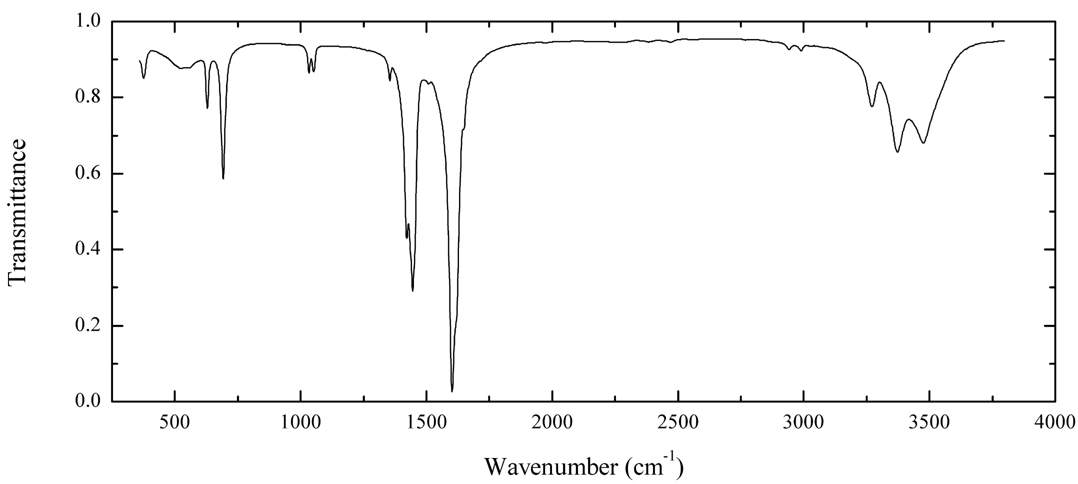
Wavenumbers (cm^{-1}): 3470w, 3450w, 3240, 3155, 2958s, 2935sh, 2850w, 1675w, 1620w, 1452, 1431, 1360, 1295, 1225, 1208, 1176s, 1135, 1013w, 990, 954, 930w, 905s, 838, 772w, 723w, 655w.

Org34 Joanneumite $Cu(C_3N_3O_3H_2)_2(NH_3)_2$



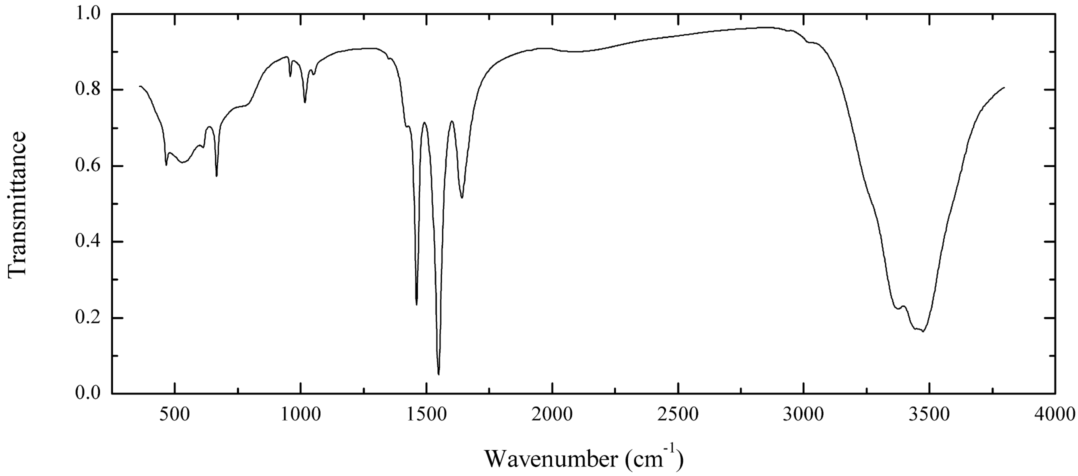
Locality: Caleta Pabellon de Pica, Iquique province, Tarapacá region, Chile (type locality).
Description: Violet aggregates from the association with salammoniac. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3545sh, 3415, 3348, 3338, 3268, 3210sh, 3186, 3170sh, 3024, 2875sh, 2855, 2821, 2715sh, 2560w, 2523w, 2342w, 2177w, 2092w, 1802w, 1780sh, 1737s, 1683, 1634s, 1610s, 1487, 1455, 1425, 1385s, 1254, 1098, 1060, 1011, 985, 955w, 867w, 825, 780, 740, 718w, 692, 630w, 592, 556, 455, 432.

Org35 Copper oxalate monohydrate $Cu(CH_3COO)_2{\cdot}2H_2O$



Locality: Rubtsovskoe base-metal deposit, Rubtsovsk ore district, northwest Altai Mts., Siberia, Russia.
Description: Dark blue crystals on native copper. Possibly technogenetic. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3475, 3373, 3272, 2990w, 2942w, 2472w, 2384w, 1645sh, 1602s, 1509w, 1446s, 1442s, 1355, 1052, 1033, 692, 629, 550w, 523w, 377.

Org36 Calclacite $Ca(CH_3COO)Cl{\cdot}5H_2O$



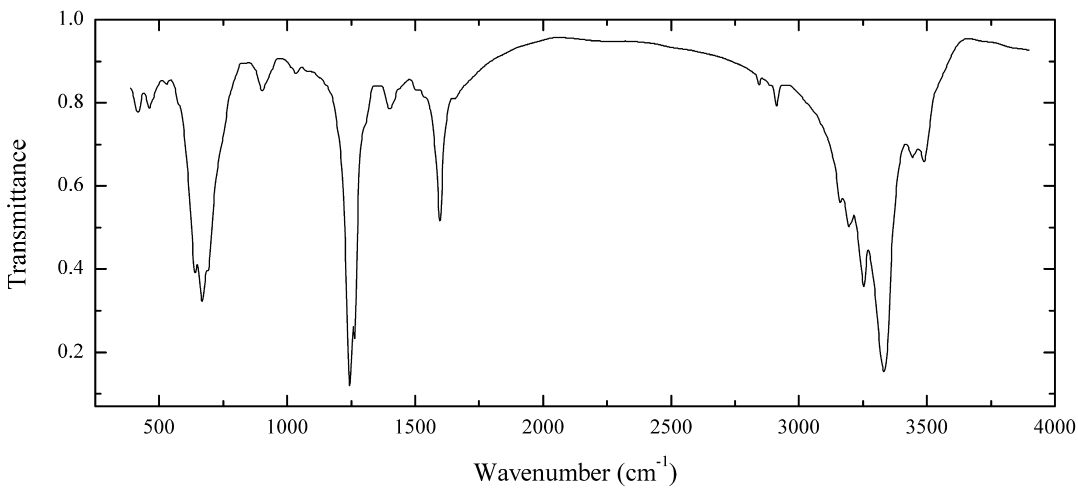
Locality: Royal Museum of Natural History of Belgium, Brussels, Belgium (type locality).

Description: White acicular crystals. Anthropogenic, due to the action of acetic acid derived from oak storage cabinets. By IR spectrum is close to calclacite identified by powder X-ray diffraction pattern, but needs further investigation.

Wavenumbers (cm^{-1}): 3474s, 3345s, 3377s, 3027w, 2935w, 2090, 1641, 1548s, 1461s, 1425, 1351w, 1052, 1017, 959, 765sh, 665, 611, 530, 466.

2.4 Ammino-Complexes, Nitrates and Sulfato-Nitrates

Am1 "Amminite" $Zn(NH_3)_2Cl_2$



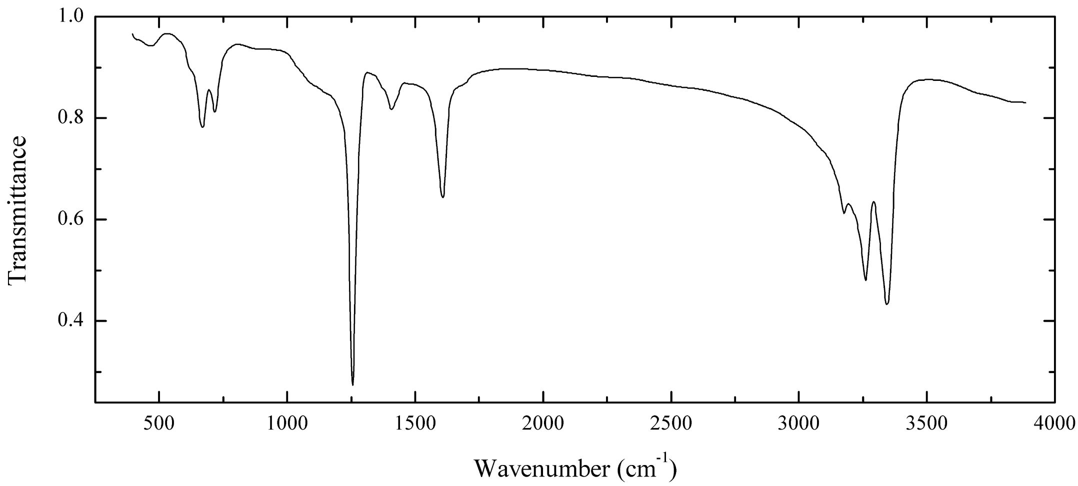
Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Technogenetic, not approved by the IMA CNMNC. Together with zincite forms pseudomorph after zinc sheet. Light brown grains with perfect cleavage. Investigated by B.V. Chesnokov. Orthorhombic, $a = 8.12(1)$, $b = 8.46(2)$, $c = 7.77(1)$ Å, $Z = 4$. Optically biaxial (−), $\alpha = 1.598$, $\beta = 1.618$, $\gamma = 1.624$. $D_{meas} = 2.11(1)$ g/cm^3. Strong lines of powder

X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.88 (90) (110), 5.75 (80) (011), 3.90 (80) (002), 3.39 (90) (121), 3.31 (80) (211), 3.24 (90) (112), 2.94 (100) (220), 2.87 (90) (022), 1.956 (70) (330), 1.696 (90) (242). Weak bands at 2,910 and 2,842 cm^{-1} can correspond to the admixture of an organic substance.

Wavenumbers (cm^{-1}): 3490, 3445, 3330s, 3253s, 3195, 3160, 2910w, 2842w, 1900w, 1605, 1405, 1268s, 1247s, 1035w, 904, 688, 667s, 638, 573w, 528w, 460w, 413w.

Am2 Ammineite $Cu(NH_3)_2Cl_2$

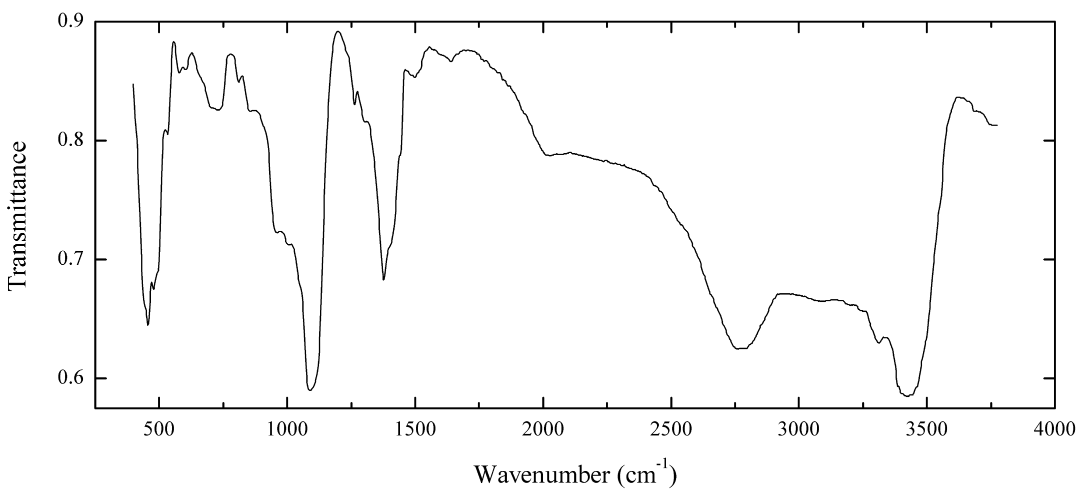


Locality: Calleta Pabellon de Pica, Tarapaća region, Chile (type locality).

Description: Blue crystals from the association with halite, atacamite, salammoniac and darapskite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3318s, 3235s, 3155, 2475w, 1608, 1405, 1247s, 1150sh, 1100sh, 716, 669, 470w.

N1 Buttgenbachite $Cu_{19}(NO_3)_2Cl_4(OH)_{32}\cdot 2H_2O$

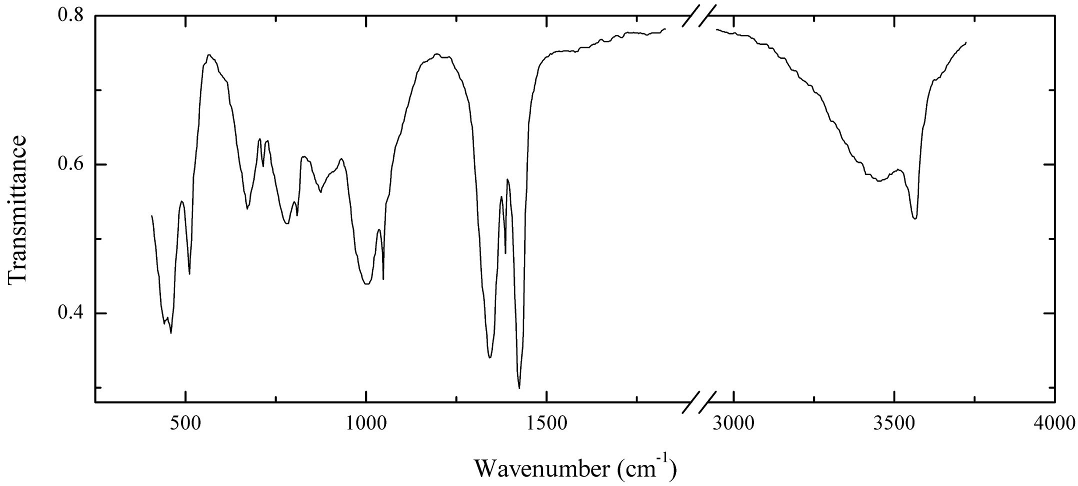


Locality: Likasi mine, Katanga Copper Crescent, Katanga, Democratic Republic of Congo (type locality).

Description: Blue prismatic crystals from the association with likasite and brochantite. SO_4-rich variety with zones of connellite. The empirical formula is (electron microprobe, NO_3 and OH are calculated) $(Cu_{19.00}[(NO_3)_{0.8–1.2}(SO_4)_{1.2–0.8}]Cl_{3.8}OH)_{31.2}·nH_2O$.

Wavenumbers (cm^{-1}): 3425s, 3305, 3090, 2770, 2030w, 1630w, 1500w, 1446, 1405sh, 1383s, 1310, 1267, 1110sh, 1097s, 1005, 966, 868, 820w, 745, 710sh, 660sh, 610w, 584w, 535, 497, 481s, 458s, 445sh.

N2 Gerhardtite $Cu_2(NO_3)(OH)_3$

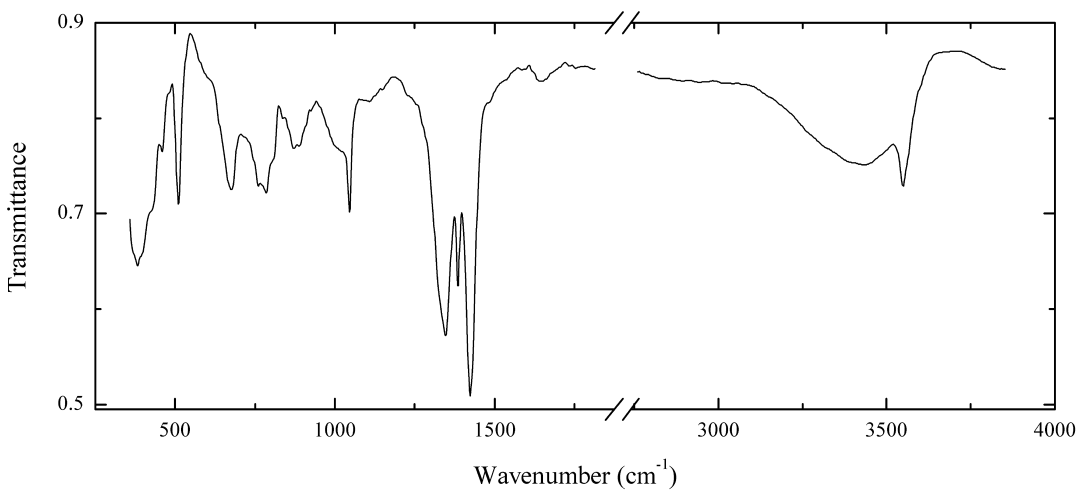


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Middle Urals, Russia.

Description: Light blue crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3430, 1430sh, 1422s, 1384, 1344s, 1047, 1003, 915sh, 871, 811, 717w, 671, 510, 459s, 440s.

N3 Gerhardtite $Cu_2(NO_3)(OH)_3$

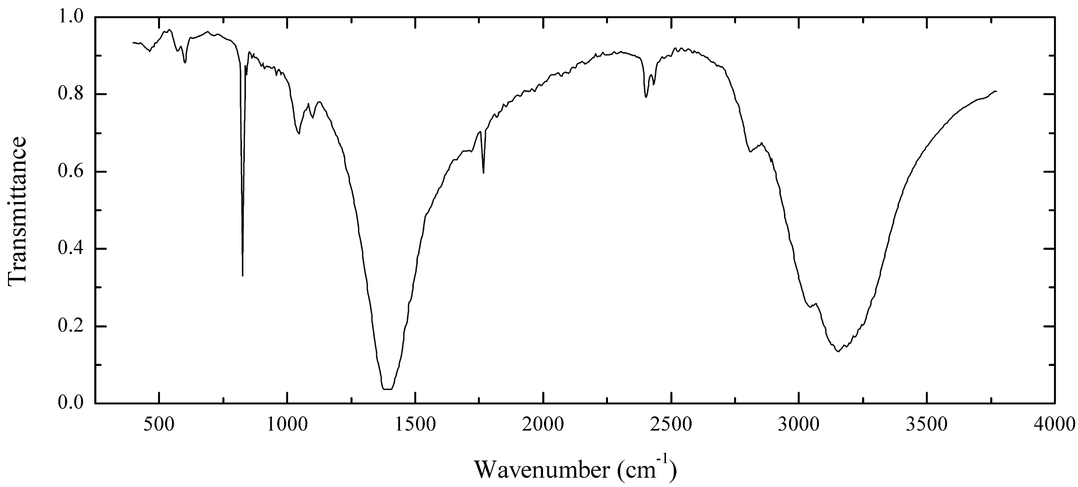


Locality: Caledonia mine, Mass, Ontonagon Co., Michigan, USA.

Description: Greenish-blue crystalline crust. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3540, 3425, 1650w, 1422s, 1386, 1345s, 1047, 1005sh, 875, 800sh, 788, 762, 673, 509, 458w, 425sh, 382.

N4 Gwihabaite $(NH_4)(NO_3)$

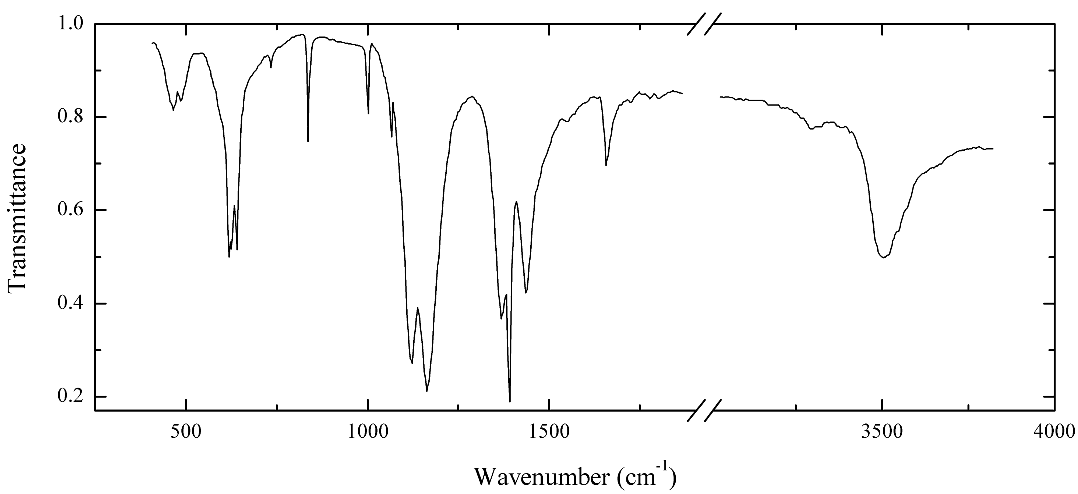


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White granular aggregate. Probably technogenetic. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3130s. 3022s, 2790, 2425w, 2390w, 1765, 1388s, 1095w, 1040, 840w, 826, 715w, 603w, 574w, 465w.

N5 Darapskite $Na_3(SO_4)(NO_3)\cdot H_2O$

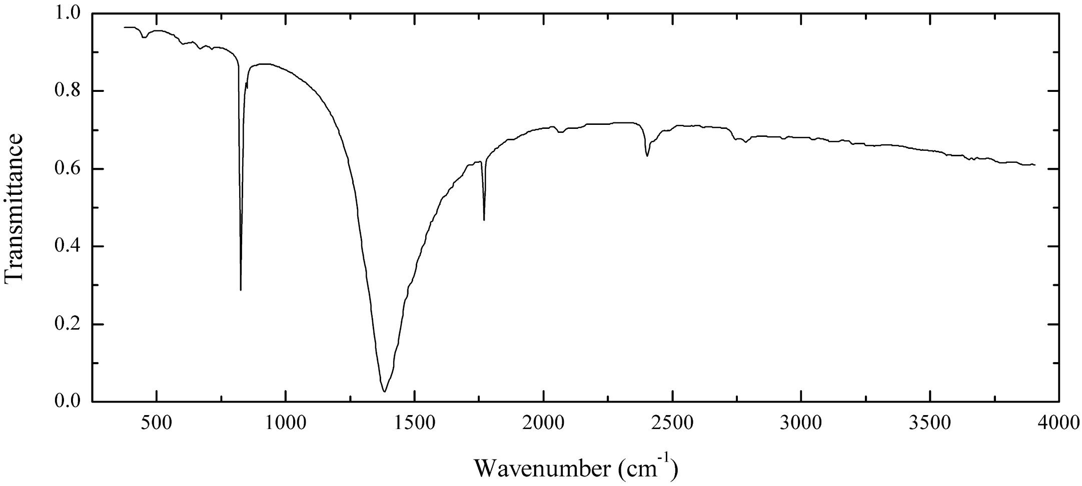


Locality: San Francisco mine, Caracoles, Sierra Gorda district, Antofagasta province, Antofagasta region, Chile.

Description: Colourless crystals from the association with löweite and kröhnkite. Identified by powder X-ray diffraction pattern, IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe, NO_3 is calculated) $Na_{2.87}Ca_{0.05}$ $[(SO_4)_{1.00}(NO_3)_{0.97}]\cdot H_2O$.

Wavenumbers (cm^{-1}): 3472, 3270w, 1651, 1547w, 1431, 1384s, 1364s, 1190sh, 1160s, 1117s, 1063, 997, 832, 733w, 640, 625, 619, 484, 462.

N6 Niter $K(NO_3)$

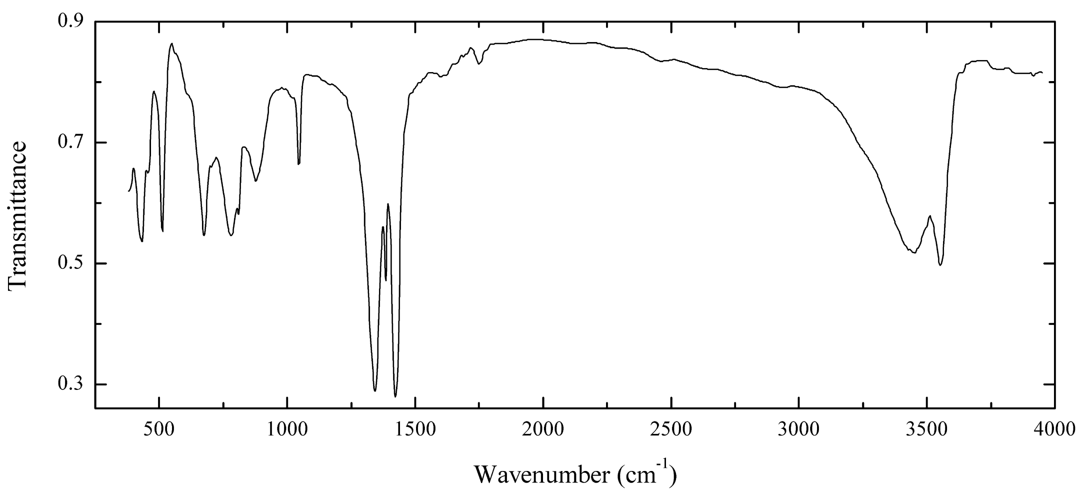


Locality: Bakla Mt, near Skalistoe village, Bakhchisaray district, Crimea, Ukraine.

Description: White crust on sandstone. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 2765w, 2730w, 2420sh, 2395, 2120w, 2060w, 1770, 1381s, 840w, 825s, 714w, 670w, 605w, 452w.

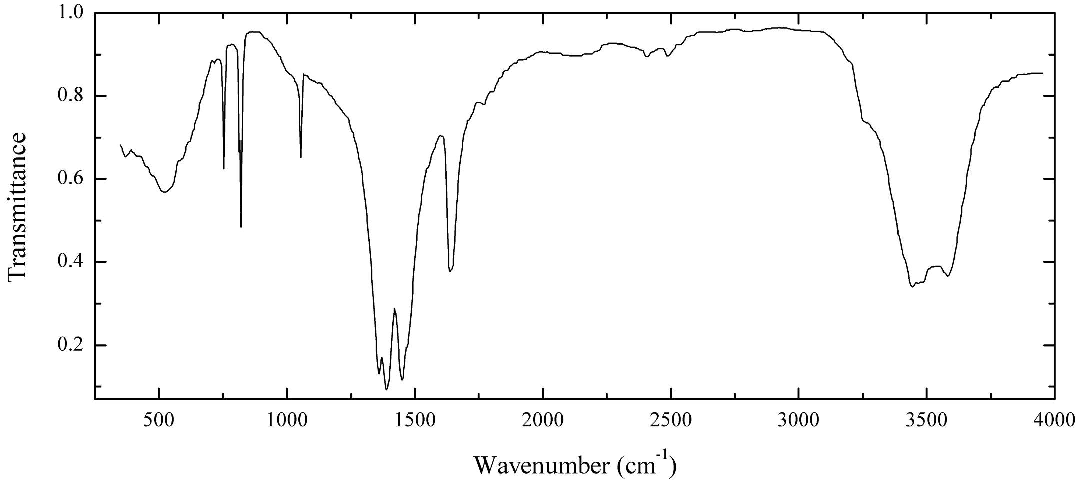
N7 Gerhardtite $Cu_2(NO_3)(OH)_3$



Locality: Mbobo Mkulu cave, Nelspruit district, Mpumalanga province, South Africa.

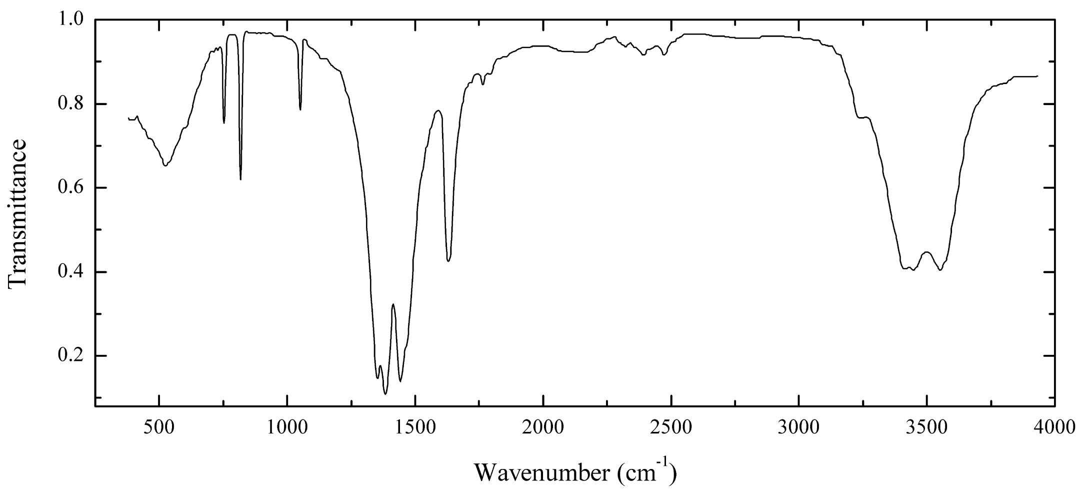
Description: Light blue fine-grained aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3540, 3435, 3250sh, 2450w, 1750w, 1610w, 1430sh, 1422s, 1385, 1344s, 1048, 877, 810, 784, 676, 510, 454w, 428.

N8 Nitrocalcite $Ca(NO_3)_2{\cdot}4H_2O$



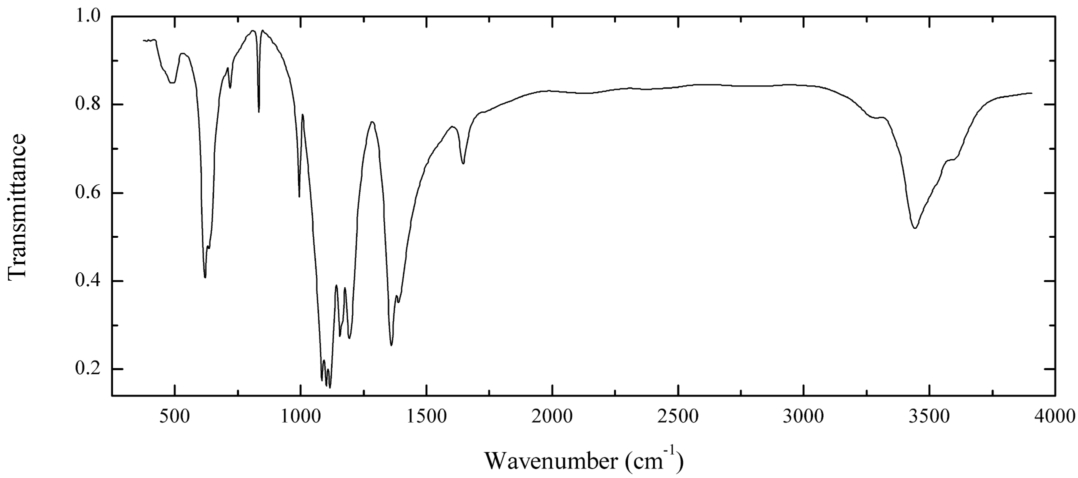
Locality: Barcelona, Spain.
Description: Colourless grains from soil. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3550s, 3445sh, 3412s, 3230sh, 2470w, 2390w, 2100w, 1767w, 1634, 1465sh, 1441s, 1383s, 1353s, 1052, 819, 813, 755w, 751, 715w, 526, 374.

N9 Nitrocalcite $Ca(NO_3)_2{\cdot}4H_2O$



Locality: Synthetic.
Description: White powdery.
Wavenumbers (cm^{-1}): 3547s, 3443s, 3407s, 3230, 2475w, 2392w, 2325w, 2130w, 1794w, 1768w, 1635, 1465sh, 1442s, 1383s, 1354s, 1052, 820, 815sh, 755w, 751, 525.

N10 Witzkeite $Na_4K_4Ca(NO_3)_2(SO_4)_4{\cdot}2H_2O$

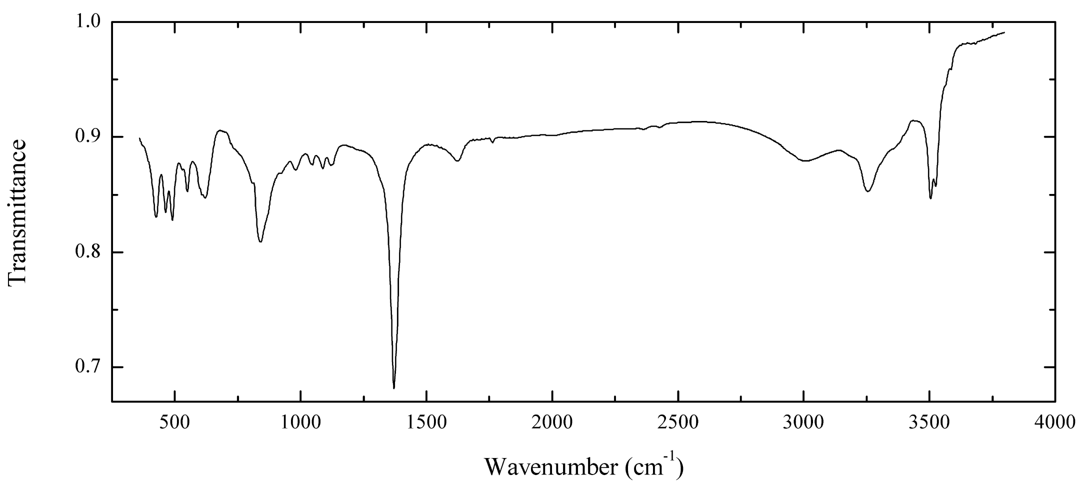


Locality: Guano mining field at south slope of Punta de Lobos, Tarapacá region, 90 km south of Iquique, Chile (type locality).

Description: Colourless elongated tabular crystals up to 140 mμ in length. Associated minerals are dittmanite and nitratine. Holotype sample. Monoclinic, space group *Cc*; $a = 24.902(2)$, $b = 5.3323(4)$, $c = 17.246(1)$ Å, $\beta = 94.281(7)°$. Optically biaxial (−), $\alpha = 1.470(5)$, $\beta = 1.495(5)$, $\gamma = 1.510(5)$. $D_{meas} = 2.40(2)$ g/cm^3, $D_{calc} = 2.403$ g/cm^3. The empirical formula is $Na_{3.40}K_{3.95}Ca_{1.11}Fe_{0.05}(NO_3)_{1.93}(SO_4)_{4.10}(H_{4.10}O_{1.81})$. The strongest lines of the powder X-ray pattern [*d*, Å, (*I*, %) (*hkl*)] are 12.38 (100) (200), 4.13 (19) (600), 3.10 (24) (800), 2.99 (7) (-802), 2.85 (6) (802), 2.69 (9) (-713), 2.48 (12) (10.0.0), 2.07 (54) (12.0.0).

Wavenumbers (cm^{-1}): 3565sh, 3419, 3260w, 2775w, 2405w, 2110w, 1638, 1385, 1354s, 1192s, 1154s, 1116s, 1101s, 1084s, 993, 830, 716, 634, 617, 499.

N11 Likasite $Cu^{2+}{}_3(NO_3)(OH)_5{\cdot}2H_2O$



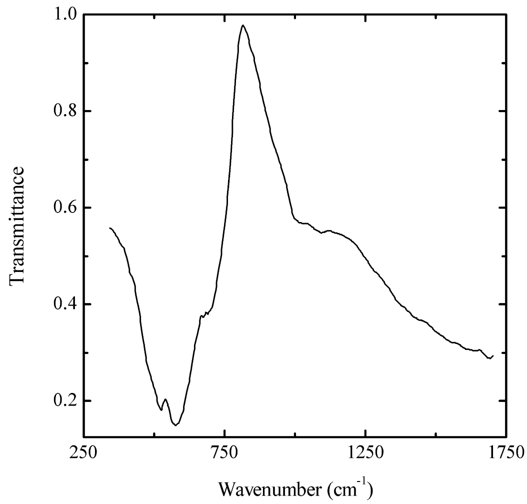
Locality: Likasi mine, Katanga Copper Crescent, Katanga, Democratic Republic of Congo (type locality).

Description: Blue crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3525, 3505, 3350sh, 3255, 3005, 2428w, 2365w, 2005w, 1765w, 1622, 1371s, 1120, 1088, 1048, 981, 919, 841, 810sh, 740sh, 621, 610sh, 600sh, 549, 530sh, 490, 463, 426.

2.5 Oxides and Hydroxides

O1 Nsutite $Mn^{2+}{}_{x}Mn^{4+}{}_{1-x}O_{2-2x}(OH)_{2x}$

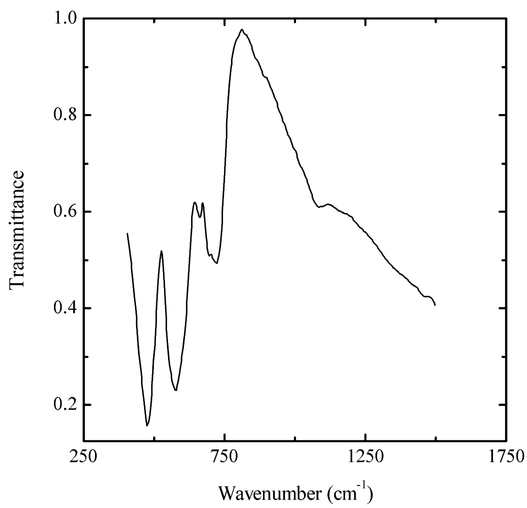


Locality: Nsuta mine, Ghana (type locality).

Description: Black crust on quartz. Identified by powder X-ray diffraction pattern. Electron microprobe analysis shows the presence of Mn. The contents of other elements with atomic numbers higher than 8 are below detection limits.

Wavenumbers (cm^{-1}): 1097w, 1024w, 685sh, 579s, 527s, 490sh.

O2 Coulsonite $Fe^{2+}V^{3+}{}_2O_4$

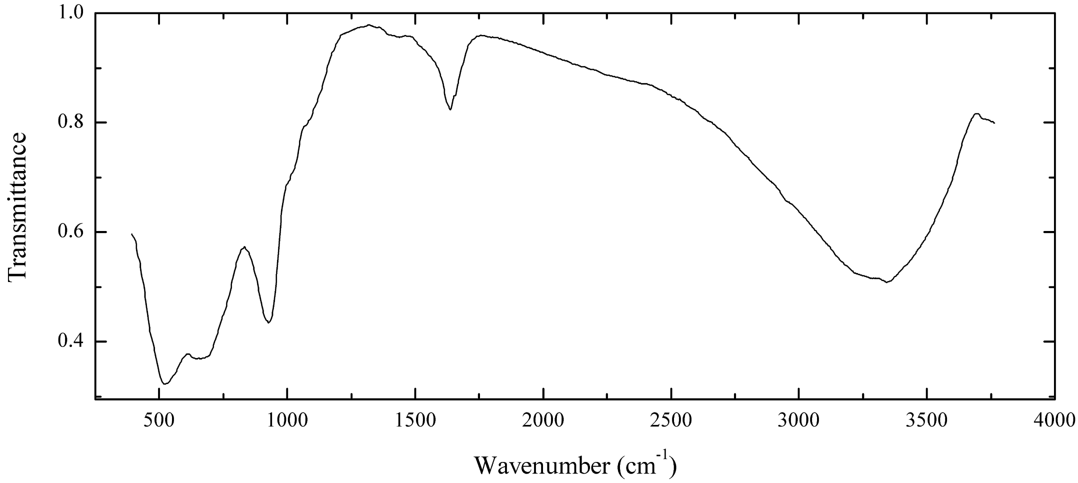


Locality: Srednyaya Padma U–V deposit, near Onega Lake, southern Karelia, Russia.

Description: Black grains from the association with dolomite, quartz, roscoelite, chromceladonite, calcite, hematite, uraninite, zincochromite, V oxides, selenides, *etc*. The empirical formula is (electron microprobe) $Fe_{1.00}(V_{1.97}Cr_{0.01}Ti_{0.01}Fe_{0.01})O_4$.

Wavenumbers (cm^{-1}): 1088w, 720, 694, 659w, 574s, 474s.

O3 Gerasimovskite $(Mn,Ca)(Nb,Ti)_{5-6}(O,OH)_{12-16}\cdot 8\text{–}9H_2O$ (?)

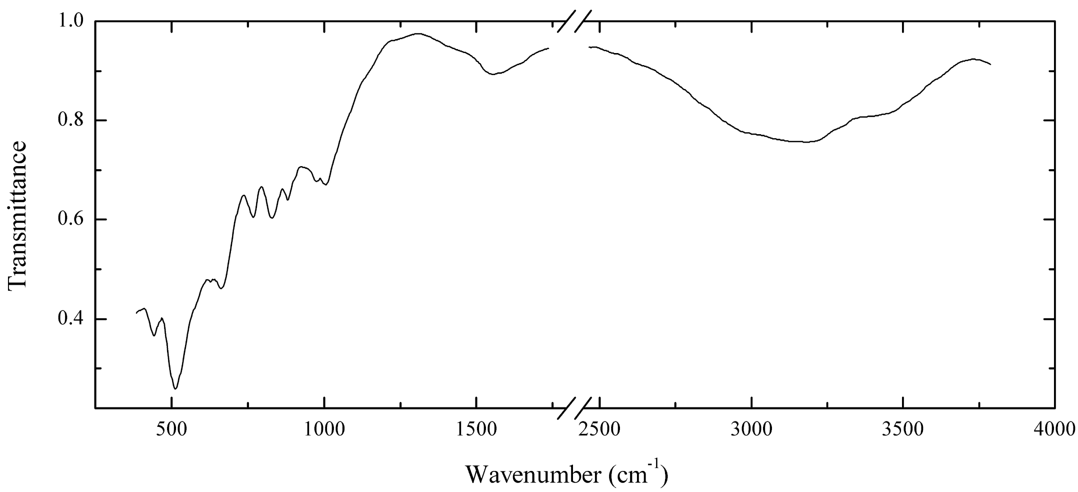


Locality: Pegmatite No. 60, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Grey platy pseudomorph after vuonnemite from the association with ussingite, manganonordite and rhabdophane-(La). The empirical formula is (electron microprobe) $Mn_{0.65}Ca_{0.2}Fe_{0.05}(Nb_{3.3}Ti_{2.4}Si_{0.3})(O,OH)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3320, 3260sh, 1633, 1080sh, 1005sh, 927, 685, 637s, 527s.

O4 Cafetite $CaTi_2O_5\cdot H_2O$

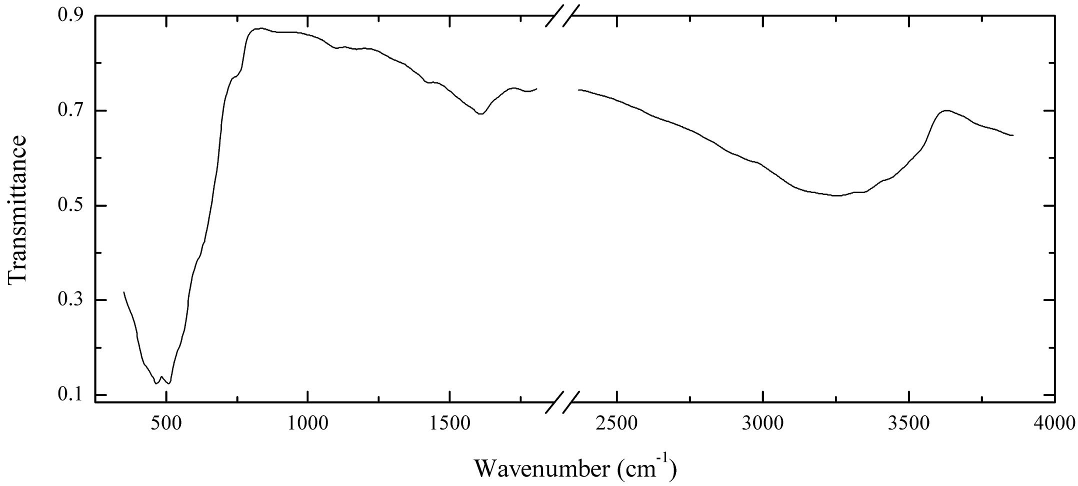


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Yellowish-beige platy pseudomorph after a heterophyllosilicate, from the association with nepheline, clinopyroxene, phlogopite, richterite, pectolite, nabalamprophyllite, lorenzenite, titanite and eudialyte. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.92}Na_{0.05}K_{0.01})(Ti_{3.86}Nb_{0.12}Fe_{0.02})O_4\cdot H_2O$.

Wavenumbers (cm^{-1}): 3350sh, 3130, 1630sh, 1570w, 1527w, 1003, 977, 879, 826, 767, 660, 509s, 441s.

O5 Birnessite $(Na,Ca)_{0.5}(Mn^{4+},Mn^{3+})_2O_4 \cdot 1.5H_2O$

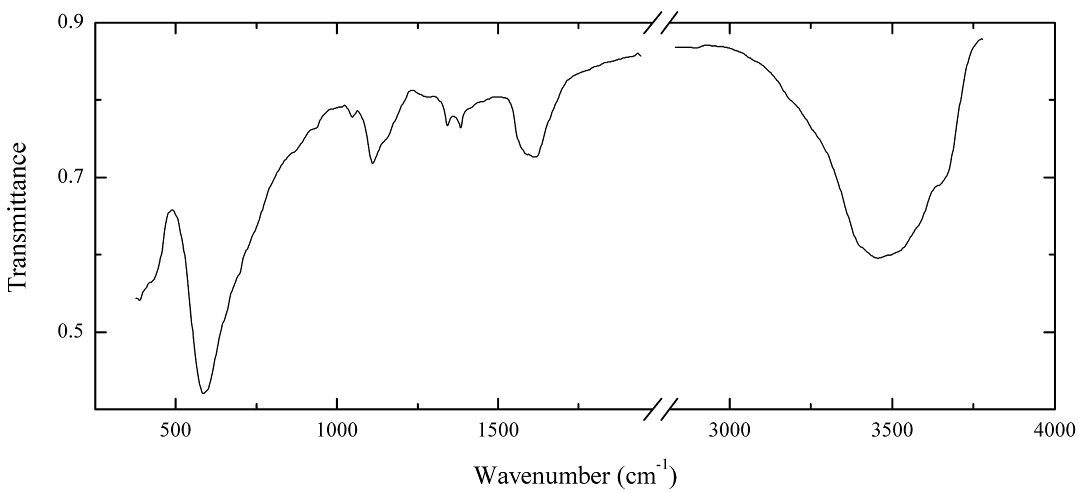


Locality: Mid-Atlantic Ridge.

Description: Dark brown massive. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Na_{0.3}Ca_{0.2}Mn_{2.0}O_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3245, 1615w, 1570sh, 1425w, 1100w, 750sh, 670sh, 620sh, 550sh, 504s, 464s, 440sh, 370sh.

O6 Iowaite $Mg_6Fe^{3+}{}_2(OH)_{16}Cl_2 \cdot 4H_2O$

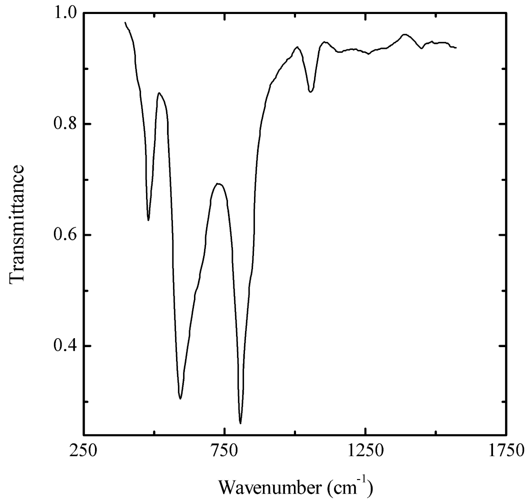


Locality: Talnakh Cu–Ni deposit, Noril'sk, Putorana Plateau, Taimyr peninsula, Eastern Siberia, Russia.

Description: Yellowish trigonal platy crystals from the coarse-grained aggregate of gypsum. Identified by IR spectrum and qualitative electron microprobe analysis. Contains little admixture of CO_3^{2-} (the bands at 1,375 and 1,345 cm^{-1}) and SO_4^{2-} (the bands at 1,140, 1,110 and 1,053 cm^{-1}).

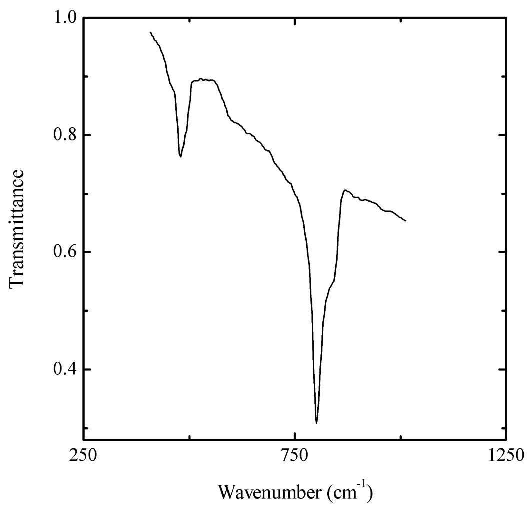
Wavenumbers (cm^{-1}): 3625sh, 3440, 1610, 1580sh, 1375w, 1345w, 1140sh, 1110, 1053w, 593s, 435sh, (420).

O7 Arsenolite As_2O_3



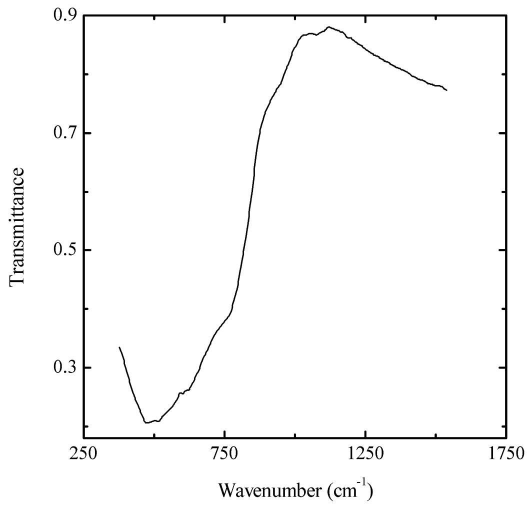
Locality: Jáchymov, Krušné Hory Mts. (Ore Mts.), Bohemia, Czech Republic.
Description: Isometric cubic crystals. Identified by powder X-ray diffraction pattern. The band at 589 cm^{-1} is gradually growing on grinding of the mineral in agate mortar.
Wavenumbers (cm^{-1}): 1045, 835sh, 801s, 630sh, 589s, 480.

O9 Arsenolite As_2O_3



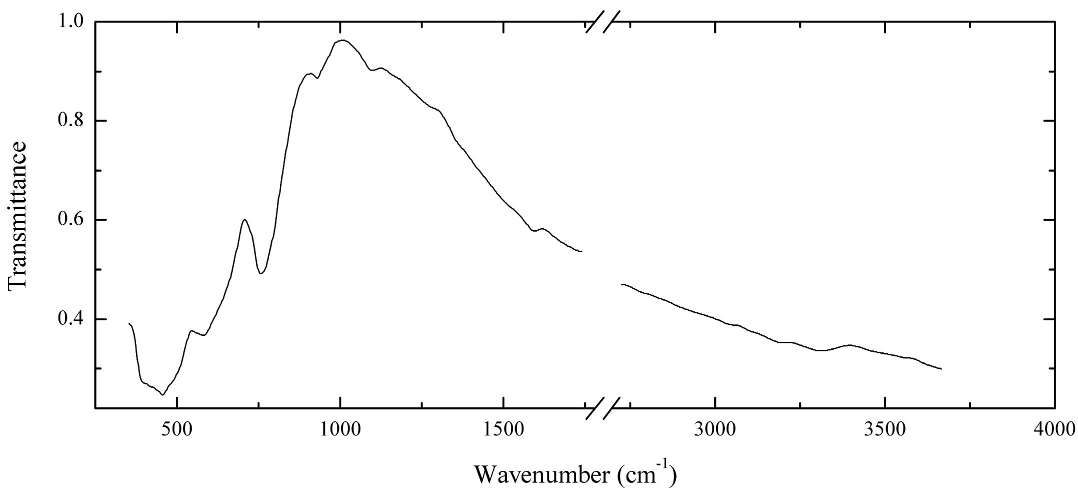
Locality: Belorechenskoe deposit, Adygea Republic, Northern Caucasus, Russia.
Description: Colourless octahedral crystals. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 840sh, 799s, 490sh, 477.

O10 Anatase TiO_2



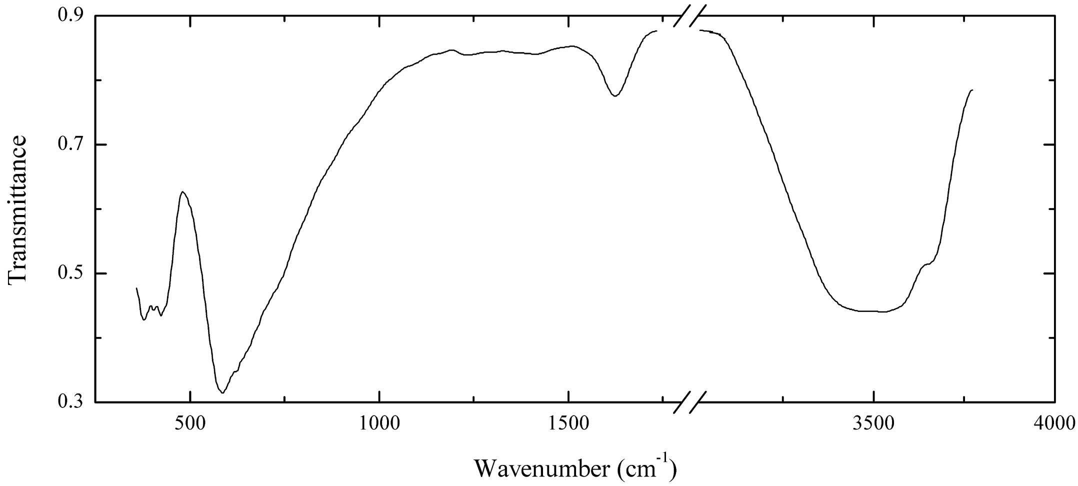
Locality: Parnok Mt., Subpolar Urals, Russia.
Description: Yellow bipyramidal crystals.
Wavenumbers (cm^{-1}): 1070w, 740sh, 610sh, 550sh, 520s, 470s.

O11 Henrymeyerite $BaFeTi_7O_{16}\cdot nH_2O$



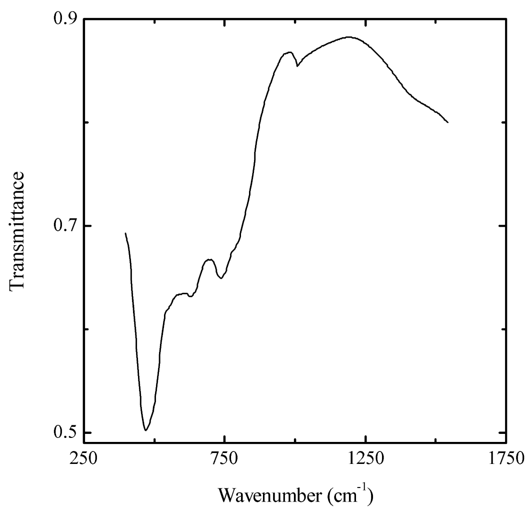
Locality: Hackman valley, Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Black crystals from the association with baotite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Ba_{1.0}La_{0.1})(Ti_{6.6}Fe_{0.9}V_{0.1}Nb_{0.1})O_{16.0}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3300w, 3190w, 1597w, 1114w, 932w, 765, 650sh, 593s, 495sh, 457s, 420sh, 395sh.

O12 Iowaite $Mg_6Fe^{3+}{}_2(OH)_{16}Cl_2{\cdot}4H_2O$



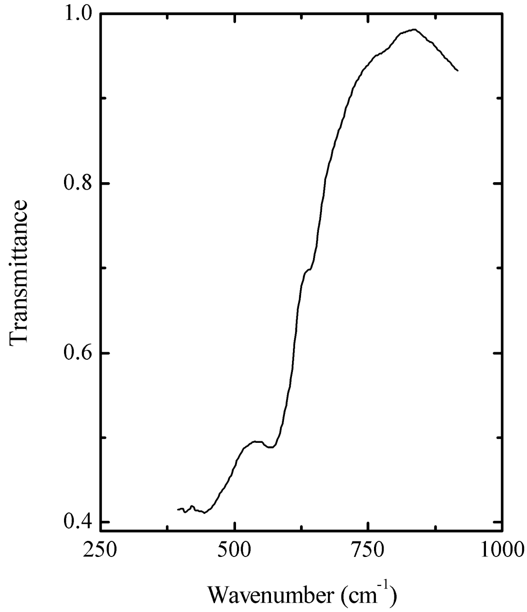
Locality: Korshunovskoe deposit, Irkutsk region, Eastern Siberia, Russia.
Description: Columnar aggregate in dolomite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mg_{5.87}Fe_{2.04}Al_{0.09}(OH)_{16}Cl_{1.87}(OH)_{0.13}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3650s, 3545s, 3475sh, 1620, 725sh, 680sh, 581s, 420, 394.

O13 Armolkolite $(Mg,Fe^{2+})Ti_2O_5$



Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.
Description: Black tabular crystals. Associated minerals are pyrrhotite, magnetite, rutile, anorthite and fluorphlogopite, fluoredenite. The crystal structure is solved. Orthorhombic, *Bbmm*; $a = 9.725(3)$, $b = 10.018(4)$, $c = 3.727(2)$ Å. The empirical formula is (wet chemical analysis) $(Mg_{0.70}Fe^{2+}{}_{0.15}Al_{0.13})Ti_{1.98}O_{5.00}$.
Wavenumbers (cm^{-1}): 1090w, 1040w, 1008w, 810sh, 745, 633, 570sh, 473s.

O14 Aciculite (technogenetic analogue of harmunite) $CaFe^{3+}{}_2O_4$

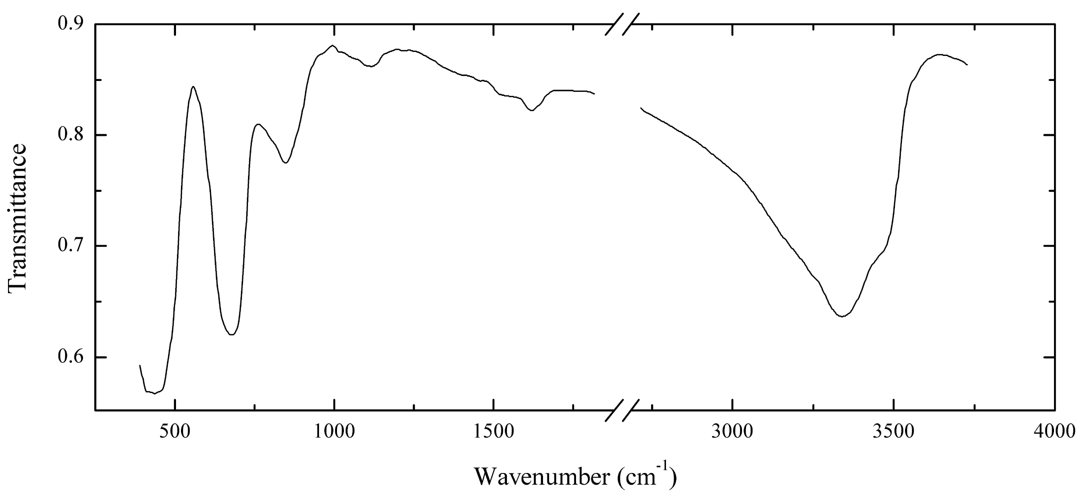


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Black acicular crystals from the association with srebrodolskite and magnesioferrite. Orthorhombic. Unit-cell parameters are $a = 9.147(1)$, $b = 10.711(2)$, $c = 3.016(1)$ Å. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 4.19 (20) (200), 2.680 (22) (040), 2.664 (100) (320), 2.526 (64) (121), 2.234 (18) (131), 1.834 (22) (241), 1.510 (20) (610, 540). $D_{calc} = 4.85$ g/cm^3; $D_{meas} = 4.75(5)$ g/cm^3.

Wavenumbers (cm^{-1}): 1143w, 1078w, 948w, 635sh, 565, 436s, 405s.

O15 Akaganeite $Fe_8(OH,O)_{16}Cl_{1.25}\cdot nH_2O$

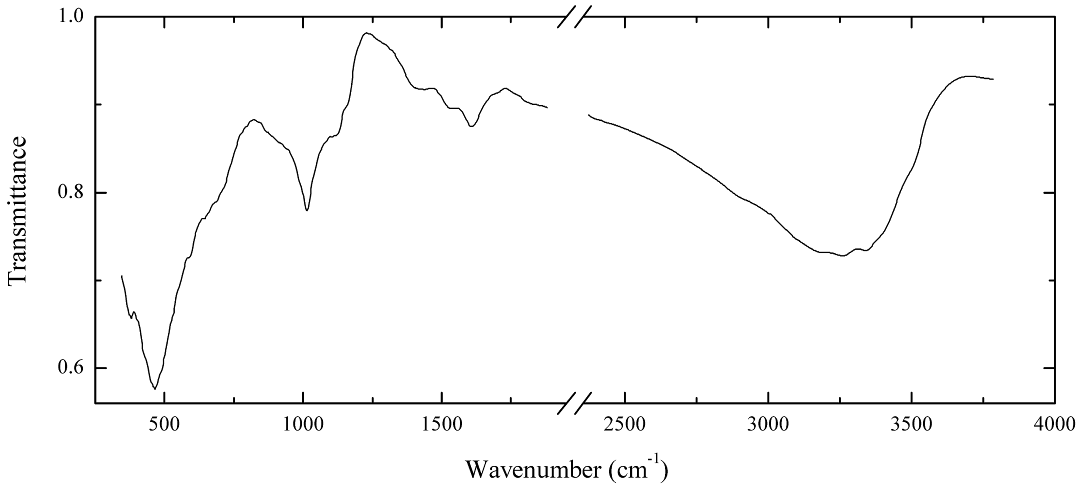


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Brown massive. Investigated by B.V. Chesnokov.

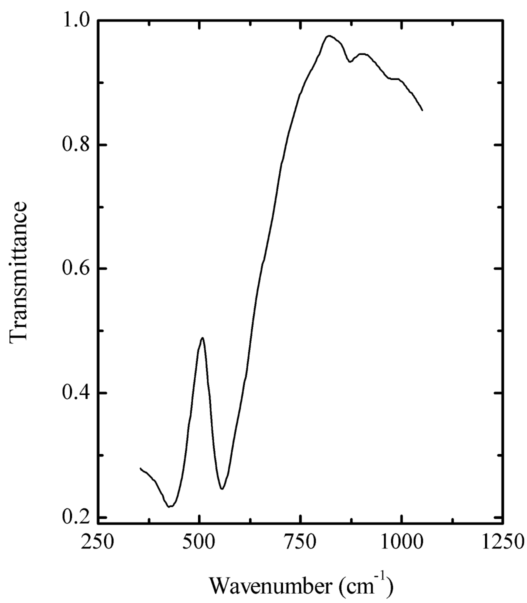
Wavenumbers (cm^{-1}): 3450sh, 3330s, 1625w, 1115w, 852, 680s, 660sh, 460sh, 433s, 408s.

O16 Ferrihydrite $5Fe_2O_3{\cdot}9H_2O$



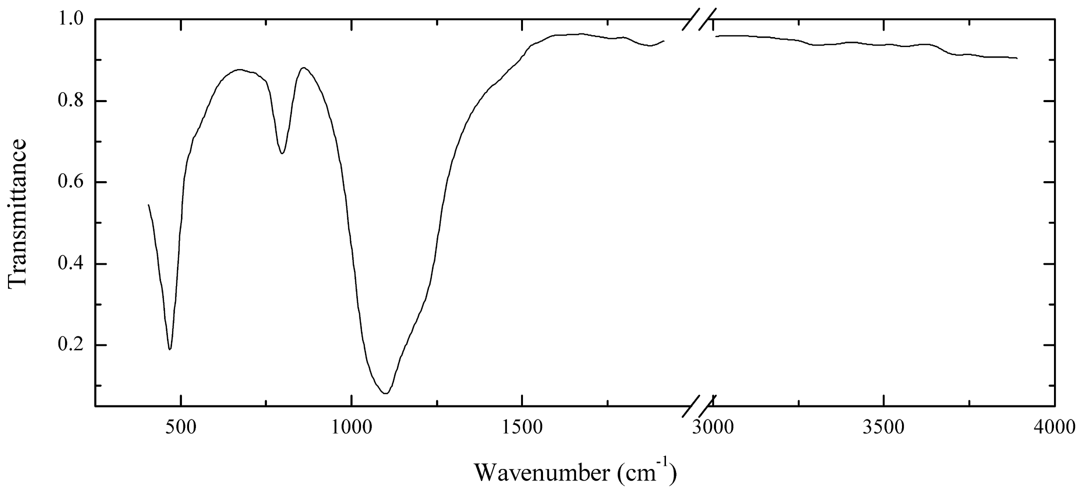
Locality: The quarry A, Kamysh-Burun deposit, Kerch iron-ore basin, Crimea, Ukraine.
Description: Orange crust from the association with anapaite. The empirical formula is $5.0Fe_2O_3{\cdot}0.3P_2O_5{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3250s, 1615, 1540, 1440w, 1105sh, 690sh, 590sh, 464s, 380.

O17 Franklinite $ZnFe^{3+}{}_2O_4$



Locality: Franklin, Ogdensburg, Sussex Co., New Jersey, USA (type locality).
Description: Black octahedral crystal from the association with rhodochrosite, willemite and zincite. The empirical formula is (electron microprobe) $Zn_{0.67}Mn_{0.44}Fe_{1.86}Al_{0.03}O_4$. The bands at 1,435 and 870 cm^{-1} correspond to the admixture of rhodochrosite.
Wavenumbers (cm^{-1}): 1435, 1080w, 870w, 559s, 427s.

O18 Lechatelierite SiO_2

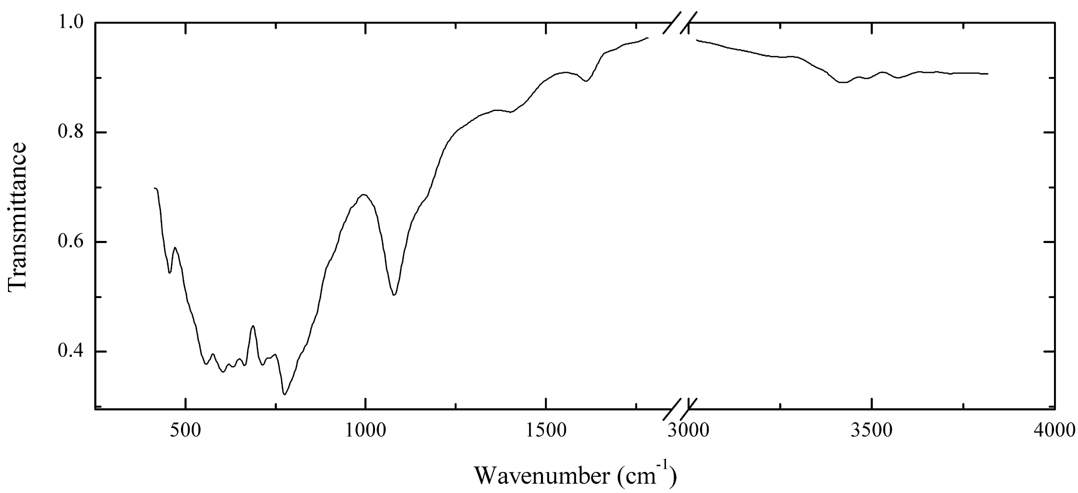


Locality: Vechec, Vranov nad Tepl'ou Co., Prešov region, Slovakia.

Description: Colourless spherulitic crust on effusive rock. Fused silica glass. Amorphous. Associated minerals are tridymite and cristobalite.

Wavenumbers (cm^{-1}): 1200sh, 1103s, 1085sh, 800, 780sh, 545sh, 470s.

O19 Diaoyudaoite $NaAl_{11}O_{17}$

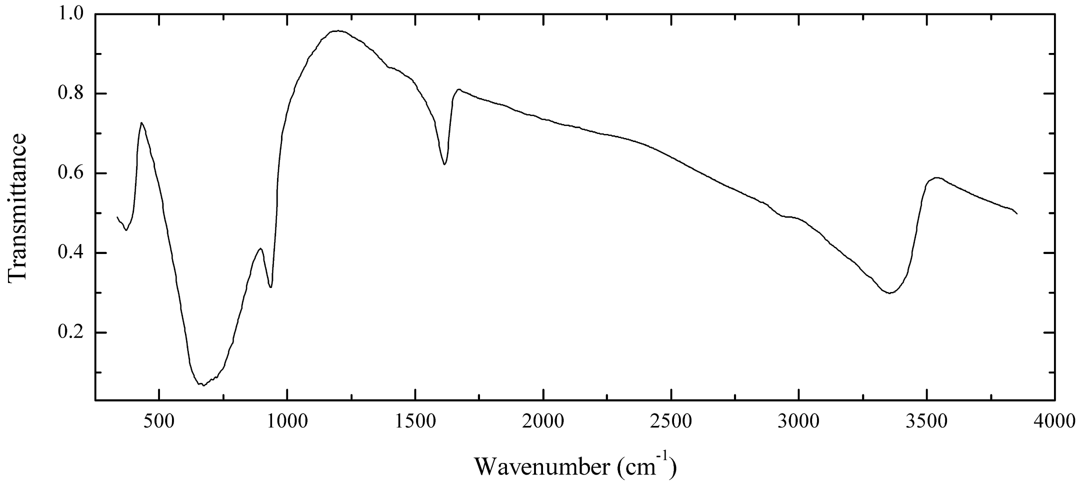


Locality: Road cut near Jersey Garden Mall, New Jersey, USA.

Description: Colourless platy crystals. The empirical formula is (electron microprobe) $(Na_{1.15}Ca_{0.07})Al_{11.00}O_{17.14}(H_2O)_x$. The bands at 1170, 1085, 800, 780 and 460 cm^{-1} correspond to the admixture of quartz.

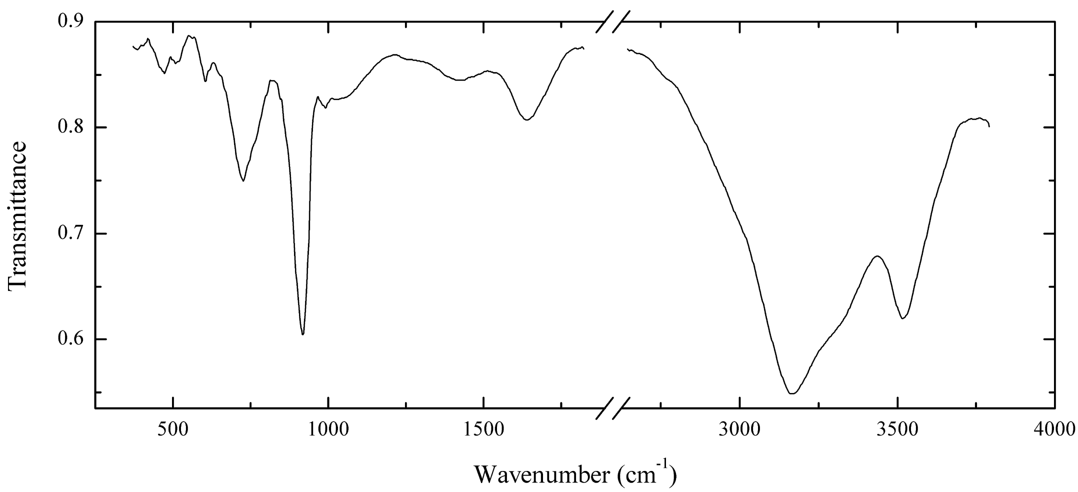
Wavenumbers (cm^{-1}): 3545w, 3460w, 3400w, 1615w, 1405w, 1170sh, 1085, 860sh, 825sh, 800sh, 780sh, 715s, 737, 713s, 663s, 633s, 603s, 556s, 460.

O20 Tungstite $WO_3{\cdot}H_2O$



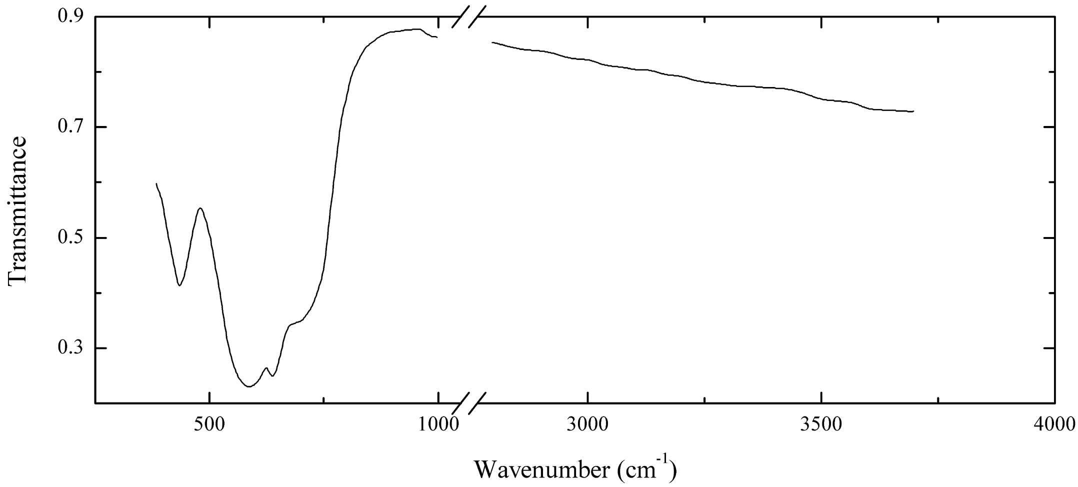
Locality: San Antonio de Calacalani mine, Cercado province, Oruro department, Bolivia.
Description: Yellow massive from the association with hydrotungstite, kaolinite and quartz.
Wavenumbers (cm^{-1}): 3350, 2950sh, 1620, 955sh, 935, 725sh, 705sh, 671s, 372.

O21 Studtite $UO_4{\cdot}4H_2O$



Locality: Menzenschwand U deposit, near Menzenschwand, Kunkelbach valley, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.
Description: Yellow fibrous crystals from the association with uranophane. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3498s, 3145s, 1630, 1420w, 1030w, 985w, 916s, 724, 599, 503w, 470w.

O23 Bismutocolumbite $BiNbO_4$

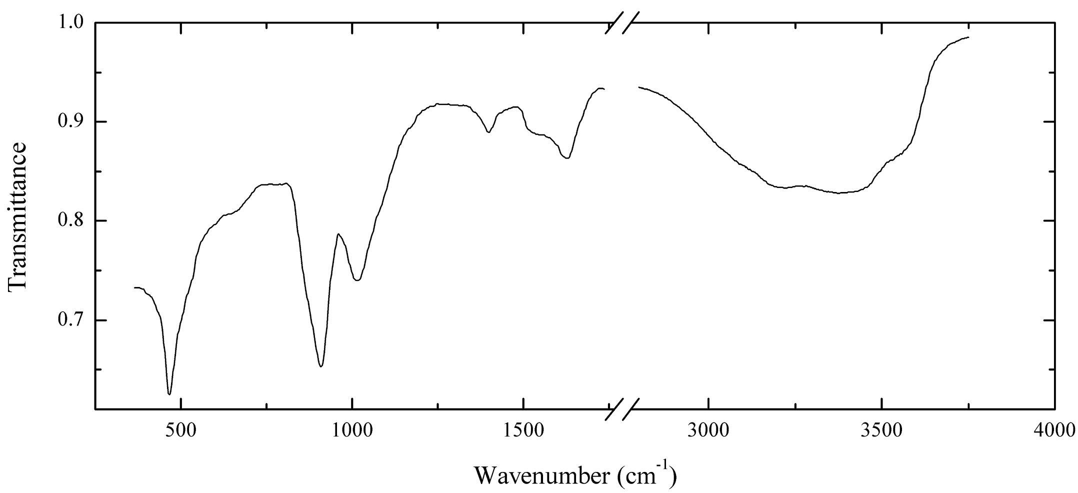


Locality: Mika pegmatite, Kukurt pegmatite field, Pamir Mts., Tajikistan.

Description: Black crystal from the association with microcline, boromuscovite, tourmaline and pyrochlore-supergroup minerals. The empirical formula is (electron microprobe) $(Bi_{0.96}Sb_{0.02})(Nb_{0.71}Ta_{0.30})O_4$.

Wavenumbers (cm^{-1}): 715sh, 690sh, 635s, 587s, 436.

O24 Billietite $Ba(UO_2)_6O_4(OH)_6{\cdot}8H_2O$

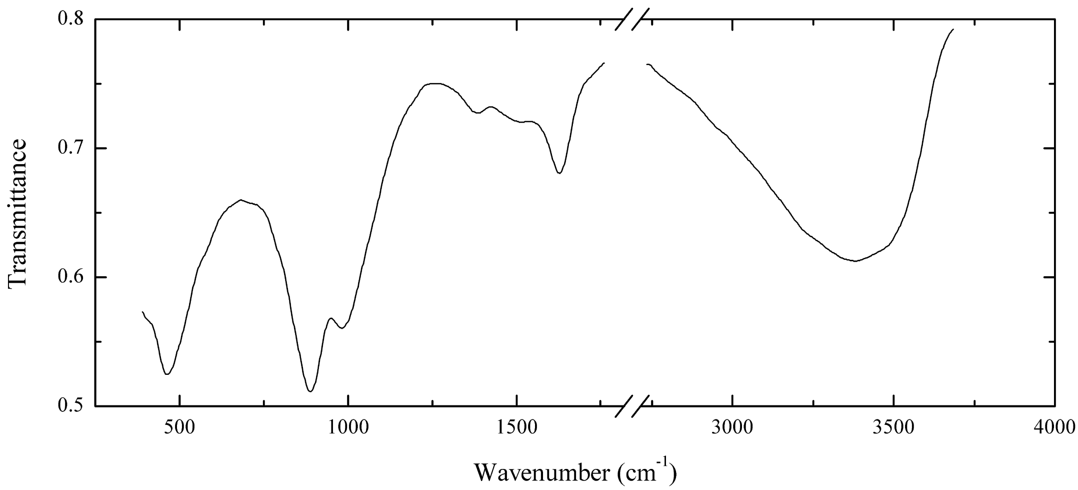


Locality: An unknown locality in Kazakhstan.

Description: Yellow massive. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3540sh, 3350, 3200, 1626, 1550sh, 1395, 1012, 906s, 645sh, 530sh, 465s.

O25 Bauranoite $BaU_2O_7 \cdot 4\text{-}5H_2O$

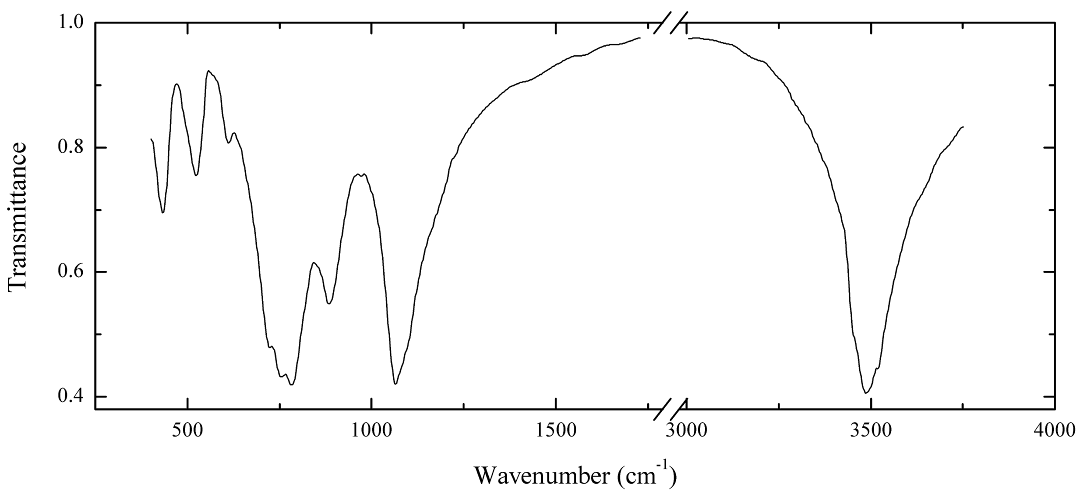


Locality: Streltsovskoe U–Mo deposit, near Krasnokamensk, Chita region, Transbaikal area, Siberia, Russia (type locality).

Description: Brown massive from the association with calciouranoite, uraninite and uranophane. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3460sh, 3375s, 3230sh, 1631, 1512w, 1390w, 986, 891s, 800sh, 463s, 400.

O26 Behoite $Be(OH)_2$

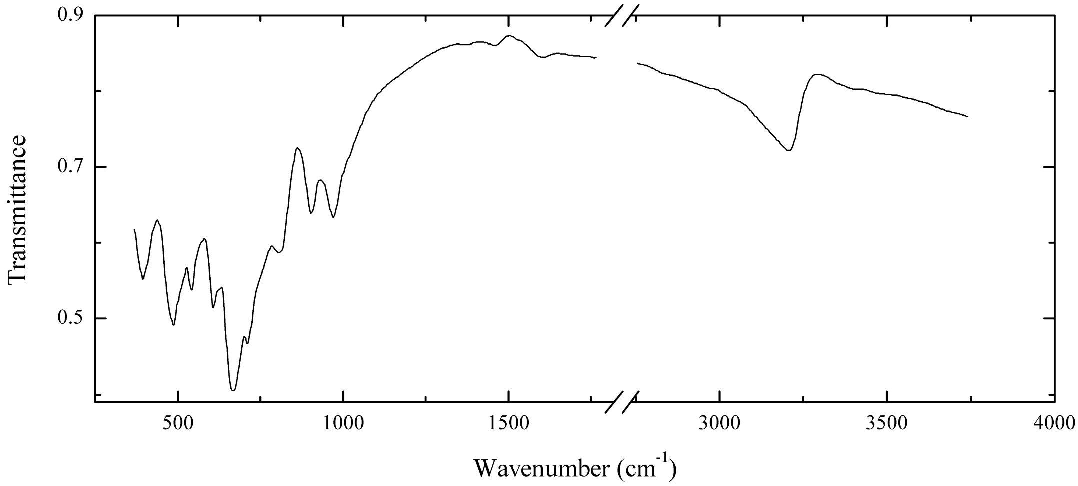


Locality: Malyshevskoe emerald deposit, Middle Urals, Russia.

Description: Rounded crystals. Identified by powder X-ray diffraction pattern.

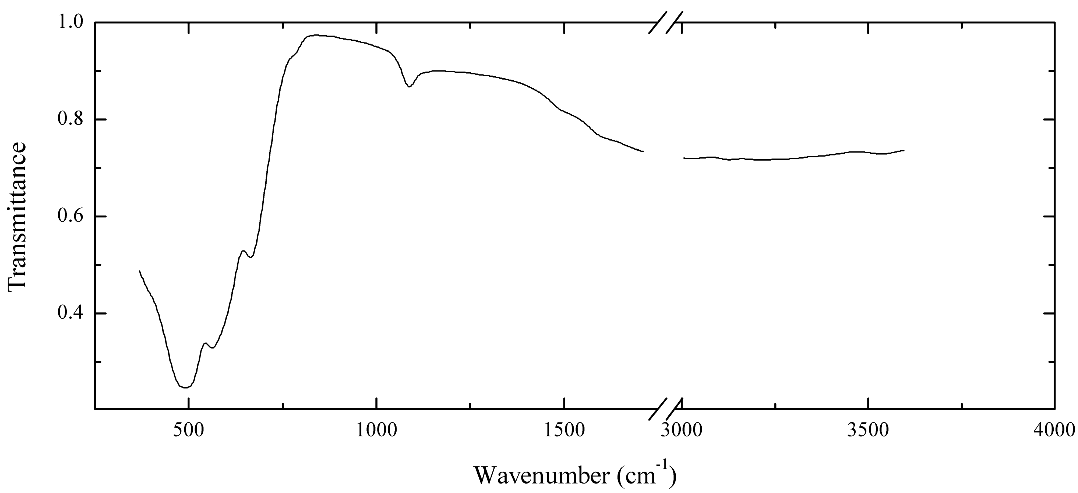
Wavenumbers (cm^{-1}): 3510, 3480, 3450sh, 1067s, 885, 782s, 755s, 719, 612w, 522, 432.

O27 Bahianite $Al_5Sb^{5+}{}_3O_{14}(OH)_2$



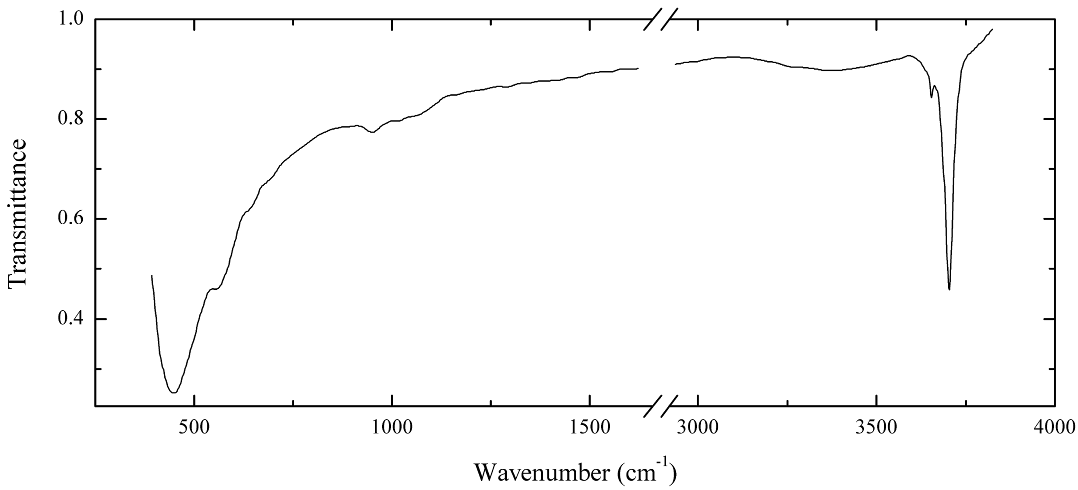
Locality: Serra das Almas, Paramirum region, Bahia, Brazil (type locality).
Description: Brown pebble. The empirical formula is (electron microprobe) $Al_{5.0}Fe_{0.2}Sb_{2.7}Nb_{0.1}(O,OH)_{16}$.
Wavenumbers (cm^{-1}): 3195, 1610w, 1460w, 973, 907, 810, 713s, 667s, 623, 609, 541, 481s, 465sh, 412.

O28 Bixbyite $(Mn^{3+},Fe^{3+})_2O_3$



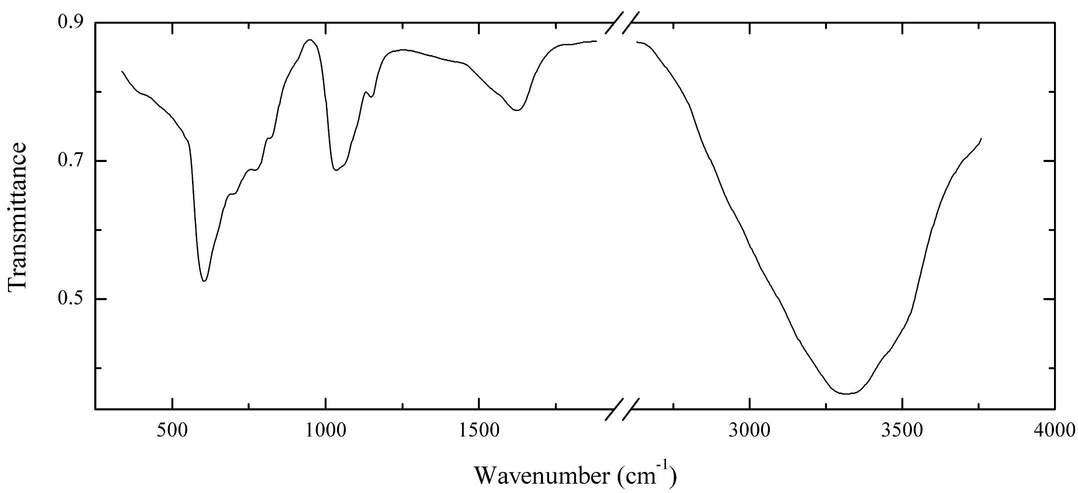
Locality: Thomas Range, Juab Co., Utah, USA.
Description: Black cubic crystal from the association with topaz, quartz and pseudobrookite.
Wavenumbers (cm^{-1}): 1085w, 666, 570sh, 557, 497s, 480s.

O29 Brucite $Mg(OH)_2$



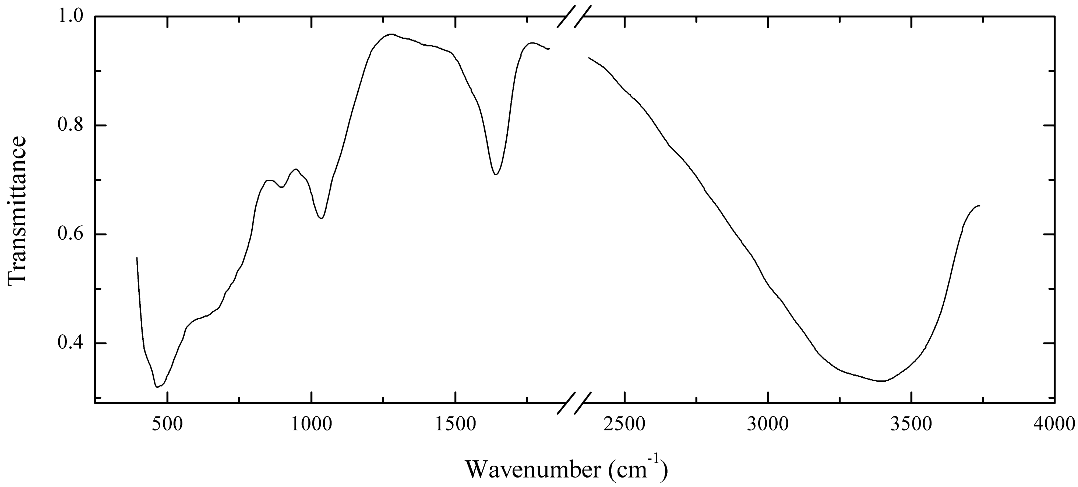
Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Middle Urals, Russia.
Description: Grey split crystal from the association with lizardite. The empirical formula is (electron microprobe) $(Mg_{0.99}Fe_{0.01})(OH)_2$.
Wavenumbers (cm^{-1}): 3702s, 3650sh, 1060sh, 1018w, 957w, 680sh, 640sh, 560, 454s.

O30 Bottinoite $Ni[Sb^{5+}(OH)_6]_2{\cdot}6H_2O$



Locality: Ramsbeck, Sauerland, Germany.
Description: Bluish green. The empirical formula is (electron microprobe) $(Ni_{0.93}Mg_{0.11}Fe_{0.03})(Sb_{1.92}Te_{0.08})(OH,O)_{12}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3510, 3450sh, 3325s, 1627, 1154, 1105sh, 1065sh, 1034, 827, 777, 704, 635sh, 605s.

O31 Belyankinite $Ca(Ti,Si,Nb,Zr)_{5–6}(O,OH)_{12–16}·8–10H_2O$ (?)

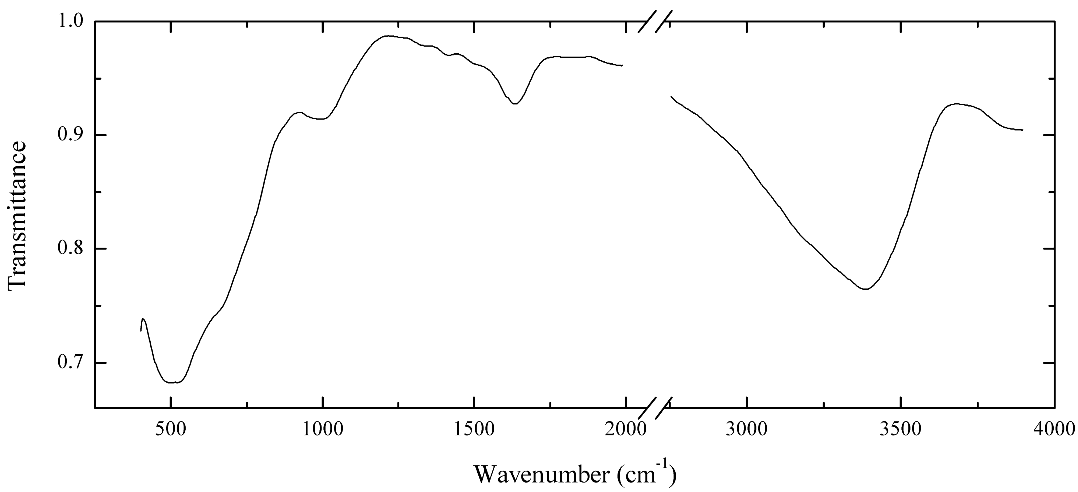


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light yellow pseudomorph after platy lomonosovite crystal. Associated minerals are aegirine, microcline and rhabdophane. The empirical formula is (electron microprobe) $(Ca_{0.72}Mn_{0.07})(Ti_{5.13}Si_{0.48}Nb_{0.39})(O,OH)_x·nH_2O$.

Wavenumbers (cm^{-1}): 3350s, 3250sh, 1655sh, 1633, 1035, 896, 750sh, 640sh, 510sh, 475s, 390sh.

O32 Belyankinite $Ca(Ti,Si,Nb,Zr)_{5–6}(O,OH)_{12–16}·8–10H_2O$ (?)

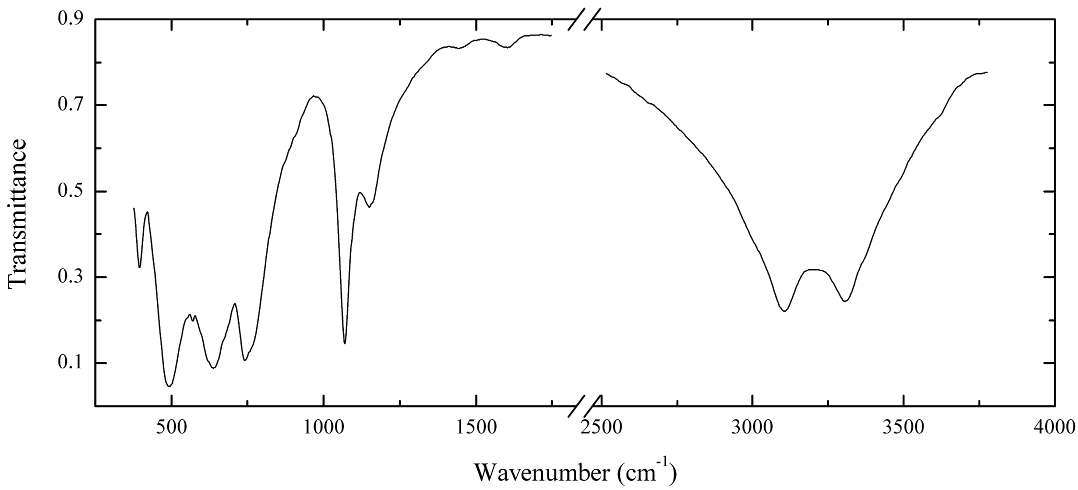


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brownish pseudomorph after platy lomonosovite crystal. Associated minerals are aegirine, microcline and rhabdophane. Mn-rich variety. The empirical formula is (electron microprobe) $(Ca_{0.67}Mn_{0.45})(Ti_{5.38}Si_{0.34}Nb_{0.28})(O,OH)_x·nH_2O$.

Wavenumbers (cm^{-1}): 3360s, 1630, 1020, 680sh, 540s, 475s, 440sh.

O33 Böhmite AlO(OH)

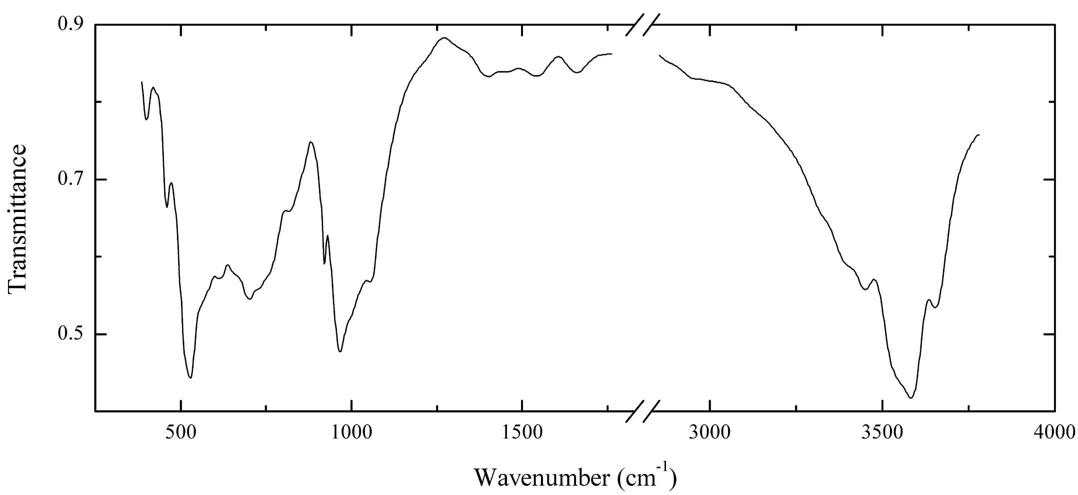


Locality: Vishnevye (Vishnyovye) Mts., Chelyabinsk region, South Urals, Russia.

Description: Yellowish crystals growing on natrolite. Identified by powder X-ray diffraction pattern and IR spectrum.

Wavenumbers (cm^{-1}): 3275s, 3075s, 1605w, 1450w, 1330w, 1151, 1067s, 760sh, 741s, 635s, 566, 493s, 397.

O34 Bayerite $Al(OH)_3$

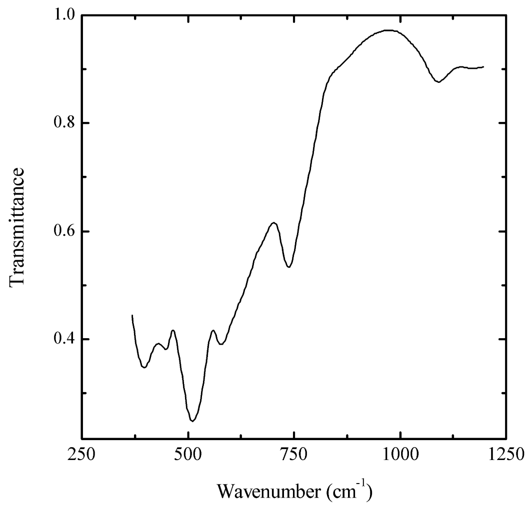


Locality: Cerro Sapo area, Ayopaya province, Cochabamba province, Bolivia.

Description: Light grey crystals from carbonatite. Identified by qualitative electron microprobe analysis (only Al has been detected) and IR spectrum.

Wavenumbers (cm^{-1}): 3625, 3560s, 3510sh, 3420, 3370sh, 3290sh, 1650w, 1540w, 1405w, 1390w, 1308w, 1057, 995sh, 966s, 922, 824, 760sh, 730sh, 703s, 670sh, 617, 565sh, 532s, 520sh, 461, 405w.

O35 Baddeleyite ZrO_2

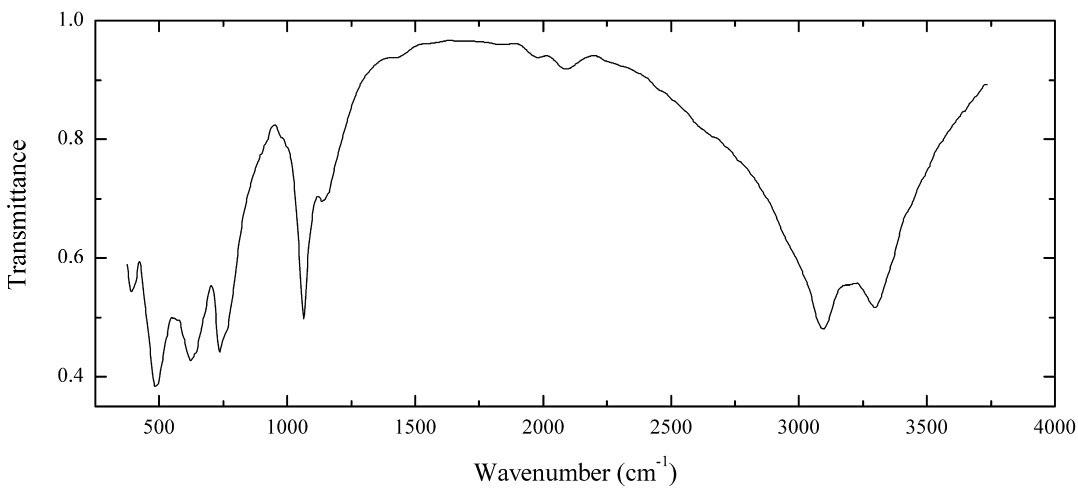


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Brown prismatic crystal from the association with fluorapatite, forsterite, magnetite and calcite. Identified by qualitative electron microprobe analysis (only Zr has been detected) and IR spectrum.

Wavenumbers (cm^{-1}): 1083w, 737, 615sh, 579, 509s, 447, 406s.

O36 Böhmite AlO(OH)

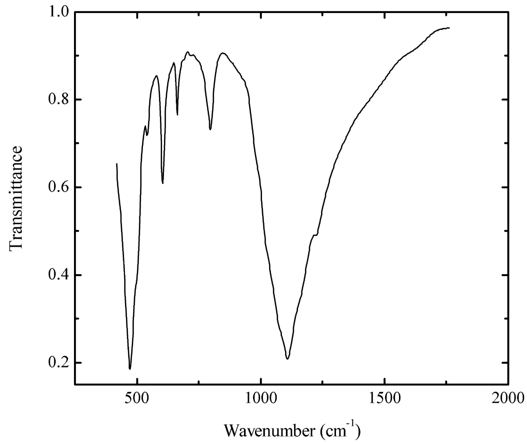


Locality: Valley of the Suluai river, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Growth of colourless crystals. Identified by IR spectrum.

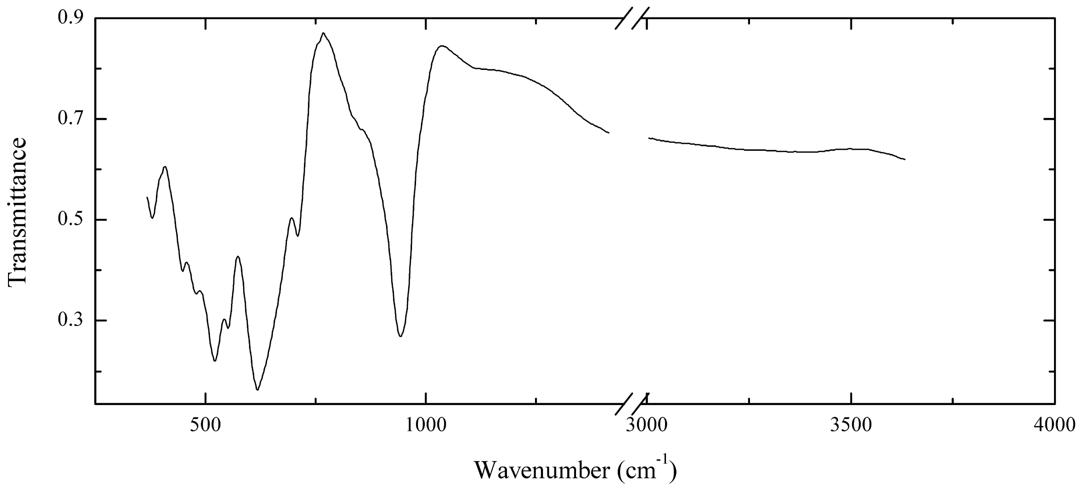
Wavenumbers (cm^{-1}): 3280, 3085s, 2088w, 1972w, 1152, 1068s, 770sh, 736s, 625s, 487s, 398.

O37 Melanophlogite $(CH_4,N_2)_{2-x}(N_2,CO_3)_{6-y}Si_{46}O_{92}$



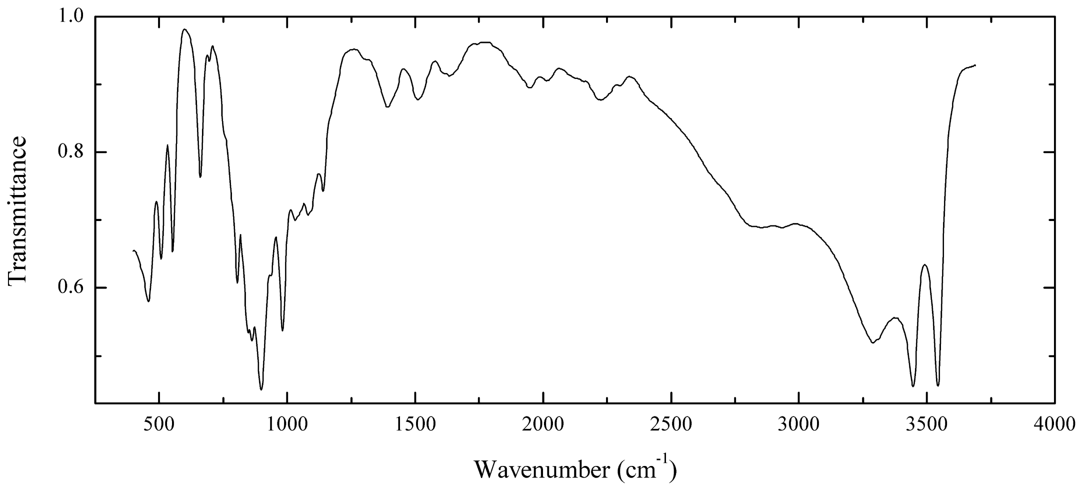
Locality: Rio Fortullino, Rosignano Marittimo, Lovorno province, Tuscany, Italy.
Description: Colourless pseudocubic crystals from the association with calcite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1230, 1170sh, 1117s, 1080sh, 1030sh, 798, 785sh, 659, 601, 538, 494, 464s.

O38 Braunite $Mn^{2+}Mn^{3+}{}_6SiO_{12}$



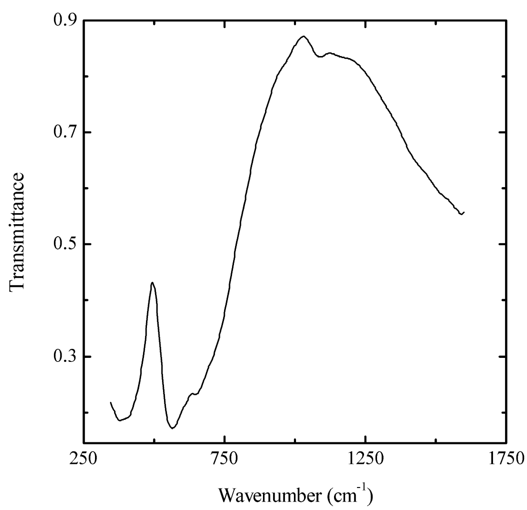
Locality: Elgersburg, Ilmenau district, Thuringian Forest, Thuringia, Germany (type locality).
Description: Black bipyramidal crystals from the association with barite and hematite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mn_{6.71}Fe_{0.16}Ca_{0.05}Mg_{0.05}Al_{0.06}Si_{1.00}O_{12}$.
Wavenumbers (cm^{-1}): 1110w, 945s, 840sh, 717, 621s, 551s, 521s, 483, 450, 420sh, 390.

O39 Vandenbrandeite $Cu^{2+}(UO_2)(OH)_4$



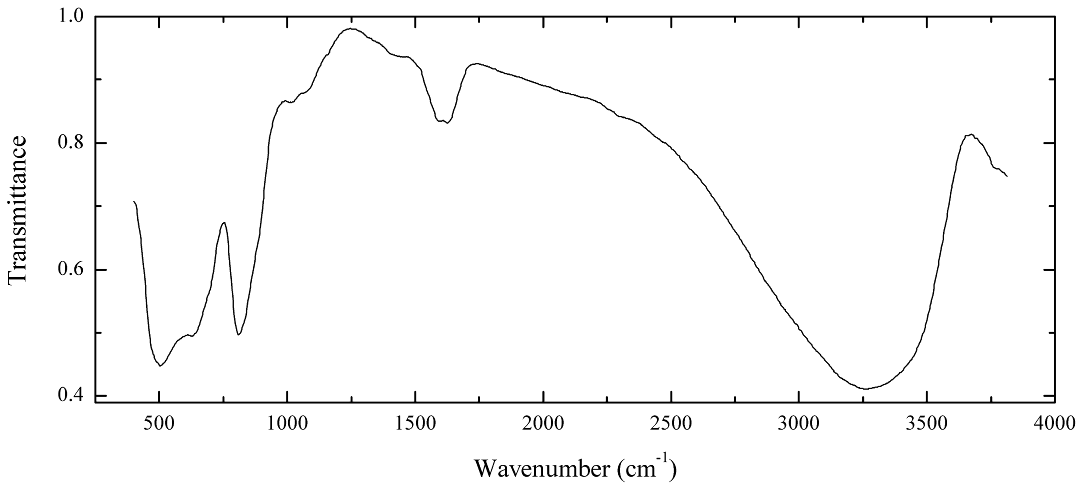
Locality: Kalongwe, Shaba, Democratic Republic of Congo (type locality).
Description: Dark green platy. Identified by powder X-ray diffraction pattern and IR spectrum.
Wavenumbers (cm^{-1}): 3510s, 3415s, 3265, 2915, 2810, 2217w, 2010w, 1940w, 1625w, 1510w, 1390w, 1137, 1080, 1029, 979s, 934, 896s, 859s, 844s, 803s, 695w, 660, 552, 507, 457s.

O40 Perovskite $CaTiO_3$



Locality: Ioko-Dovyrenskiy layered massif, Buryatia Republic, Eastern Siberia, Russia.
Description: Brown grains from calcic metasomatite. The empirical formula is (electron microprobe) $Ca_{0.90}Fe_{0.04}Ti_{1.06}O_3$.
Wavenumbers (cm^{-1}): 1091w, 965sh, 875sh, 655s, 572s, 430sh, 393s.

O42 Varlamoffite $Sn_3Fe^{3+}O_6(OH)_3 \cdot nH_2O$ (?)

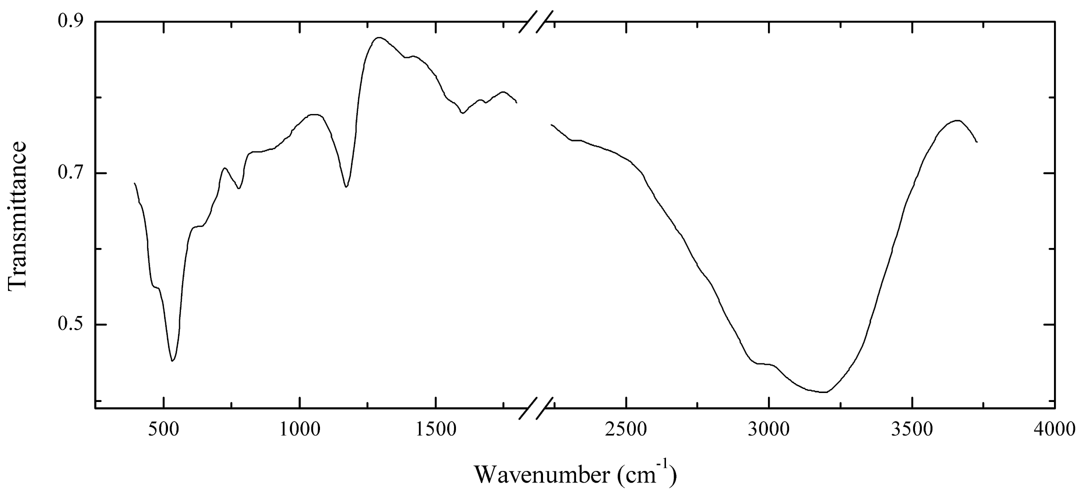


Locality: Zarechnoe Sn deposit, Pamir Mts., Tajikistan.

Description: Olive green pseudomorph after stannite. Insufficiently investigated mineral. Amorphous. Sometimes varlamovite contains admixture of cassiterite, and for this reason, it was erroneously considered as a poor-crystallized cassiterite. The empirical formula is (electron microprobe) $Sn_{3.03}Fe_{0.88}Al_{0.09}(O,OH)_x \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3250s, 1625, 1595, 1425w, 1175sh, 1080sh, 1010w, 870sh, 809s, 680sh, 621s, 500s, 475sh.

O43 Vismirnovite $ZnSn(OH)_6$

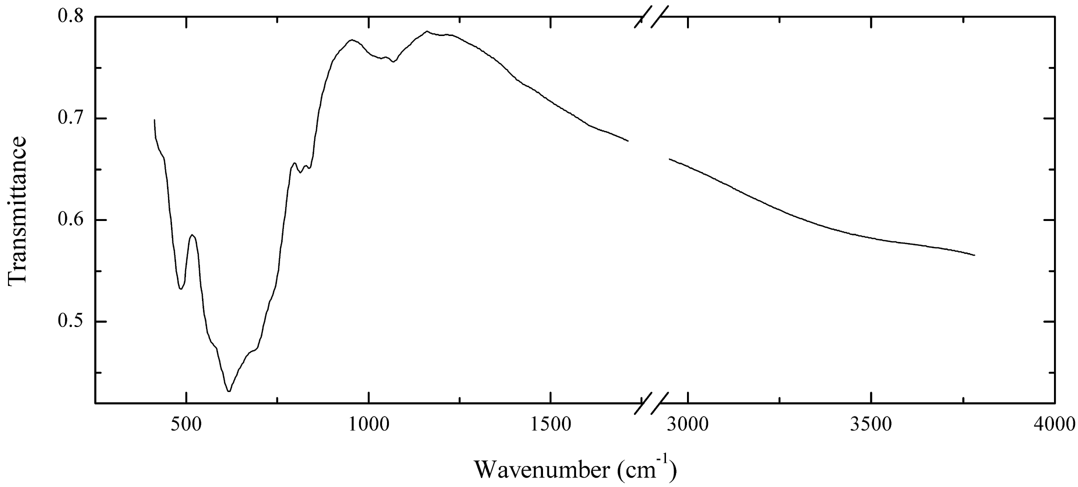


Locality: Mushiston Sn deposit, Kaznok valley, Penjikent, Zeravshan range, Tajikistan (type locality).

Description: Olive green pseudomorph after stannite or kësterite. Identified by powder X-ray diffraction pattern, IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $Zn_{0.62}Fe_{0.37}Cu_{0.07}Sn_{0.94}(OH)_6 \cdot nH_2O$.

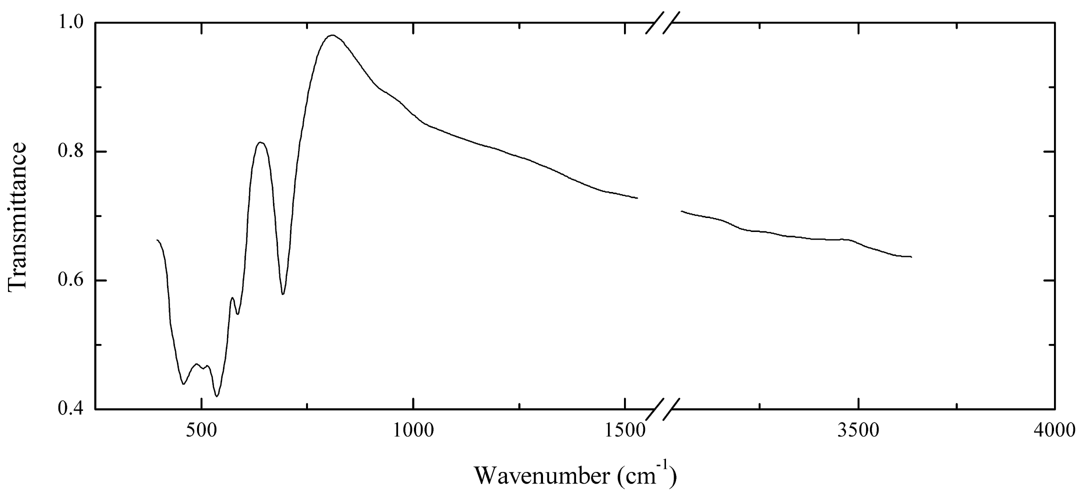
Wavenumbers (cm^{-1}): 3165s, 3125sh, 2955s, 1690w, 1625sh, 1603w, 1555sh, 1395w, 1173, 850sh, 788, 643, 534s, 470sh, 420sh.

O44 Wodginite $MnSnTa_2O_8$



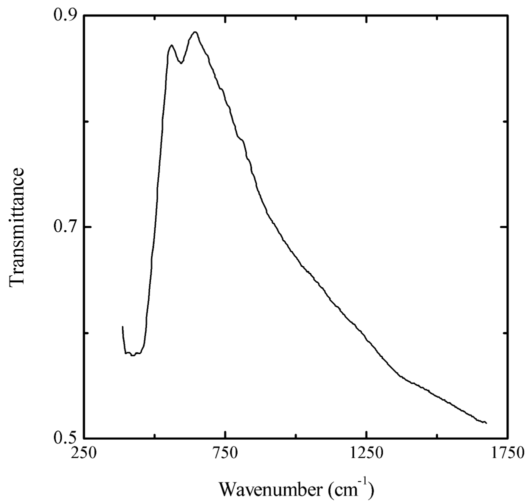
Locality: Vishnyakovskoe *REE*-Li-Ta deposit, Irkutsk region, Siberia, Russia.
Description: Brown grains in pegmatite, in the association with alkaline beryl. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Mn_{0.9}Sn_{0.4}Ta_{2.1}Nb_{0.2}Li_xO_y$.
Wavenumbers (cm^{-1}): 1070w, 1035w, 835, 810, 730sh, 685, 655sh, 613s, 560sh, 477, 420sh.

O45 Valentinite Sb_2O_3



Locality: An unknown locality in China.
Description: Yellow spherulites on stibnite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 692, 585, 539s, 500s, 465s, 440sh.

O46 Wüstite $Fe^{2+}O$

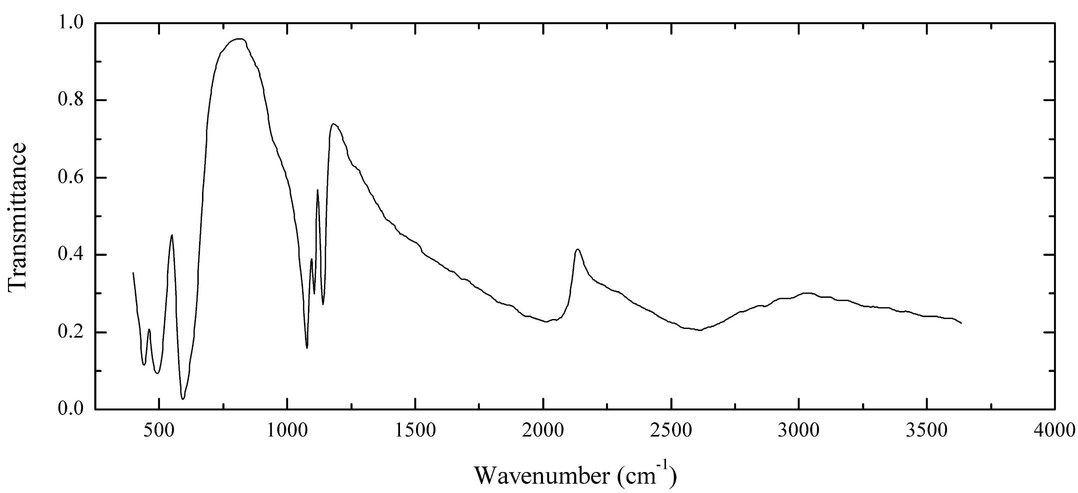


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Black crust with submetallic lustre. Investigated by B.V. Chesnokov. Identified by powder X-ray diffraction pattern. Cubic, $a = 4.032$ Å. The empirical formula is (electron microprobe) $Fe_{0.97}Mn_{0.02}Mg_{0.01}O$.

Wavenumbers (cm^{-1}): 595w. 450s, 424s, 405s.

O47 Manganite $Mn^{3+}O(OH)$

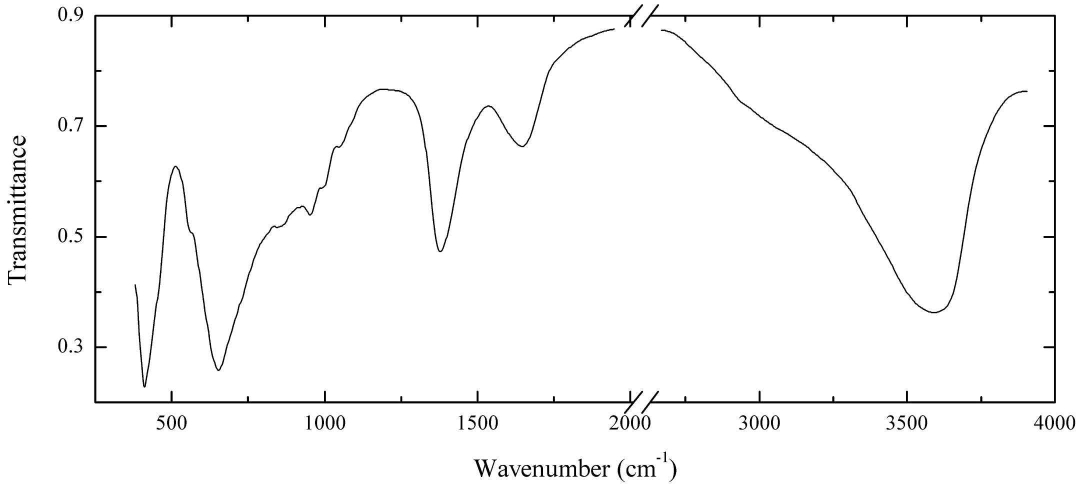


Locality: Ilfeld, Nordhausen, Harz, Thuringia, Germany (type locality).

Description: Black prismatic crystal from the association with baryte. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 2600, 2250sh, 2010s, 1600sh, 1150, 1114, 1085s, 630sh, 610sh, 596s, 499s, 449s.

O48 Hydrotalcite $Mg_6Al_2(CO_3)(OH)_{16}{\cdot}4H_2O$

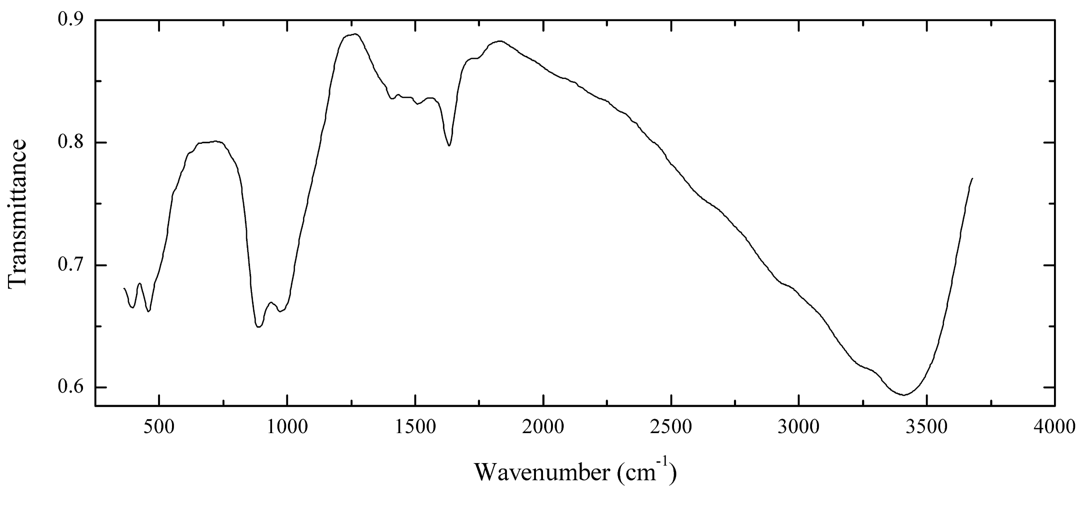


Locality: Solvverkets Kisgrube, Snarum, Norway (type locality).

Description: White platy grain with perfect cleavage from massive lizardite, from the association with dolomite. The empirical formula is (electron microprobe) $Mg_{5.95}Al_{1.88}Fe_{0.17}(CO_3)(OH)_{16}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3590s, 2950sh, 1655, 1378s, 1056w, 995w, 956, 855, 651s, 555sh, 405s.

O49 "Hydronasturan" $H_2U_2O_7{\cdot}5\text{-}6H_2O$ (?)

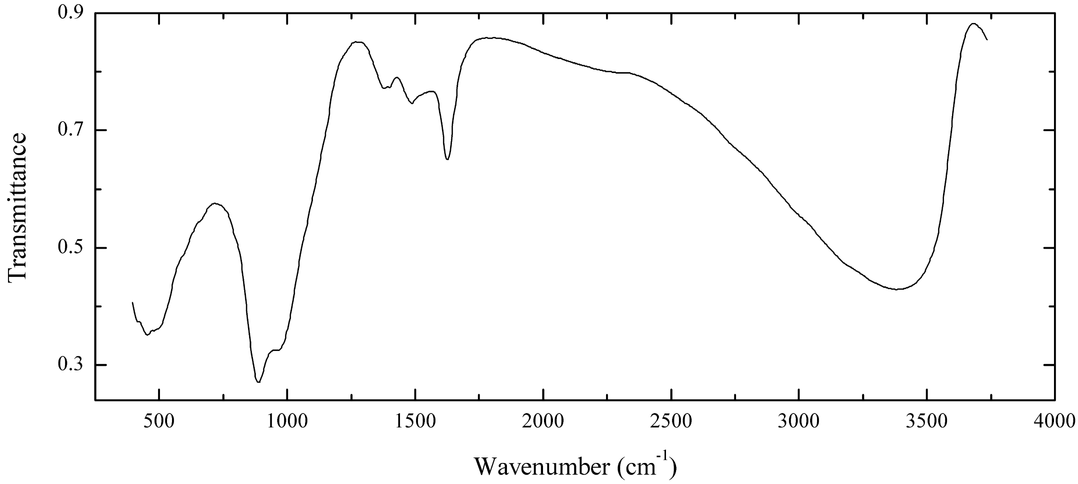


Locality: Streltsovskoe U-Mo deposit, near Krasnokamensk, Chita region, Transbaikal area, Siberia, Russia.

Description: Black massive, with resinous lustre. Investigated by G.A. Sidorenko. Possibly structurally related to bauranoite.

Wavenumbers (cm^{-1}): 3400s, 1635, 1510w, 1410w, 978s, 890s, 460, 395.

O50 "Hydronasturan" $H_2U_2O_7·5\text{-}6H_2O$ (?)

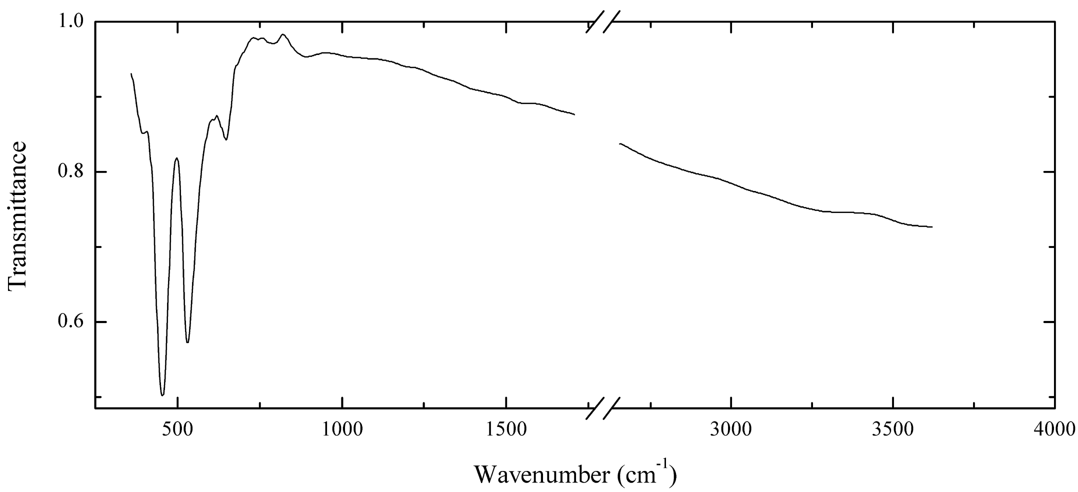


Locality: Streltsovskoe U-Mo deposit, near Krasnokamensk, Chita region, Transbaikal area, Siberia, Russia.

Description: Black massive, with resinous lustre. Investigated by G.A. Sidorenko. Possibly structurally related to bauranoite.

Wavenumbers (cm^{-1}): 3390s, 1629, 1490w, 1390w, 960s, 887s, 490sh, 455s, 420sh.

O51 Hematite Fe_2O_3

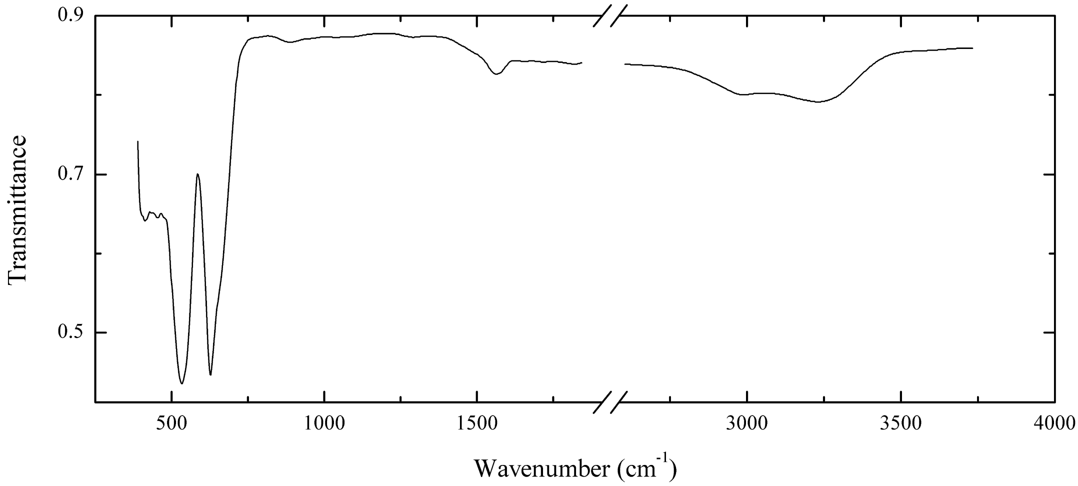


Locality: Bou Azzer, Morocco.

Description: Black spherulites with red streak. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 647, 532s, 455s, 401w.

O52 Hydrohetaerolite $Zn_2Mn^{3+}{}_4O_8{\cdot}H_2O$

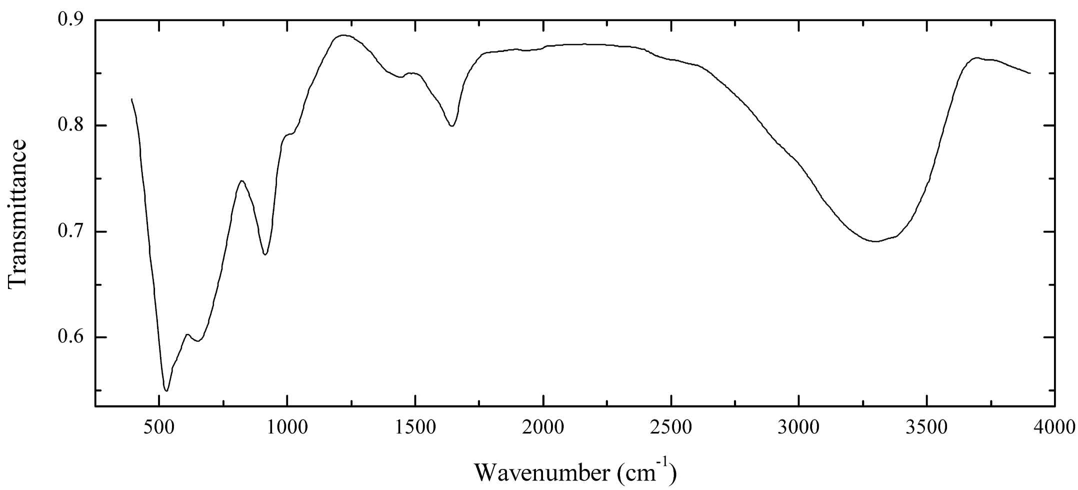


Locality: Esperanza mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Black octahedra. Identified by morphological features, IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $(Zn_{1.61}Mn_{0.39})Mn_{2.00}O_8{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3210, 1565, 660sh, 627s, 533s, 475, 445, 405.

O53 Gerasimovskite $(Mn,Ca)(Nb,Ti)_{5-6}(O,OH)_{12-16}{\cdot}8{-}9H_2O$ (?)

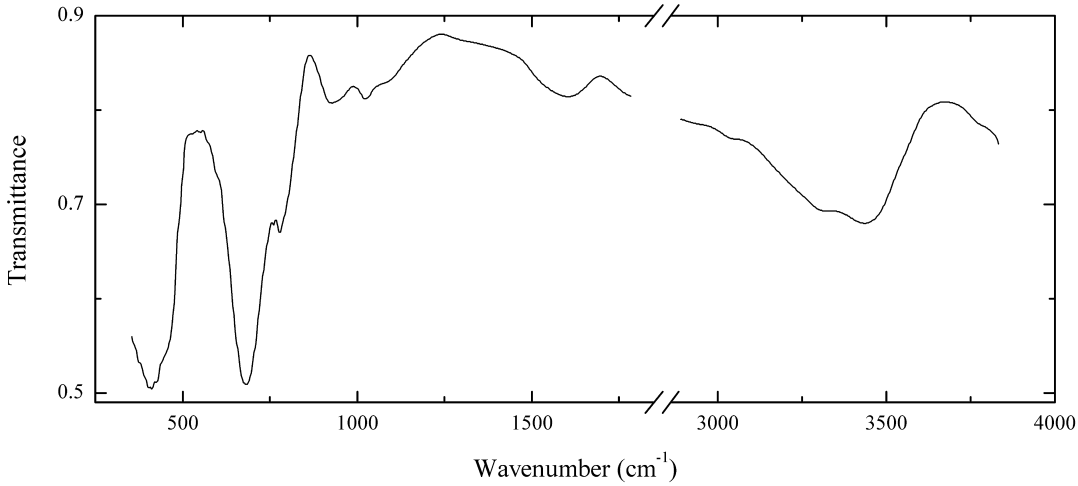


Locality: Mt. Malyi Punkaruaiv, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Grey platy pseudomorph after vuonnemite from the association with ussingite, manganoneptunite, rhabdophane-(Ce) and tugtupite. The empirical formula is (electron microprobe) $Mn_{0.5}Ca_{0.3}(Nb_{3.5}Ti_{2.3}Si_{0.2})(O,OH)_x{\cdot}nH_2O$.

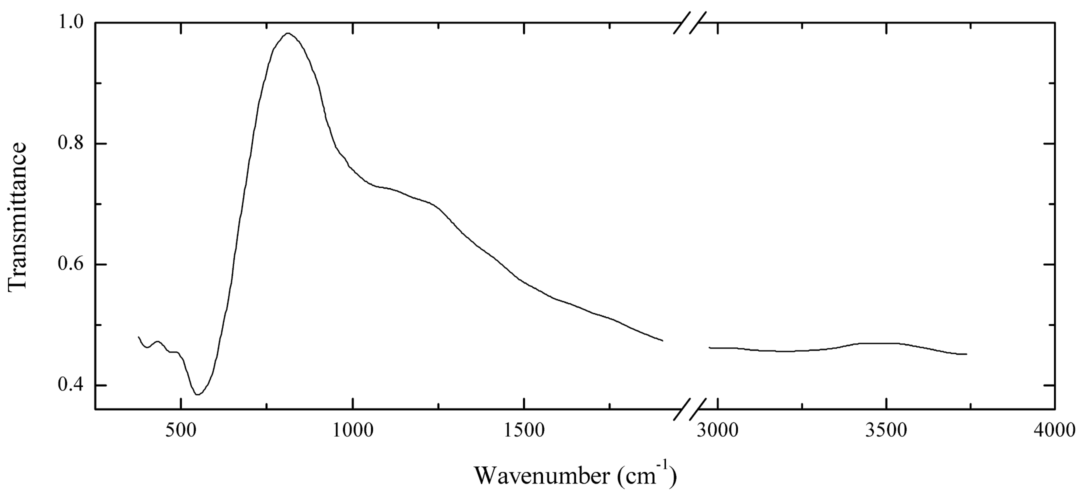
Wavenumbers (cm^{-1}): 3300s, 1645, 1450, 1015, 927, 635s, 536s.

O54 Bindheimite $(Pb,\square)_2Sb_2O_6(O,OH)\cdot nH_2O$



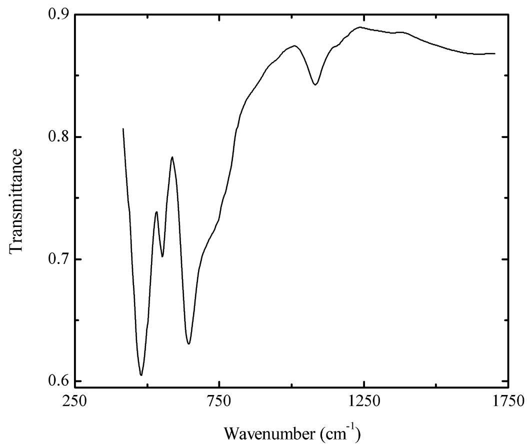
Locality: Bottomley prospect, San Jacinto district, Pershing Co., Nevada, USA.
Description: Fine-grained aggregate forming pseudomorph after a sulfosalt mineral. The empirical formula is (electron microprobe) $(Pb_{1.16}Ca_{0.28}Na_{0.20}Mn_{0.14})Sb_{2.00}O_6(O,OH)\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3430, 3310, 1600, 1024, 930, 783, 686s, 450sh, 428s, 410sh.

O56 "Grandiferrite" $CaFe^{3+}{}_4O_7$



Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.
Description: Grey massive from the association with hematite, srebrodolskite, magnesioferrite and aciculite. Grandiferrite was investigated by B.V. Chesnokov. It has technogenetic origin, and for this reason, it is not approved by the IMA CNMNC. Trigonal. Unit-cell parameters are $a = 6.0$, $c = 31.3$ Å. The chemical composition is (electron microprobe, wt. %) Fe_2O_3 84.37, Al_2O_3 0.11, CaO 11.72, MnO 3.45, MgO 2.35, total 102.00.
Wavenumbers (cm^{-1}): 570sh, 544s, 465, 403.

O57 Galaxite $Mn^{2+}Al_2O_4$

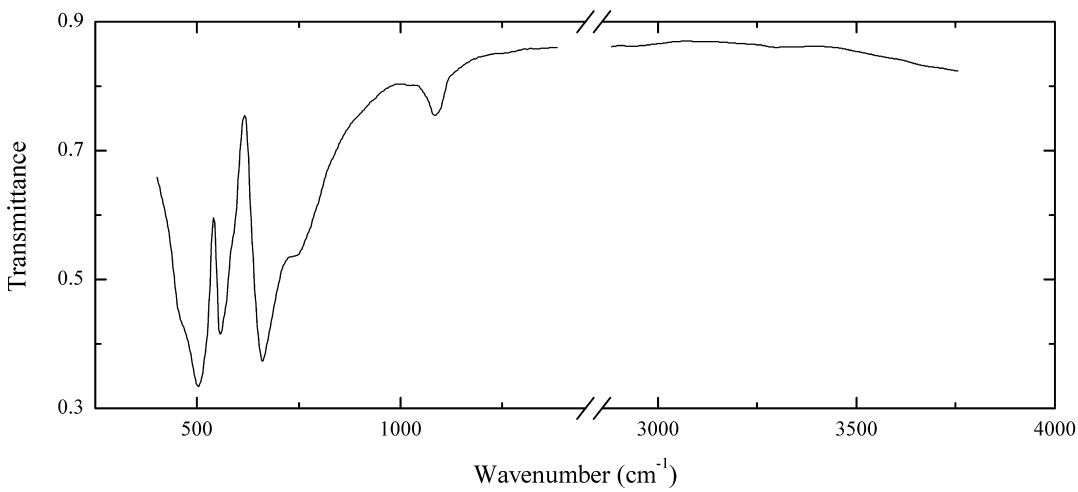


Locality: Malosidelnikovskoe Mn deposit, Middle Urals, Russia.

Description: Dark brown grains from the association with sonolite, tephroite, rhodochrosite and alabandite. The empirical formula is (electron microprobe) $(Mn_{0.98}Fe_{0.02})(Al_{1.95}Fe_{0.04}V_{0.01})O_4$.

Wavenumbers (cm^{-1}): 1087w, 710sh, 640s, 546, 472s.

O58 Gahnite $ZnAl_2O_4$

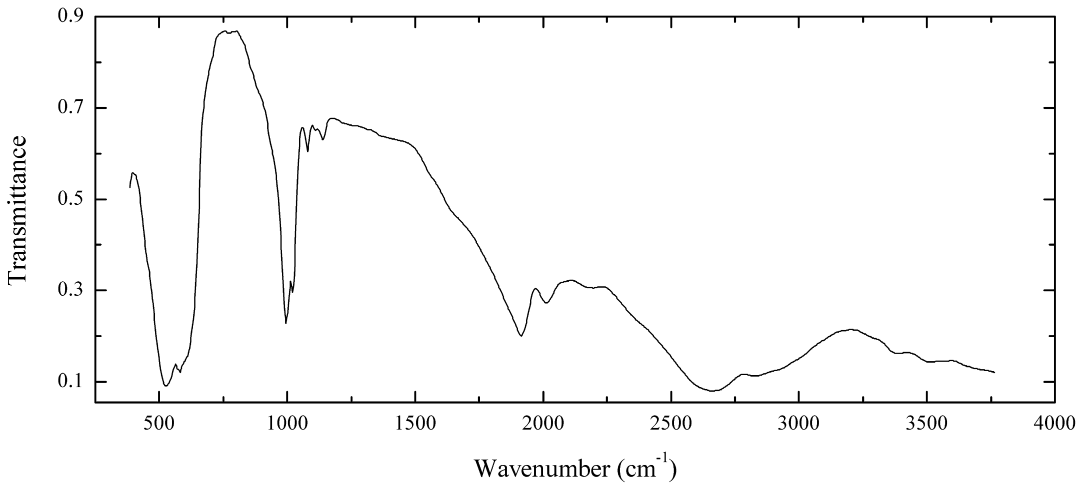


Locality: Verbannyi stream, Rezh district, Middle Urals, Russia.

Description: Greenish-blue pebble. The empirical formula is (electron microprobe) $(Zn_{0.65}Fe_{0.17}Mg_{0.17}Mn_{0.01})Al_{2.00}O_4$.

Wavenumbers (cm^{-1}): 1085w, 735, 661s, 590sh, 556, 503s.

O59 Groutite MnO(OH)

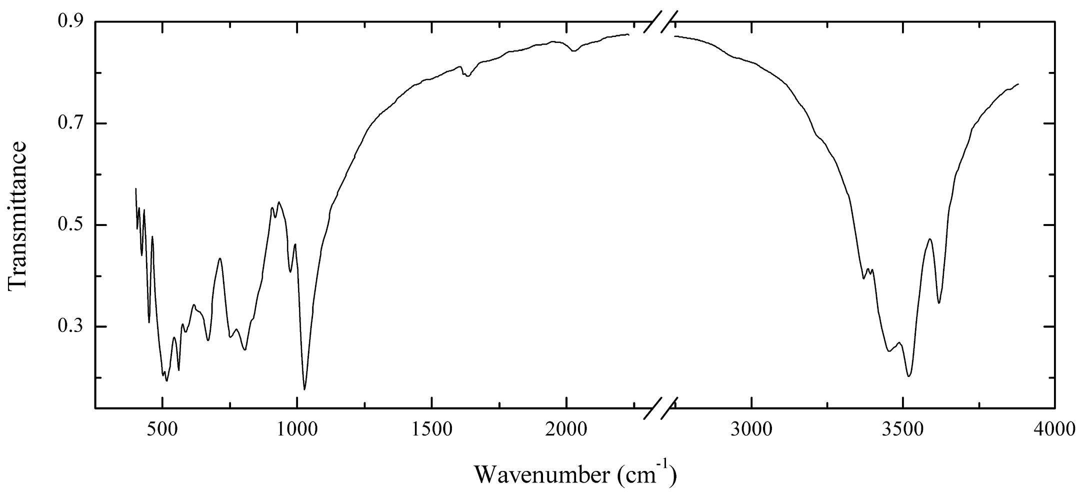


Locality: Kirivograd, Ukraine.

Description: Radial aggregates of black flattened crystals. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 2820, 2655s, 2015, 1925, 1142w, 1115w, 1085w, 1025s, 998s, 610sh, 582s, 532s.

O60 Gibbsite $Al(OH)_3$

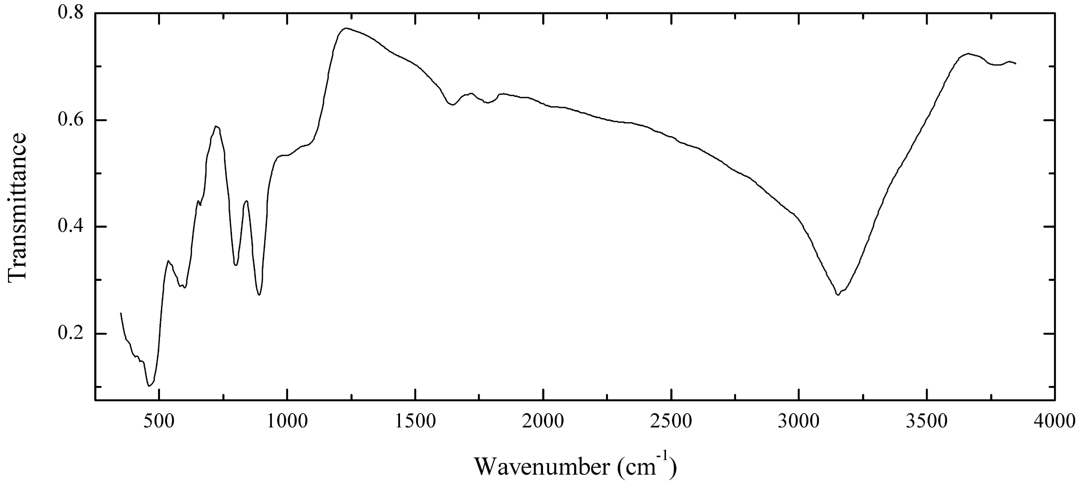


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless crystals from the association with natrolite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3620, 3520s, 3468s, 3392, 3374, 2005w, 1635w, 1615w, 1020s, 968, 040sh, 914, 830sh, 799, 750, 695sh, 667, 625, 590sh, 583, 560s, 530sh, 516s, 503s, 453, 426, 415sh.

O61 Goethite FeO(OH)

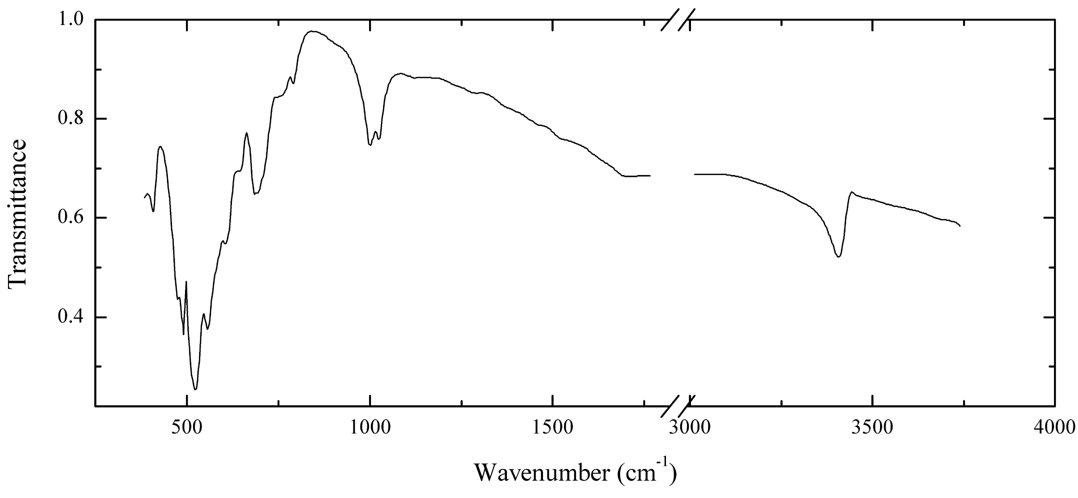


Locality: Hagendorf South pegmatite, Cornelia mine, Hagendorf, Waidhaus, Upper Palatinate, Bavaria, Germany.

Description: Cluster of brown acicular crystals from the association with phosphate minerals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3350sh, 3120s, 1770, 1640, 1080, 1000, 890s, 797, 660, 593s, 465s, 410sh.

O62 Mn-hydroxide O62

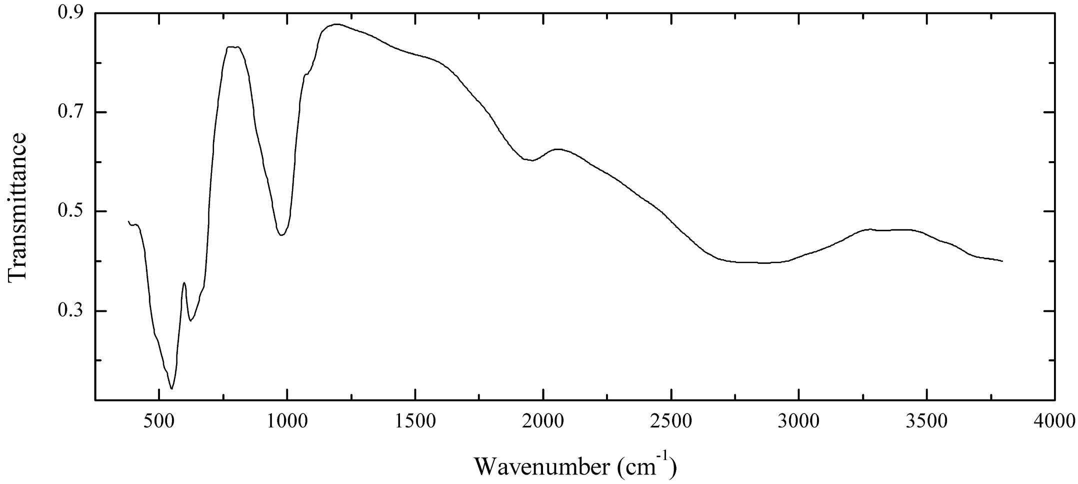


Locality: Black Water mine, Apache Co., Arizona, USA.

Description: Black acicular crystals. Only Mn has been detected by electron microprobe analysis. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 4.24 (100), 4.10 (80), 2.828 (50), 2.694 (50), 2.458 (60), 2.390 (90), 2.351 (50), 2.193 (50), 1.783 (50), 1.710 (70), 1.623 (50), 1.448 (70). The mineral needs further investigation.

Wavenumbers (cm^{-1}): 3390, 1024, 1001, 792w, 754w, 705sh, 695sh, 685, 648, 604, 554s, 523s, 515sh, 488s, 474, 405.

O63 Bracewellite CrO(OH)

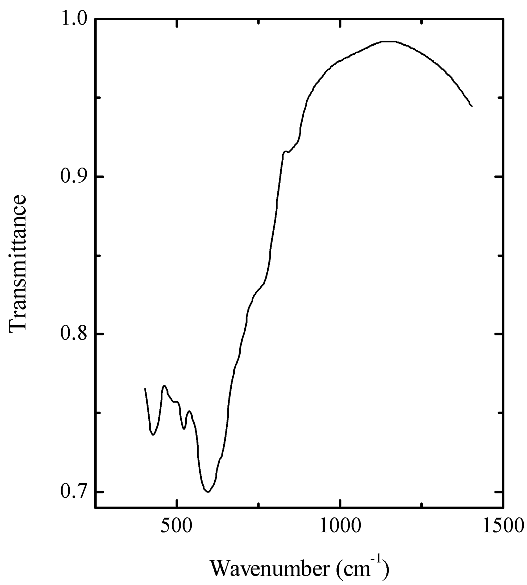


Locality: Merume river, Mazaruni district, Guyana (type locality).

Description: Brown pebble. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Cr_{0.63}Fe_{0.22}Al_{0.14}V_{0.01})O(OH)$.

Wavenumbers (cm^{-1}): 2840s, 1962, 1925, 1080sh, 983, 915sh, 665sh, 645sh, 624s, 549s, 525sh, 495sh, 407.

O64 Brookite TiO_2

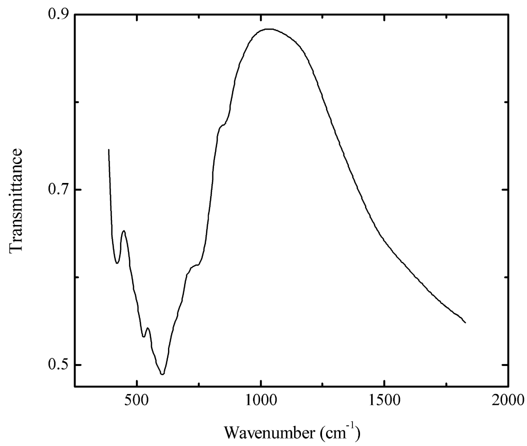


Locality: Crosetto talc mine, Prali, Germanasca valley, Torino province, Piedmont, Italy.

Description: Yellow-brown platy crystals. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is (electron microprobe) $Ti_{0.99}Fe_{0.01}O_2$.

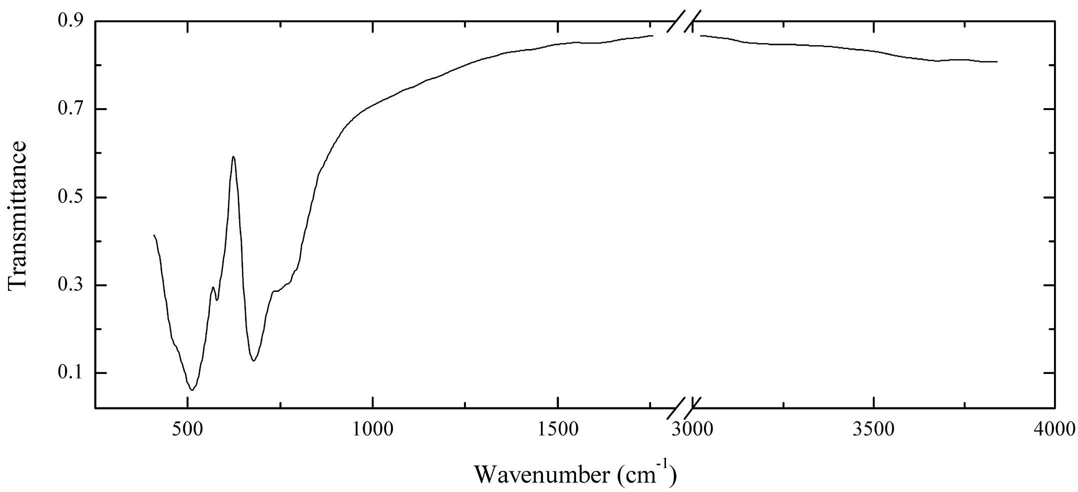
Wavenumbers (cm^{-1}): (3420), 850sh, 750sh, 598s, 523, 490, 430.

O65 Brookite TiO_2



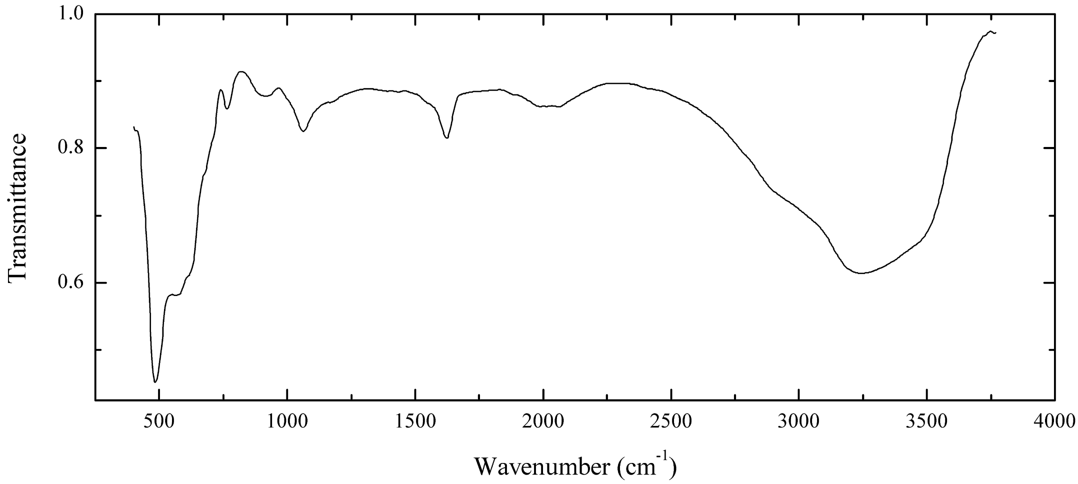
Locality: Saranpaul, Subpolar Urals, Russia.
Description: Brown platy crystals from the association with monazite-(Ce), muscovite and quartz. Identified by morphological features and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 855sh, 735, 605s, 530, 550sh, 422.

O66 Spinel $MgAl_2O_4$



Locality: Twin Lakes, Fresno Co., California, USA.
Description: Blue crystals. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 715sh, 775sh, 745sh, 680s, 595sh, 579, 511s, 470sh.

O67 Cr-hydroxide O67 $CrO(OH)\cdot nH_2O$

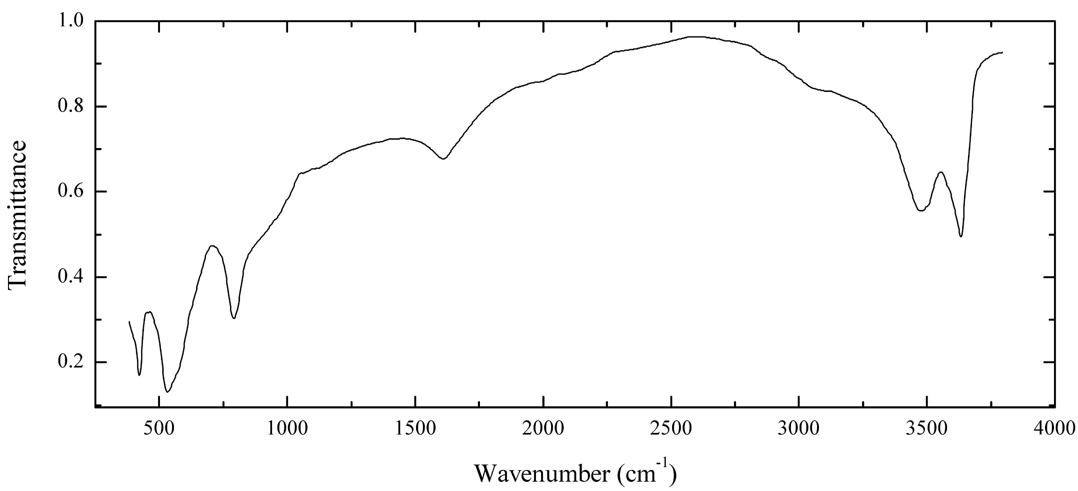


Locality: Onega Lake, Karelia, Russia.

Description: Green massive aggregate from the association with gibbsite. Isostructural with lepidocrocite and γ-CrO(OH). Identified by electron diffraction pattern and electron microprobe analysis. The empirical formula is (electron microprobe) $(Cr_{0.71}Al_{0.29})O(OH)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3450sh, 3240s, 2900sh, 2030w, 1625, 1050, 920w, 763w, 720sh, 615sh, 565s, 484s, 420sh, 400w.

O68 Hydrocalumite $Ca_2Al(OH)_6(Cl,OH)\cdot 3H_2O$

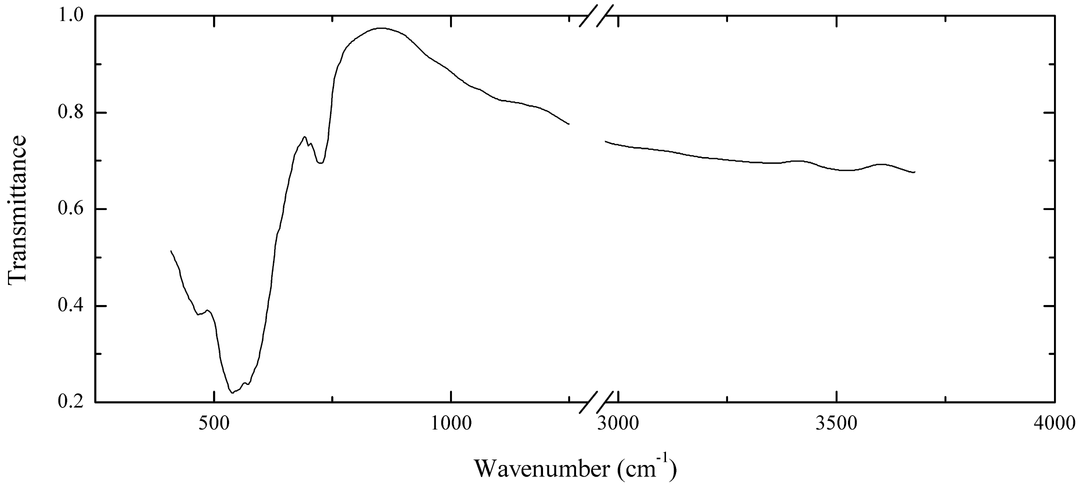


Locality: Lakargi Mt., Upper Chegem caldera, Kabardino-Balkarian Republic, Northern Caucasus, Russia.

Description: Grey massive from the association with spurrite and calcite. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

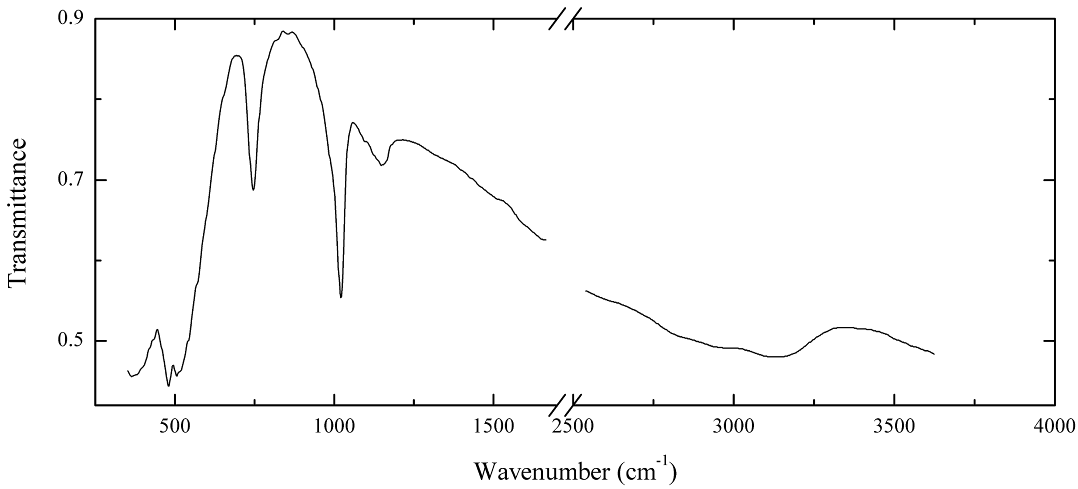
Wavenumbers (cm^{-1}): 3635s, 3480, 3100sh, 1615w, 792s, 620sh, 565sh, 533s, 421s.

O69 Hollandite $Ba(Mn^{4+}{}_6Mn^{3+}{}_2)O_{16}$



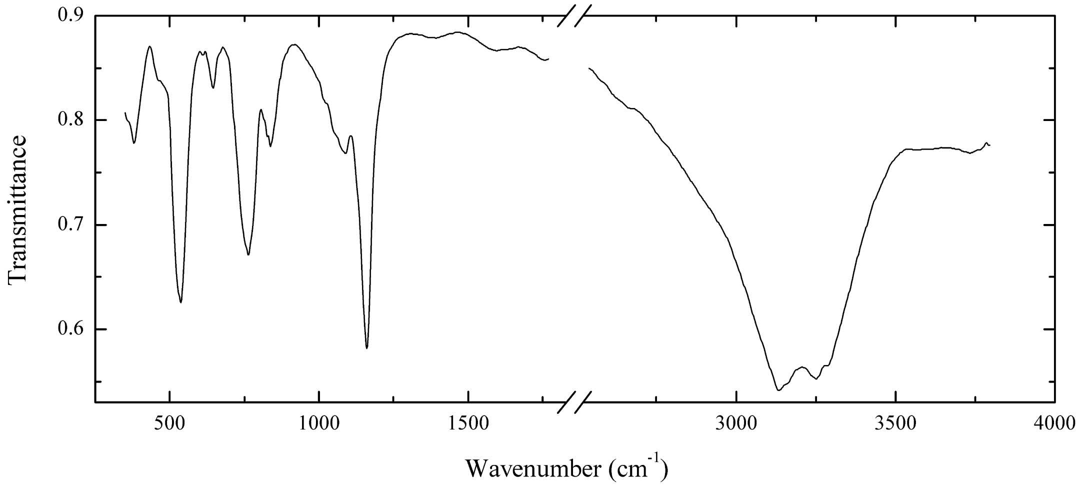
Locality: Dry Gill mine, Caldbeck Fells, Cumbria, England, UK.
Description: Black massive aggregate from the association with mimetite. The empirical formula is (electron microprobe) $Ba_{0.9}Pb_{0.2}Mn_{7.6}Fe_{0.3}O_{16}$.
Wavenumbers (cm^{-1}): 722, 568s, 540s, 470.

O70 Lepidocrocite FeO(OH)



Locality: Gestoso mine, Gestoso, Manhouce, São Pedro do Sul, Viseu district, Portugal.
Description: Dark red crust from the association with beudantite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3120, 2900sh, 1157w, 1020, 746, 515s, 478s, 370s.

O71 Schoenfliesite $MgSn(OH)_6$

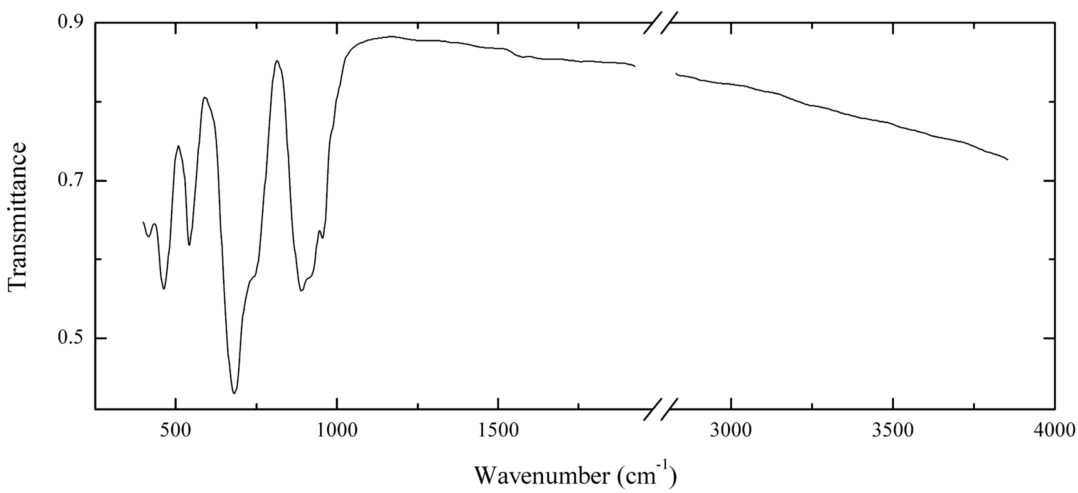


Locality: Lupikko mine, Pitkäranta district, Karelia Republic, Russia.

Description: Yellow grains from the association with magnetite, phlogopite, fluorite, hambergite, helvine, serpentine and calcite. The empirical formula is (electron microprobe) $Mg_{0.85}Mn_{0.14}Sn_{0.97}Fe_{0.04}(OH)_6$.

Wavenumbers (cm^{-1}): 3240s, 3125s, 1160s, 1080, 1020sh, 965sh, 833, 759s, 645, 531s, 374.

O72 Demidovskite $Ca_{18}(Fe^{3+}{}_{15}Al)Si_4O_{47}Cl_6$

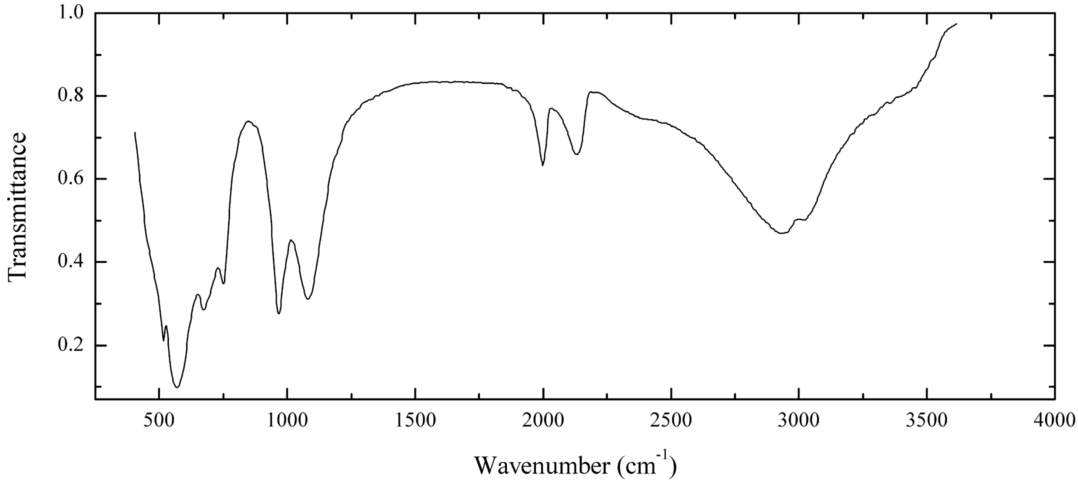


Locality: Burned dump of the coal mine number 45, Kopeisk, Chelyabinsk coal basin, South Urals, Russia.

Description: Technogenetic compound related to mayenite and brearleyite. Investigated by B.V. Chesnokov.

Wavenumbers (cm^{-1}): 980sh, 955, 920sh, 889s, 740sh, 683s, 543, 463s, 414.

O73 Diaspore AlO(OH)

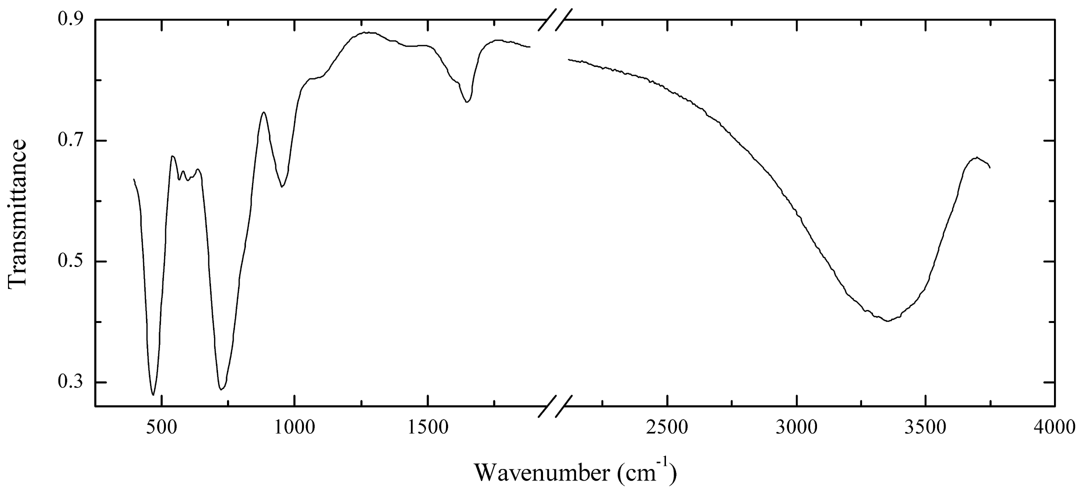


Locality: Saranovskiy mine, Sarany, Perm region, Middle Urals, Russia.

Description: Lilac platy crystals. The empirical formula is (electron microprobe) $Al_{0.96}Cr_{0.03}Fe_{0.01}(OH)$.

Wavenumbers (cm^{-1}): 3350sh, 2990, 2910, 2400sh, 2115, 1983, 1082s, 966s, 755, 705sh, 677s, 577s, 520s.

O74 "Hydroroméite" $(H_2O,Ca)_2Sb_2O_6(OH,O)\cdot nH_2O$

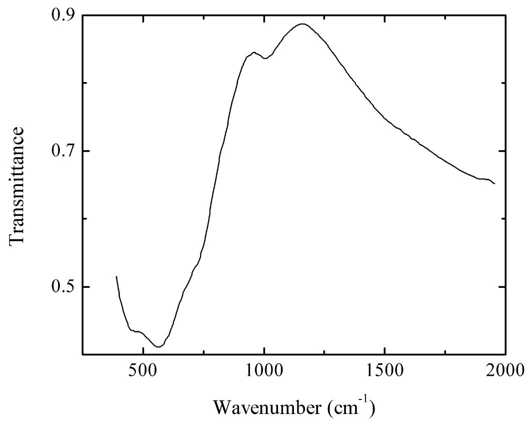


Locality: Khaidarkan Sb–Hg deposit, Fergana valley, Alay range, Osh region, Kyrgyzstan.

Description: Yellow fine-grained aggregate. Pseudomorph after stibnite. The empirical formula is (electron microprobe) $(Ca_{0.87}Na_{0.05}K_{0.02})Sb_{1.89}Si_{0.11}O_6(OH,O)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3355s, 1650, 1600sh, 1090w, 955, 810sh, 725s, 606w, 589w, 566w, 460s.

O75 Davidite-(La) $(La,Ce)(Y,U,Fe^{2+})(Ti,Fe^{3+})_{20}(O,OH)_{38}$

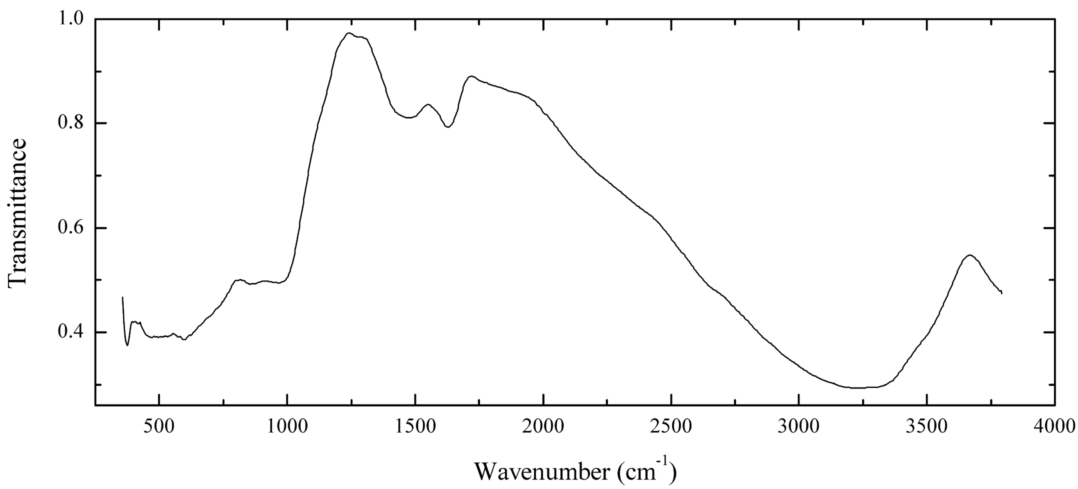


Locality: Bektau-Ata massif, Karagandy region, Kazakhstan.

Description: Black crystal. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $La_{0.8}Ce_{0.5}Nd_{0.1}Y_{0.5}Ti_{12.9}Fe_{6.7}Mn_{0.5}(O,OH)_{38}$.

Wavenumbers (cm^{-1}): 1015w, 710sh, 567s, 470.

O76 Yttrocrasite-(Y) $(Y,Th,Ca,U)(Ti,Fe^{3+})_2(O,OH)_6$

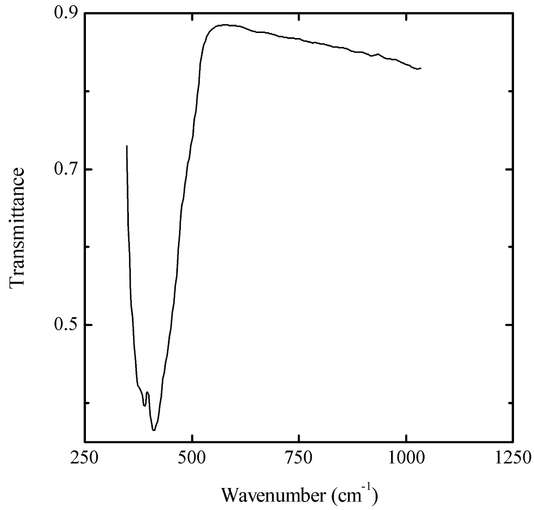


Locality: Diabazovoe deposit, near Zhitkovichi, Homel region, Byelorussia.

Description: Black grains from the association with euxenite-(Y) and synchysite-(Y). Metanict, amorphous and hydrated variety. Weak band at 1,475 cm^{-1} is due to the admixture of synchysite-(Y). The empirical formula is (electron microprobe) $(Y_{0.36}Ca_{0.11}Ce_{0.11}Ba_{0.11}U_{0.09}Nd_{0.09}Gd_{0.04}Dy_{0.03}La_{0.02}Yb_{0.02}Sm_{0.02})(Ti_{1.16}Nb_{0.72}Fe_{0.07}Al_{0.05})(O,OH)_6 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3260, 3200sh, 2660sh, 1627, 1475w, 967, 865, 740sh, 595s, 525sh, 470s, 373s.

O77 Delafossite $Cu^{+}Fe^{3+}O_2$

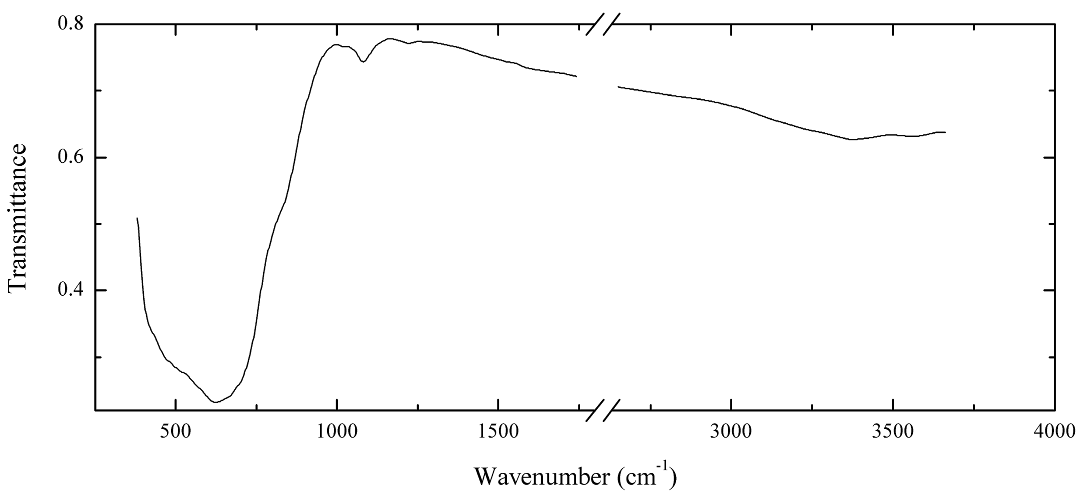


Locality: Gayskoe Zn–Cu deposit, Orenburg region, South Urals, Russia.

Description: Black crusts. Identified by powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 425sh, 406s, 386, 375sh.

O78 Ixiolite (Ta,Nb,Fe,Mn)O_2

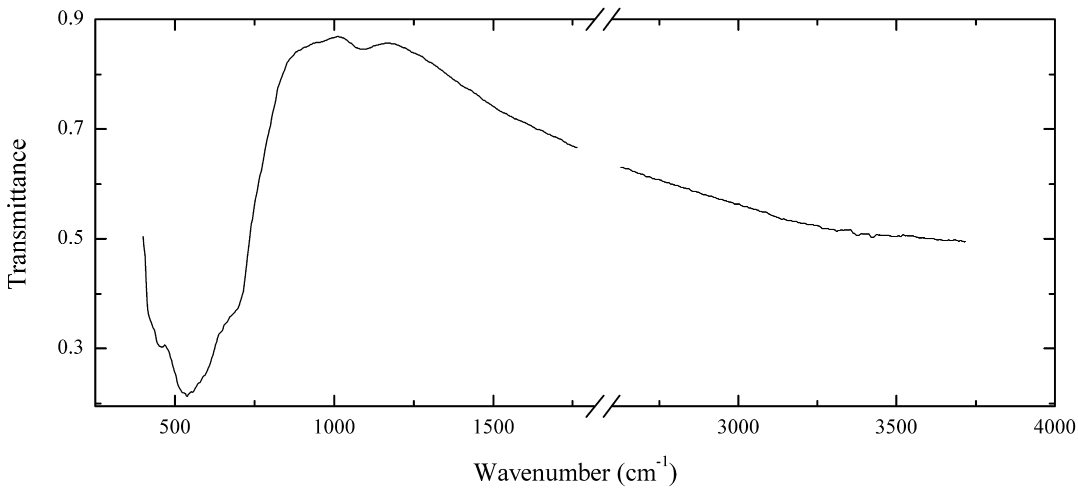


Locality: Vasin-Myl'k Mt., Voron'i Tundras, Kola peninsula, Murnansk region, Russia.

Description: Dark grey grains from the granitic pegmatite. Associated minerals are albite, pollucite, trilithionite, microlite and zircon. The empirical formula is (electron microprobe) $(Ta_{0.48}Mn_{0.22}Sn_{0.11}Nb_{0.08}Fe_{0.08}Ti_{0.03})O_2$.

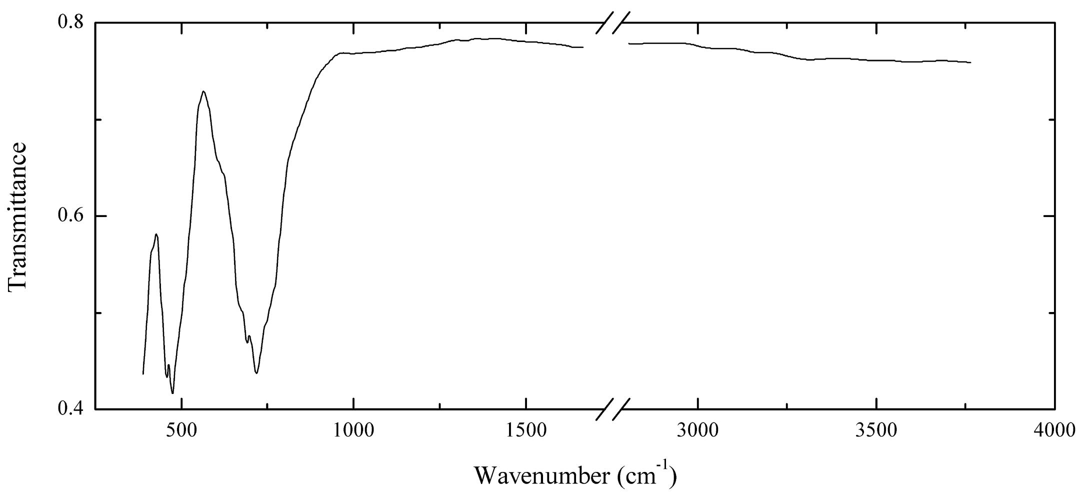
Wavenumbers (cm^{-1}): 1080w, 820sh, 627s, 500sh.

O79 Ilmenite $Fe^{2+}TiO_3$



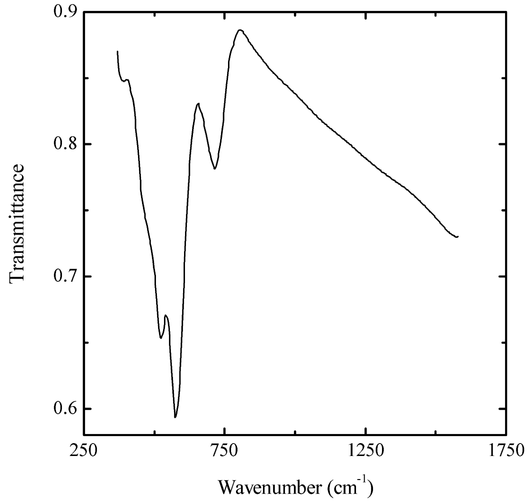
Locality: Vavnbed Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Black platy crystal from the association with albite and zircon. Mn-rich variety. The empirical formula is (electron microprobe) $Fe_{0.71}Mn_{0.32}Ti_{0.97}O_3$.
Wavenumbers (cm^{-1}): 1090w, 690sh, 542s, 455s.

O80 Ingersonite $Ca_3Mn^{2+}Sb^{5+}{}_4O_{14}$



Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).
Description: Yellow crystals from the association with filipstadite and roméite. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 765sh, 745sh, 719s, 692, 670sh, 615sh, 490sh, 468s, 451s.

O81 Coronadite $Pb(Mn^{4+}{}_6Mn^{3+}{}_2)O_{16}$

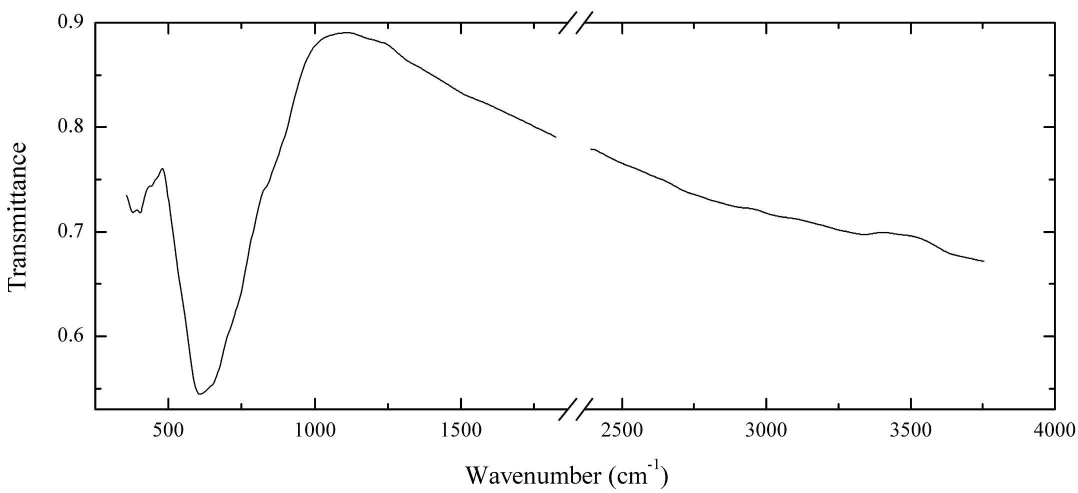


Locality: Imiter mine, Imiter district, Djebel Saghro, Ouarzazate province, Morocco.

Description: Black crust from the association with mimetite. The empirical formula is (electron microprobe) $Pb_{1.00}(Mn_{7.58}Al_{0.15}V_{0.14}Fe_{0.07}Mg_{0.06})O_{16}$.

Wavenumbers (cm^{-1}): 715, 579s, 527s, 475sh.

O82 Isolueshite $(Na,La,Ca)(Nb,Ti)O_3$

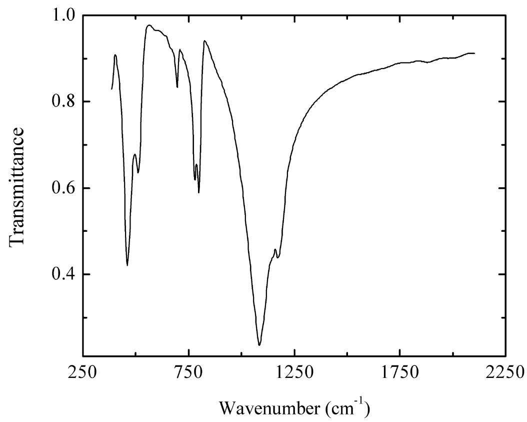


Locality: Kirovskii apatite mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Dark brown crystal from the association with microcline, sodalite and natrolite. Investigated by A.R. Chakhmouradian.

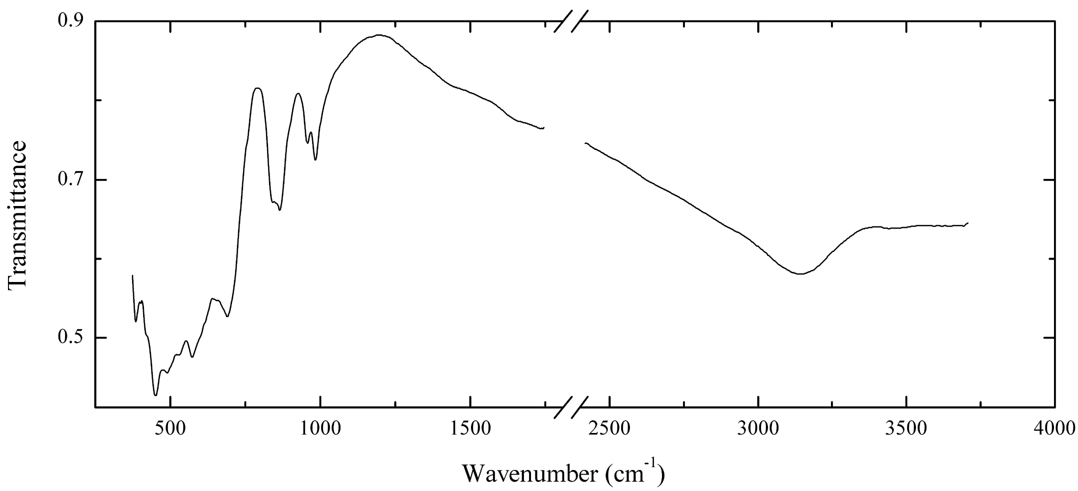
Wavenumbers (cm^{-1}): 905sh, 840sh, 730sh, 655sh, 609s, 440sh, 402w, 380w.

O83 Quartz SiO_2



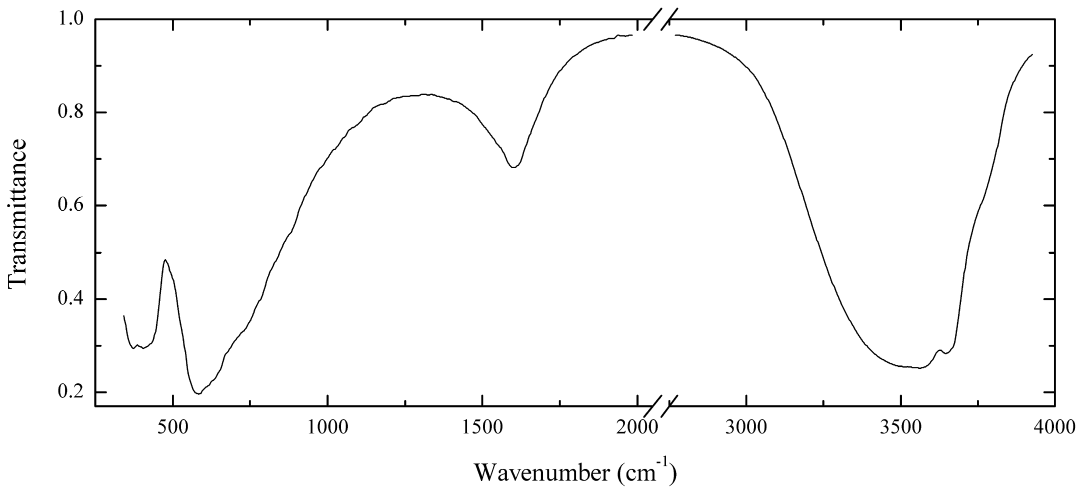
Locality: Kara-Oba W deposit, Betpakdala desert, Karagandy region, Kazakhstan.
Description: Colourless crystal from the association with fluorite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1171s, 1145sh, 1084s, 798, 779, 696, 513, 459s.

O84 Kassite $CaTi_2O_4(OH)_2$



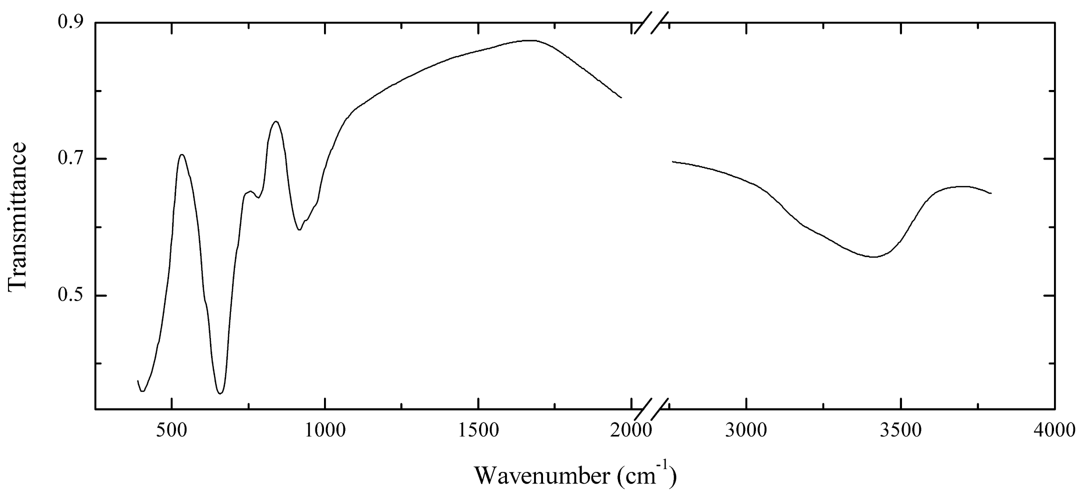
Locality: Saranovskiy mine, Sarany, Perm region, Middle Urals, Russia.
Description: Radial aggregate of green platy crystals. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Ca_{0.93}Mg_{0.04}Na_{0.01})(Ti_{1.89}Cr_{0.08}Al_{0.04})O_4(OH)_2$.
Wavenumbers (cm^{-1}): 3135, 984, 958, 866, 846, 690, 605sh, 575s, 530sh, 495s, 455s, 425sh, 393.

O85 Korshunovskite $Mg_2Cl(OH)_3 \cdot 3.5–4H_2O$



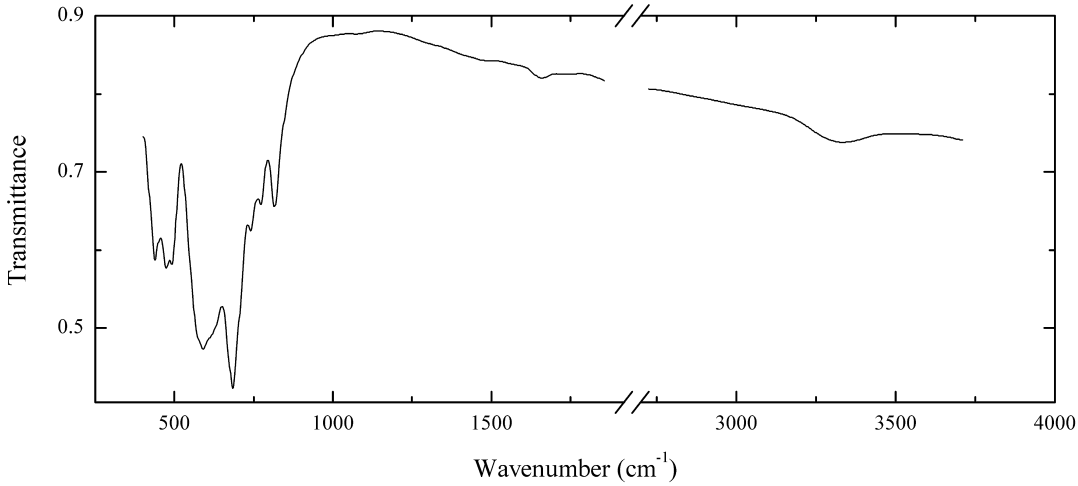
Locality: Borehole at the Korshunovskoe deposit, Irkutsk region, Siberia, Russia (type locality).
Description: White fibrous aggregate forming veinlet in granular dolomite. Identified by powder X-ray diffraction pattern and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3650s, 3545s, 3475sh, 1620, 725sh, 680sh, 581s, 420, 394.

O86 Hydroxyplumboroméite $(Pb,\square)_2(Sb^{5+},Fe^{3+})_2O_6(OH,O)$



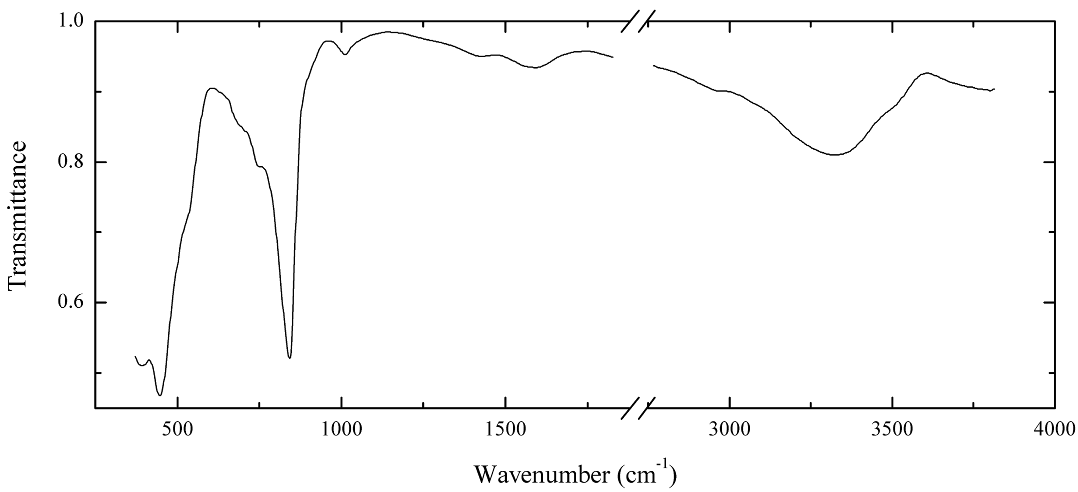
Locality: Kremikovtsi iron mine, near Sofia, Bulgaria.
Description: Brownish-yellow fine-grained aggregate from the association with galena, goethite, azurite and quartz. The empirical formula is (electron microprobe) $(Pb_{1.6}Ca_{0.1}Na_{0.1})(Sb_{1.6}Fe_{0.4})$ $O_6(OH,O)$.
Wavenumbers (cm^{-1}): 3390, 915, 779, 660s, 405s.

O87 Cafarsite $Ca_8(Ti,Fe,Mn)_{6–7}(AsO_3)_{12}·4H_2O$



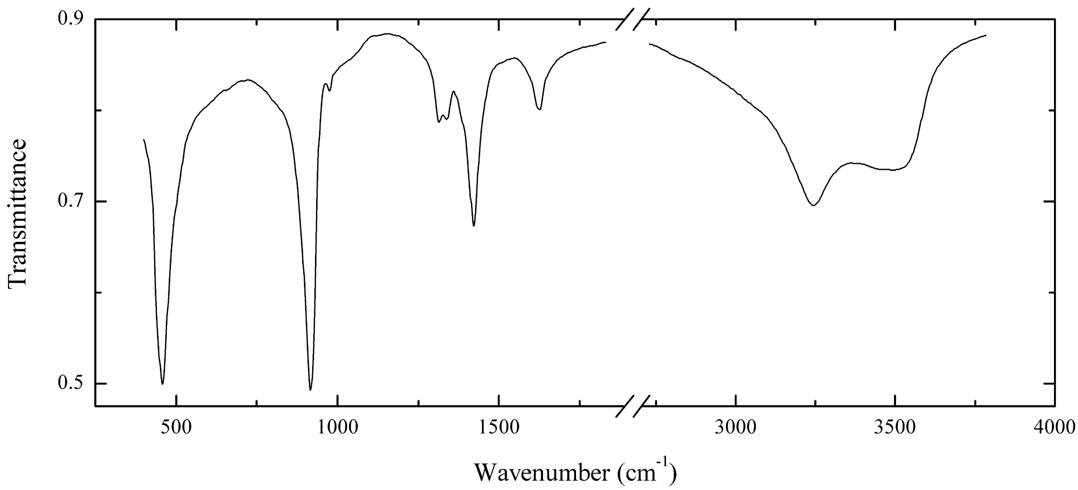
Locality: Cervandone Mt., Val Devero, Baceno, Verbano-Cusio-Ossola province, Piedmont, Italy.
Description: Red-brown grain in rock. Identified by morphological features and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3325, 1640w, 818, 773, 744, 685s, 620sh, 605sh, 588s, 493, 476, 440.

O88 Uranyl oxide O88 $Pb(UO_2)O_2·nH_2O$



Locality: Synthetic.
Description: Investigated by wet chemical analysis and powder X-ray diffraction. Isostructural with clarkeite.
Wavenumbers (cm^{-1}): 3480sh, 3295, 1580w, 1535w, 1415w, 1010w, 841s, 750, 685sh, 550sh, 520sh, 450s, 392s.

O89 Uranyl oxide O89 $Ca(UO_2)O_2{\cdot}nH_2O$

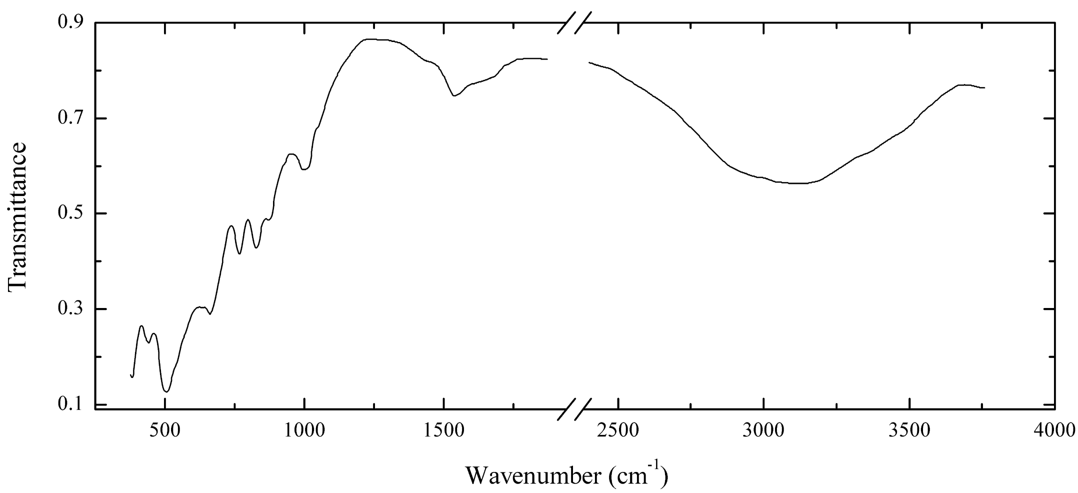


Locality: Synthetic.

Description: Investigated by wet chemical analysis and powder X-ray diffraction. Isostructural with clarkeite.

Wavenumbers (cm^{-1}): 3500, 3230, 1625, 1427, 1340w, 1318w, 981w, 918s, 460s.

O90 Cafetite $CaTi_2O_5{\cdot}H_2O$

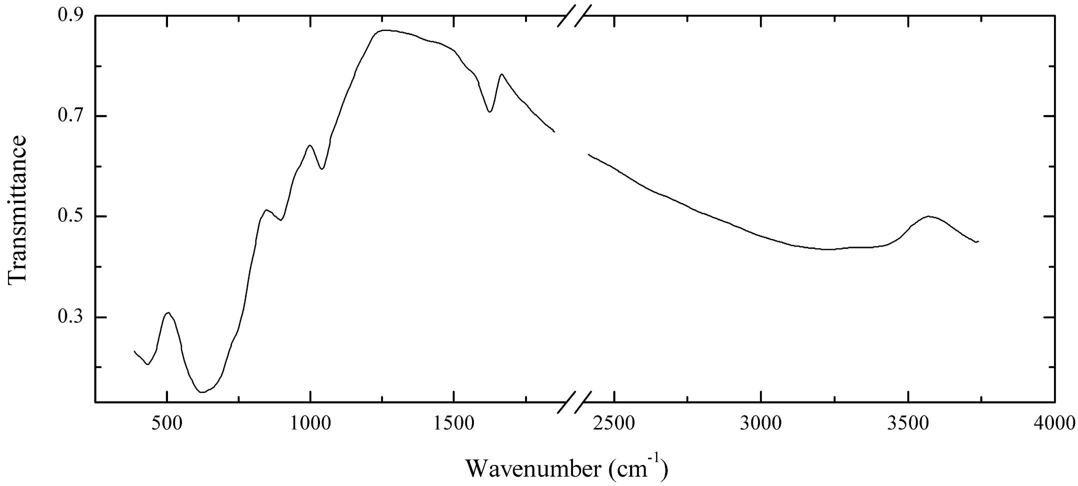


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Beige platelets from the association with nabalamprophyllite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.98}Na_{0.04})(Ti_{3.93}Nb_{0.07})O_4{\cdot}H_2O$.

Wavenumbers (cm^{-1}): 3330sh, 3080, 2960sh, 1670sh, 1615sh, 1534w, 1000, 876, 828, 767, 663s, 508s, 440s.

O91 "Hydropyrochlore" $(H_2O,H_3O^+,Ca)_2Nb_2(O,OH)_7$

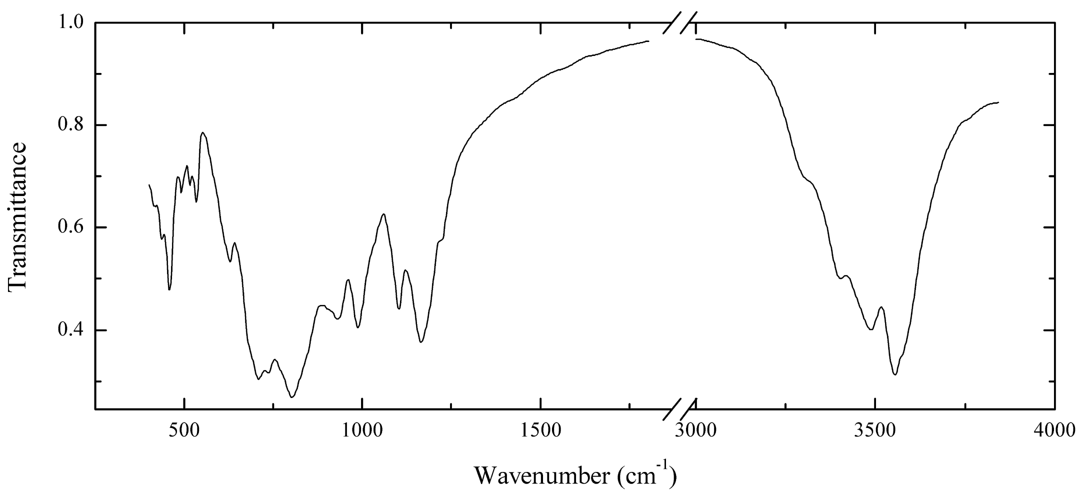


Locality: Lueshe mine, Kivu, Democratic Republic of Congo.

Description: Octahedral crystal. The empirical formula is (electron microprobe) $[(H_2O,H_3O^+,\square)_x Ca_{0.17}Na_{0.06}K_{0.04}Sr_{0.03}U_{0.03}](Nb_{1.90}Ti_{0.10})(O,OH)_7$.

Wavenumbers (cm^{-1}): 3360, 3230, 1634, 1610sh, 1037, 897, 740sh, 645sh, 614s, 470sh, 426s, 405sh.

O92 Clinobehoite $Be(OH)_2$

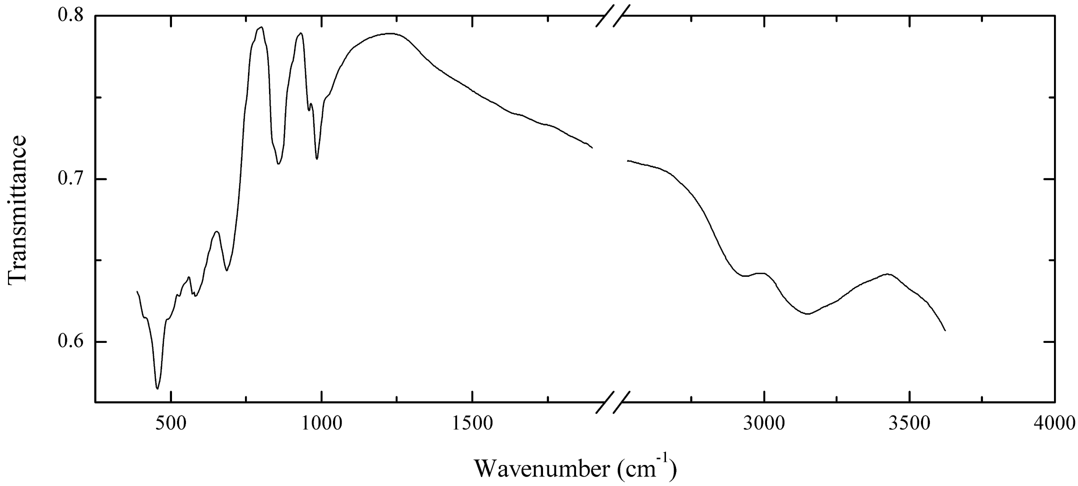


Locality: Malyshevskoe emerald deposit, near Malyshevo township, Ekaterinburg region, Middle Urals, Russia (type locality).

Description: Radial aggregate of colourless elongated platy crystals. Holotype sample. Associated minerals are bavenite, bityite, phillipsite, analcime and albite. Monoclinic, space group $P2_1$; $a = 11.020(8)$, $b = 4.746(6)$, $c = 8.646(9)$ Å, $\beta = 98.94(8)°$. Optically biaxial (−), $\alpha = 1.539(1)$, $\beta = 1.544(1)$, $\gamma = 1.548(1)$; $2V = -80°$. $D_{meas} = 1.93(3)$ g/cm^3, $D_{calc} = 1.92$ g/cm^3. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.714 (100), 3.61 (90), 5.43 (80), 3.76 (70), 3.16 (70), 2.306 (70), 3.98 (60).

Wavenumbers (cm^{-1}): 3570sh, 3550s, 3490, 3475sh, 3450sh, 3400, 3310, 1225sh, 1167s, 1104, 988, 935, 840sh, 805s, 732s, 706s, 685sh, 627, 620sh, 532, 516w, 491w, 456, 433, 420w.

O93 Kassite $CaTi_2O_4(OH)_2$

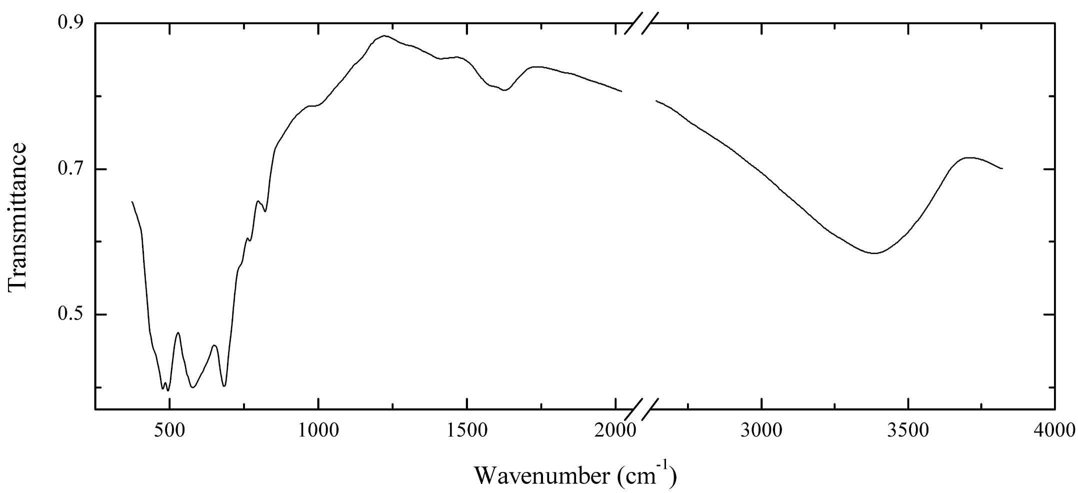


Locality: Afrikanda massif, Afrikanda, Kola peninsula, Murnansk region, Russia.

Description: Aggregate of brownish platy crystals from the association with cafetite, perovskite and titanite. Holotype sample. Orthorhombic. Optically biaxial (−), $\alpha = 1.95(1)$, $\beta = 2.13(1)$, $\gamma = 2.21(1)$; $2V = -58°$. $D_{meas} = 3.42$ g/cm^3, $D_{calc} = 3.418$ g/cm^3. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.30 (100), 1.761 (100), 4.77 (50), 3.63 (40), 2.29 (40), 1.501 (40), 7.2 (30).The empirical formula is $[Ca_{0.95}(H_3O)_{0.04}Na_{0.01}](Ti_{1.92}Fe_{0.06}Al_{0.05})O_{3.96}(OH)_{2.04}$.

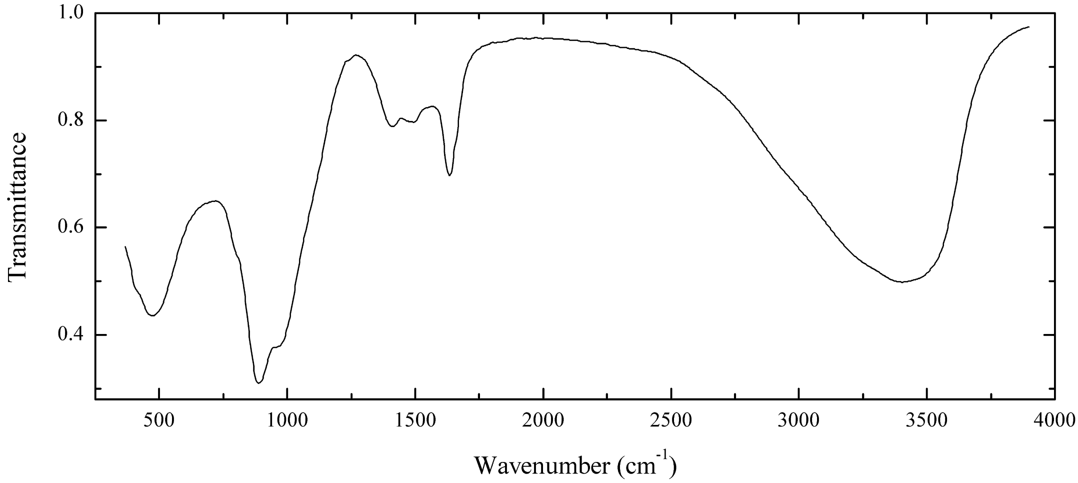
Wavenumbers (cm^{-1}): 3140, 2915, 1020sh, 984, 958, 864, 845sh, 690s, 600sh, 584s, 530sh, 500sh, 454s, 405sh.

O94 Cafarsite $Ca_8(Ti,Fe,Mn)_{6-7}(AsO_3)_{12}\cdot 4H_2O$



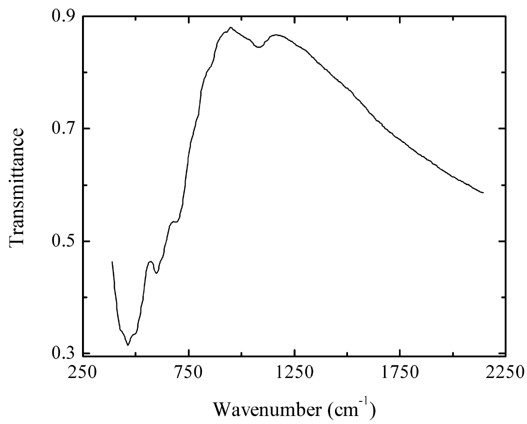
Locality: Cervandone Mt., Val Devero, Baceno, Verbano-Cusio-Ossola province, Piedmont, Italy.
Description: Red-brown grain in rock. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3335, 1620w, 1580w, 1000w, 820, 772, 740sh, 681s, 620sh, 575s, 491s, 475s, 445sh.

O96 Calciouranoite $(Ca,Ba,Pb)U_2O_7{\cdot}5H_2O$



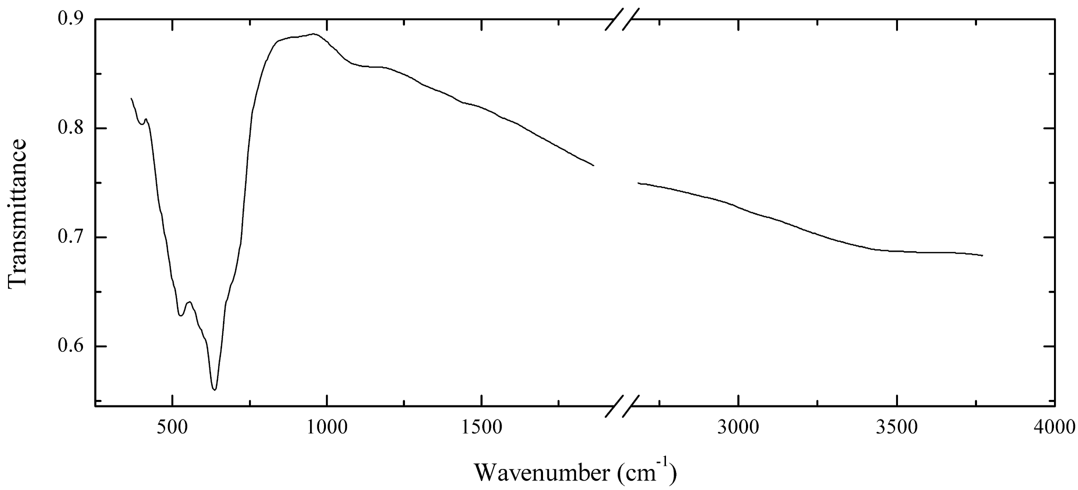
Locality: Streltsovskoe U-Mo deposit, near Krasnokamensk, Chita region, Transbaikal area, Siberia, Russia (type locality).
Description: Orange prismatic crystals from the association with calcite, bauranoite, uraninite and uranophane. Holotype sample. Optically biaxial (−), $\alpha = 1.76$, $\beta = 1.84$, $\gamma = 1.87$. $D_{meas} = 4.62$ g/cm^3. The powder X-ray diffraction pattern is indistinct; the strongest reflections are at 4.00, 3.406, 3.050, 2.68 and 2.00 Å. The empirical formula is $(Ca_{0.74}Ba_{0.13}Pb_{0.07}Na_{0.06})U_{1.70}O_7{\cdot}4.8H_2O$.
Wavenumbers (cm^{-1}): 3475sh, 3375s, 3220sh, 1633, 1495w, 1408w, 960sh, 889s, 800sh, 475s, 430sh.

O97 Calzirtite $Ca_2Zr_5Ti_2O_{16}$



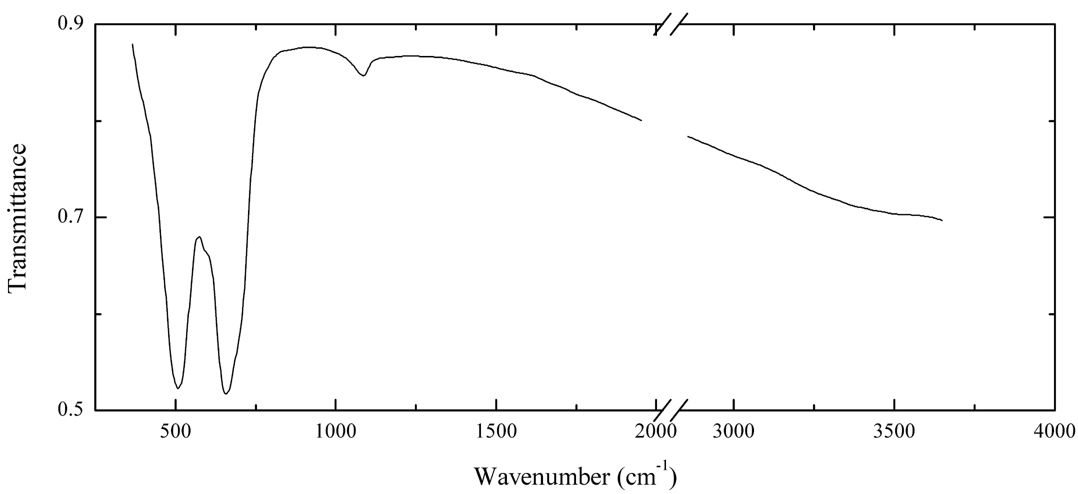
Locality: Afrikanda massif, Afrikanda, Kola peninsula, Murnansk region, Russia.
Description: Black tetragonal crystal from the association with perovskite, titanite, zirconolite-2*M*, magnetite, diopside, magnesiohastingsite, phlogopite and calcite. Identified by powder X-ray diffraction pattern and electron microprobe analysis. Investigated by I.V. Pekov. The chemical composition is (wt. %) CaO 11.26, FeO 1.48, TiO_2 16.04, ZrO_2 70.56, Nb_2O_5 0.10, total 99.85.
Wavenumbers (cm^{-1}): 1085w, 860sh, 695, 596s, 492s, 460s, 405sh.

O98 Cassiterite SnO_2



Locality: Merekskoe Sn deposit, Bureinskii range, near Chegdomyn, Khabarovsk region, Russia.
Description: Brown transparent twin. Almost pure SnO_2 (only trace amounts of Fe and Nb have been detected by electron microprobe analysis).
Wavenumbers (cm^{-1}): 690sh, 632s, 600sh, 528, 380w.

O99 Cassiterite SnO_2

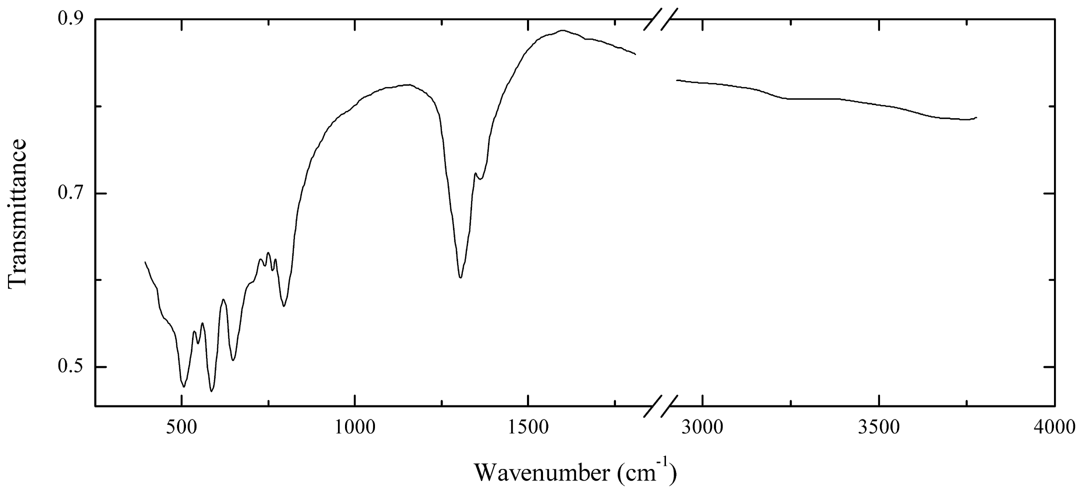


Locality: Dzhalindinskoe Sn deposit, Khabarovsk region, Russia.

Description: Brown botryoidal aggregate ("wood tin"). The empirical formula is (electron microprobe) $(Sn_{0.94}Al_{0.03}Fe_{0.02}Si_{0.02})O_2$.

Wavenumbers (cm^{-1}): 1080w, 705sh, 664s, 600sh, 509s, 400sh.

O100 Painite $CaZrAl_9O_{15}(BO_3)$

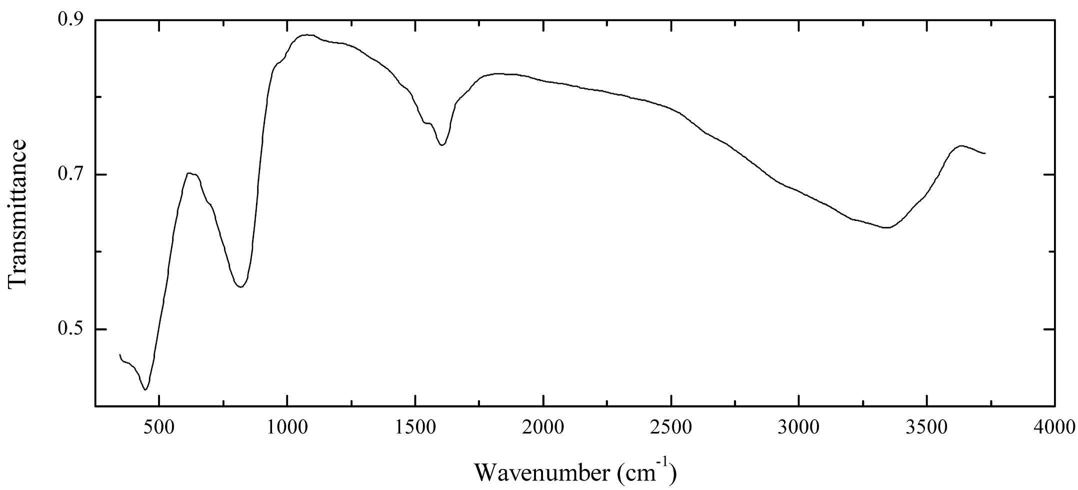


Locality: Nam Ya (Namya), Shan State, Kumon Range, Myanmar.

Description: Orange crystal. The empirical formula is (electron microprobe) $(Ca_{0.93}Mn_{0.01})Zr_{1.03}Al_{9.00}O_{15}(BO_3)$.

Wavenumbers (cm^{-1}): 1366, 1307, 796, 761, 732, 705sh, 650s, 588s, 547, 520sh, 505s, 450sh, 420sh.

O101 Curite $Pb_2U^{6+}{}_5O_{17}\cdot 4H_2O$

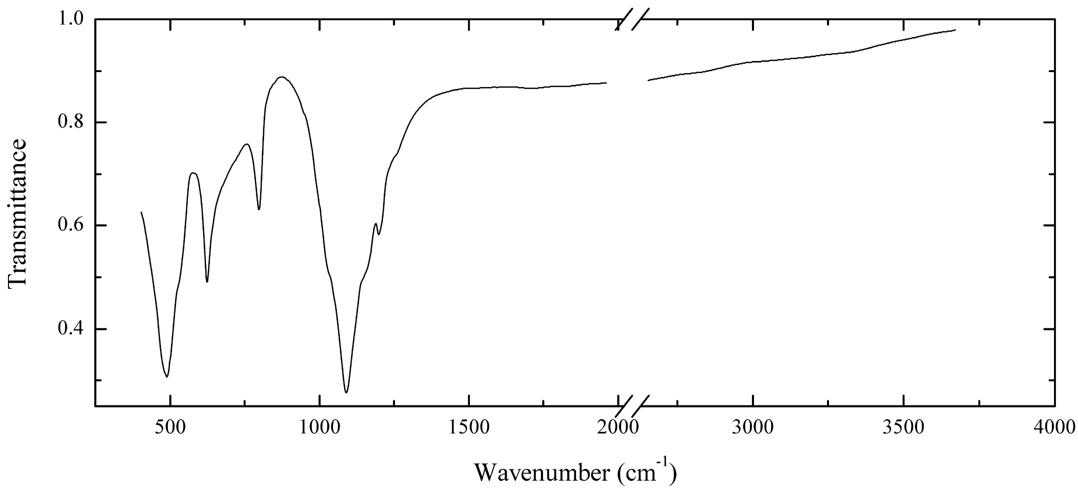


Locality: Iron mine, Kovdor, Kovdor alkaline-ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Orange-red massive. Identified by electron microprobe analysis (U:Pb = 5:2).

Wavenumbers (cm^{-1}): 3490sh, 3310, 3195, 2920sh, 1610, 1550w, 960sh, 833, 705sh, 455s, 410sh.

O102 Cristobalite SiO_2

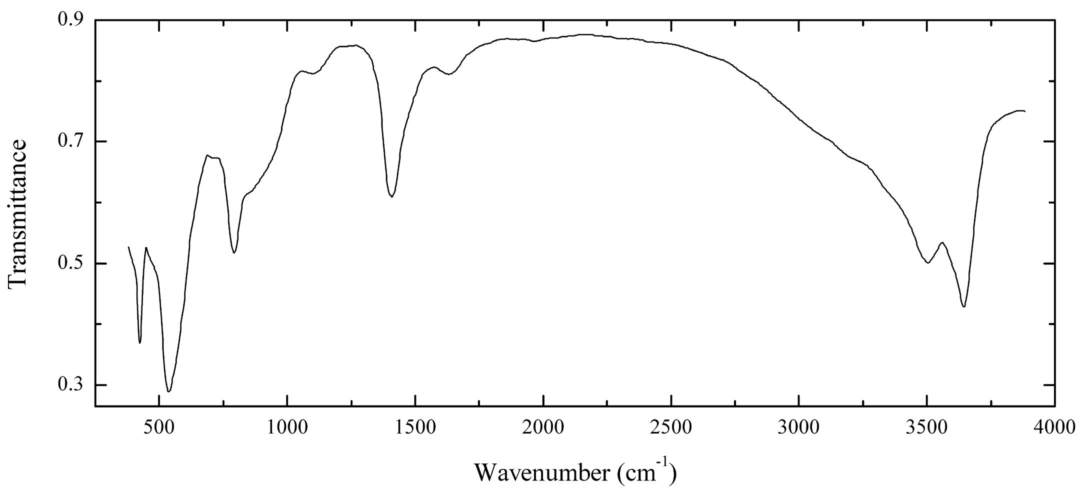


Locality: Technogenetic.

Description: Colourless grains from slag. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1200, 1160sh, 1093s, 1040sh, 795, 680sh, 620, 520sh, 483s.

O103 Hydrocalumite $Ca_2Al(OH)_6(Cl,OH){\cdot}3H_2O$

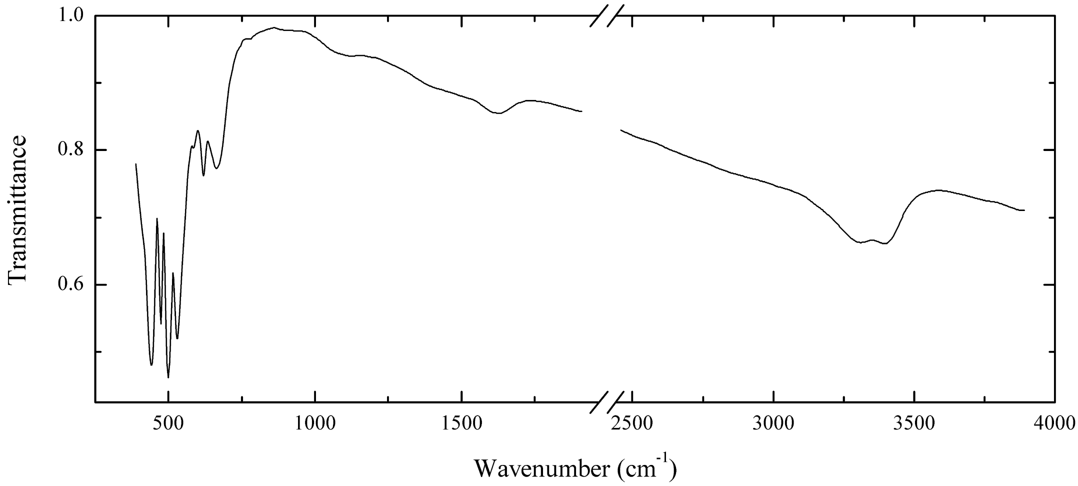


Locality: Lakargi Mt., Upper Chegem caldera, Kabardino-Balkarian Republic, Northern Caucasus, Russia.

Description: Black massive from the association with spurrite and calcite. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Ca_{2.17}Mg_{0.04}Al_{0.83}Fe_{0.03}Cl_{0.6}(OH)_{6.4}{\cdot}nH_2O$. Contaminated by a carbonate?

Wavenumbers (cm^{-1}): 3635s, 3490, 3100sh, 1650w, 1615w, 1105w, 850sh, 792, 535s, 422s.

O104 Chalcophanite $ZnMn^{4+}{}_3O_7 \cdot 3H_2O$

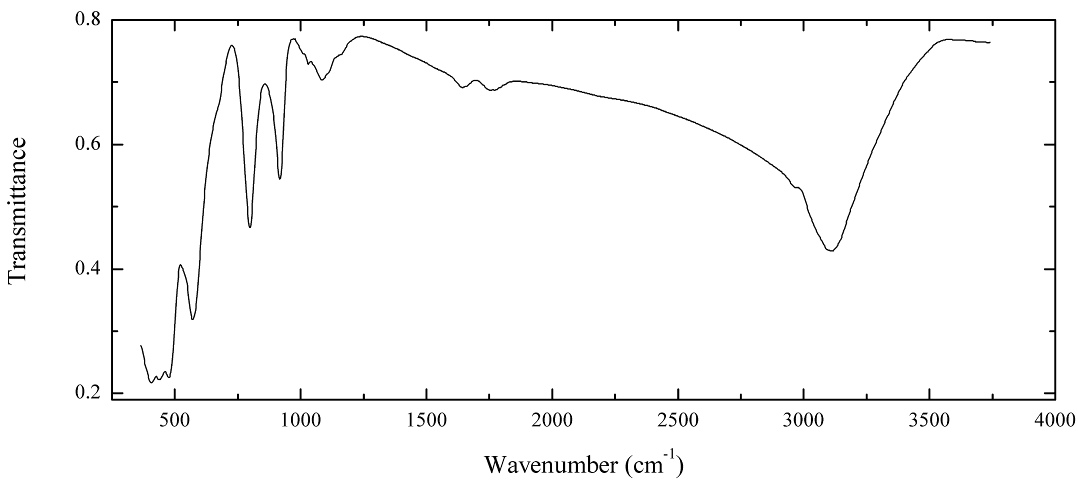


Locality: Kremikovtsi iron mine, near Sofia, Bulgaria.

Description: Black (with red reflexes) platy crystals from the association with hematite, cryptomelane and goethite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Zn_{1.01}Fe_{0.03}Mn_{2.96}O_7 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3385, 3295, 1625w, 790w, 662, 619, 588w, 531s, 499s, 475s, 440s, 400sh.

O105 Goethite FeO(OH)

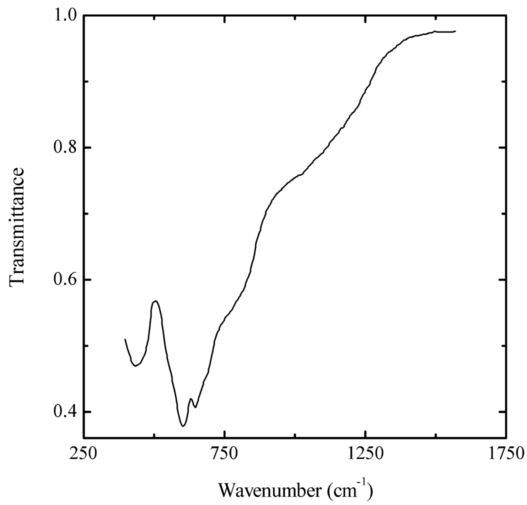


Locality: Hagendorf South pegmatite, Hagendorf, Waidhaus, Upper Palatinate, Bavaria, Germany.

Description: Parallel-fibrous aggregate forming crust on rock. Identified by IR spectrum. Weak band at 1,085 cm^{-1} is due to the admixture of quartz.

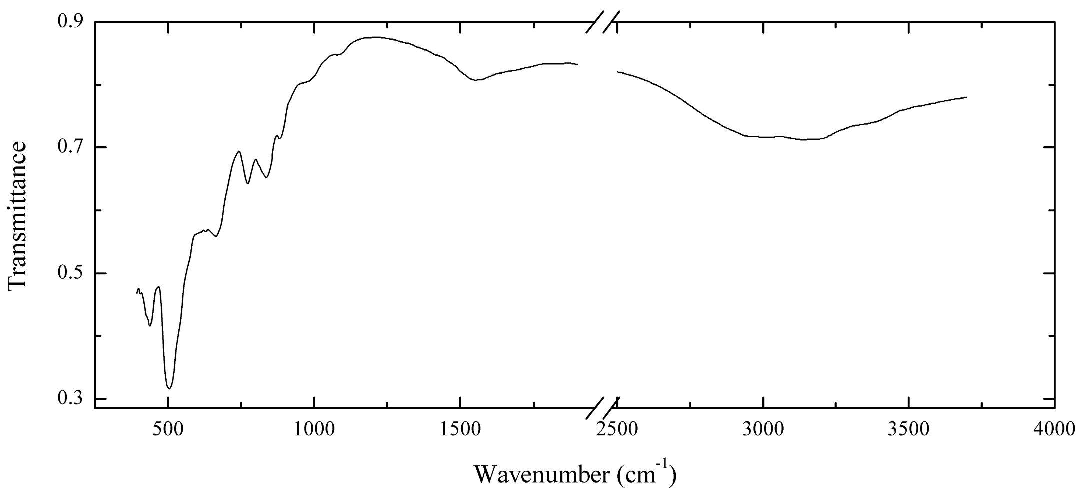
Wavenumbers (cm^{-1}): 3110, 1760w, 1640w, 1085w, 910, 796, 564, 468s, 432s, 396s.

O106 Corundum Al_2O_3



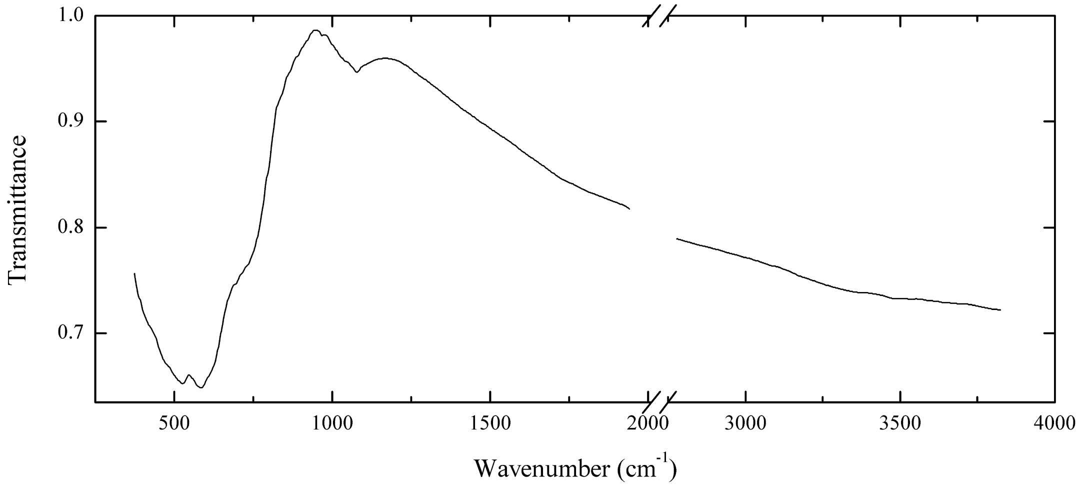
Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.
Description: Blue crystal from desiliconized pegmatite.
Wavenumbers (cm^{-1}): 770sh, 643s, 602s, 433.

O107 Cafetite $CaTi_2O_5 \cdot H_2O$



Locality: Rasvumchorr Mt., near Yuksporlak pass, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Beige spherulites from the association with natrolite, annite, astrophyllite, titanite, aeschynite-(Ce), fluorapatite and pyrophanite. Investigated by I.V. Pekov. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. The chemical composition is (wt. %) Na_2O 0.5, K_2O 0.1, CaO 22.5, FeO 0.8, TiO_2 63.5, Nb_2O_5 3.1, H_2O not determined. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3350w, 3125, 2950, 1540, 970w, 881, 835, 771, 662, 508s, 439s.

O108 Crichtonite $Sr(Fe,Mn)_3(Ti,Fe)_{18}O_{38}$

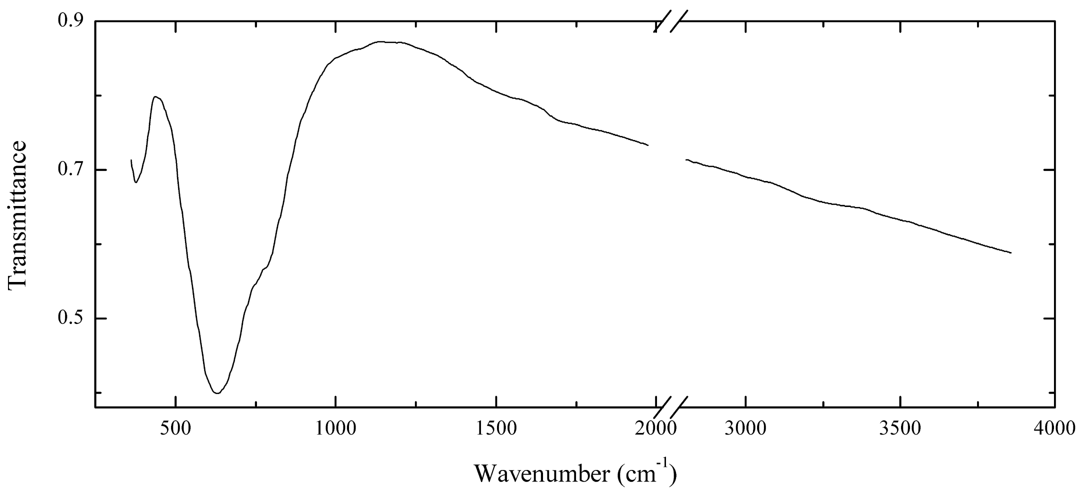


Locality: Kaskasnyunachorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Black isometric grains from the contact zone of foyaite. Associated minerals are sanidine, freudenbergite, ilmenite and titanite. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $(Sr_{0.55}Ca_{0.45})(Fe_{2.7}Mn_{0.3})(Ti_{15.3}Fe_{1.7}Zr_{0.6}Mg_{0.3}Cr_{0.1})O_{38}$.

Wavenumbers (cm^{-1}): 1075w, 1020sh, 740sh, 710sh, 625sh, 582s, 535s, 485sh, 430sh.

O109 Lueshite $NaNbO_3$

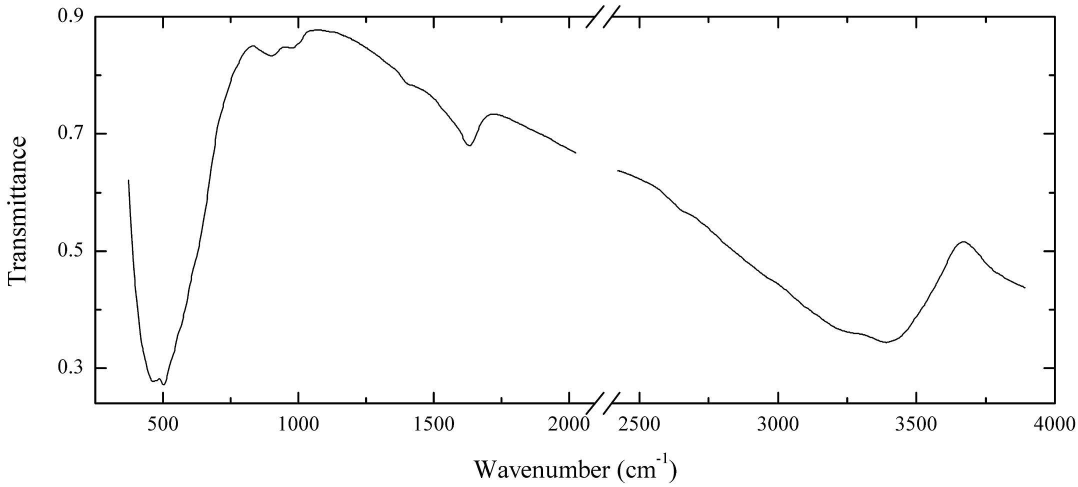


Locality: Sallanlatva massif, southern Karelia, Russia.

Description: Dark brown cubic crystal. The empirical formula is (electron microprobe) $(Na_{0.81}Ca_{0.15}Ce_{0.02})(Nb_{0.85}Ti_{0.12}Fe_{0.03})O_3$.

Wavenumbers (cm^{-1}): 770sh, 635s, 375.

O110 Lithiophorite $(Al,Li)Mn^{4+}O_2(OH)_2$

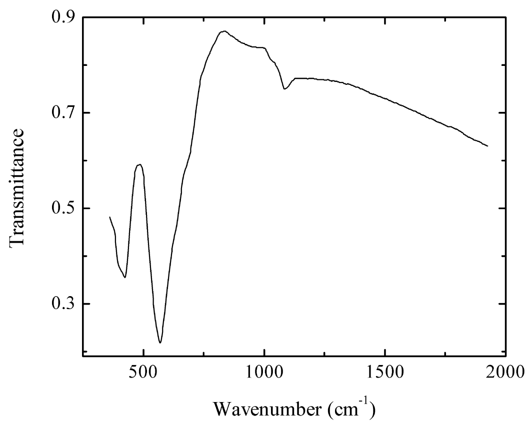


Locality: Mt. Malyi Punkaruaiv, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Black pseudomorph after serandite from the association with natrolite, rhabdophane-(Ce), murmanite, gerasimovskite and punkaruaivite. The empirical formula is (electron microprobe) $Ca_{0.03}Sr_{0.01}Al_{0.46}Mg_{0.03}Fe_{0.02}Ta_{0.02}Nb_{0.01}Li_xMn_{1.00}O_2(OH)_yCl_{0.02}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3370, 3250sh, 1627, 980w, 905w, 630sh, 570sh, 505s, 468s, 430sh.

O111 Magnesioferrite $MgFe^{3+}{}_2O_4$

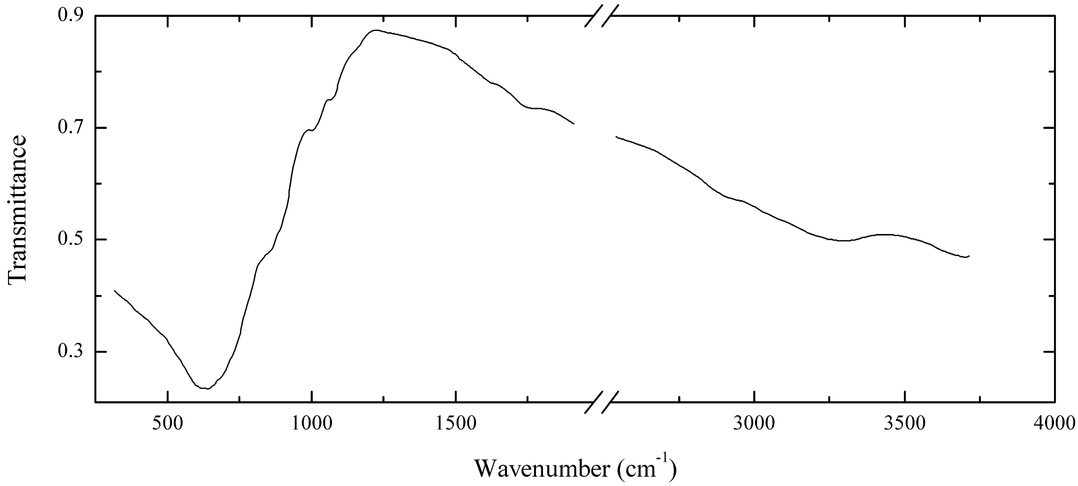


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: Black octahedral crystals from the association with hematite and calcite. The empirical formula is (electron microprobe) $(Mg_{0.83}Mn_{0.09}Fe_{0.08})Fe_{2.00}O_4$.

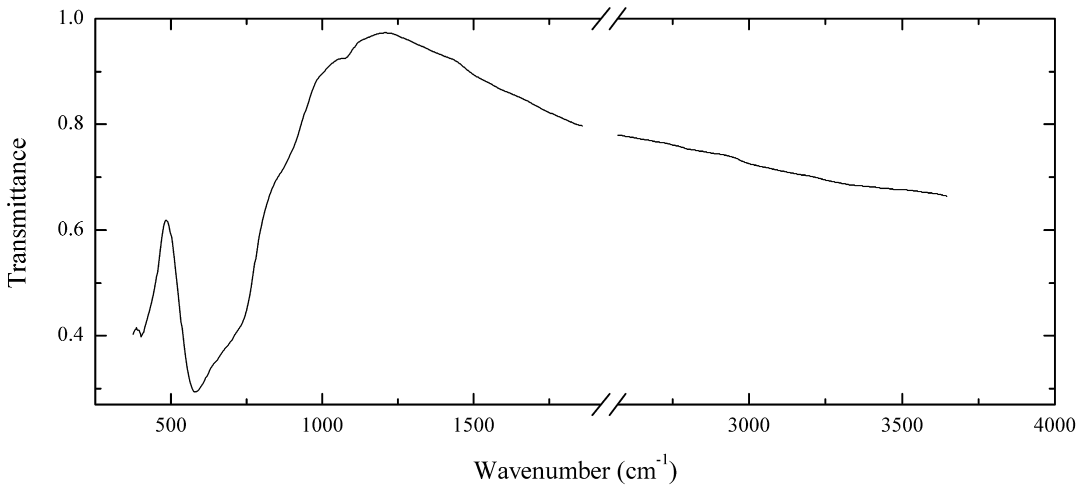
Wavenumbers (cm^{-1}): 1089w, 680sh, 630sh, 567s, 424, 410sh.

O112 "Microlite" $(Ca,Na,H_2O,H_3O)_2Ta_2O_6(OH,F,O)$



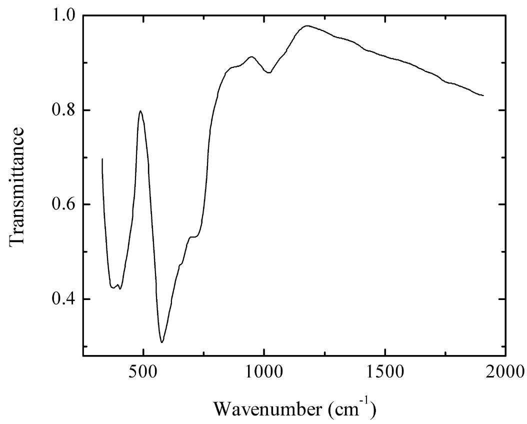
Locality: Orlovka, Transbaikal area, Eastern Siberia Region, Russia.
Description: Brown crystal. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3300w, 2930sh, 1065w, 1005w, 850sh, 635s.

O113 "Microlite" $(Ca,Na)_2Ta_2O_6(F,O,OH)$



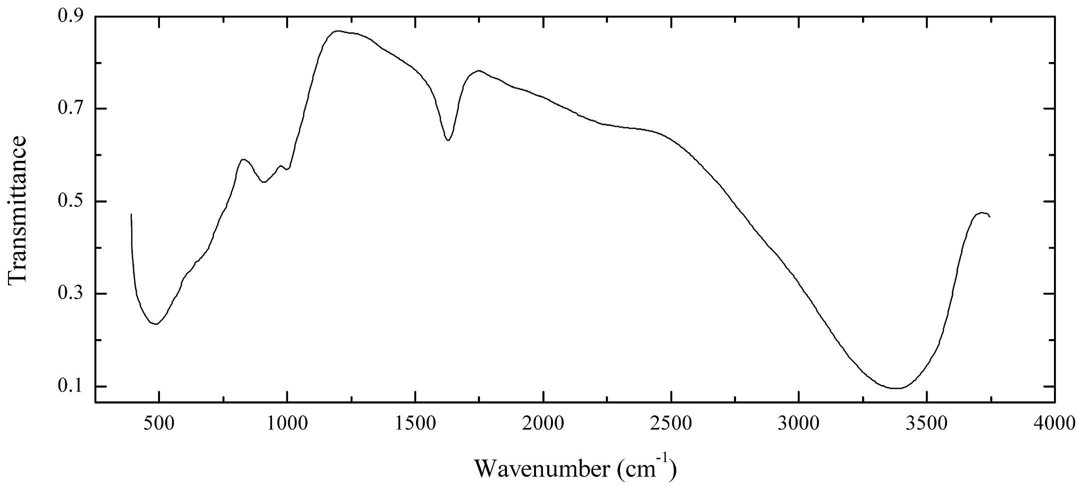
Locality: Alto Ligonha district, Zambezia province, Mozambique.
Description: Brown crystal. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1080w, 905sh, 730sh, 680sh, 577s, 401s.

O114 Hydroxynatromicrolite $(Na,Ca,Bi)_2Ta_2O_6(OH)$



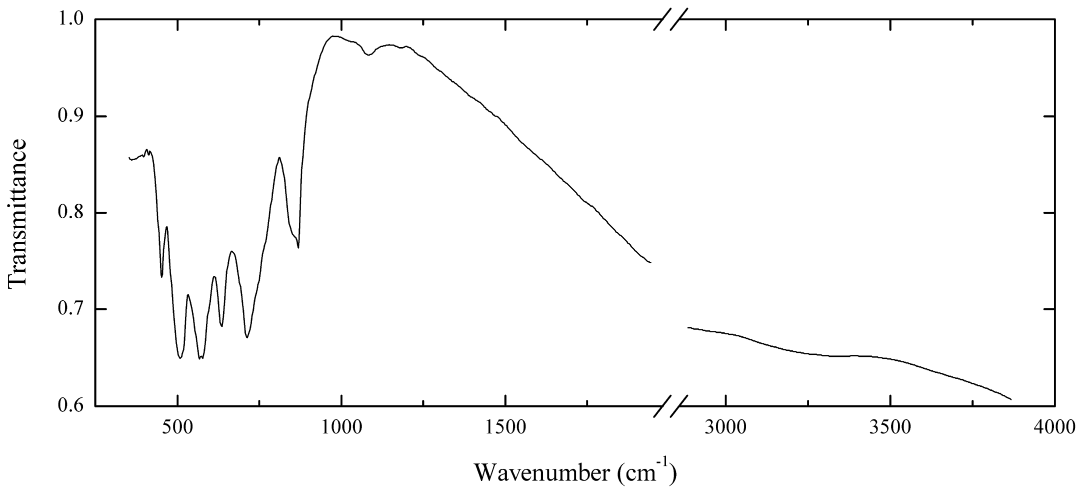
Locality: An unknown locality in China.
Description: Green grain from pegmatite. Confirmed by electron microprobe analysis. Bi-bearing variety. The empirical formula is $(Na_{0.95}Ca_{0.88}Bi_{0.14}Ce_{0.02}K_{0.02})(Ta_{1.93}Nb_{0.06}Fe_{0.01})(O,OH)_7$.
Wavenumbers (cm^{-1}): 1015w, 880sh, 715, 660sh, 578s, 405s, 375s.

O115 Manganbelyankinite $(Mn^{2+},Ca)(Ti,Nb)_5(O,OH)_{12}\cdot 9H_2O$ (?)



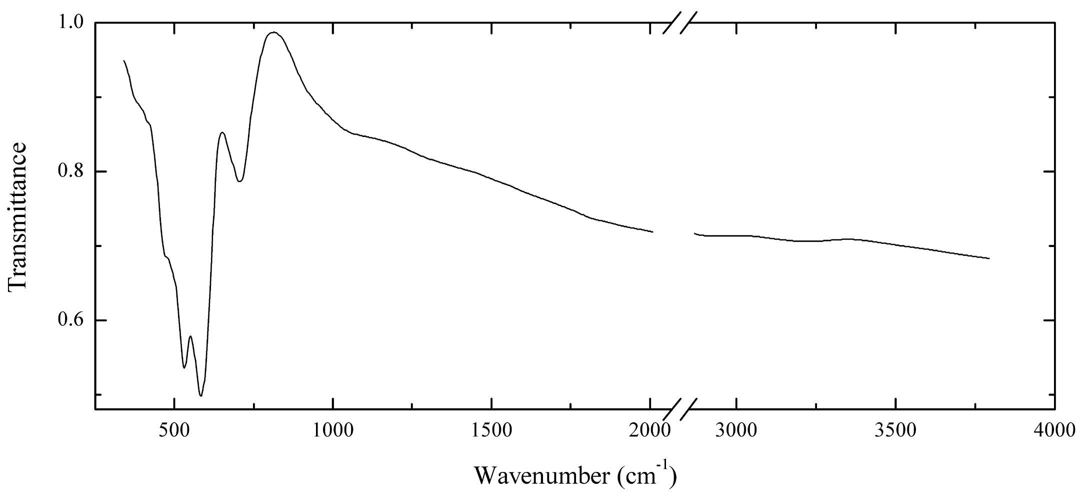
Locality: Pegmatite No. 31, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: Brown pseudomorph after platy lomonosovite crystal. Associated minerals are aegirine, eudialyte, microcline, natrolite and rhabdophane-(Ce). The empirical formula is (electron microprobe) $(Mn_{0.67}Ca_{0.59})(Ti_{4.25}Nb_{0.44}Si_{0.31})(O,OH)_x\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3475sh, 3350s, 1633, 1004, 913, 750sh, 670sh, 580sh, 490s.

O116 Tantalite-(Mn) $Mn^{2+}Ta_2O_6$



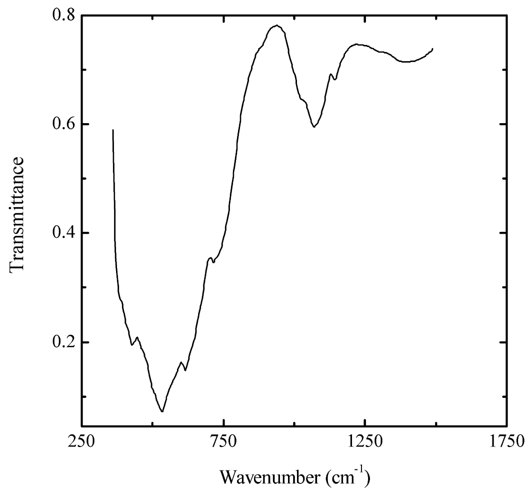
Locality: Alto do Giz pegmatite, Equador, Rio Grande do Norte, Brazil.
Description: Light brown from the association with calciotantite. The empirical formula is (electron microprobe) $(Mn_{0.87}Fe_{0.09}Ca_{0.02})(Ta_{0.99}Nb_{0.02})O_6$.
Wavenumbers (cm^{-1}): 870, 860sh, 760sh, 720s, 636s, 571s, 511s, 455.

O117 Manjiroite $(Na,K)(Mn^{4+}{}_7Mn^{3+})O_{12}{\cdot}nH_2O$ (?)



Locality: Kohare mine, Iwate prefecture, Japan (type locality).
Description: Black massive.
Wavenumbers (cm^{-1}): 704, 585s, 534s, 475sh, 415sh.

O118 Landauite $(Na,Pb)(Mn^{2+},Y)(Zn,Fe)_2(Ti,Fe^{3+},Nb)_{18}O_{38}(O,OH,F)$

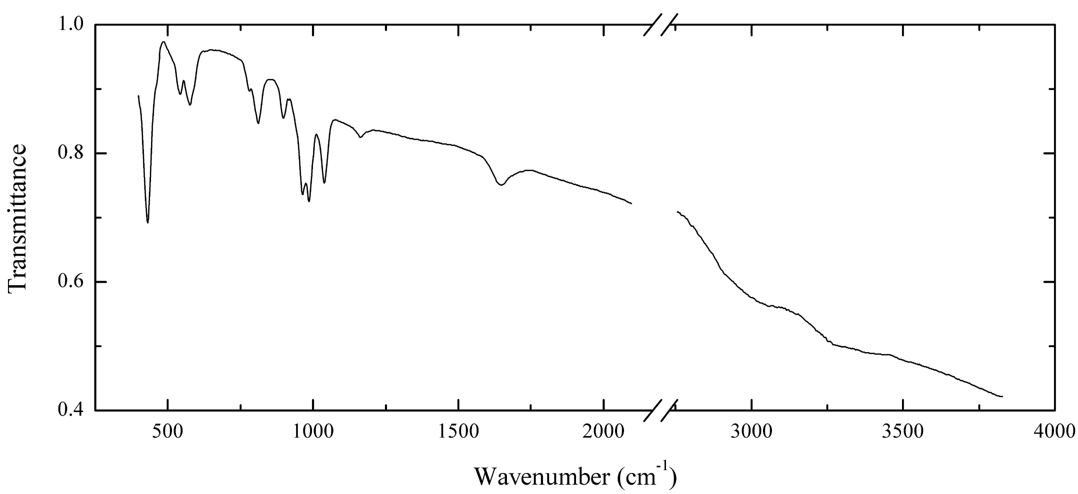


Locality: Burpala alkaline complex, North Baikal area, Siberia, Russia (type locality).

Description: Coarse black crystals from the association with albite and monazite. The empirical formula is (electron microprobe) $(Na_{0.7}Pb_{0.2}Ca_{0.1})Mn_{1.3}Zn_{1.9}Fe_{2.3}Ti_{15.5}(O,OH,F)_{39}$.

Wavenumbers (cm^{-1}): 1154w, 1078w, 1035sh, 725, 618s, 534s, 433.

O119 Lenoblite $VO_2{\cdot}H_2O$

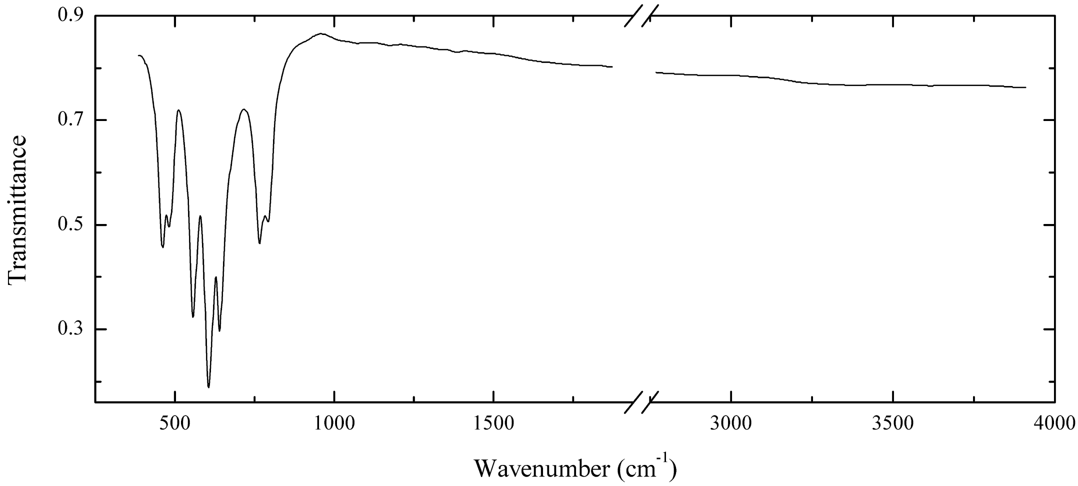


Locality: Borehole number 70, Novyi district, Altyntau ore field, Uchkuduk, Kyzylkum desert, Uzbekistan.

Description: Lilac-grey fibrous aggregate. Identified by powder X-ray diffraction pattern.

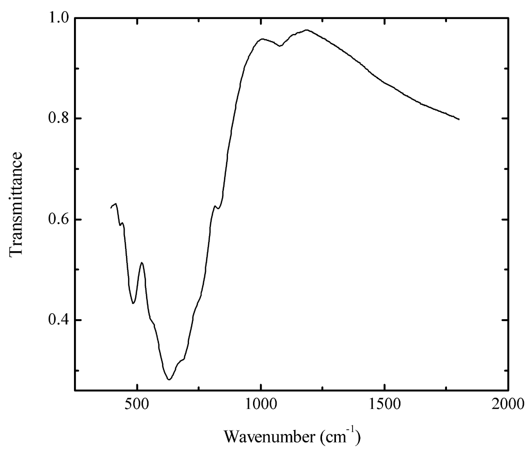
Wavenumbers (cm^{-1}): 3270, 3030, 1645, 1165w, 1041, 988s, 965s, 897, 815, 783w, 578, 547, 520sh, 434s.

O120 Leiteite $ZnAs^{3+}{}_2O_4$



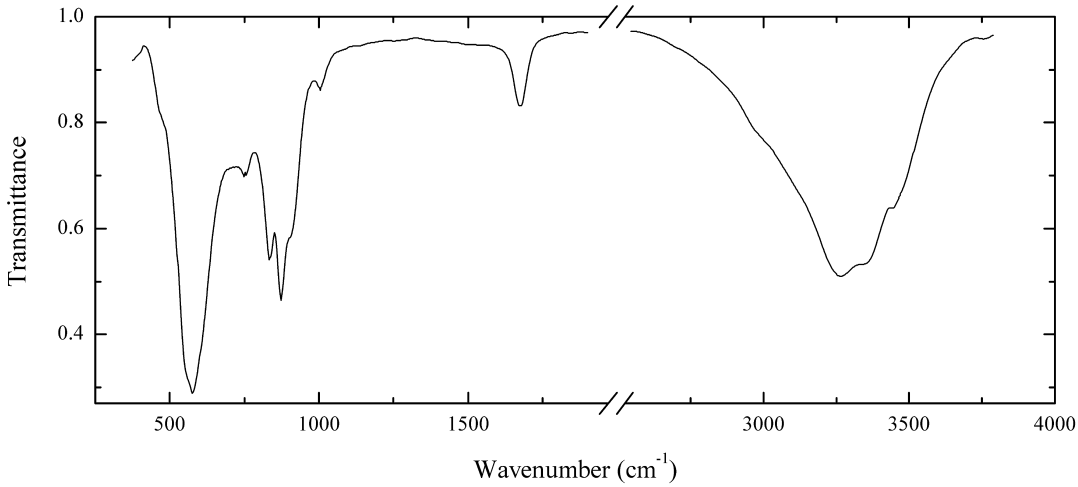
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: White flexible talc-like plates. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 793, 765, 641s, 605s, 556s, 462, 460.

O121 Lithiowodginite $LiTa_3O_8$



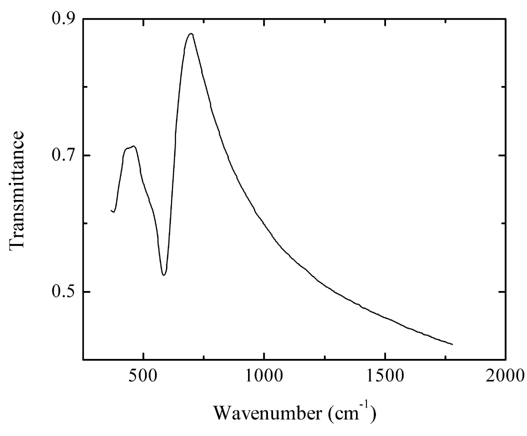
Locality: Bakennoe deposit, Ognyovka, Eastern Kazakhstan (type locality?).
Description: Pinkish-brown grains from pegmatite. Associated minerals are wodginite, ixiolite and albite. The empirical formula is (electron microprobe) $(Li_xMn_{0.23}Fe_{0.03})(Ta_{2.60}Nb_{0.18}Sn_{0.18}Ti_{0.04})O_8$.
Wavenumbers (cm^{-1}): 1084w, 825, 740sh, 680sh, 625s, 555sh, 479, 425.

O122 Niobate O122 $MgNb_4O_5(OH)_{12}\cdot 9H_2O$ (?)



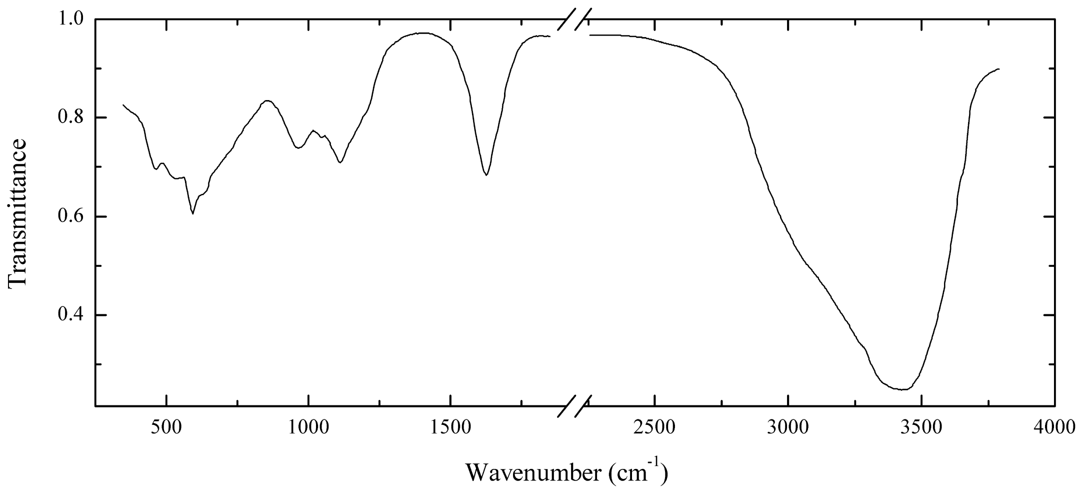
Locality: Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: White fibrous. Related to ternovite. Insufficiently investigated mineral.
Wavenumbers (cm^{-1}): 3445, 3336s, 3254s, 2975sh, 1685sh, 1669, 1002w, 900sh, 870s, 832, 747, 570s, 550sh.

O123 Magnetite $Fe^{2+}Fe^{3+}{}_2O_4$



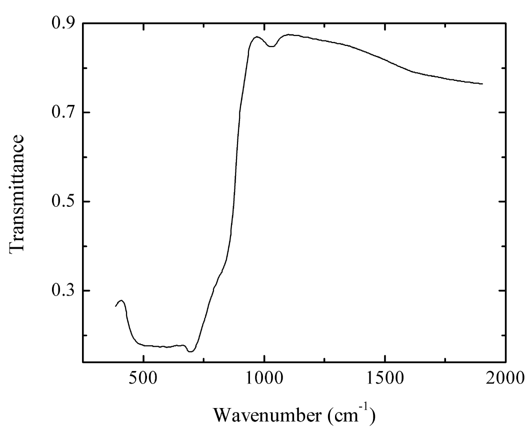
Locality: Synthetic.
Description: Ti-bearing. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Fe_{2.7}Ti_{0.3}O_4$. Homogeneous.
Wavenumbers (cm^{-1}): 585s, 530sh, 453w.

O124 Lesukite $Al_2(OH)_5Cl{\cdot}2H_2O$



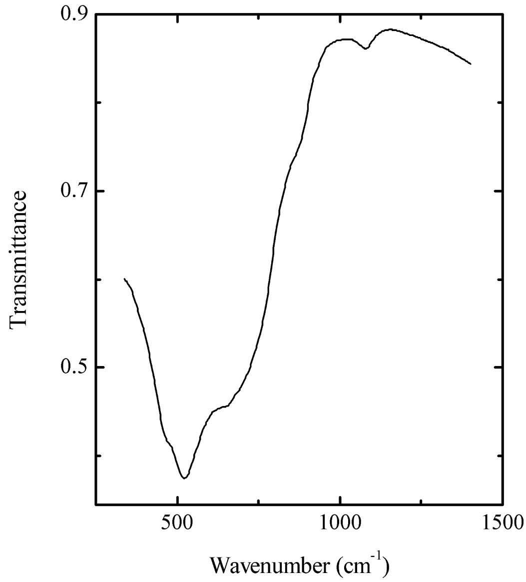
Locality: Northern Break of the Large Fissure Tolbachik Eruption (1975–1976), Tolbachik volcano, Kamchatka peninsula, Russia (type locality).
Description: Yellow-orange, massive. Holotype sample. Cubic, space group $Im3m$, a = 19.878(1)Å. The empirical formula is $(Al_{1.78}Fe_{0.22})(OH)_{4.44}Cl_{1.56}{\cdot}3.04H_2O$. Optically isotropic, n = 1.53-1.55. D = 1.91 g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 9.94 (20), 8.11 (70), 7.03 (50), 4.47 (60), 3.23 (70), 2.706 (100), 2.446 (80), 1.957 (70).
Wavenumbers (cm^{-1}): 3660sh, 3420s, 3250sh, 3080sh, 1630s, 1200sh, 1114, 1045, 969, 770sh, 710sh, 630sh, 590s, 523, 465.

O125 Columbite-(Mn) $(Mn^{2+},Fe^{2+})(Nb,Ta)_2O_6$



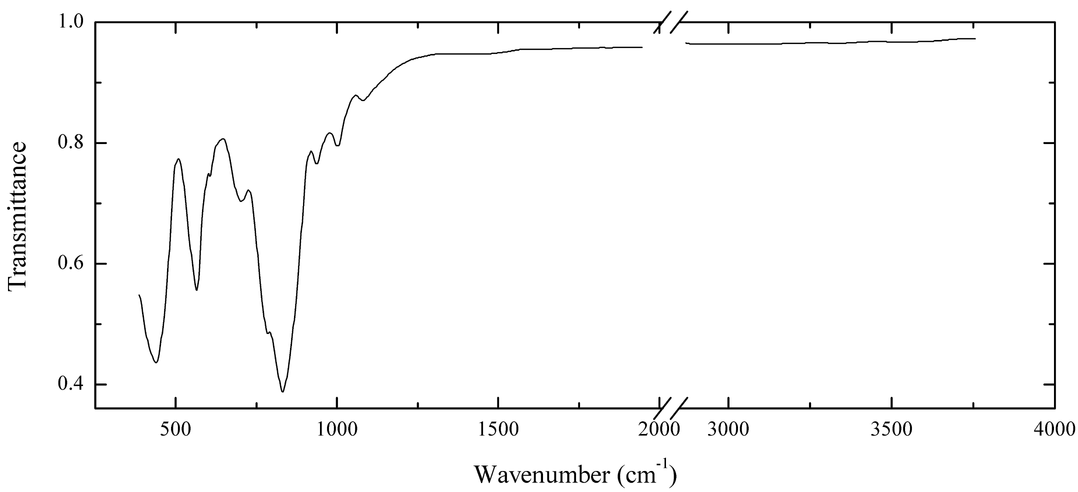
Locality: Bakennoe deposit, Ognyovka, Eastern Kazakhstan.
Description: Black crystal from granitic pegmatite. The empirical formula is (electron microprobe) $(Mn_{0.71}Fe_{0.29})(Nb_{1.69}Ta_{0.26}Ti_{0.05})O_6$.
Wavenumbers (cm^{-1}): 1030w, 830sh, 695s, 600s, 550s, 510sh.

O127 Murataite-(Y) $(Y,Na)_6Zn(Zn,Fe^{3+})_4(Ti,Nb)_{12}O_{29}(O,F,OH)_{10}F_4$



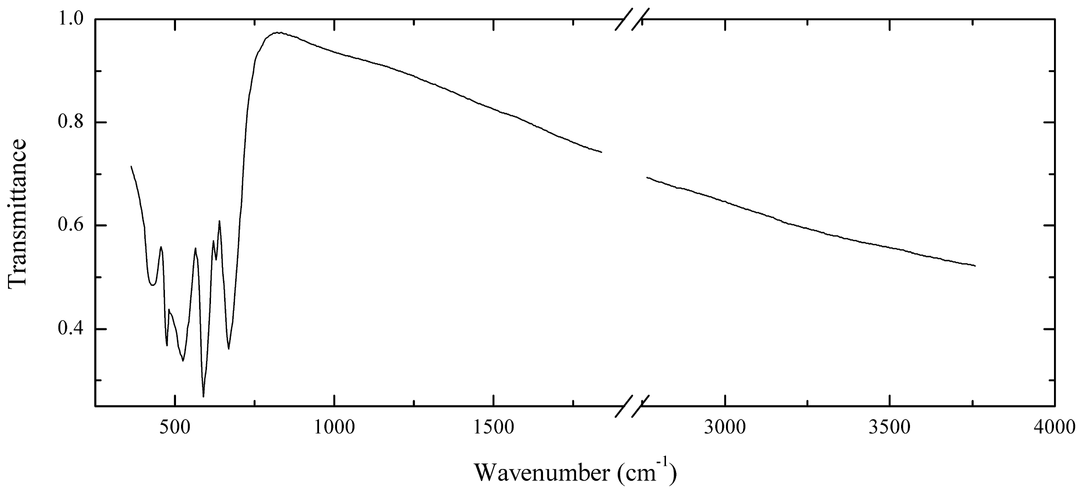
Locality: Synthetic.
Description: Investigated by N.I. Organova.
Wavenumbers (cm^{-1}): 1085w, 860sh, 720sh, 650sh, 522s, 470sh.

O128 Brearleyite $Ca_{12}Al_{14}O_{32}Cl_2$



Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.
Description: Yellow-green massive from the association with cuspidine and melilite. Technogenetic. The empirical formula is $Ca_{12.25}Mg_{0.23}Al_{12.88}Fe^{3+}{}_{1.12}(SiO_4)_{0.21}O_{31.68}Cl_{2.77}(O,OH)_x$.
Wavenumbers (cm^{-1}): 1078w, 1004, 940, 831s, 784s, 700, 606, 561s, 442s.

O129 Marokite $CaMn^{3+}{}_2O_4$

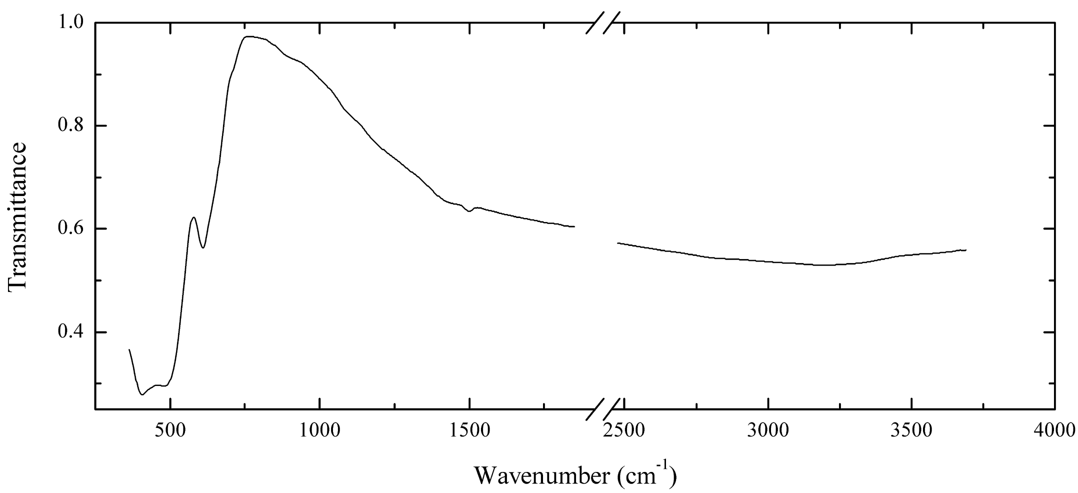


Locality: Dump of vein No. 2, Tashgagalt, 17 km SE of Ouarzazate, Ouarzazate province, Morocco (type locality).

Description: Black crystal from the association with braunite and hausmannite. Streak is brownish-red. The empirical formula is (electron microprobe) $Ca_{0.98}Mg_{0.01}Fe_{0.01}Mn_{2.00}O_4$.

Wavenumbers (cm^{-1}): 685sh, 668s, 627, 600sh, 587s, 523s, 472s, 431.

O130 Manganosite $Mn^{2+}O$

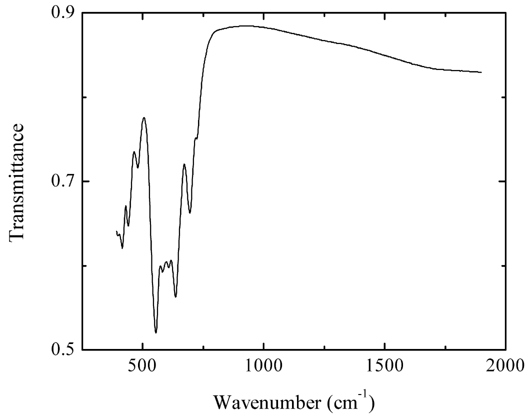


Locality: Nordmark deposit, Filipstad district, Värmland, Sweden.

Description: Green grains from the association with dolomite and hausmannite.

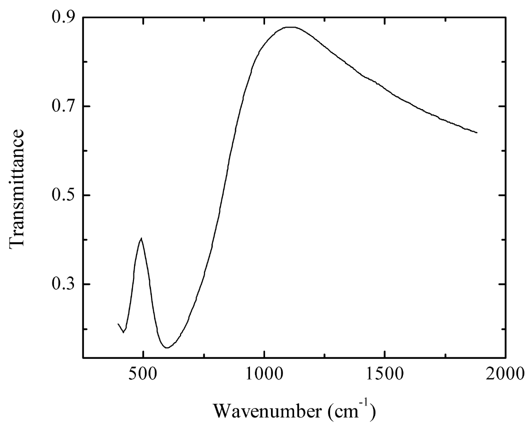
Wavenumbers (cm^{-1}): 1493w, 609, 494s, 405s.

O131 Maghemite Fe_2O_3



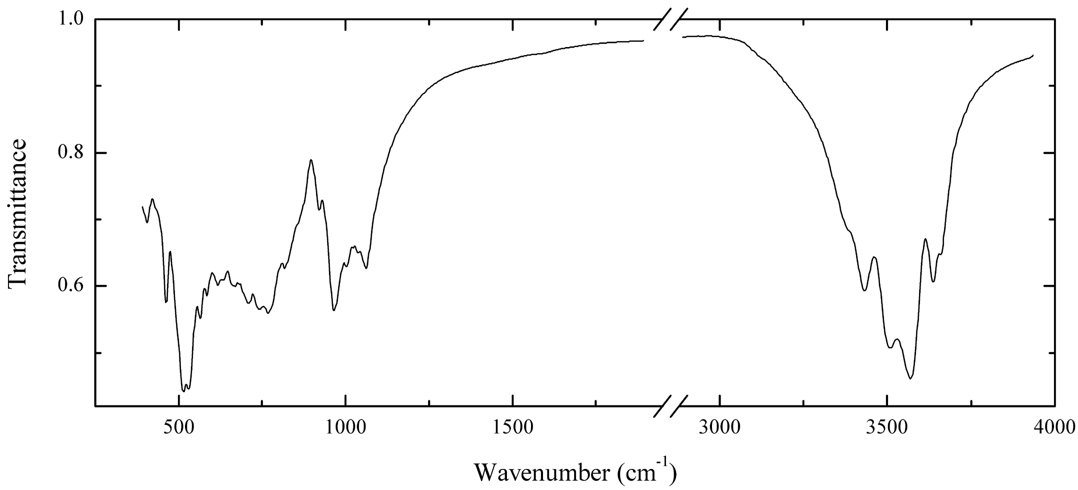
Locality: Synthetic γ-Fe_2O_3.
Description: Brown fine powder. Specific surface area is 25 m^2/g. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 722w, 693, 635s, 608, 585, 552s, 479w, 438, 417, 400.

O132 Loparite-(Ce) (Na,Ce,Ca,Sr,Th)(Ti,Nb)O_3



Locality: Railway station Khibiny, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: Black twin from alkaline pegmatite. Partly metamict. The empirical formula is (electron microprobe) $(Na_{0.44}Ce_{0.20}La_{0.16}Nd_{0.03}Ca_{0.09}Sr_{0.05}Th_{0.01})(Ti_{0.87}Nb_{0.11}Fe_{0.02})O_3$.
Wavenumbers (cm^{-1}): 680sh, 609s, 410s.

O133 Nordstrandite $Al(OH)_3$

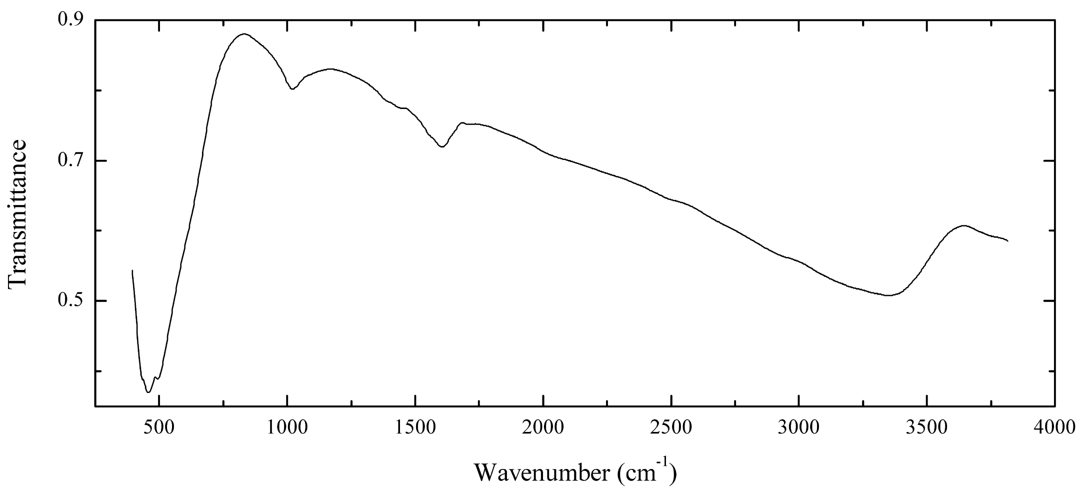


Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Aggregate of snow-white scaly crystals from the association with natrolite and hilairite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3660, 3625, 3555s, 3500s, 3430, 3380sh, 1060, 1035sh, 1003, 966s, 917, 815, 766s, 740sh, 707, 668, 630, 612, 585, 564s, 527s, 511s, 458, 405.

O134 Takanelite $Mn^{2+}Mn^{4+}{}_4O_9{\cdot}3H_2O$

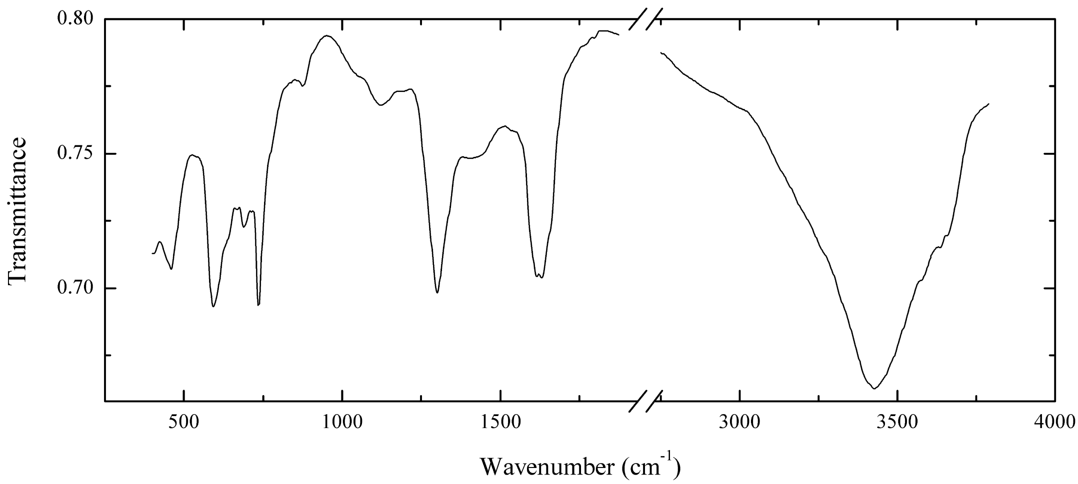


Locality: Bautzen, eastern Saxony, Germany.

Description: Black massive. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $(Mn_{0.76}Ca_{0.14}Fe_{0.05}K_{0.05})Mn_4O_9{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3350, 1610w, 1015w, 610sh, 496s, 457s, 440sh.

O135 Nepskoeite $[Mg_4Cl(OH)_7 \cdot 6H_2O]$

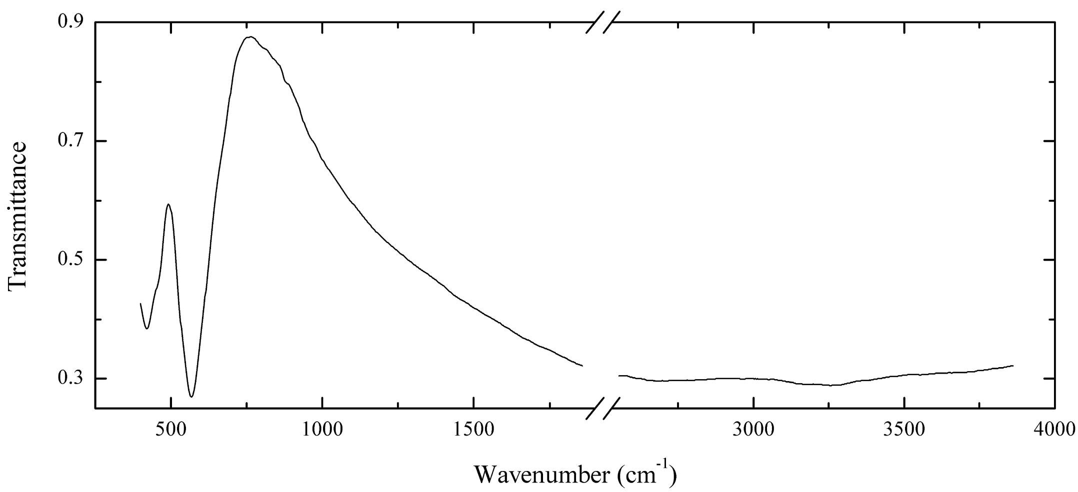


Locality: Asia Nepskoe salt deposit, Nepa river basin, Lower Tunguska, Eastern Siberia, Russia (type locality).

Description: Yellowish nodule from the association with anhydrite and halite. Nepskoeite was erroneously described as a new chloride-hydroxide mineral. Really its powder X-ray diffraction pattern, IR spectrum and other physical properties correspond to borate mineral shabynite, $Mg_5(BO_3)(Cl,OH)_2(OH)_5 \cdot 4H_2O$. Nepskoeite shows colour reaction on boron with quinalizarine.

Wavenumbers (cm^{-1}): 3665w, 3640w, 3580w, 3410s, 1634s, 1380sh, 1301s, 880, 734s, 692, 594, 455.

O136 Plumboferrite $Pb_2(Mn^{2+},Mg)_{0.33}Fe^{3+}{}_{10.67}O_{18.33}$

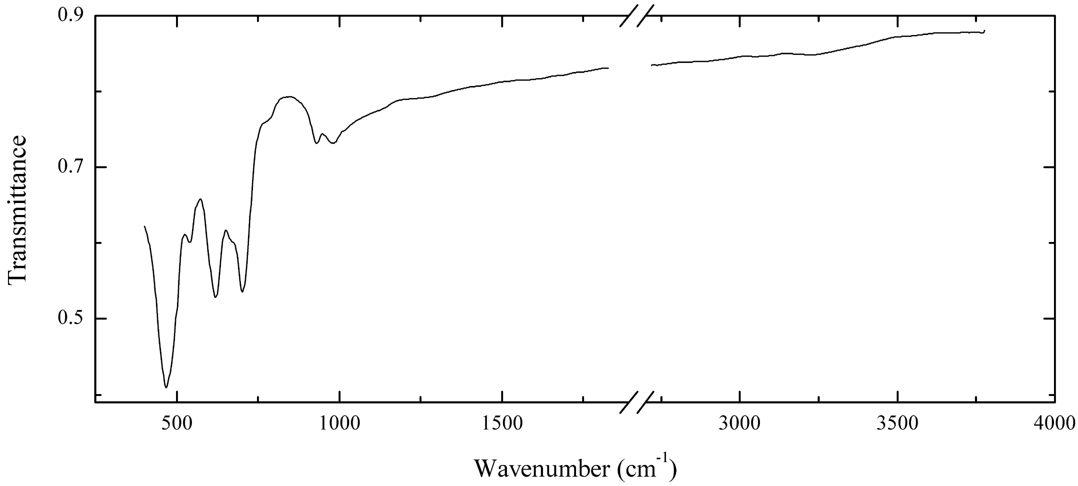


Locality: Jakobsberg, Filipstad, Värmland, Sweden (type locality).

Description: Black tabular crystal from the association with jacobsite and hematite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 565s, 450sh, 405.

O137 Onoratoite $Sb_8O_{11}Cl_2$

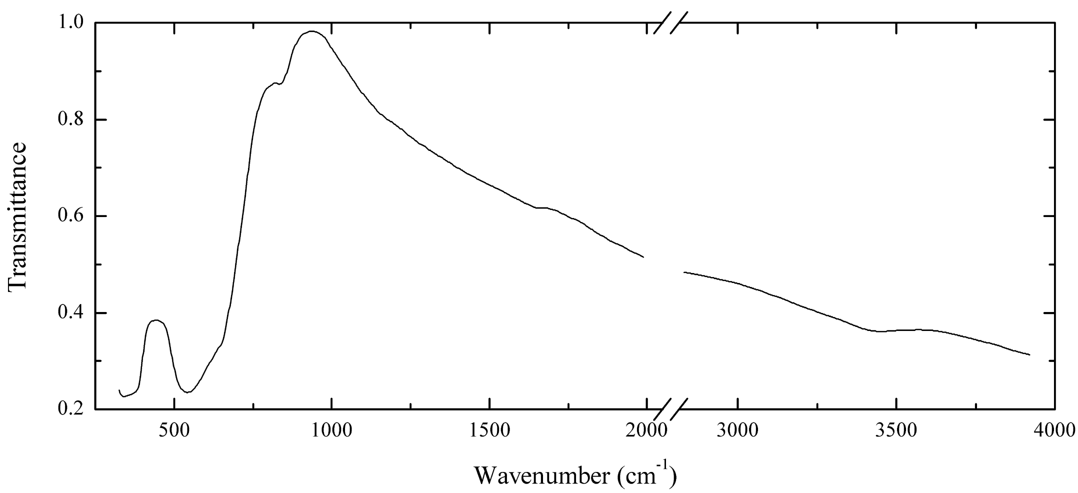


Locality: Cetine de Cotorniano mine, Rosia, Siena, Tuscany, Italy (type locality).

Description: Cluster of white acicular crystals from the association with stibnite, cetineite, klebelsbergite and quartz. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 983w, 929w, 775sh, 701, 665sh, 619, 539, 470s.

O138 Plumbomicrolite $(Pb,\square)_2Ta_2O_6(OH)$

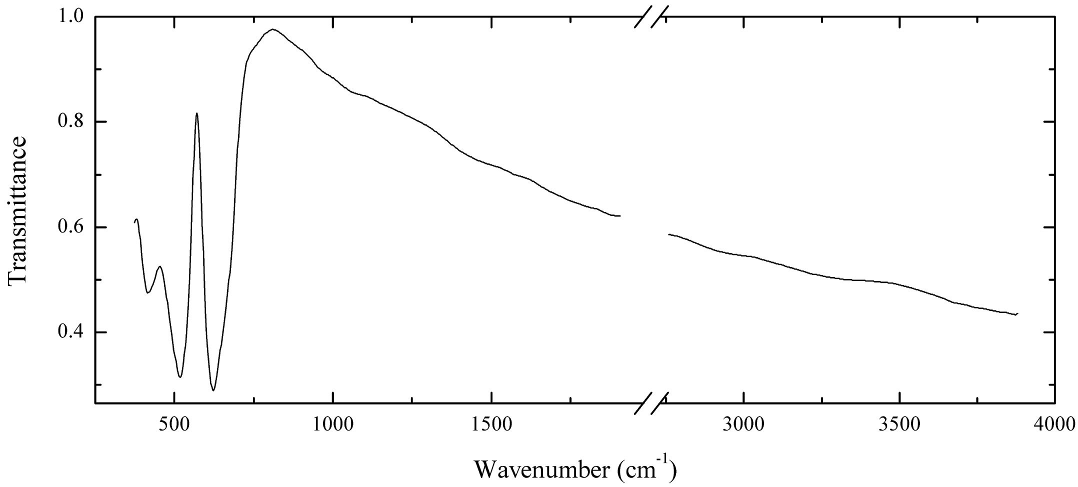


Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: Brown octahedral crystal from amazonite pegmatite. The empirical formula is (electron microprobe) $(Pb_{1.52}Sn^{2+}_{0.11}U^{4+}_{0.03})(Ta_{0.97}Nb_{0.67}Ti_{0.18}Fe_{0.13}W_{0.05})O_6(OH,F)\cdot nH_2O$. Plumbomicrolite has been discredited, but the existence of this specimen shows that it is a valid mineral species.

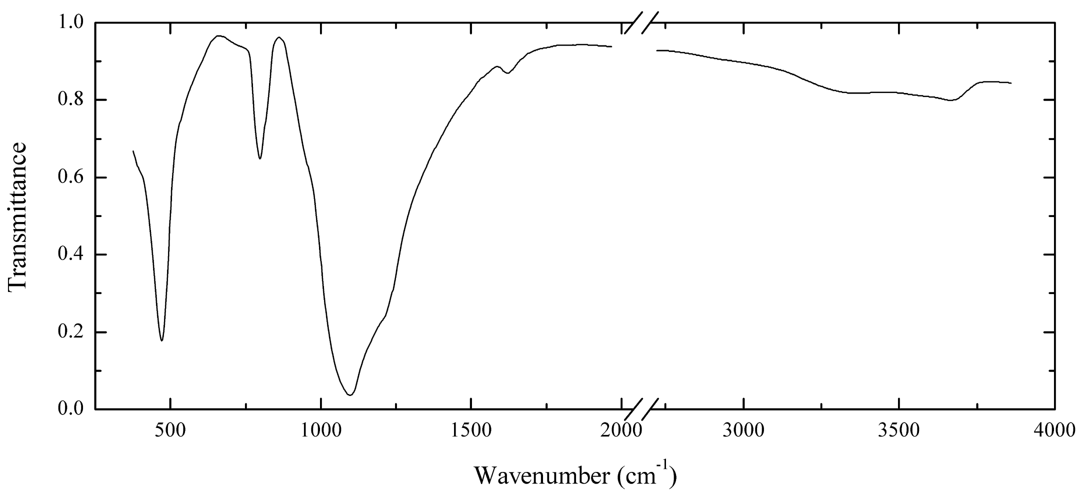
Wavenumbers (cm^{-1}): 3420w, 1650w, 840w, 630sh, 542s, 375sh, 348s.

O139 Hausmannite $Mn^{2+}Mn^{3+}{}_2O_4$



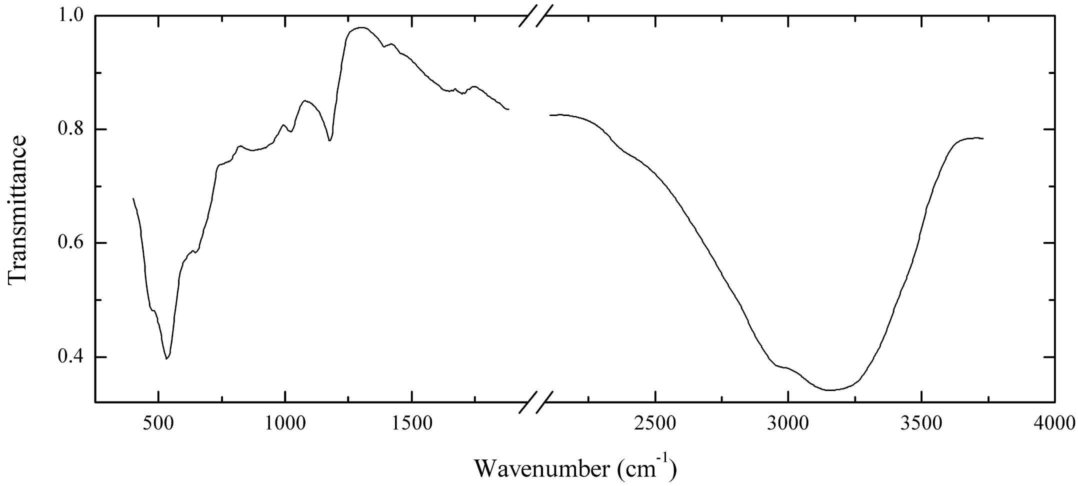
Locality: Långban deposit, Bergslagen ore region, Filipstad, Värmland, Sweden.
Description: Black isometric crystals from the association with barytocalcite and brucite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Mn_{2.64}Zn_{0.17}Fe_{0.16}Al_{0.03}O_4$.
Wavenumbers (cm^{-1}): 1080w, 980sh, 617s, 514s, 417.

O140 Opal $SiO_2{\cdot}nH_2O$



Locality: Valeč, Karlovy Vary region, Bohemia, Czech Republic.
Description: Colourless, botryoidal (hyalite).
Wavenumbers (cm^{-1}): 3570w, 3350w, 1628w, 1200sh, 1103s, 1060sh, 940sh, 798, 700sh, 570sh, 470.

O141 Natanite $Fe^{2+}Sn(OH)_6$

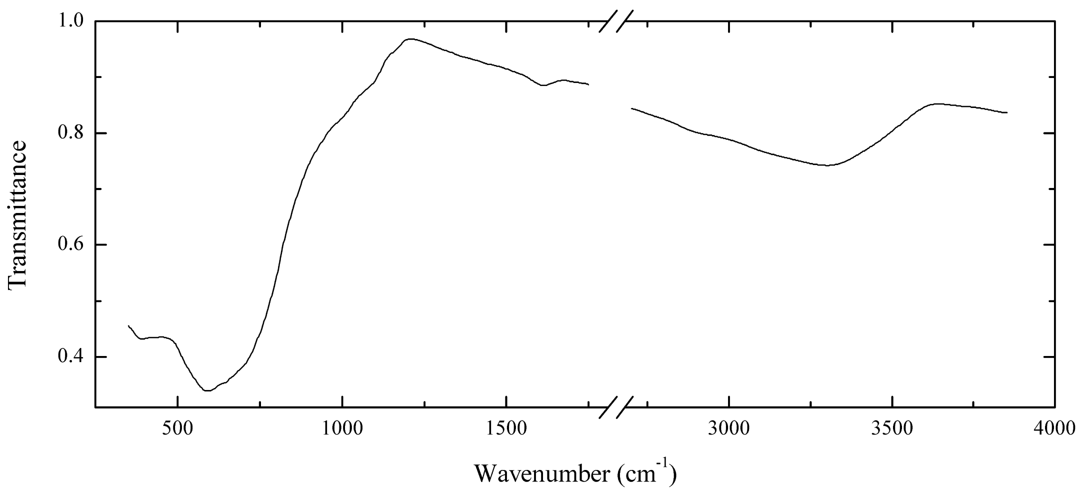


Locality: Mushiston Sn deposit, Kaznok valley, Penjikent, Zeravshan range, Tajikistan (type locality).

Description: Greenish-brown pseudomorph after stannite or kësterite. Identified by powder X-ray diffraction pattern, IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $Fe_{0.6}Cu_{0.25}Zn_{0.15}Sn_{1.0}(OH)_6$.

Wavenumbers (cm^{-1}): 3140s, 2945s, 2390sh, 1700w, 1650w, 1395w, 1174, 1022, 870, 780sh, 641, 534s, 472s.

O142 Natroniobite $NaNb_2O_5(OH)$ (?)

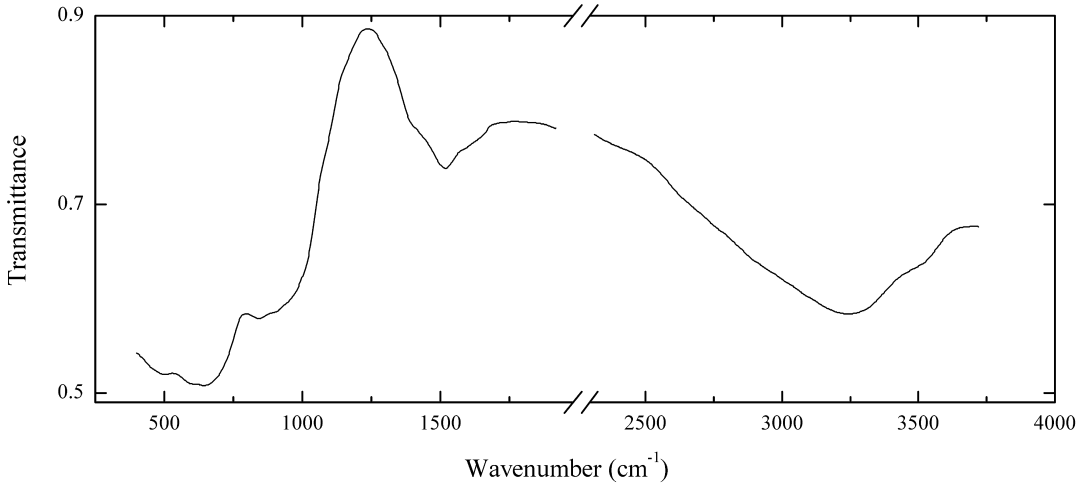


Locality: Lesnaya Varaka, near Khabozero, Kola peninsula, Murnansk region, Russia (type locality).

Description: Honey-yellow grains from the association with dolomite and phlogopite. The empirical formula is (electron microprobe) $(Na_{0.7}Ca_{0.6})(Nb_{1.9}Ti_{0.1})(O,OH)_6$.

Wavenumbers (cm^{-1}): 3290, 2900sh, 1625w, 1100sh, 690sh, 596s, 413.

O143 Polycrase-(Y) (Y,Ca,Ce,U,Th)(Ti,Nb,Ta)$_2$O$_6$

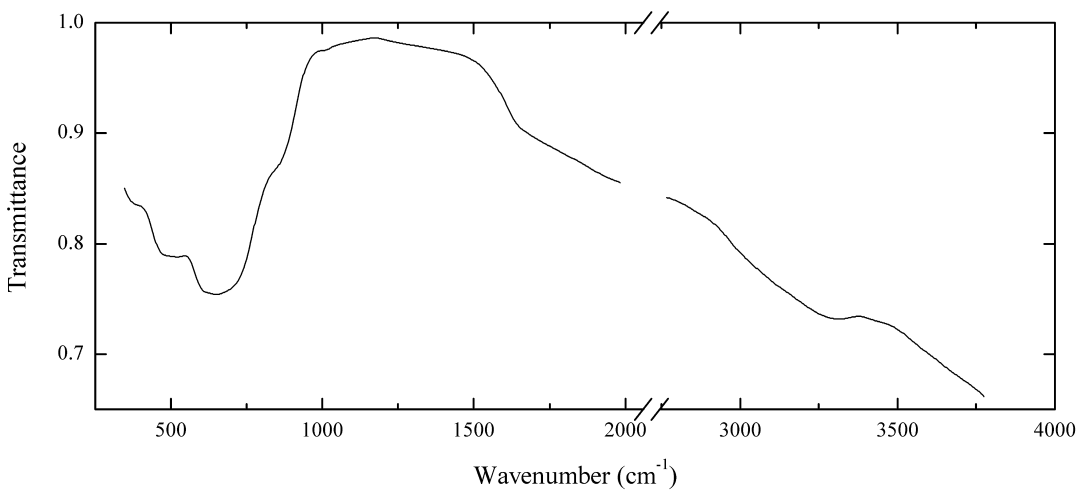


Locality: Flakaberget, Jokkmokk, Lappland, Sweden.

Description: Dark brown grains from the association with microcline, quartz and allanite-(Y). Metamict, amorphous. The empirical formula is (electron microprobe) $(Y_{0.42}Ca_{0.25}Ce_{0.05}La_{0.04}Dy_{0.04}Nd_{0.03}Gd_{0.03}U_{0.04}Th_{0.03})(T_{1.45}Nb_{0.31}Fe_{0.17}Ta_{0.07})\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3480w, 3240, 1620sh, 1520, 1400sh, 960sh, 850, 645s, 490.

O144 Oxycalciopyrochlore (Ca,Na,U)$_2$Nb$_2$O$_6$O

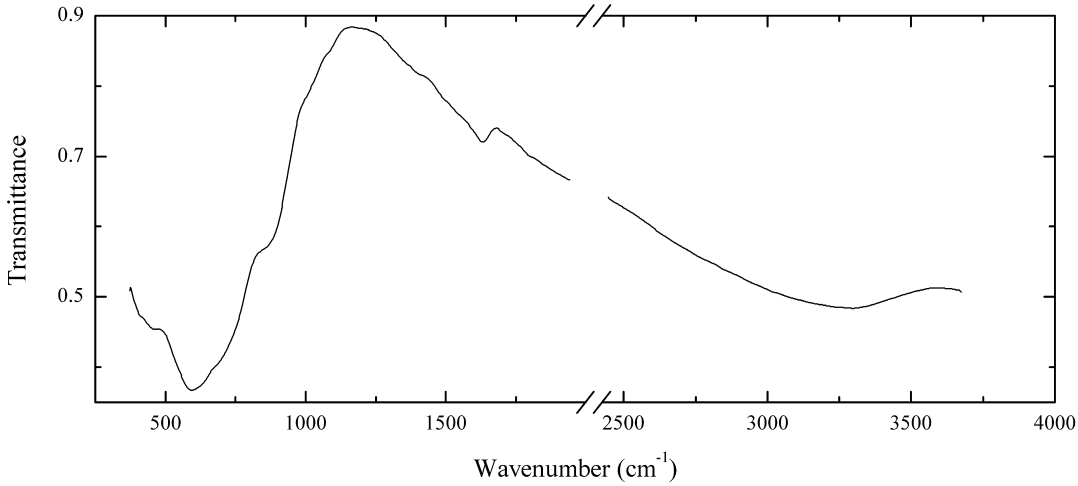


Locality: Bjørkedalen, Porsgrunn, Telemark, Norway.

Description: Brown grain from pegmatite. The empirical formula is (electron microprobe) $(Ca_{0.90}Na_{0.82}U^{4+}{}_{0.16}Ce_{0.09}Nd_{0.02}Th_{0.02}Pb_{0.01})(Nb_{1.32}Ti_{0.60}Ta_{0.08})O_{6.71}(OH,F)_{0.29}$. Oxycalciopyrochlore has been discredited, but the existence of this specimen shows that it is probably a valid mineral species.

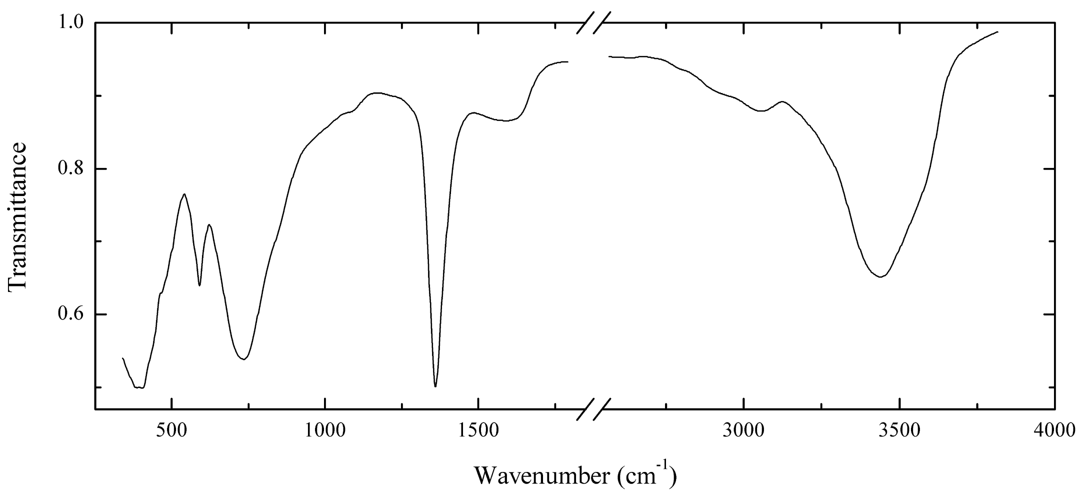
Wavenumbers (cm^{-1}): 850sh, 650s, 610sh, 465, 390.

O145 Hydroxycalciopyrochlore $(Ca,Na,H_2O)_2Nb_2O_6(OH)$



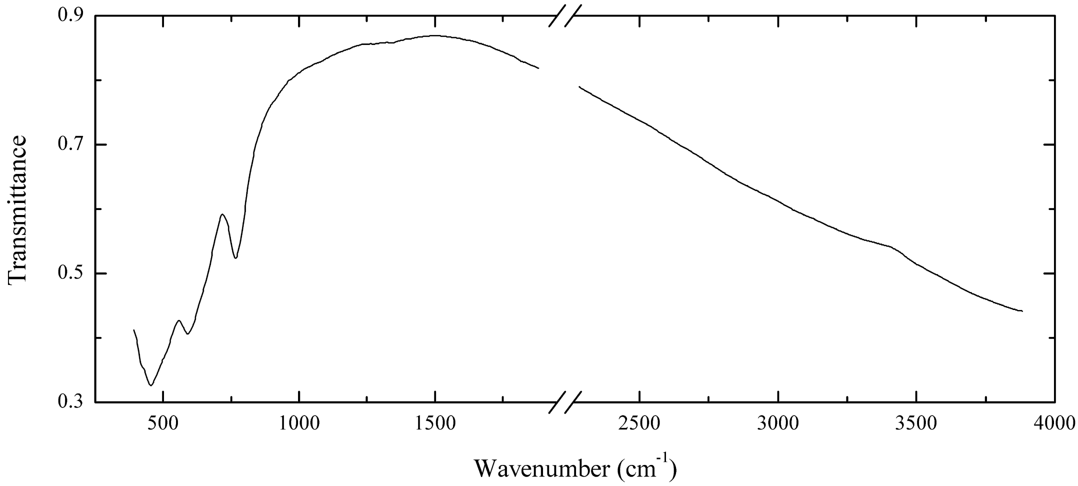
Locality: Vishnevye Mts., Chelyabinsk region, South Urals, Russia.
Description: Brown crystal from alkaline pegmatite. The empirical formula is (electron microprobe) $(Ca_{1.08}Na_{0.67}U^{4+}{}_{0.03}Ce_{0.03}La_{0.02})(Nb_{1.74}Ti_{0.21}Ta_{0.05})O_{6.00}(OH)_{0.89}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3270, 1630, 860sh, 750sh, 675sh, 630sh, 599s, 461, 403.

O146 Pyroaurite $Mg_6Fe^{3+}{}_2(CO_3)(OH)_{16}\cdot 4H_2O$



Locality: Kraubath, Leoben, Styria, Austria.
Description: Brown platelets. Identified by IR spectrum and electron microprobe analysis. Mn-rich variety. The empirical formula is $(Mg_{5.2}Fe^{2+}{}_{0.8})(Fe^{3+}{}_{1.2}Mn^{3+}{}_{0.8})(CO_3)(OH)_{16}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3445s, 3060w, 2950sh, 1600w, 1360s, 731s, 695sh, 589, 465sh, 420sh, 387s.

O147 Priderite $(K,Ba)_x(Ti,Fe)_8O_{16}$

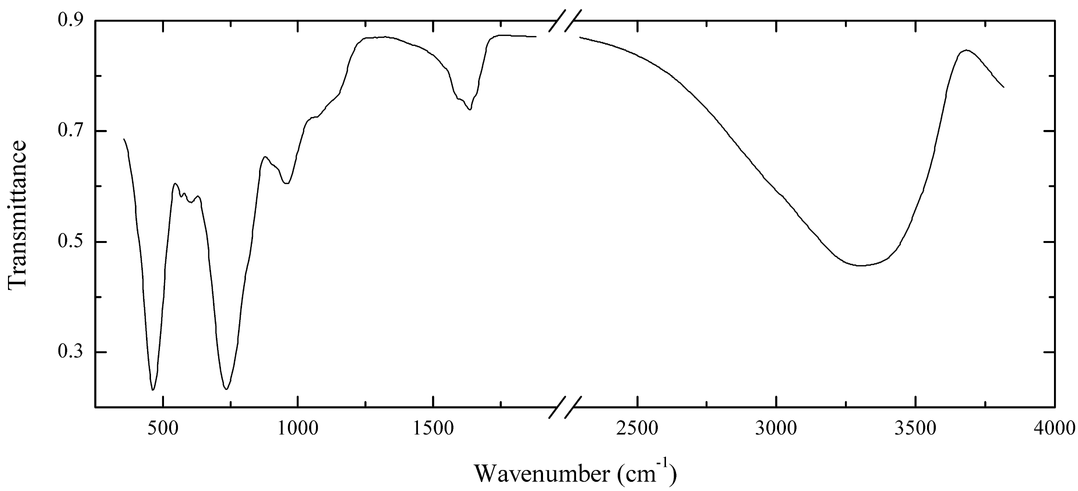


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Black crystals from the association with natrolite, titanite and ilmenite. Identified by IR spectrum and electron microprobe analysis. The crystals contains Ba-dominant zones corresponding to henrymeyerite. The mean empirical formula is $(K_{1.1}Ba_{0.2})(Ti_{7.2}Fe_{0.7}Nb_{0.1})(O,OH)_{16}$.

Wavenumbers (cm^{-1}): 772, 590, 461s, 420sh.

O148 Partzite $(Cu^{2+},H_2O)_2Sb^{5+}{}_2O_6(OH,O)$

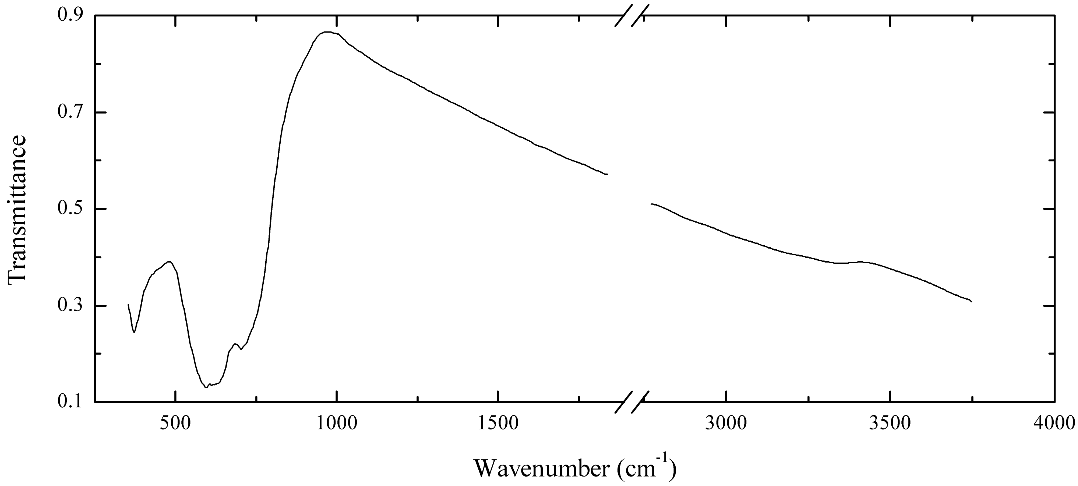


Locality: Tereksai deposit, Jalalabad region, Kyrgyzstan.

Description: Green pseudomorph after chalcostibite. Identified by IR spectrum and qualitative electron microprobe analysis. A questionable and insufficiently investigated mineral. Discredited by the IMA CNMNC.

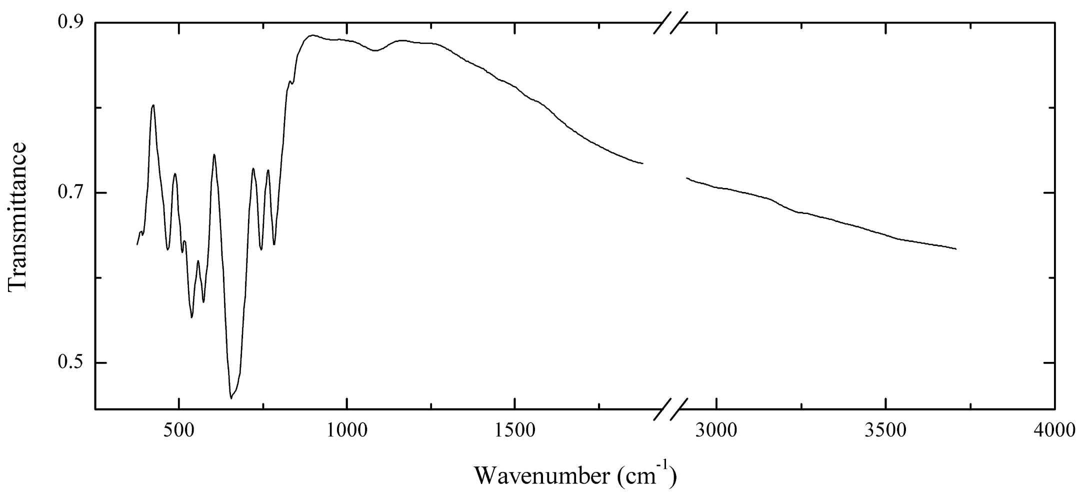
Wavenumbers (cm^{-1}): 3520sh, 3300s, 1660sh, 1640, 1600sh, 1165sh, 1080sh, 960, 910sh, 810sh, 732s, 604, 569, 462s.

O149 Stibiocolumbite $SbNbO_4$



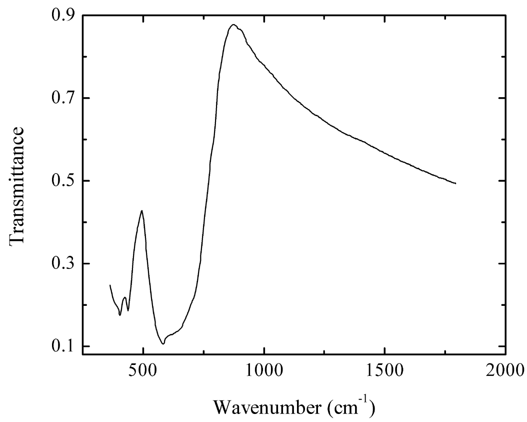
Locality: Little Three mine, Ramona, Ramona district, San Diego Co., California, USA.
Description: Brown crystal from granitic pegmatite. The empirical formula is (electron microprobe) $(Sb_{0.76}Bi_{0.20}Sr_{0.05})(Nb_{0.76}Ta_{0.23}Ti_{0.02})O_4$.
Wavenumbers (cm^{-1}): 708, 620sh, 590s, 370.

O150 Stenhuggarite $CaFe^{3+}(As^{3+}O_2)(As^{3+}Sb^{3+}O_5)$



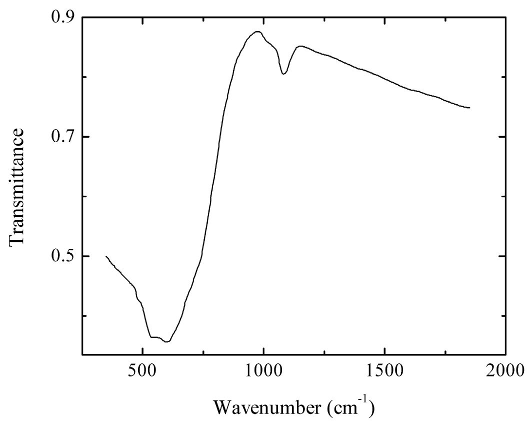
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).
Description: Orange grains from the association with hematite.
Wavenumbers (cm^{-1}): 836w, 781, 742, 675sh, 656s, 580sh, 568s, 532s, 503, 461, 440sh, 390sh.

O151 Srebrodolskite $Ca_2Fe^{3+}{}_2O_5$



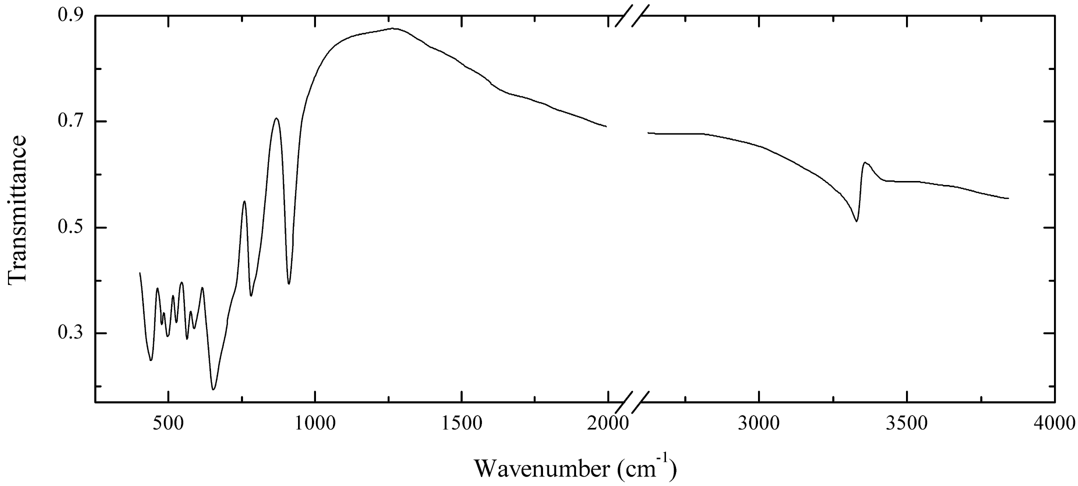
Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia (type locality).
Description: Black granular aggregate from the association with anhydrite, magnesioferrite and fluorellestadite. Investigated by B.V. Chesnokov. $D_{meas} = 4.04(1)$ g/cm^3, $D_{calc} = 4.03$ g/cm^3. Orthorhombic, $a = 5.420$ (3), $b = 14.752$ (3), $c = 5.594$ (3) Å. The empirical formula is (electron microprobe) $Ca_{1.99}Fe_{1.90}Mg_{0.08}Mn_{0.03}O_{5-x}$.The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 7.381 (100) (020), 3.690 (100) (040), 2.797 (60) (002), 2.710 (60) (200), 2.676 (100) (141), 1.946 (70) (202), 1.844 (100) (080).
Wavenumbers (cm^{-1}): 705sh, 630sh, 582s, 438, 402, 385sh.

O152 Rutile TiO_2



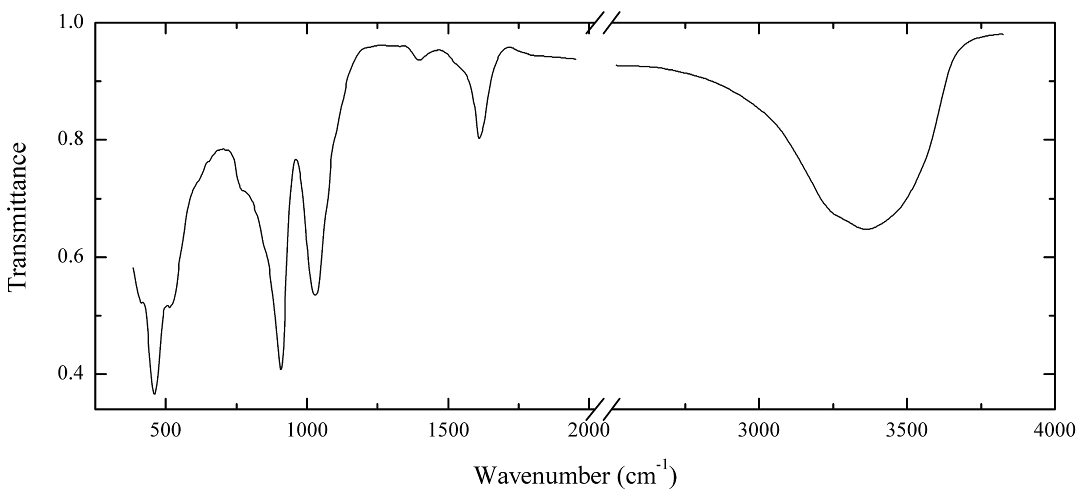
Locality: Alto Ligonha, Mozambique.
Description: Black pebble from a placer. Ta,Fe-rich variety (struverite). The empirical formula is (electron microprobe) $(Ti_{0.6}Fe_{0.2}Ta_{0.15}Nb_{0.05})O_2$.
Wavenumbers (cm^{-1}): 1084w, 680sh, 594s, 539s, 470sh, 385.

O153 Simpsonite $Al_4Ta_3O_{13}(OH)$



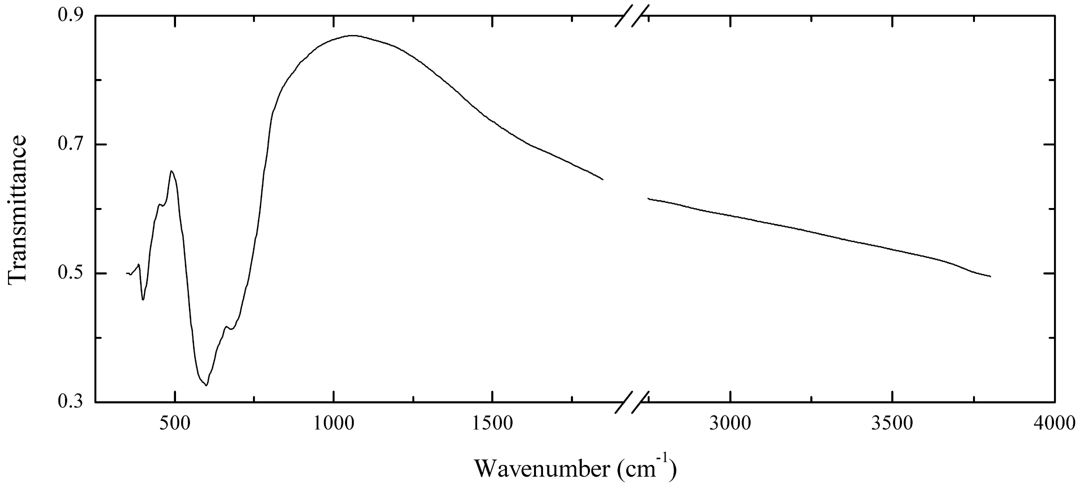
Locality: Manono mine, Manono town, Katanga, Democratic Republic of Congo.
Description: Beige massive from the association with quartz, rankamaite and alumotantite. Investigated by A.V. Voloshin.
Wavenumbers (cm^{-1}): 3320, 908, 795sh, 781, 720sh, 653s, 585, 561s, 525, 497s, 476, 434s.

O154 Schoepite $(UO_2)_8O_2(OH)_{12}\cdot 12H_2O$



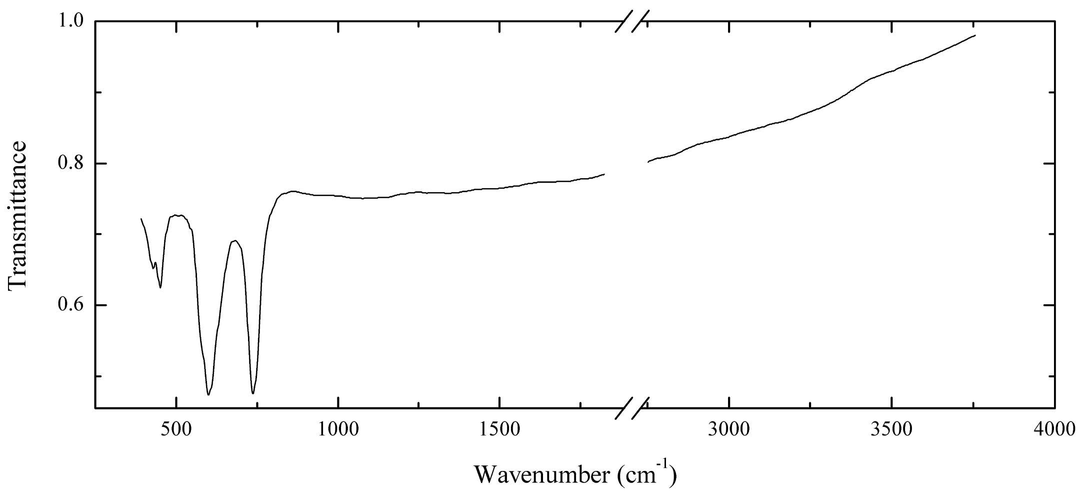
Locality: Gornoe U deposit, Transbaikal area, Siberia, Russia.
Description: Yellow tabular crystals. Identified by powder X-ray diffraction pattern. Investigated by G.A. Sidorenko.
Wavenumbers (cm^{-1}): 3550sh, 3350, 3265sh, 1615, 1400w, 1030, 907s, 850sh, 513, 457s, 405.

O155 Stibiotantalite $SbTaO_4$



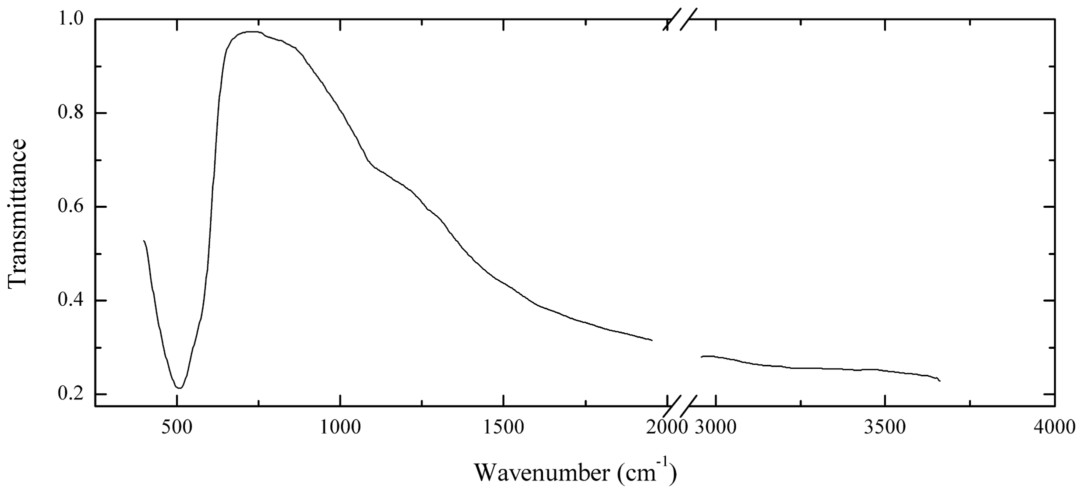
Locality: Vasin-Myl'k Mt., Voron'i Tundras, Kola peninsula, Murnansk region, Russia.
Description: Black crystals from the association with quartz, microcline, albite and holtite. Investigated by A.V. Voloshin.
Wavenumbers (cm^{-1}): 688s, 599s, 465, 417, 394.

O156 Tellurite TeO_2



Locality: Bambolla mine, Moctezuma, Sonora, Mexico.
Description: Yellow acicular crystals with perfect cleavage. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 734s, 597s, 449, 422.

O157 Tenorite CuO

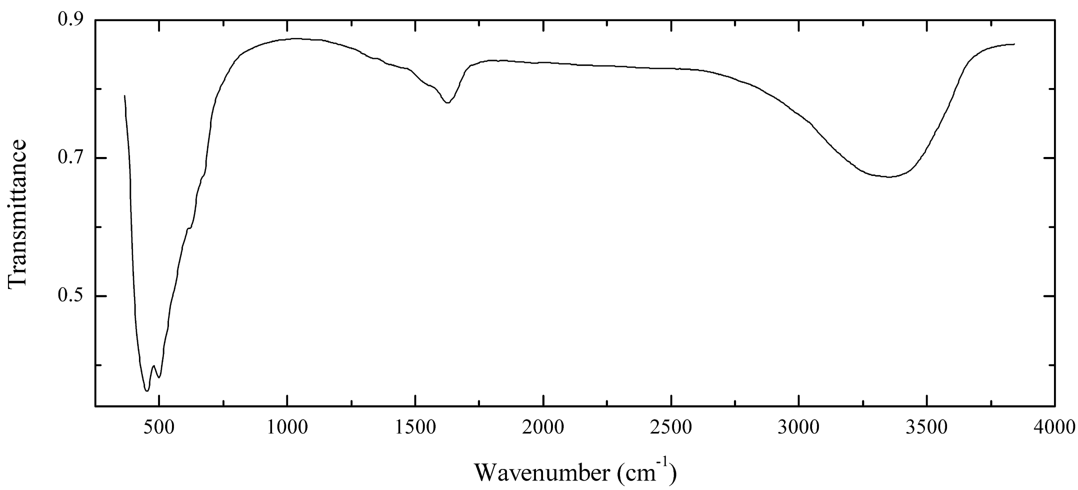


Locality: Northern Break of the Large Fissure Tolbachik Eruption, Tolbachik volcano, Kamchatka peninsula, Russia.

Description: Black prismatic crystals. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 575sh, 515s, 455sh.

O158 Ranciéite $(Ca,Mn^{2+})Mn^{4+}{}_4O_9 \cdot 3H_2O$

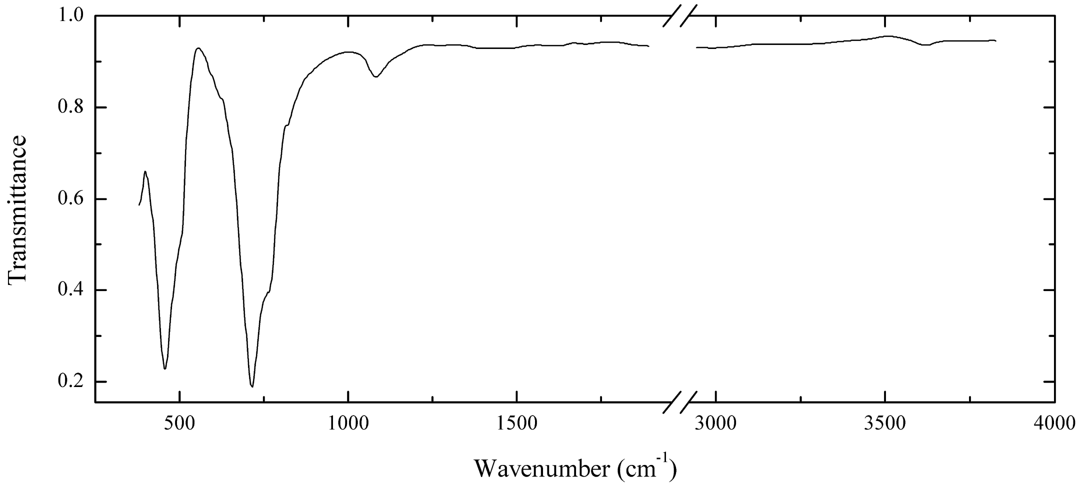


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown pseudomorph after serandite from the association with natrolite, taeniolite, fluorapatite and neptunite. Identified by powder X-ray diffraction pattern, IR spectrum and electron microprobe analysis. The empirical formula is $(Ca_{0.57}Mn_{0.37}Na_{0.06})(Mn_{3.95}Fe_{0.05})(O,OH)_4 \cdot nH_2O$.

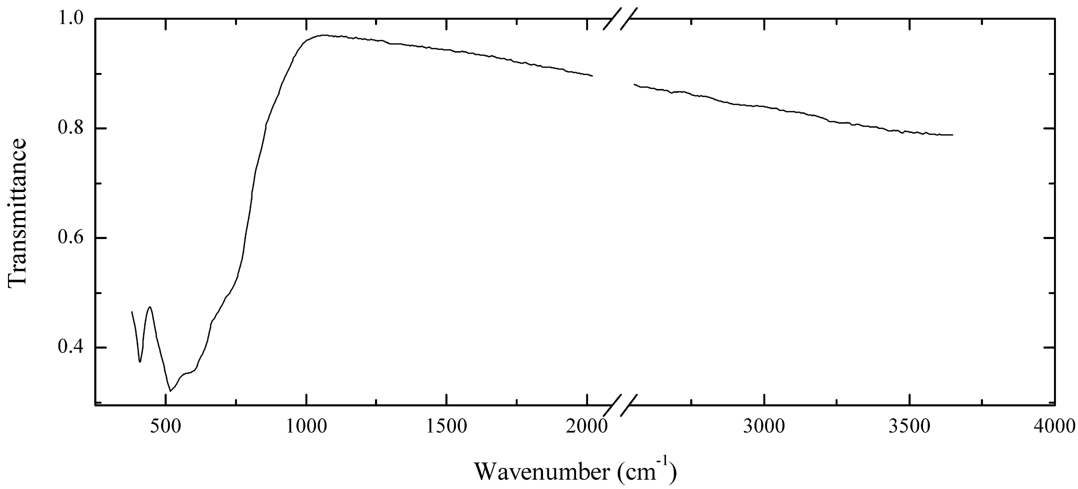
Wavenumbers (cm^{-1}): 3540sh, 3310, 1650sh, 1615, 1550sh, 675sh, 620sh, 502s, 448s.

O159 Hydroxycalcioroméite $(Ca,Na)_2(Sb^{5+},Ti)_2O_6(OH,O)$



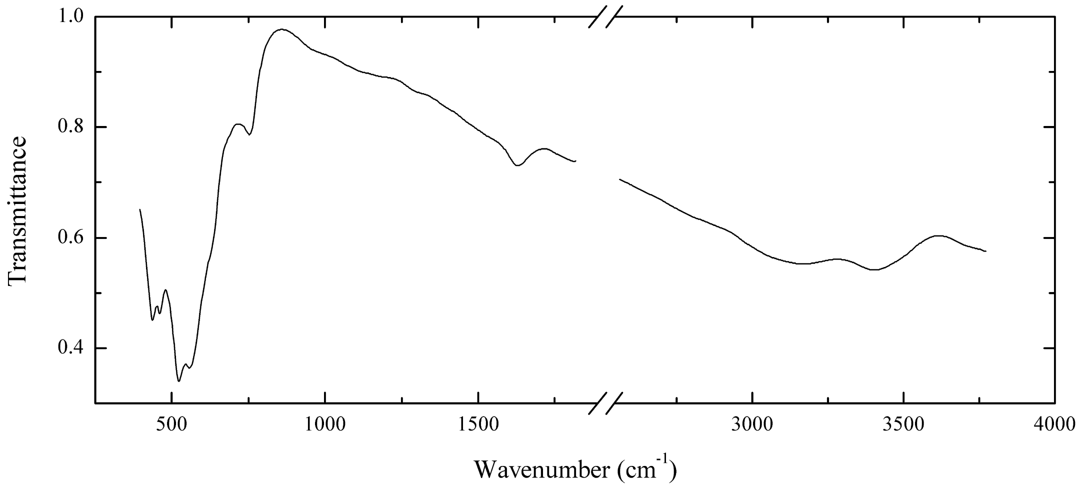
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: Brownish-yellow octahedral crystal from the association with calcite and phlogopite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Ca_{1.56}Na_{0.17}Mn_{0.11})(Sb_{1.94}Fe_{0.04}Ti_{0.02})O_6(O,OH)$.
Wavenumbers (cm^{-1}): 3560w, 1074w, 820, 760sh, 710s, 500sh, 455s.

O160 Rutile TiO_2



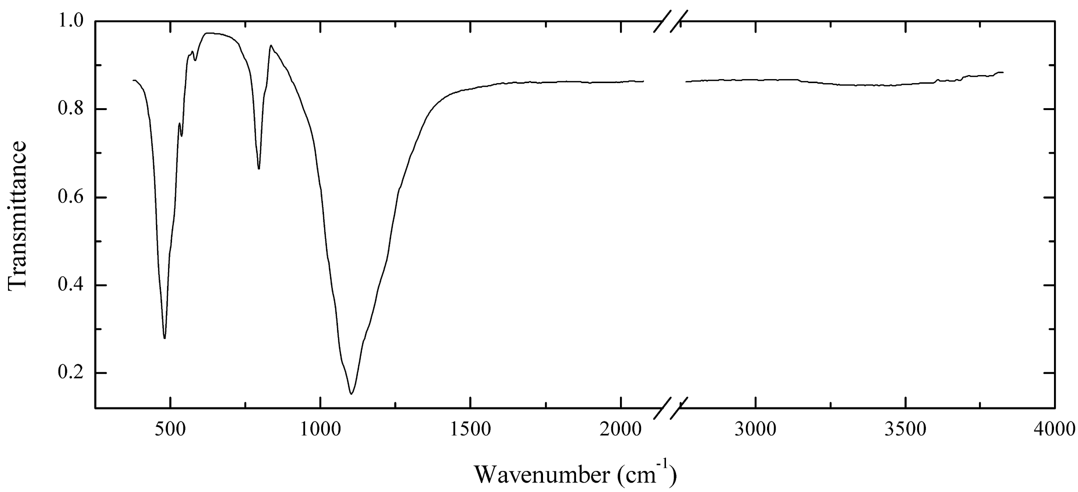
Locality: Polozhikha river, Middle Urals, Russia.
Description: Dark brown pebble from a placer. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 740sh, 590sh, 524s, 407.

O161 Todorokite $(Na,Ca)_x(Mn,Mg,Al)_6O_{12}\cdot3\text{–}4H_2O$



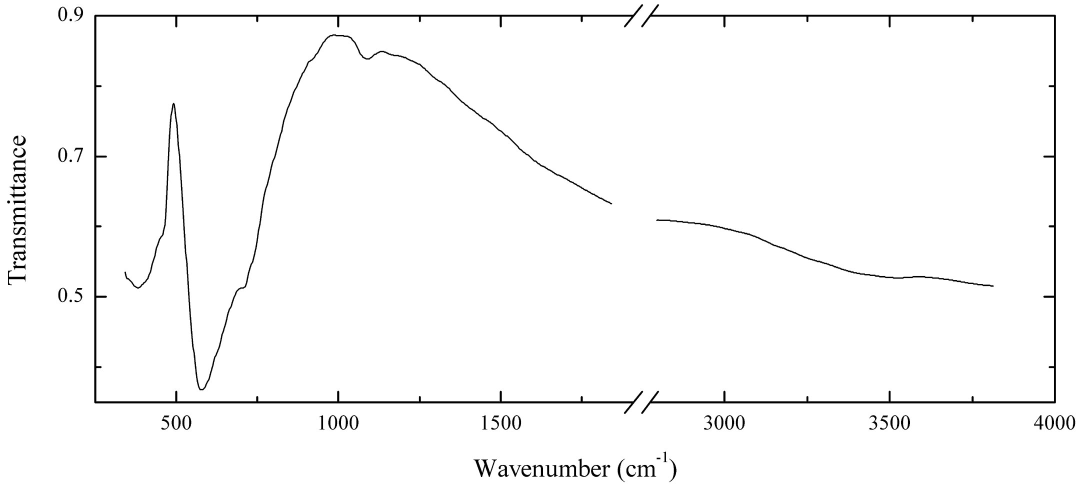
Locality: Akhtenskiy mine, near Magnitka, South Urals, Russia.
Description: Brown dendrite from the association with pyrolusite and goethite. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3400, 3150, 1635, 760, 625sh, 557s, 524s, 458, 435.

O162 Tridymite SiO_2



Locality: Vechec, Vranov nad Tepl’ou, Prešov region, Slovakia.
Description: Twinned platy crystals from the association with lechatelierite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1160sh, 1103s, 1075sh, 810sh, 790, 580w, 535, 510sh, 478s.

O163 Tausonite $SrTiO_3$

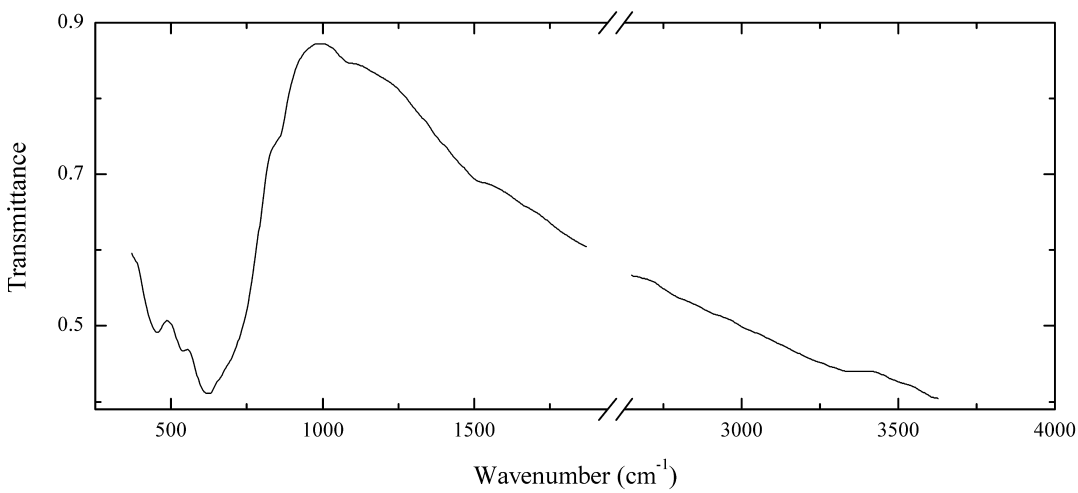


Locality: Tausonitovaya Gorka, Murun alkaline complex, Aldan shield, Eastern Siberia, Russia (type locality).

Description: Dark red cubic crystals from the association with aegirine, microcline and magnetite. The empirical formula is (electron microprobe) $(Sr_{0.73}Na_{0.08}Ca_{0.05}Ce_{0.03}La_{0.02})(Ti_{0.96}Fe_{0.02}Nb_{0.02})O_3$.

Wavenumbers (cm^{-1}): (1087), 795sh, 705sh, 576s, 455sh, 385.

O164 Tapiolite-(Fe) $Fe^{2+}Ta_2O_6$

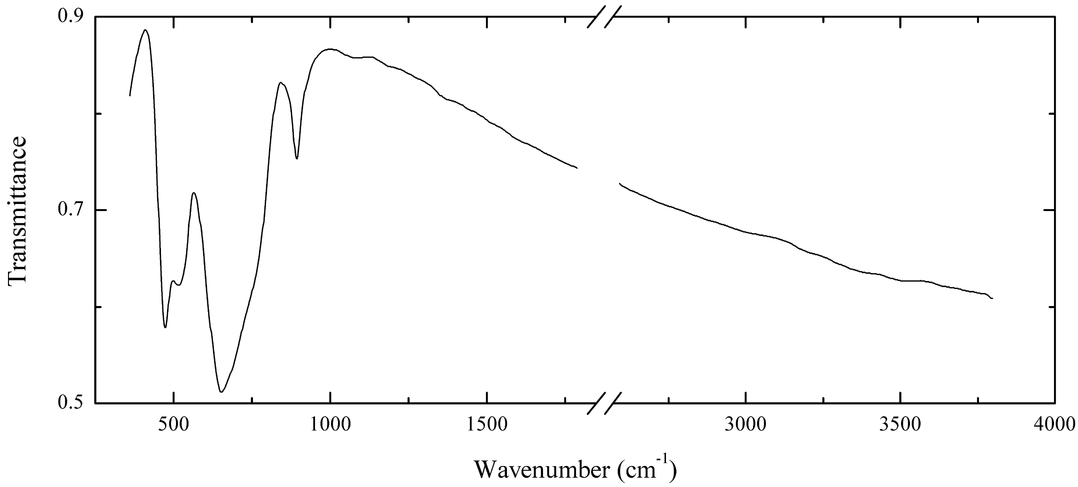


Locality: Parelhas, Borborema province, Rio Grande do Norte, Brazil.

Description: Black crystals from pegmatite. Streak is brown. The empirical formula is $(Fe_{0.97}Mn_{0.03})(Ta_{1.68}Nb_{0.16}Al_{0.07}Fe_{0.06}Ti_{0.03})O_6$.

Wavenumbers (cm^{-1}): 860sh, 725sh, 627s, 540, 457.

O165 Thoreaulite $Sn^{2+}Ta_2O_6$

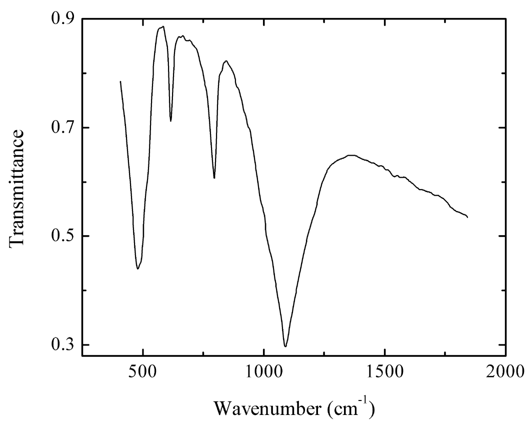


Locality: Manono mine, Manono town, Katanga, Democratic Republic of Congo.

Description: Yellow grains from the association with microcline, cassiterite and lithiotantite. The empirical formula is $(Sn_{0.94}Pb_{0.08})(Ta_{1.88}Nb_{0.11})O_6$.

Wavenumbers (cm^{-1}): 887, 765sh, 700sh, 650s, 527sh, 510, 468s.

O166 Cristobalite SiO_2

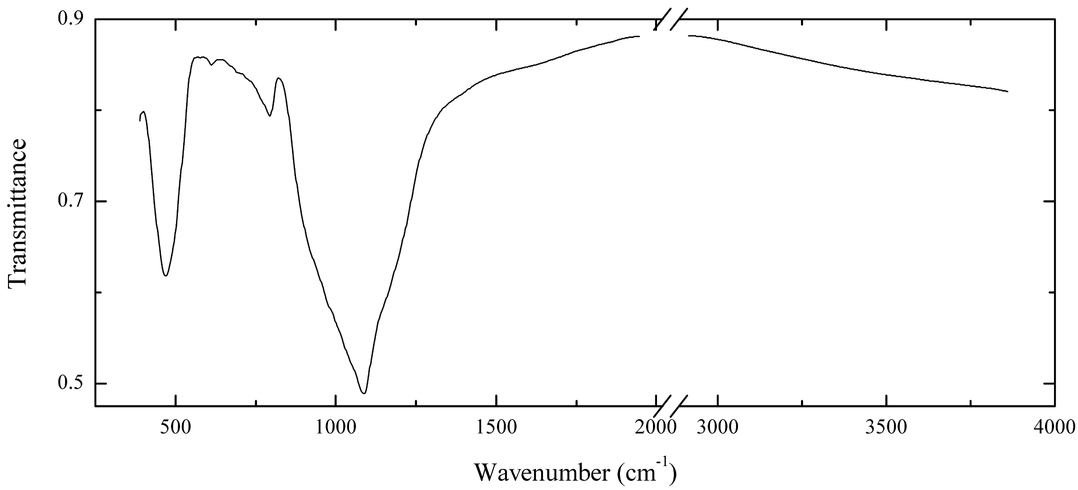


Locality: Contact zone of meteorite from an unknown locality.

Description: White granular aggregate. Identified by IR spectrum.

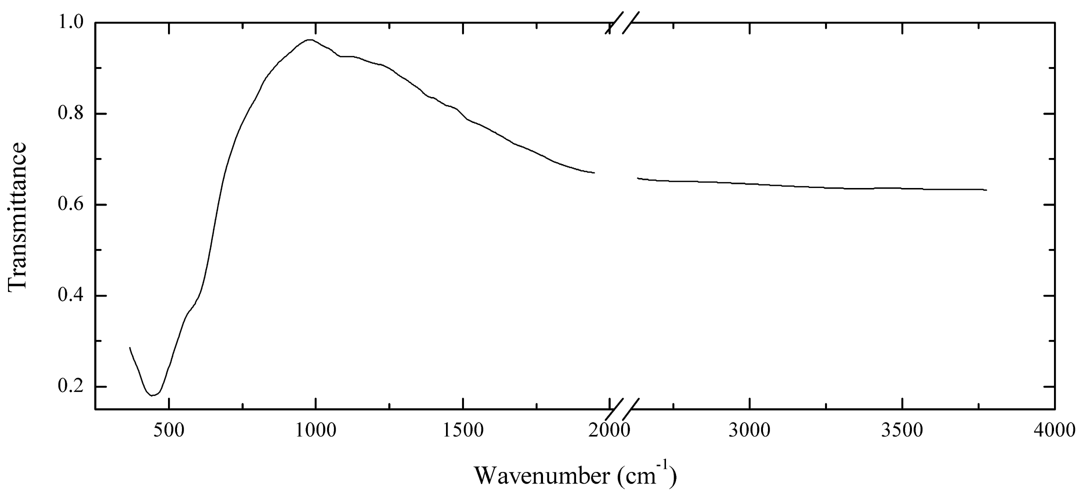
Wavenumbers (cm^{-1}): 1192, 1087s, 790, 614, 482s.

O167 Lechatelierite SiO_2



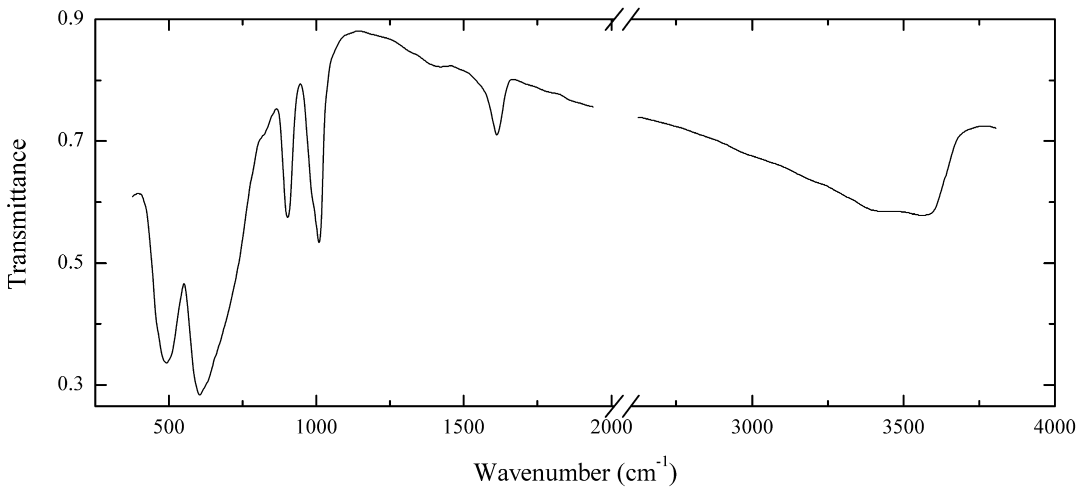
Locality: Contact zone of meteorite from an unknown locality.
Description: Grey massive, with conchoidal fracture. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1190sh, 1150sh, 1090s, 940sh, 790, 610w, 470s.

O168 Periclase MgO



Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.
Description: Deep red crystals. Fe-rich variety. The empirical formula is (electron microprobe) $Mg_{0.63}Fe_{0.34}Mn_{0.03}O$.
Wavenumbers (cm^{-1}): 580sh, 443s.

O169 Uvanite $U^{6+}{}_2U^{5+}{}_6O_{21}\cdot15H_2O$ (?)

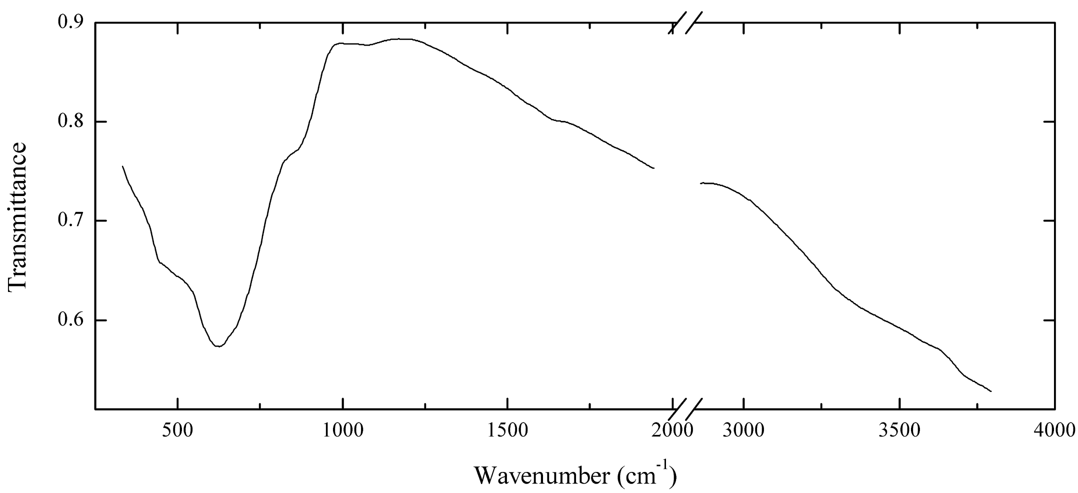


Locality: Synthetic.

Description: Yellow powder. Identified by powder X-ray diffraction pattern. Investigated by G.A. Sidorenko.

Wavenumbers (cm^{-1}): 3560, 3425, 1615, 1430w, 1010, 990sh, 903, 605s, 495s.

O170 "Bismutopyrochlore" $(Bi,U,Ca,Pb)_{1+x}(\square,H_2O)_{1-x}(Nb,Ta,Fe^{3+})_2O_6(O,OH)$

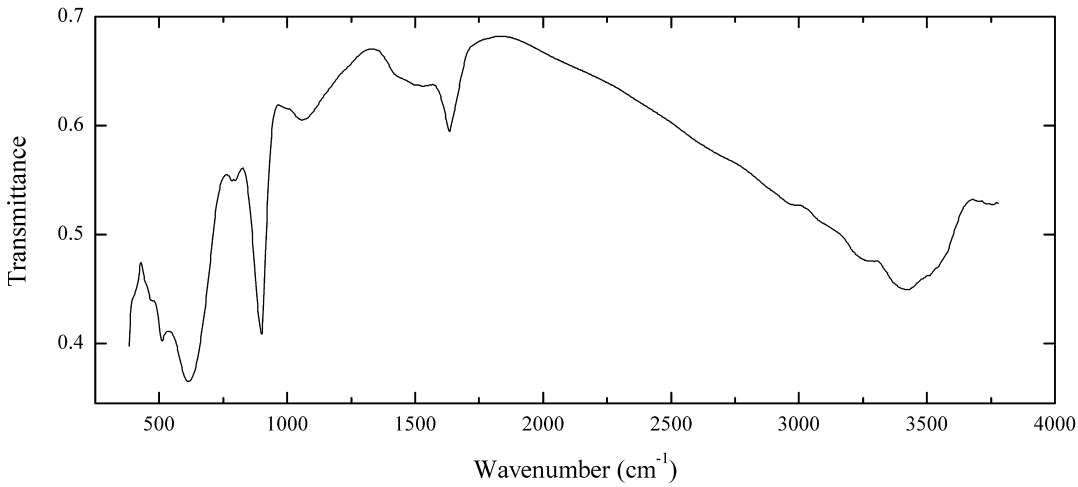


Locality: Mika pegmatite, Rangkul' Highlands, Pamir Mts., Tajikistan.

Description: Black crystal from the association with lepidolite and topaz. Metamict, amorphous. The empirical formula is $(Bi_{0.37}U_{0.31}Ca_{0.27}Pb_{0.16}Na_{0.06}K_{0.06}Sb_{0.05}Mn_{0.01}Ce_{0.01}La_{0.01}Th_{0.01})(Nb_{1.53}Ta_{0.23}Fe_{0.13}Al_{0.05}Mg_{0.04}Ti_{0.02})O_{6.10}(OH)_{0.90}\mathit{n}H_2O$.

Wavenumbers (cm^{-1}): 3300w, 1640w, 845sh, 620s, 490sh, 450sh.

O171 Holfertite $(UO_2)_{1.75}TiO_4[(H_2O)_3Ca_{0.25}]$

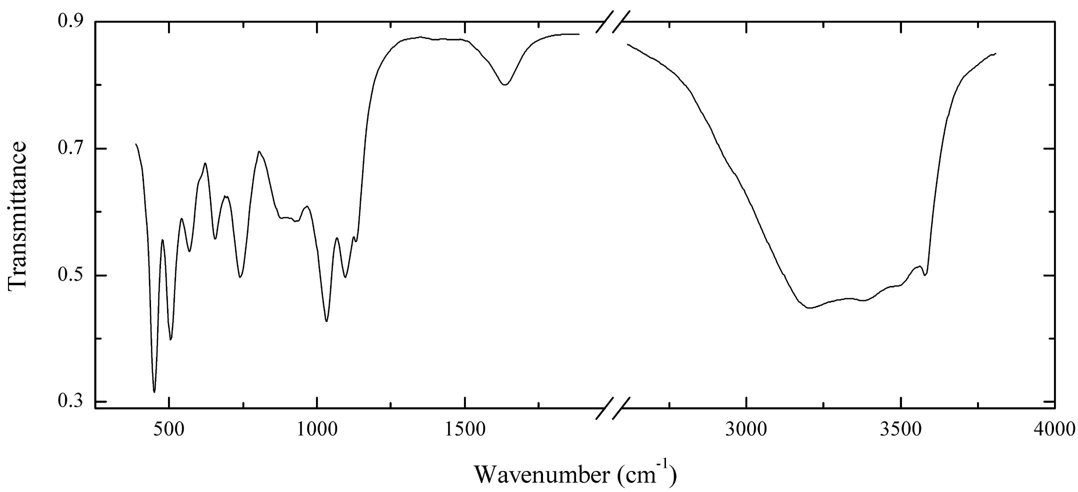


Locality: Starvation Canyon, Thomas Range, Utah, USA (type locality).

Description: Yellow prismatic crystals from the association with quartz, topaz, pseudobrookite and hematite. The empirical formula is $Ca_{0.19}Na_{0.04}K_{0.02}(UO_2)_{1.81}(Ti_{0.91}Fe_{0.06}Mg_{0.03})(O,OH)_4 \cdot nH_2O$. Weak bands at 1,085, 799, 780 and 460 cm^{-1} correspond to the admixture of quartz.

Wavenumbers (cm^{-1}): 3390, 3230w, 1645sh, 1626, 1085w, 1050w, 897, 799w, 780w, 650sh, 613s, 516, 460w.

O172 Khaidarkanite $Cu_4Al_3(OH)_{14}F_3 \cdot 2H_2O$



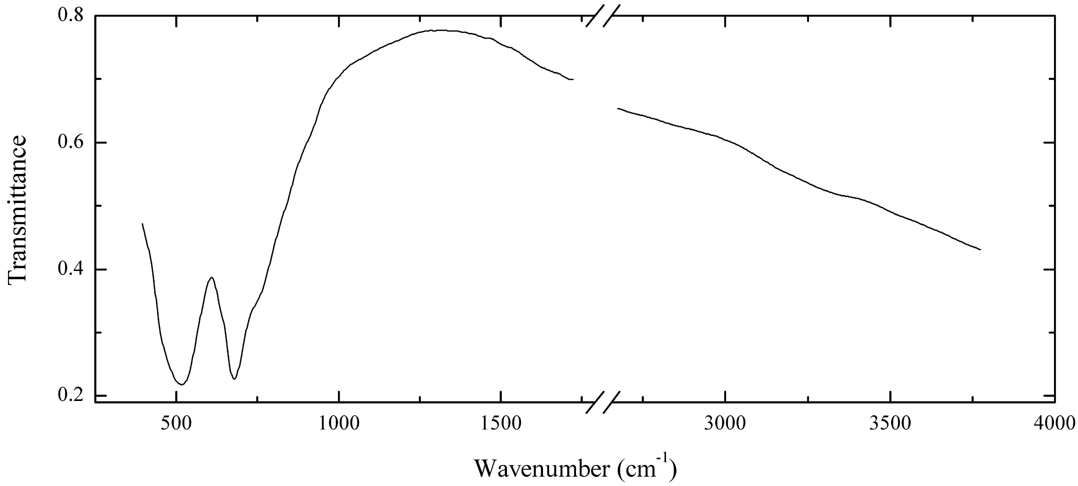
Locality: Khaidarkan Sb–Hg deposit, Fergana valley, Alai range, Osh region, Kyrgyzstan (type locality).

Description: Random aggregate of blue needle-like crystals from the association with calcite, quartz, barite, fluorite, malachite, Cu-allophane, conichalcite, chrysocolla and poor-investigated aluminium fluorhydroxyde. Holotype sample. Monoclinic, space group $C2/m$, $a = 12.346(3)$,

$b = 2.907(3)$, $c = 10.369(7)$ Å, $\beta = 97.90(2)$ Å, $V = 368(1)$ Å^3, $Z = 1$. The empirical formula is $Na_{0.26}Cu_{4.00}Al_{3.12}(OH)_{14.51}F_{2.89}(SO_4)_{0.19}(SiO_4)_{0.05}\cdot 1.19H_2O$. Optically biaxial (+), $\alpha = 1.585(2)$, $\beta = 1.615(3)$, $\gamma = 1.648(2)$, $2V = 80°–90°$. $D_{meas} = 2.84(1)$ g/cm^3, $D_{calc} = 3.00$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 10.29 (80) (001); 5.589 (90) (20-1); 4.232 (100) (20-2); 2.828 (90) (203); 2.362 (100) (310); 1.871 (80) (114, 51-1); 1.817 (80) (51-2).

Wavenumbers (cm^{-1}): 3585, 3500, 3390, 3210s, 1635, 1590sh, 1135, 1100, 1036s, 930, 885, 742, 656, 610sh, 572, 506s, 450s.

O173 Högbomite $(Mg,Fe)_3(Al,Ti)_8O_{15}(OH)$

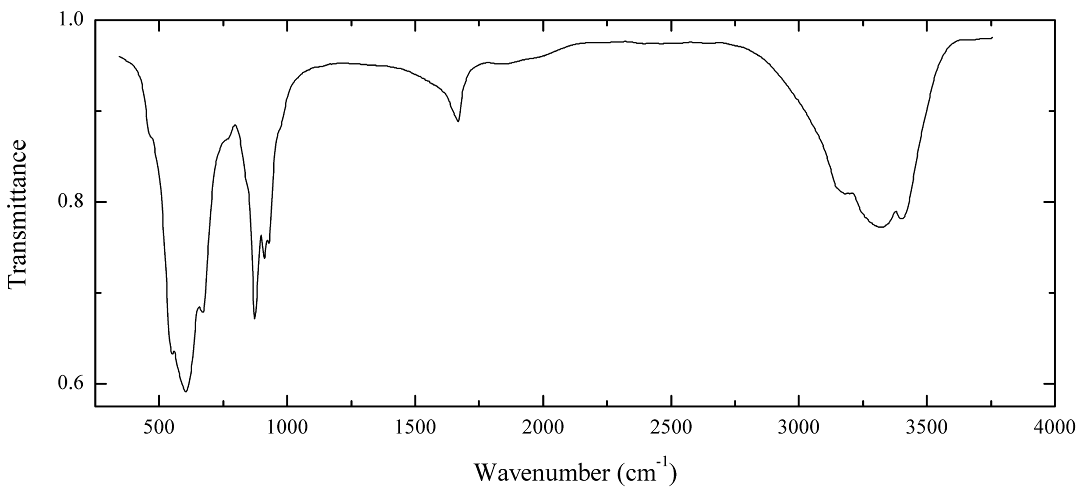


Locality: Nikolae-Maximilianovskaya pit, near Magnitka, Chelyabinsk region. South Urals, Russia.

Description: Dark brown dipyramidal crystals from the association with clinochlore. Investigated by V.I. Stepanov.

Wavenumbers (cm^{-1}): 3330w, 740sh, 675s, 635sh, 511s.

O174 Franconite $Na_2Nb_4O_{14}\cdot 9H_2O$

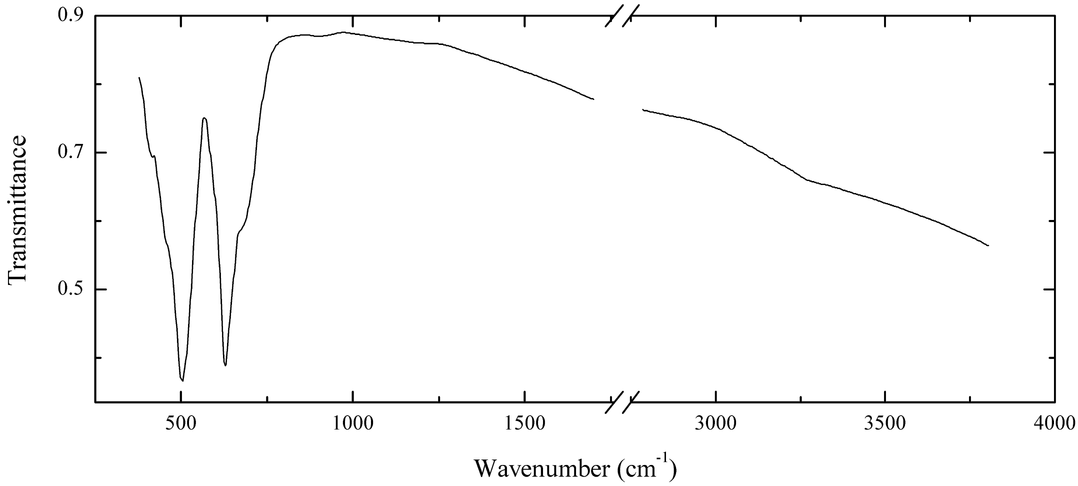


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada.

Description: White fibrous aggregate from pegmatite. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3410, 3330, 3190, 1676w, 1650sh, 931, 913, 876, 840sh, 671, 601s, 575sh, 544s, 465sh.

O175 Chromite $Fe^{2} + Cr_2O_4$

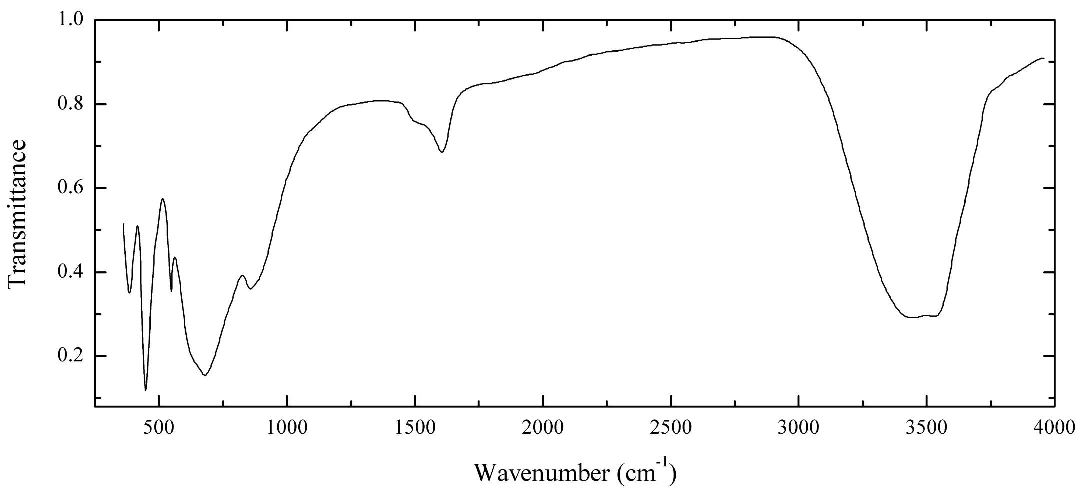


Locality: Shurugwi, Great Dyke, Zimbabwe.

Description: Black isometric crystals. The empirical formula is (electron microprobe) $Fe_{0.95}Mg_{0.33}Cr_{1.44}Al_{0.26}Ti_{0.02}O_4$.

Wavenumbers (cm^{-1}): 690sh, 629s, 502s, 450sh, 410sh.

O176 Chlormagaluminite $(Mg,Fe^{2+})_4Al_2(OH)_{12}(Cl_2,CO_3){\cdot}2H_2O$

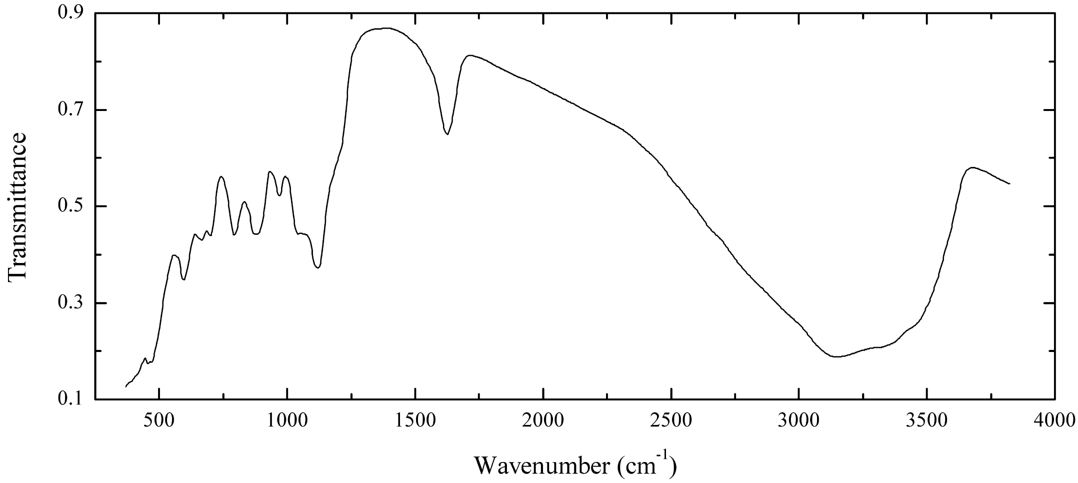


Locality: Kapaevskaya pipe, middle Angara river, Irkutsk region, Siberia, Russia (type locality).

Description: Yellow-brown scaly aggregate from the association with clinochlore and magnetite. Specimen No. 82771 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 3500s, 3430s, 1615w, 1500sh, 880sh, 855, 678s, 640sh, 547, 445s, 377.

O178 Schwertmannite $Fe^{3+}{}_{16}O_{16}(OH)_{12}(SO_4)_2$

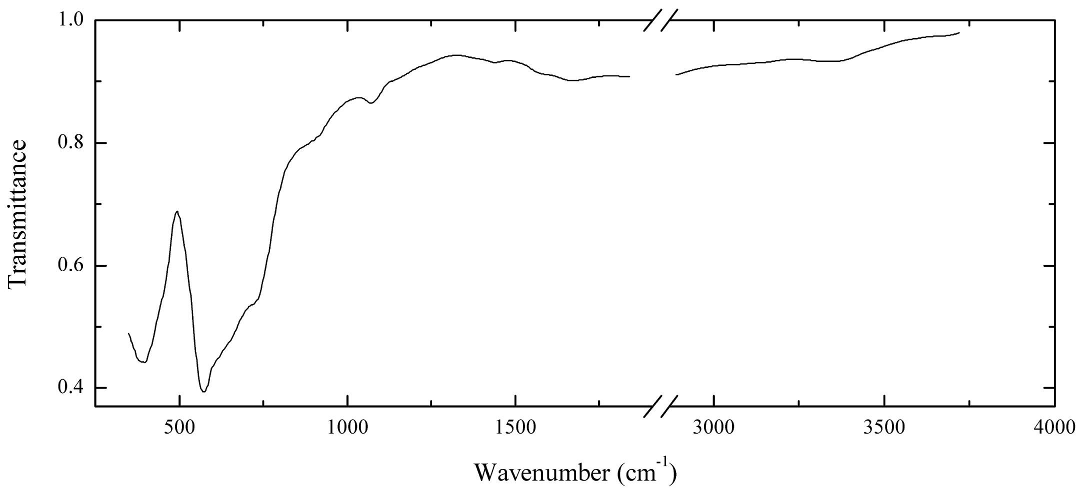


Locality: Dubnik, Prešov region, Slovakia.

Description: Brown massive. Confirmed by powder X-ray diffraction pattern and semiquantitative electron microprobe analysis. Contains admixture of hydrogoethite.

Wavenumbers (cm^{-1}): 3350sh, 3150s, 1630, 1210sh, 1130s, 1065sh, 975, 887, 798, 702, 670, 603s, 460s.

O179 Fluorcalciomicrolite $(Ca,Na,\square)_2(Ta,Nb,Ti)_2O_6(F,O,OH)$

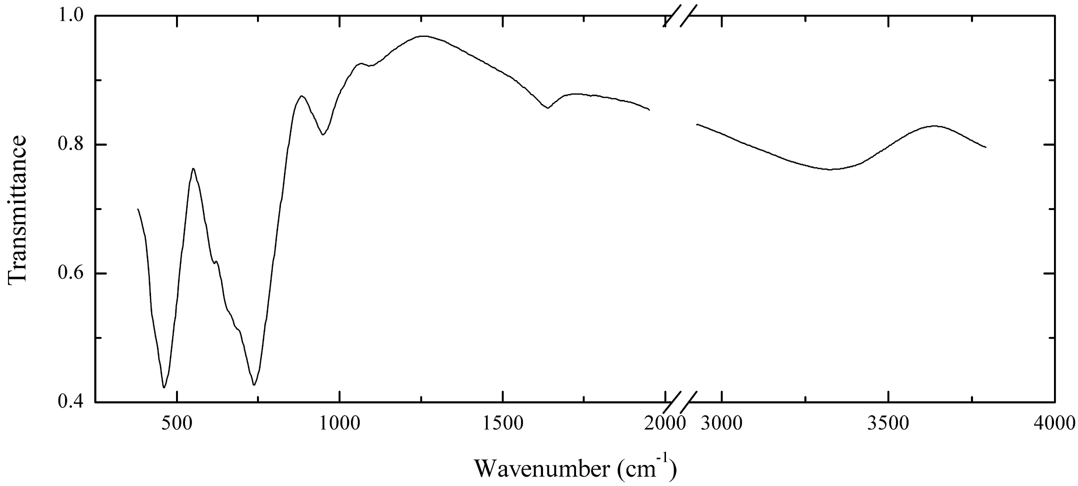


Locality: An unknown locality in Minas Gerais, Brazil.

Description: Brown octahedral crystals. The empirical formula is (electron microprobe) $(Ca_{1.32}Na_{0.34}Sb_{0.04})(Ta_{1.38}Nb_{0.46}Ti_{0.16})O_{6.3}F_{0.7}\cdot nH_2O$.

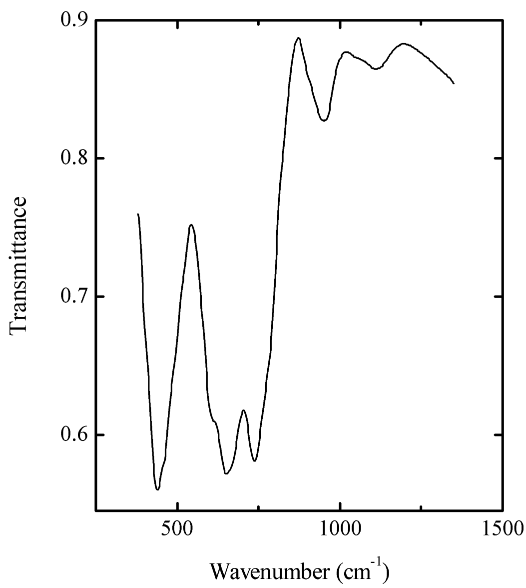
Wavenumbers (cm^{-1}): 3350, 1670w, 1610sh, 1555w, 1074w, 880sh, 720sh, 650sh, 575s, 390s.

O180 Stibiconite $Sb^{3+}Sb^{5+}{}_2O_6(OH)$



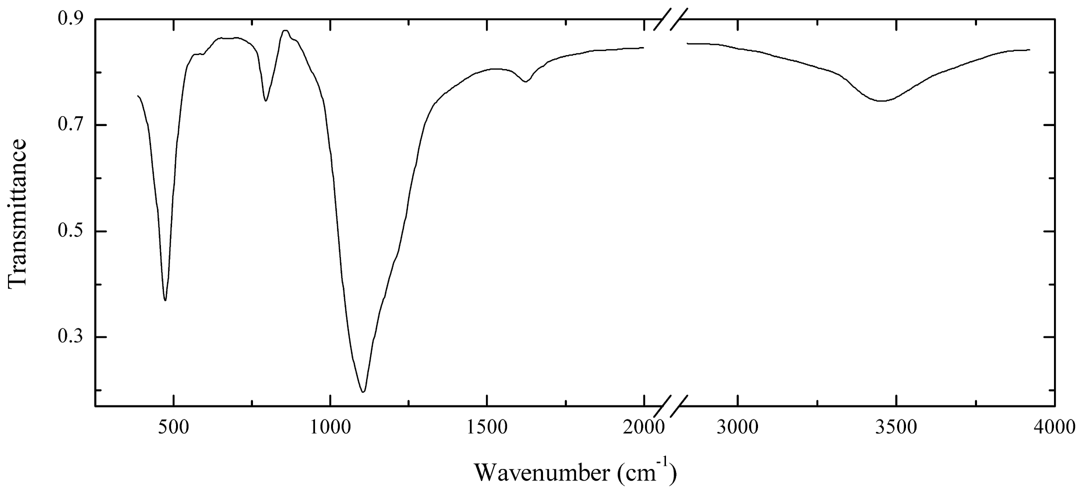
Locality: Tereksai deposit, Jalalabad region, Kyrgyzstan.
Description: Fine-grained light green aggregate from the association with quartz. H_2O-bearing variety. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3340, 1640w, 1090w, 954, 735s, 675sh, 655sh, 610, 458s, 430sh.

O181 Cervantite $Sb^{3+}Sb^{5+}O_4$



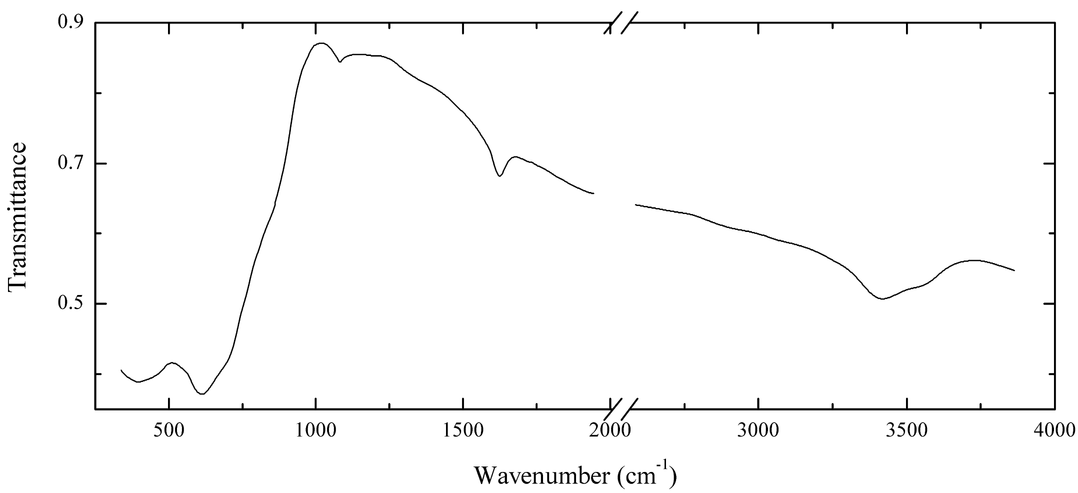
Locality: Le Cetine di Cotorniano mine, Chiusdino, Siena province, Tuscany, Italy.
Description: Acicular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1110w, 950, 738s, 665sh, 646s, 611, 450sh, 434s.

O182 Opal $SiO_2 \cdot nH_2O$



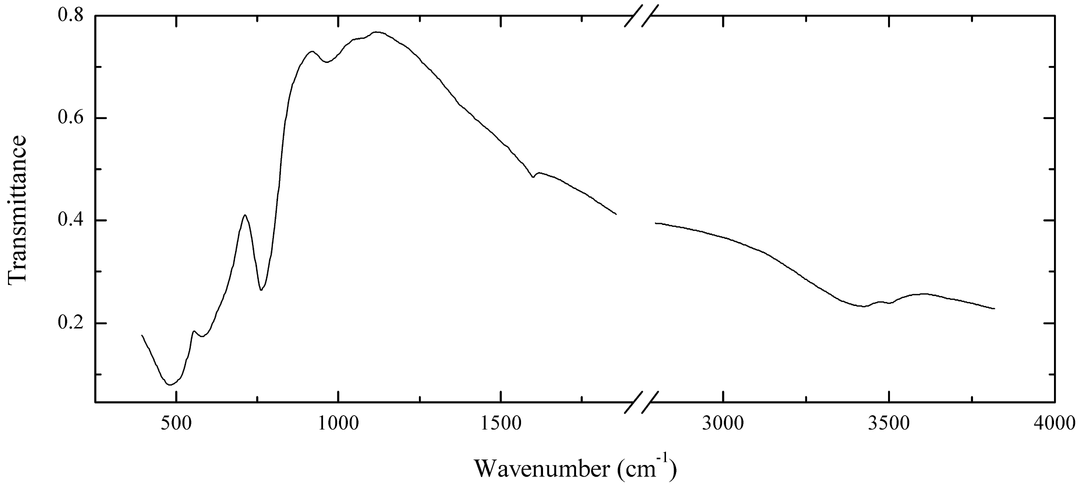
Locality: Lausitz, Saxony, Germany.
Description: White massive. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3427, 1627, 1200sh, 1099s, 795, 678w, 657w, 585w, 474s.

O183 Aeschynite-(Y) $(Y,Ca,Fe,Th)(Ti,Nb)_2(O,OH)_6$



Locality: Western Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: Black grains from pegmatite. Metamict, amorphous. Confirmed by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3540sh, 3400, 1625, 1077w, 850sh, 700sh, 620s, 440sh, 405s.

O184 Redledgeite $Ba(Ti_6Cr_2)O_{16}{\cdot}nH_2O$

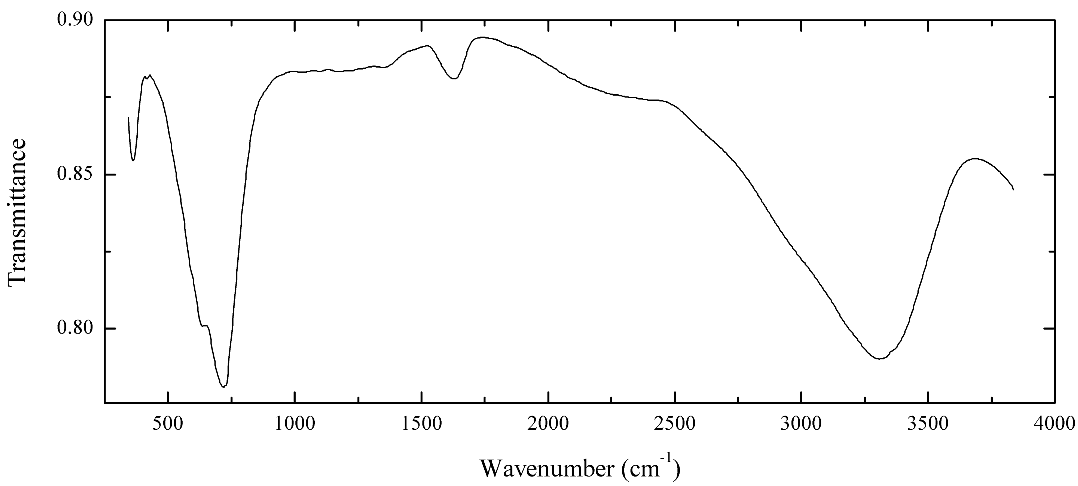


Locality: Saranovskii mine, Perm region, Middle Urals, Russia.

Description: Black grains from the association with chromite. The empirical formula is (electron microprobe) $(Ba_{1.0}K_{0.1})(Ti_{5.9}Cr_{1.9}Fe_{0.15}Mg_{0.05})(O,OH)_{16}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3520w, 3450, 1605w, 1075sh, 960w, 762, 620sh, 585s, 486s, 415sh.

O185 "Laurielawrenceite" (IMA 2005-001) $Fe^{2+}{}_2Sb^{5+}{}_2O_7{\cdot}nH_2O$ (?)

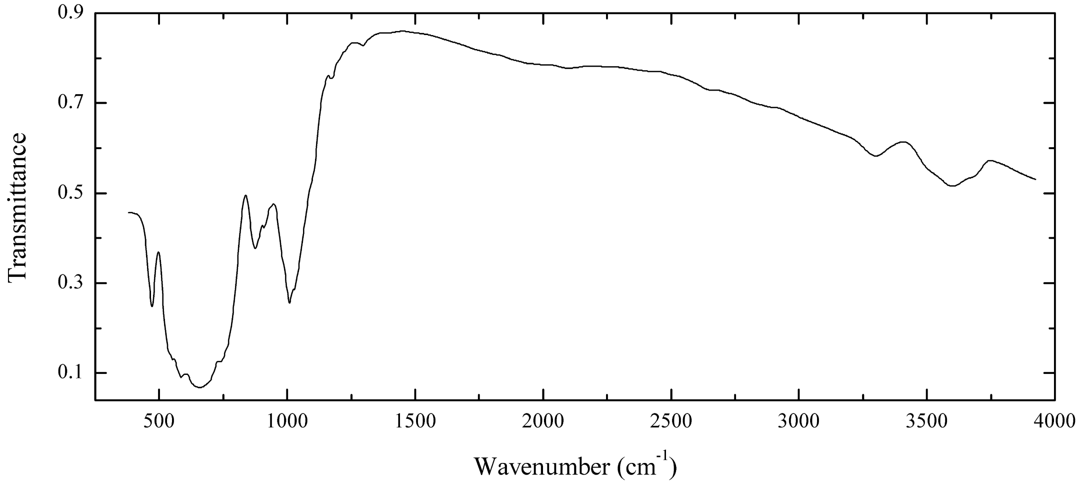


Locality: Wu Ling Sb mine, Jiangxi province, China.

Description: Brown octahedral crystals on altered stibnite. The empirical formula is (electron microprobe) $(Fe_{1.8}Ca_{0.1})(Sb_{1.8}As_{0.2})O_7{\cdot}nH_2O$. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3360w, 3290, 2350sh, 1630w, 718s, 640, 365.

O187 Rankamaite $(Na,K)_{1-x}(Ta,Nb,Al)_4(O,OH)_{11}$

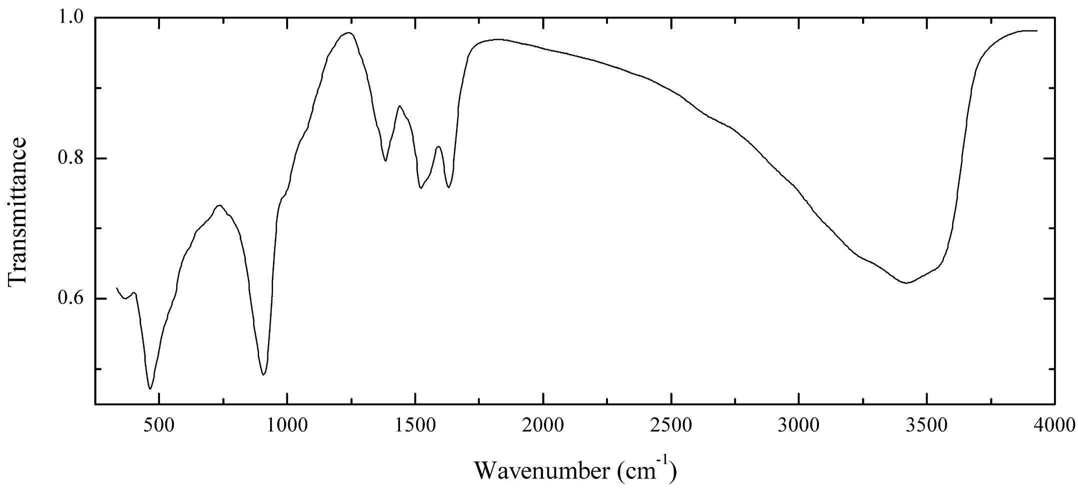


Locality: Mumba, NW of lake Kivu, Shaba, Democratic Republic of Congo (type locality).

Description: White fibrous aggregate from the association with muscovite, microlite and simpsonite. The empirical formula is (electron microprobe) $(Na_{0.4}K_{0.3}Ca_{0.1}Pb_{0.05})(Ta_{2.8}Nb_{0.7}Al_{0.3}Fe_{0.2})(O,OH)_{11}$.

Wavenumbers (cm^{-1}): 3690w, 3585, 3295w, 1175w, 1090sh, 1027, 1007, 909, 874, 740sh, 658s, 584s, 552s, 473.

O188 Fourmarierite $PbU^{6+}{}_4O_{13}\cdot4H_2O$

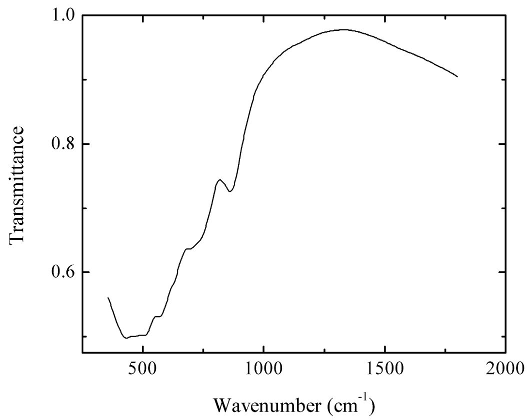


Locality: Fergana valley, Uzbekistan.

Description: Orange massive. Identified by powder X-ray diffraction pattern. Investigated by G.A. Sidorenko.

Wavenumbers (cm^{-1}): 3525sh, 3380, 3250sh, 1627, 1520, 1382, 990sh, 905s, 580sh, 464s, 380.

O189 Freudenbergite $Na_2(Ti,Fe)_8O_{16}$

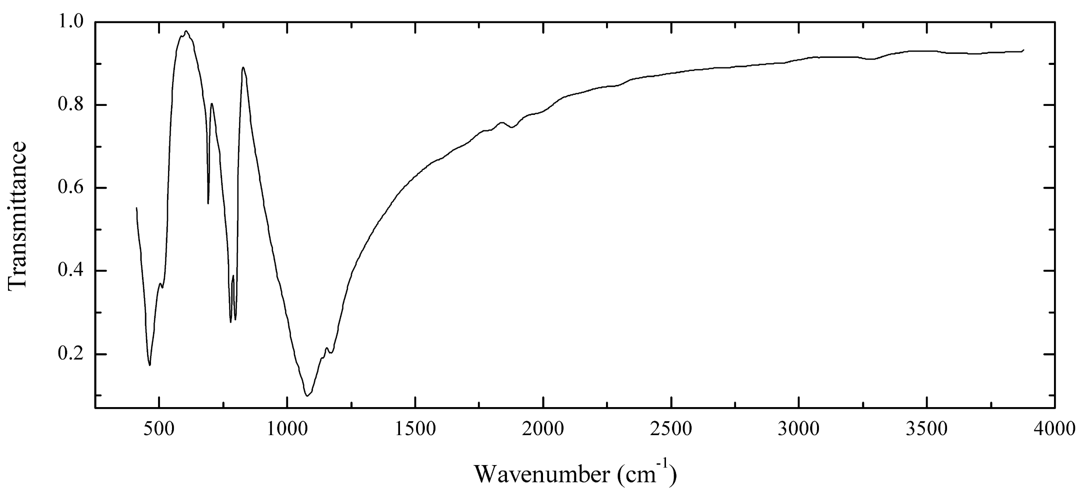


Locality: Kaskasnyunachorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Black grains from the association with rutile, crichtonite, titanite and sanidine. The empirical formula is (electron microprobe) $Na_{1.95}(Ti_{6.85}Fe_{0.95}Mg_{0.13}Al_{0.04}Cr_{0.03})O_{16}$.

Wavenumbers (cm^{-1}): 863, 745sh, 720, 580sh, 565, 511s, 464s, 427s.

O190 Quartz SiO_2

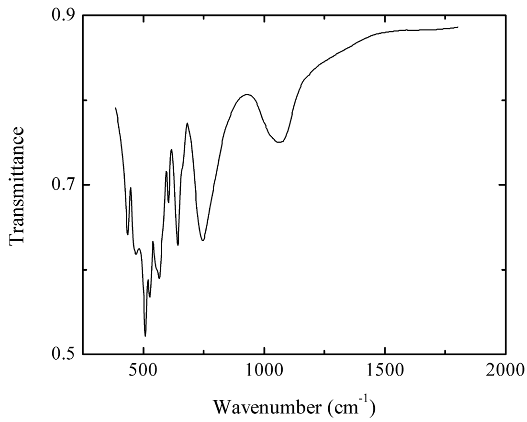


Locality: Antandrokomby, near Bity Mt., Manandona Valley, Antsirabe district, Madagascar.

Description: Grey prismatic crystals from the association with elbaite and rhodizite. Identified by IR spectrum.

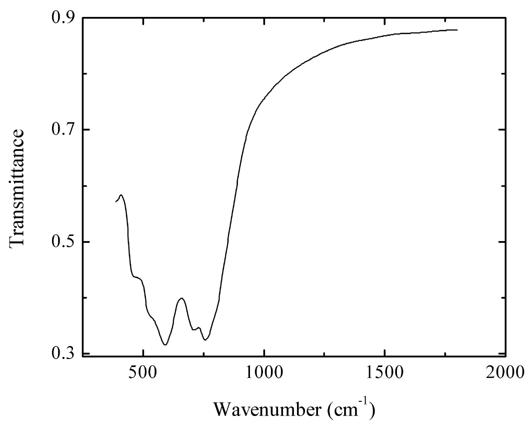
Wavenumbers (cm^{-1}): 1880w, 1800w, 1170s, 1140sh, 1083s, 798, 779, 694, 512, 459s.

O191 Chrysoberyl $BeAl_2O_4$



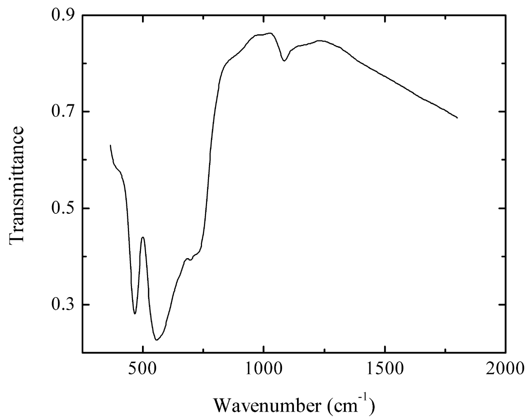
Locality: Espírito Santo, Minas Gerais state, Brazil.
Description: Greenish-yellow transparent twinned crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): (1060), 746, 665sh, 643, 605, 564, 555sh, 528s, 510s, 466, 438.

O192 Hibonite $(Ca,Ce)(Al,Ti,Mg)_{12}O_{19}$



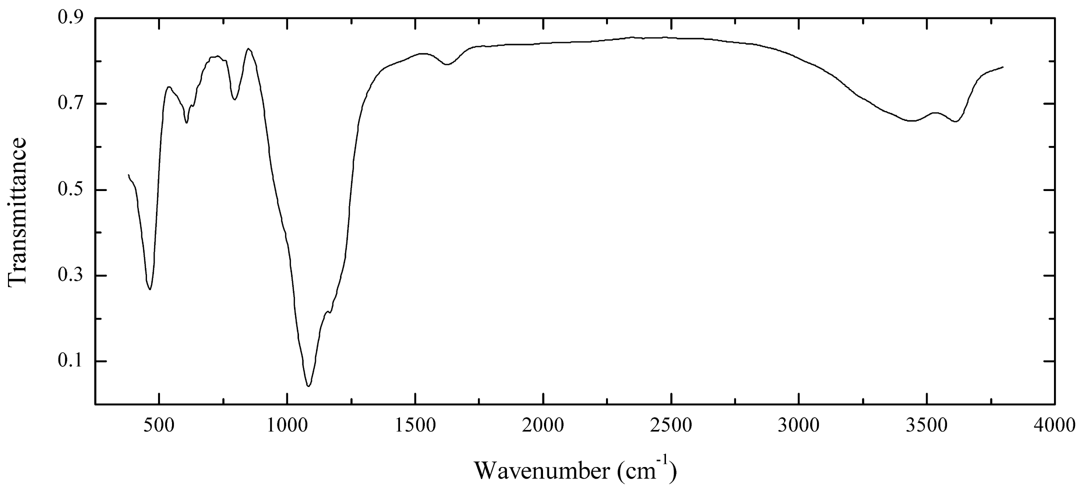
Locality: Elsiva, Fort Dauphin region, Madagascar (type locality).
Description: Brown platy crystal from the association with plagioclase and corundum. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.8}Ce_{0.1}La_{0.05})(Al_{10.3}Ti_{0.6}Mg_{0.6}Fe_{0.5})O_{19}$.
Wavenumbers (cm^{-1}): 820sh, 753s, 712s, 594s, 535sh, 460sh.

O193 Geikielite $MgTiO_3$



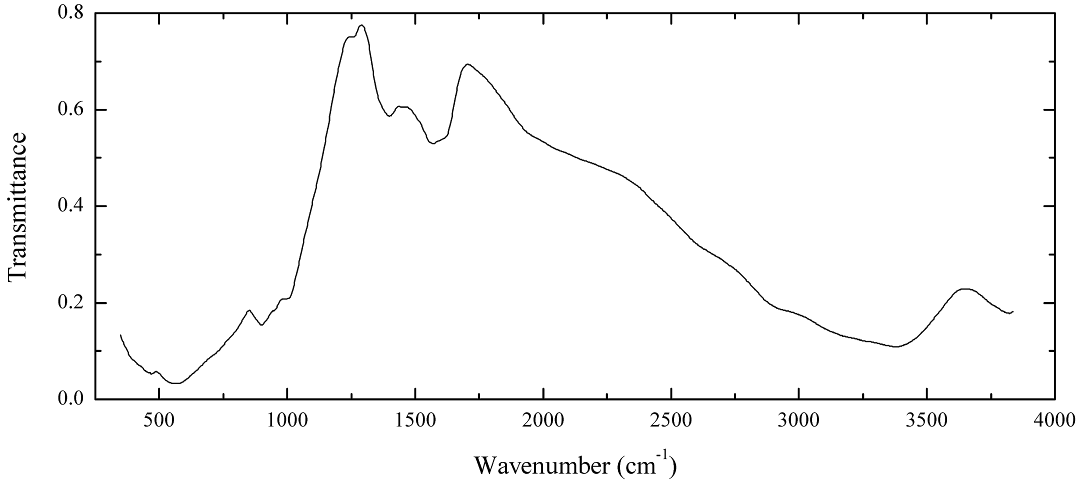
Locality: Staryi district, Malyi Murun alkaline massif, Irkutsk region, Eastern Siberia, Russia.
Description: Black grains in carbonate, from the association with richterite. Streak is brown. The empirical formula is (electron microprobe) $Mg_{0.81}Fe_{0.19}Mn_{0.03}Ti_{0.97}O_3$.
Wavenumbers (cm^{-1}): 1177w, 1083w, 720sh, 697, 558s, 466s, 400sh.

O194 Opal $SiO_2 \cdot nH_2O$



Locality: Hale Creek mine, Mad River ridge, Trinity Co., California, USA.
Description: White massive from the association with inesite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3630, 3445, 1665w, 1625w, 1210sh, 1172, 1084s, 975sh, 798, 640, 608, 464s.

O195 “Silicopyrochlore” $(Na,H_3O,Ca)_2(Nb,Ti,Si)_2O_6(OH,O)\cdot nH_2O$

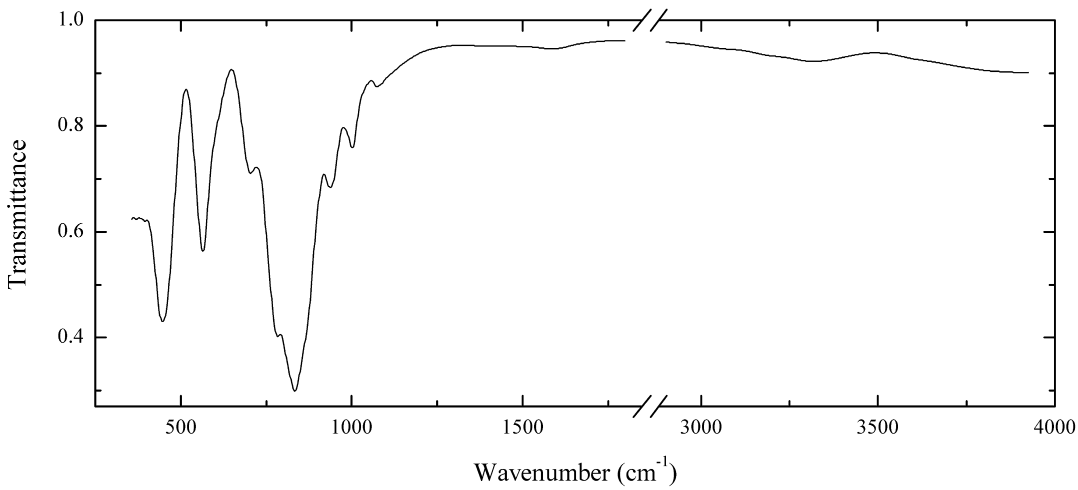


Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brownish-yellow, massive, with conchoidal fracture, from the association with aegirine, natrolite and bitumen. The empirical formula is (electron microprobe) $(Na_{0.93}Ca_{0.12})(Nb_{1.22}Ti_{0.26}Si_{0.44}Fe_{0.08})(O,OH)_7(H_2O,H_3O)_x$.

Wavenumbers (cm^{-1}): 3325s, 3200sh, 2900sh, 2700sh, 2100sh, 1620sh, 1570, 1404w, 1385sh, 1216w, 998, 897s, 567s, 473s.

O196 Brearleyite $Ca_{12}Al_{14}O_{32}Cl_2$

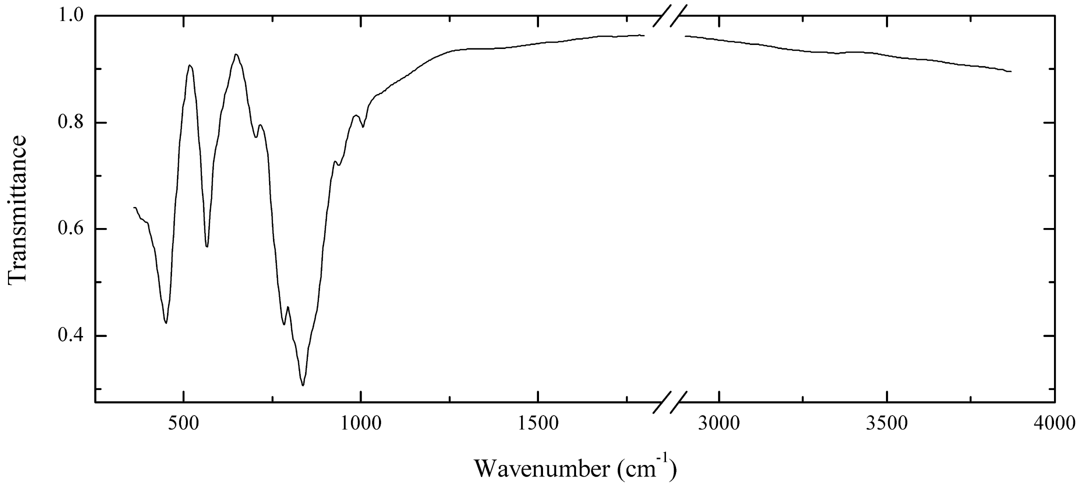


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Green crust from the association with cuspidine. Technogenetic. The empirical formula is $Ca_{12.78}Mg_{0.60}Al_{12.80}Fe^{3+}_{1.20}(SiO_4)_{0.45}O_{31.68}Cl_{2.04}(OH)_{1.54}$.

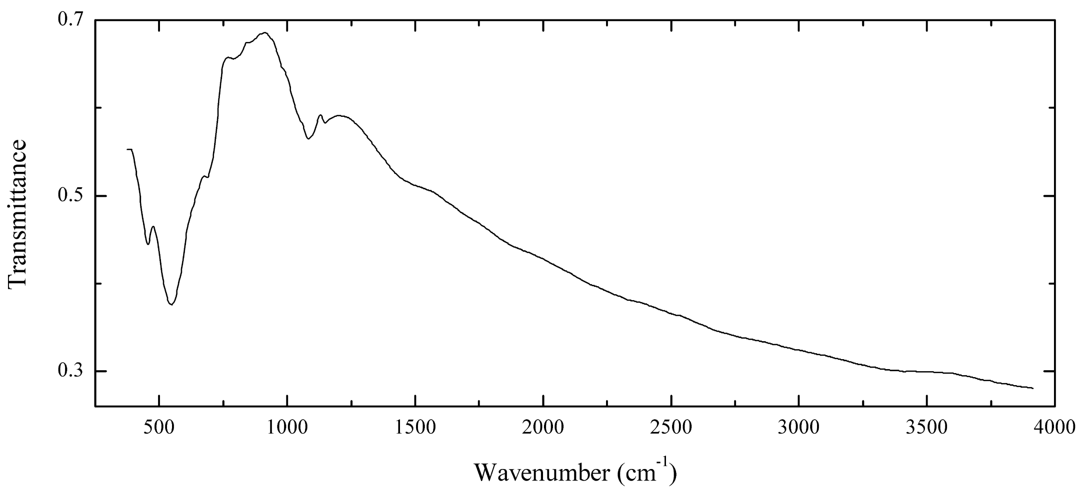
Wavenumbers (cm^{-1}): 3300w, 1596w, 1075w, 1003, 938, 834s, 783s, 703, 564, 447s.

O197 Mayenite $Ca_{12}Al_{14}O_{33}$



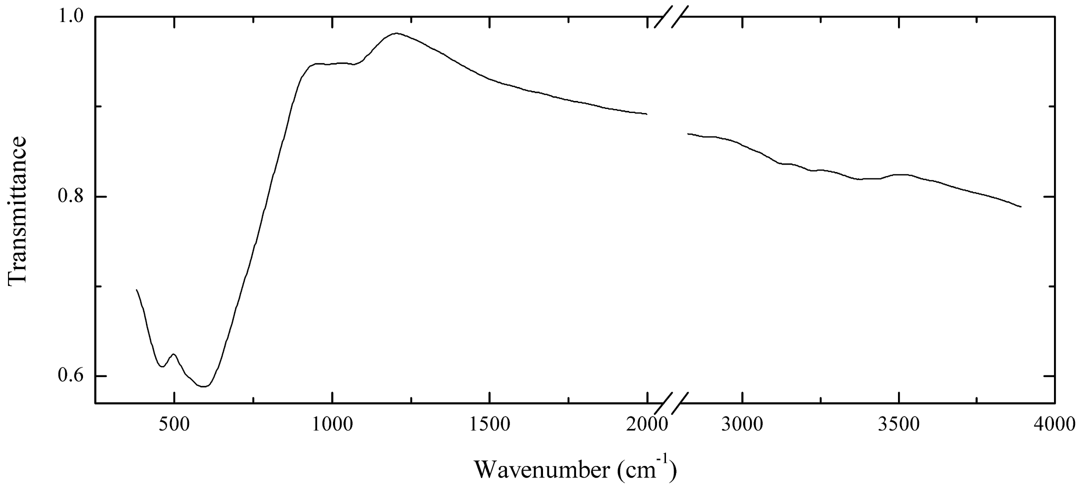
Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.
Description: White massive from the association with anhydrite and fluorellestadite. Technogenetic. The empirical formula is (electron microprobe) $Ca_{11.89}Mg_{0.37}Al_{13.54}Fe_{0.46}(SiO_4)_{0.43}O_x$.
Wavenumbers (cm^{-1}): 1078w, 1003w, 935, 865sh, 836s, 782s, 704, 695sh, 567, 450s.

O198 Ilmenite $Fe^{2+}TiO_3$



Locality: Kukurt, Pamir Mts., Tajikistan.
Description: Black twin from the association with epidote. The empirical formula is (electron microprobe; Fe^{2+}:Fe^{3+} distributed based on crystal-chemical background) $(Fe^{2+}_{0.75}Fe^{3+}_{0.17}Mg_{0.06}Mn_{0.02})(Ti_{0.83}Fe^{3+}_{0.17})O_3$.
Wavenumbers (cm^{-1}): 1147w, 1083, 800sh, 780w, 690, 547s, 457.

O199 Zirkelite $(Ti,Zr,Ca)O_{2-x}$

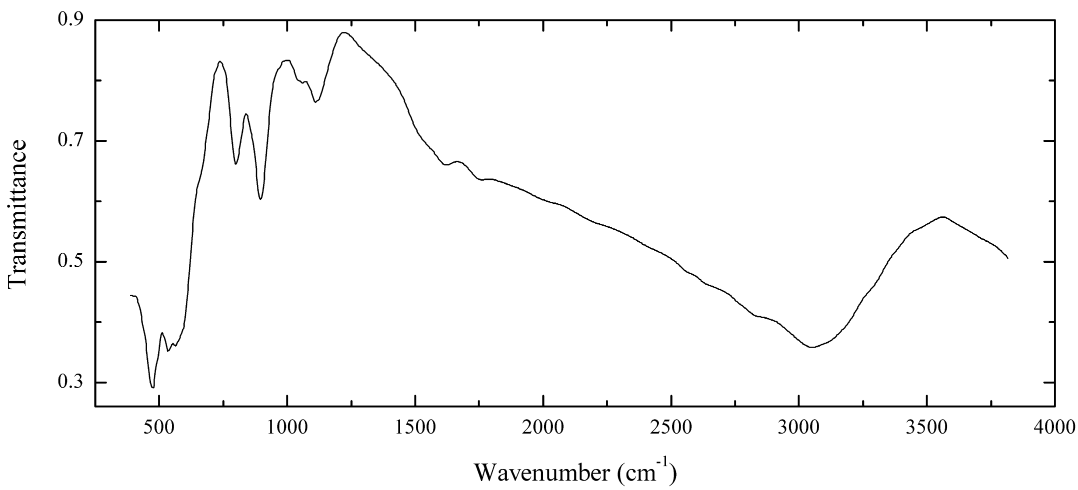


Locality: Gornoozerskii massif, Aldan shield, Siberia, Russia.

Description: Black platy twins. Metamict, amorphous. Identified by morphological features and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3400w, 3210w, 3120w, 1080w, 605s, 472s.

O200 Goethite $FeO(OH)$

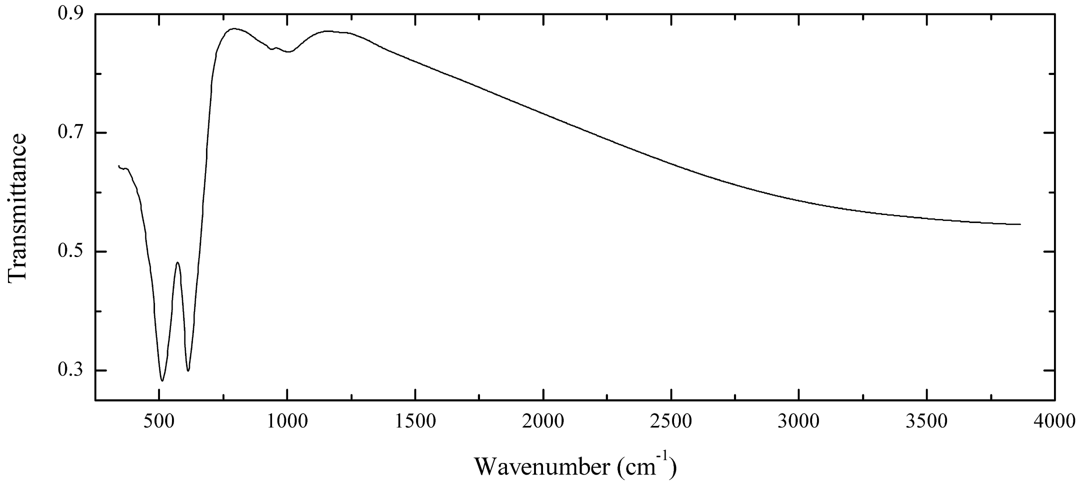


Locality: Qinglong, Guizhou province, China.

Description: Brown spherulitic crust on gypsum crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3050s, 1750w, 1615w, 1560w, 1110, 1060, 898, 800, 560s, 534s, 471s.

O201 Zincochromite $ZnCr_2O_4$

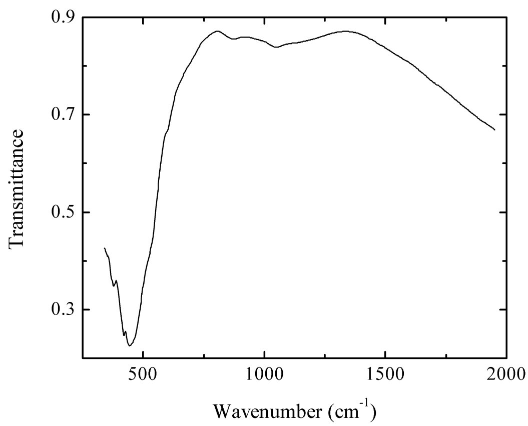


Locality: Srednyaya Padma, near Onega Lake, Karelia Russia.

Description: Black grains from the association with chromceladonite and roscoelite. The empirical formula is (electron microprobe) $(Zn_{0.55}Fe_{0.38}Mg_{0.06})(Cr_{1.81}Fe_{0.09}V_{0.06}Al_{0.03}Ti_{0.01})O_4$.

Wavenumbers (cm^{-1}): 1005w, 938w, 910sh, 611s, 512s, 465sh.

O202 Zincite ZnO

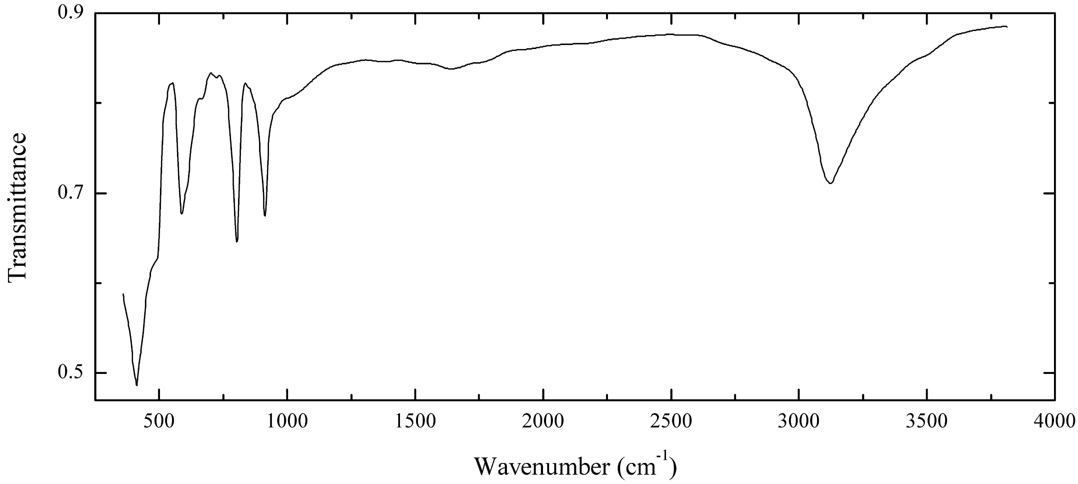


Locality: Franklin, New Jersey, USA.

Description: Deep red platy, from the association with franklinite. Identified by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1050w, 865w, 600sh, 530sh, 442s, 420s, 375.

O203 Goethite FeO(OH)

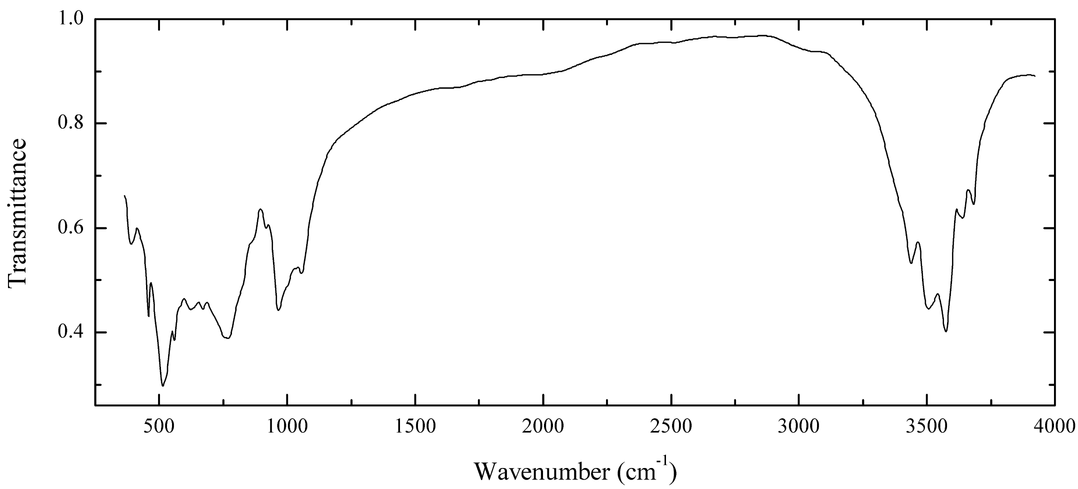


Locality: Poona, India.

Description: Brown columnar aggregate from the association with zeolites. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Fe_{0.95}V_{0.02}Cr_{0.01}Al_{0.01}Mn_{0.01})O(OH)$.

Wavenumbers (cm^{-1}): 3100, 914, 800, 600sh, 588, 480sh, 412s.

O204 Nordstrandite $Al(OH)_3$

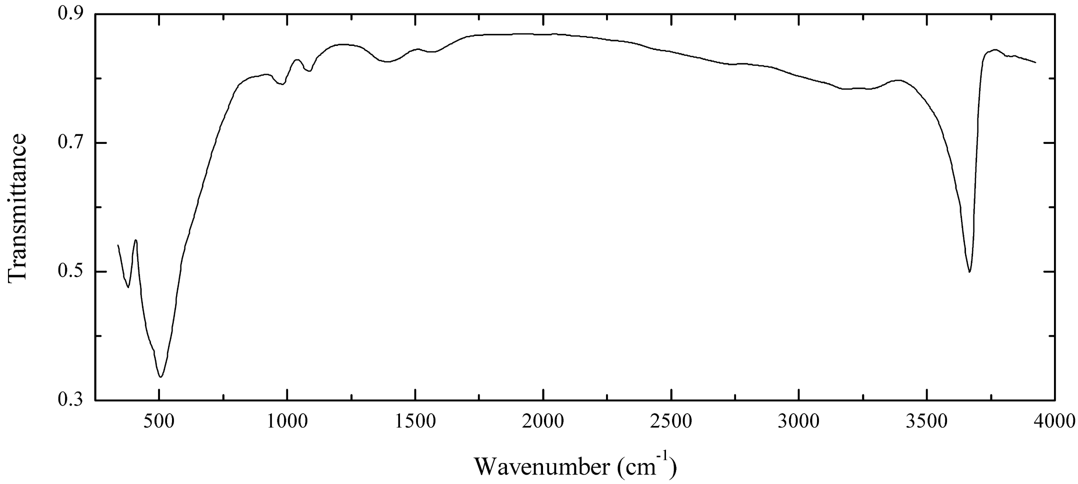


Locality: Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.

Description: Colourless platy crystals from carbonatite (from the association with ancylite-(Ce)). Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3658, 3620, 3550s, 3480s, 3414, 3360sh, 1057, 1000sh, 966, 918, 860sh, 815sh, 768s, 668, 620, 585sh, 558, 525sh, 511s, 458, 395.

O205 Theophrastite $Ni(OH)_2$

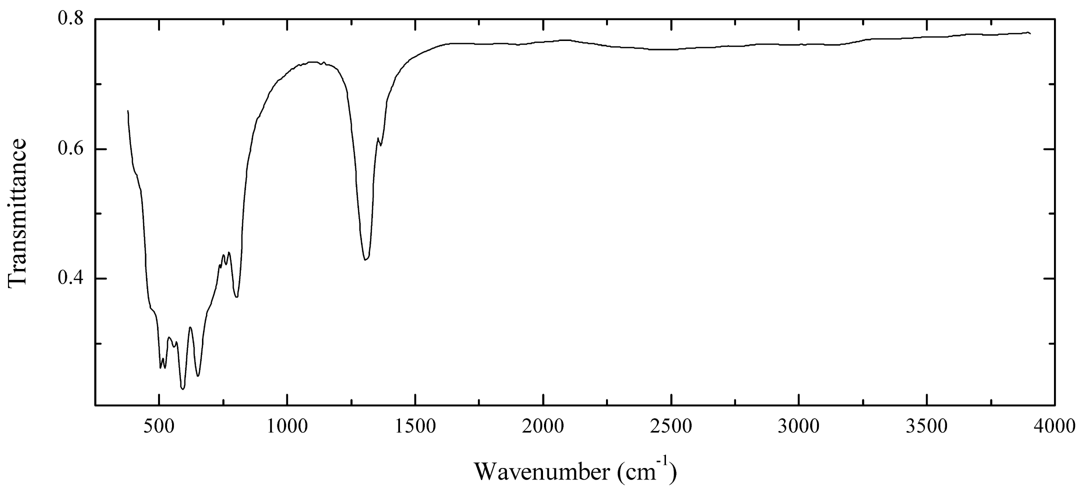


Locality: An unknown locality in Greece.

Description: Green crust from the association with serpentine and carbonate. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3655s, 1570w, 1420sh, 1375w, 1070w, 975w, 502s, 470sh, 377.

O206 Painite $CaZrBAl_9O_{18}$

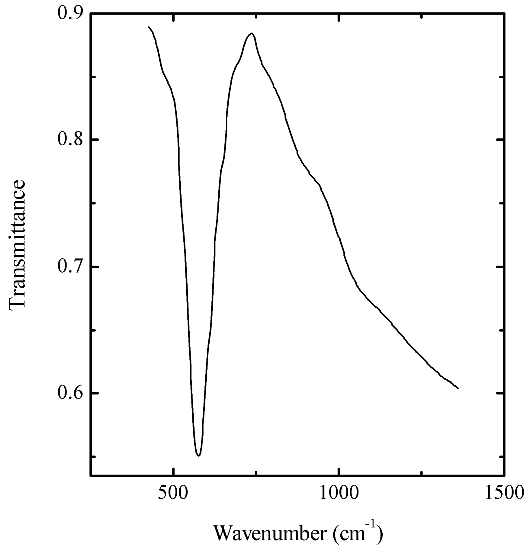


Locality: Namya, Kumon Range, Myanmar.

Description: Brownish red crystal from a placer. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1368, 1308, 798, 761, 738, 700sh, 650s, 589s, 557, 523s, 505s, 470sh, 410sh.

O207 Magnetite $Fe^{2+}Fe^{3+}_2O_4$

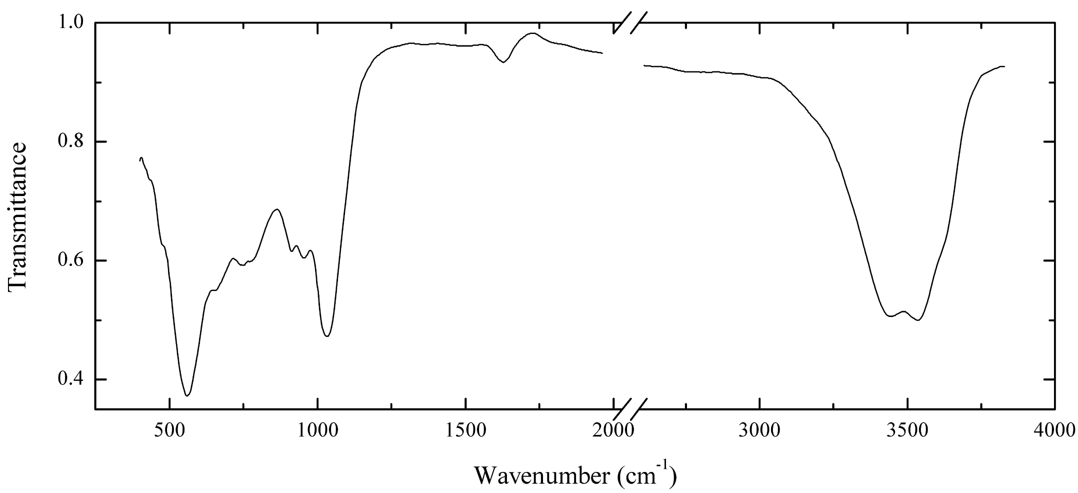


Locality: Dronino iron meteorite, near Dronino village, Ryazan region, Russia.

Description: Black ferrimagnetic octahedral crystals from the association with taenite, goethite and chlorides of Ni. Identified by IR spectrum, magnetic properties and morphological features. Streak is black. The empirical formula is (electron microprobe) $Fe_{2.93}Ni_{0.03}Co_{0.03}O_4$.

Wavenumbers (cm^{-1}): 900sh, 790sh, 572s, 385sh.

O208 Fluorhydroxide O208 $Al(OH)_2F{\cdot}nH_2O$

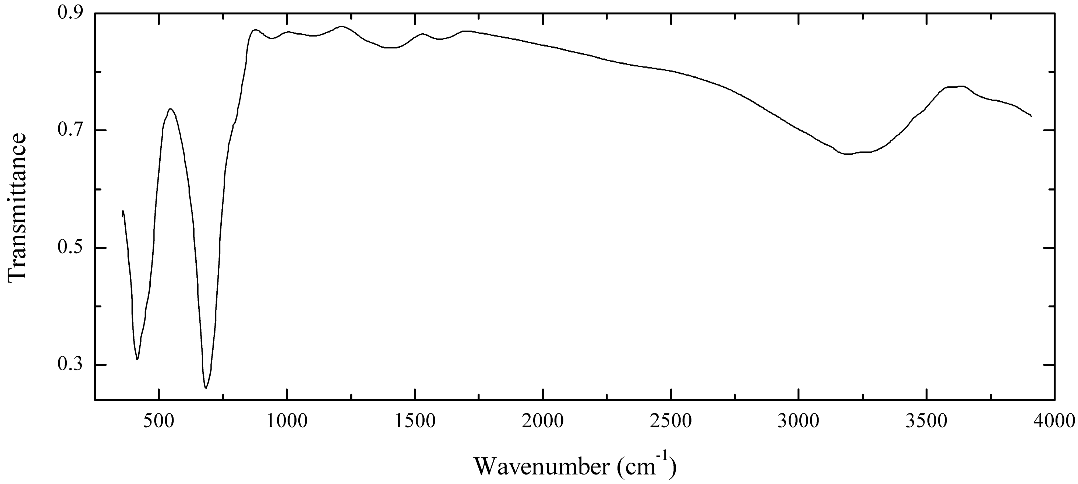


Locality: Khaidarkan Sb–Hg deposit, Fergana valley, Alai range, Osh region, Kyrgyzstan**.**

Description: Light blue massive from the association with khaidarkanite, chrysocolla, allophane and fluorite. Related to doyleite. The empirical formula is $Al_{1.00}(OH)_{1.97}F_{1.03}{\cdot}nH_2O$. The lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 4.796 (100), 4.332 (32), 4.171 (25), 2.420 (13), 2.398 (14), 2.359 (20), 2.341 (16), 1.967 (7), 1.864 (10), 1.454 (8).

Wavenumbers (cm^{-1}): 3610sh, 3520s, 3425s, 1634w, 1034s, 956, 915, 780sh, 754, 659, 561s, 478.

O209 Oxyplumboroméite $(Pb,\square)_2Sb_2O_6(O,OH)$

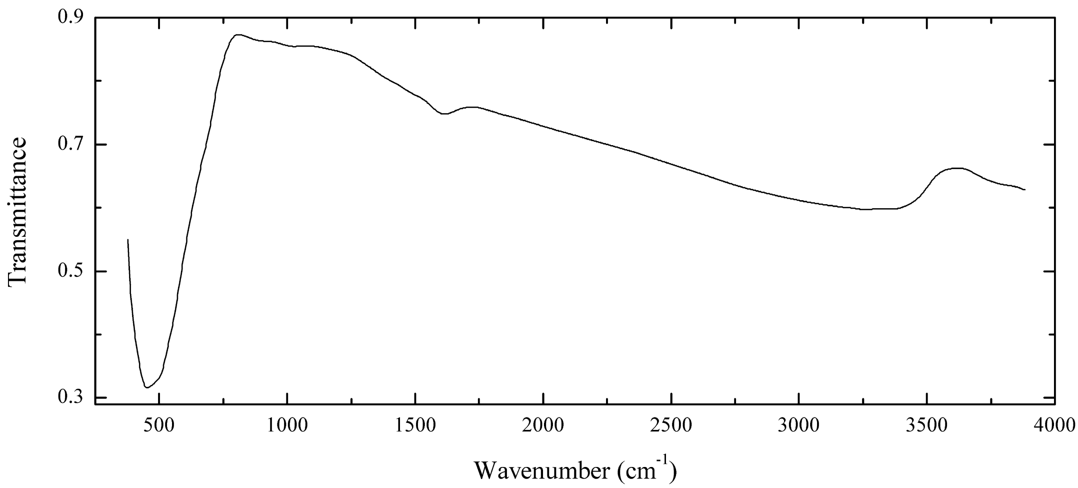


Locality: Hamman N'Bail mine, Constantine, Constantine province, Algeria.

Description: Yellow fine-grained aggregate. The empirical formula is (electron microprobe) $(Pb_{1.34}Sb^{3+}_{0.17}Zn_{0.12}Ca_{0.10})(Sb^{5+}_{1.89}Fe_{0.11})O_6(O,OH)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3200, 1600w, 1410w, 1100w, 940w, 780sh, 682s, 416s.

O210 Hydrous oxide O210 $CuMn^{4+}{}_3O_7\cdot nH_2O$

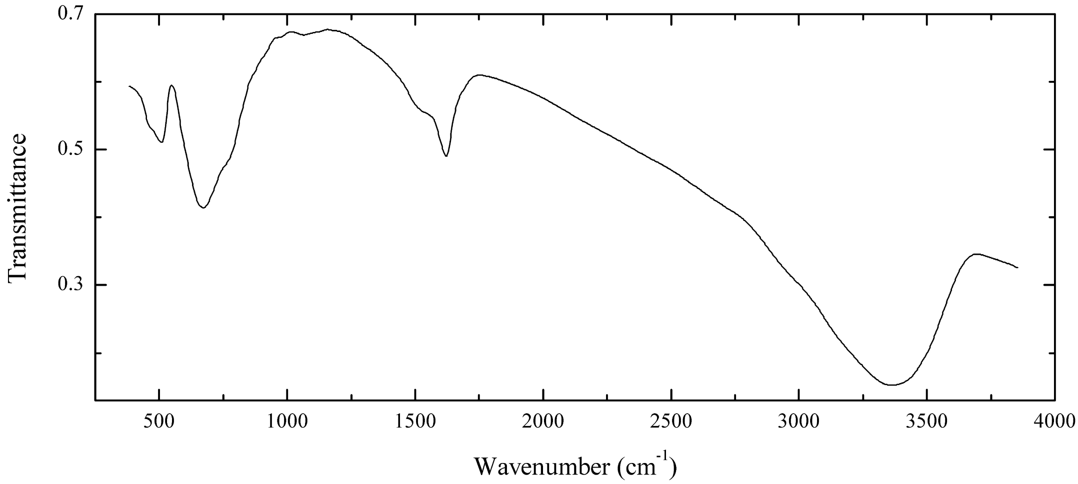


Locality: Kremikovtsi iron mine, near Sofia, Bulgaria.

Description: Brown pseudostalactites from the association with goethite, malachite, azurite and segnitite. Related to chalcophanite. The empirical formula is (electron microprobe) $Ba_{0.1}Cu_{1.0}(Mn_{2.8}Fe_{0.1}Sb_{0.1})O_7\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3320, 3000sh, 1610w, 1025w, 885w, 670sh, 500sh, 450s, 400sh.

O211 Droninoite $Ni_3Fe^{3+}Cl(OH)_8{\cdot}2H_2O$

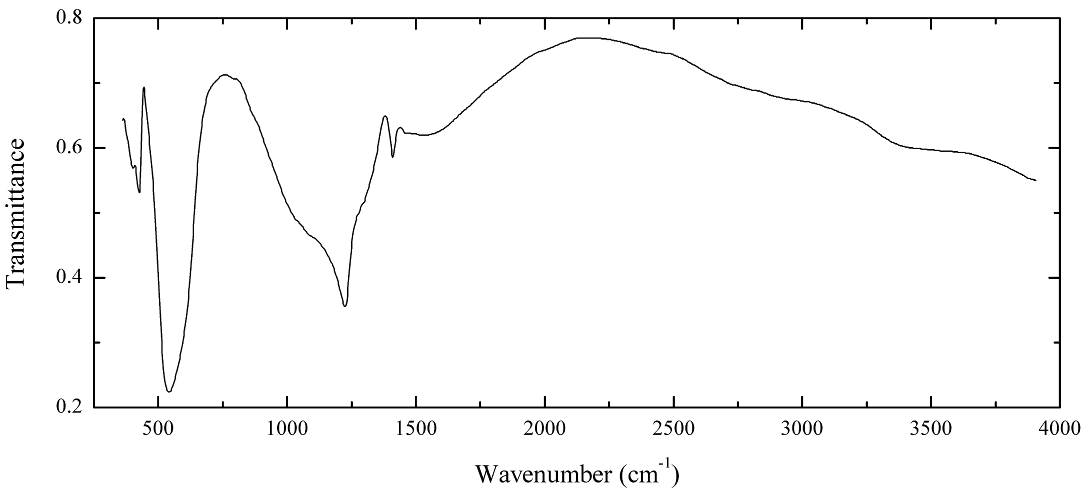


Locality: Weathered iron meteorite Dronino, Dronino village, Kasimov District, Ryazan' region, Russia (type locality).

Description: Brownish green earthy aggregate from the association with taenite, violarite, troilite, chromite, goethite, lepidocrocite, nickelbischofite and X-ray amorphous Fe^{3+} hydroxides. Holotype sample. Trigonal, space group *R*-3*m*, *R*3*m* or *R*32; $a = 6.206(2)$, $c = 46.184(18)$ Å; $V = 1540.4$ (8) Å^3. The empirical formula is $Ni_{2.16}Fe^{2+}_{0.75}Fe^{3+}_{0.97}Cl_{1.62}(OH)_{7.10}{\cdot}2.28H_2O$. $D_{calc} = 2.857$ g/cm^3. Mean refraction index is 1.72(1). The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 7.76 (100) (006), 3.88 (40) (0.0.12), 2.64 (25) (202, 024), 2.32 (20) (0.2.10), 1.965 (0.2.16).

Wavenumbers (cm^{-1}): 3375s, 3210sh, 3000sh, 1628, 1540sh, 1058w, 750sh, 674s, 508, 465sh.

O212 Guyanaite CrO(OH)

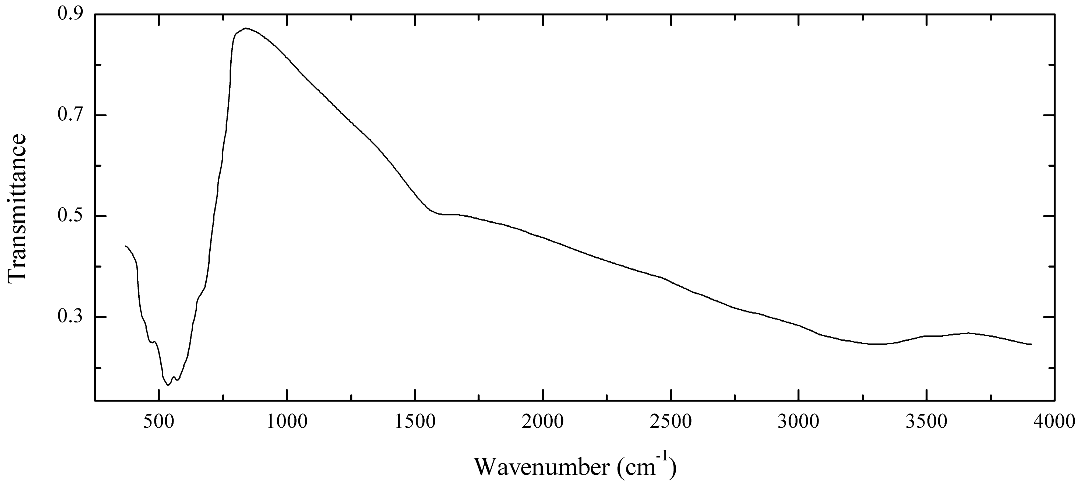


Locality: Merume river, Mazaruni district, Guyana (type locality).

Description: Brown pebble. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.23 (100), 2.531 (20), 2.437 (50), 2.180 (40), 2.113 (20), 1.721 (30), 1.635 (30), 1.612 (20), 1.518 (10), 1.477 (10), 1.419 (20), 1.340 (10) (Debye-Scherer method, Cu radiation).

Wavenumbers (cm^{-1}): 3400w, 2800sh, 1565w, 1515w, 1460w, 1412, 1300sh, 1225s, 1090sh, 537s, 474, 405.

O213 Woodruffite $(Zn,Mg)_{3-x}(Mn^{4+},Mn^{3+},Mg)_{14}O_{28}\cdot 9\text{–}10H_2O$

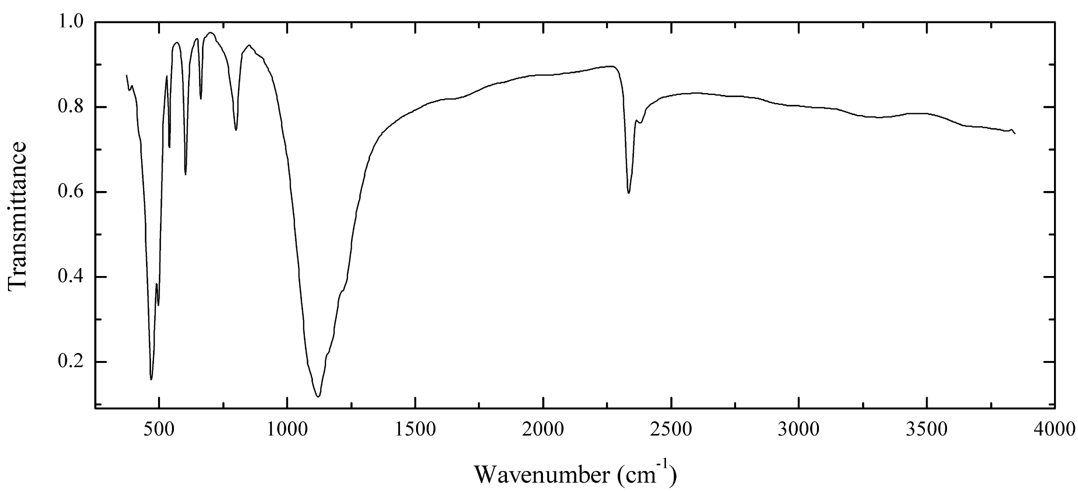


Locality: Pegmatite No. 62, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Black nodule from the association with todorokite, natrolite and polylithionite. The empirical formula is (electron microprobe) $Zn_{2.0}Mg_{4.6}Mn_{12.4}O_{28}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3325, 1600w, 760sh, 665sh, 570s, 535s, 470s, 430sh.

O215 Melanophlogite $(CH_4,N_2)_{2-x}(N_2,CO_3)_{6-y}Si_{46}O_{92}$

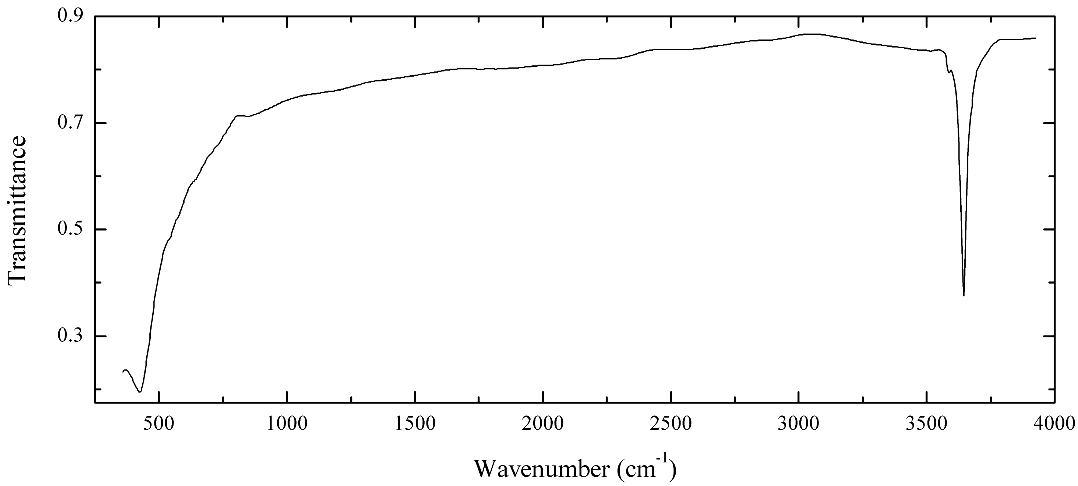


Locality: Rio Fortullino, Rosignano Marittimo, Lovorno province, Tuscany, Italy.

Description: Colourless pseudocubic crystals from the association with calcite. Identified by morphological features and IR spectrum.

Wavenumbers (cm^{-1}): 2375w, 2330, 1230sh, 1165sh, 1118s, 798, 660, 602, 539, 496, 466s, 385w.

O216 Portlandite $Ca(OH)_2$

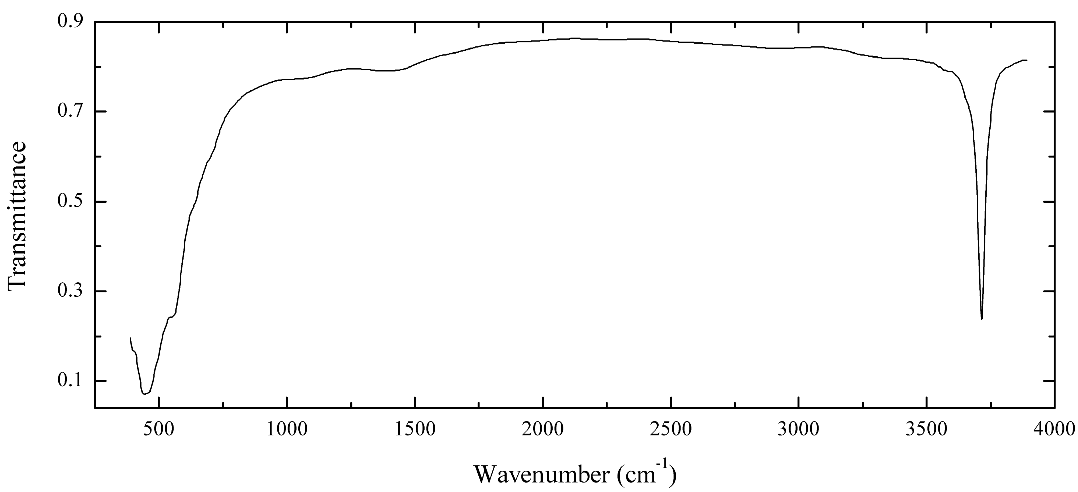


Locality: Ettringer Bellerberg, near Meien, Eifel, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Colourless platy crystals from the association with afwillite and ettringite. Identified by morphological features, IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3645s, 3585w, 427s.

O217 Brucite $Mg(OH)_2$

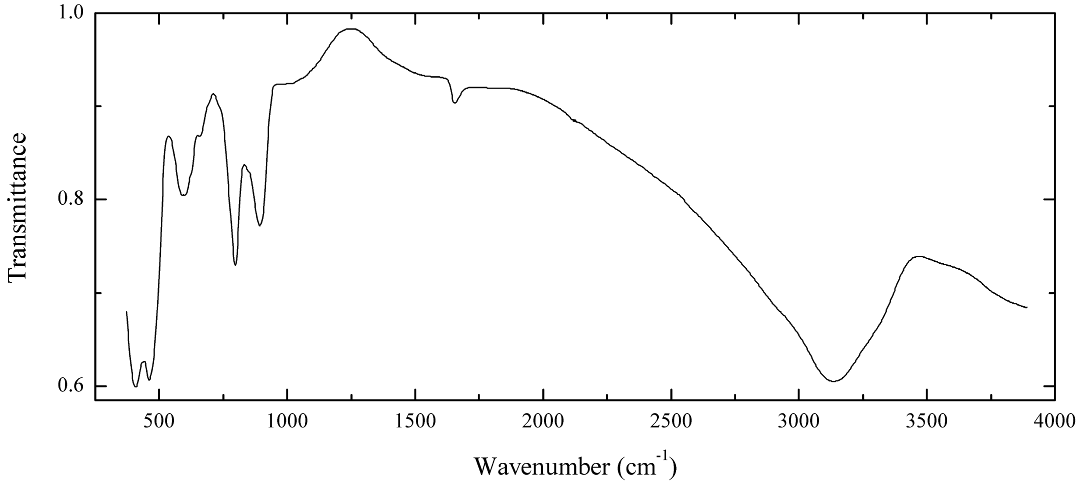


Locality: An unknown kimberlite pipe, Sakha (Yakutia) Republic, Siberia, Russia.

Description: Greenish-brown grain. Fe-bearing variety. The empirical formula is (electron microprobe) $(Mg_{0.94}Fe_{0.05}Mn_{0.01})(OH)_2$.

Wavenumbers (cm^{-1}): 3705s, 550, 443s, 415sh.

O218 Goethite FeO(OH)

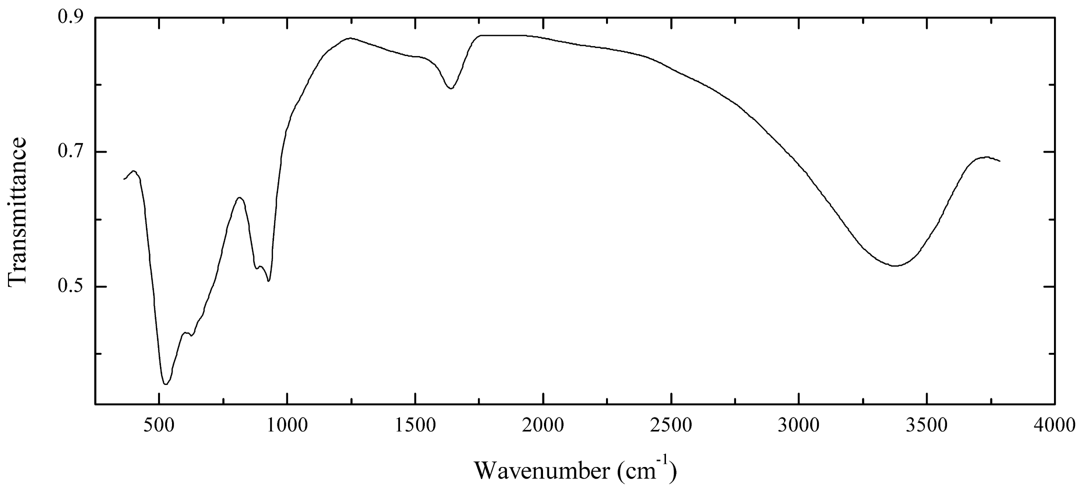


Locality: Hilarion mine, Kamariza mines, Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Brown scaly aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3300sh, 3120s, 1655w, 1030sh, 894, 797, 655sh, 595, 465s, 412s.

O219 Hochelagaite $(Ca,Na)(Nb,Ti)_4O_{11}·8H_2O$

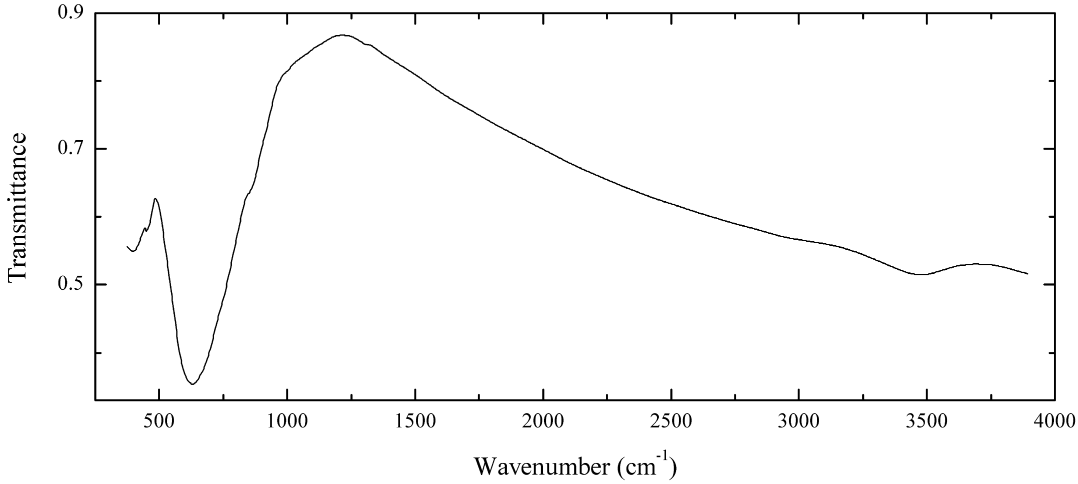


Locality: Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.

Description: Grey fibrous aggregate from carbonatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.46}Ba_{0.18}K_{0.07}Na_{0.06}Sr_{0.06}Th_{0.03})(Nb_{2.45}Ti_{1.10}Zr_{0.18}Fe_{0.15}Mg_{0.12})O_{11}·nH_2O$.

Wavenumbers (cm^{-1}): 3360s, 1633, 928, 883, 660sh, 623s, 527s.

O220 Isolueshite (Na,La,Ca)(Nb,Ti)O_3

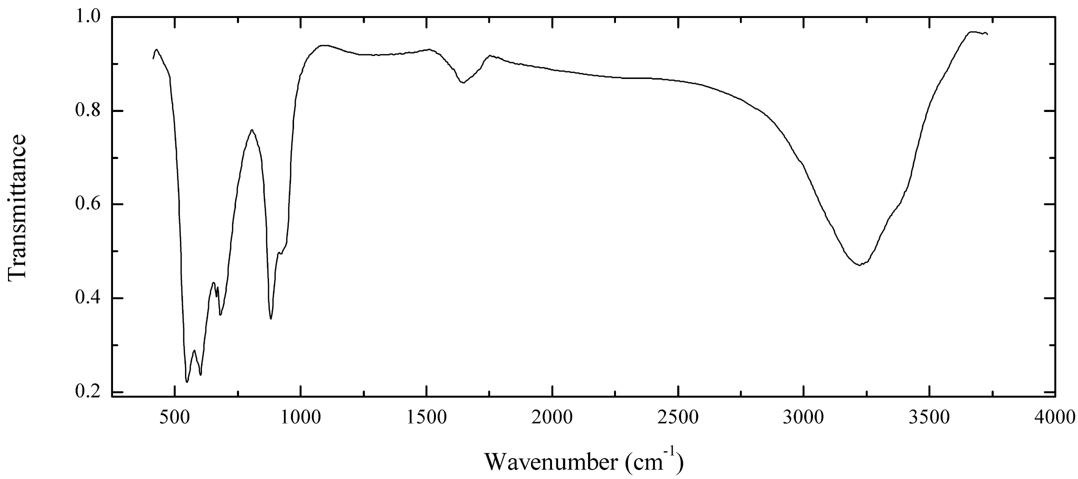


Locality: Kirovskii apatite mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Dark brown crystal from the association with microcline, sodalite and natrolite. The empirical formula is (electron microprobe) $(Na_{0.75}Ca_{0.1}Ce_{0.05}La_{0.05}Th_{0.05})(Nb_{0.6}Ti_{0.4})O_3$.

Wavenumbers (cm^{-1}): 3420w, 850sh, 609s, 460sh, 400.

O221 Ternovite (Mg,Ca)$(Nb,Ti)_4O_{11}\cdot 10H_2O$ (?)

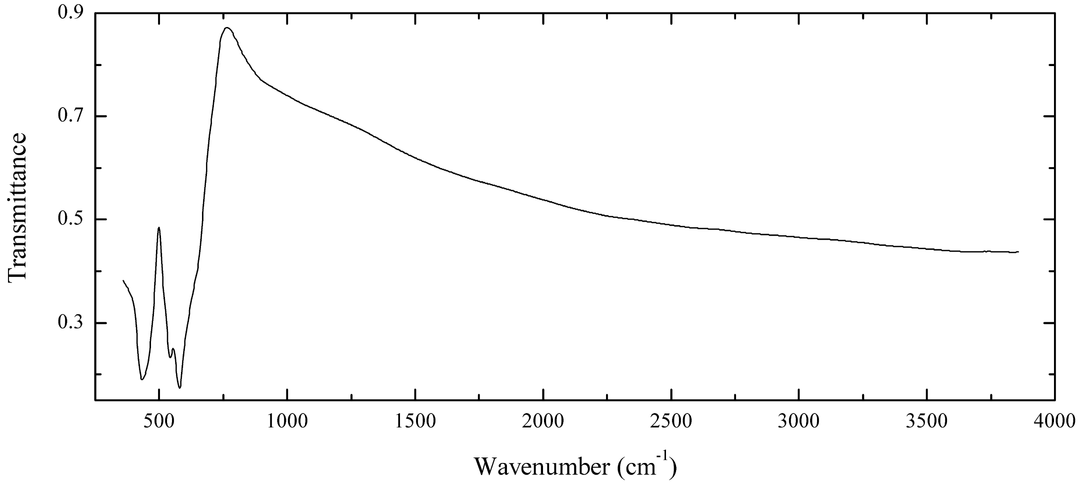


Locality: Vuoriyarvi massif, Northern Karelia, Russia.

Description: White fibrous aggregate from carbonatite. Investigated by V.N. Yakovenchuk.

Wavenumbers (cm^{-1}): 3222, 1667, 1600sh, 940sh, 922, 878, 678, 600s, 546s.

O222 Barioferrite $BaFe^{3+}{}_{12}O_{19}$

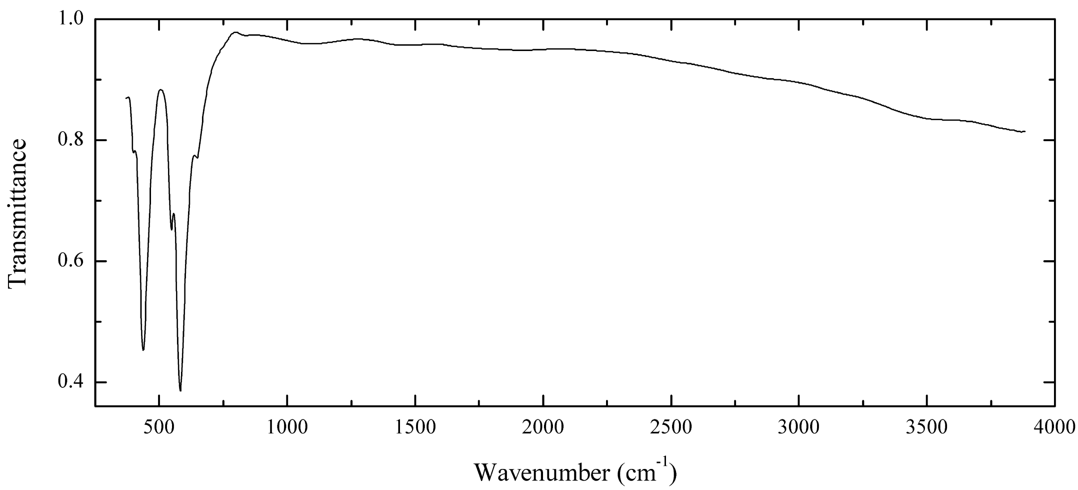


Locality: Southern slope of Har Ye'elim Mt., Hatrurim formation ("Mottled Zone"), Israel (type locality).

Description: Black aggregate of microscopic platy crystals from the association with baryte, calcite, magnetite and maghemite. Holotype sample. Hexagonal, space group $P6_3/mmc$, $a = 5.875$ (3) Å, $c = 23.137$ (19) Å; V = 691.6 (5) Å^3; $Z = 2$. The empirical formula is $Ba_{0.95}Fe^{3+}{}_{12.03}O_{19}$. Ferrimagnetic. $D_{calc} = 5.31$ g/cm^3. Reflectance values R_O/R_E, % (λ, nm) are 24.51/22.80 (470), 24.17/22.25 (546), 23.65/21.68 (589), 22.67/20.85 (650). The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 2.938 (46) (110), 2.770 (100) (107), 2.624 (94) (114, 200), 2.420 (44) (203), 2.225 (40) (205), 1.627 (56) (304, 2.0.11).

Wavenumbers (cm^{-1}): 635sh, 582s, 544s, 433s.

O223 Barioferrite $BaFe^{3+}{}_{12}O_{19}$

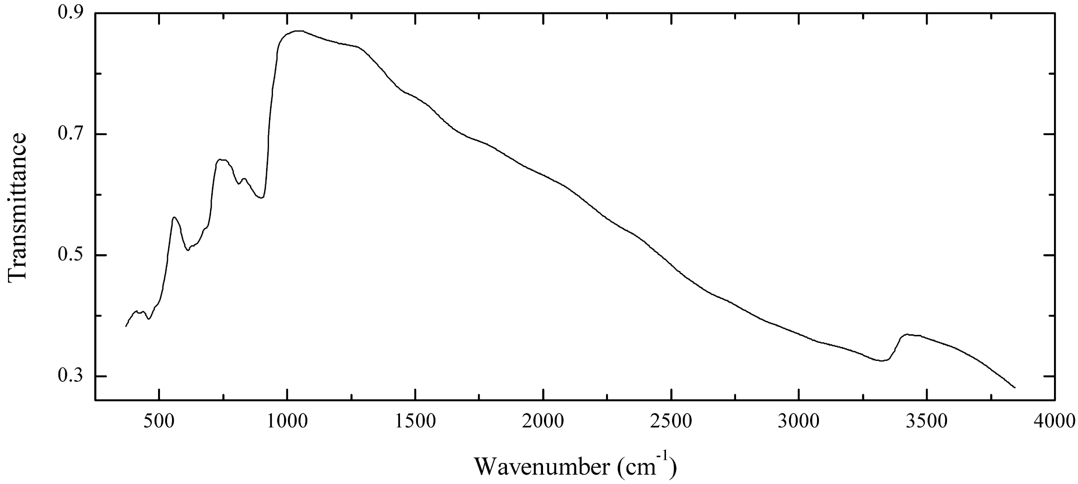


Locality: Synthetic.

Description: Brown powdery. Confirmed by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 645w, 583s, 547, 437s, 400w.

O224 Montroseite $(V^{3+},Fe^{3+})O(OH)$

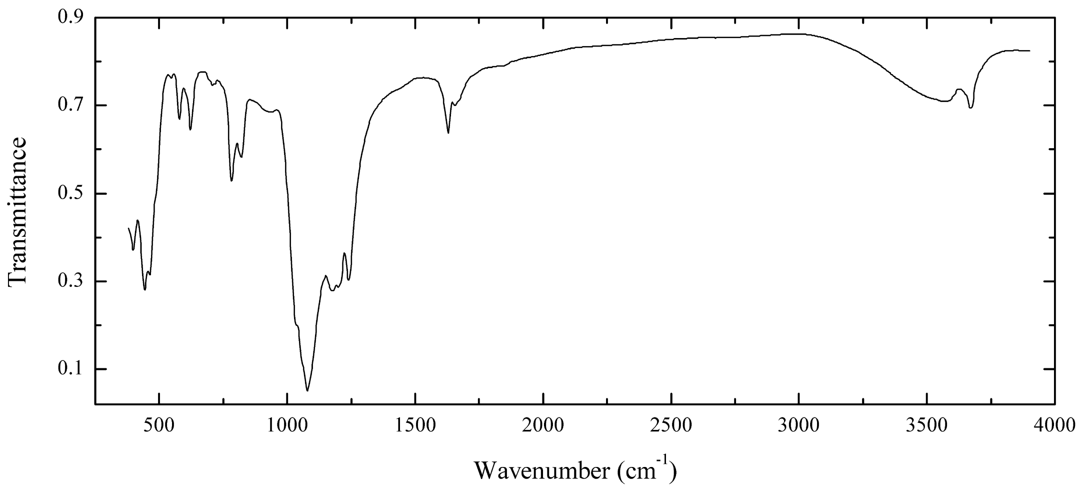


Locality: Práchovice, Železné Hory, Bohemia, Czech Republic.

Description: Black columnar aggregate from the association with Mn-rich calcite. The empirical formula is (electron microprobe) $(V_{0.72}Fe_{0.25}Al_{0.03})O(OH)$.

Wavenumbers (cm^{-1}): 3310s, 2900sh, 2750sh, 1680w, 1450w, 898, 805, 680sh, 635sh, 611, 460s.

O226 Silhydrite $3SiO_2 \cdot H_2O$

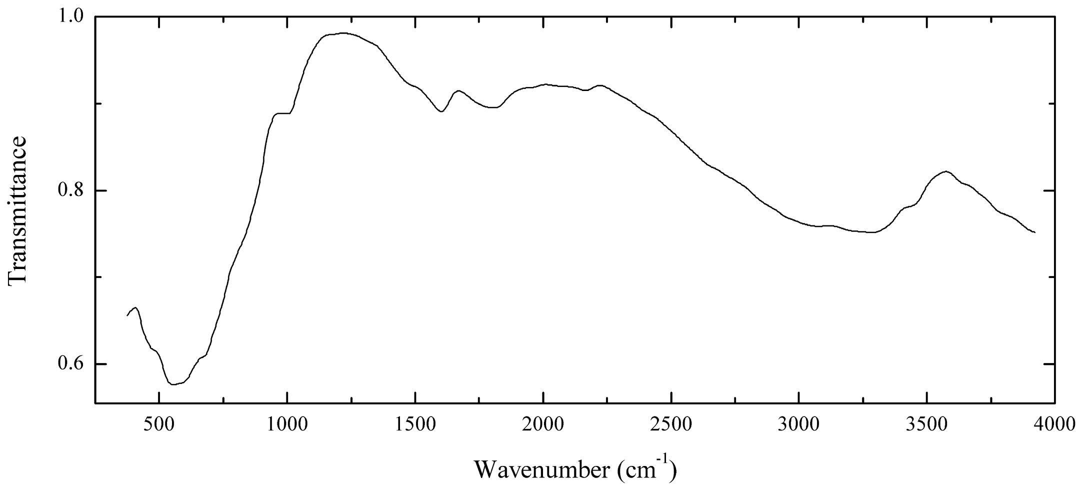


Locality: Trinity mining claim, Trinity Center, Trinity Co., California, USA (type locality).

Description: White massive. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3650, 3550, 1660w, 1630, 1240s, 1200s, 1176s, 1080s, 1060sh, 1035s, 936w, 820, 783, 710w, 623, 575, 545w, 490sh, 462s, 444s, 401.

O227 Menezesite $Ba_2MgZr_4(BaNb_{12}O_{42})\cdot 12H_2O$

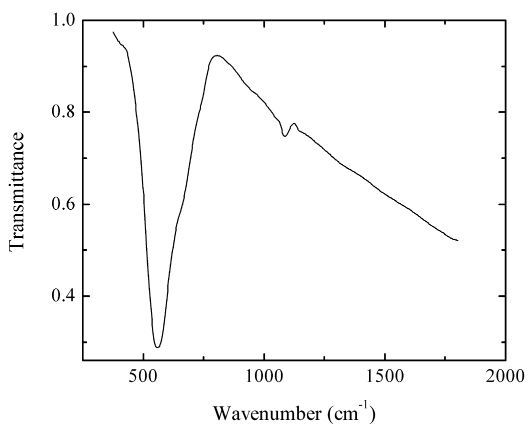


Locality: Jacupiranga mine, Cajati Co., São Paulo state, Brazil (type locality).

Description: Reddish brown rhombododecahedra from the association with dolomite, calcite, magnetite, clinohumite, phlogopite, ancylite-(Ce), strontianite, pyrite and tochilinite. Holotype sample. Cubic, space group *Im*-3, $a = 13.017(1)$ Å, V = 2206(1) Å^3, Z = 2. The empirical formula is $(Ba_{1.47}K_{0.53}Ca_{0.31}Ce_{0.17}Nd_{0.10}Na_{0.06}La_{0.02})(Mg_{0.94}Mn_{0.23}Fe_{0.23}Al_{0.03})(Zr_{2.75}Ti_{0.96}Th_{0.29})(Ba_{0.72}Th_{0.26}U_{0.02})(Nb_{9.23}Ti_{2.29}Ta_{0.26}Si_{0.12}O_{42}\cdot 12H_2O$. $D_{calc} = 4.181$ g/cm^3). Optically isotropic, $n_{calc} = 2.034$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 9.183 (100), 4.592 (12), 4.136 (11), 3.256 (16), 3.070 (13), 2.923 (11), 2.655 (13), 1.741(21).

Wavenumbers (cm^{-1}): 3425, 3280, 3060sh, 2165w, 1800, 1605, 1500sh, 1005, 830sh, 675, 590sh, 560s, 480sh.

O228 Pyrolusite MnO_2

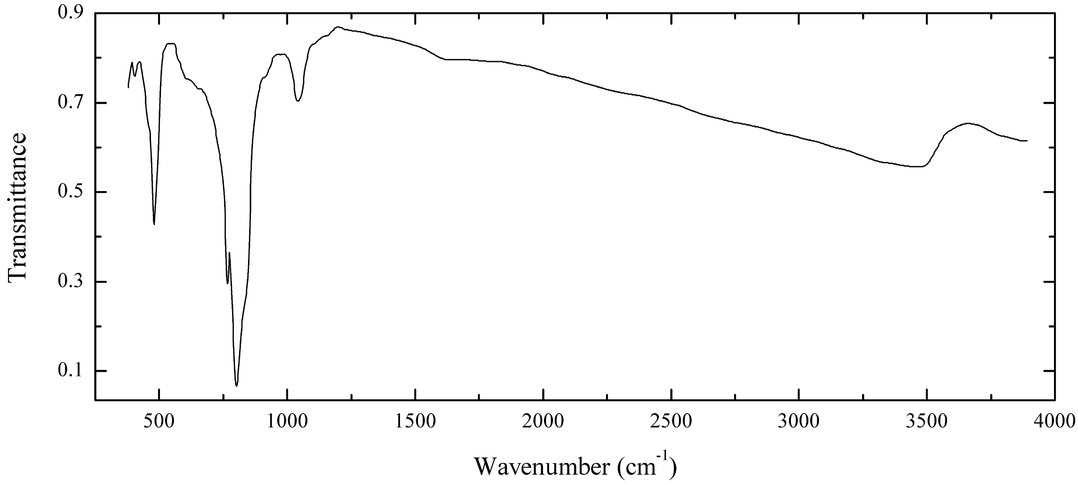


Locality: Berezovskoe gold deposit, Middle Urals, Russia.

Description: Black crystals. Identified by single-crystal X-ray diffraction pattern and qualitative electron microprobe analysis. Unit-cell parameters are $a = 4.42(2)$, $c = 2.882(12)$ Å.

Wavenumbers (cm^{-1}): 1075w, 645sh, 558s.

O230 Arsenolite As_2O_3

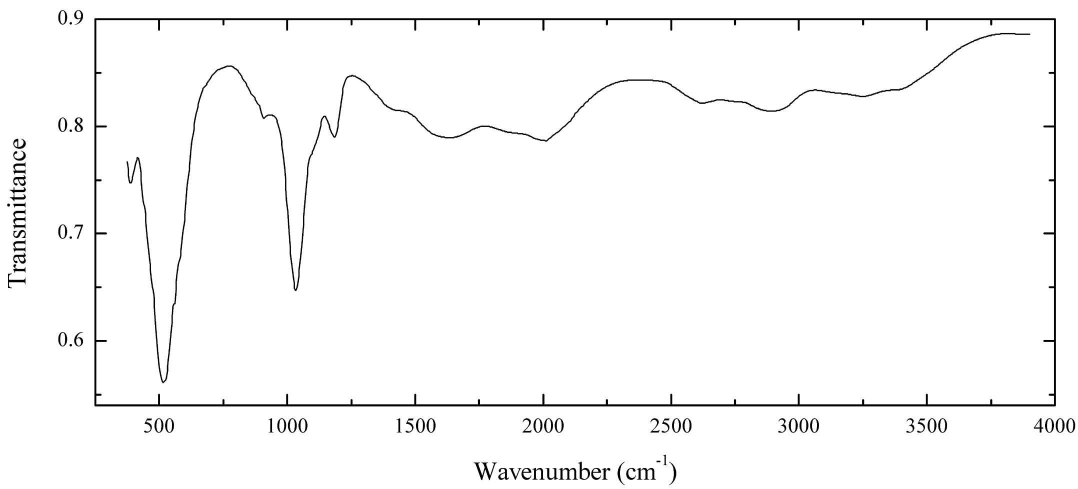


Locality: Plaka porphyry deposit, Plaka, Lavrion mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Colourless crystals from the association with stibnite and arsenic. Identified by IR spectrum and qualitative electron microprobe analysis. Contains admixture of a hydrous phase (the bands at 3,460, 1,610, 1,041 and 620 cm^{-1}).

Wavenumbers (cm^{-1}): 3460, 1610w, 1041, 830sh, 800s, 766, 620sh, 479s, 403w.

O231 Rilandite $(Cr^{3+},Al)_6SiO_{11}\cdot 5H_2O$ (?)

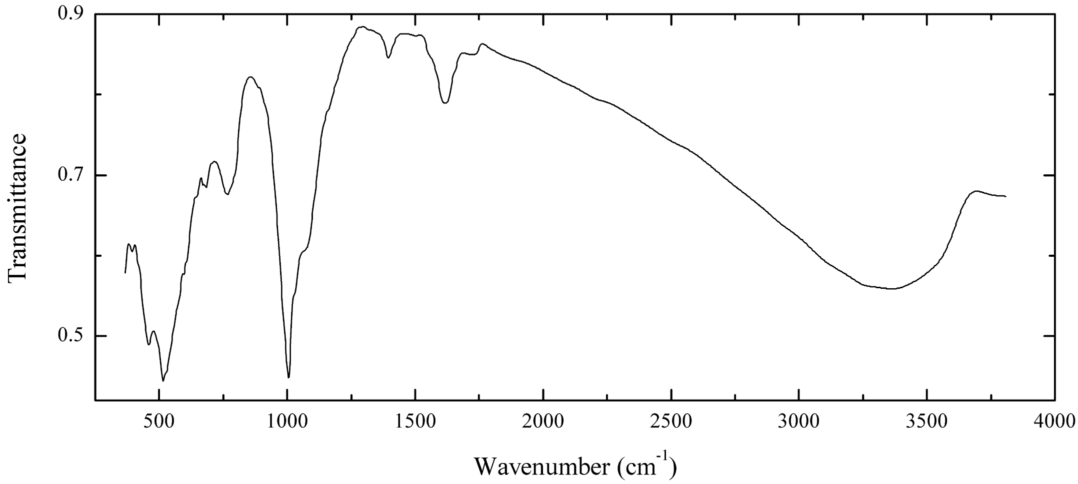


Locality: 21 km ENE of Meeker, Rio Blanco Co., Colorado, USA.

Description: Brown massive. Probably a fine mixture of a hydroxide and a clay mineral. Needs further investigation. Holotype sample. The empirical formula is (electron microprobe) $Cr_{5.16}Al_{0.76}Fe_{0.31}Si_{0.78}(O,OH)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3370sh, 3235w, 2900, 2620, 2000, 1620, 1185, 1136s, 908w, 517s, 387.

O232 Doloresite $H_8V^{4+}O_{16}$

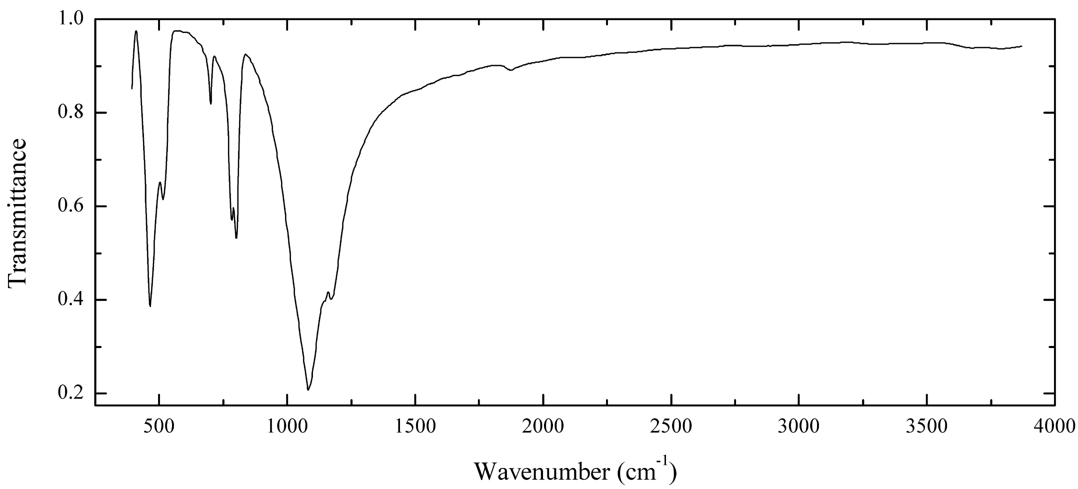


Locality: Mineral Joe # 1 mine, Colorado, USA.

Description: Dark green massive from the association with quartz. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3310, 1710w, 1615, 1395w, 1075sh, 1030sh, 1005s, 762, 676w, 518s, 460.

O233 Quartz SiO_2

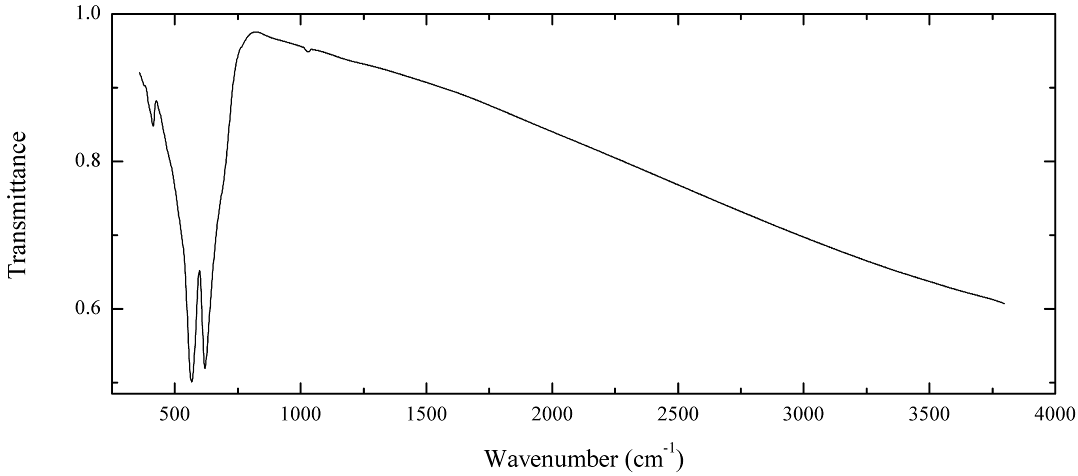


Locality: San Vito quarry, Ercolano, Monte Somma, Somma-Vesuvius complex, Naples province, Campania, Italy.

Description: Colourless rounded grains. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1877w, 1173s, 1150sh, 1084s, 798, 780, 696, 513, 460s.

O234 Eskolaite Cr_2O_3

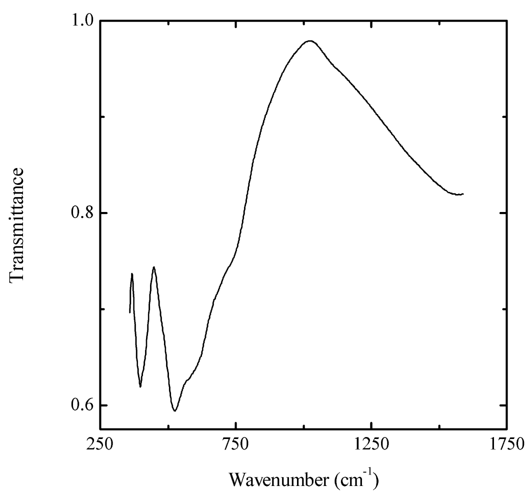


Locality: Merume river, Mazaruni district, Guyana.

Description: Black grain from the association with bracewellite and rutile. The empirical formula is (electron microprobe) $Cr_{1.66}Fe_{0.20}Al_{0.12}Ti_{0.02}O_3$.

Wavenumbers (cm^{-1}): 1030w, 685sh, 620s, 567s, 413.

O235 Rutile TiO_2

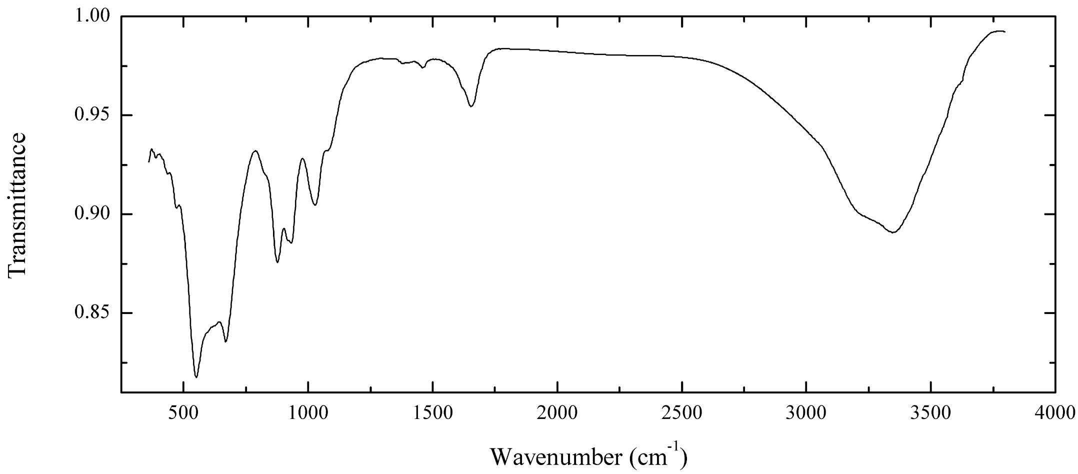


Locality: Merume river, Mazaruni district, Guyana.

Description: Black grain from the association with bracewellite and eskolaite. The empirical formula is (electron microprobe) $(Ti_{0.97}Cr_{0.015}Fe_{0.01}Nb_{0.01})O_2$.

Wavenumbers (cm^{-1}): 730sh, 585sh, 526s, 400s.

O236 Hochelagaite $(Ca,Na)(Nb,Ti)_4O_{11}·8H_2O$

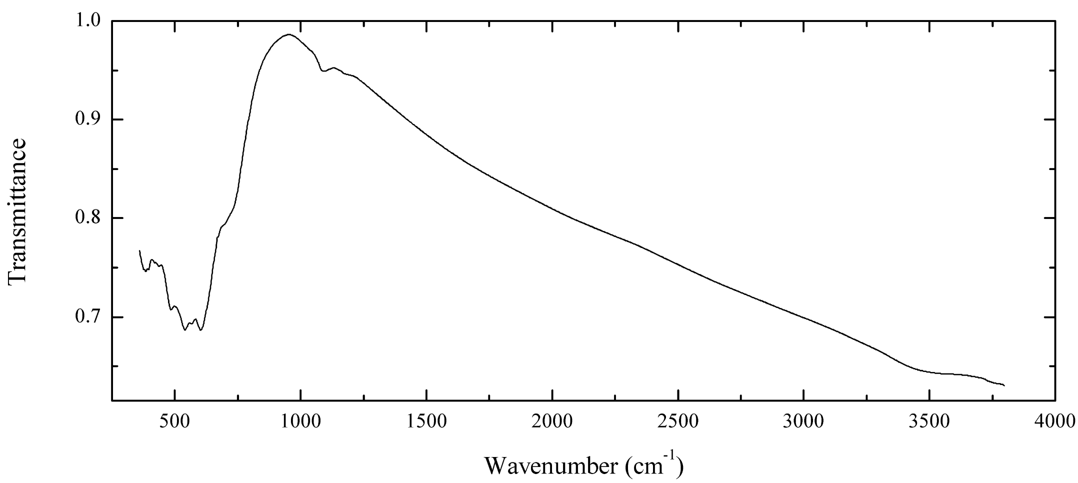


Locality: Karavai Mt., Vishnevye (Vishnyovye) Mts., Chelyabinsk region, South Urals, Russia.

Description: White fibrous aggregate from the association with natrolite and gibbsite. Investigated by I.V. Pekov. Monoclinic, $a = 19.81$, $b = 12.934$, $c = 6.492$ Å, $\beta = 92.86°$. The empirical formula is (electron microprobe) $(Ca_{0.86}K_{0.06}Sr_{0.05}Mn_{0.02}Ba_{0.02}Mg_{0.01})(Nb_{3.81}Ti_{0.16}Ta_{0.06}Fe_{0.01})O_{11}·nH_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 4.94 (50) (400); 3.43 (80) (421); 3.24 (30) (040, 002); 3.21 (100) (012, -112); 2.73 (60) (-222, 440, 531); 2.24 (70) (612). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3615sh, 3346, 3240sh, 1653, 1458w, 1390w, 1074, 1028, 932, 920sh, 877, 830sh, 669s, 620sh, 590sh, 551s, 475, 443w, 392w.

O237 Gramaccioliite-(Y) $(Pb,Sr)(Y,Mn)Fe^{3+}{}_2(Ti,Fe^{3+})_{18}O_{38}$

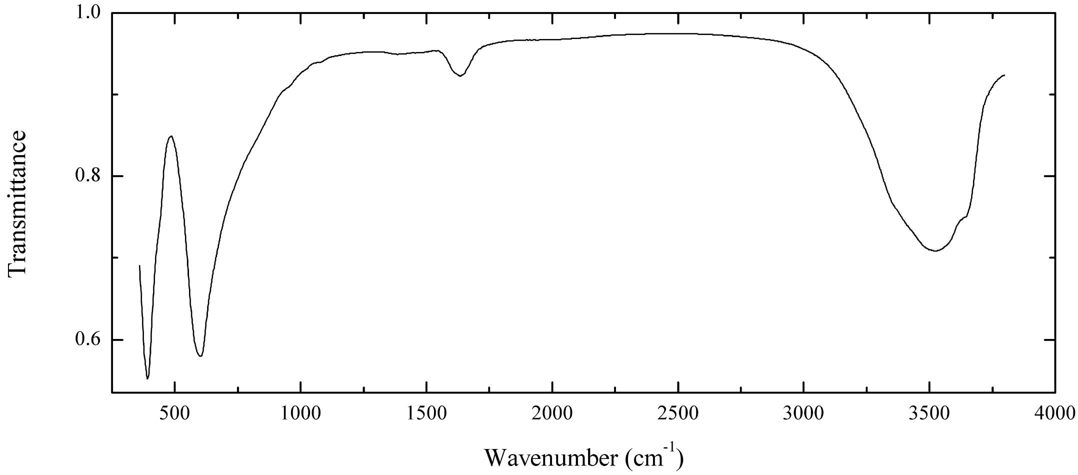


Locality: An abandoned shaft at Novo Horizonte, Bahia, Brazil.

Description: Black tabular crystal from the association with quartz, rutile and hematite. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $(Pb_{0.70}Sr_{0.24}Ce_{0.06})(Y_{0.58}Mn_{0.41})(Fe_{1.53}Zn_{0.47})(Ti_{13.22}Fe_{4.66}Nb_{0.12})O_{38}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540w, 1190w, 1095w, 730sh, 695sh, 602s, 568s, 541s, 488, 440, 388.

O238 Iowaite $Mg_6Fe^{3+}{}_2(OH)_{16}Cl_2{\cdot}4H_2O$

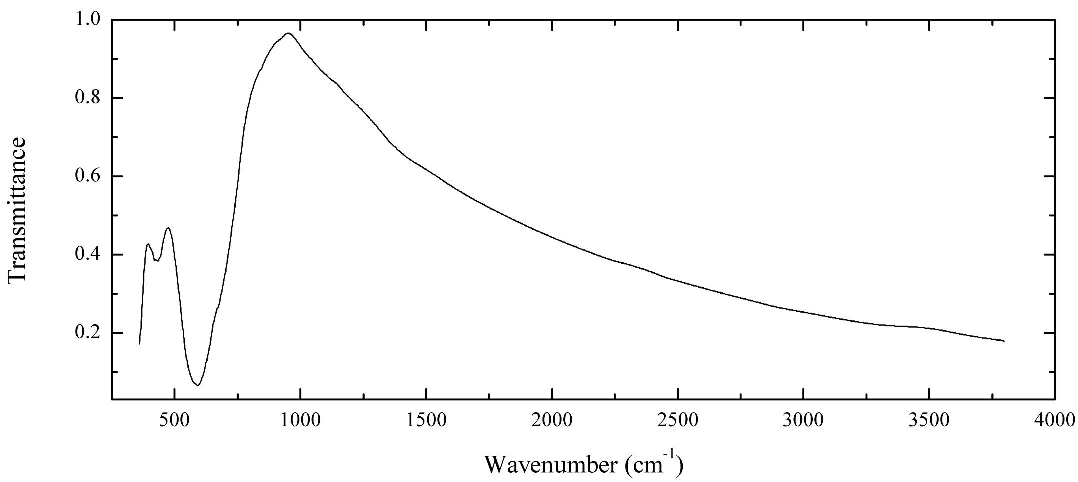


Locality: Kyzyl-Uyuk stream, Terektin ridge, Altai Mts., Siberia, Russia.

Description: Lilac crust on serpentine. Cr-rich variety. The empirical formula is (electron microprobe) $Mg_{6.0}(Fe_{0.95}Cr_{0.85}Al_{0.2})Cl_{1.8}(CO_3,SO_4)_x(OH)_{16}{\cdot}nH_2O$ ($x \approx 0.1$, $n \approx 4$). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3640sh, 3520s, 3370sh, 1635, 1385w, 1073w, 1020sh, 940sh, 810sh, 600s, 393s.

O239 Bismutotantalite $Bi(Ta,Nb)O_4$

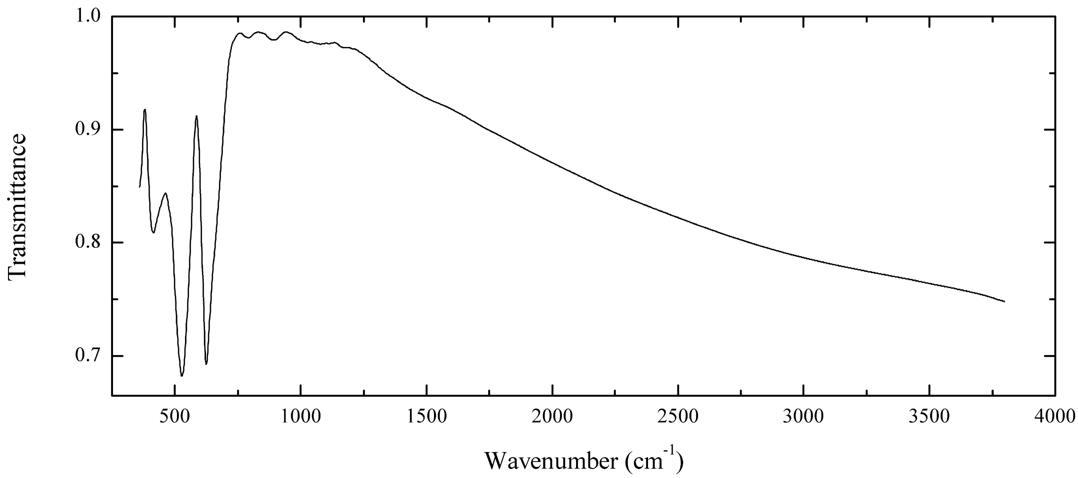


Locality: Gamba Hill, Busiro Co., Uganda (type locality).

Description: Dark brown grain from the association with muscovite and cassiterite. The empirical formula is (electron microprobe) $Bi_{0.95}Sb_{0.02}Ca_{0.02}Mg_{0.02}K_{0.01}(Ta_{0.78}Nb_{0.22})O_4$.

Wavenumbers (cm^{-1}): 675sh, 592s, 434, (350s).

O240 Hetaerolite $ZnMn^{3+}{}_2O_4$

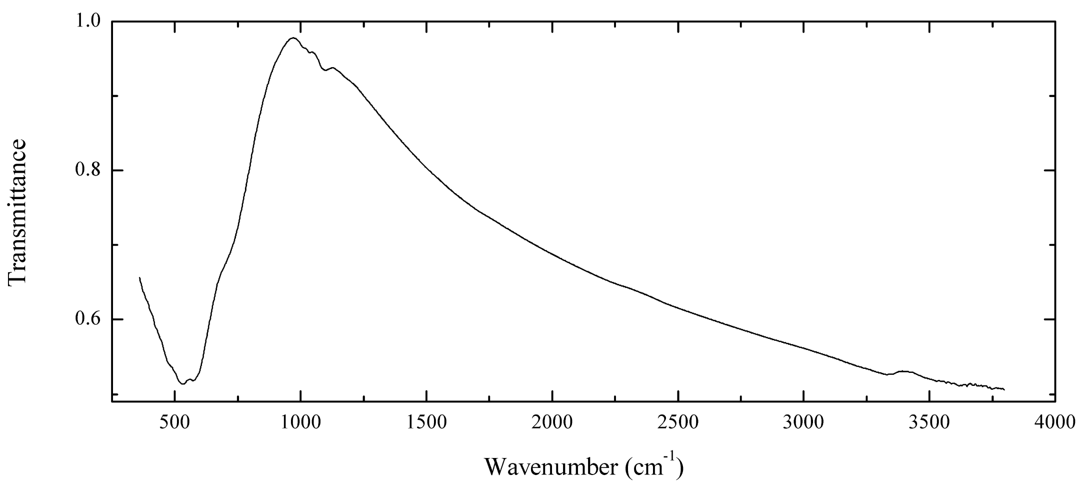


Locality: Esperanza mine, Agios Konstantinos (Kamariza), Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Black dipyramidal crystals from the association with chalcophanite, pyrolusite and goethite. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $(Zn_{0.94}Mn_{0.06})Mn_{2.00}O_4$.

Wavenumbers (cm^{-1}): 625s, 528s, 416.

O241 Almeidaite $PbZn_2(Mn,Y)(Ti,Fe^{3+})_{18}O_{37}(OH,O)$

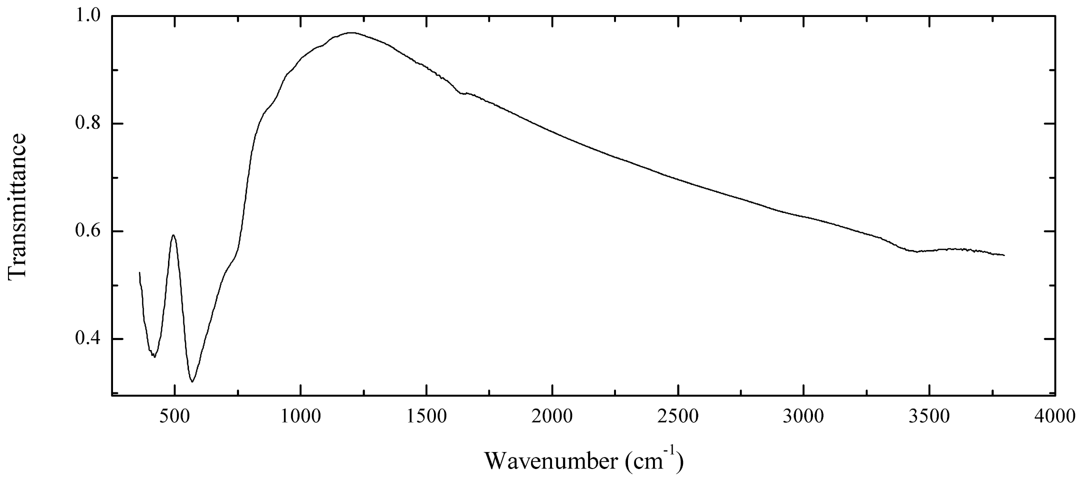


Locality: An abandoned shaft at Novo Horizonte, Bahia, Brazil (type locality).

Description: Black tabular crystal from the association with quartz, rutile, anatase, hematite, xenotime-(Y) and bastnaesite-(La). Holotype sample. The crystal structure is solved. Trigonal, space group *R*-3, $a = 10.4359(2)$, $c = 21.0471(4)$ Å, $V = 1985.10(7)$ Å^3, $Z = 3$. The empirical formula is $H_{0.82}(Pb_{0.59}Sr_{0.12}Ca_{0.04}La_{0.03})Zn_{1.43}(Mn_{0.69}Y_{0.46})(Ti_{13.02}Fe^{3+}_{5.30})O_{38}$. Optically uniaxial (+). $D_{meas} = 4.68(5)$ g/cm^3, $D_{calc} = 4.62$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.436 (48), 3.074 (50), 3.023 (50), 2.907 (100), 2.781 (44), 2.492 (55), 2.157 (55), 1.615 (50).

Wavenumbers (cm^{-1}): 3340w, 1099w, 1041w, 1012w, 695sh, 574s, 534s, 485sh.

O242 Hydroxymanganopyrochlore $(Mn^{2+},Th,Na,Ca,REE)_2(Nb,Ti)_2O_6(OH)$

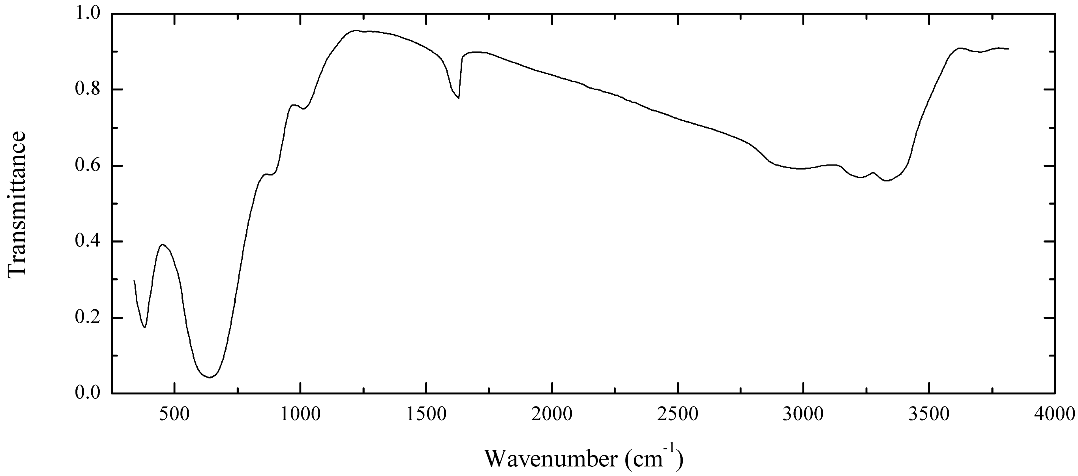


Locality: In the Dellen, Laacher See area, Eifel volcanic region, Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Black octahedral crystals from the association with sanidine, nosean, gahnite, hercynite, jacobsite, biotite and tephroite. Holotype sample. The crystal structure is solved. Cubic, space group $Fd\overline{3}m$, $a = 10.2523(2)$ Å, $V = 1077.62(4)$ Å^3, $Z = 8$. The empirical formula is $(Mn_{0.51}Th_{0.37}Na_{0.35}Ca_{0.29}Ce_{0.18}La_{0.09}Nd_{0.02}U_{0.04})(Nb_{0.97}Ti_{0.85}Fe^{3+}_{0.19})O_6[(OH)_{0.65}O_{0.24}F_{0.11}]$. $D_{calc} = 5.398$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.969 (100), 2.569 (40), 1.816 (47), 1.548 (40).

Wavenumbers (cm^{-1}): 3290, 960sh, 870sh, 720sh, 569, 420.

O243 Hydrokenomicrolite $(\square,H_2O)_2Ta_2(O,OH)_6(H_2O)$

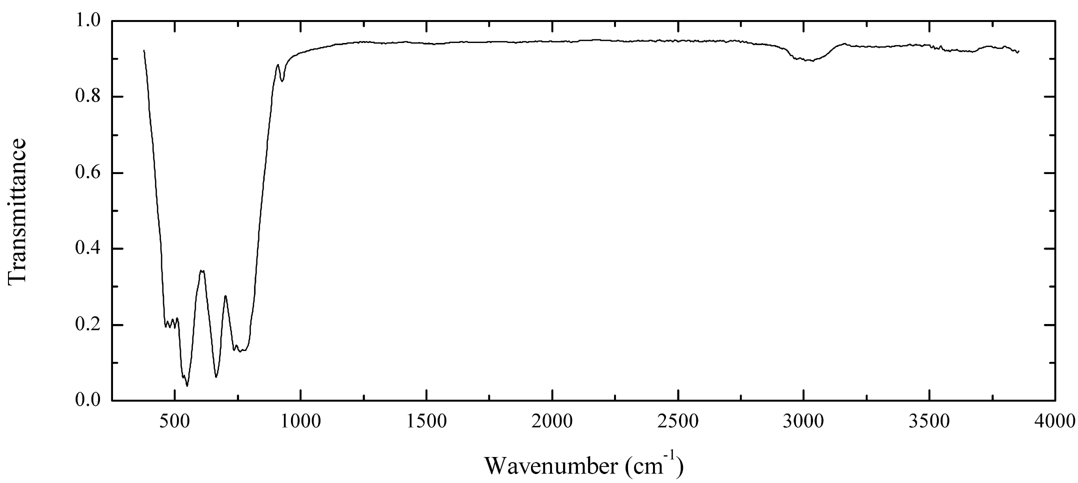


Locality: Volta Grande pegmatites, Nazareno, Minas Gerais, Brazil (type locality).

Description: Pinkish-brown octahedral crystals from the association with microcline, albite, quartz, muscovite, spodumene, lepidolite, cassiterite, tantalite-(Mn), monazite-(Ce), fluorite, apatite, beryl and garnet. Holotype sample. The crystal structure is solved. Cubic, space group $Fd\bar{3}m$, $a = 10.454(1)$ Å, $V = 1142.5(2)$ Å^3, $Z = 8$. The crystal-chemical formula is $[\square_{0.71}(H_2O)_{0.48}Ba_{0.33}Sr_{0.27}U_{0.10}Mn_{0.02}Nd_{0.02}Ce_{0.02}La_{0.02}Ca_{0.01}Bi_{0.01}Pb_{0.01}](Ta_{1.75}Nb_{0.10}Sn_{0.10}Si_{0.04}Ti_{0.01})[O_{5.77}(OH)_{0.23}][(H_2O)_{0.97}Cs_{0.03}]$. $D_{calc} = 6.67$ g/cm^3. Optically isotropic, $n_{calc} = 2.055$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 6.112 (86) (111), 3.191 (52) (311), 3.052 (100) (222), 2.642 (28) (400), 2.035 (11) (511, 333), 1.869 (29) (440), 1.788 (10) (531), 1.594 (24) (622).

Wavenumbers (cm^{-1}): 3335, 3230, 2980, 1640, 1620sh, 1015, 890, 646s, 383s.

O244 Tashelgite $CaMgFe^{2+}Al_9O_{16}(OH)$



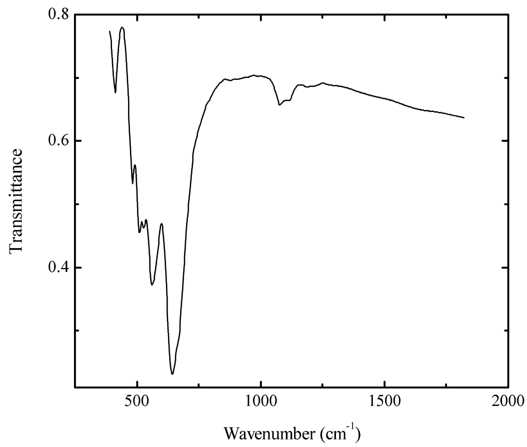
Locality: Tashelginskoe formation of calcic metasomatic rocks, of Tashelga river, Kuznetsky Alatau Mountains, Gornaya Shoriya, Russia (type locality).

Description: Bluish-green prismatic crystals from the association with calcite, hibonite, grossular, vesuvianite, hercynite, magnetite, corundum, perovskite, scapolite, diopside and apatite. Holotype sample. The crystal structure is solved. monoclinic, pseudo-orthorhombic, space group *Pc*; $a = 5.6973(1)$, $b = 17.1823(4)$, $c = 23.5718(5)$ Å; $\beta = 90.046(3)°$, $V = 2307.5(1)$ Å^3, $Z = 8$. The empirical formula is $H_{1.27}Ca_{0.90}Mg_{1.06}Mn_{0.04}Fe^{2+}{}_{1.00}Fe^{3+}{}_{0.11}Al_{8.80}O_{17.00}$. $D_{calc} = 3.67$ g/cm^3. Optically biaxial (−), $\alpha = 1.736(2)$, $\beta = 1.746(2)$, $\gamma = 1.750(2)$, $2V$ (meas.) $= -20(2)°$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.79 (48) (002), 2.845 (43) (061), 2.616 (100) (108), 2.584 (81) (146), 2.437 (44) (163), 2.406 (61) (057), 2.202 (72) (244).

Wavenumbers (cm^{-1}): 3655w, 3035w, 2985w, 929w, 790s, 761s, 740s, 668s, 610, 556s, 508s, 486, 470, 429.

2.6 Fluorides

F1 Weberite Na_2MgAlF_7

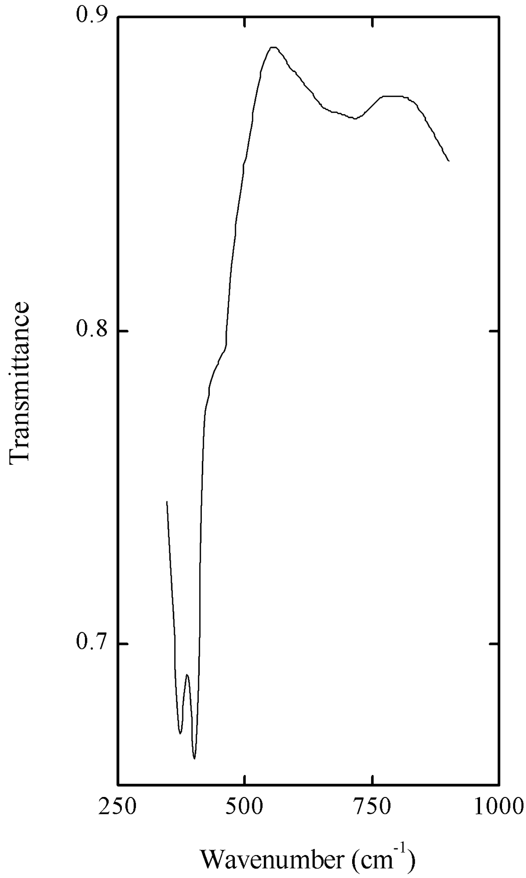


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).

Description: White granular aggregate from the association with cryolite, ralstonite and thomsenolite. Identified by IR spectrum and qualitative electron microprobe analysis.

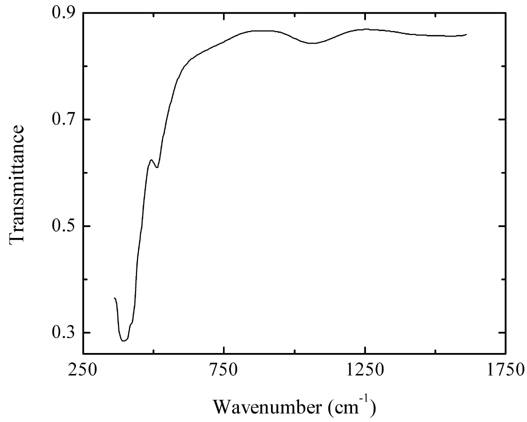
Wavenumbers (cm^{-1}): 1108w, 1072w, 655sh, 632s, 544s, 518, 499, 471, 404.

F2 Villiaumite NaF



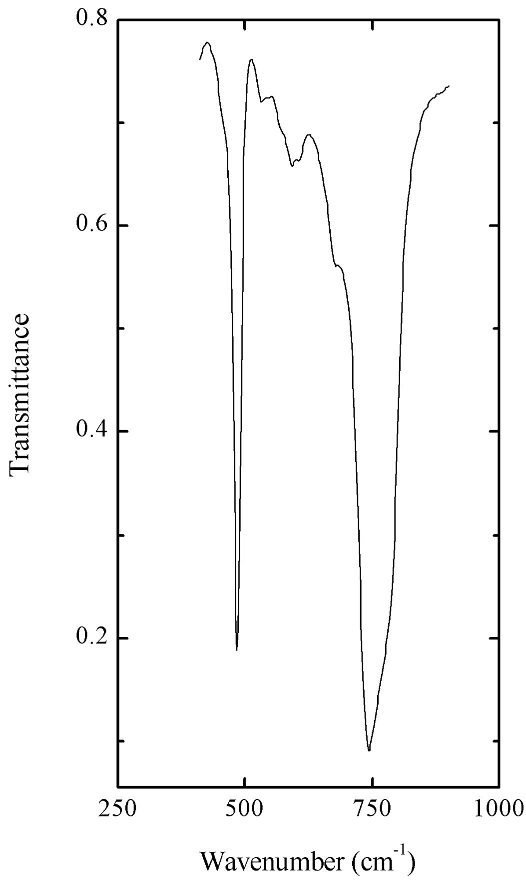
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Red coarse-grained aggregate from the association with lomonosovite and barytolamprophyllite. Identified by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 725w, 450sh, 403s, 377s.

F4 Fluorite CaF_2



Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: White granular aggregate from the association with amazonite, albite and zinnwaldite. *REE*-rich variety ("yttrofluorite"). Contains 34.5 wt.% Ca, 11.2 wt.% Y and 9.52 wt.% *Ln*.
Wavenumbers (cm^{-1}): 1060w, 510, 420sh, 395.

F5 Hieratite K_2SiF_6

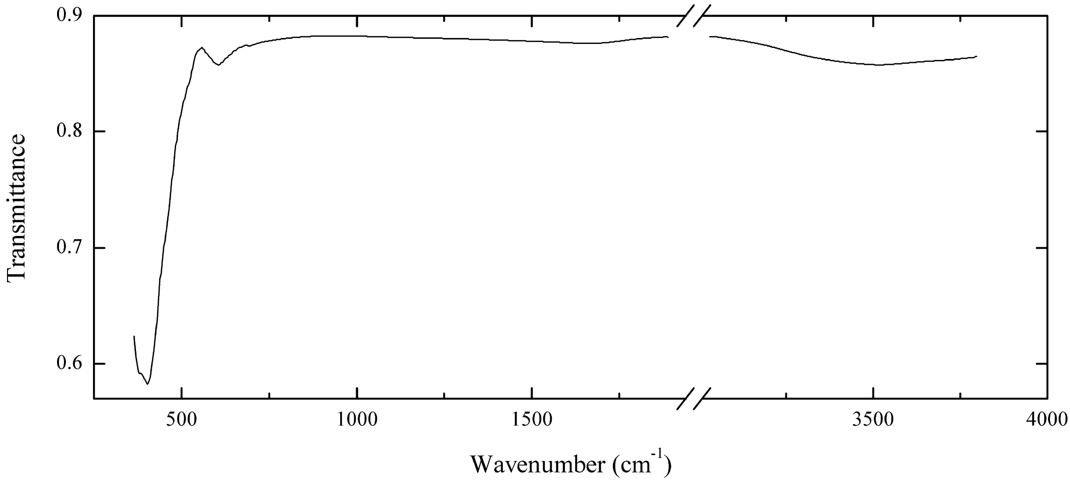


Locality: Monte Somma-Vesuvius volcanic complex, Campania, Italy.

Description: White fine-grained aggregate forming crust. The empirical formula is $K_{1.7}Na_{0.1}(\square,H_3O,NH_3)_{0.1}Si_{1.00}F_{5.9}$. The bands in the range 500–700 cm^{-1} correspond to the admixture of another mineral.

Wavenumbers (cm^{-1}): 770sh, 745s, 483.

F6 Gagarinite-(Y) $Na_x(Ca_xY_{2-x})F_6$

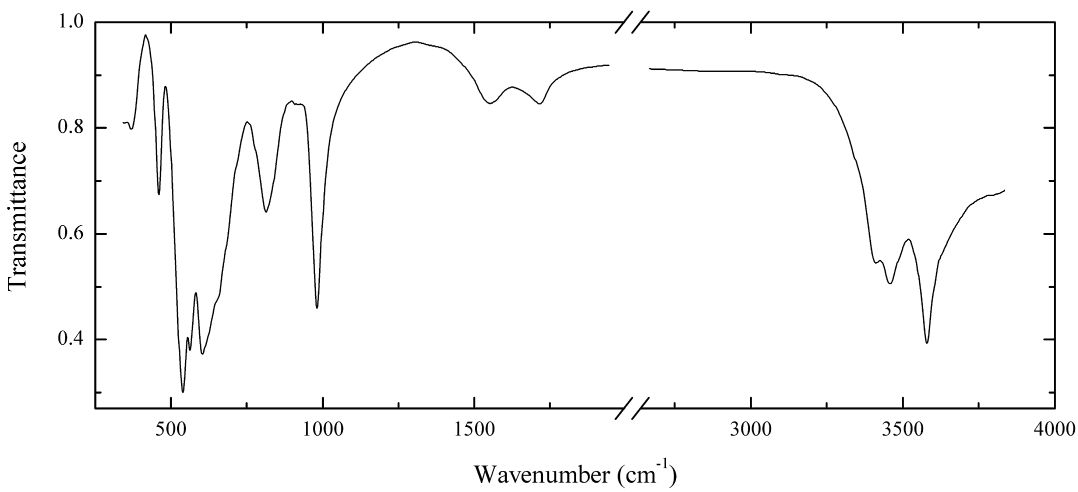


Locality: Katugin Ta–Nb deposit, Chita region, Transbaikal area, Eastern Siberia, Russia.

Description: Brownish-red imperfect crystal from the association with cryolite and fluorannite. The empirical formula is $Na_{0.71}Ca_{0.90}Y_{0.78}Dy_{0.09}Er_{0.07}Gd_{0.04}Yb_{0.03}Ce_{0.03}Nd_{0.03}Sm_{0.02}Ce_{0.01}F_{5.85}$.

Wavenumbers (cm^{-1}): 609w, 398s, 380sh.

F7 Tikhonenkovite $SrAlF_4(OH){\cdot}H_2O$

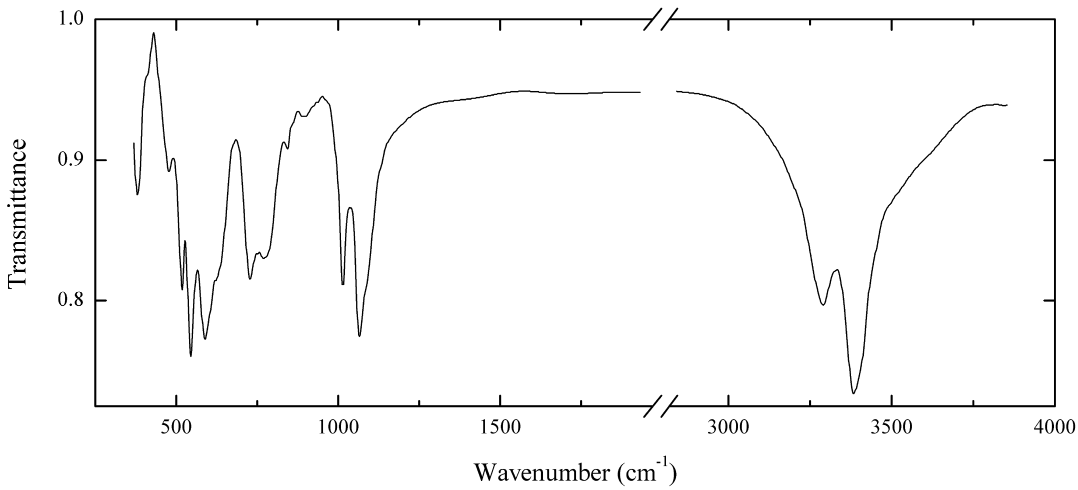


Locality: Karasug Fe–*REE*–barite–fluorite deposit, western Tannu-Ola range, Republic of Tuva, Siberia, Russia (type locality).

Description: Colourless crystal from the association with fluorite and gearksutite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3567s, 3448, 3400, 1720w, 1560w, 982, 819, 650sh, 615sh, 604s, 562s, 538s, 458, 370w.

F8 Zharchikhite $Al(F,OH)_3$

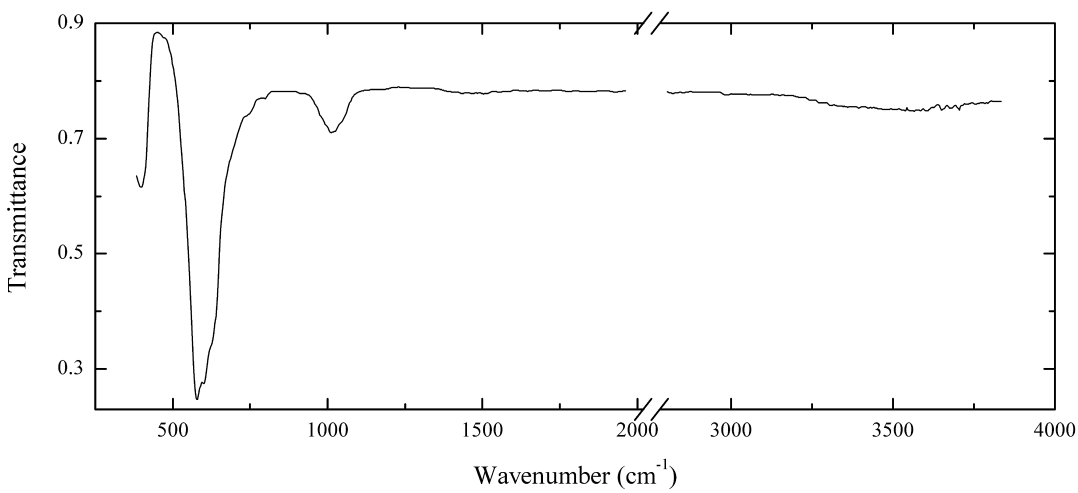


Locality: Zharchikhinskoe Mo deposit, Transbaikal area, Eastern Siberia, Russia (type locality).

Description: White fine-grained aggregate. Specimen No. 87567 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

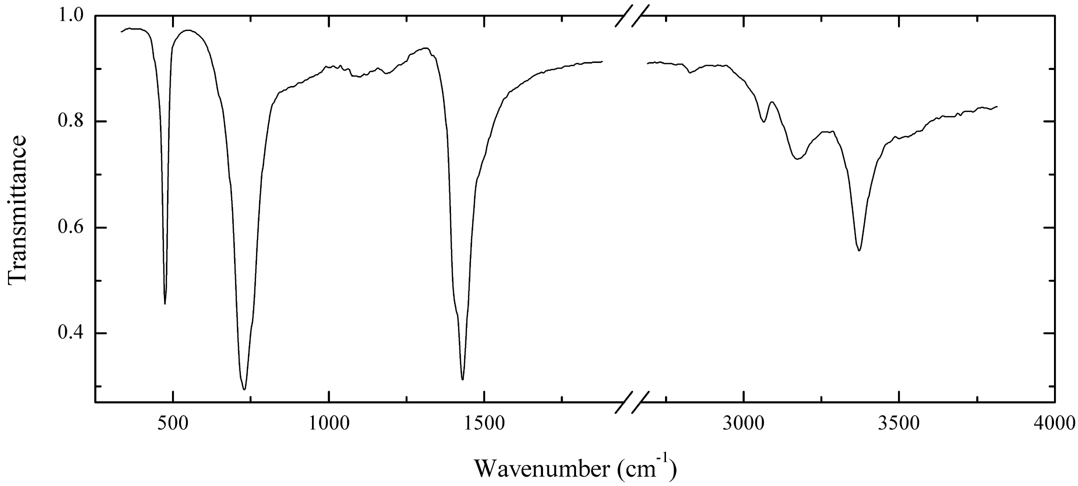
Wavenumbers (cm^{-1}): 3340sh, 3320s, 3275, 1090sh, 1068s, 1016, 890w, 844w, 773, 726, 625sh, 590s, 541s, 517, 477, 411w, 379.

F9 Cryolite Na_3AlF_6



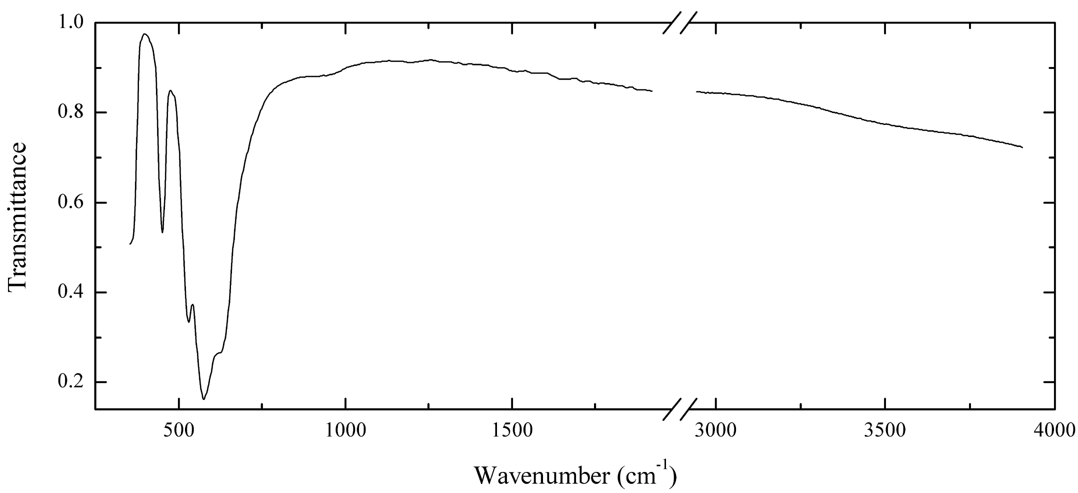
Locality: Katugin Ta–Nb deposit, Chita region, Transbaikal area, Eastern Siberia, Russia.
Description: White granular aggregate from the association with gagarinite-(Y) and fluorannite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1020w, 625sh, 598s, 576s, 399.

F10 Cryptohalite $(NH_4)_2SiF_6$



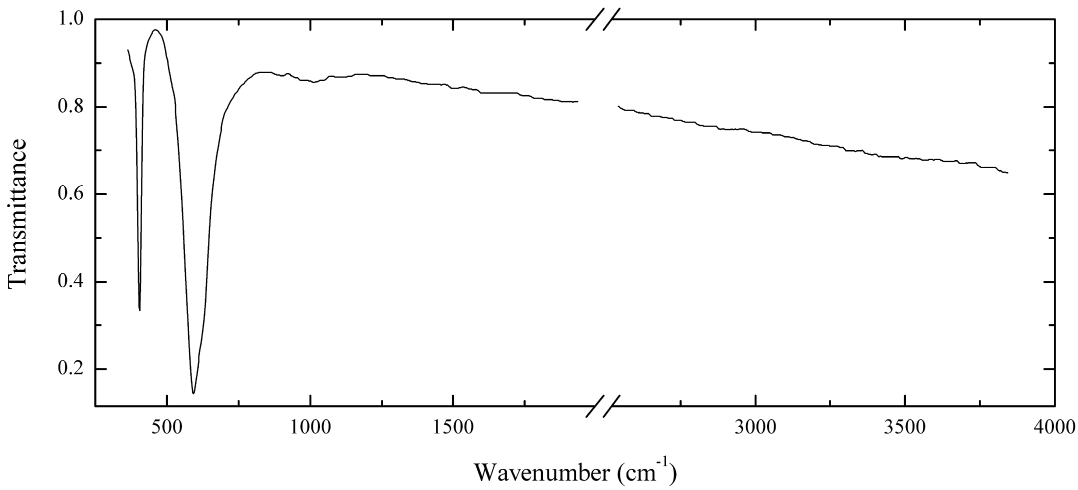
Locality: Shamokin coal field, Northumberland Co., Pennsylvania, USA.
Description: Pink crystals. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3465w, 3340, 3145, 3035w, 2800w, 1427s, 1405sh, 1190w, 1095w, 736s, 481.

F11 Cryolithionite $Na_3Li_3Al_2F_{12}$



Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).
Description: Colourless crystal from the association with cryolite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 930w, 625s, 580s, 536s, 461.

F12 Elpasolite K_2NaAlF_6

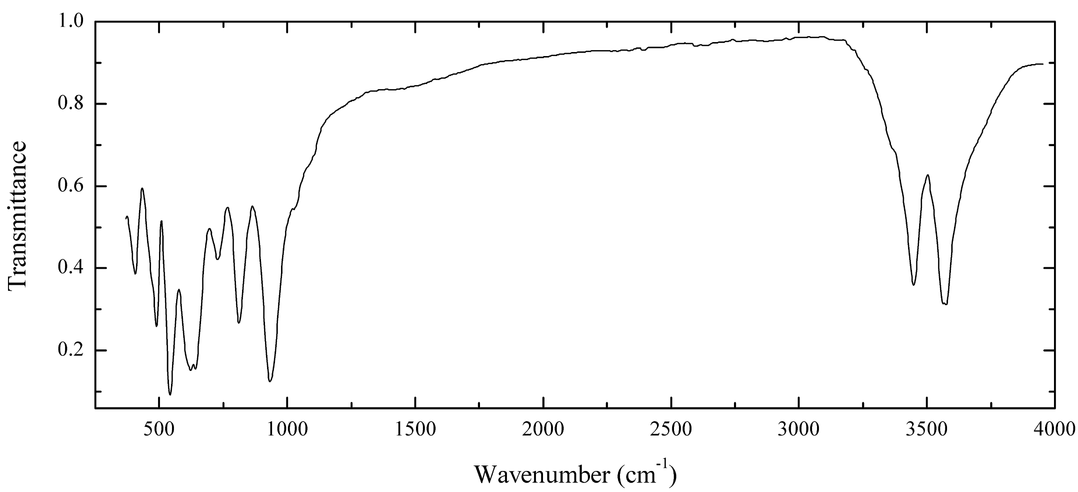


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pale pink crystals with blue fluorescence under short-wave UV radiation, growing on amicite. Other associated minerals are vinogradovite, sitinakite and lemmleinite-K. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $K_{1.96}Na_{0.98}Al_{1.01}F_{6.05}$.

Wavenumbers (cm^{-1}): 1010w, 620sh, 590s, 515sh, 400s.

F13 Prosopite $CaAl_2(F,OH)_8$

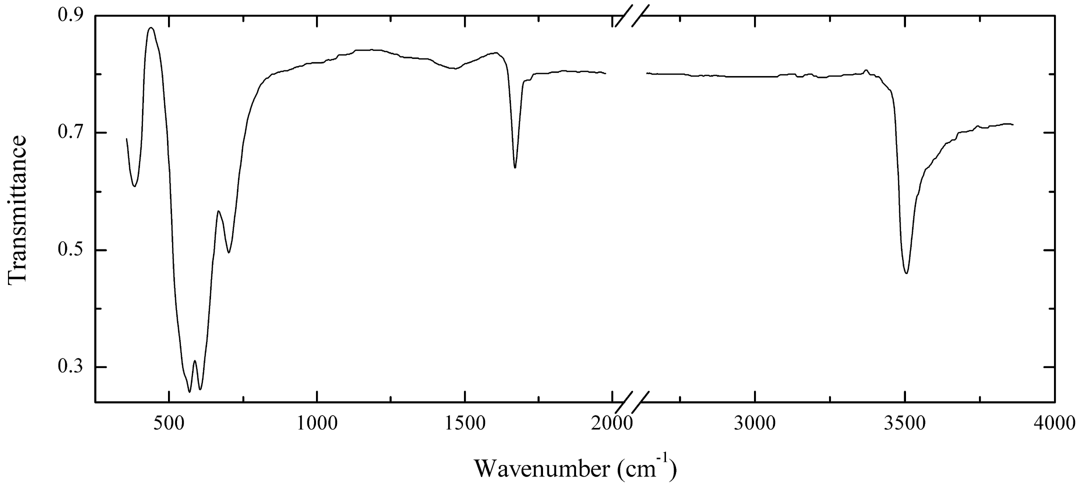


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland.

Description: Bluish-grey spherulites from the association with cryolite, siderite and kaolinite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3568s, 3555s, 3440, 1080sh, 1025sh, 933s, 810, 730, 640s, 622s, 540s, 488, 470sh, 450sh, 410.

F14 Pachnolite $NaCaAlF_6 \cdot H_2O$

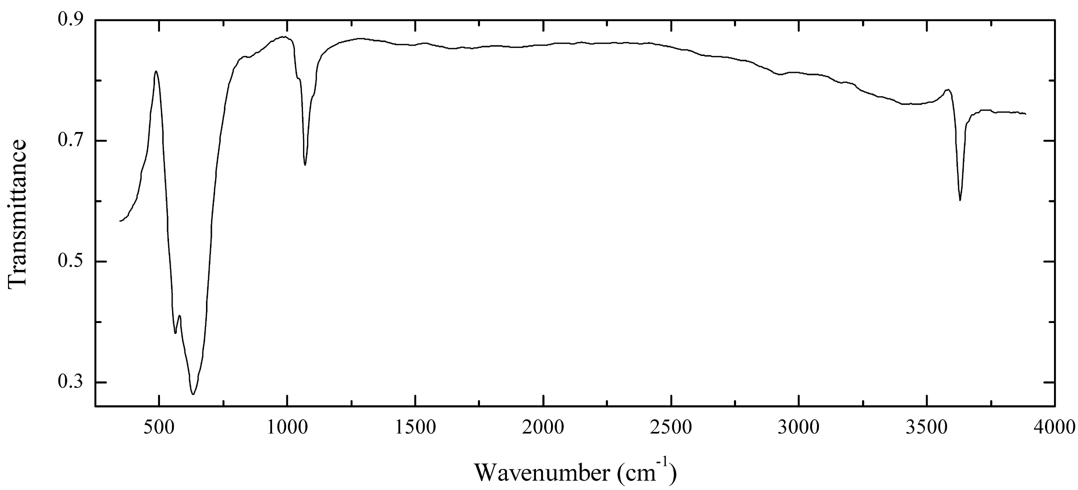


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).

Description: Colourless prismatic crystals from the association with cryolite and quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3490, 1672, 1465w, 698, 602s, 568s, 555sh, 385.

F15 Jarlite $Na(Sr,Na,\square)_7(Mg,\square)Al_6F_{32}(OH,H_2O)_2$

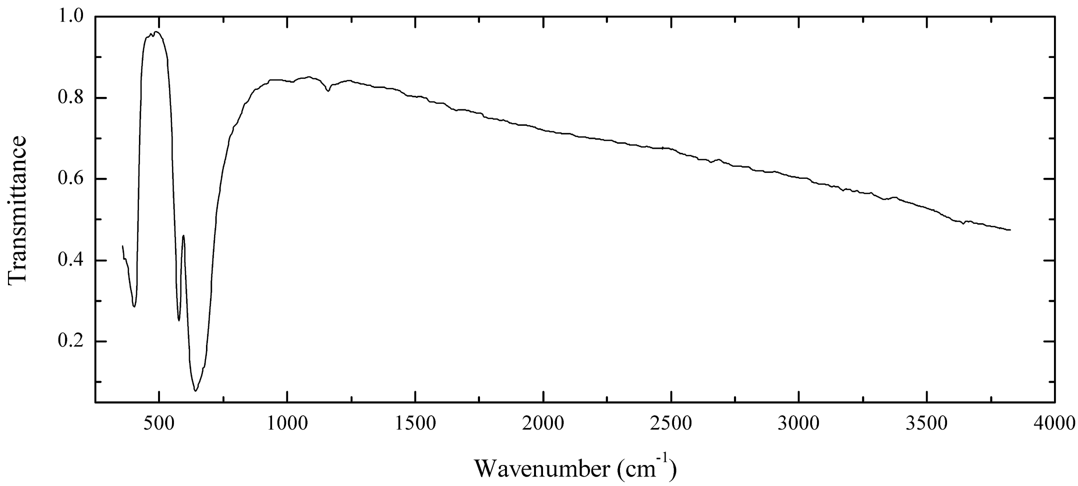


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).

Description: Colourless crystals from the association with cryolite, chiolite, thomsenolite and ralstonite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3615, 3440w, 1105w, 1072, 1050w, 660sh, 635s, 563s, 450sh, 410sh.

F16 Chiolite $Na_5Al_3F_{14}$

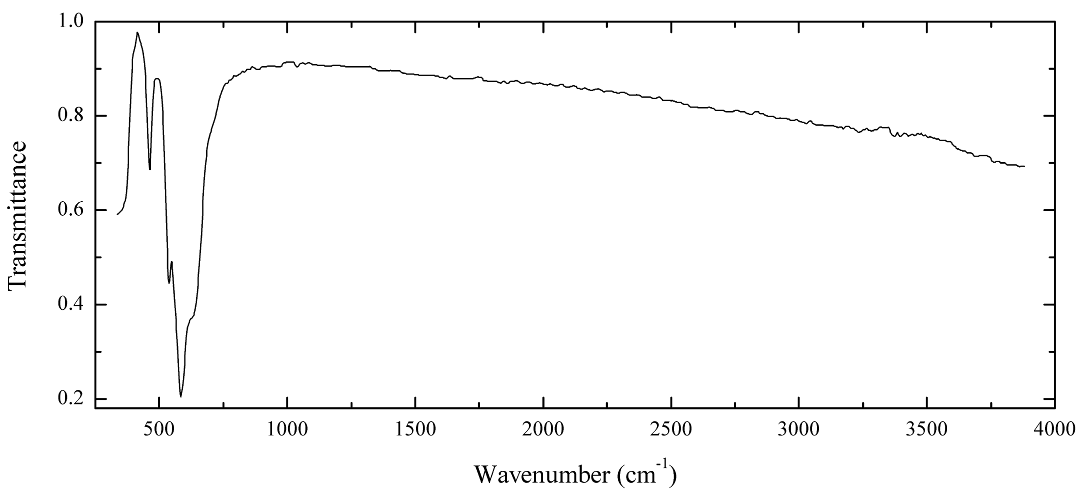


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland.

Description: Colourless grains from the association with cryolite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1165w, 680sh, 640s, 575, 403.

F17 Cryolithionite $Na_3Li_3Al_2F_{12}$

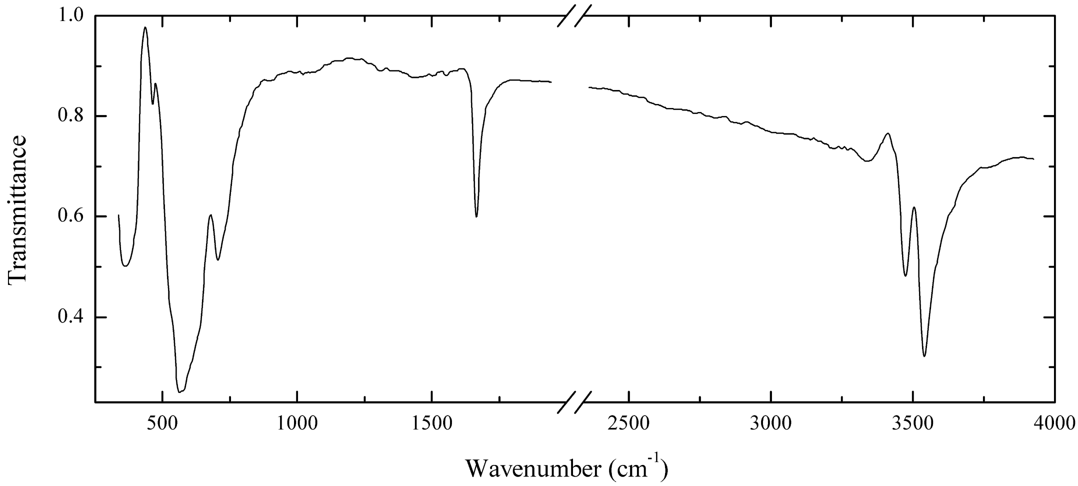


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).

Description: Colourless crystal from the association with cryolite, pachnolite and thomsenolite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 625sh, 580s, 537s, 461.

F18 Thomsenolite $NaCaAlF_6{\cdot}H_2O$

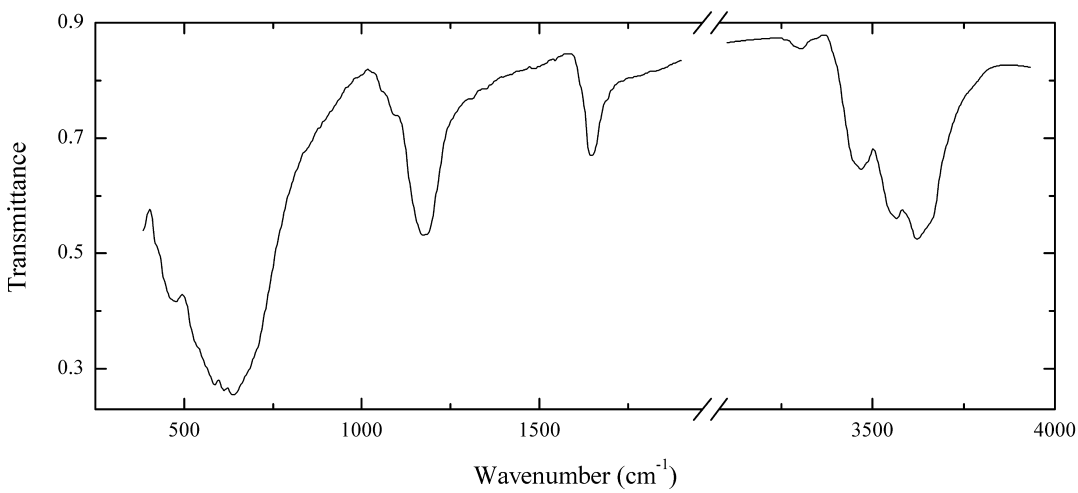


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).

Description: Colourless crystals from the association with cryolite and chiolite. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $Na_{0.93}Ca_{1.00}Al_{1.05}Fe_{0.02}F_{6.1}{\cdot}H_2O$.

Wavenumbers (cm^{-1}): 3525s, 3460, 3330w, 1667, 1450w, 730sh, 705, 630sh, 600sh, 575s, 563s, 530sh, 461w, 390sh, 360.

F19 Ralstonite $Na_xMg_xAl_{2-x}(F,OH)_6{\cdot}H_2O$

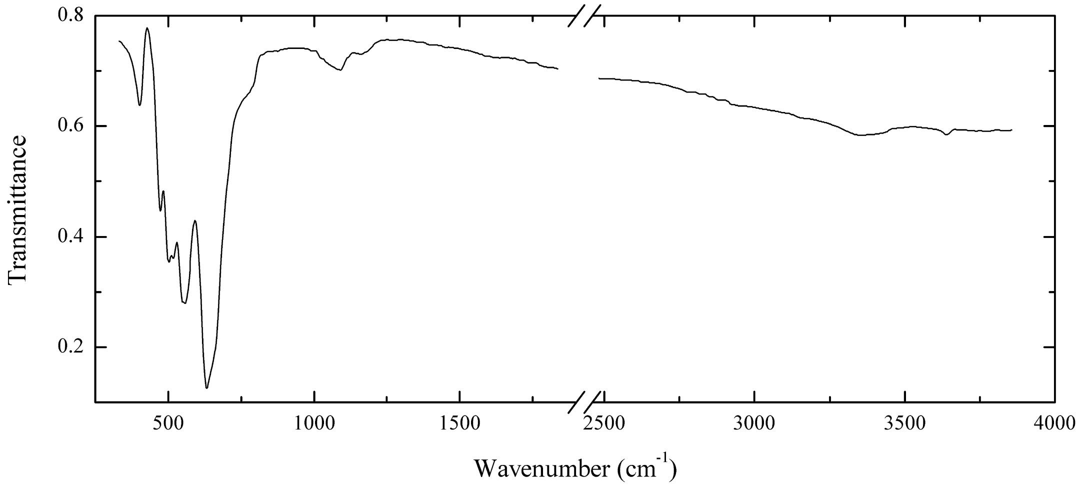


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).

Description: Colourless octahedral crystal from the association with thomsenolite and prosopite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3640sh, 3605, 3553, 3540sh, 3453, 3290w, 1648, 1174, 1090w, 1060sh, 695sh, 635s, 606s, 583s, 473, 420sh.

F20 Weberite Na_2MgAlF_7

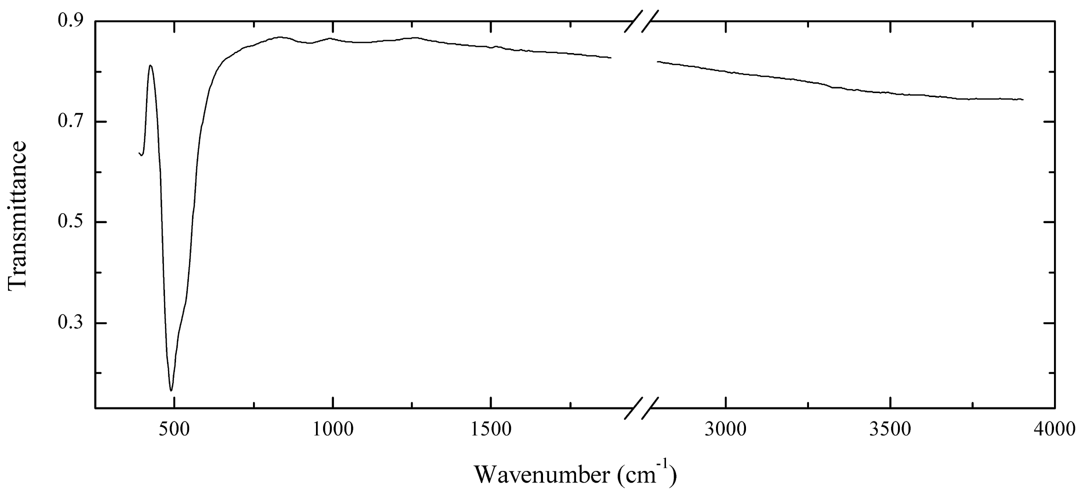


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland (type locality).

Description: Light grey fine-grained aggregate from the association with fluorite and topaz. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3625w, 3360w, 1160w, 1090w, 780sh, 655sh, 636s, 556s, 517, 501, 472, 409.

F21 Neighborite $NaMgF_3$

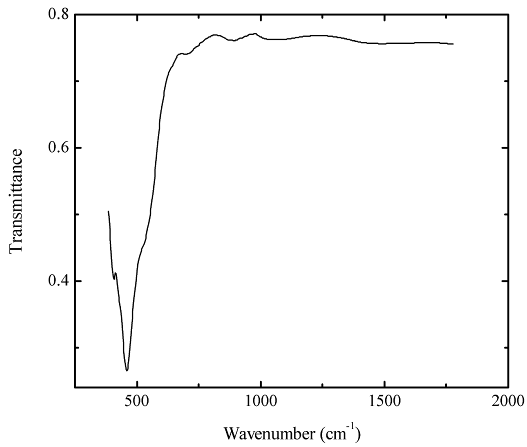


Locality: Katugin Ta–Nb deposit, Chita region, Transbaikal area, Eastern Siberia, Russia.

Description: Cream-coloured crystals from the association with cryolite. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Na_{0.97}Ca_{1.02}Mg_{0.96}Fe_{0.02}Al_{0.02}F_{3.02}$.

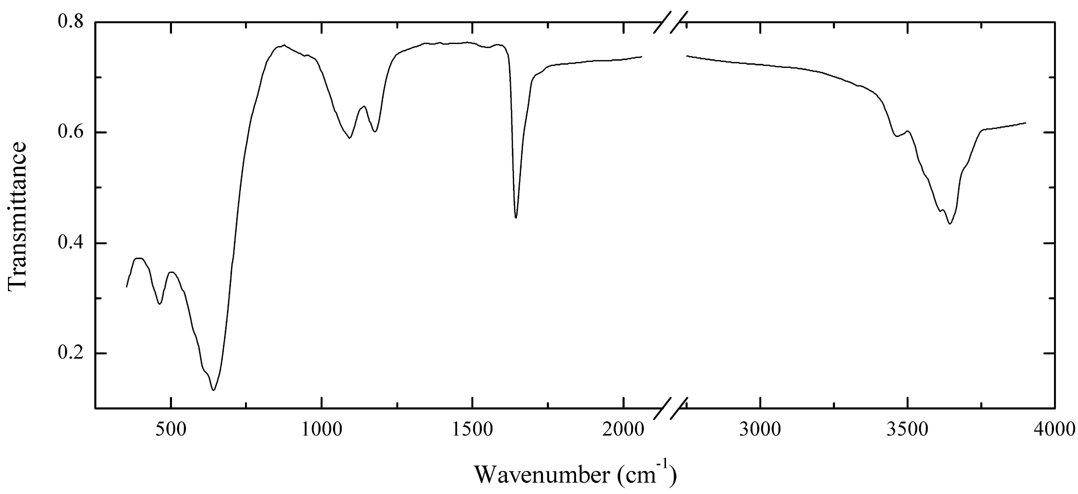
Wavenumbers (cm^{-1}): 925w, 520sh, 484s, 398.

F22 Sellaite MgF_2



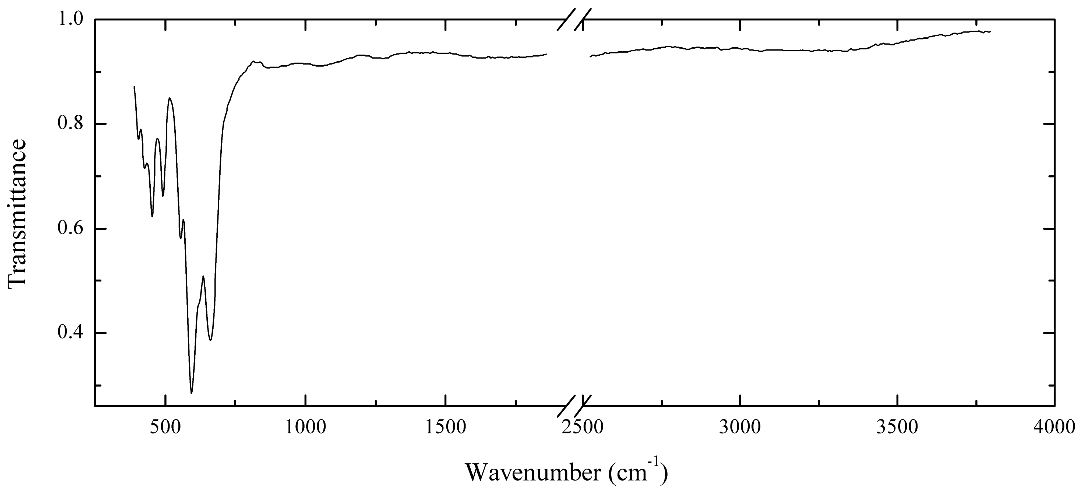
Locality: Suranskoe deposit, Ishlya, Beloretsk district, Bashkortostan Republic, South Urals, Russia.
Description: White coarse-grained aggregate from the association with fluorite. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1020w, 880w, 700w, 525sh, 460s, 406.

F23 Ralstonite $Na_xMg_xAl_{2-x}(F,OH)_6 \cdot H_2O$



Locality: Gjerdingselva, Lunner, Oppland, Oslo Region, Norway.
Description: White crystals from the association with gjerdingenite-Fe, gjerdingenite-Mn, janhaugite, elpidite, kupletskite, aegirine, orthoclase, albite, quartz, pyrochlore and monazite-(Ce). Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3640, 3610, 3570w, 1647, 1172, 1092, 647s, 620sh, 465.

F24 Usovite $Ba_2CaMgAl_2F_{14}$

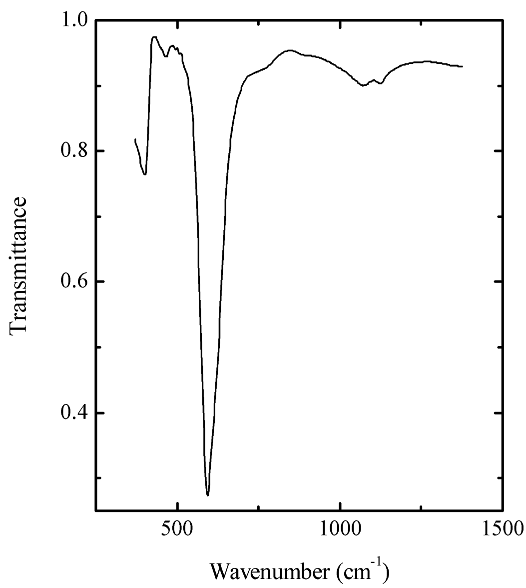


Locality: Pravaya Noiba river, Teya river basin, Enisey range, Krasnoyarsk region, Eastern Siberia, Russia (type locality).

Description: Brownish grains from the association with fluorite, calcjarlite, muscovite, thorite, chamosite, zeolites and halloysite. Specimen No. 69852 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 1270w, 1065w, 860w, 659s, 620sh, 593s, 555, 490, 453, 426, 400.

F25 Elpasolite K_2NaAlF_6

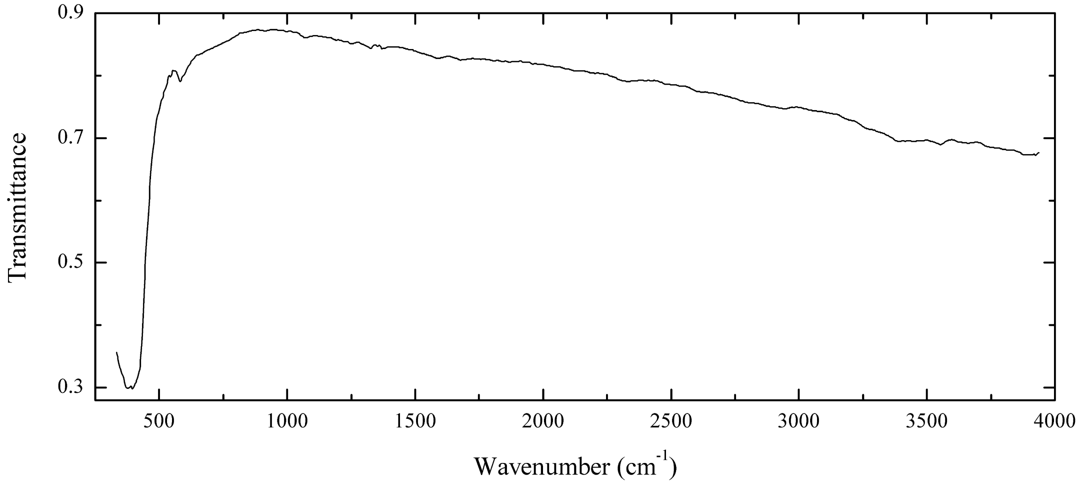


Locality: Le Cetine mine, Chiusdino, Siena province, Tuscany, Italy.

Description: Grey crystal from the association with ralstonite and gypsum. Identified by IR spectrum.

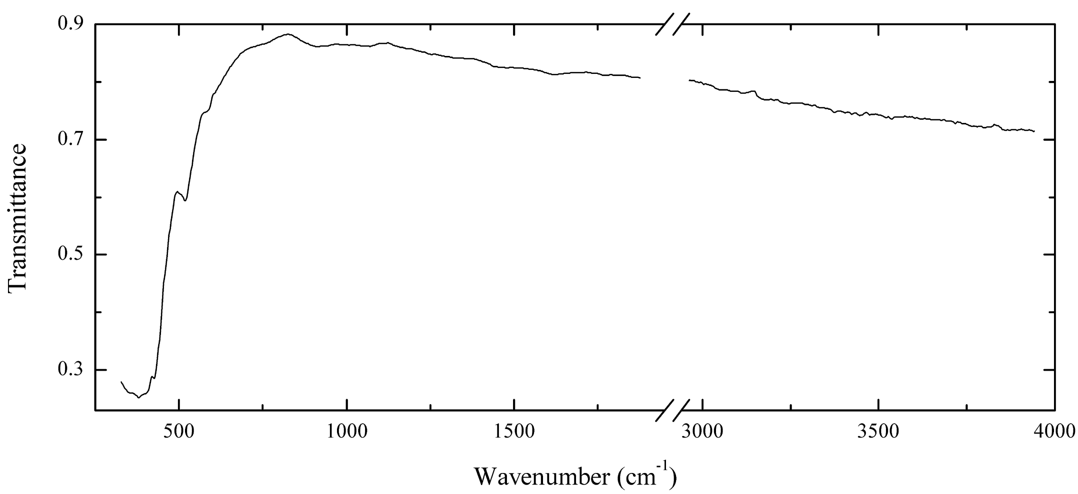
Wavenumbers (cm^{-1}): 1122w, 1070w, 620sh, 588s, 394.

F26 Fluorite CaF_2



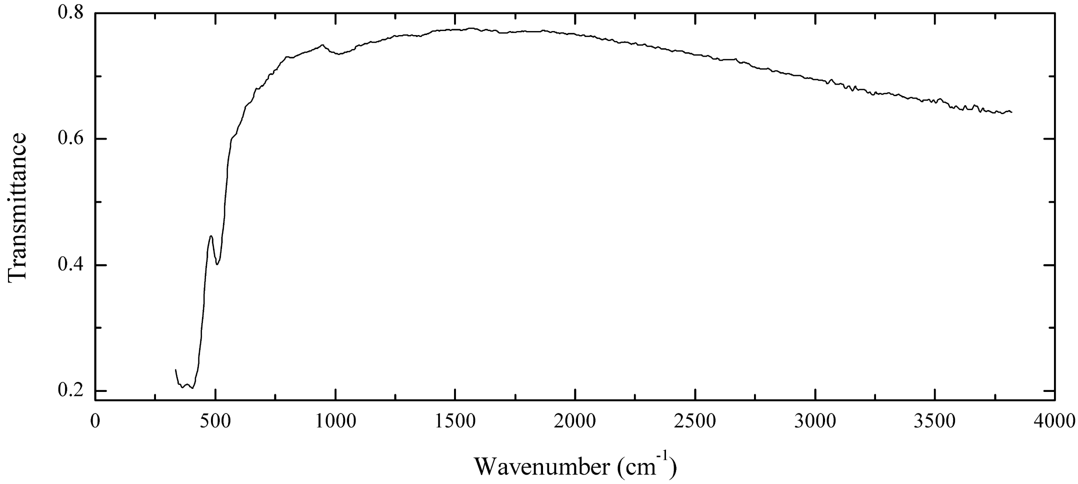
Locality: Parusnaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: Pale yellow granular aggregate from the association with amazonite, albite and quartz. Contains 45.5 wt.% Ca and 1.0 wt.% Y.
Wavenumbers (cm^{-1}): 584w, 420sh, 380s, 355sh.

F27 Fluorite CaF_2



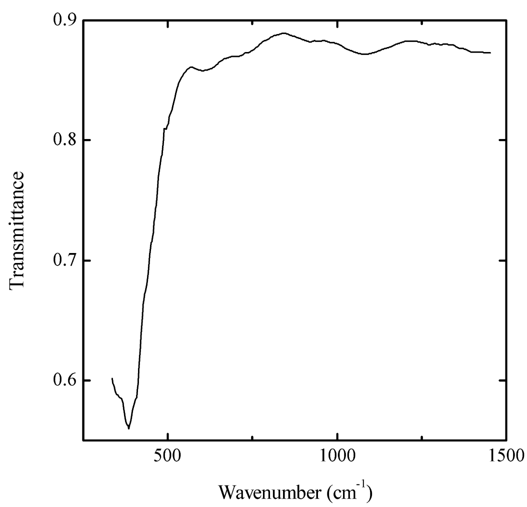
Locality: Stetind Mt., near Tysfjord, Nordland, Norway.
Description: Pinkish granular aggregate from the association with feldspar, quartz, bastnaesite-(Ce) and okanoganite-(Y). *REE*-rich variety ("yttrofluorite"). Contains 35.9 wt.% Ca, 8.9 wt.% Y and 6.8 wt.% *Ln*. Optically isotropic.
Wavenumbers (cm^{-1}): 585sh, 518, 422s, 400sh, 380s, 355sh.

F28 Tveitite-(Y) $Ca_{14}Y_5F_{43}$



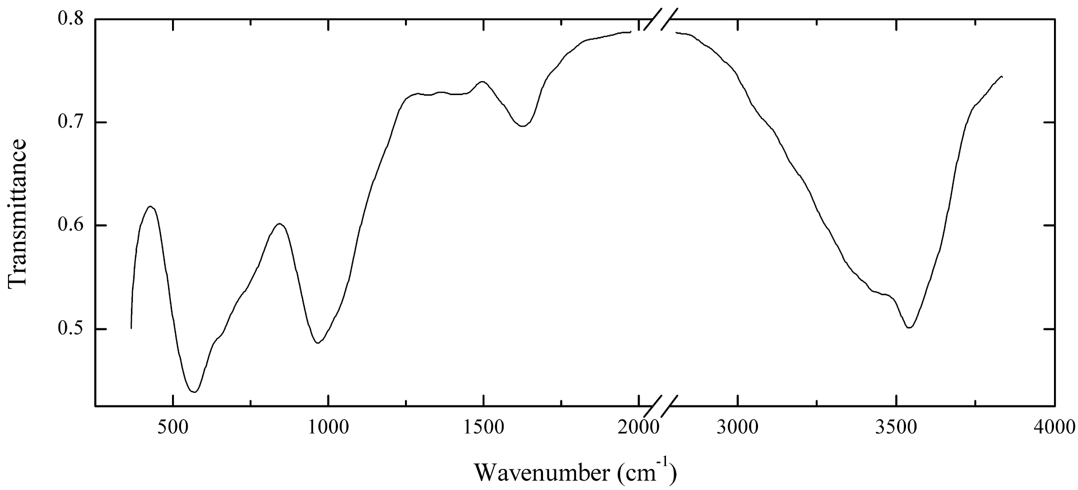
Locality: Rov Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: Pale pink granular aggregate with yellow fluorescence under LW and SW UV radiation, from the association with microcline, albite, zinnwaldite, muscovite, fluorapatite, zircon, genthelvite, gadolinite-(Y), allanite-(Ce), thorite, fergusonite-(Y), plumbopyrochlore, plumbomicrolite and quartz. Fine intergrowth of phases with the formulae $(Ca_{9.63}Na_{1.7})(Y_{5.32}Ce_{0.56}La_{0.35}Nd_{0.18}Gd_{0.17}Yb_{0.15}Pr_{0.15}Er_{0.12}Dy_{0.12}Sm_{0.09}Ho_{0.05}Eu_{0.03})F_{43.3}$ and $(Ca_{11.6}Na_{1.9})(Y_{4.44}Ce_{0.27}La_{0.18}Gd_{0.15}Yb_{0.15}Sm_{0.13}Er_{0.11}Dy_{0.1}Pr_{0.09}Nd_{0.09}Tb_{0.05}Tm_{0.03}Lu_{0.02})F_{42.7}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.218 (33), 3.184 (100), 1.967 (30), 1.950 (50), 1.669 (19), 1.665 (22).
Wavenumbers (cm^{-1}): 1020w, 512, 408s, 368s.

F29 Gagarinite-(Y) $Na_x(Ca_xY_{2-x})F_6$



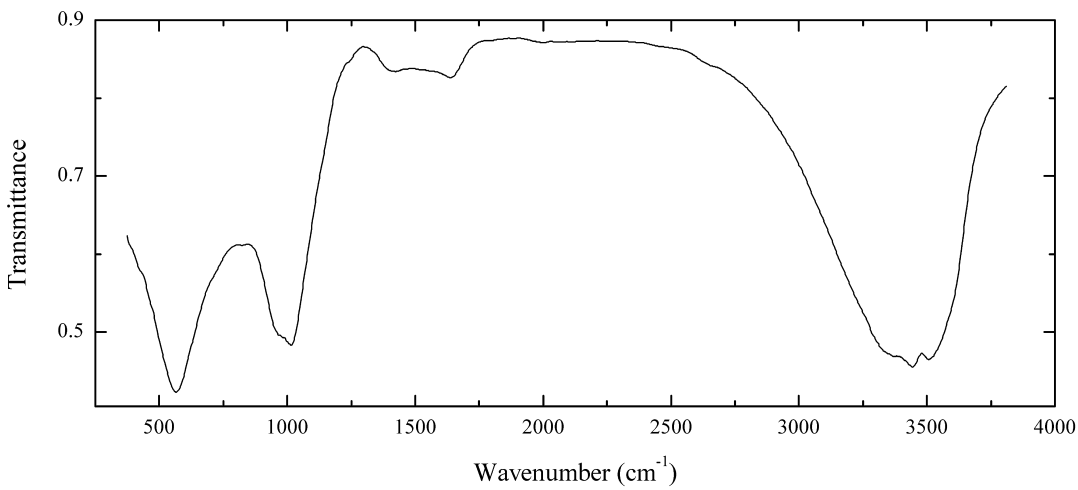
Locality: Katugin Ta–Nb deposit, Chita region, Transbaikal area, Eastern Siberia, Russia.
Description: Cream-coloured imperfect crystal from the association with cryolite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 608w, 396s, 375sh.

F30 Hydroxyfluoride F30 Al(OH,F)$_3$



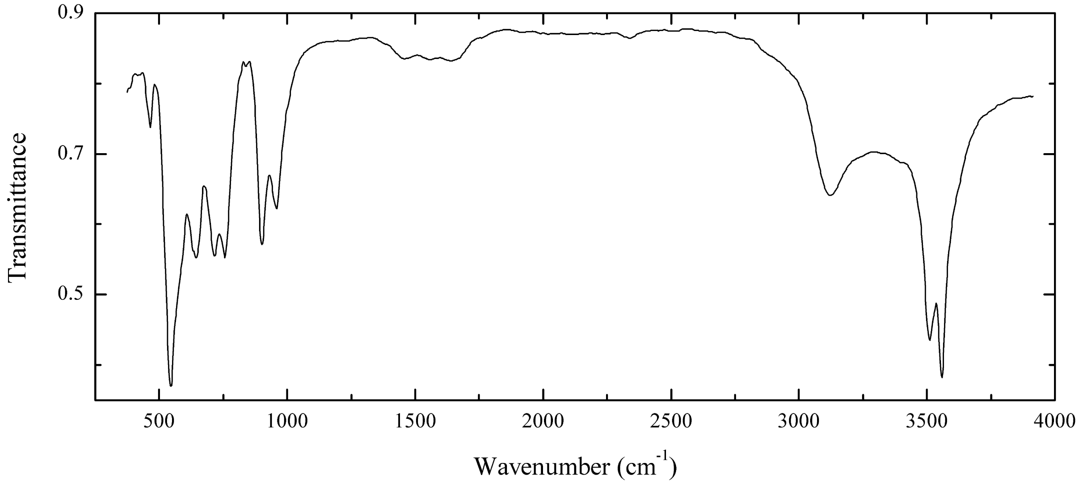
Locality: Comeglians, Tolmezzo, Udine province, Friuli–Venezia Giulia, Italy.
Description: White massive from the association with cualstibite. The empirical formula is (electron microprobe) $Al_{0.96}Fe_{0.03}Cu_{0.01}(OH)_{2.63}F_{0.37}$. Related to gibbsite. Needs further investigation.
Wavenumbers (cm^{-1}): 3525s, 3430sh, 1630, 1040sh, 1005sh, 962s, 700sh, 650sh, 568s.

F31 Hydroxyfluoride F31 AlF(OH)$_2$



Locality: Comeglians, Tolmezzo, Udine province, Friuli–Venezia Giulia, Italy.
Description: White massive from the association with gearksutite. The empirical formula is (electron microprobe) $Al_{0.96}Fe_{0.02}Cu_{0.02}F_{1.1}(OH)_{1.9}$. Related to gibbsite. Needs further investigation.
Wavenumbers (cm^{-1}): 3500s, 3400s, 3375sh, 1640w, 1430w, 1025, 975sh, 568s.

F32 Gearksutite $CaAlF_4(OH)$

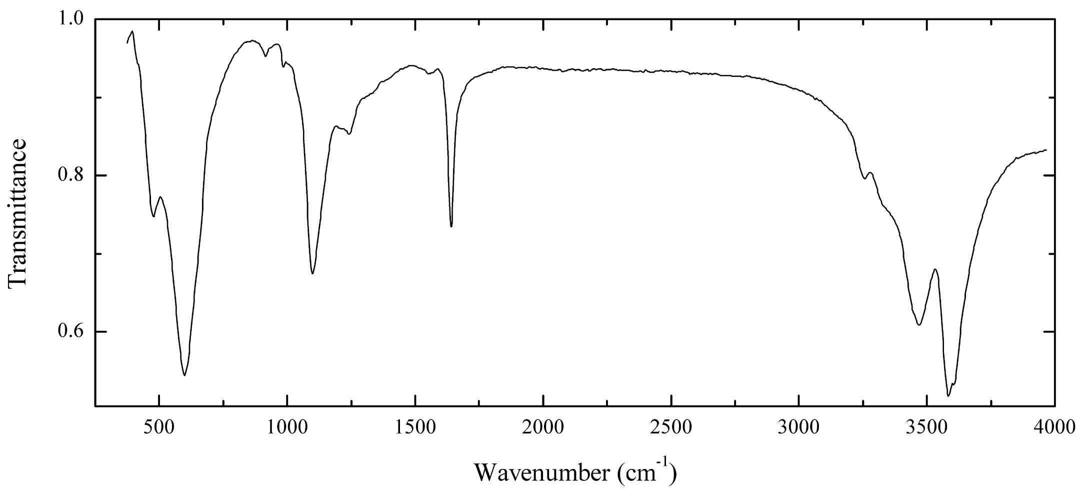


Locality: Comeglians, Tolmezzo, Udine province, Friuli–Venezia Giulia, Italy.

Description: White fine-grained aggregate. Identified by IR spectrum. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3546s, 3498s, 3114, 1665w, 1625w, 1560w, 1475w, 955, 900, 755, 714, 644, 545s, 463w.

F33 Chukhrovite-(Y) $Ca_2(Y,Ce)Al_2(SO_4)F_{13}$

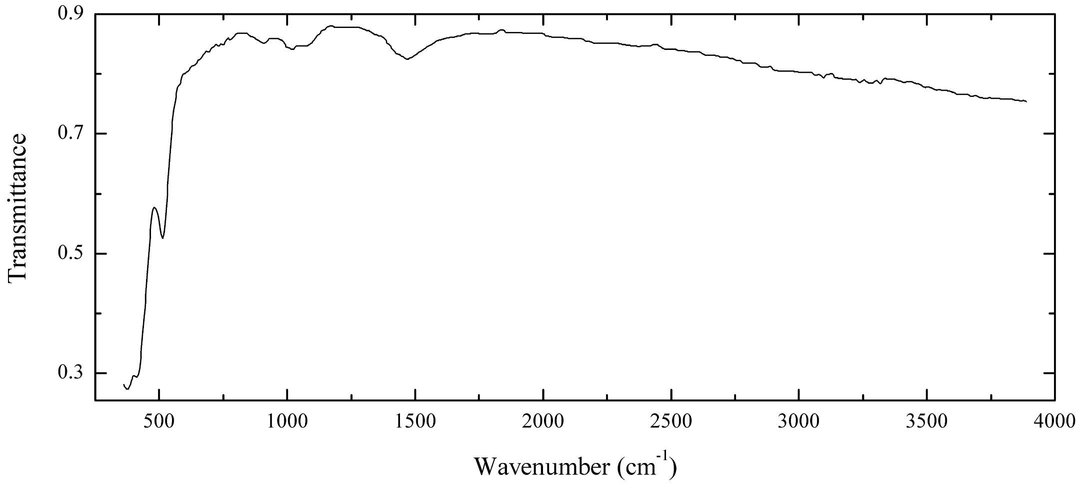


Locality: Katugin Ta–Nb deposit, Chita region, Transbaikal area, Eastern Siberia, Russia.

Description: Yellowish octahedral crystals from the association with cryolite, gagarinite and fluorannite. Identified by IR spectrum and qualitative electron microprobe analysis. Y:Ce ≈ 2:1 (in atomic proportion).

Wavenumbers (cm^{-1}): 3580s, 3560s, 3545, 3315sh, 3245, 1635, 1550w, 1247, 1200sh, 1097, 983w, 910w, 650sh, 596s, 475, 410sh.

F34 Tveitite-(Y) $Ca_{14}Y_5F_{43}$

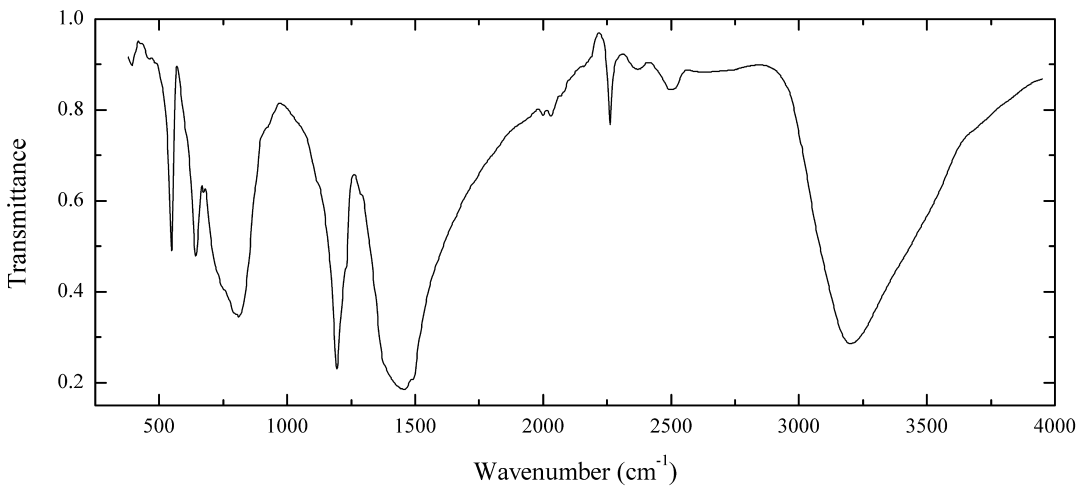


Locality: Høydalen, Tørdal, Norway (type locality).

Description: White granular aggregate. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1475w, 1065w, 1020w, 510, 412s, 372s.

F35 Barberiite $(NH_4)BF_4$

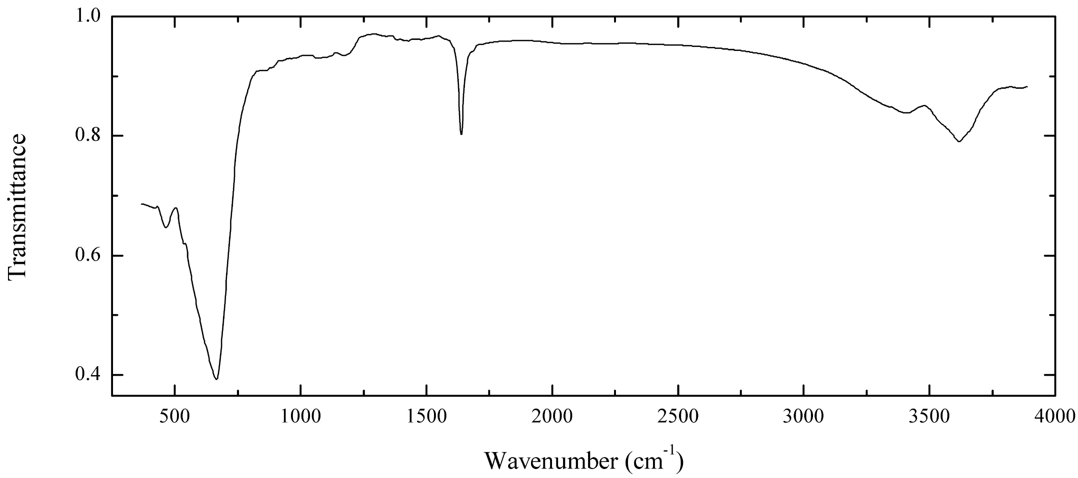


Locality: La Fossa crater, Vulcano island, Aeolian islands, Sicily, Italy (type locality).

Description: Soft colourless platelets from the association with salammoniac. Confirmed by IR spectrum.

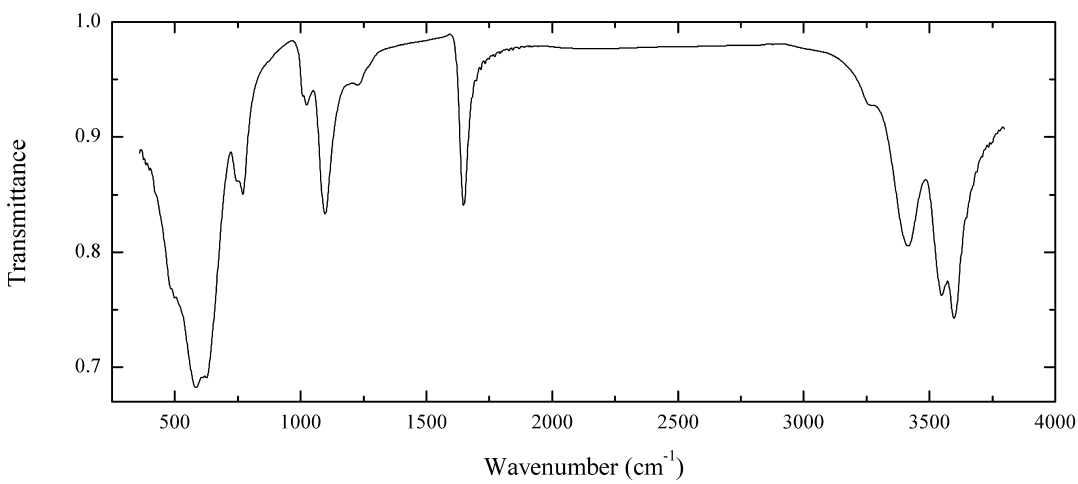
Wavenumbers (cm^{-1}): 3190s, 2500w, 2360w, 2255, 2025w, 1997w, 1495sh, 1464s, 1230sh, 1196s, 791s, 760sh, 673w, 645, 545, 390w.

F36 Ralstonite $Na_xMg_xAl_{2-x}(F,OH)_6 \cdot H_2O$



Locality: Vesuvius Mt., Monte Somma-Vesuvius complex, Naples province, Campania, Italy.
Description: White powdery aggregate. OH-poor variety. The empirical formula is (electron microprobe) $(Na_{0.38}Ca_{0.11}K_{0.06})(Al_{1.26}Mg_{0.67}Fe_{0.07})F_{5.7}(OH)_{0.3} \cdot H_2O$.
Wavenumbers (cm^{-1}): 3610, 3390w, 1644, 1168w, 1080w, 665s, 535, 463.

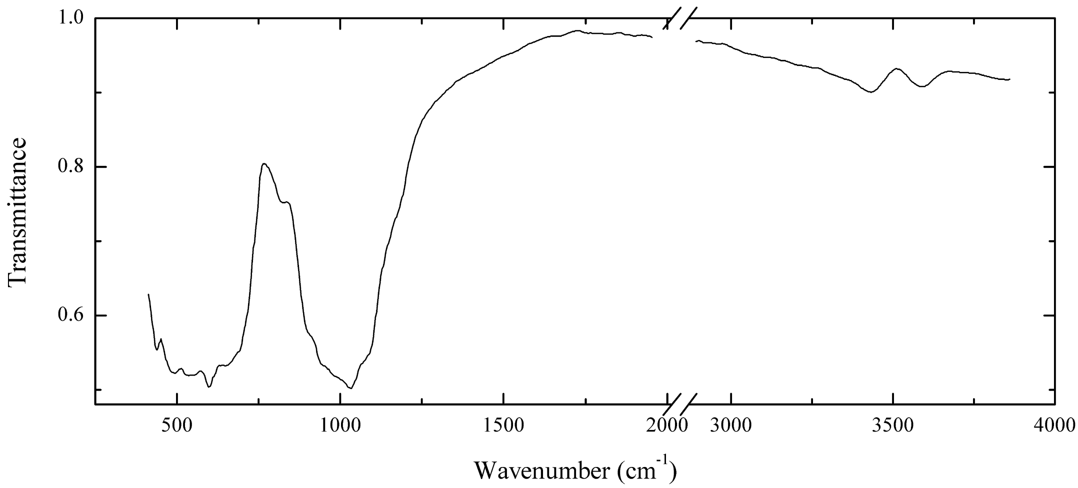
F37 Meniaylovite $Ca_4AlSi(SO_4)F_{13} \cdot 12H_2O$



Locality: First cone of the North Breach of the Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia (type locality).
Description: White octahedral crystals. Investigated by I.V. Pekov. Identified by IR spectrum, powder X-ray diffraction pattern and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3597s, 3548, 3516, 3268w, 2190w, 1648, 1229w, 1097, 1024w, 1010sh, 770, 755sh, 620s, 608s, 583s, 505sh, 485sh.

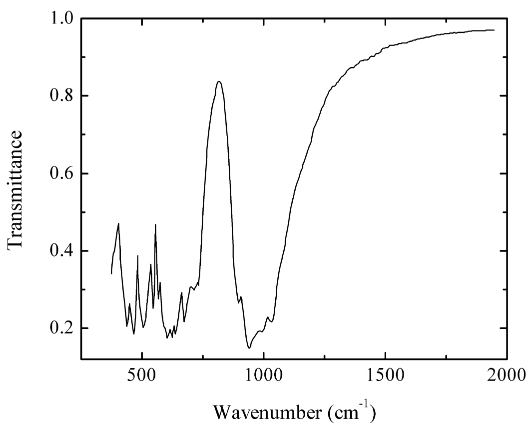
2.7 Silicates

Si1 Magnesiostaurolite $\square_4Mg_4Al_{16}(Al_2\square_2)Si_8O_{40}[(OH)_2O_6]$



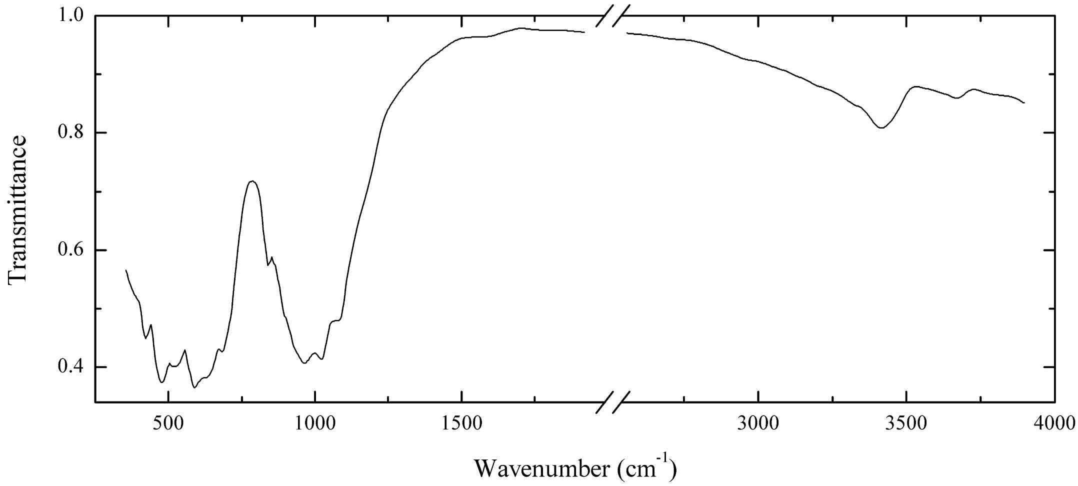
Locality: Dora-Maira massif, Vallone di Gilba, Val Varaita, Western Alps, Italy (type locality).
Description: Yellow grains from the association with talc, quartz and pyrope. The empirical formula is (electron microprobe) $(Mg_{3.8}Fe_{0.1}Al_{0.1})Al_{18.0}Si_{8.0}O_{40}[(OH)_{1.9}O_{6.1}]$.
Wavenumbers (cm^{-1}): 3570w, 3420w, 1080sh, 1028s, 990sh, 950sh, 905sh, 823w, 680sh, 649, 597s, 545, 525, 480, 437.

Si3 Kyanite Al_2SiO_5



Locality: Upper course of the Ladjvardara river, Pamir Mts., Tajikistan.
Description: Colourless platy crystals from the association with quartz and plagioclase. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3560w, 1034, 996s, 965sh, 940s, 898, 730, 715, 673, 636s, 622s, 602s, 590sh, 565, 544, 525sh, 515sh, 503, 464s, 436, 385sh.

Si4 Staurolite $(Fe,Mg)_4(Al,Fe)_{18}(Si,Al)_8O_{40}(O,OH)_8$

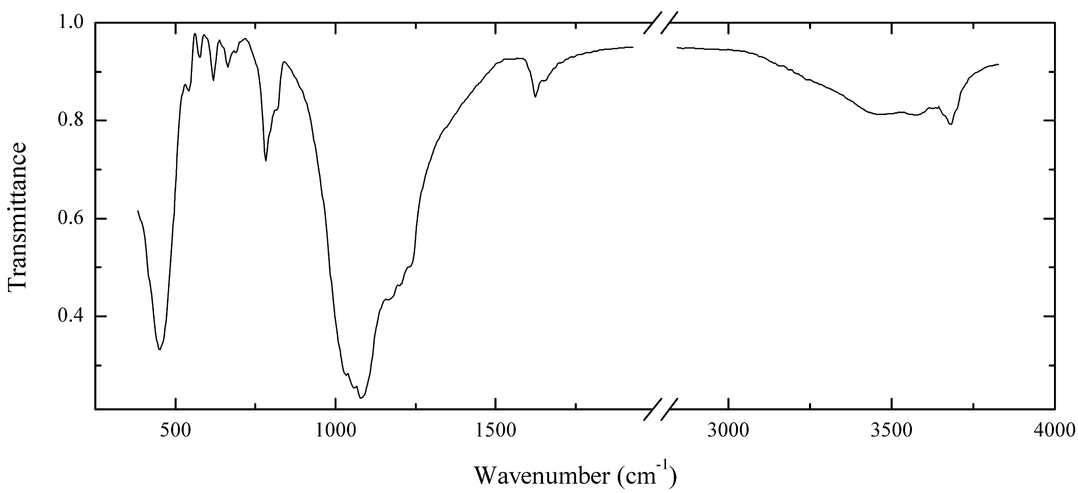


Locality: Pizzo Forno, Chironico valley, Leventina, Ticino (Tessin), Switzerland.

Description: Brown crystals from the association with muscovite and quartz. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3650w, 3395, 1170sh, 1078, 1025s, 967s, 900sh, 874, 686, 630sh, 592s, 522s, 488s, 426, 390sh.

Si5 Magadiite $NaSi_7O_{13}(OH)_3{\cdot}4H_2O$

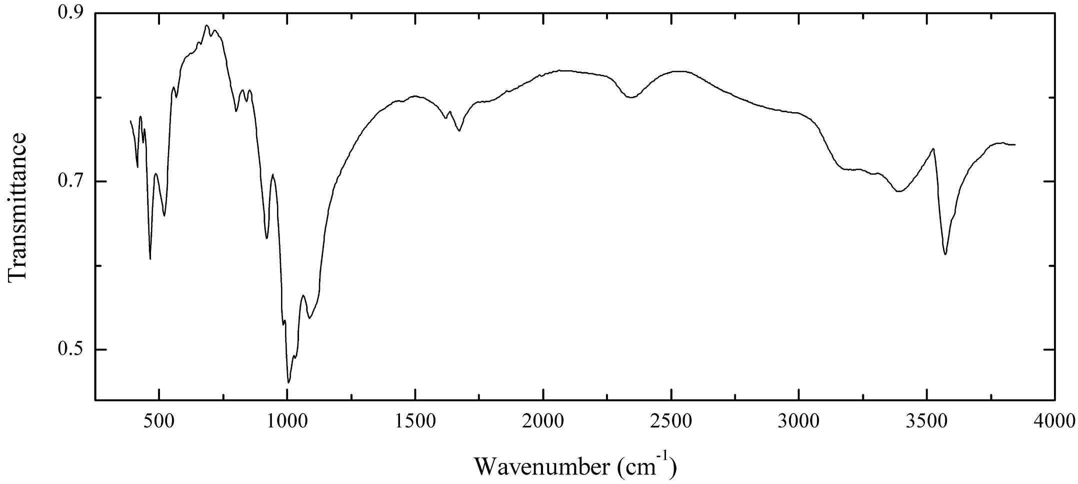


Locality: Watson Creek, trinity Co., California, USA.

Description: White fine-grained aggregate from the association with silhydrite. Identified by IR spectrum. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 14.7 (22), 7.63 (63), 5.63 (59), 5.49 (60), 4.96 (80), 4.51 (86), 3.60 (42), 3.40 (100), 2.38 (55), 3.12 (65).

Wavenumbers (cm^{-1}): 3667, 3570, 3430, 1655sh, 1628w, 1235sh, 1207, 1172, 1082s, 1059s, 1030sh, 820sh, 795sh, 782, 691w, 663w, 620, 576w, 539, 485sh, 450s, 415sh.

Si6 Makatite $Na_2Si_4O_8(OH)_2 \cdot 4H_2O$

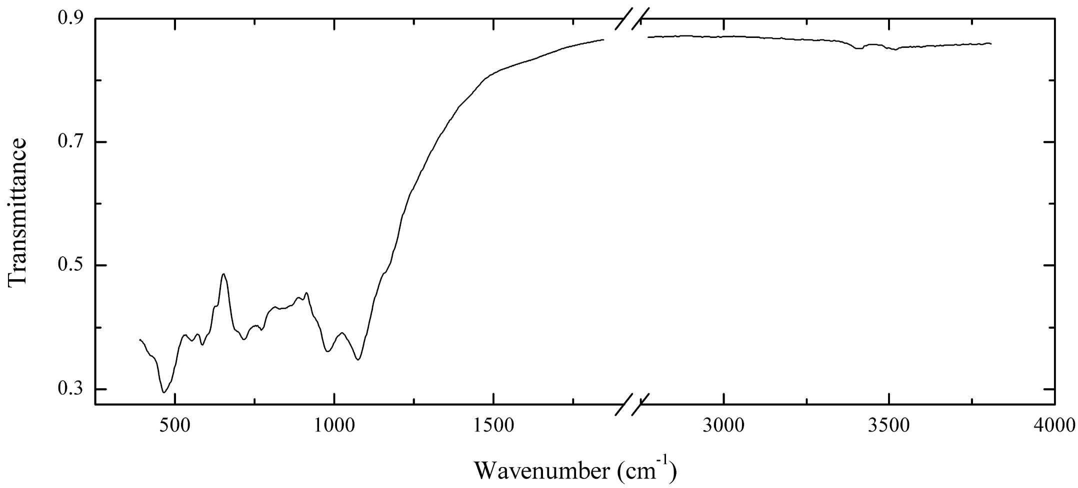


Locality: Umbozero underground mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White lamellar aggregate. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3640sh, 3570, 3490sh, 3410, 3320sh, 3190, 2340w, 1680w, 1630w, 1120sh, 1094s, 1040s, 1009s, 985s, 919, 835, 796, 775sh, 700w, 660w, 630w, 563, 515, 458, 430, 409.

Si7 Sapphirine $Mg_4(Mg_3Al_9)(Si_3Al_9O_{36})O_4$

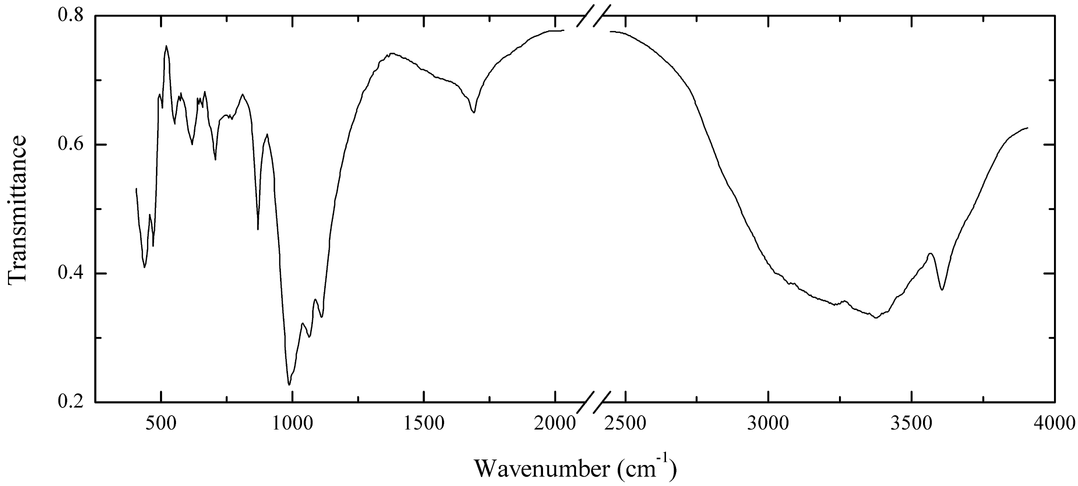


Locality: Morafeno, Tranomaro commune, Amboasary District, Anosy region, Tuléar Province, Madagascar.

Description: Blue-grey crystal from the association with phlogopite and scapolite. Confirmed by IR spectrum.

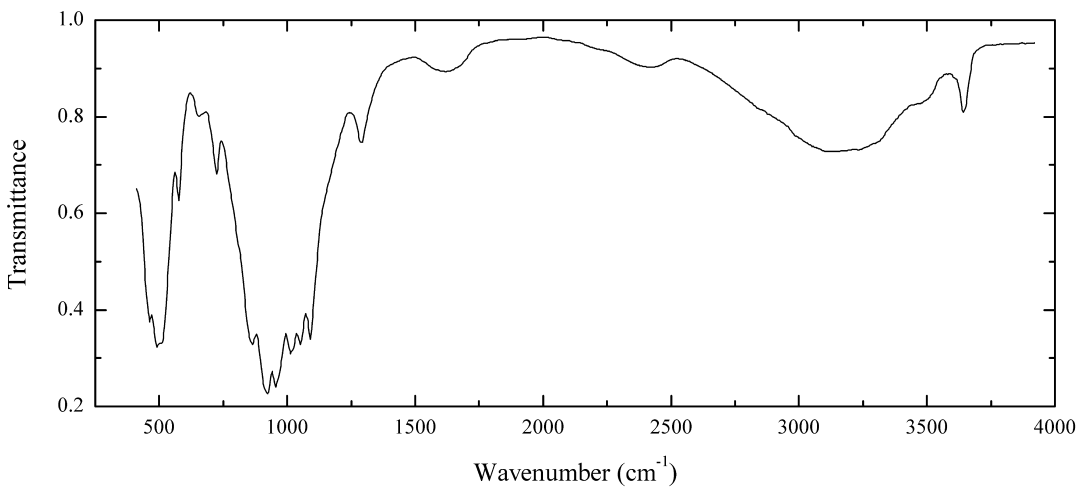
Wavenumbers (cm^{-1}): 3525w, 3430w, 3390w, 1170sh, 1081s, 987s, 940sh, 904, 839, 773, 718, 695sh, 634, 605sh, 587, 557, 466s, 425sh.

Si8 Revdite $Na_{16}[Si_4O_6(OH)_5]_2[Si_8O_{15}(OH)_6](OH)_{10}{\cdot}28H_2O$



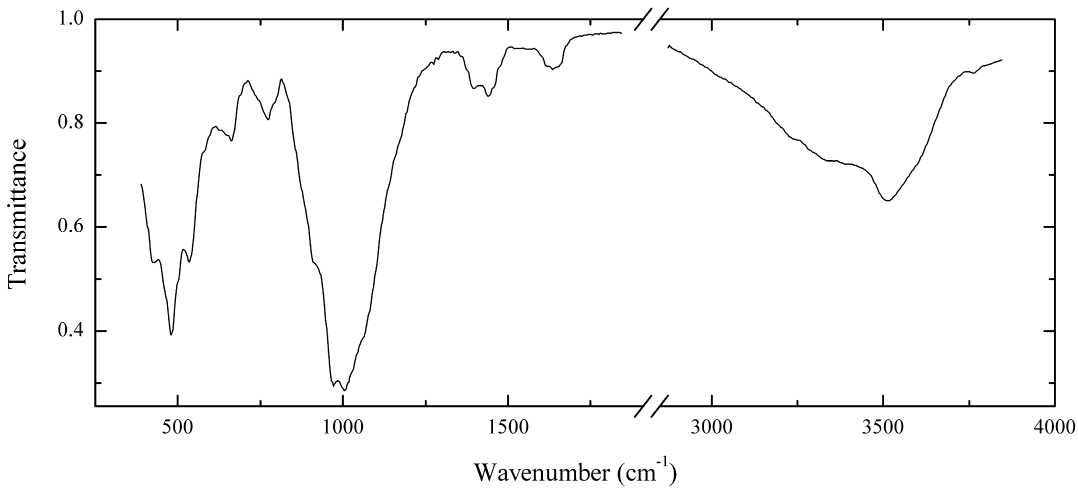
Locality: Palitra pegmatite, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Greenish crystals on natrosilite. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3596, 3370s, 3240, 1685, 1600w, 1455w, 1115s, 1069s, 1020sh, 990s, 872, 771w, 707, 658w, 622, 553, 500w, 469, 440s.

Si9 Hubeite $Ca_2Mn^{2+}Fe^{3+}[Si_4O_{12}(OH)]{\cdot}2H_2O$



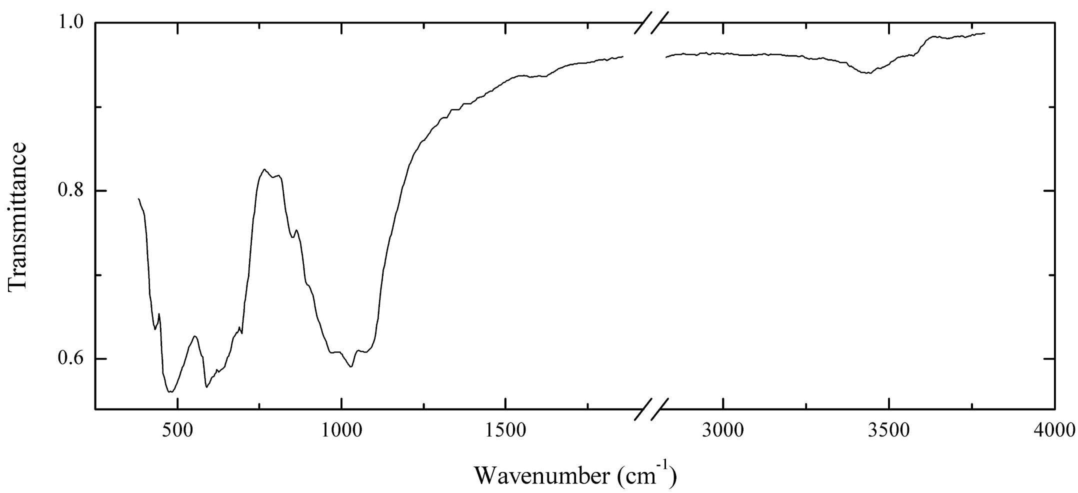
Locality: Fengjiashan (Daye) copper mine, near Huangshi, Hubei province, China (type locality).
Description: Brownish-red crystals from the association with inesite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3610, 3440sh, 3150, 2410w, 1610w, 1285, 1089s, 1051s, 1013s, 958s, 924s, 866s, 723, 663w, 575, 509s, 492s, 462.

Si10 Aerinite $(Ca,Na)_4Mg_3(Fe^{3+},Fe^{2+},Al)_3[(Si,Al)_{18}O_{42}](OH)_6 \cdot nH_2O$



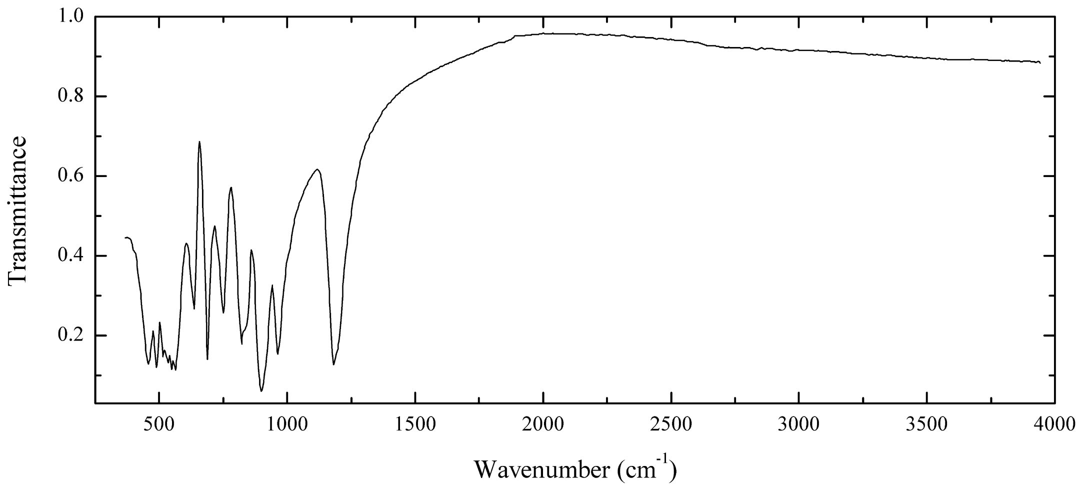
Locality: Caserras del Castillo, Juesca province, Aragón, Spain (type locality).
Description: Blue massive. Identified by IR spectrum.
Wavenumbers ($\mathbf{cm^{-1}}$): 3500, 3380sh, 1638, 1445, 1400, 1060sh, 1007s, 974s, 920sh, 795sh, 773, 661, 537, 482s, 433.

Si13 Staurolite $(Fe,Mg)_4(Al,Fe)_{18}(Si,Al)_8O_{40}(O,OH)_8$



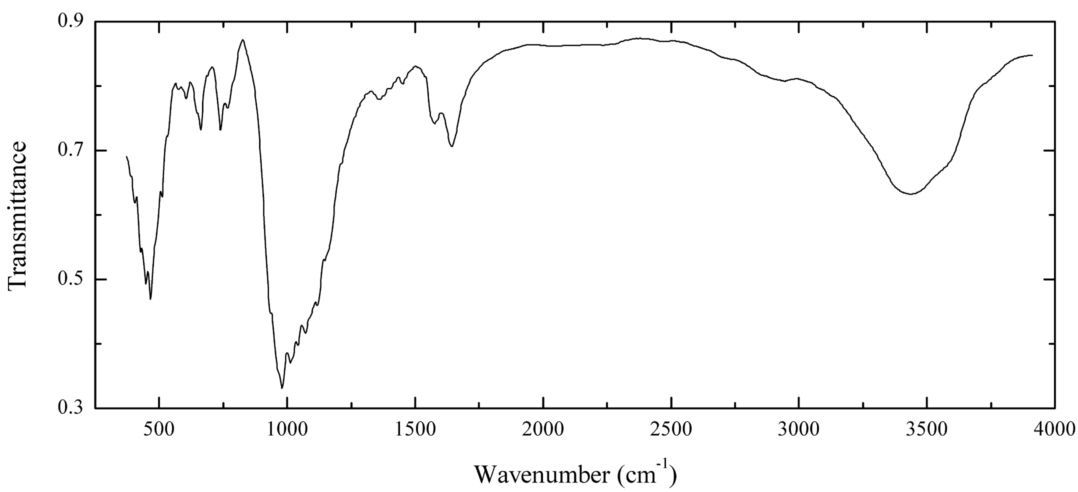
Locality: Semiostrov'e, Western Keivy Mts., Kola peninsula, Murnansk region, Russia.
Description: Brown semitransparent crystal from the association with quartz, muscovite and ilmenite. Confirmed by IR spectrum.
Wavenumbers ($\mathbf{cm^{-1}}$): 3560w, 3405w, 1083, 1027, 977, 910sh, 857, 790w, 690sh, 635sh, 593s, 470s, 429.

Si14 Sillimanite Al_2SiO_5



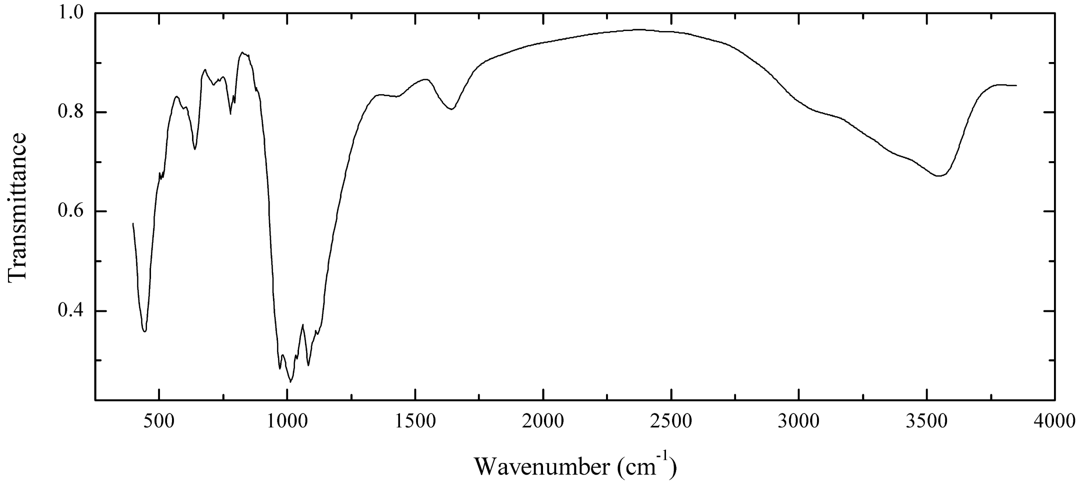
Locality: Dundas mineral field, Zeehan district, Tasmania, Australia.
Description: White fibrous aggregate from the association with stichtite, clinochlore and serpentine. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1195sh, 1181s, 963, 898, 840sh, 820, 746, 689s, 634, 564s, 545s, 532s, 511, 488s, 456s.

Si15 Okenite $Ca_{10}Si_{18}O_{46}(O,OH)_8·18H_2O$



Locality: Pune (Poonah) district, Maharashtra, India.
Description: White radial fibrous aggregate from the association with gyrolite and calcite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3430, 1645, 1580, 1455w, 1363w, 1240sh, 1153, 1125, 1095sh, 1076s, 1046s, 1015s, 932s, 920sh, 938, 780sh, 767, 739, 660, 645sh, 602w, 535sh, 509, 480sh, 464, 444, 424, 403.

Si16 Nekoite $Ca_3Si_6O_{15}\cdot 7H_2O$

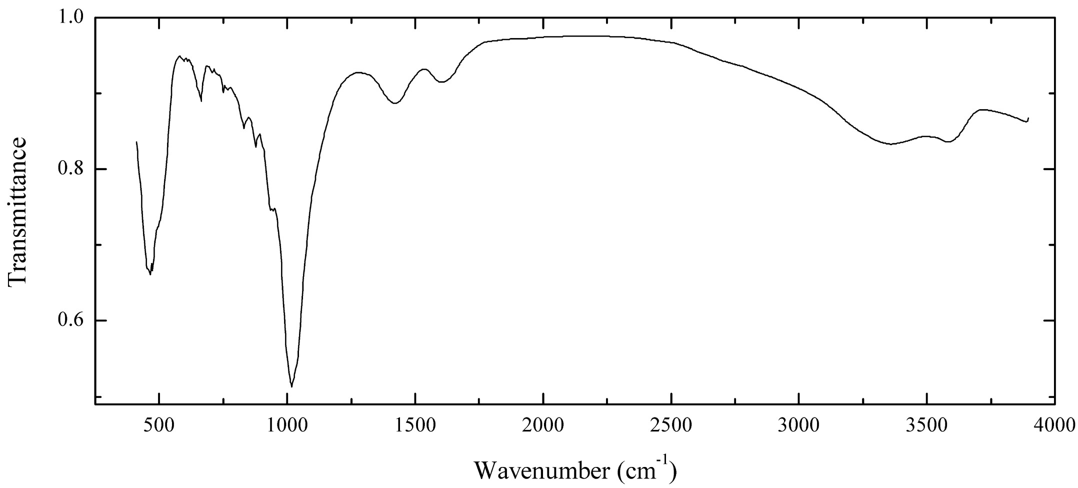


Locality: Iron Cap mine, Landsman Camp, Aravaipa, Santa Teresa Mts., Aravaipa district, Graham Co., Arizona, USA.

Description: White radial fibrous aggregate. Weak bands at 1,428 and 878 cm^{-1} are caused by the admixture of calcite.

Wavenumbers (cm^{-1}): 3555, 3410sh, 3260sh, 3110sh, 1628, 1428w, 1130sh, 1115sh, 1087s, 1040sh, 1018s, 1000sh, 975s, 878w, 800sh, 780, 716w, 643, 596w, 513, 443s.

Si17 Apachite $Cu^{2+}{}_9Si_{10}O_{29}\cdot 11H_2O$

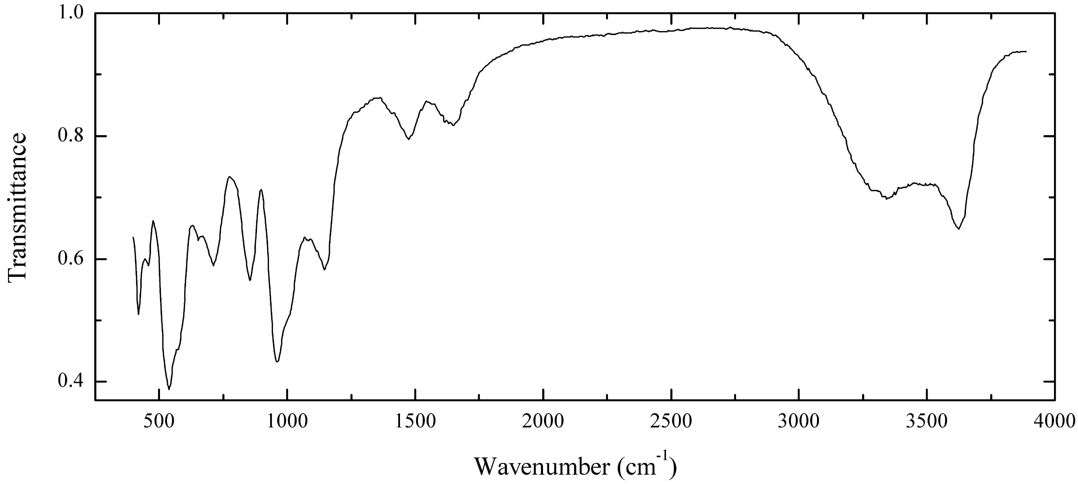


Locality: Christmas mine, Gila Co., Arizona, USA (type locality).

Description: Blue crust from the association with apophyllite and calcite. The bands at 1,427 and 877 cm^{-1} are caused by the admixture of calcite.

Wavenumbers (cm^{-1}): 3605, 3350, 1625, 1427, 1035sh, 1023s, 939, 877, 834, 763w, 666, 520sh, 501sh, 465s.

Si18 Vertumnite $Ca_8Al_4(Al_4Si_5)O_{12}(OH)_{36}\cdot 10H_2O$

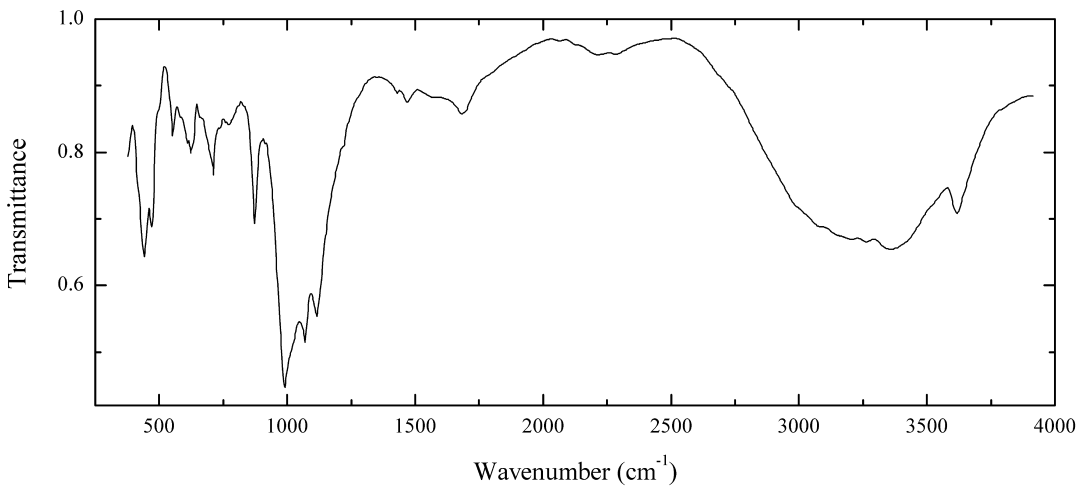


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: White platy crystals from the association with afwillite, plombierite, aragonite and calcite. Identified by IR spectrum and powder X-ray diffraction pattern. Weak band at 1,481 cm^{-1} is caused by the admixture of aragonite.

Wavenumbers (cm^{-1}): 3615, 3340, 1650w, 1481w, 1151, 1005sh, 963s, 858, 715, 660w, 580sh, 540s, 459w, 421.

Si19 Revdite $Na_{16}[Si_4O_6(OH)_5]_2[Si_8O_{15}(OH)_6](OH)_{10}\cdot 28H_2O$

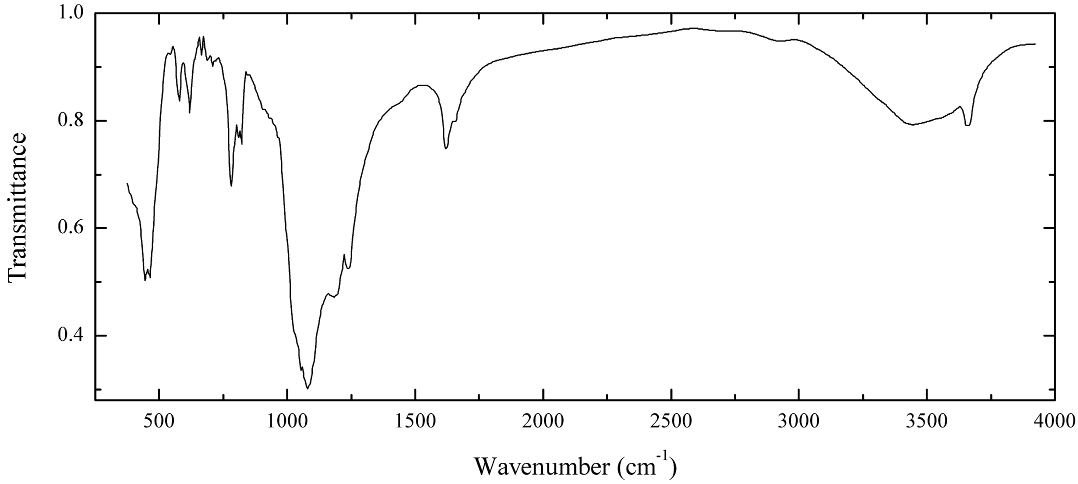


Locality: Palitra pegmatite, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless soft grains from the association with ussingite, natrosilite and thermonatrite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3588, 3345, 3200, 2220w, 1705sh, 1686, 1465w, 1430w, 1115s, 1068s, 1020sh, 990s, 873, 770w, 707, 622, 552, 500sh, 469, 441.

Si20 Magadiite $NaSi_7O_{13}(OH)_3{\cdot}4H_2O$

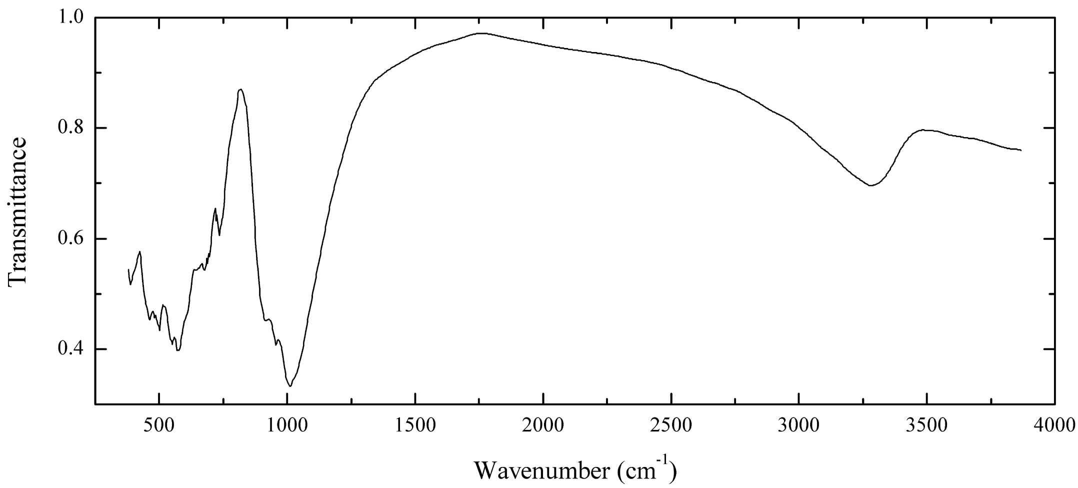


Locality: Kanem region, Chad.

Description: White fine-grained aggregate. Specimen No. 74003 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3656, 3440, 1655sh, 1633, 1242s, 1176s, 1077s, 1030sh, 825, 812, 782, 710w, 685w, 665w, 621, 577, 465s, 444s, 400sh.

Si21 Yoderite $Mg_2(Al,Fe^{3+})_6Si_4O_{18}(OH)_2$

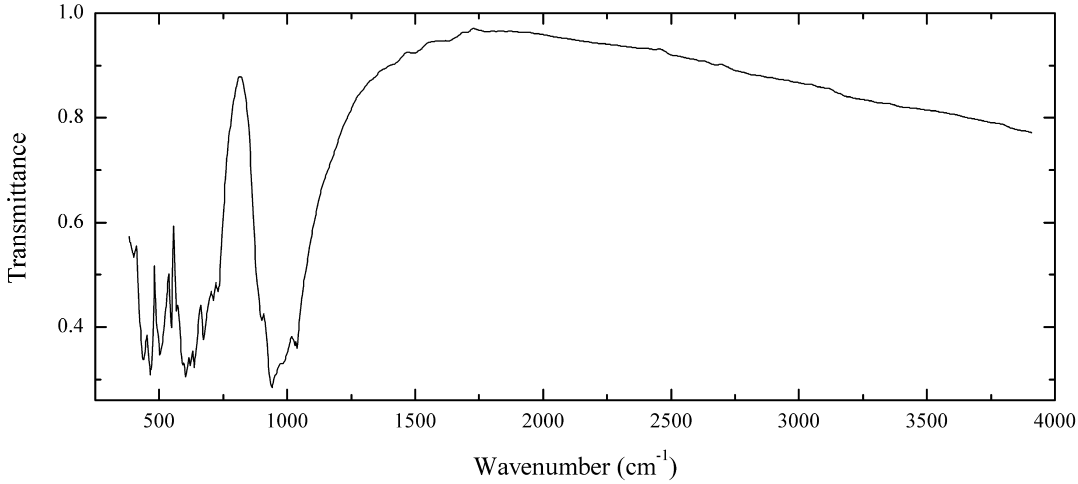


Locality: Mautia Hill, Kongwa, Dodoma region, Tanzania (type locality).

Description: Black (with violet tint) crystal from the association with talc, kyanite and hematite. Identified by IR spectrum.

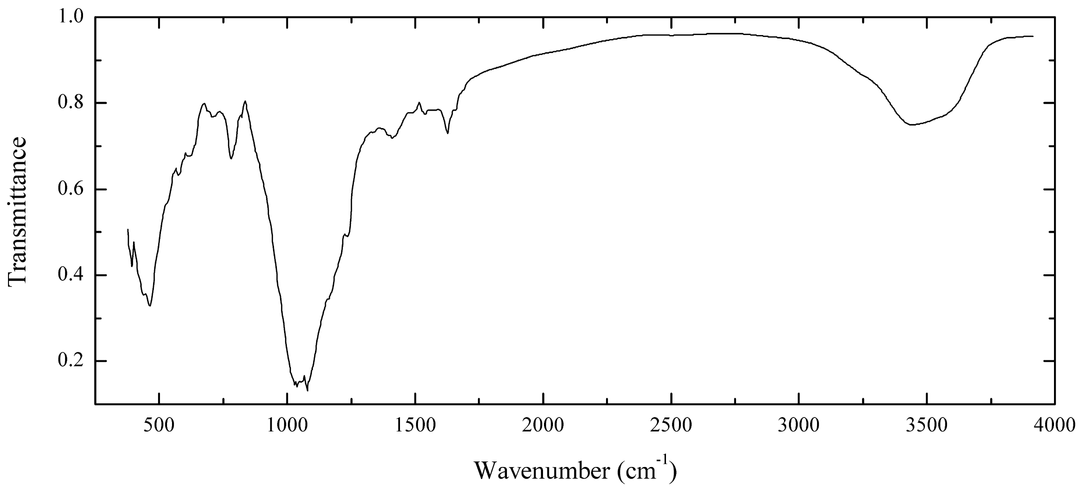
Wavenumbers (cm^{-1}): 3305, 3240w, 1160sh, 1012s, 957s, 916, 735, 690sh, 676, 642, 605sh, 574s, 550s, 498, 480sh, 460, 388.

Si22 Kyanite Al_2SiO_5



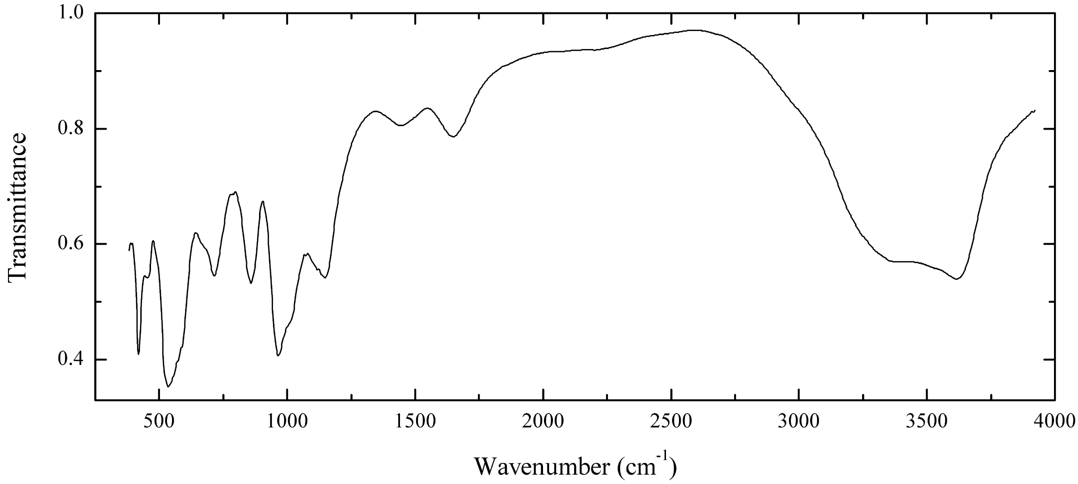
Locality: Mautia Hill, Kongwa, Dodoma region, Tanzania (type locality).
Description: Orange prismatic crystals from the association with yoderite, talc and hematite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1035, 985sh, 940s, 899, 730, 713, 673, 636s, 621s, 602s, 590sh, 565, 545, 502s, 464s, 436s, 397.

Si24 Magadiite $NaSi_7O_{13}(OH)_3{\cdot}4H_2O$



Locality: Lake Magadi, South Rift Valley, Rift Valley province, Kenya (type locality).
Description: White powdery pseudomorph after kenyaite. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3600sh, 3525, 3445, 3395sh, 1630w, 1540w, 1410w, 1237, 1195sh, 1160sh, 1080s, 1055sh, 1040s, 815sh, 782, 712w, 618w, 577, 464s, 440, (400).

Si25 Vertumnite $Ca_8Al_4(Al_4Si_5)O_{12}(OH)_{36}\cdot 10H_2O$

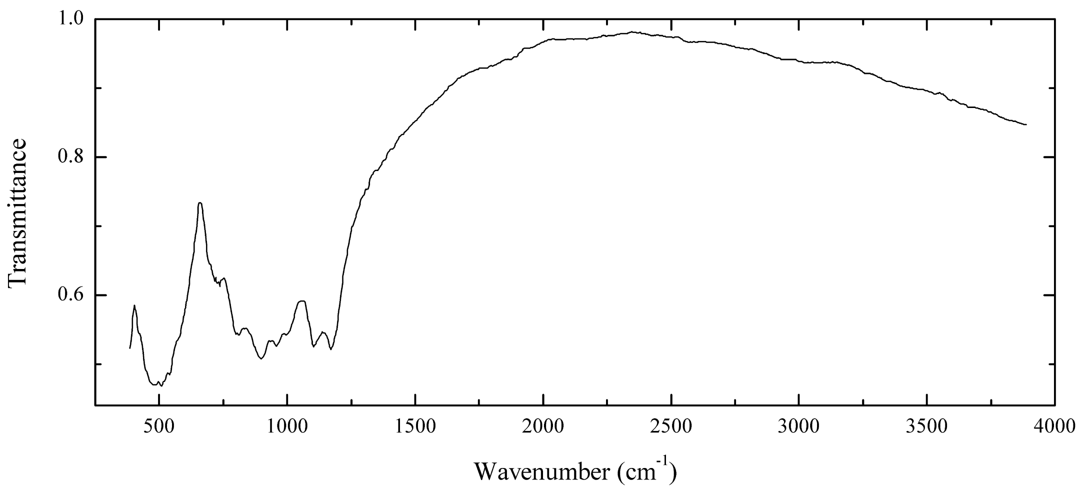


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Colourless platy crystals from the association with phillipsite-K and calcite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3617, 3370, 1650, 1440w, 1145, 1000sh, 964s, 857, 713, 570sh, 535s, 453, 421.

Si27 Mullite $Al_{4+2x}Si_{2-2x}O_{10-x}$

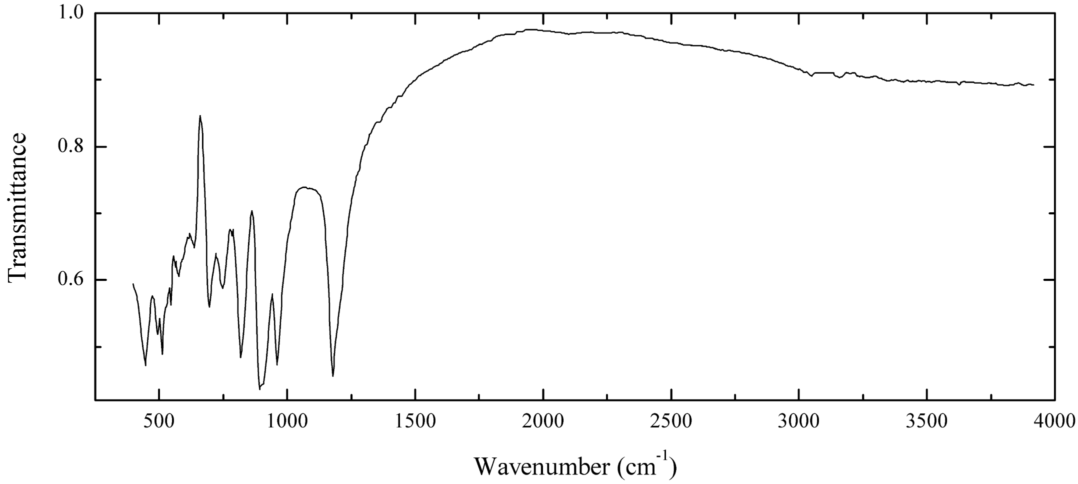


Locality: Nickenicher Weinberg, Eifel volcanic area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Clusters of pale violet acicular crystals. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1175, 1104, 997, 956, 897s, 808, 730, 570sh, 540s, 508s, 483s.

Si28 Sillimanite Al_2SiO_5

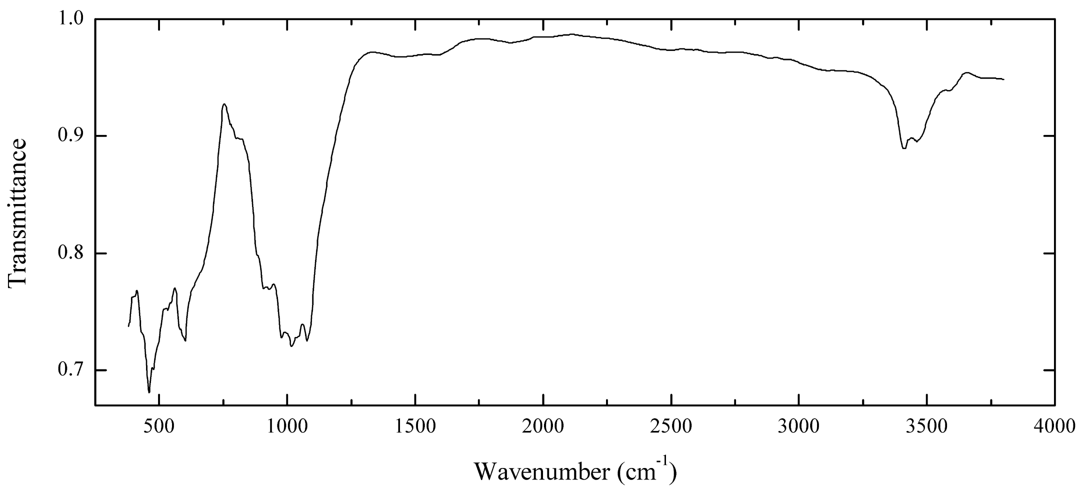


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Light grey fibrous aggregate from the association with tridimite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3140w, 3030w, 1195sh, 1176s, 961s, 905sh, 890s, 746, 694, 637, 590sh, 575, 545, 527, 510, 488, 446s.

Si29 Magnesiostaurolite $\square_4Mg_4Al_{16}(Al_2\square_2)Si_8O_{40}[(OH)_2O_6]$

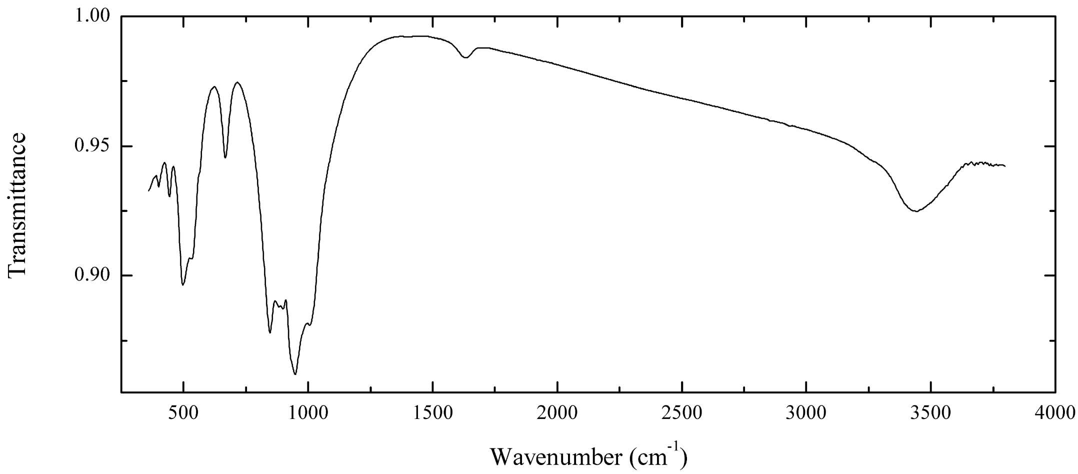


Locality: Dora-Maira massif, Vallone di Gilba, Val Varaita, Western Alps, Italy (type locality).

Description: Light yellow grains from the association with talc, ellenbergerite, hydroxylwagnerite and pyrope. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3570w, 3410w, 1175sh, 1075sh, 1042s, 1025s, 960sh, 900, 826w, 670sh, 640sh, 597s, 526s, 480s, 435sh.

Si30 Rowlandite-(Y) $Y_4Fe^{2+}Si_4O_{14}F_2 \cdot nH_2O$ (?)

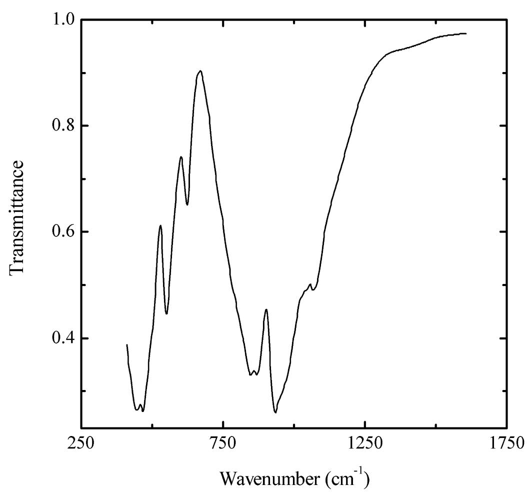


Locality: Stetind pegmatite, Tysfjord, Nordland, Norway.

Description: Greenish-grey grain from massive Y-rich fluorite. The empirical formula is (electron microprobe) $(Y_{1.4}Yb_{0.4}Nd_{0.4}La_{0.4}Ce_{0.4}Dy_{0.2}Sm_{0.2}Gd_{0.2}...)(Fe_{0.6}Mg_{0.4})Si_{4.2}O_xF_{2.5} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3445, 3270sh, 1635, 1006s, 948s, 899, 885, 847s, 668, 530, 497, 443, 402.

Sio1 Spessartine $Mn^{2+}{}_3Al_2(SiO_4)_3$

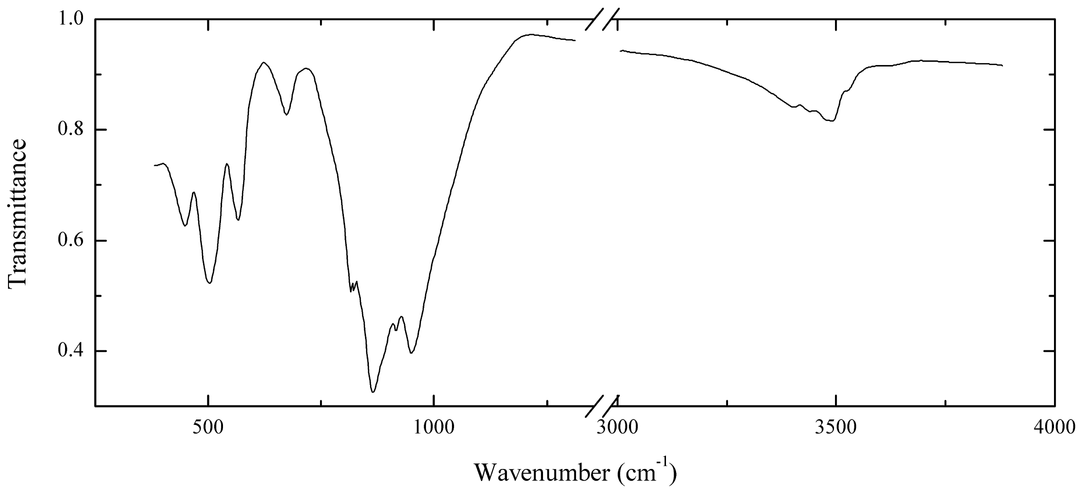


Locality: Harstigen mine, Pajsberg, near Filipstad, Värmland, Sweden.

Description: Red-brown grains from skarn. The empirical formula is (electron microprobe) $(Mn_{1.7}Fe_{0.7}Mg_{0.5}Ca_{0.1})(Al_{1.9}Fe_{0.1})(SiO_4)_3$.

Wavenumbers (cm^{-1}): 1078, 1065sh, 937s, 873s, 851s, 621, 546, 462s, 438s.

Sio2 Alleghanyite $Mn^{2+}{}_5(SiO_4)_2(OH)_2$

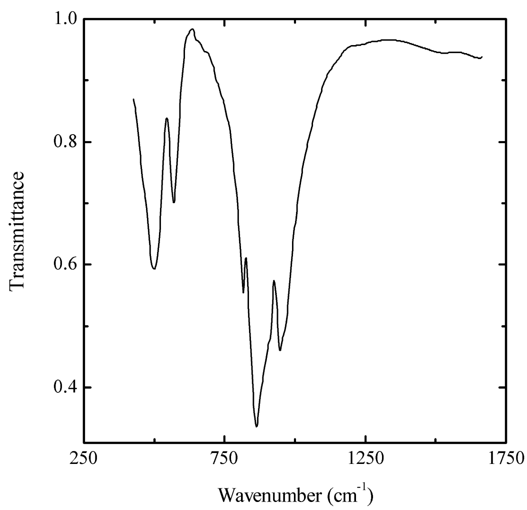


Locality: Razoare Mn deposit, Preluca massif, Eastern Carpathians, Romania.

Description: Orange-red grains in rock, in the association with tephroite and jerrygibbsite. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Mn_{4.62}Mg_{0.32}Fe_{0.06}(SiO_4)_{2.00}(OH)_{1.91}F_{0.09}$.

Wavenumbers (cm^{-1}): 3520sh, 3480, 3430w, 3395w, 952s, 920s, 890sh, 865s, 823, 816, 674w, 565, 502, 448.

Sio3 Tephroite $Mn^{2+}{}_2(SiO_4)$

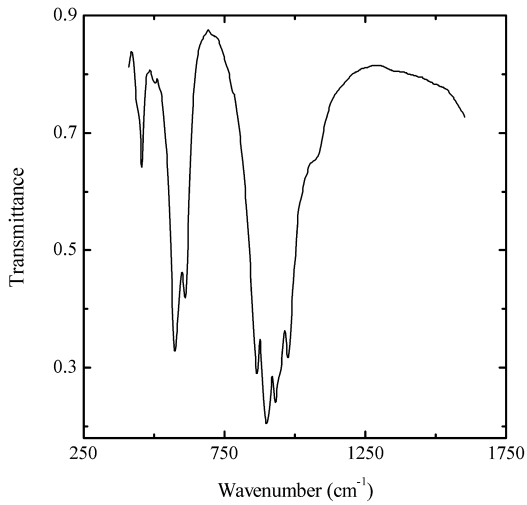


Locality: Razoare Mn deposit, Preluca massif, Eastern Carpathians, Romania.

Description: Light grey grains in rock, in the association with alleghanyite and carbonate. The empirical formula is (electron microprobe) $(Mn_{1.7}Mg_{0.25}Fe_{0.05})(SiO_4)_2$. Confirmed by IR spectrum.

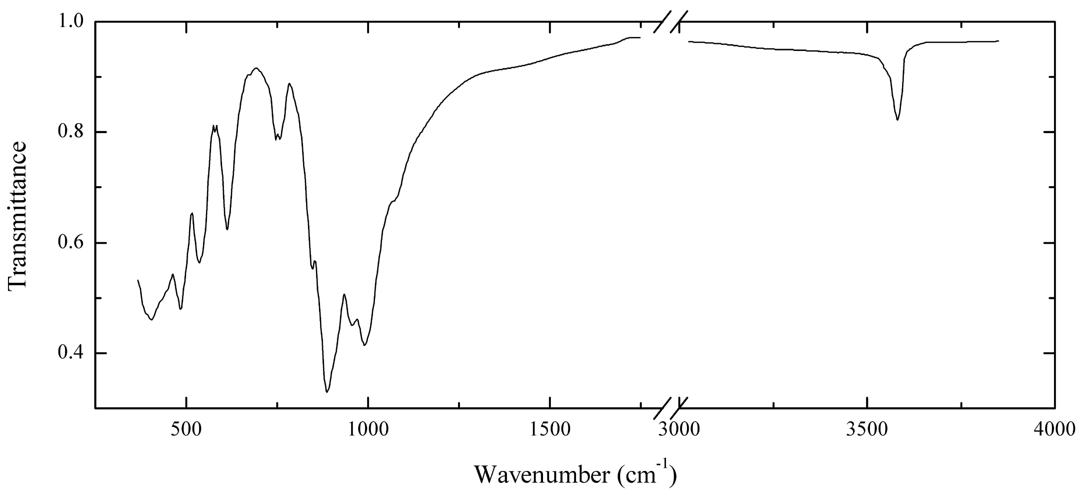
Wavenumbers (cm^{-1}): 965sh, 950s, 915sh, 867s, 820s, 680sh, 569, 499.

Sio4 Willemite $Zn_2(SiO_4)$



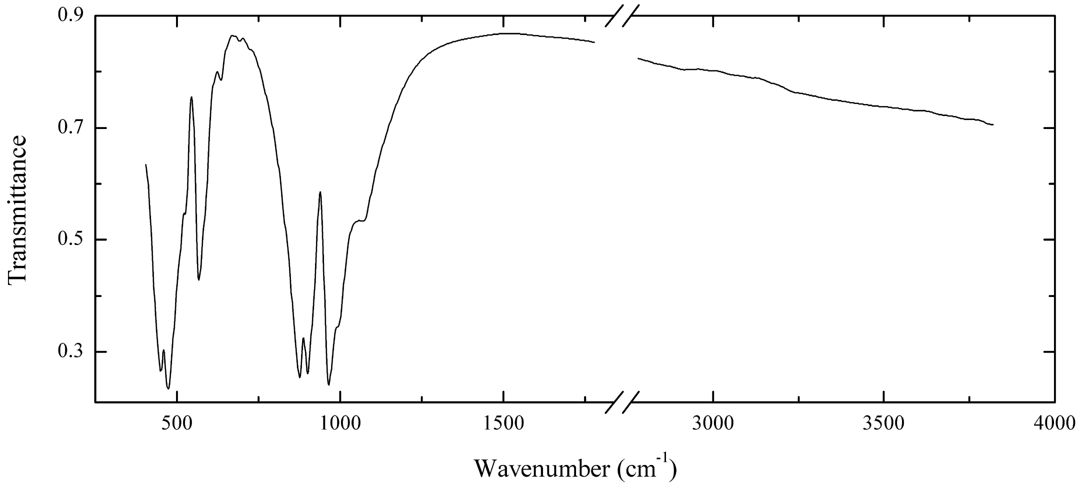
Locality: Sterling mine, Franklin mining district, Sussex Co., New Jersey, USA.
Description: Orange-brown crystal in manganoan calcite. Mn-rich variety.
Wavenumbers (cm^{-1}): 1060sh, 977s, 945sh, 932s, 901s, 868s, 614, 585sh, 576s, 460, 445sh.

Sio5 Humite $Mg_7(SiO_4)_3(F,OH)_2$



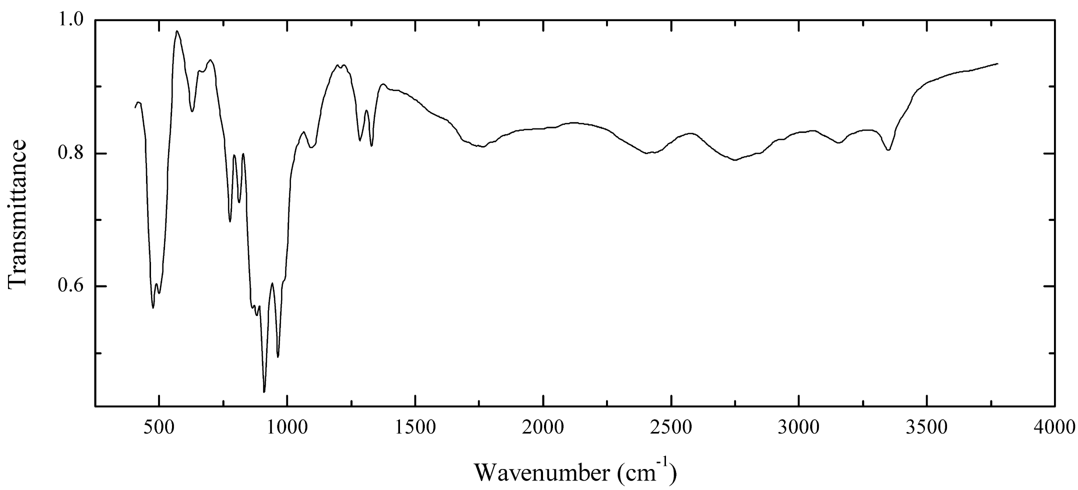
Locality: San Vito quarry, Ercolano, Monte Somma, Naples province, Campania, Italy (type locality).
Description: Yellow transparent crystal. The empirical formula is (electron microprobe) $(Mg_{5.5}Fe_{1.5})(SiO_4)_3F_{1.4}(OH)_{0.6}$.
Wavenumbers (cm^{-1}): 3560, 3430sh, 990s, 956s, 888s, 848, 760, 750, 614, 540, 488s, 440sh, 404s, 390sh.

Sio6 Almandine $Fe^{2+}{}_3Al_2(SiO_4)_3$



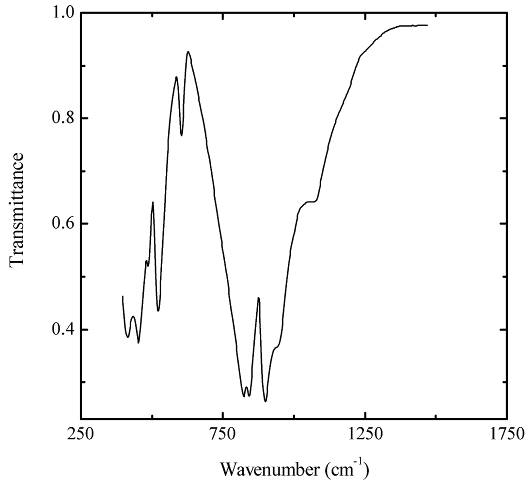
Locality: Ruby Mountain, Nathrop, near Buona Vista, Colorado, USA.
Description: Perfect crystal in cavity within liparite. Mn-rich variety (Mn:Fe ≈ 2:3).
Wavenumbers (cm^{-1}): 1084, 992, 961s, 896s, 873s, 632, 580sh, 564, 525sh, 470s, 448s.

Sio7 Afwillite $Ca_3(SiO_3OH)_2{\cdot}2H_2O$



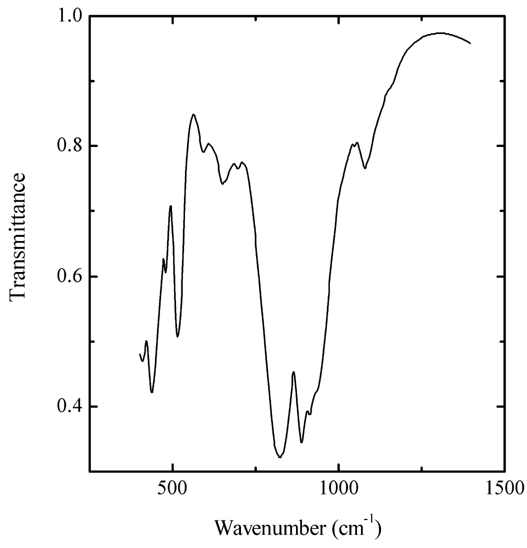
Locality: Crestmore quarry, north of Riverside, Riverside Co., California, USA.
Description: Colourless crust on rock. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3330, 3140, 2740, 2420, 1750, 1327, 1284, 1100, 990sh, 965s, 912s, 882s, 864s, 814, 780, 745sh, 670w, 629, 520sh, 500s, 475s.

Sio8 Andradite $Ca_3Fe^{3+}{}_2(SiO_4)_3$



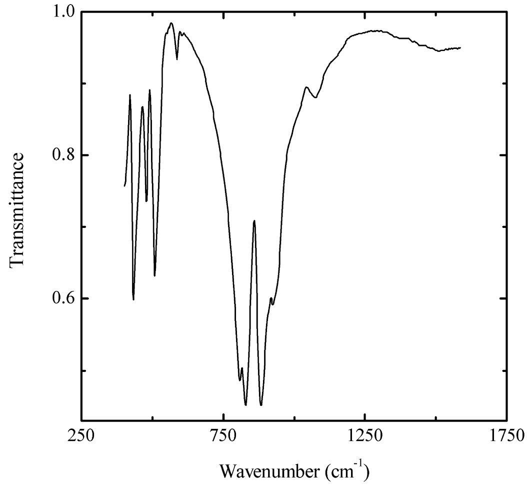
Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.
Description: Black crystals on rodingite. The empirical formula is (electron microprobe) $Ca_{2.9}Fe_{1.4}Al_{0.7}(SiO_4)_3$.
Wavenumbers (cm^{-1}): 1071, 945sh, 899s, 842s, 823s, 602, 521, 488, 451s, 411s.

Sio9 Andradite $Ca_3Fe^{3+}{}_2(SiO_4)_3$



Locality: Mogo-Vid Mt., Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Coarse black crystals in carbonatite, in the association with calcite, diopside, vermiculite and perovskite. Ti-rich variety. The empirical formula is (electron microprobe) $Ca_{3.02}Fe_{1.36}Ti_{0.30}Al_{0.24}Mg_{0.09}Mn_{0.02}(SiO_4)_3$.
Wavenumbers (cm^{-1}): 1083, 935sh, 910sh, 890s, 830s, 690w, 760, 690w, 511, 476, 435s, (397).

Sio10 Andradite $Ca_3Fe^{3+}{}_2(SiO_4)_3$

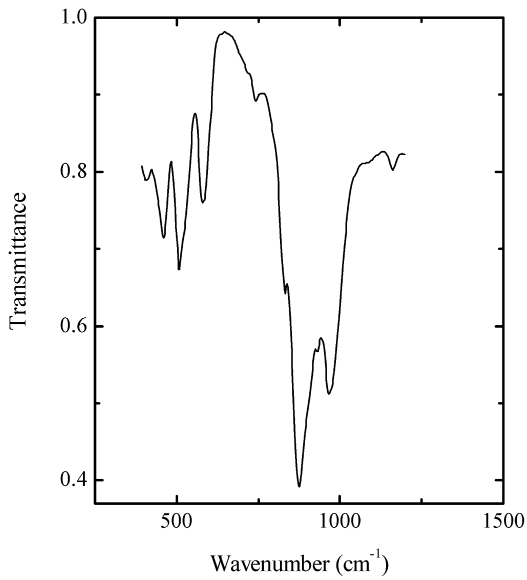


Locality: Bobrovka river, near Nizhnii Tagil, Middle Urals, Russia.

Description: Green transparent crystal form a placer deposit. The empirical formula is close to the idealized formula.

Wavenumbers (cm^{-1}): 1085w, 930, 885, 831, 811, 592w, 507s, 477, 433s.

Sio11 Ribbeite $Mn_5(SiO_4)_2(OH)_2$

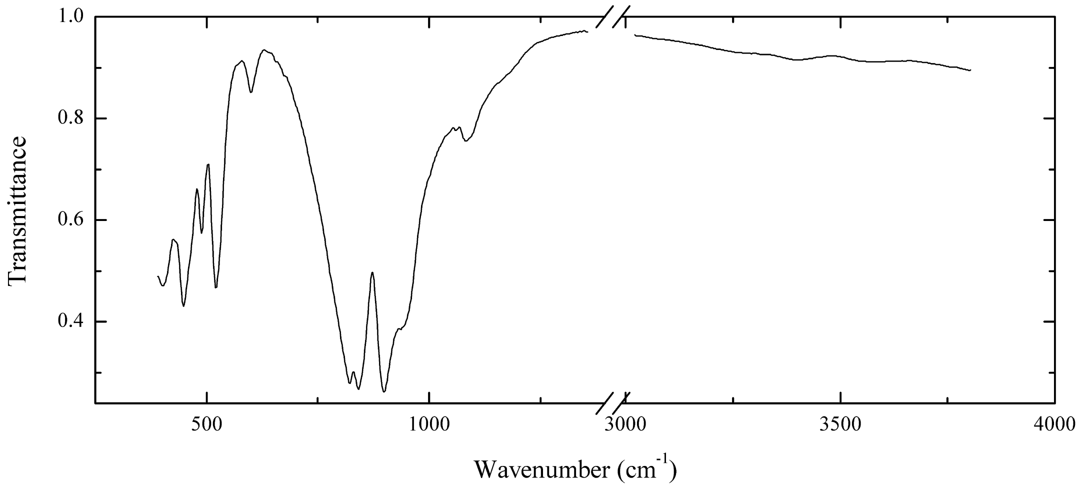


Locality: Nordmark, near Filipstad, Värmland, Sweden.

Description: Platy red-brown crystals from skarn, from the association with katoptrite, manganostibite and hematolite. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Mn_{3.92}Mg_{1.03}Ca_{0.02}Fe_{0.01}Al_{0.01})(SiO_4)_2(OH,F)_2$.

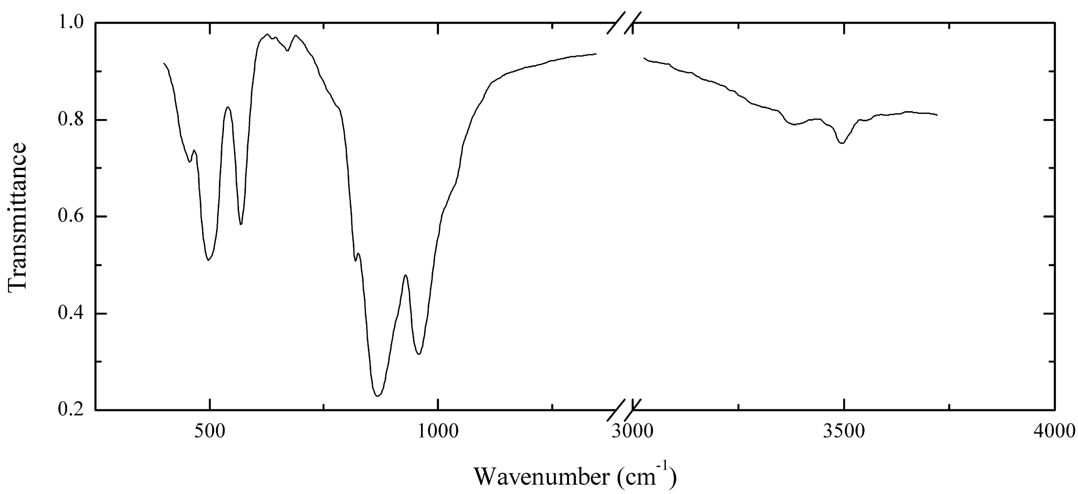
Wavenumbers (cm^{-1}): 961s, 928, 871s, 828, 741w, 715w, 575, 520sh, 506, 455, 400.

Sio12 Andradite $Ca_3Fe^{3+}{}_2(SiO_4)_3$



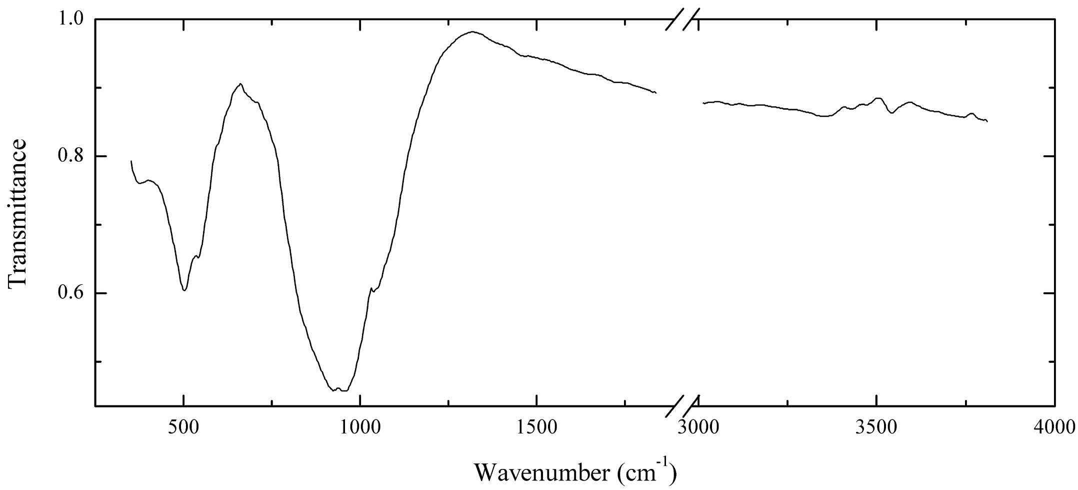
Locality: Mica mine, Kovdor, Kovdor massif, Kola peninsula, Murmansk region, Russia.
Description: Green outer zone of a black Ti-bearing andradite crystal. Associated minerals are vesuvianite, tobermorite and riversideite. Identified by IR spectrum and qualitative electron microprobe analysis. Lines of Mg, Mn, Al, Cr and Ti are absent in X-ray spectrum.
Wavenumbers (cm^{-1}): 1082, 930sh, 892s, 834s, 814s, 592w, 511, 479, 438s, 383.

Sio13 Alleghanyite $Mn^{2+}{}_5(SiO_4)_2(OH)_2$



Locality: Southern Faizulinskoe deposit, South Urals, Russia.
Description: Pinkish-beige massive from the association with tephroite. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3470, 3355, 3270sh, 1020sh, 958s, 866s, 819, 674w, 570, 510sh, 498, 456, 440sh.

Sio14 Britholite-(Ce) $(Ce,Ca)_5(SiO_4,PO_4)_3(OH,F)$

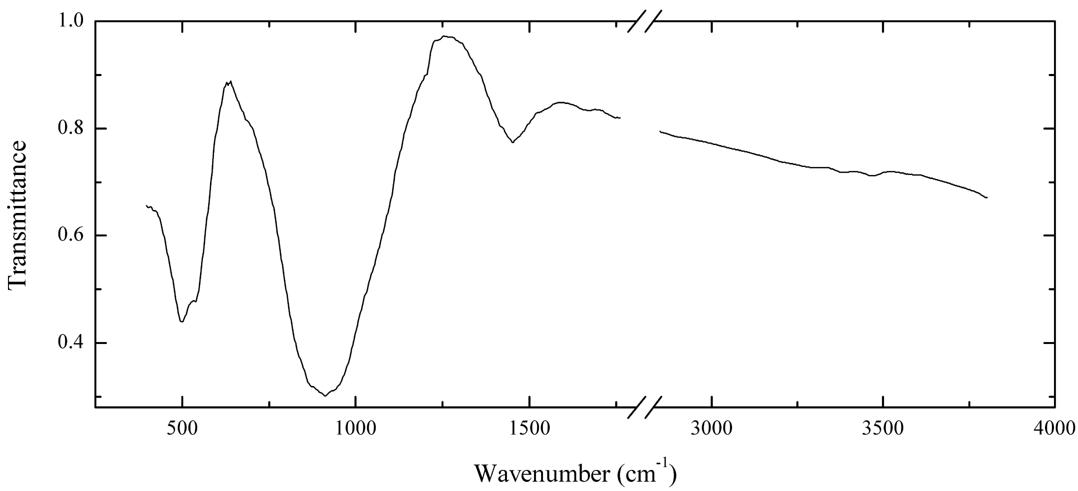


Locality: Naujakasik, Ilímaussaq alkaline complex, Narsaq municipality, South Greenland, Greenland (type locality).

Description: Brown grains. Specimen No. 69499 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Confirmed by IR spectrum and qualitative electron microprobe analysis. Na-bearing variety.

Wavenumbers (cm^{-1}): 3528w, 3465w, 3420w, 3345w, 1080sh, 1040sh, 957s, 928s, 595sh, 542, 501, 375.

Sio15 Britholite-(Ce) $(Ce,Ca)_5(SiO_4,PO_4)_3(OH,F)$

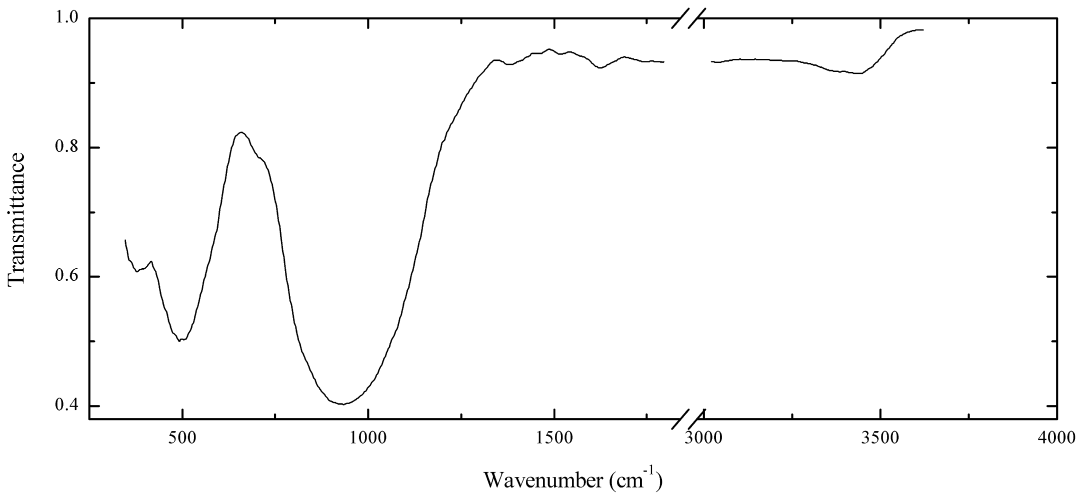


Locality: Yum'echorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Specimen No. 73609 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. *REE*-rich, Na-bearing metamict variety. Investigated by I.V. Pekov. The band at 1,455 cm^{-1} is due to inclusions of bastnaesite-(Ce).

Wavenumbers (cm^{-1}): 1455, 915s, 872sh, 538, 500s.

Sio16 Fluorbritholite-(Y) $(Y,Ca,\mathit{Ln})_5[(Si,P)O_4]_3F$

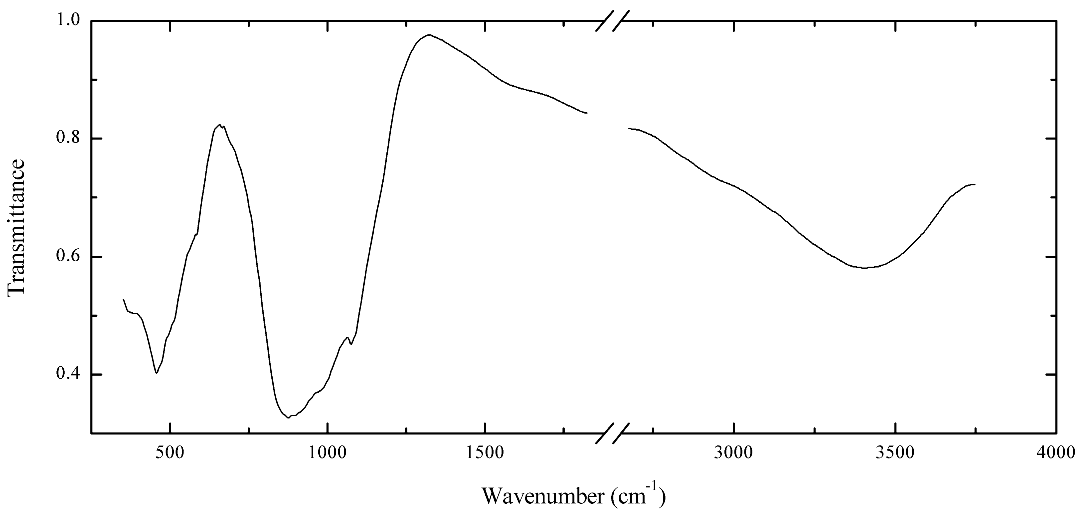


Locality: Vyuntspakhk Mt., Western Keivy Mts., Kola peninsula, Murmansk region, Russia.

Description: Dark brown grains from the association with quartz, microcline, magnetite, zircon, fergusonite-(Y) and Fe-bearing thorite. Metamict variety. Cotype specimen. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $Ca_{2.05}Mn_{0.08}Na_{0.06}(Y_{1.80}Ce_{0.31}Nd_{0.24}La_{0.13}Sm_{0.12}Pr_{0.05}Dy_{0.05}Gd_{0.03}Er_{0.03}Yb_{0.02})Th_{0.03}(Si_{2.70}P_{0.30}O_{12})F_{0.95}O_{0.07}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3410, 1635w, 1390w, 1060sh, 930s, 710sh, 590sh, 501s, 385.

Sio17 Thorite $ThSiO_4$

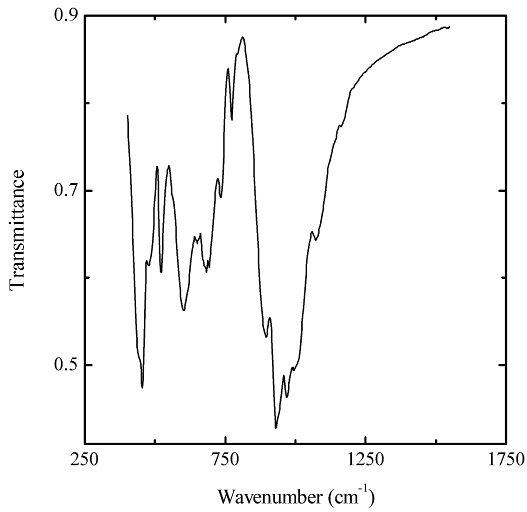


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Beige granular aggregate. Metamict, hydrated variety. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3405, 1675w, 1635w, 1577w, 1540sh, 1445w, 1377w, 1074, 970sh, 878s, 575sh, 510sh, 495sh, 456s, 380sh.

Sio18 Andalusite $Al_2(SiO_4)O$

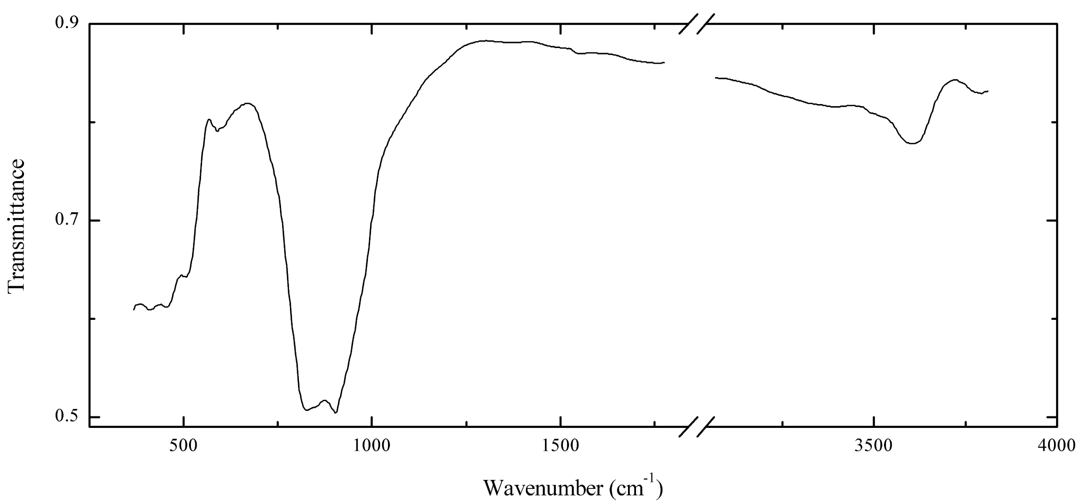


Locality: Hunan province, China.

Description: Brownish-pink crystal with carbonaceous inclusions regularly arranged along the longer axis of the crystal ("chiastolite"). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1077, 1005sh, 997, 973s, 945sh, 935s, 899, 777, 688, 650, 606, 521, 480, 455s, 445sh.

Sio20 Morimotoite $Ca_3TiFe^{2+}(SiO_4)_3$

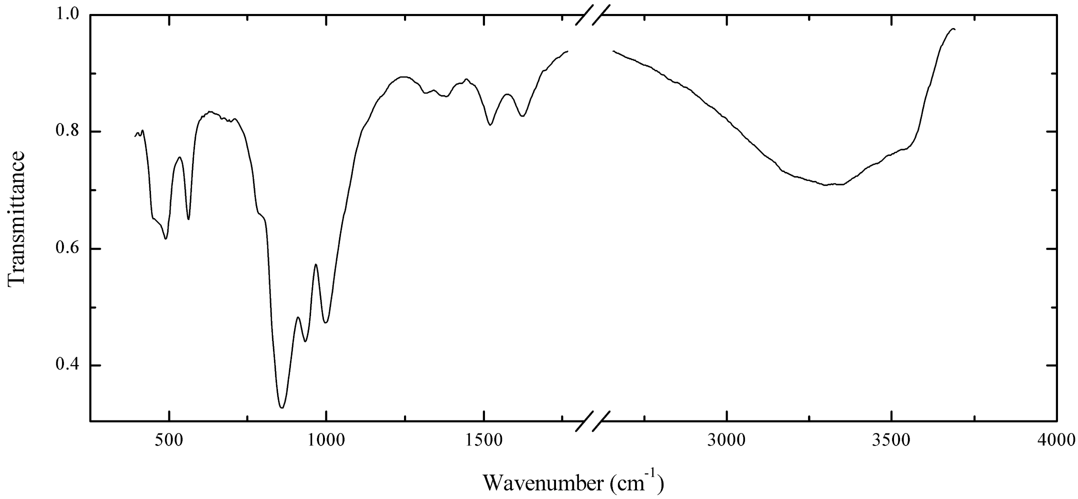


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-yellow crystals from the association with natrolite. OH-rich variety (hydrogarnet). Cotype specimen. Investigated by Yu. P. Menshikov. The empirical formula is $(Ca_{2.99}Mn_{0.01})(Ti_{0.88}Fe_{0.69}Al_{0.37}Nb_{0.05})[(SiO_4)_{1.93}(OH)_{4.57}]\cdot 0.29H_2O$.

Wavenumbers (cm^{-1}): 3555, 3460sh, 3320w, 965sh, 898s, 850sh, 825s, 596w, 510, 462, 410.

Sio21 Boltwoodite $HK(UO_2)(SiO_4)\cdot 1.5H_2O$

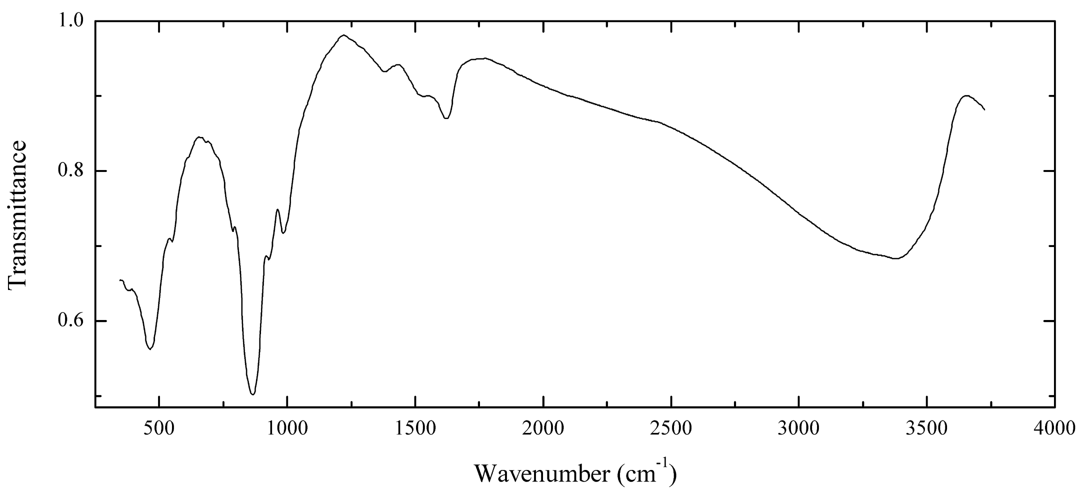


Locality: An unknown locality near Balkhash lake, Central Kazakhstan.

Description: Aggregate of yellow acicular crystals. Investigated by G.A. Sidorenko. Identified by wet chemical analysis and powder X-ray diffraction pattern. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3515sh, 3300, 1630, 1525, 1480w, 1420w, 999, 932s, 859s, 785sh, 558, 485, 445sh.

Sio22 Boltwoodite $HK(UO_2)(SiO_4)\cdot 1.5H_2O$

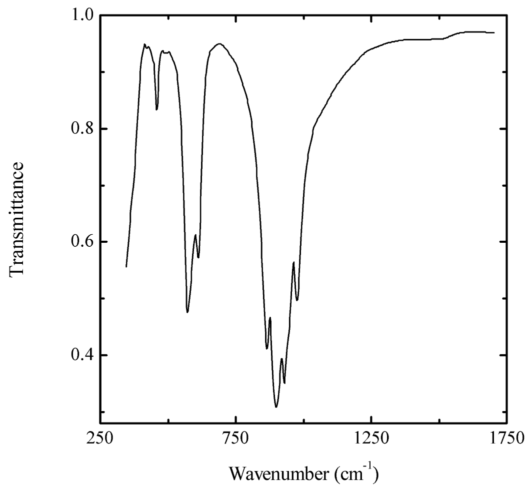


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow massive. Investigated by A.V. Voloshin. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3360, 3250sh, 1625, 1525w, 1383w, 987, 928, 864s, 788, 553, 470s, 400.

Sio23 Willemite $Zn_2(SiO_4)$

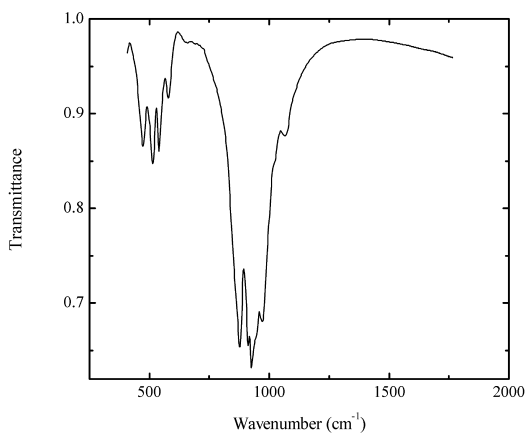


Locality: Sterling mine, Sterling Hill, Ogdensburg, Franklin mining district, Sussex Co., New Jersey, USA.

Description: Dark red grains from the association with holdenite and Mn-rich calcite. The empirical formula is (electron microprobe) $Zn_{1.80}Mn_{0.14}Fe_{0.03}Mg_{0.02}(Si_{1.00}O_4)$.

Wavenumbers (cm^{-1}): 976, 945sh, 931s, 901s, 866s, 612, 574s, 457.

Sio24 "Albovite" $Ca_3(SiO_4)Cl_2$

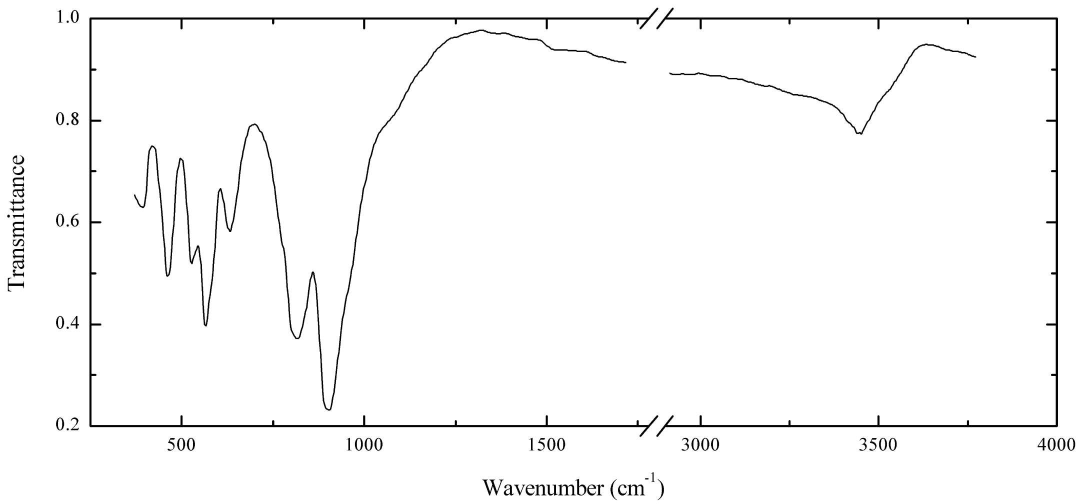


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Grey grains from the association with spurrite, periclase and calcite. Not approved by the IMA CNMNC. Described by B.V. Chesnokov. Monoclinic, space group $P2_1/c$, $a = 9.85$, $b = 6.75$, $c = 10.88$ Å, $\beta = 106.31°$; $Z = 4$. Optically biaxial (−), $\alpha = 1.647$, $\beta = 1.665$, $\gamma = 1.672$. $D_{calc} = 2.709$ g/cm^3. The empirical formula is $Ca_{2.9}(SiO_4)Cl_{1.8}$.Strong lines of powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 9.37 (30) (100), 3.37 (36) (211), 2.863 (100) (310), 2.834 (46) (022), 2.720 (77) (104), 1.968 (60) (422).

Wavenumbers (cm^{-1}): 1070w, 1025sh, 970s, 945sh, 925s, 915sh, 877s, 579w, 538, 511, 473.

Sio25 Henritermierite $Ca_3(Mn,Al)_2(SiO_4)_2(OH)_4$

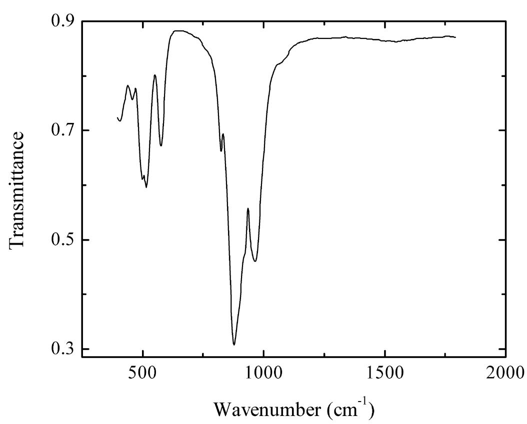


Locality: N'Chwaning II Mine, Kalahari manganese fields, South Africa.

Description: Red-brown crystals from the association with hausmannite. The empirical formula is (electron microprobe) $Ca_{3.00}(Mn_{1.84}Al_{0.11}Fe_{0.05})(SiO_4)_{2.00}(OH)_4$.

Wavenumbers (cm^{-1}): 3490sh, 3425, 960sh, 905s, 885sh, 818s, 633, 585sh, 565s, 535sh, 529, 465, 384.

Sio26 Glaucochroite $CaMn^{2+}(SiO_4)$

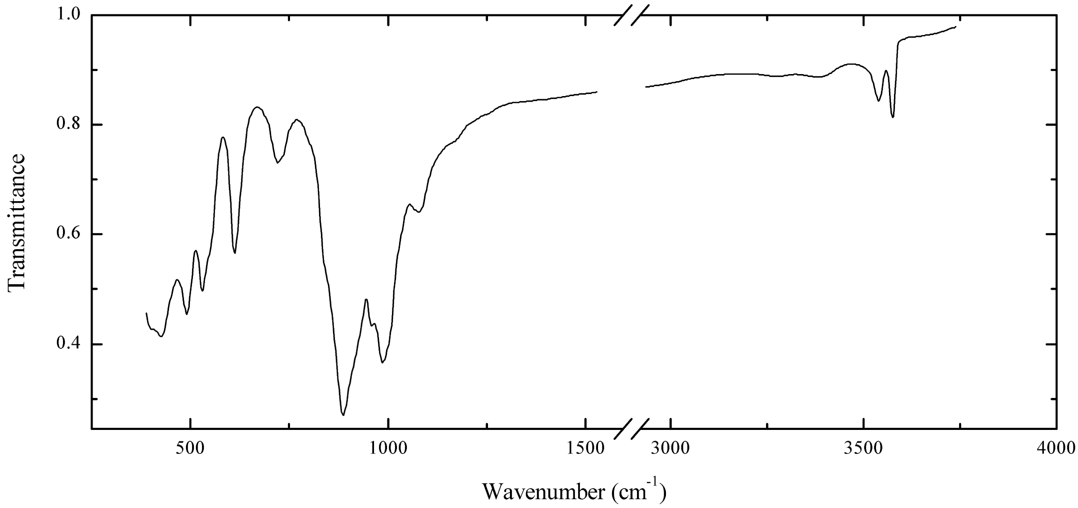


Locality: Borehole at Namuaiv Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pale yellow grains from the association with cuspidine, wollastonite, alumoåkermanite, schorlomite, andradite, nepheline, *etc*. Investigated by A.P. Khomyakov. Optically biaxial (−), $\alpha = 1.681$, $\beta = 1.714$, $\gamma = 1.724$, $2V_{meas} = -56°$. $D_{meas} = 3.34$ g/cm^3. The empirical formula is (electron microprobe) $Ca_{1.0}(Mn_{0.5}Mg_{0.3}Fe_{0.2})(SiO_4)_{1.0}$.

Wavenumbers (cm^{-1}): 963s, 945sh, 920sh, 877s, 824, 575, 516, 499, 456w, 402.

Sio27 Hydroxylclinohumite $Mg_9(SiO_4)_4(OH,F)_2$

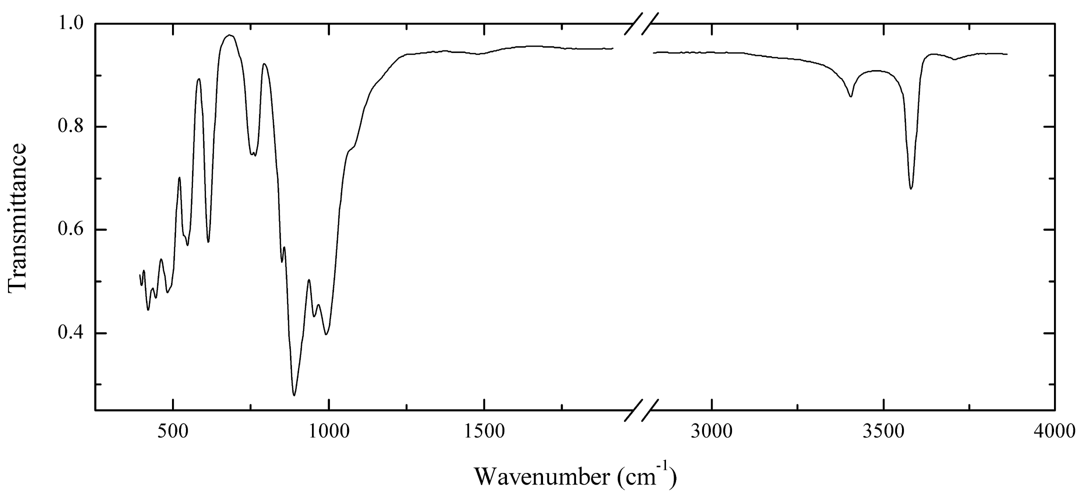


Locality: Zelentsovskaya pit, Kusinskiy massif, South Urals, Russia (type locality).

Description: Transparent orange-yellow grain from the association with calcite and spinel. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/b$, $a = 13.6894(2)$, $b = 4.7480(3)$, $c = 10.2730(7)$ Å, $\beta = 100.721(5)°$. Optically biaxial (+), = 1.631(1), = 1.641 (1), = 1.664(1), $2V_{meas} = 70(10)$. $D_{meas} = 3.13(1)$ g/cm^3, $D_{calc} = 3.14(1)$ g/cm^3. The empirical formula is $(Mg_{8.82}Fe_{0.06}Mn_{0.01}Ti_{0.05})(Si_{4.00}O_{15.98})(OH_{1.86}F_{0.16})$. The strongest lines of powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.05 (70) (020), 4.46 (52) (021), 3.72 (100) (022), 3.35 (64) (004), 2.772 (91) (13-1), 2.754 (60) (11-4), 2.551 (80) (114), 2.516 (93) (13-3).

Wavenumbers (cm^{-1}): 3560, 3524, 3380w, 1082, 1000sh, 987s, 960, 910sh, 888s, 846sh, 735sh, 724, 610, 550sh, 530, 492, 433s, 415sh, 405sh.

Sio28 Humite $Mg_7(SiO_4)_3(F,OH)_2$

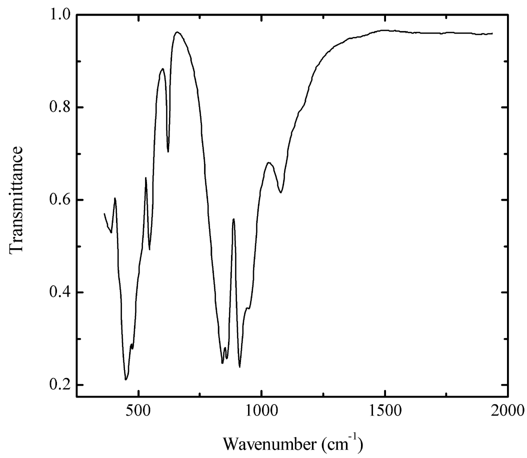


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Transparent orange-yellow crystals from the association with calcite and chrysotile. Orthorhombic. Single-crystal unit-cell parameters are $a = 10.27$, $b = 20.82$, $c = 4.74$ Å.

Wavenumbers (cm^{-1}): 3555, 3375, 1075sh, 995s, 955s, 910sh, 888s, 850, 760sh, 749, 613, 541, 486, 444, 422, 392s.

Sio29 Grossular $Ca_3Al_2(SiO_4)_3$

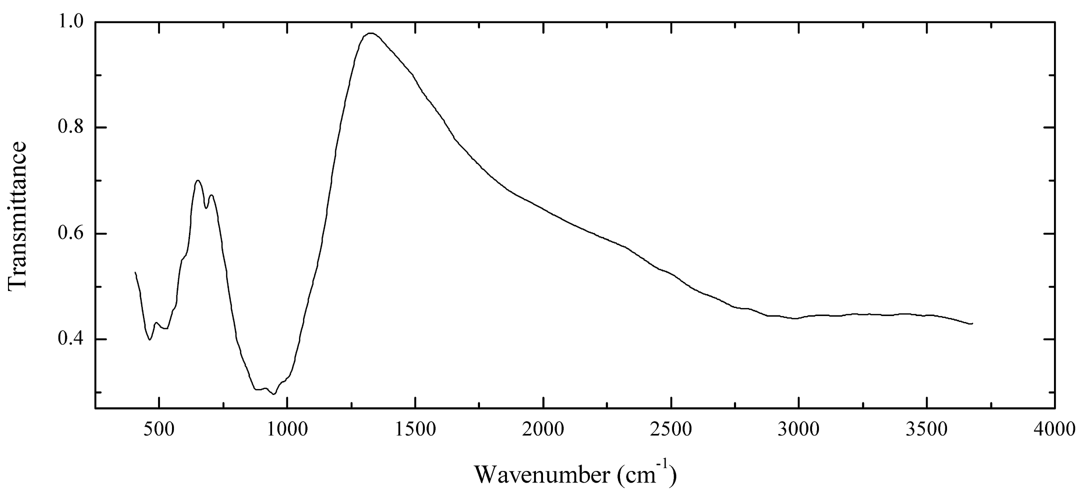


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.

Description: Pink transparent crystals from rodingite, from the association with vesuvianite. The empirical formula is (electron microprobe) $(Ca_{2.95}Mn_{0.02}Mg_{0.02})(Al_{1.80}Fe_{0.22})(SiO_4)_{3.00}$.

Wavenumbers (cm^{-1}): 1081, 951, 913s, 861s, 843s, 618, 550sh, 542, 505sh, 472s, 451s, 389.

Sio30 Törnebohmite-(Ce) $(Ce,La)_2Al(SiO_4)_2(OH)$

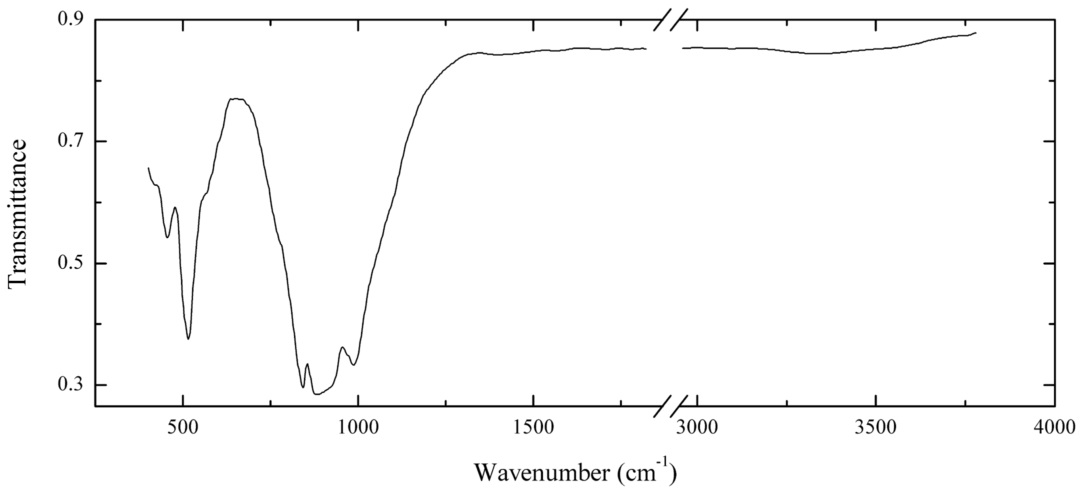


Locality: Biraya deposit, Irkutsk region, Siberia, Russia.

Description: Pinkish-brown grains from the association with biraite-(Ce), cordylite-(Ce), cordylite-(La), aragonite, strontianite, dolomite, ancylite-(Ce), ancylite-(La), hydroxylbastnaesite-(Ce), daqingshanite-(Ce) and daqingshanite-(La), tremolite, winchite, ferriallanite-(Ce), cerite, chevkinite-(Ce), belkovite, humite, fergusonite-(Ce), fergusonite-(Nd), pyrochlore, barite and monazite-(Ce). Investigated by P.M. Kartashov.

Wavenumbers (cm^{-1}): 2900, 990sh, 949s, 893s, 805sh, 691, 600sh, 558, 527, 505sh, 464s.

Sio31 Larnite $Ca_2(SiO_4)$

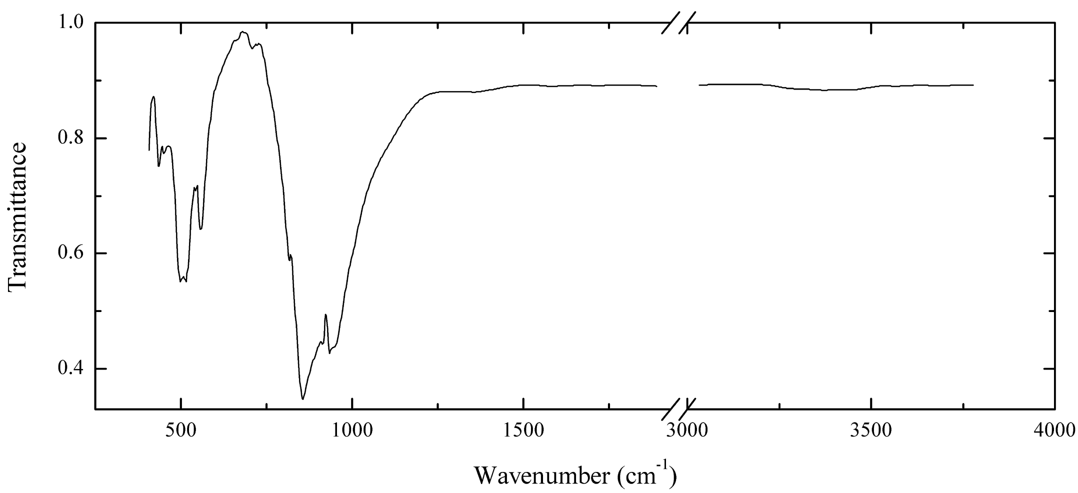


Locality: Mottled Zone, Hatrurim formation, Israel.

Description: Fine-grained aggregate from the association with ye'elimite and shulamitite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1100sh, 994s, 930sh, 905sh, 893s, 847s, 830sh, 595sh, 585sh, 570sh, 520s, 469, 440w.

Sio32 Calcio-olivine $Ca_2(SiO_4)$



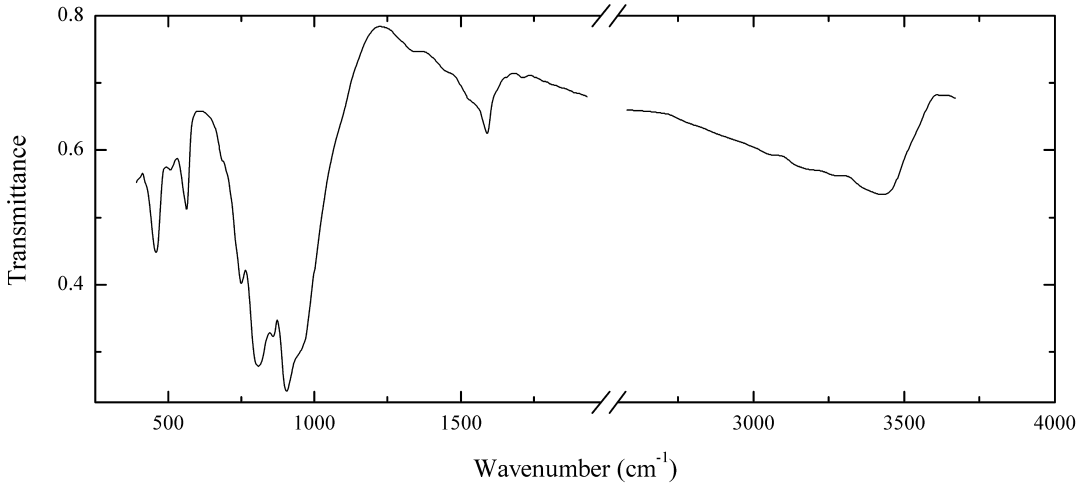
Locality: Lakargi Mt., Upper-Chegem caldera, Northern Caucasus, Republic of Kabardino-Balkaria, Russia.

Description: Rims around relics of larnite from the association with spurrite, rondorfite, wadalite, tilleyite, kilchoanite, cuspidine, wadalite, reinhardbraunsite, lakargiite and secondary low-temperature minerals (hillebrandite, afwillite, thaumasite and ettringite). Neotype specimen.

Orthorhombic, space group *Pbnm*, $a = 5.0739$ (1), $b = 11.2113$ (1), $c = 6.7534$ (1) Å, $Z = 4$. Optically biaxial (–), $\alpha = 1.642(2)$, $\beta = 1.652(2)$, $\gamma = 1.657(2)$. $D_{calc} = 2.99$ g/cm^3, $D_{meas} = 2.91(2)$ g/cm^3. The empirical formula is $Ca_{1.97}Na_{0.02}Mg_{0.01}Al_{0.01}Si_{1.00}O_4$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.323 (34) (021), 3.822 (35) (111), 3.014 (90) (130), 2.897 (18) (022), 2.752 (70) (112), 2.730 (100) (112), 1.909 (53) (222).

Wavenumbers (cm^{-1}): 943s, 931s, 915s, 855s, 817, 810sh, 705w, 559, 512, 500, 452, 440.

Sio33 Kasolite $Pb(UO_2)(SiO_4){\cdot}H_2O$

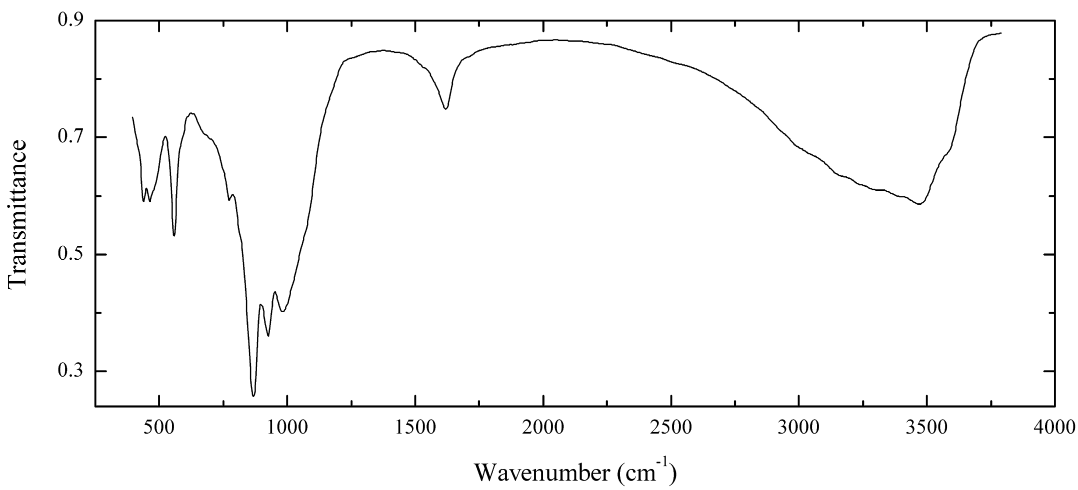


Locality: Bota-Burum U deposit, Alakol lake, Almaty region, Kazakhstan.

Description: Yellow fibrous aggregate. Investigated by G.A. Sidorenko. Identified by wet chemical analysis and powder X-ray diffraction pattern. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3420, 3350h, 3200sh, 1596, 1530sh, 1463w, 1347w, 955sh, 903s, 861s, 811s, 751, 562, 499w, 458.

Sio34 Cuprosklodowskite $Cu(UO_2)_2[SiO_3(OH)]_2{\cdot}6H_2O$ (?)

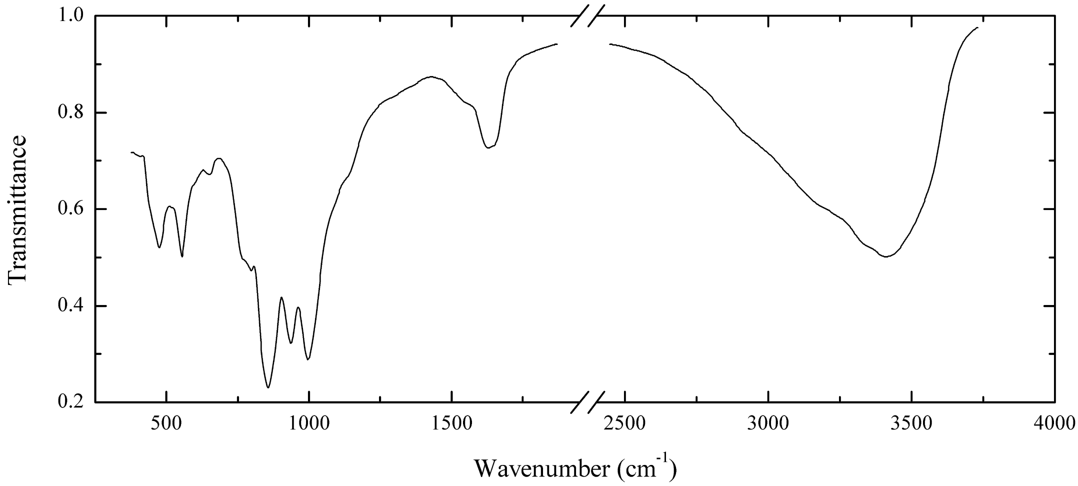


Locality: Kolwezi district, Katanga (Shaba), Democratic Republic of Congo.

Description: Green massive. Specimen No. 69447 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Investigated by A.A. Chernikov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3570sh, 3460, 3300sh, 3160sh, 3050sh, 1622, 1060sh, 988s, 930s, 871s, 777, 700sh, 557, 490sh, 469, 440.

Sio35 Uranophane-alpha $Ca(UO_2)_2[SiO_3(OH)]_2{\cdot}5H_2O$

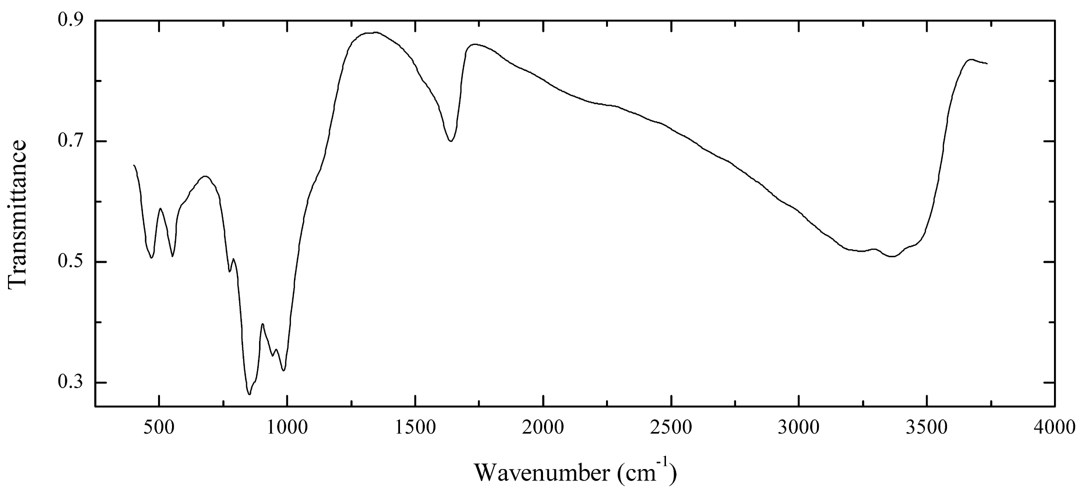


Locality: Bota-Burum U deposit, Alakol lake, Almaty region, Kazakhstan.

Description: Yellow fibrous aggregate. Investigated by G.A. Sidorenko. Identified by wet chemical analysis and powder X-ray diffraction pattern. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3550sh, 3400, 3345sh, 3180sh, 1665sh, 1632, 1560sh, 1135sh, 999s, 939s, 860s, 802, 775sh, 654w, 557, 477, 450sh.

Sio36 Uranophane-alpha $Ca(UO_2)_2[SiO_3(OH)]_2{\cdot}5H_2O$

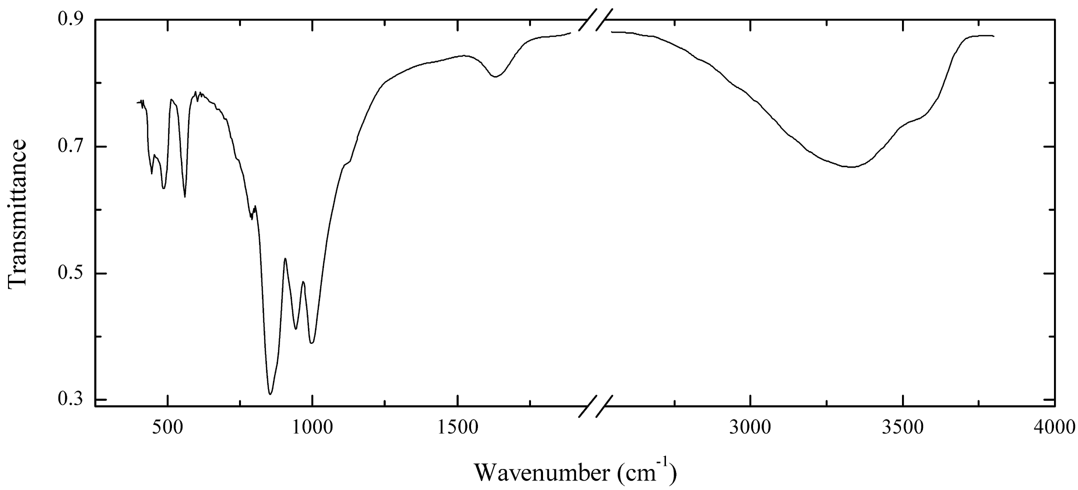


Locality: Bota-Burum U deposit, Alakol lake, Almaty region, Kazakhstan.

Description: Yellow prismatic crystals. Investigated by G.A. Sidorenko. Identified by wet chemical analysis, single-crystal and powder X-ray diffraction pattern. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3460, 3338, 3210, 1655sh, 1658, 1540sh, 1100sh, 986s, 946s, 920sh, 880sh, 854s, 778, 551, 469.

Sio37 Uranophane-alpha $Ca(UO_2)_2[(SiO_3(OH)]_2·5H_2O$

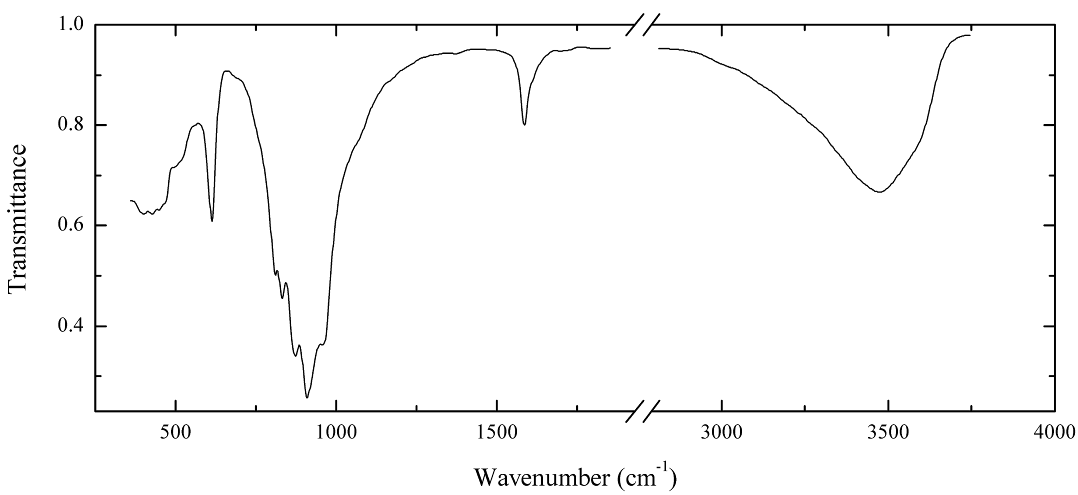


Locality: Kyzylsai Mo–U deposit, Almaty region, Kazakhstan.

Description: Yellow massive. Investigated by G.A. Sidorenko. Identified by wet chemical analysis, and powder X-ray diffraction pattern. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3530sh, 3310, 1630w, 1120sh, 994s, 937s, 875sh, 851s, 785, 555, 483, 444.

Sio38 Soddyite $(UO_2)_2(SiO_4)·2H_2O$

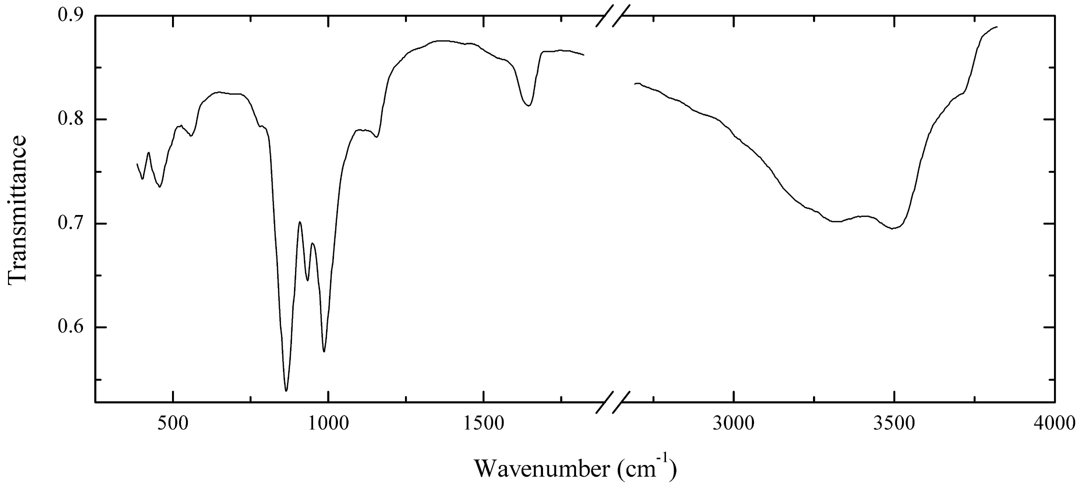


Locality: Shinkolobwe, Katanga (Shaba), Democratic Republic of Congo.

Description: Yellow massive from the association with kasolite. Confirmed by IR spectrum.

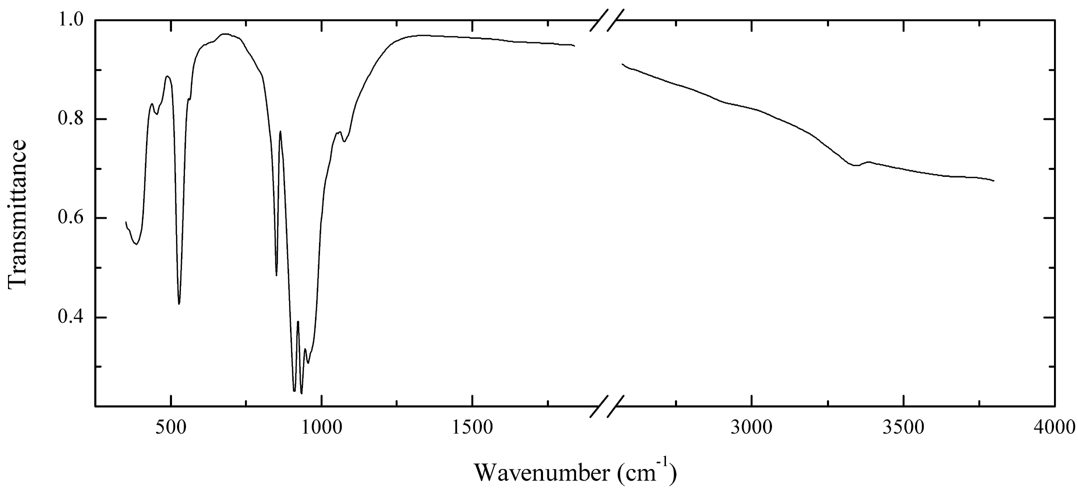
Wavenumbers (cm^{-1}): 3530sh, 3440, 1585, 959s, 906s, 872s, 832, 811, 613, 520sh, 500sh, 460sh, 445, 407.

Sio39 Sklodowskite $Mg(UO_2)_2[SiO_3(OH)]_2 \cdot nH_2O$ (?)



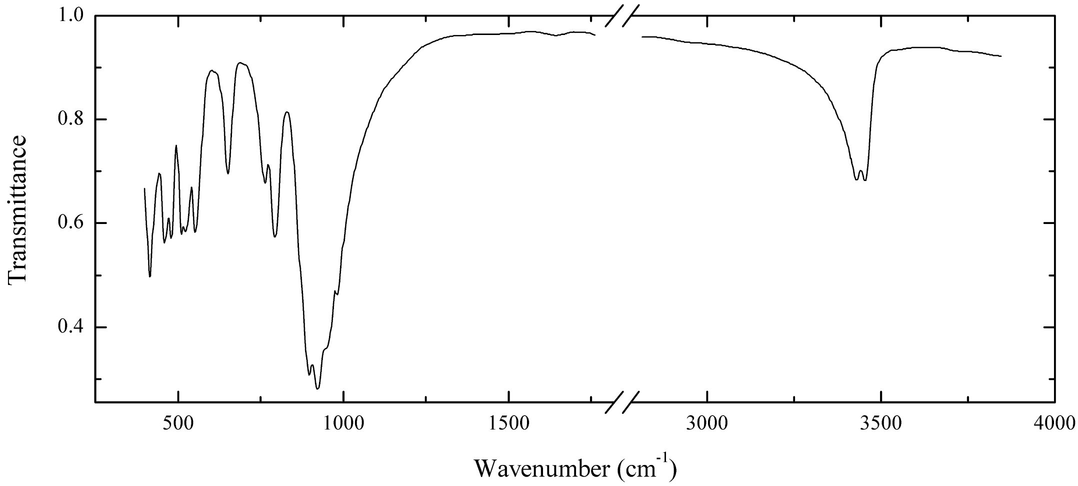
Locality: Karamazar Mts., Adrasman, Sogd region, Tajikistan.
Description: Yellow crust from the association with uranophane-alpha. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3690sh, 3490, 3320, 3220sh, 1650, 1160, 990s, 934, 864s, 781w, 560w, 490sh, 467, 385.

Sio40 Rondorfite $Ca_8Mg(SiO_4)_4Cl_2$



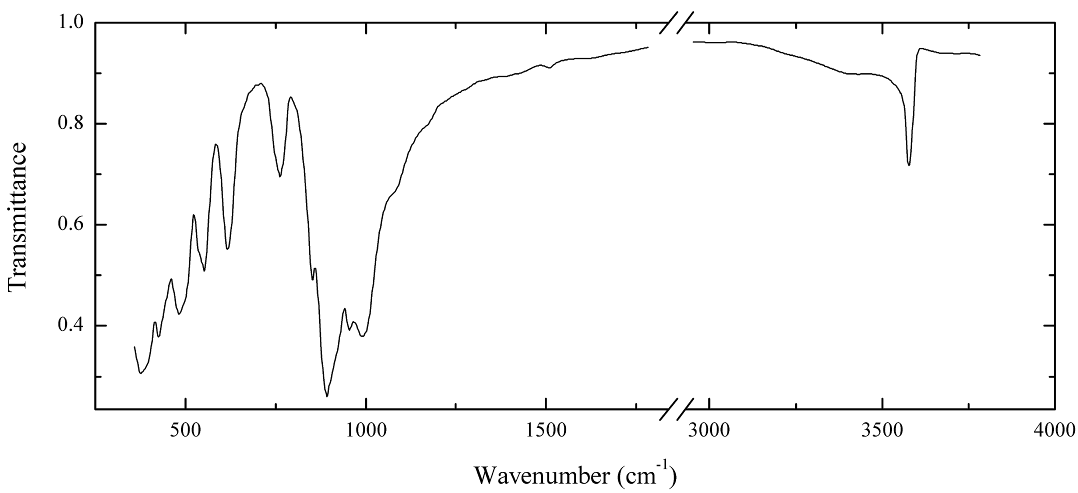
Locality: Lakargi Mt., Verkhnechegemskaya caldera, Kabardino-Balkaria, Northern Caucasus, Russia.
Description: Yellow grains from the association with lakargiite and calico-olivine. The empirical formula is (electron microprobe) $Ca_{7.88}Na_{0.07}Mg_{0.93}Fe_{0.12}Al_{0.02}(Si_{4.00}O_4)Cl_{1.73}(OH)_x$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3330w, 1160sh, 1075, 970sh, 955s, 934s, 910s, 852, 788w, 760w, 564, 527s, 455, 385.

Sio41 Kuliokite-(Y) $(Y,Yb)_4Al(SiO_4)_2(OH)_2F_5$



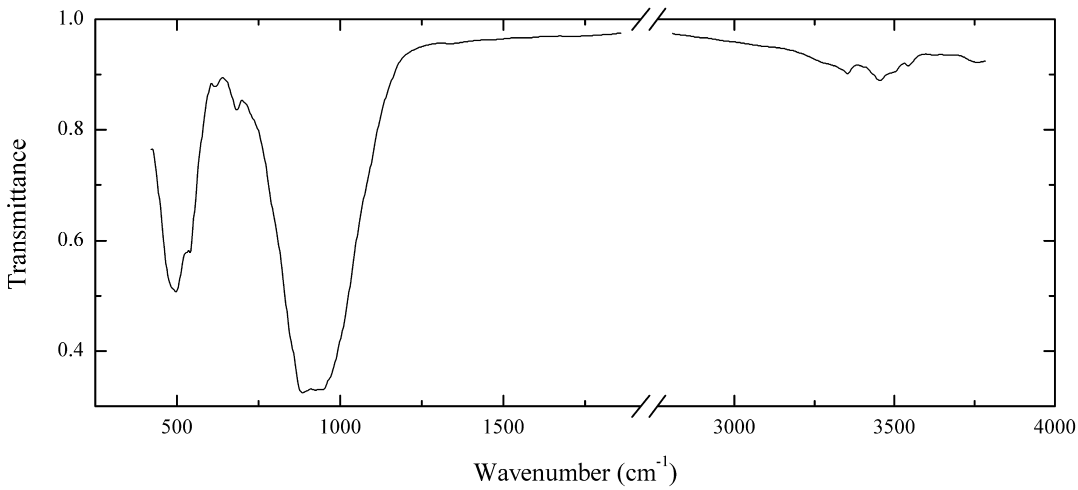
Locality: Ploskaya Mt., Western Keivy Mts., Kola peninsula, Murmansk region, Russia.
Description: Rose tabular crystals from the association with Y-rich fluorite and amazonite. Identified by IR spectrum and qualitative electron microprobe analysis..
Wavenumbers (cm^{-1}): 3438, 3417, 981, 951s, 923s, 897s, 793, 762, 650, 552, 524, 508, 480, 458, 411.

Sio42 Humite $Mg_7(SiO_4)_3(F,OH)_2$



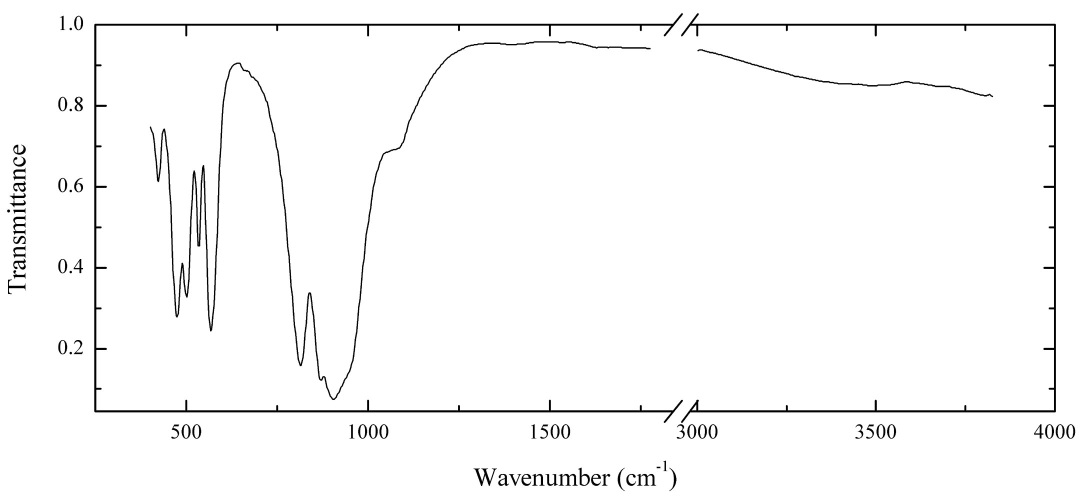
Locality: Västmanland, Sweden.
Description: Yellow grains. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3560, 3405w, 1075sh, 991s, 954s, 915sh, 888s, 851, 763, 617, 552, 540sh, 495sh, 484, 420s, 395s.

Sio43 Cerite-(Ce) $(Ce,La,Ca)_9(Mg,Fe^{3+})(SiO_4)_6[SiO_3(OH)](OH)_3$



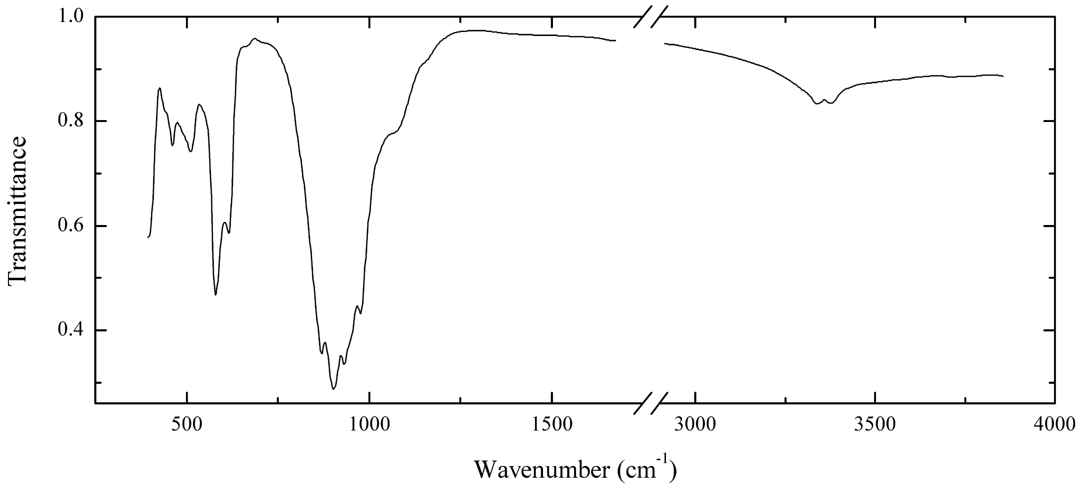
Locality: Crosetto talc mine, Prali, Germanasca valley, Torino province, Piedmont, Italy.
Description: Reddish-brown grains. Nd-, Cl- and F-rich variety. The empirical formula is (electron microprobe) $(Ce_{4.3}Nd_{2.1}La_{1.5}Pr_{0.8}Sm_{0.2})(Mg_{0.8}Fe_{0.2})Si_7O_{27}Cl_{1.4}F_{1.2}(OH)_x$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3545w, 3490sh, 3457w, 3356w, 940s, 920sh, 890s, 683w, 615w, 540, 498.

Sio44 Malayaite $CaSn(SiO_4)O$



Locality: Ehrenfriedersdorf, Saxony, Germany.
Description: Beige grains. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1070sh, 945sh, 906s, 870s, 816s, 566, 533, 499, 472, 422.

Sio45 Jerrygibbsite $Mn^{2+}_9(SiO_4)_4(OH)_2$

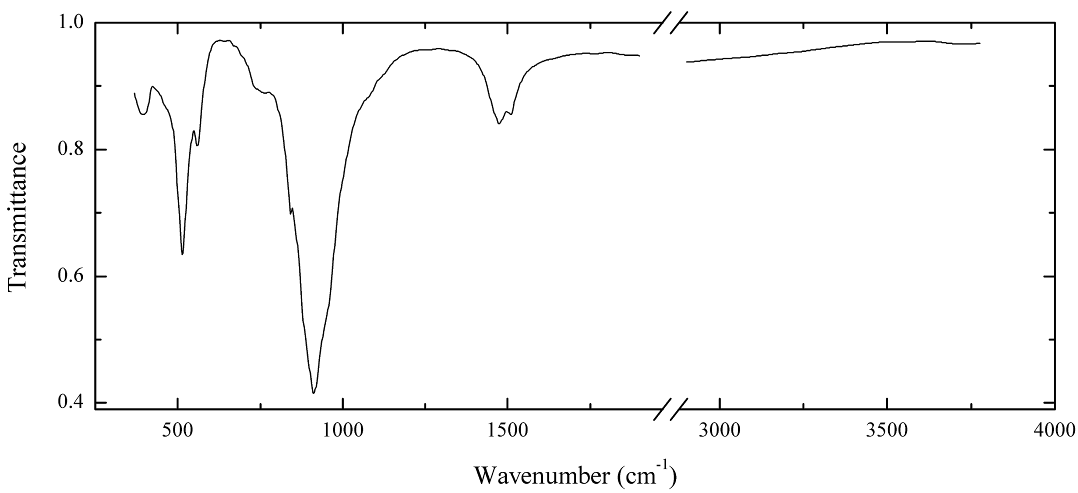


Locality: Franklin mine, Franklin, Sussex Co., New Jersey, USA (type locality).

Description: Rose granular aggregate from the association with leucophoenicite, tephroite, franklinite, willemite and zincite. The empirical formula is (electron microprobe, OH calculated) $(Mn_{7.80}Mg_{0.55}Zn_{0.34}Ca_{0.30}Fe_{0.08})(SiO_4)_{4.00}F_{1.72}(OH)_{0.28}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3360w, 3340w, 1075sh, 976, 945sh, 932s, 900s, 870s, 615, 575, 512, 460, 440sh, (390).

Sio46 Jasmundite $Ca_{11}(SiO_4)_4O_2S$

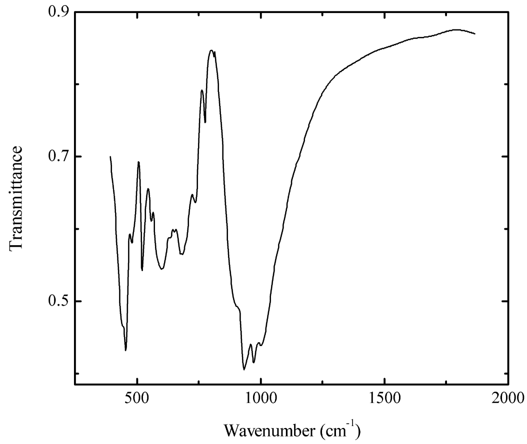


Locality: Bellerberg, near Ettringen, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Dark brown translucent grains from metamorphosed limestone inclusion in basalt, from the association with brownmillerite, larnite, thaumasite, brearleyite and carbonates. Confirmed by IR spectrum. The bands at 1,505 and 1,470 cm^{-1} correspond to the admixture of a carbonate.

Wavenumbers (cm^{-1}): 1505, 1470, 950sh, 913s, 885sh, 842, 766, 745sh, 558, 513s, 398.

Sio47 Andalusite $Al_2(SiO_4)O$

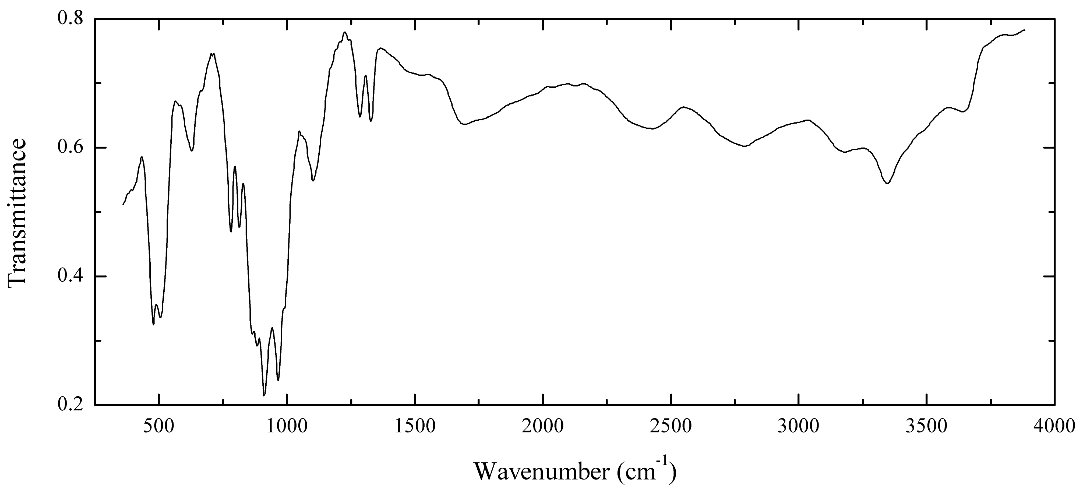


Locality: Ardino, Kardzali (Kurdzhali) region, Rhodope Mts, Bulgaria.

Description: Pinkish-brown transparent crystal from the association with potash feldspar, quartz and biotite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1070sh, 1005s, 974s, 950sh, 934s, 905sh, 776, 735, 684, 600, 562, 519, 479, 455s, 440sh.

Sio48 Afwillite $Ca_{12}(SiO_4)_4[SiO_2(OH)_2]_4{\cdot}8H_2O$

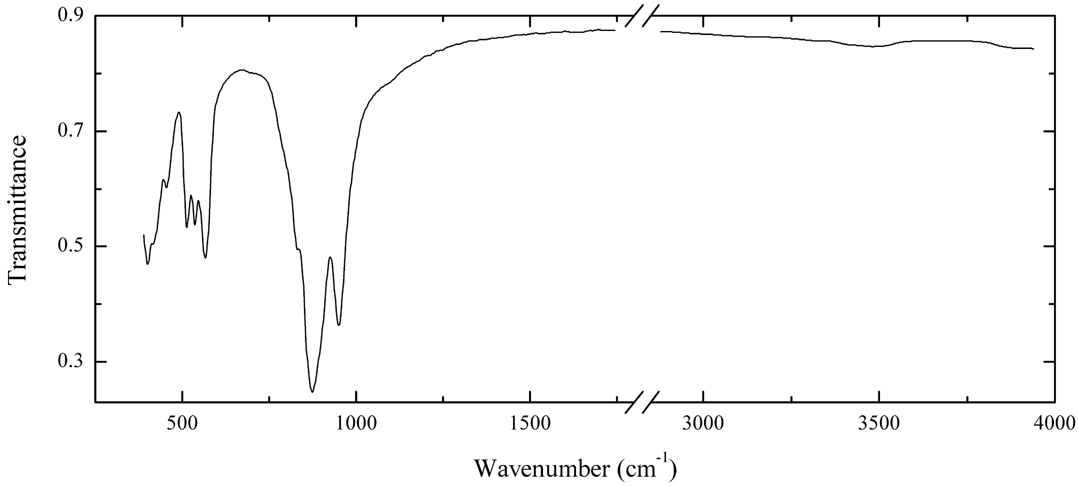


Locality: Lakargi Mt., Upper-Chegem caldera, Northern Caucasus, Republic of Kabardino-Balkaria, Russia.

Description: White fine-grained aggregate from the association with spurrite, hillebrandite and thaumasite. Identified by IR spectrum and powder X-ray diffraction pattern.

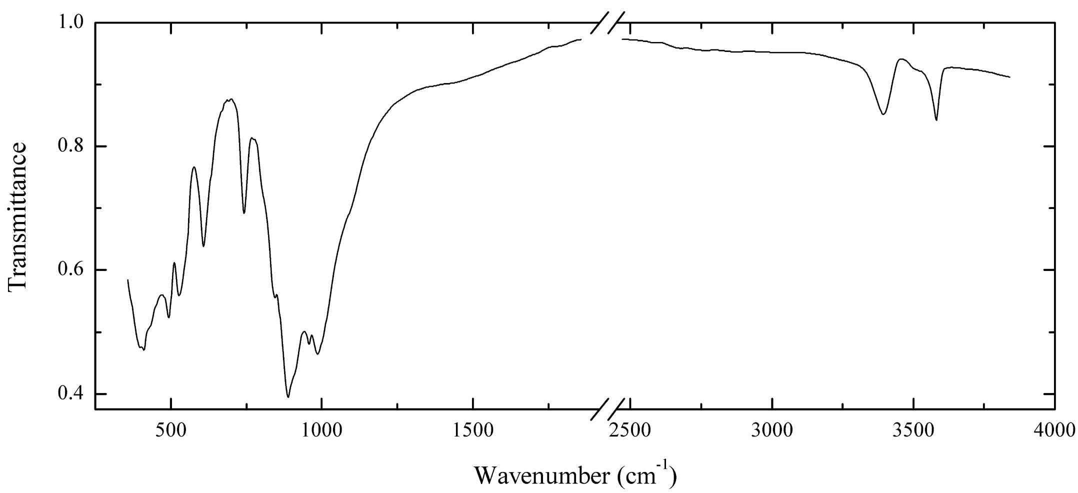
Wavenumbers (cm^{-1}): 3630, 3335, 3160, 2770, 2420, 1750sh, 1700, 1500w, 1328, 1285, 1100, 990sh, 965s, 910s, 883s, 865s, 814, 780, 670sh, 627, 502s, 475s, 420sh.

Sio49 Kumtyubeite $Ca_5(SiO_4)_2F_2$



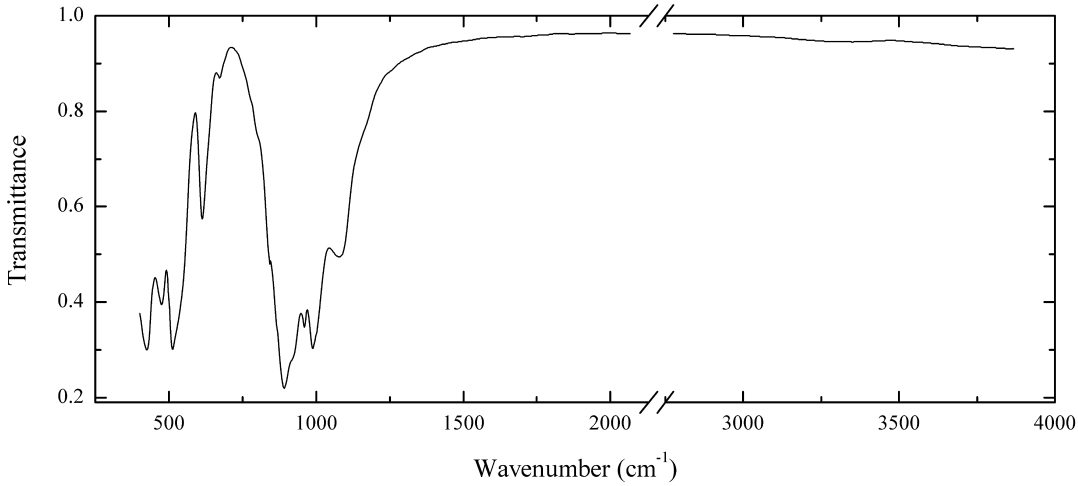
Locality: Burned dump of the shaft No. 44, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.
Description: Pale rose fine-grained aggregate from the association with srebrodolskite, fluorellestadite and calico-olivine. Technogenetic. Described by B.V. Chesnokov under the name "kutyukhinite". Monoclinic, $a = 11.447$, $b = 5.036$, $c = 8.686$ Å, $\beta = 109.12°$; $Z = 4$. Optically biaxial (−), $\alpha = 1.587$, $\beta = 1.597$, $\gamma = 1.600$. $D_{calc} = 2.957$ g/cm^3, $D_{meas} = 2.88$ g/cm^3. The empirical formula is $(Ca_{4.89}Mg_{0.02})Si_{2.01}O_{8.00}F_{1.55}(OH)_{0.55}$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 3.79 (40) (111), 3.30 (41) (30-2), 3.032 (73) (31-1), 2.862 (75) (112), 2.753 (40) (31-2), 2.490 (47) (212), 1.893 (100) (60-2). Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 943s, 866s, 825, 562, 530, 507, 445w, 425, 415.

Sio50 Clinohumite $Mg_9(SiO_4)_4(F,OH)_2$



Locality: Kuh-i Lal spinel deposit, Pamir Mts., Tajikistan.
Description: Yellow transparent crystal from the association with forsterite, spinel and lizardite. The empirical formula is $(Mg_{8.79}Ti_{0.12}Fe_{0.03})(SiO_4)_{4.00}[F_{0.95}(OH)_{0.93}O_{0.12}]$.
Wavenumbers (cm^{-1}): 3555, 3375, 1085sh, 992s, 963s, 910sh, 893s, 849, 840sh, 743, 607, 550sh, 533, 496s, 470sh, 430sh, 408s.

Sio51 Clinohumite $Mg_9(SiO_4)_4(F,OH)_2$

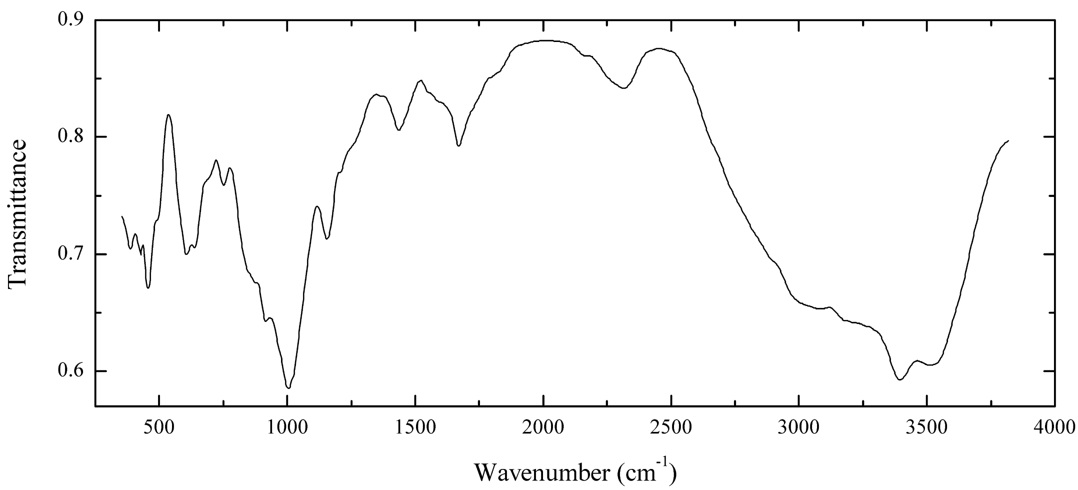


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Grey fine-grained aggregate. OH-free variety close to the $Mg_9(SiO_4)_4F_2$ endmember. Investigated by B.V. Chesnokov.

Wavenumbers (cm^{-1}): 1074, 985s, 960s, 920sh, 888s, 842, 800sh, 755sh, 670w, 612, 545sh, 508s, 472s, 419s.

Sio52 Chesnokovite $Na_2[SiO_2(OH)_2]\cdot 8H_2O$

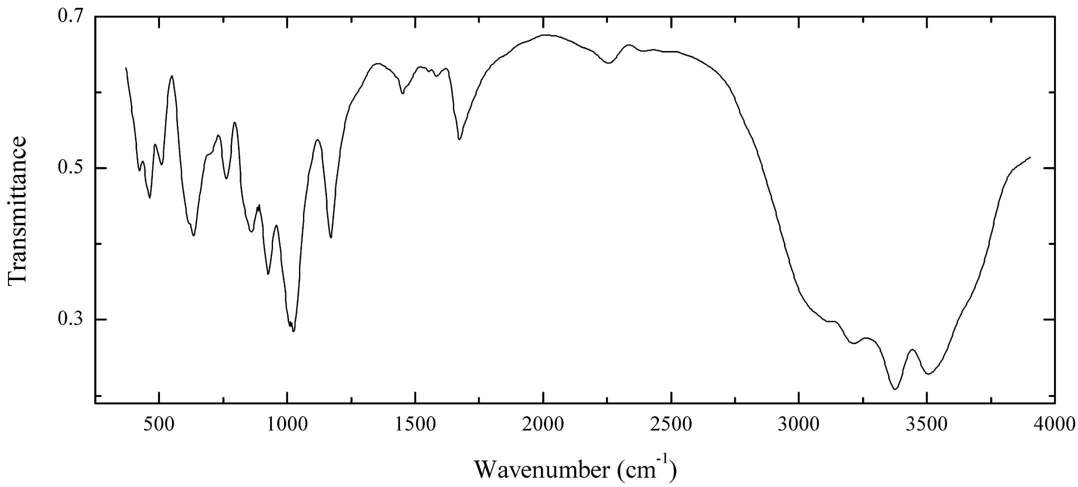


Locality: Synthetic.

Description: White powdery.

Wavenumbers (cm^{-1}): 3625sh, 3515, 3180, 3375s, 3200sh, 3090, 3010sh, 2800sh, 2320, 1675, 1590sh, 1445, 1210, 1162, 1022sh, 1007s, 917, 865sh, 830sh, 755, 640, 607, 498, 458, 425, 386.

Sio53 Chesnokovite $Na_2[SiO_2(OH)_2]·8H_2O$

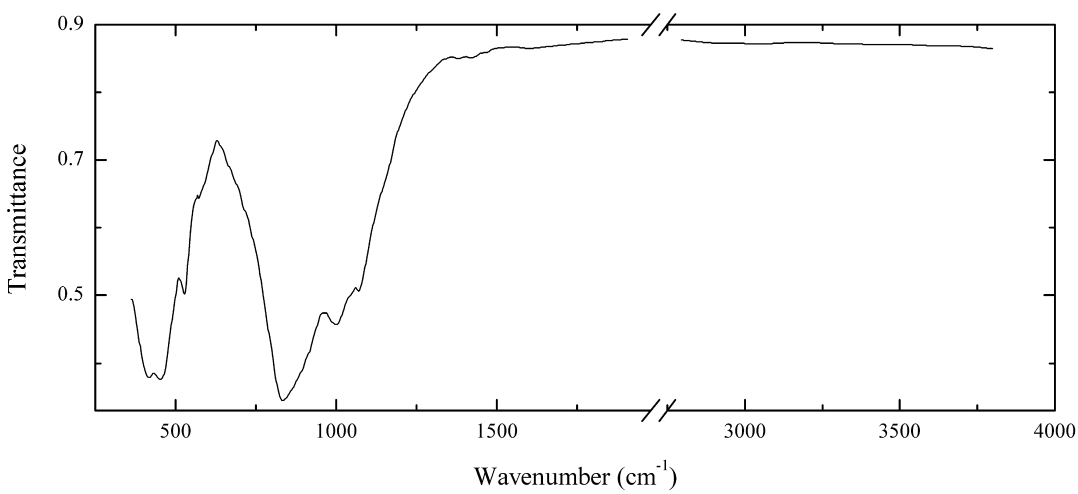


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Pale brownish-yellow granular aggregate from the association with natrolite, sodalite, vuonnemite, steenstrupine-(Ce), phosinaite-(Ce), natisite, gobbinsite, villiaumite, natrosilite and revdite. Holotype sample. Orthorhombic, space group *Ibca*, $a = 11.7119$, $b = 16.973$, $c = 11.5652$ Å. Optically biaxial (+), $\alpha = 1.449$, $\beta = 1.453$, $\gamma = 1.458$, $2V_{meas} = 80°$. $D_{meas} = 1.68$ g/cm^3, $D_{calc} = 1.60$ g/cm^3. The empirical formula is $(Na_{1.96}K_{0.02})Si_{1.005}O_2(OH)_2·7.58H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.001 (30) (211), 4.788 (42) (022), 3.847 (89) (231), 2.932 (42) (400), 2.832 (35) (060), 2.800 (97) (332, 233), 2.774 (100) (341, 143, 114).

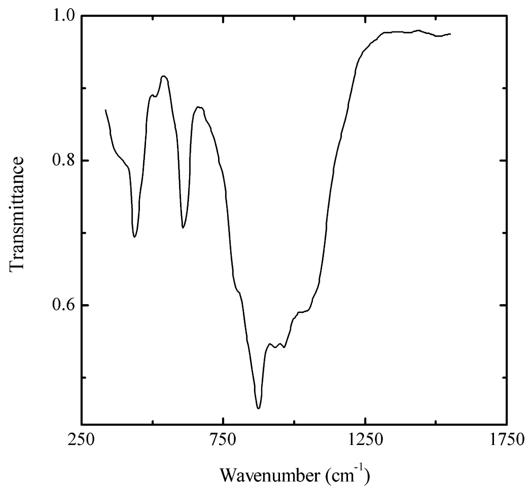
Wavenumbers (cm^{-1}): 3635sh, 3510sh, 3470s, 3360s, 3190, 3095, 3020sh, 2770sh, 2380w, 2253w, 1673, 1580w, 1450w, 1171s, 1027s, 1010sh, 924s, 859s, 830sh, 764, 700w, 637s, 610sh, 506, 461, 421, 390sh.

Sio54 Majorite $Mg_3Fe^{3+}{}_2(SiO_4)_3$



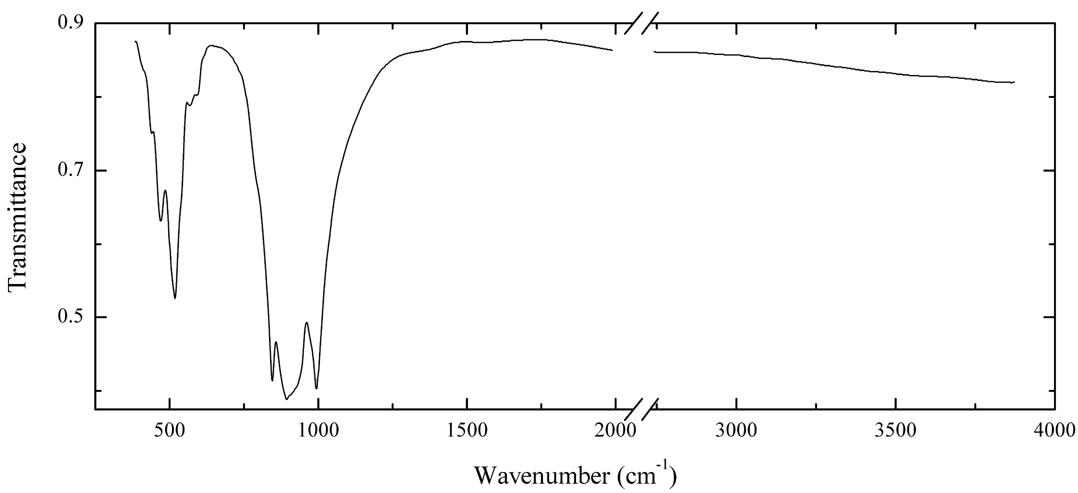
Locality: Tenham-2 chondritic meteorite, Tenham station, South Gregory, Queensland, Australia.
Description: Brown grains from the association with wadsleyite and ringwoodite. Investigated by S.N. Britvin. Identified by electron microprobe analysis and powder X-ray diffraction pattern. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1075, 1005s, 920sh, 890sh, 841s, 580sh, 460s, 430s.

Sio55 Hafnon Hf(SiO_4)



Locality: Voron'i Tundras Mts., Kola peninsula, Murmansk region, Russia.
Description: Microscopic inclusions in zircon. Investigated by A.V. Voloshin. The IR spectrum was obtained as a difference between IR spectra of zircon with hafnon inclusions and pure zircon.
Wavenumbers (cm^{-1}): 1037, 963s, 933s, 973s, 800sh, 604, 580sh, 510w, 440sh, 430, 410sh.

Sio56 Larnite $Ca_2(SiO_4)$

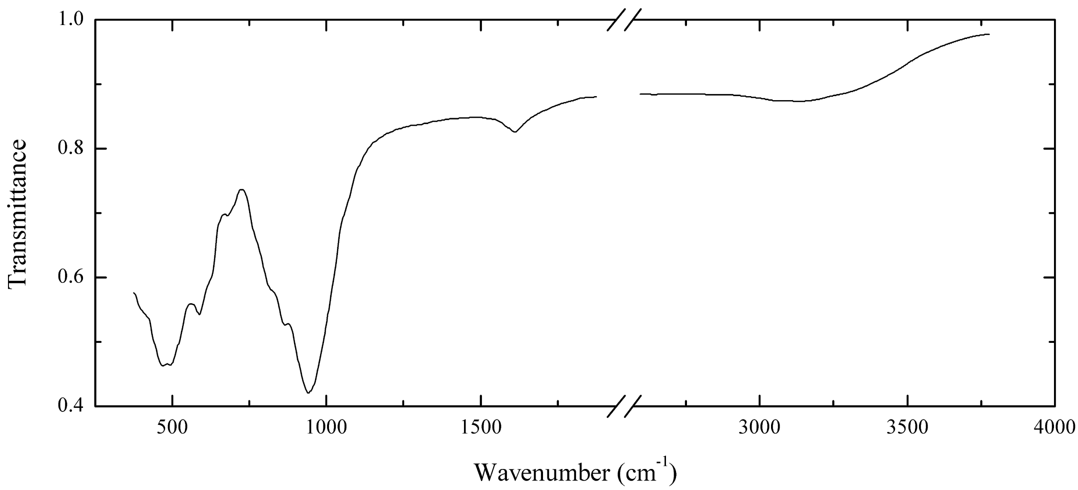


Locality: Burned dump of the shaft No. 44, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Pale rose veinlets in the aggregate of altered lime and periclase. Investigated by B.V. Chesnokov. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.01 (90), 2.74 (100), 1.911 (80), 1.807 (70), 1.253 (70), 1.138 (60). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 994s, 930sh, 905sh, 894s, 847s, 830sh, 595w, 573w, 537sh, 520, 469, 440.

Sio57 Laihunite $Fe^{2+}Fe^{3+}_2(SiO_4)_2$

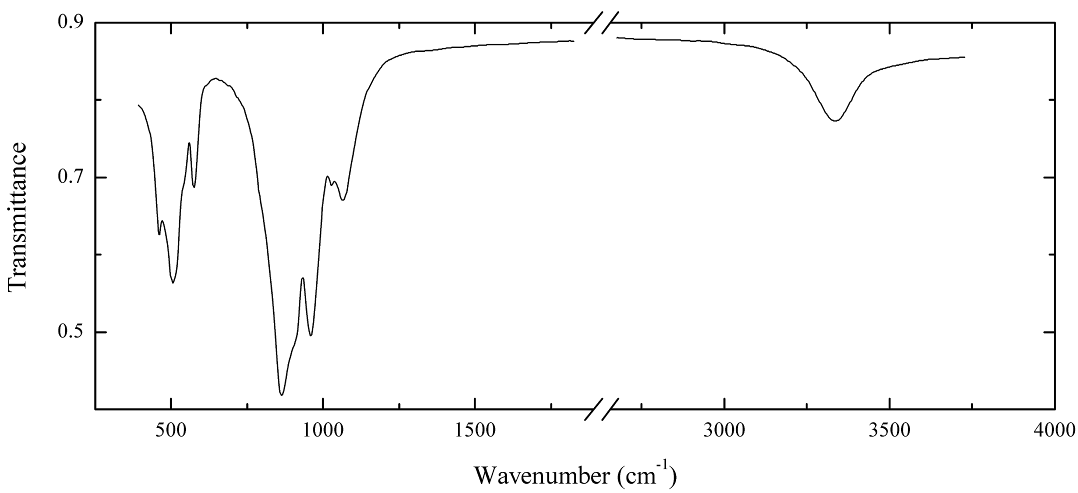


Locality: Crystal peak, Colorado, USA.

Description: Dark brown massive. Pseudomorph after fayalite. Probably contaminated by other minerals.

Wavenumbers (cm^{-1}): 3200w, 1610w, 946s, 874, 820sh, 675w, 625sh, 588, 495sh, 495s, 470s, 425sh.

Sio58 Leucophoenicite $Mn^{2+}_7(SiO_4)_3(OH)_2$

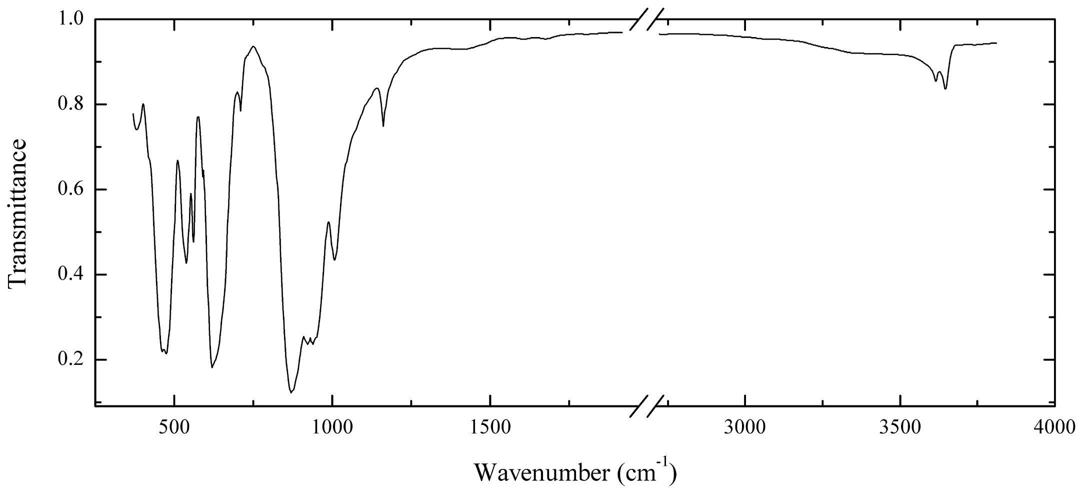


Locality: Franklin, Franklin mining district, Sussex Co., New Jersey, USA (type locality).

Description: Pink granular aggregate from the association with willemite and garnet. The empirical formula is (electron microprobe) $(Mn_{6.1}Ca_{0.5}Zn_{0.3}Mg_{0.1})(SiO_4)_{3.0}(OH,F)_2$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3330, 1067, 1032, 960s, 905sh, 864s, 574, 540sh, 510sh, 501, 459.

Sio59 Topaz $Al_2(SiO_4)(F,OH)_2$

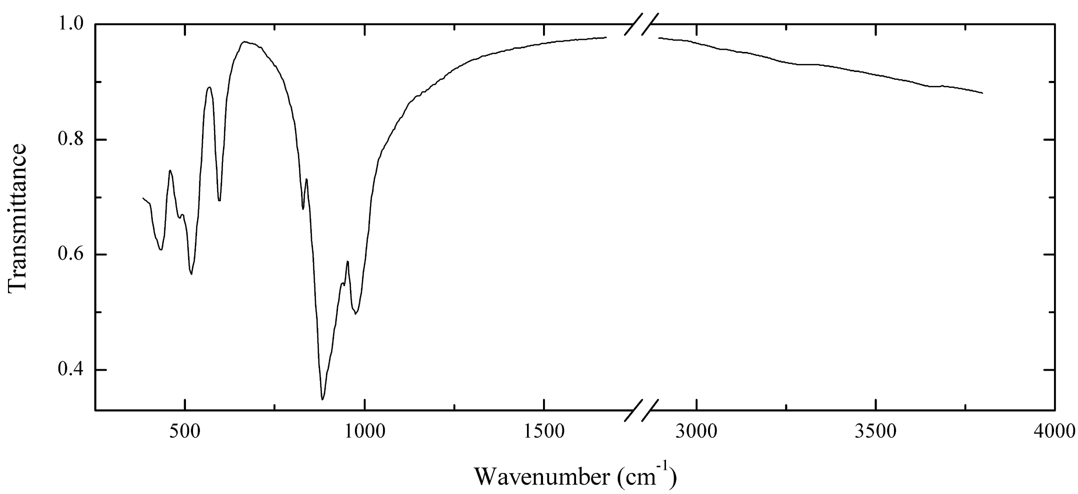


Locality: Ivigtut cryolite deposit, Ivittuut municipality, Arsuk Firth, West Greenland province, Greenland.

Description: White granular aggregate from the association with weberite and fluorite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3635, 3605, 1670w, 1605w, 1410w, 1166, 1009, 940s, 925s, 870s, 707w, 645sh, 619s, 589, 558, 537, 530sh, 481s, 462s, 425sh, 380.

Sio60 Monticellite $CaMg(SiO_4)$

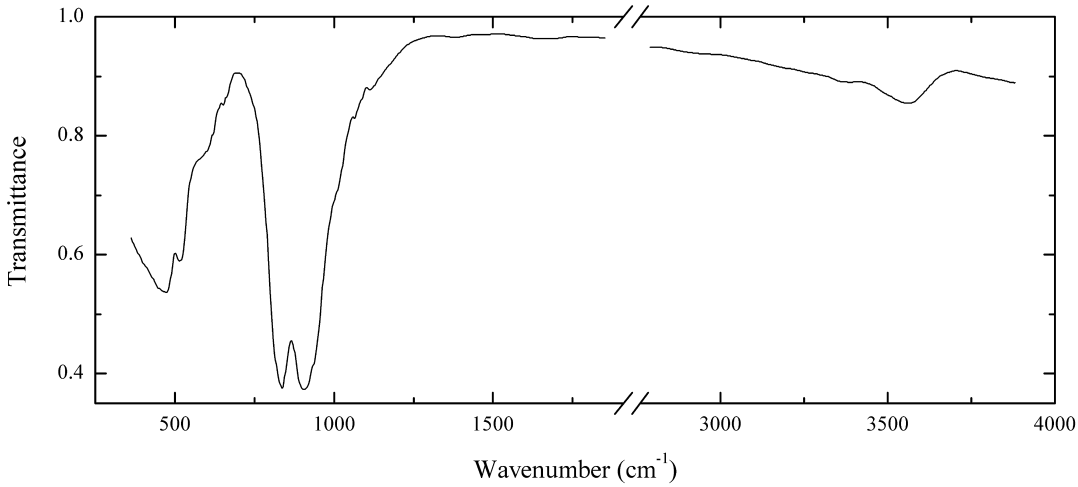


Locality: Konder (Kondyor) alkaline–ultrabasic massif, Aldan shield, Krasnoyarskiy Kray, Siberia, Russia.

Description: Greenish-brown crystals. Investigated by A.E. Zadov. Identified by electron microprobe analysis, optical data, IR spectrum and powder X-ray diffraction pattern.

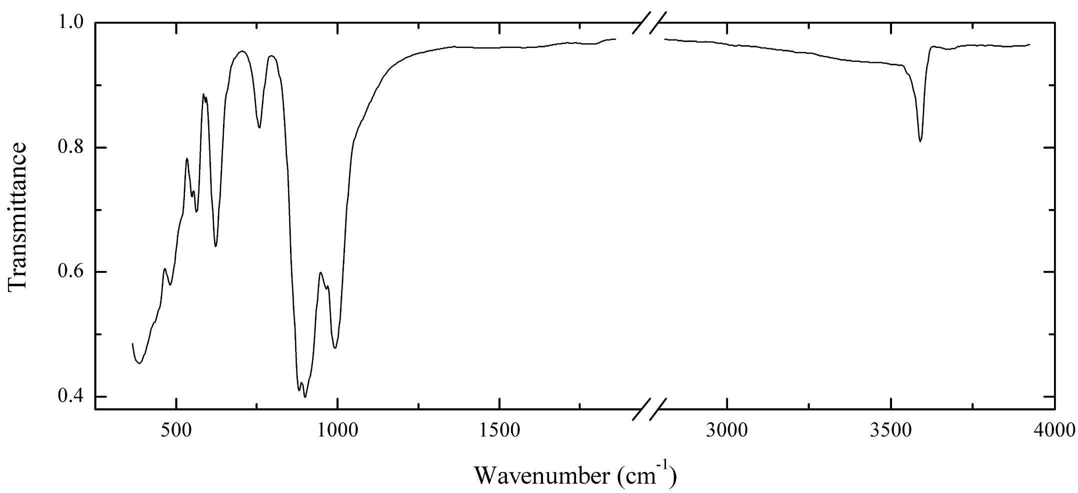
Wavenumbers (cm^{-1}): 981s, 948, 910sh, 885s, 830, 594, 516, 486, 436, 420sh.

Sio61 Hibschite $Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$ ($x = 0.2$–1.5)



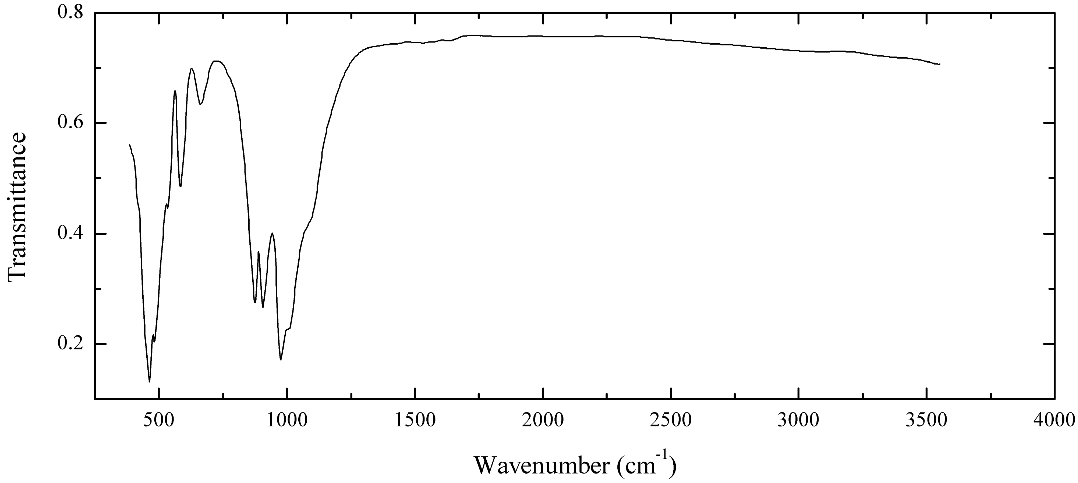
Locality: Wessels mine, Hotazel, Kalahari manganese fields, Northern Cape province, South Africa.
Description: Red grains from the association with sugilite, quartz and pectolite. Fe-rich variety. The empirical formula is (electron microprobe, OH calculated): $Ca_{3.0}(Al_{1.1}Fe_{0.7}Mn_{0.2})(SiO_4)_{2.2}(OH)_{3.2}$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3575, 909s, 895sh, 833s, 645sh, 580sh, 515, 473s, 450sh, 390sh.

Sio62 Norbergite $Mg_3(SiO_4)(F,OH)_2$



Locality: Ristiniemi cape, northern coast of the Ladoga sea, Yulyaristi, near Pitkäranta, Karelia, Russia.
Description: Yellow grains from calciphyre, from the association with calcite, chondrodite, diopside and phlogopite. The empirical formula is (electron microprobe, OH calculated) $(Mg_{2.94}Fe_{0.04}Mn_{0.01}Ti_{0.01})(SiO_4)_{1.00}[F_{1.61}(OH)_{0.37}O_{0.02}]$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3568, 995s, 965, 900s, 881s, 756, 623, 564, 548, 520sh, 482, 430sh, 387s.

Sio63 Pyrope $Mg_3Al_2(SiO_4)_3$

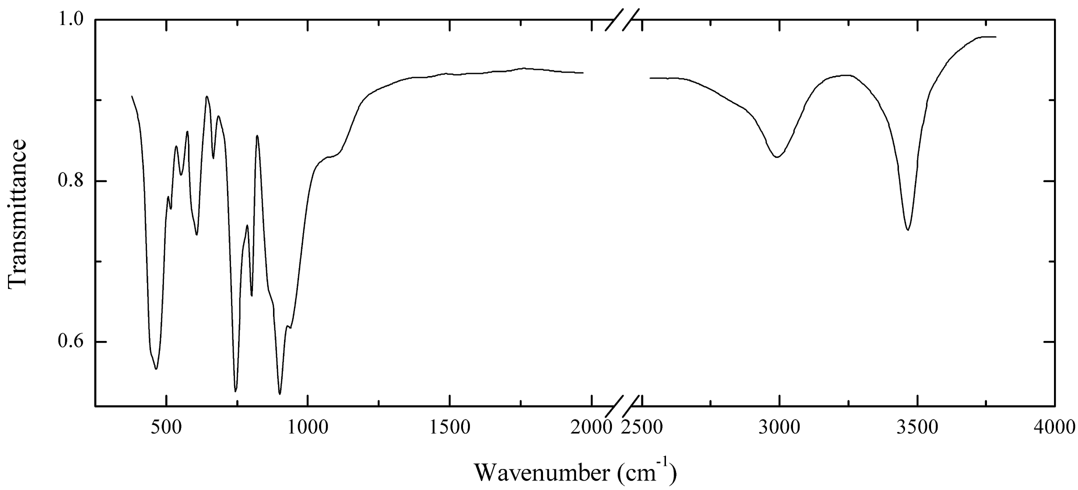


Locality: Dora-Maira massif, Cuneo province, Piedmont, Italy.

Description: Coarse-grained aggregate. Associated minerals are talc, quartz, magnesiostaurolite, ellenbergerite and rutile. Fe-rich variety. The empirical formula is (electron microprobe) $Ca_{0.04}Mg_{2.93}Al_{1.92}Fe_{0.11}(SiO_4)_{3.00}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1080sh, 1005sh, 972s, 906s, 876s, 669, 581, 536, 480s, 461s, 420sh.

Sio64 Chloritoid $(Fe^{2+},Mg,Mn)_2Al_4Si_2O_{10}(OH)_4$

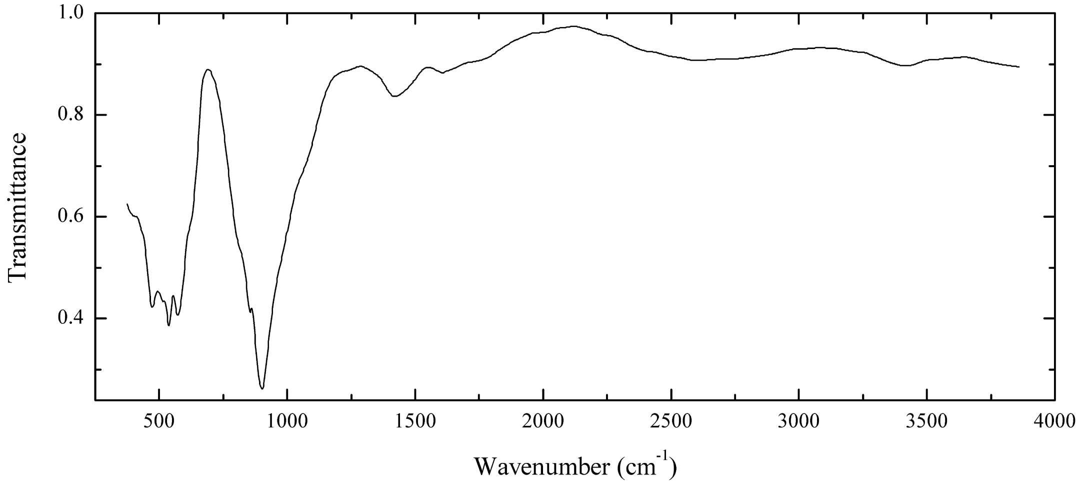


Locality: Ottré, Stavelot massif, Province of Liége, Belgium.

Description: Dark greenish-grey tabular crystals. Mn-rich variety. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3445, 2975, 1095w, 935, 900s, 865sh, 799, 744s, 667, 605, 590sh, 550, 515, 458s, 445sh.

Sio65 Mozartite $CaMn^{3+}(SiO_4)(OH)$

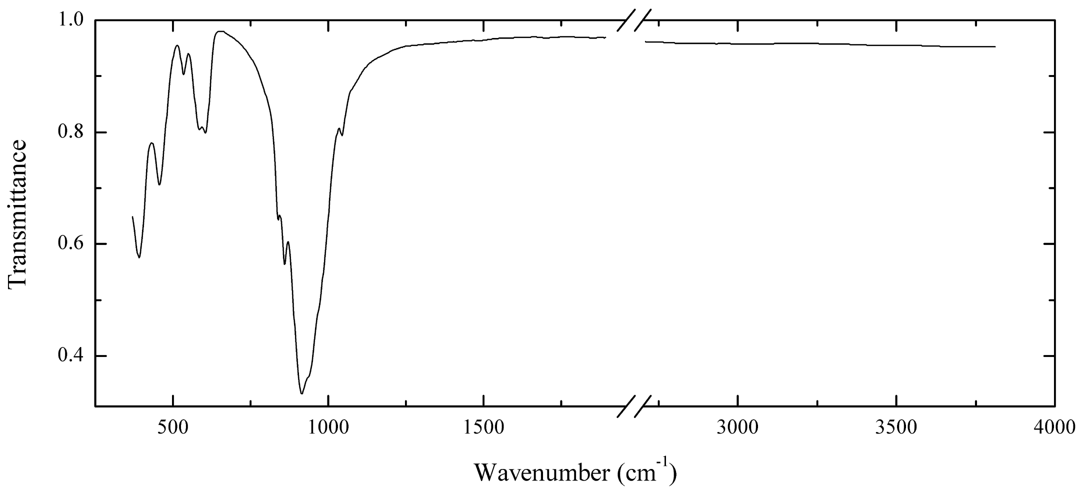


Locality: Cerchiara mine, near Faggiona, Val di Vara, northern Apennines, La Spezia, Liguria, Italy (type locality).

Description: Dark red grains from the association with pectolite, hausmannite and calcite. The band at 1,423 cm^{-1} can correspond to the admixture of calcite.

Wavenumbers (cm^{-1}): 3400, 2700, 1740sh, 1603w, 1423, 1060sh, 970sh, 900s, 855s, 815sh, 620sh, 571s, 538s, 515, 472s, 400sh.

Sio66 Paranatisite $Na_2Ti[SiO_4]O$

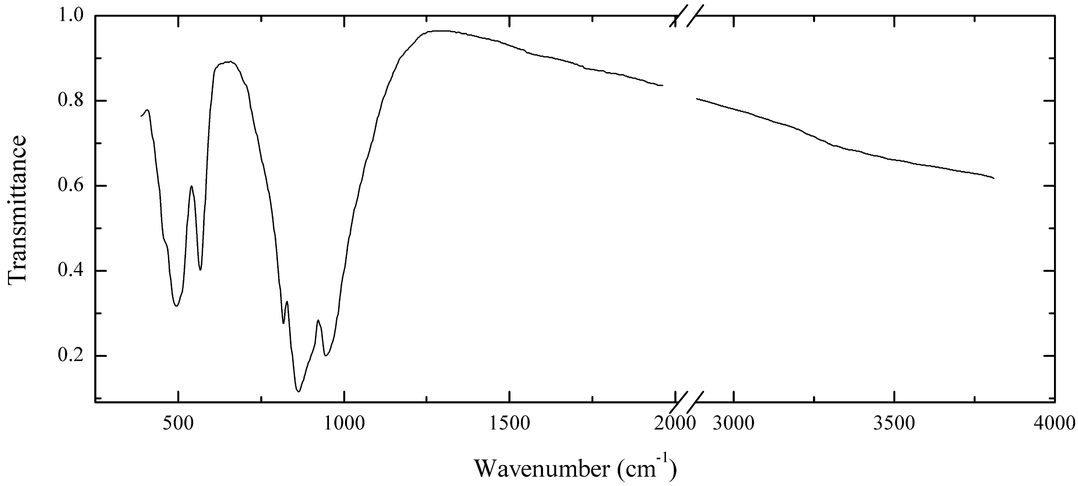


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange-brown grains from the association with nepheline, potassic feldspar, aegirine, aenigmatite, natisite, lamprophyllite, lorenzenite, shcherbakovite, delhayelite, villiaumite and lbiotite. Holotype sample. Orthorhombic, space group *Pmma*, $a = 9.827(3)$ $b = 9.167(2)$

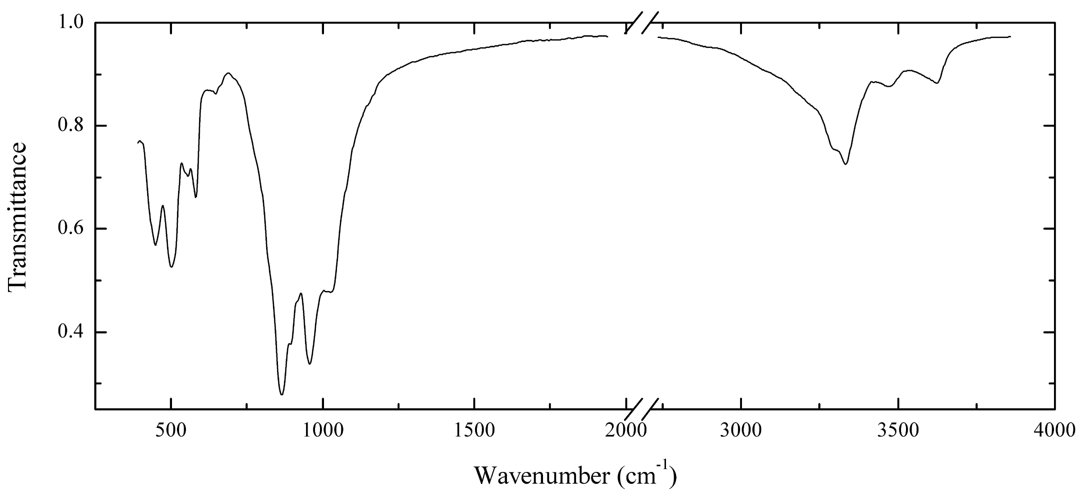
c = 4.799(2) Å, Z = 4. Optically biaxial (+), α = 1.740(2), β = 1.741(2), γ = 1.765(2), $2V_{meas}$ = 20(1)°. D_{calc} = 3.07 g/cm^3, D_{meas} = 3.12(5) g/cm^3. The empirical formula is $Na_{1.9}Mn_{0.1}Ti_{0.95}Fe_{0.05}Si_{1.00}O_4(O,F)$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 2.748 (100), 2.257 (25), 1.720 (30), 1.680 (30), 1.660 (22), 1.475 (33), 1.443 (35).
Wavenumbers (cm^{-1}): 1043, 965sh, 925sh, 908s, 854s, 833, 595, 577, 527, 446, 382s.

Sio67 Tephroite $Mn^{2+}{}_2(SiO_4)$



Locality: Inylchek glacier, Central Tien-Shan Mts., Kyrgyzstan.
Description: Brown veins from the association with spessartite, rhodonite, rhodochrosite, alabandite, sonolite and alleghanyite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 960sh, 944s, 910sh, 863s, 819, 565, 496, 460sh.

Sio69 Ribbeite $Mn_5(SiO_4)_2(OH)_2$

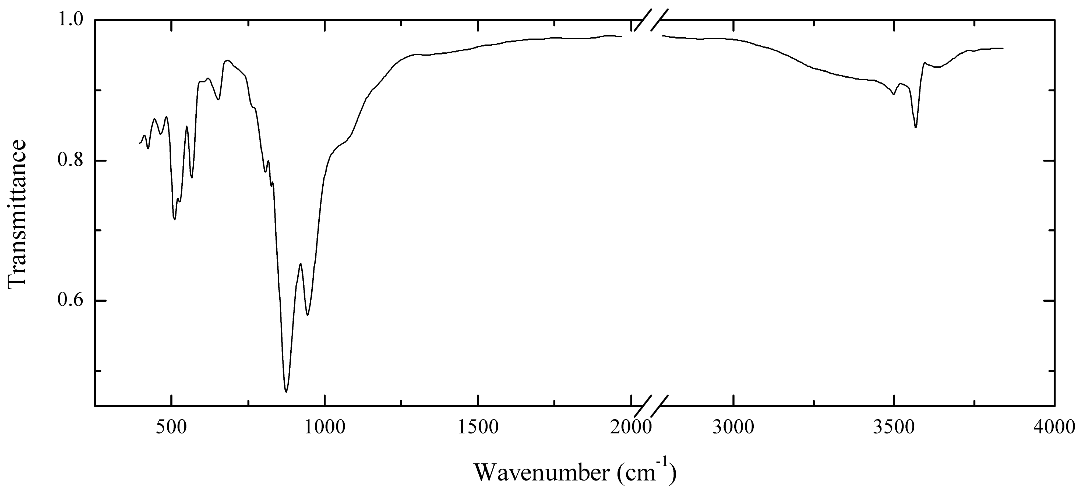


Locality: Faizulinskoe Mn deposit, South Urals, Bashkortostan, Russia.

Description: Beige granular aggregate. Investigated by A.I. Brusnitsyn. Identified by powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3625w, 3470w, 3330, 3295, 1033, 957s, 915sh, 894s, 866s, 830sh, 645w, 580, 555, 545, 515sh, 502, 454, 435sh.

Sio70 Reinhardbraunsite $Ca_5(SiO_4)_2(OH,F)_2$

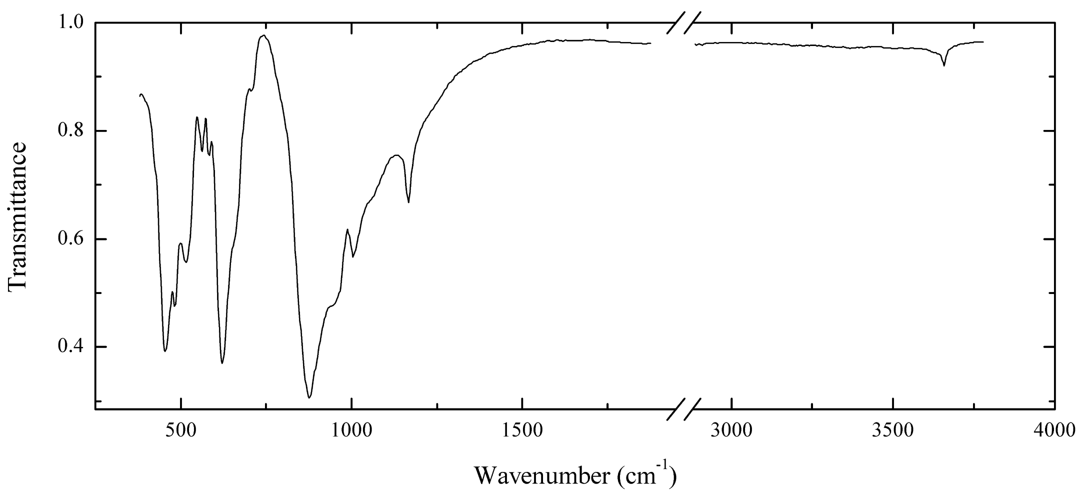


Locality: Ettringer Bellerberg volcano, near Mayen and Laacher See, Eifel, Rheinland-Pfalz (Rhineland-Palatinate), Germany (type locality).

Description: Rose fine-grained aggregate from the association with fluorellestadite, brownmillerite, and brearleyite. The empirical formula is $(Ca_{5.0}Mn_{0.05})(SiO_4)_{2.0}[(OH,O)_{1.1}F_{0.9}]$. Confirmed by IR spectrum.

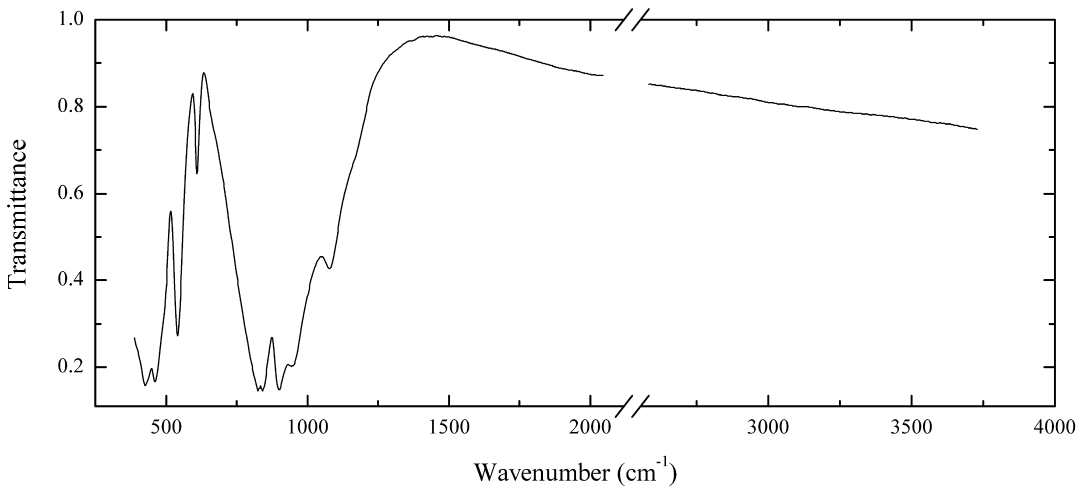
Wavenumbers (cm^{-1}): 3545, 3475w, 1060sh, 943s, 870s, 824, 803, 761w, 647, 609w, 562, 526, 505, 460, 420.

Sio71 Topaz $Al_2(SiO_4)(F,OH)_2$



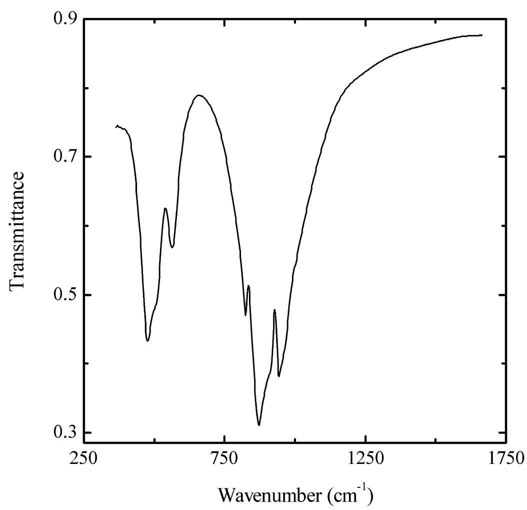
Locality: Mika pegmatite, Kukurt pegmatite field, Pamir Mts., Tajikistan.
Description: Colourless crystal from the association with potash feldspar, quartz, elbaite and beryl. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3632w, 1165, 1005, 947, 875s, 706w, 655sh, 619s, 584w, 562, 516, 481s, 450s, 420sh.

Sio72 Uvarovite $Ca_3Cr_2(SiO_4)_3$



Locality: Saranovskoe Cr deposit, Perm region, Middle Urals, Russia (type locality).
Description: Deep green crystals from the association with chromite, shuiskite and calcite. Confirmed by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 1082, 944, 900s, 841s, 826s, 610, 538, 456s, 423s.

Sio73 Fayalite $Fe^{2+}_2(SiO_4)_2$

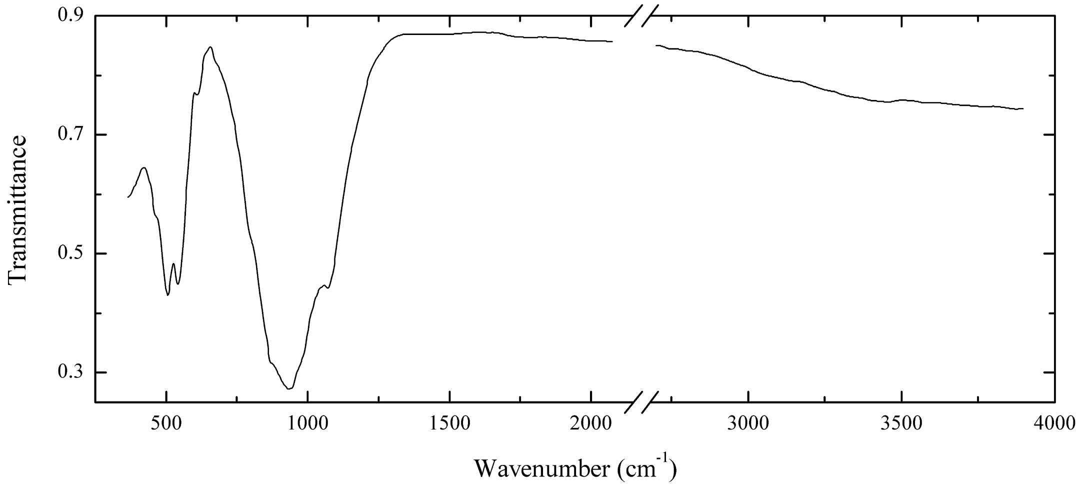


Locality: Adjuk River valley, Tajikistan.

Description: Dark brown massive. Mn-bearing variety. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 960sh, 944s, 910sh, 873s, 826, 560, 500sh, 473.

Sio74 Fluorbritholite-(Ce) $(Ce,Ca)_5[(Si,P)O_4]_3F$

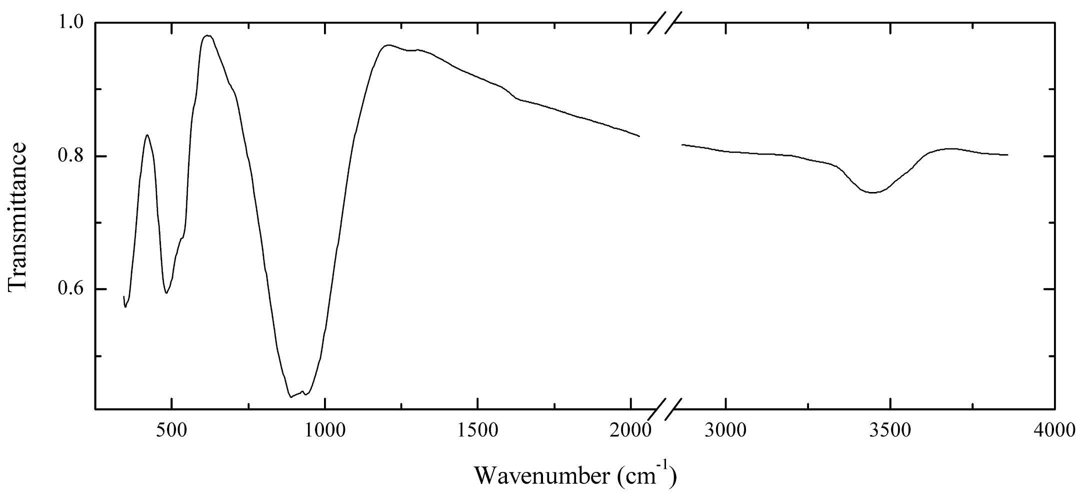


Locality: Jamestown, Jamestown district, Boulder Co., Colorado, USA.

Description: Brown grains Identified by electron microprobe analysis and powder X-ray diffraction pattern. The empirical formula is $Ca_{1.8}Ce_{1.6}Nd_{0.7}La_{0.5}Pr_{0.2}Y_{0.1}Sm_{0.1}(Si_{2.9}P_{0.1})O_{11.8}F_{1.2}$. Weak band at 1,454 cm^{-1} corresponds to the admixture of bastnäsite-(Ce).

Wavenumbers (cm^{-1}): 1454w, 1072, 980sh, 938s, 875sh, 805sh, 614w, 542s, 506s, 460sh.

Sio75 Cerite-(Ce) $(Ce,La,Ca)_9(Mg,Fe^{3+})(SiO_4)_6[SiO_3(OH)](OH)_3$

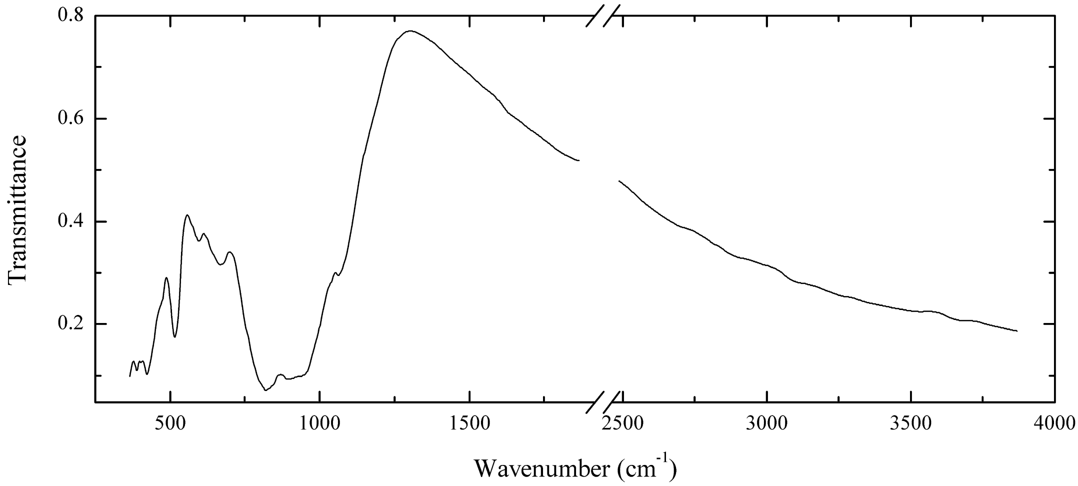


Locality: Bastnäs, Riddarhyttan, Sweden (type locality).

Description: Reddish-brown grains from the association with bastnäsite-(Ce), ferriallanite-(Ce) and törnebohmite-(Ce). Confirmed by IR spectrum.

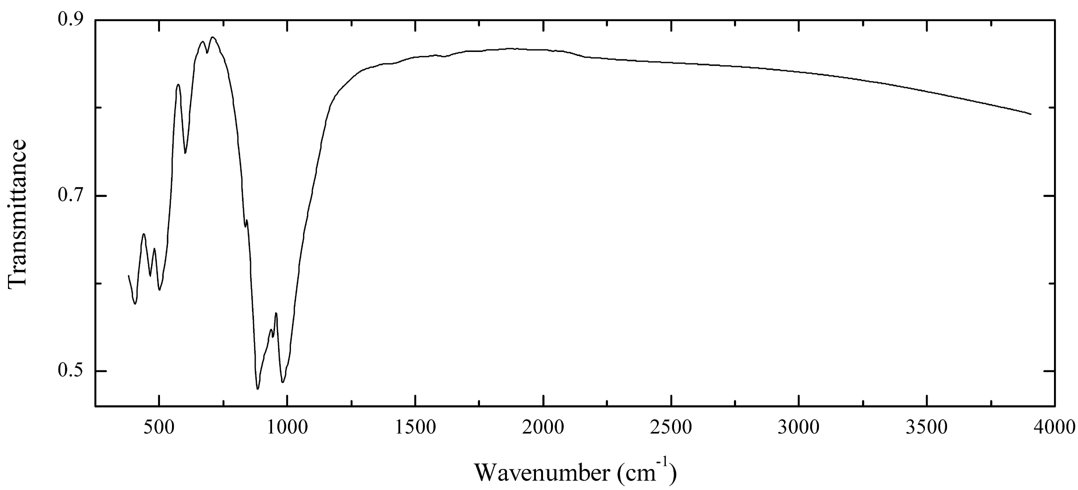
Wavenumbers (cm^{-1}): 3420, 946s, 891s, 537, 500sh, 483, (350).

Sio77 Morimotoite $Ca_3TiFe^{2+}(SiO_4)_3$



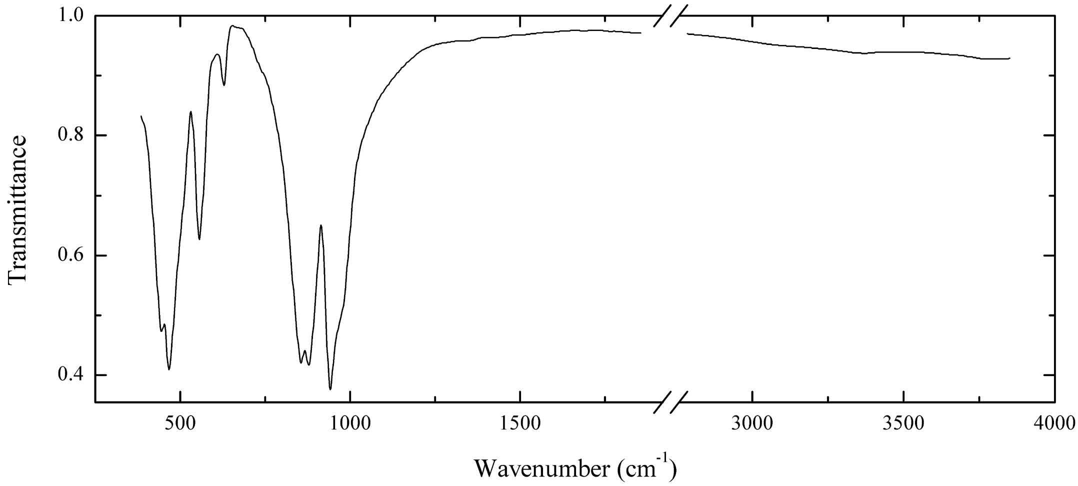
Locality: Outcrop at Fuka, Bichu-Cho, Pkayama prefecture, Japan (type locality).
Description: Black grains (with brown streak) from skarn. Collected and investigated by I.V. Pekov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1060, 935sh, 900s, 824s, 760sh, 673, 602, 516, 423s, (383s).

Sio78 Forsterite $Mg_2(SiO_4)$



Locality: Vispi quarry, San Venanzo, Terni province, Umbria, Italy.
Description: Light brown short-prismatic crystals from the association with kalsilite, leucite and clinopyroxene. Fe-rich variety. The empirical formula is (electron microprobe) $(Mg_{1.59}Fe_{0.36}Mn_{0.02}Ca_{0.02})(Si_{1.00}O_4)$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1000sh, 985s, 947, 915sh, 885s, 837, 688w, 600, 515sh, 497, 463, 400.

Sio79 Spessartine $Mn_3Al_2(SiO_4)_3$

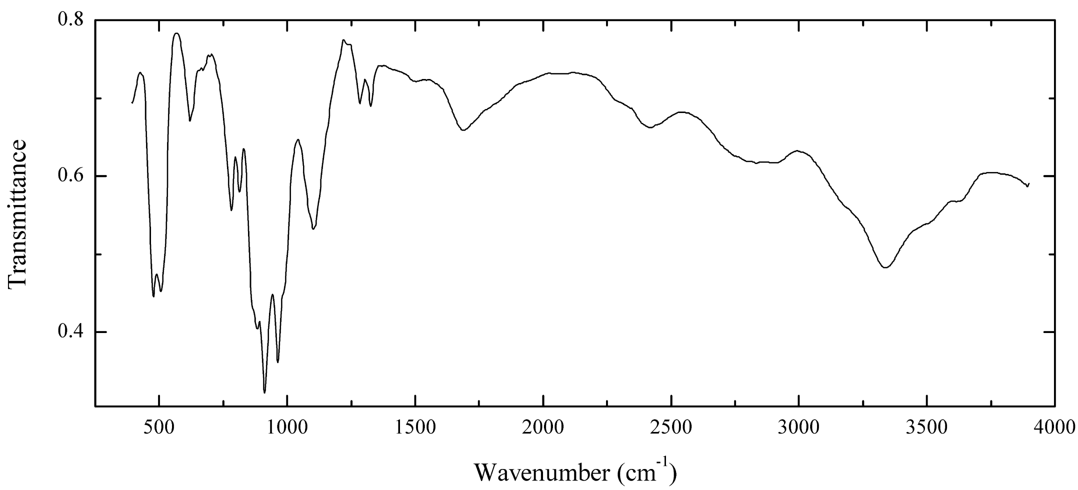


Locality: Bakhtinskoe Mn deposit, Chelyabinsk region, South Urals, Russia.

Description: Brownish crystal from the association with quartz, rhodonite and tephroite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Mn_{2.3}Ca_{0.4}Fe_{0.3})(Al_{1.8}Fe_{0.2})Si_{3.0}O_{12}$.

Wavenumbers (cm^{-1}): 975sh, 942s, 878s, 856s, 623, 551, 465s, 444.

Sio80 Afwillite $Ca_{12}(SiO_4)_4[SiO_2(OH)_2]_4 \cdot 8H_2O$

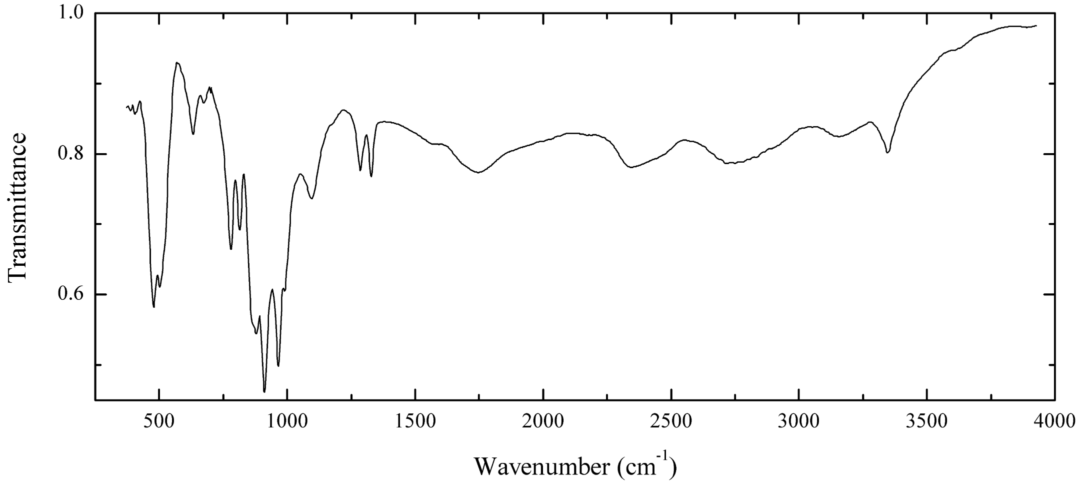


Locality: Lakargi Mt., Upper-Chegem caldera, Northern Caucasus, Republic of Kabardino-Balkaria, Russia.

Description: White fine-grained aggregate from the association with spurrite, hillebrandite and CO_3-bearing ettringite. Identified by IR spectrum, optical data and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3625w, 3450w, 3326, 3150sh, 2820, 2460sh, 2420w, 2300w, 1760sh, 1670, 1520w, 1490sh, 1418w, 1327, 1284, 1104, 990sh, 964s, 913s, 882s, 865sh, 813, 781, 668w, 630sh, 622, 525sh, 503s, 474s.

Sio81 Afwillite $Ca_{12}(SiO_4)_4[SiO_2(OH)_2]_4 \cdot 8H_2O$

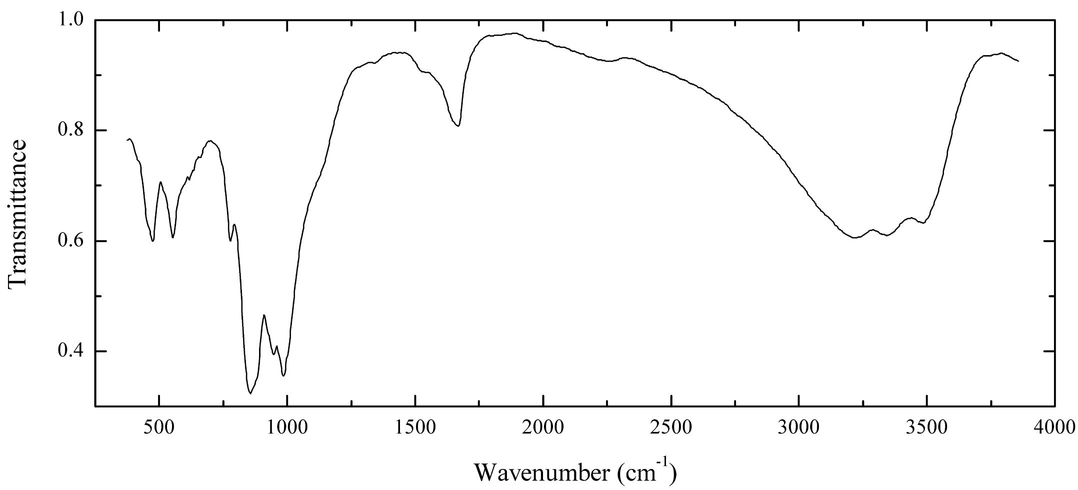


Locality: Ioko-Dovyren (Yoko-Dovyrenskiy) layered massif, Buryatia Republic, Transbaikal Territory, Siberia, Russia.

Description: Colourless crystals from the association with merwinite. Identified by IR spectrum and powder X-ray diffraction pattern. The crystal structure is solved. Triclinic, space group $P1$, a = 16.330(2), b = 5.6389(6), c = 11.685(1) Å, α = 90.08(1), β = 126.446(2), γ = 89.95(1)°. Optically biaxial (+), $\alpha \approx \beta = 1.618(2)$, $\gamma = 1.621(1)$, $2V_{meas} = 30(10)°$.

Wavenumbers (cm^{-1}): 3332, 3150, 2750, 2430sh, 2350, 1745, 1332, 1286, 1095, 990, 964s, 911s, 877s, 865sh, 813, 779, 670w, 629, 500s, 476s, 403w.

Sio82 Uranophane-alpha $Ca(UO_2)_2[SiO_3(OH)]_2 \cdot 5H_2O$

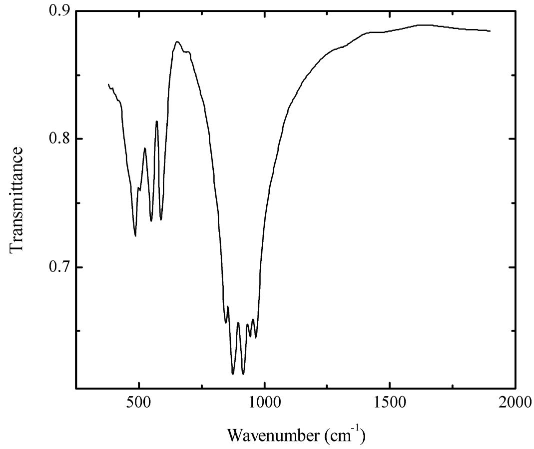


Locality: Bota-Burum U deposit, Alakol lake, Almaty region, Kazakhstan.

Description: Orange-yellow prismatic crystals from the association with chistyakovaite and uramarsite. Investigated by G.A. Sidorenko. Identified by wet chemical analysis, single-crystal and powder X-ray diffraction patterns. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3465, 3330, 3205, 2250w, 1662, 1535w, 1110sh, 987s, 946s, 880sh, 855s, 778, 600sh, 552, 473.

Sio83 Esperite $PbCa_3Zn_4(SiO_4)_4$

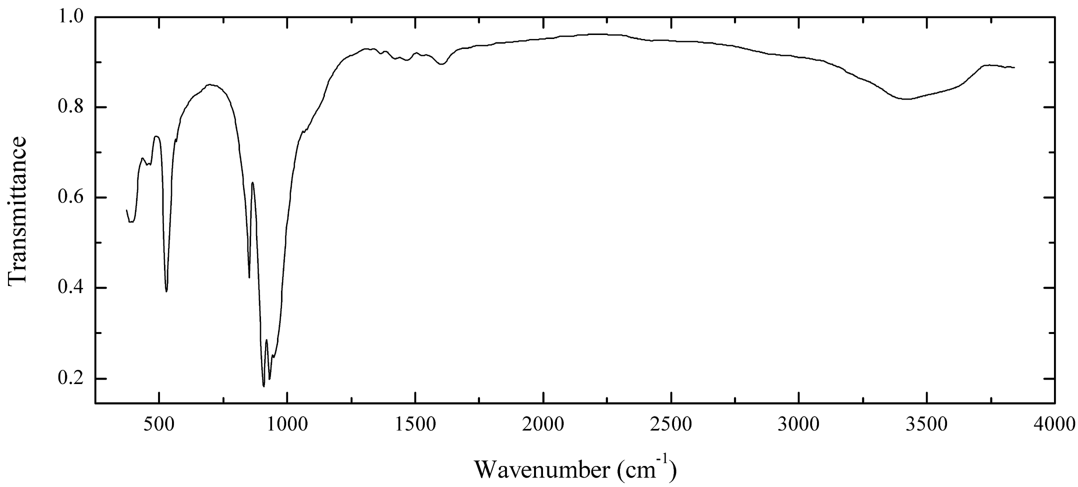


Locality: Franklin, Sussex Co., New Jersey, USA (type locality).

Description: Yellow grains from the association with andradite, willemite, zincite, hardystonite, and calcite.

Wavenumbers (cm^{-1}): 963s, 947s, 917s, 874s, 842s, 586, 545, 507, 487, 480sh, 460sh.

Sio84 Rondorfite $Ca_8Mg(SiO_4)_4Cl_2$

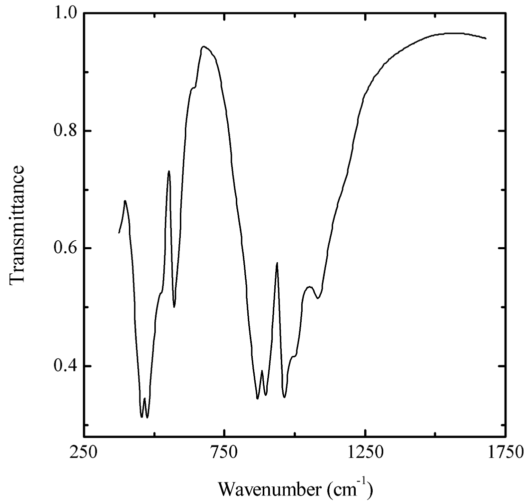


Locality: Lakargi Mt., Verkhnechegemskaya caldera, Kabardino-Balkaria, Northern Caucasus, Russia.

Description: Yellow crystal from the association with calico-olivine. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis. Fe- and Al-bearing variety. Confirmed by IR spectrum. Contains inclusions of secondary minerals.

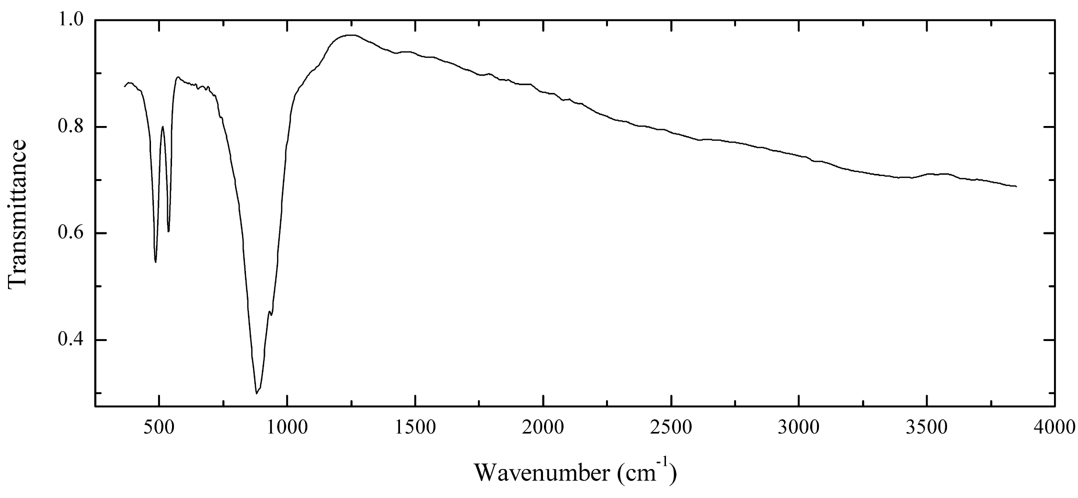
Wavenumbers (cm^{-1}): 3600sh,3405, 1610w, 1475w, 1426w, 1364w, 1145sh, 1070sh, 970sh, 952s, 935s, 909s, 853, 825sh, 564w, 527, 465, 450, 388.

Sio85 Pyrope $Mg_3Al_2(SiO_4)_3$



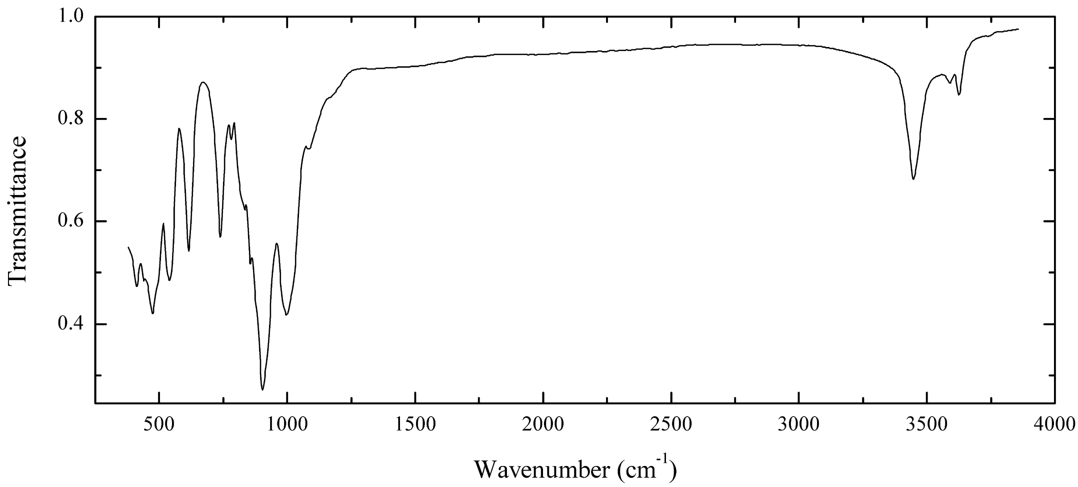
Locality: An unknown locality in Madagascar.
Description: Violet-red crystal. Confirmed by IR spectrum and electron microprobe analysis. Mn-rich variety. The empirical formula is $(Mg_{1.35}Mn_{1.02}Fe_{0.41}Ca_{0.22})(Al_{1.82}Fe_{0.09}V_{0.06}Cr_{0.03})(Si_{0.97}Al_{0.03}O_4)_3$.
Wavenumbers (cm^{-1}): 1165sh, 1082, 996, 960s, 895s, 867s, 640sh, 585sh, 569, 525, 475s, 457s.

Sio86 Eulytine $Bi_4(SiO_4)_3$



Locality: Syuigachan Sn-W occurrence, Bodzhalskiy ore district, Khabarovskiy Kray, Russia.
Description: Light green grains. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 936s, 890sh, 882s, 533, 482.

Sio87 Hydroxylchondrodite $Mg_5(SiO_4)_2(OH,F)_2$

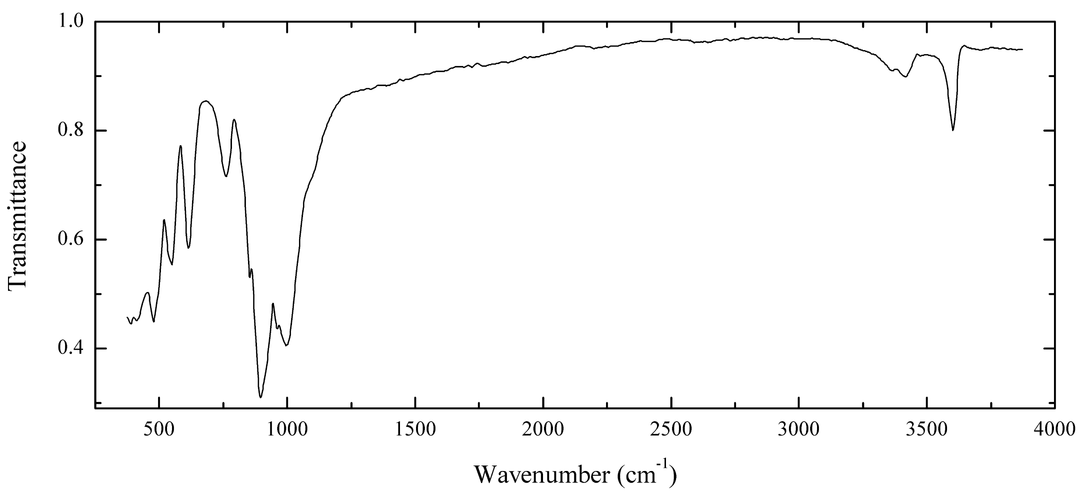


Locality: Perovskite Pit, Chuvashskie Mts., Zlatoust district, South Urals, Russia (type locality).

Description: Orange grains from the association with calcite, dolomite, clinochlore and tremolite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Mg_{4.6}Ti_{0.3}Fe_{0.1})(SiO_4)_{2.0}F_{0.3}(OH,O)_{1.7}$.

Wavenumbers (cm^{-1}): 3560w, 3512w, 3380, 1085w, 1040sh, 1020sh, 997s, 901s, 875sh, 853, 833, 823sh, 780w, 739, 615, 546sh, 541, 534sh, 495sh, 456s, 446, 416.

Sio88 Chondrodite $Mg_5(SiO_4)_2(F,OH)_2$

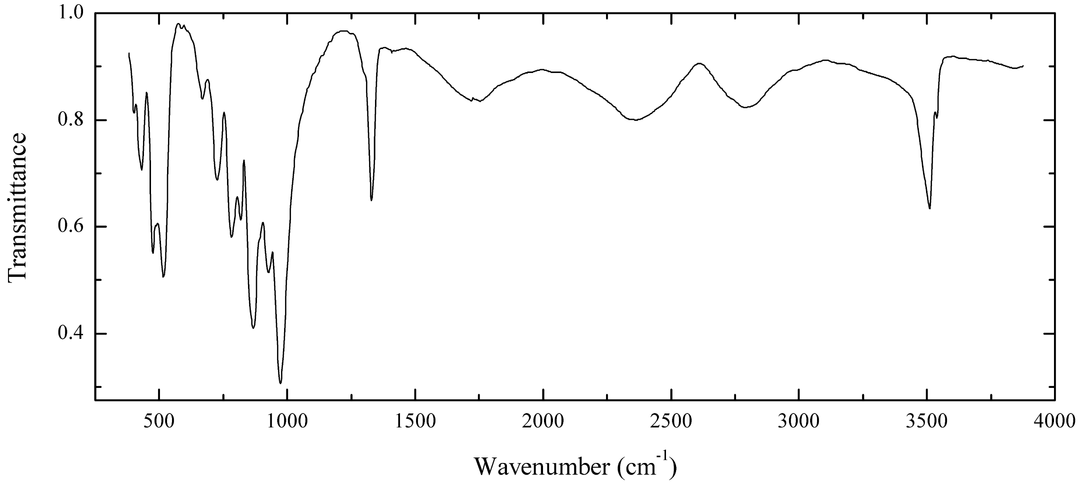


Locality: Malyshevskoe emerald deposit, Middle Urals, Russia.

Description: Orange-brown grain from the association with phlogopite. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis. Fe-rich variety. The empirical formula is $(Mg_{4.2}Fe_{0.7}Ti_{0.1})(SiO_4)_{2.0}F_{0.9}(OH,O)_{1.1}$.

Wavenumbers (cm^{-1}): 3560, 3380w, 3330w, 1078sh, 992s, 961, 910sh, 891s, 848, 756, 609, 545, 530sh, 490sh, 472s, 411s, 398s.

Sio89 Olmiite $CaMn[SiO_3(OH)](OH)$

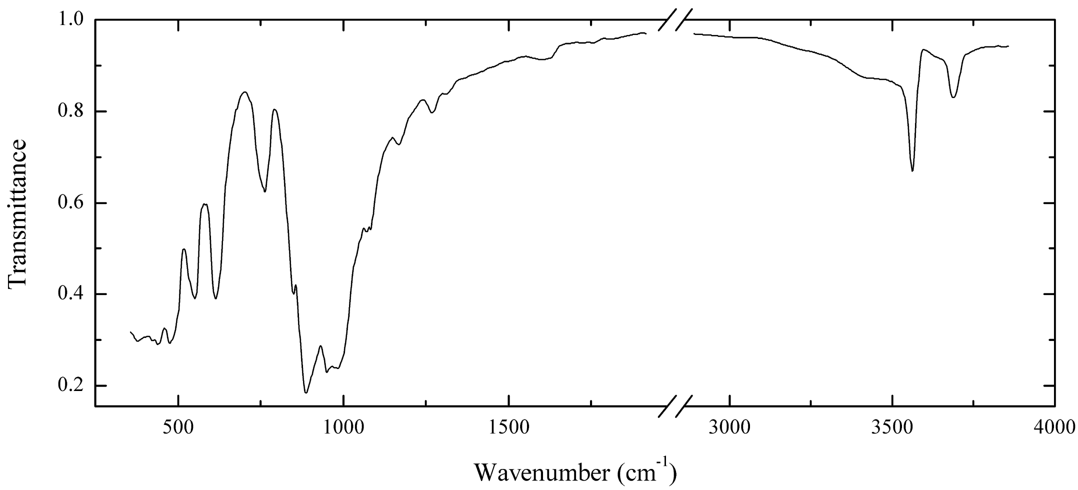


Locality: N'Chwaning II Mine, Kalahari manganese fields, South Africa.

Description: Pinkish-brown split crystals. The empirical formula is $Ca_{1.1}Mn_{0.8}Fe_{0.1}[SiO_3(OH)](OH)_{0.8}F_{0.2}$.

Wavenumbers (cm^{-1}): 3537w, 3508, 2790, 2360, 1750, 1334, 1305sh, 973s, 924s, 895sh, 872s, 819, 785, 724, 668, 517s, 472, 432, 420sh, 403w.

Sio90 Chondrodite $Mg_5(SiO_4)_2(F,OH)_2$

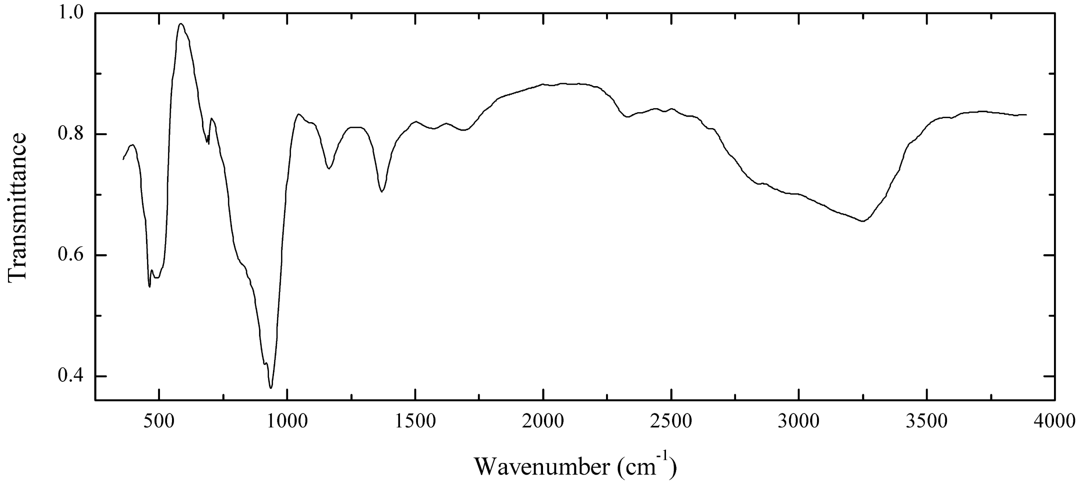


Locality: Lupikko mine, Pitkyaranta district, near Ladoga sea, Karelia, Russia.

Description: Yellow-brown grain from the association with serpentine and diopside. The empirical formula is $(Mg_{4.6}Fe_{0.4})[(SiO_4)_{1.9}(BO_3)_{0.1}]F_{1.1}(OH,O)_{0.9}$. The band at 3,680 cm^{-1} can correspond to the admixture of serpentine. The bands at 1,315, 1,275 and 1,167 cm^{-1} correspond to B–O stretching vibrations.

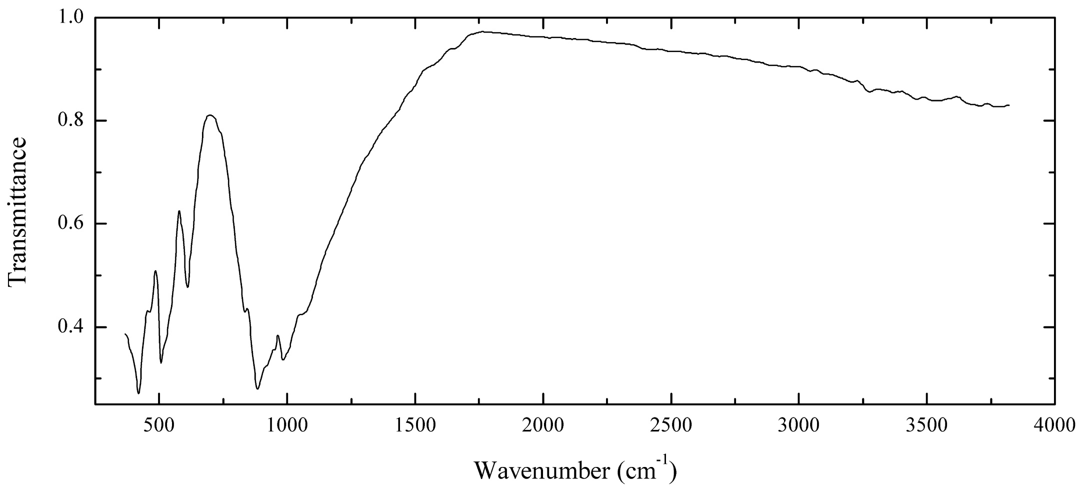
Wavenumbers (cm^{-1}): 3680, 3555, 1315w, 1275w, 1167, 1073, 984s, 952s, 888s, 850, 762, 615, 553, 477s, 442s, 380s.

Sio91 Bultfonteinite $Ca_4[SiO_3(OH)]_2F_2{\cdot}2H_2O$



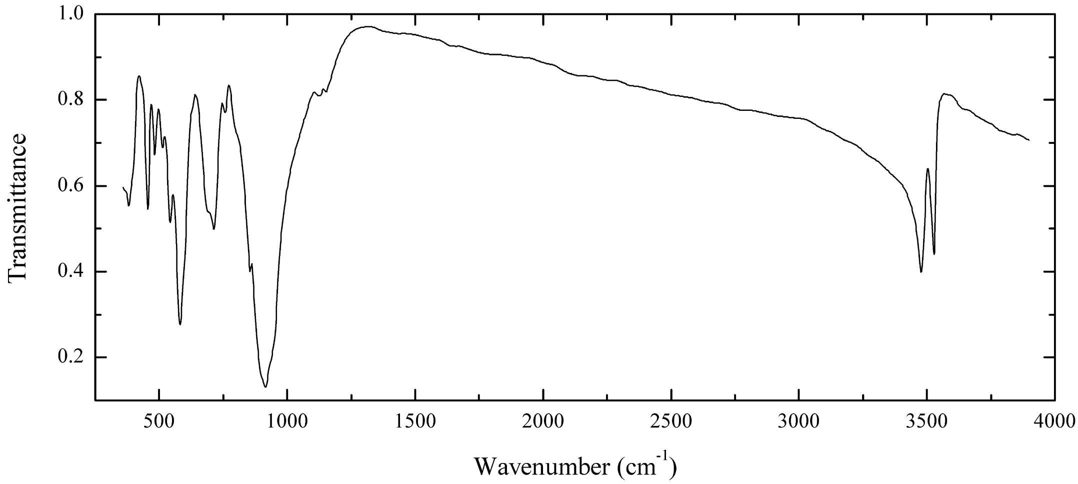
Locality: Wessels mine, Kalahari manganese fields, South Africa.
Description: Colourless crystals from the association with olmiite.
Wavenumbers (cm^{-1}): 3245, 2960sh, 2840sh, 2340, 1695, 1560, 1373, 1167, 937s, 911s, 820sh, 730sh, 686, 515sh, 487s, 460.

Sio92 Forsterite $Mg_2(SiO_4)$



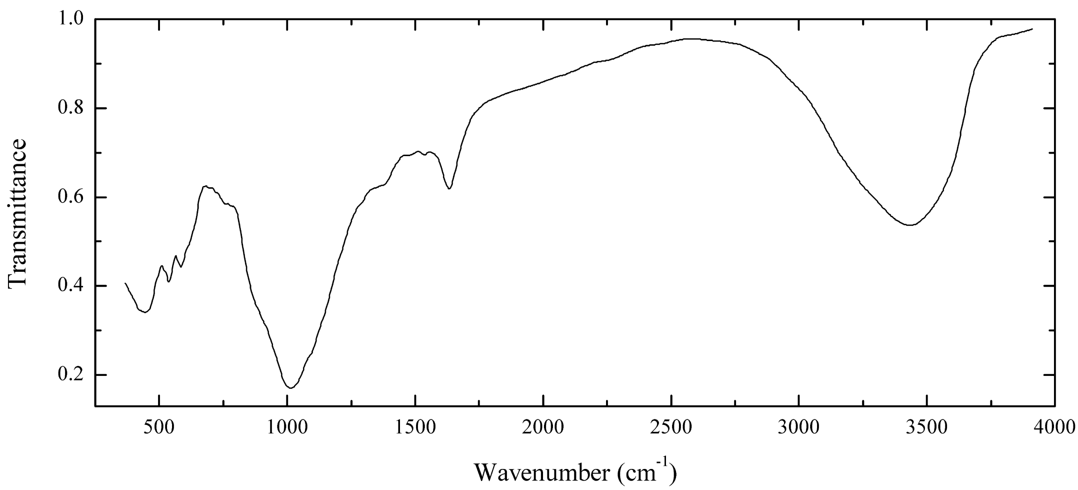
Locality: Luc Yen, Yenbai province, Vietnam.
Description: White grains from the association with spinel. The empirical formula is (electron microprobe) $(Mg_{1.85}Fe_{0.11}Ca_{0.02})(Si_{1.00}O_4)$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1050sh, 1005sh, 990s, 910sh, 885s, 834, 609, 506s, 465, 420s.

Sio94 Hodgkinsonite $Mn^{2+}Zn_2(SiO_4)(OH)_2$



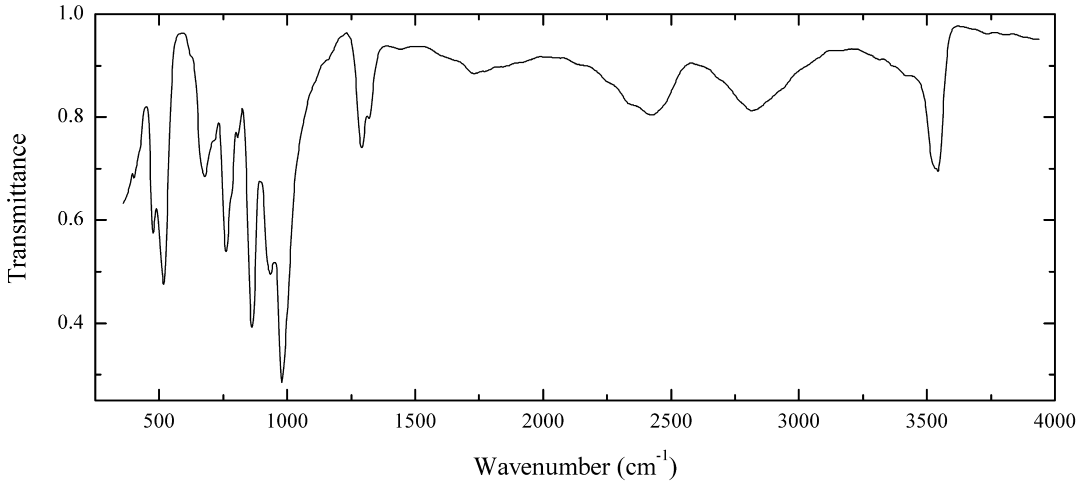
Locality: Franklin, Sussex Co., New Jersey, USA (type locality).
Description: Rose coarse-grained aggregate from the association with willemite, franklinite, tephroite and calcite.
Wavenumbers (cm^{-1}): 3500, 3450, 1642w, 1148w, 1122w, 935sh, 915s, 900sh, 857, 800sh, 757w, 712, 690sh, 580s, 541, 510, 455, 400sh, 382.

Sio95 Thorite $Th(SiO_4)$



Locality: Flora (Selsurt) Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.
Description: Yellow grains from the association with albite and narsarsukite. Altered (metamict, amorphous and hydrated) variety. The empirical formula is (electron microprobe) $H_x(Th_{0.74}Al_{0.12}Fe_{0.08}Ca_{0.07}Ti_{0.03}Mg_{0.03})[(SiO_4)_{0.84}(PO_4)_{0.16}]\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3425s, 1635, 1542w, 1480w, 1360sh, 1290sh, 1085sh, 1014s, 900sh, 770sh, 615sh, 585, 535, 490sh, 446s.

Sio96 Poldervaartite $Ca(Ca,Mn)[SiO_3(OH)](OH)$

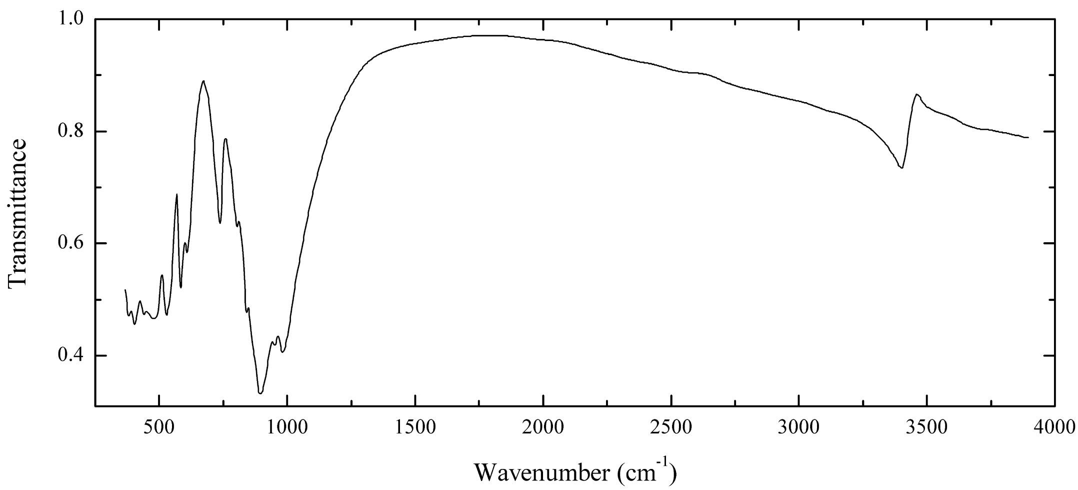


Locality: Wessels, Kalahari manganese fields, South Africa.

Description: Beige split crystals. The empirical formula is (electron microprobe) $Ca_{1.00}(Ca_{0.78}Mn_{0.21}Fe_{0.005}Al_{0.003})[Si_{1.00}O_3(OH)](OH)$.

Wavenumbers (cm^{-1}): 3520, 2800, 2420, 2350sh, 1725w, 1325, 1295, 981s, 937s, 863s, 805, 785sh, 763, 710sh, 676, 517s, 474.

Sio97 Hydroxylclinohumite $Mg_9(SiO_4)_4(OH,F)_2$

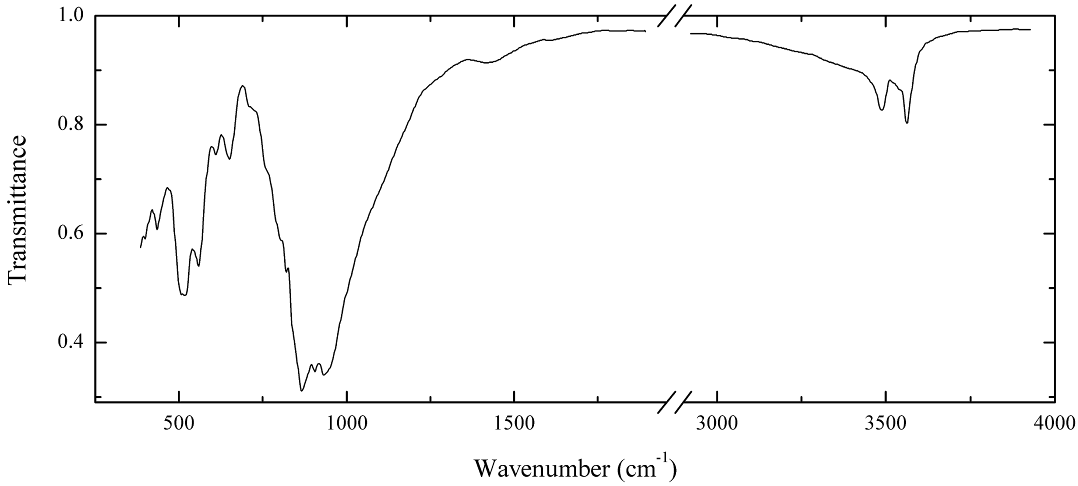


Locality: Val Malenco, Lombardy, Alps, Italy.

Description: Dark reddish-brown grain. Specimen No. 21703 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. Fe- and Ti-rich variety. The empirical formula is $(Mg_{7.3}Fe_{1.2}Ti_{0.5})(SiO_4)_{4.00}(OH_xO_{2-x})$ ($x \approx 1$). The content of F is below detection limit.

Wavenumbers (cm^{-1}): 3375, 983s, 952s, 896s, 870sh, 841, 804, 737, 609, 583, 528s, 480s, 440s, 404s, 380s.

Sio98 Chegemite $Ca_7(SiO_4)_3(OH)_2$

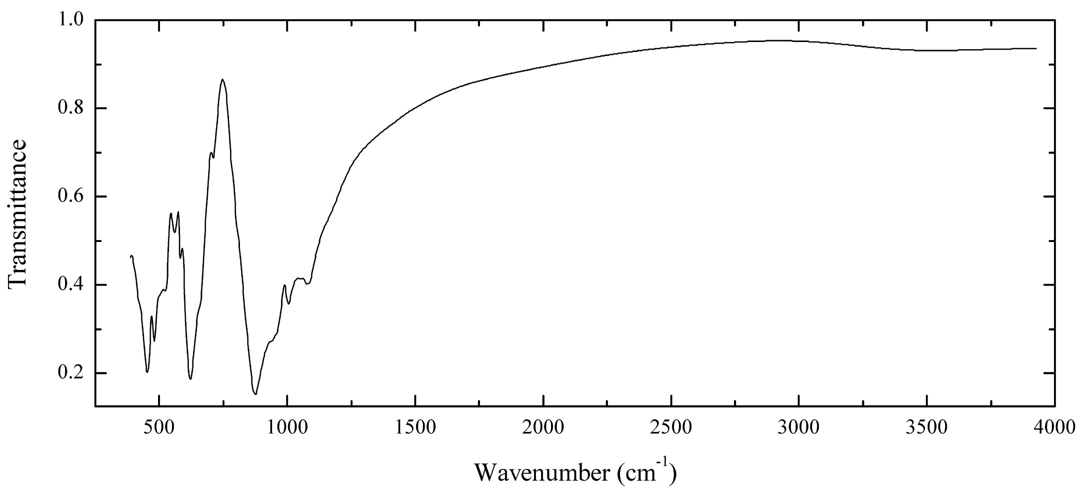


Locality: Lakargi Mt., Upper-Chegem caldera, Northern Caucasus, Republic of Kabardino-Balkaria, Russia (type locality).

Description: Pink grains from the association with larnite, spurrite, rondorfite, reinhardbraunsite, wadalite, lakargiite and srebrodolskite. Investigated by A.E. Zadov.

Wavenumbers (cm^{-1}): 3545, 3470, 945sh, 935s, 907s, 868s, 822, 805sh, 760sh, 647, 607, 562, 522, 505, 435.

Sio99 Topaz $Al_2(SiO_4)(F,OH)_2$

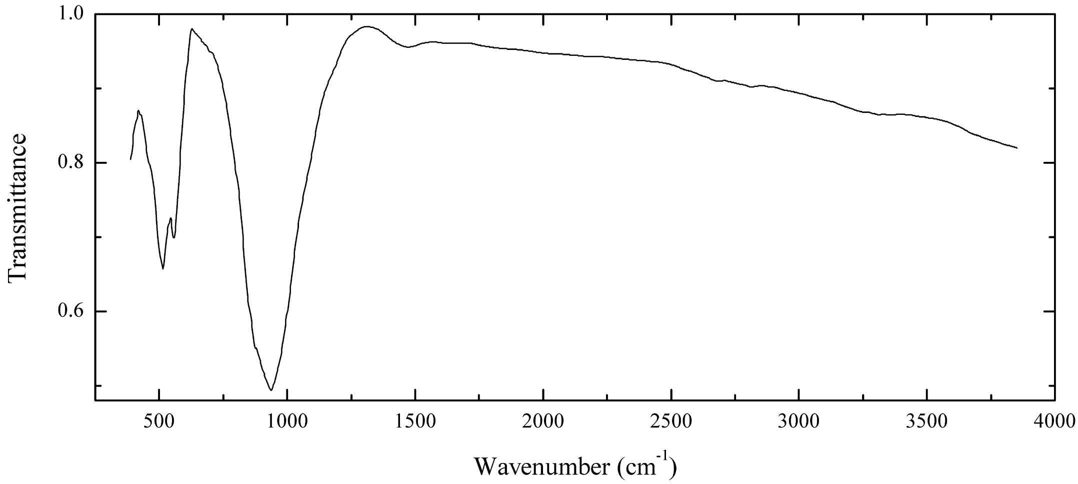


Locality: Emmelberg, Üdersdorf, near Daun, Eifel Mts., Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Cluster of colourless acicular crystals from the association with mullite, pseudobrookite and jeremejevite. High-temperature OH-deficient variety. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1080, 1004, 935sh, 874s, 706w, 655sh, 620s, 583, 558, 525, 500, 480, 453s.

Sio100 Fluorbritholite-(Y) $(Y,Ca,Ln)_5[(Si,P)O_4]_3F$

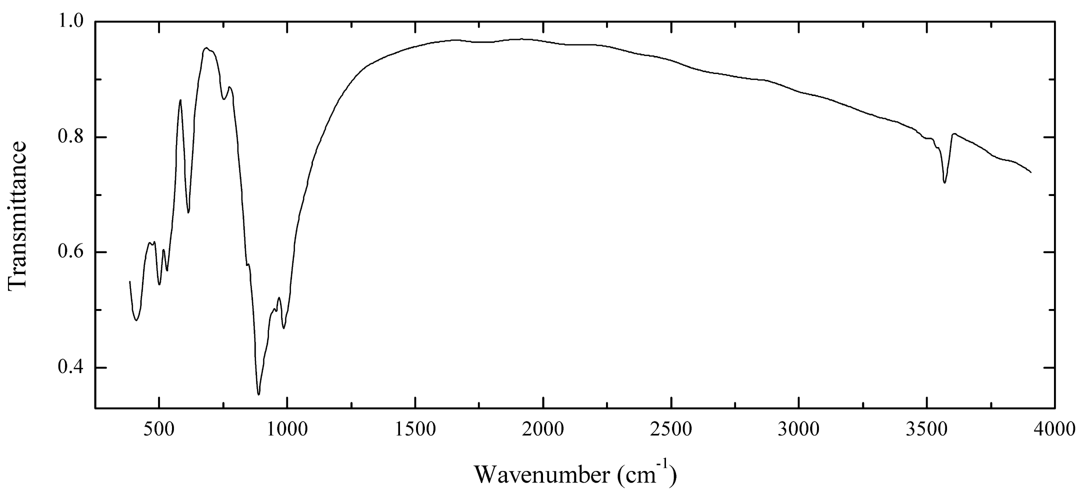


Locality: Lagmannsvik, Hamarøy, Nordland, Norway (type locality).

Description: Dark brown grains from the association with Y-rich fluorite, allanite-(Ce), quartz, bastnäsite-(Ce), britholite-(Y), gadolinite-(Y), hundholmenite-(Y), *etc*. Holotype sample. The crystal structure is solved. Hexagonal, space group $P6_3/m$, $a = 9.4437(2)$, $c = 6.8169(2)$ Å, $Z = 2$. Optically uniaxial (+), $\omega = 1.784(2)$, $\varepsilon = 1.789(3)$. $D_{calc} = 4.61$ g/cm^3. The empirical formula is $(Y_{2.013}Ce_{0.320}Nd_{0.300}Yb_{0.140}Dy_{0.111}Er_{0.101}Gd_{0.091}Sm_{0.091}La_{0.051}Pr_{0.031})Ca_{1.607}Mn_{0.110}[(Si_{2.970}P_{0.030})O_{12}]$ $[F_{0.781}O_{0.210}(OH)_{0.009}]$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.104 (27) (200), 3.160 (27) (102), 3.102 (29) (210), 2.826 (100) (121), 2.775 (58) (112), 2.737 (46) (300), 1.948 (25) (222), 1.839 (28) (123).

Wavenumbers (cm^{-1}): 1458w, 1065sh, 938s, 874s, 555, 514, 495sh, 460sh.

Sio101 Clinohumite $Mg_9(SiO_4)_4(F,OH)_2$

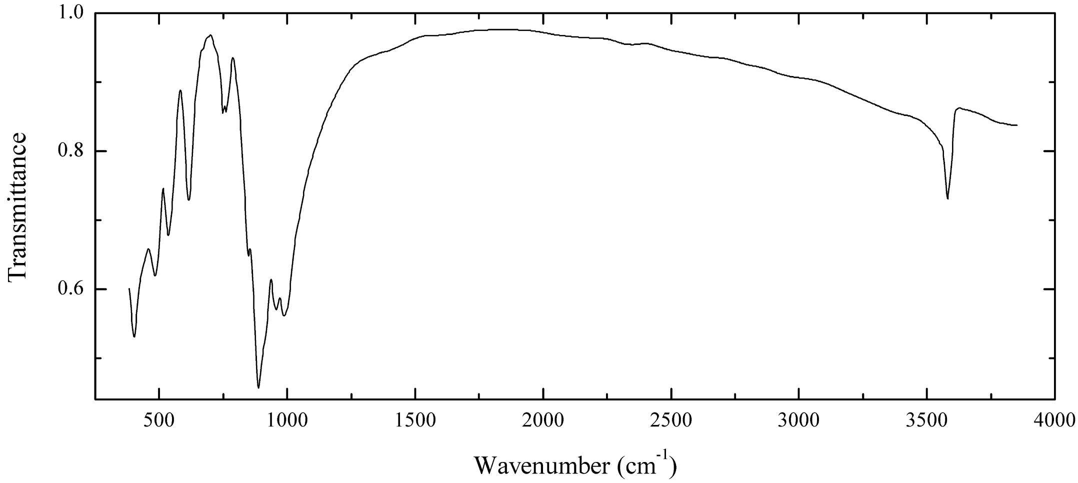


Locality: San Vito quarry, Ercolano, Monte Somma, Naples province, Campania, Italy (type locality).

Description: Yellow crystal. Specimen No. 30905 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. Monoclinic, $a = 10.248$, $b = 4.731$, $c = 13.75$ Å, $\beta = 101.17°$. The empirical formula is (electrom nicroprobe, OH calculated) $Mg_{8.65}Fe_{0.34}Mn_{0.06}Ti_{0.03}Si_{3.92}O_{16}F_{1.23}(OH)_{0.77}$.

Wavenumbers (cm^{-1}): 3555, 1180sh, 1075sh, 985s, 957, 900sh, 888s, 845, 760sh, 753w, 612, 530, 499, 470, 405s.

Sio102 Humite $Mg_7(SiO_4)_3(F,OH)_2$

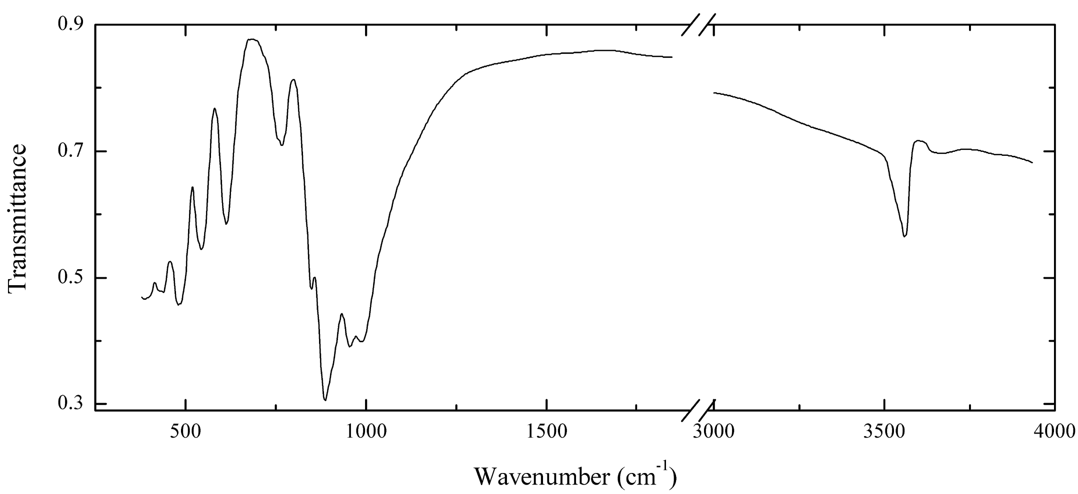


Locality: Monte Somma, Naples province, Campania, Italy (type locality).

Description: Yellow crystal. Specimen No. 27825 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. Orthorhombic, $a = 4.734$, $b = 10.274$, $c = 20.861$ Å. The empirical formula is (electrom nicroprobe, OH calculated) $Mg_{6.73}Fe_{0.26}Mn_{0.07}Zn_{0.02}Si_{2.92}O_{12}F_{1.08}(OH)_{0.92}$.

Wavenumbers (cm^{-1}): 3553, 1180sh, 1075sh, 984s, 955s, 900sh, 887s, 847, 759, 749, 613, 537, 484s, 407s.

Sio103 Chondrodite $Mg_5(SiO_4)_2(F,OH)_2$

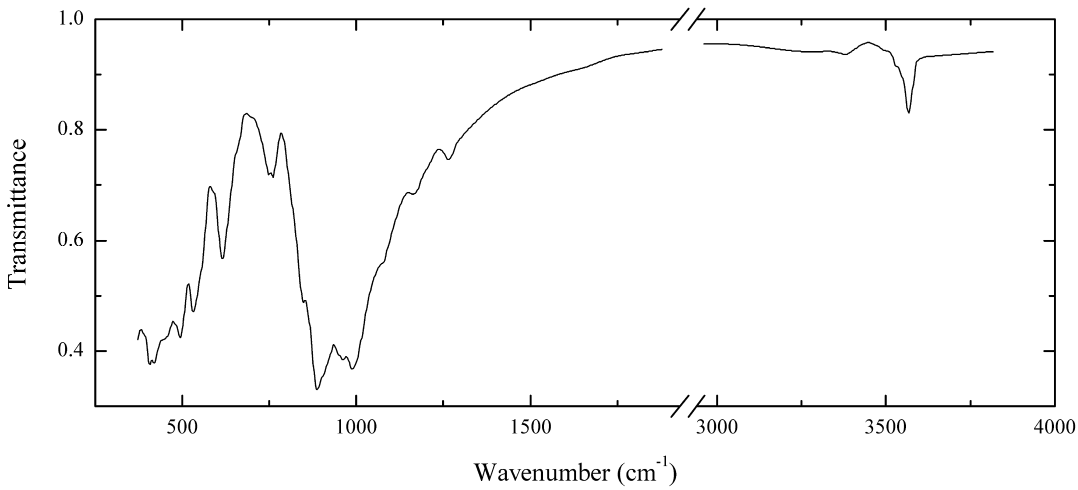


Locality: Franklin, Sussex Co., New Jersey, USA.

Description: Yellow grains. Specimen No. 87821 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. Monoclinic, $a = 7.898$, $b = 4.737$, $c = 10.304$ Å, $\beta = 109.09°$. Zn-bearing variety. The empirical formula is (electrom nicroprobe, OH calculated) $Mg_{4.56}Mn_{0.31}Zn_{0.16}Si_{1.96}O_8F_{1.09}(OH)_{0.91}$.

Wavenumbers (cm^{-1}): 3610w, 3549, 1170sh, 1080sh, 986s, 954s, 885s, 850, 763, 750sh, 613, 545, 480s, 442, 380s.

Sio104 Clinohumite $Mg_9(SiO_4)_4(F,OH)_2$

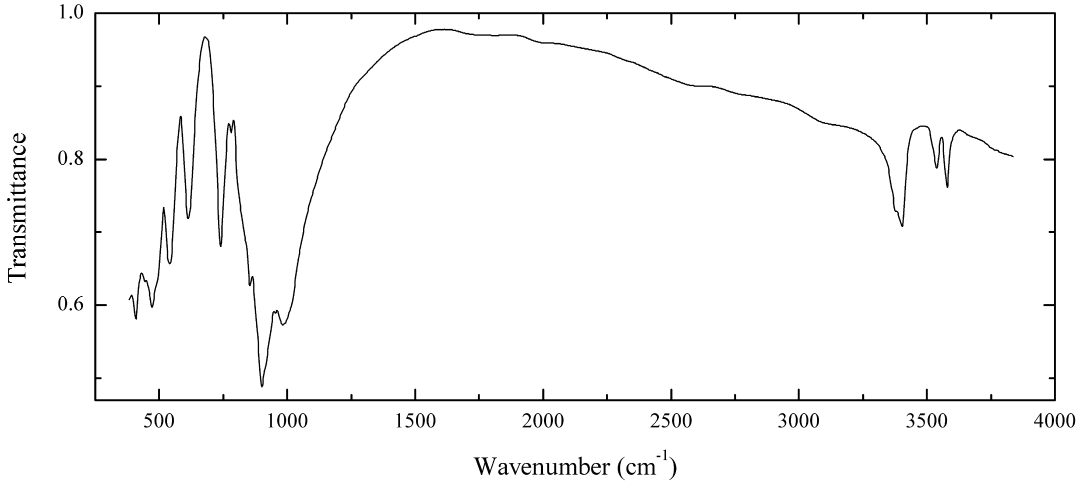


Locality: Monte Somma, Somma-Vesuvius volcanic complex, Campania, Italy. Naples province, Campania, Italy (type locality).

Description: Brownish-yellow grains from the association with balliranoite, orthoclase, phlogopite, calcite, diopside, pargasite, haüyne and apatite. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. Monoclinic, $a = 10.243(9)$, $b = 4.747(2)$, $c = 13.677(12)$ Å, $\beta = 101.90(13)°$. The empirical formula is (electrom nicroprobe) $Mg_{8.31}Fe_{0.55}Ti_{0.14}Mn_{0.02}Si_{4.00}O_{16}F_{1.11}(OH,O)_{0.89}$.

Wavenumbers (cm^{-1}): 3552, 3360w, 1265w, 1163w, 1075sh, 990s, 962s, 885s, 847, 760, 750, 615, 550sh, 530, 495s, 445sh, 420s, 404s.

Sio105 Hydroxylchondrodite $Mg_5(SiO_4)_2(OH,F)_2$

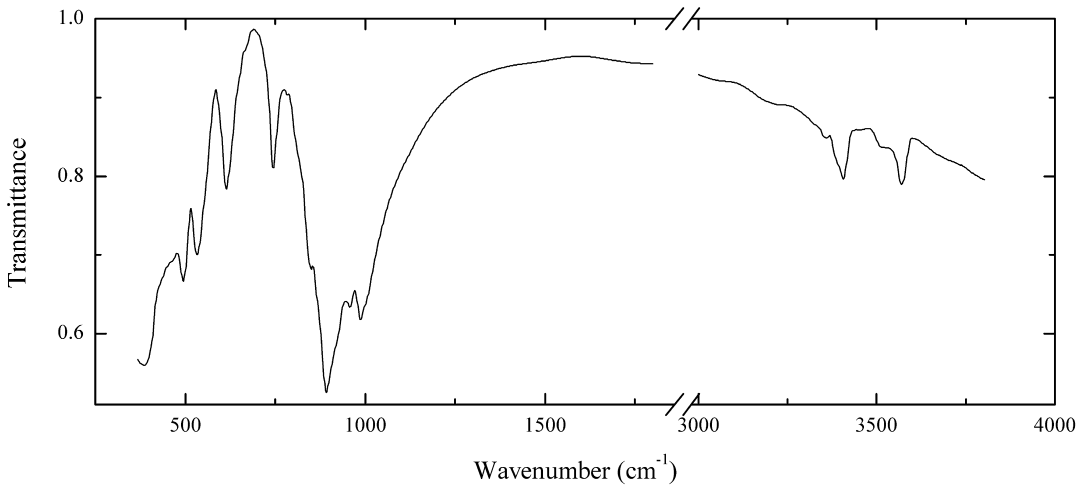


Locality: Perovskite Pit, Chuvashskie Mts., Zlatoust district, South Urals, Russia (type locality).

Description: Orange grains from the association with calcite, dolomite, clinochlore and tremolite. Identified by single-crystal X-ray diffraction pattern and IR spectrum. Monoclinic, $a = 7.887$, $b = 4.726$, $c = 10.274$ Å, $\beta = 109.13°$.

Wavenumbers (cm^{-1}): 3553, 3510, 3375, 3350sh, 1070sh, 989s, 901s, 853, 840sh, 800sh, 779w, 738, 614, 541, 490sh, 474s, 450, 413s.

Sio106 Hydroxylclinohumite $Mg_9(SiO_4)_4(OH,F)_2$

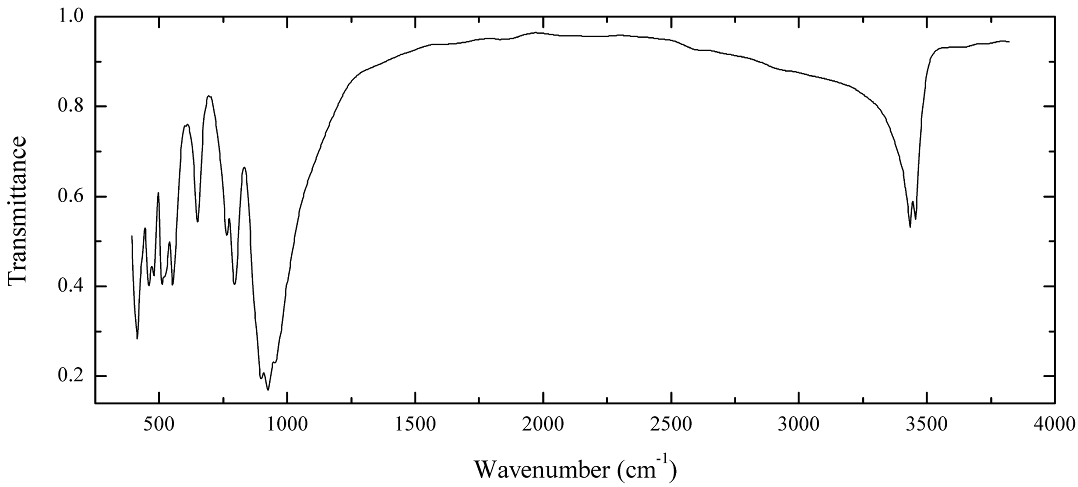


Locality: Irkutskiy district, Murun massif (Murunskii alkaline complex), Aldan Shield, southwest Yakutia, Siberia, Russia.

Description: Brownish-yellow grains. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. Monoclinic, $a = 10.268$, $b = 4.749$, $c = 13.664$ Å, $\beta = 100.89°$. The empirical formula is (electrom nicroprobe) $Mg_{8.56}Fe_{0.32}Ti_{0.04}Mn_{0.01}Si_{4.06}O_{16}F_{0.04}(OH,O)_x$.

Wavenumbers (cm^{-1}): 3553, 3495w, 3390, 987s, 957s, 905sh, 890s, 846, 741, 611, 529, 493s, 407s.

Sio107 Kuliokite-(Y) $(Y,Yb)_4Al(SiO_4)_2(OH)_2F_5$

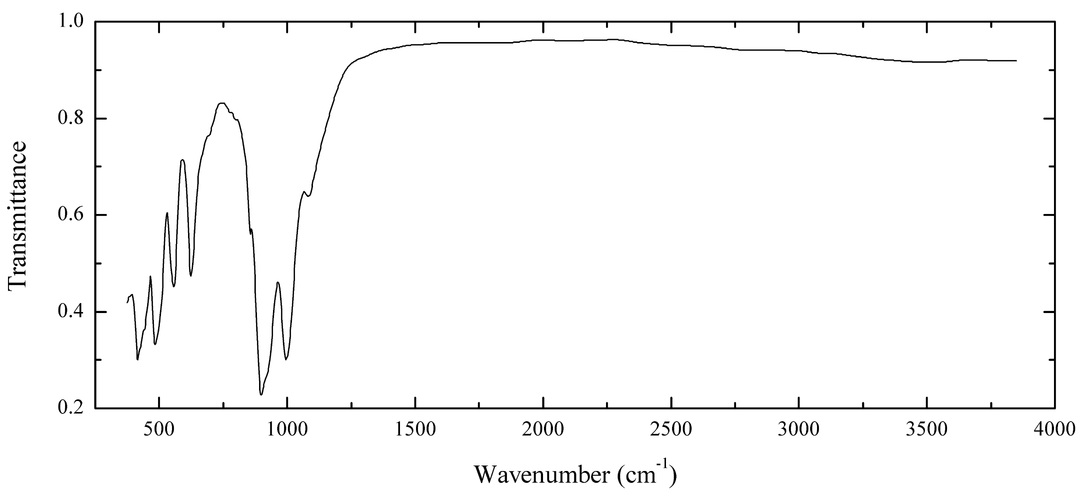


Locality: Ploskaya Mt., Western Keivy Mts., Kola peninsula, Murmansk region, Russia.

Description: Pale rose tabular crystals from the association with Y-rich fluorite and amazonite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3435, 3416, 1065sh, 980sh, 950s, 923s, 896s, 793, 762, 649, 552, 522, 508, 480, 458, 415s.

Sio108 Chondrodite $Mg_5(SiO_4)_2(F,OH)_2$

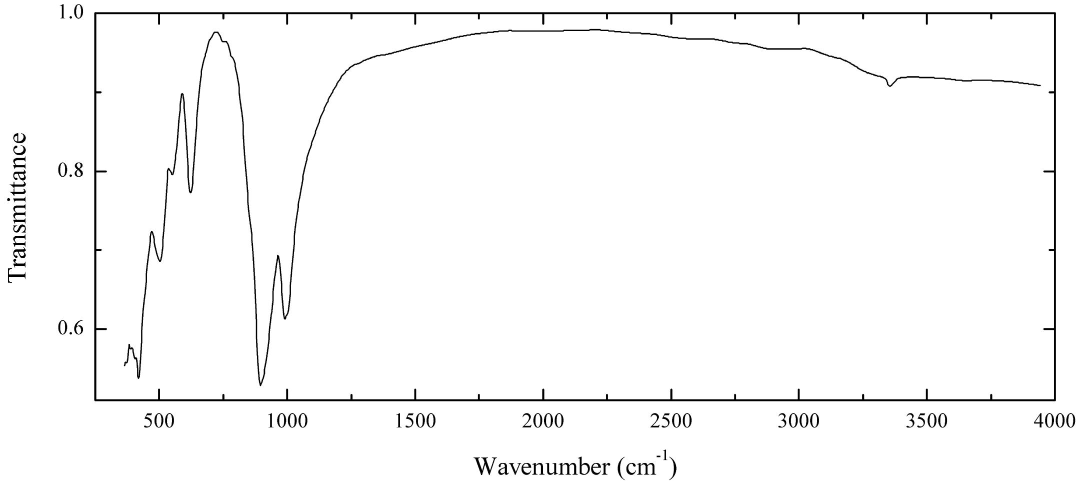


Locality: Burned dump of the shaft No. 45, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Light grey grains from the association with norbergite, anorthite, forsterite, spinel, fluorite, sellaite, hematite, cohenite and pyrrhotite. Investigated by B.V. Chesnokov. Identified by powder X-ray diffraction pattern and wet chemical analysis. OH-free variety. Optically biaxial (+), $\alpha = 1.587$, $\beta = 1.600$, $\gamma = 1.621$.

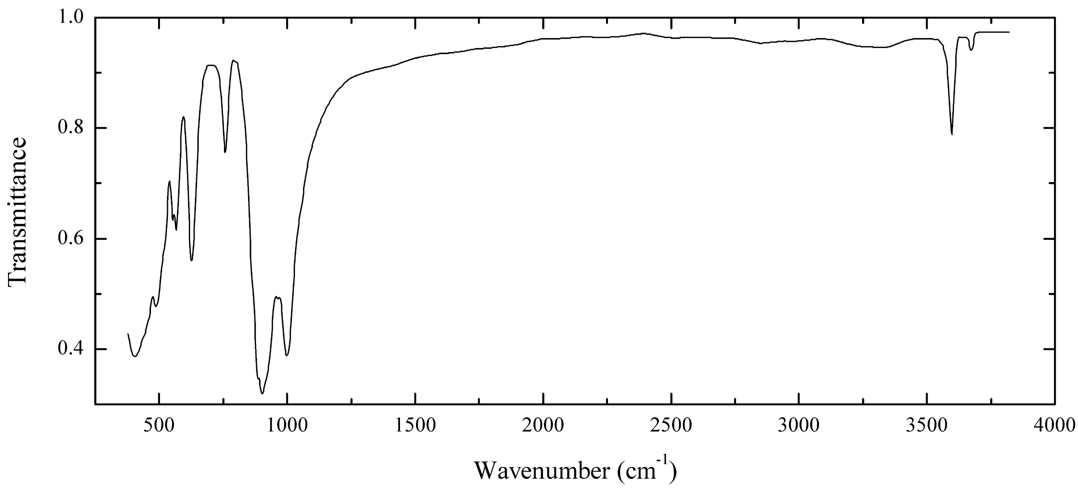
Wavenumbers (cm^{-1}): 1083, 996s 920sh, 897s, 854, 622, 555, 484s, 430sh, 420s.

Sio109 Norbergite $Mg_3(SiO_4)(F,OH)_2$



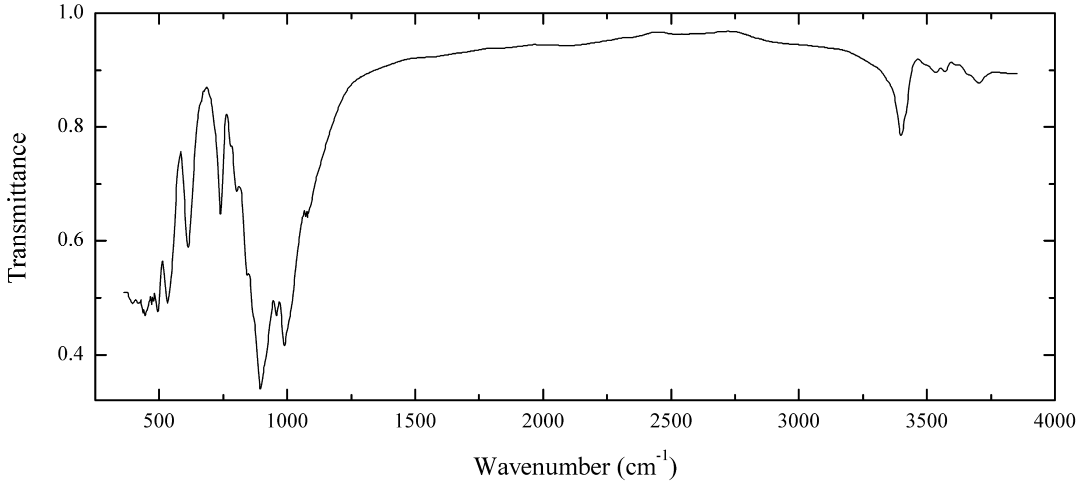
Locality: Burned dump of the shaft No. 45, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.
Description: Grey grains from the association with chondrodite, anorthite, forsterite, spinel, fluorite, sellaite, hematite, cohenite and pyrrhotite. Investigated by B.V. Chesnokov. Identified by powder X-ray diffraction pattern and wet chemical analysis. OH-poor variety. Optically biaxial (+), $\alpha = 1.585$, $\beta = 1.566$, $\gamma = 1.558$.
Wavenumbers (cm^{-1}): 3350w, 1000sh, 992s, 896s, 855sh, 622, 550, 500, 419s.

Sio110 Norbergite $Mg_3(SiO_4)(F,OH)_2$



Locality: Plast, Chelyabinsk region, South Urals, Russia.
Description: Pale yellow grains from marble. Investigated by B.V. Chesnokov. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3655w, 3577, 1170sh, 1070sh, 996s, 962, 900s, 883s, 757, 625, 564, 551, 484, 440sh, 405s.

Sio111 Hydroxylclinohumite $Mg_9(SiO_4)_4(OH,F)_2$

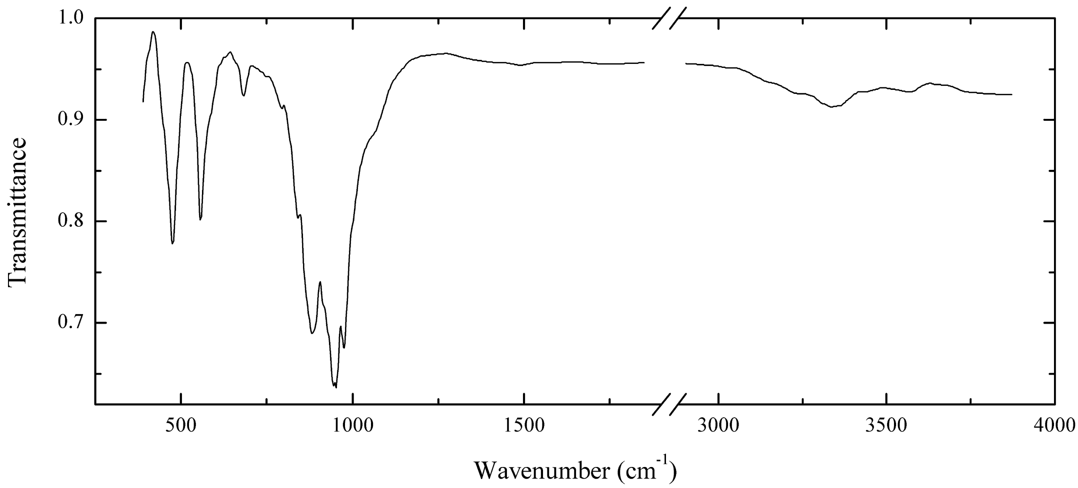


Locality: Perovskite Pit, Chuvashskie Mts., Zlatoust district, South Urals, Russia.

Description: Brownish-yellow grains from the association with calcite, hydroxylchondrodite, diopside and perovskite. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. The empirical formula is (electrom nicroprobe, OH calculated) $Mg_{8.21}Ti_{0.40}Fe_{0.21}Mn_{0.03}Si_{4.00}O_{16.50}(OH)_{1.48}F_{0.02}$.

Wavenumbers (cm^{-1}): 3685, 3640sh, 3555w, 3520w, 3385, 1078, 1010sh, 988s, 958s, 896s, 870sh, 842, 801, 779w, 729, 612, 530s, 493s, 469, 438s, 420s, 385s.

Sio112 "Rhythmite" $Ca_7(SiO_4)_2Cl_6$ (?)

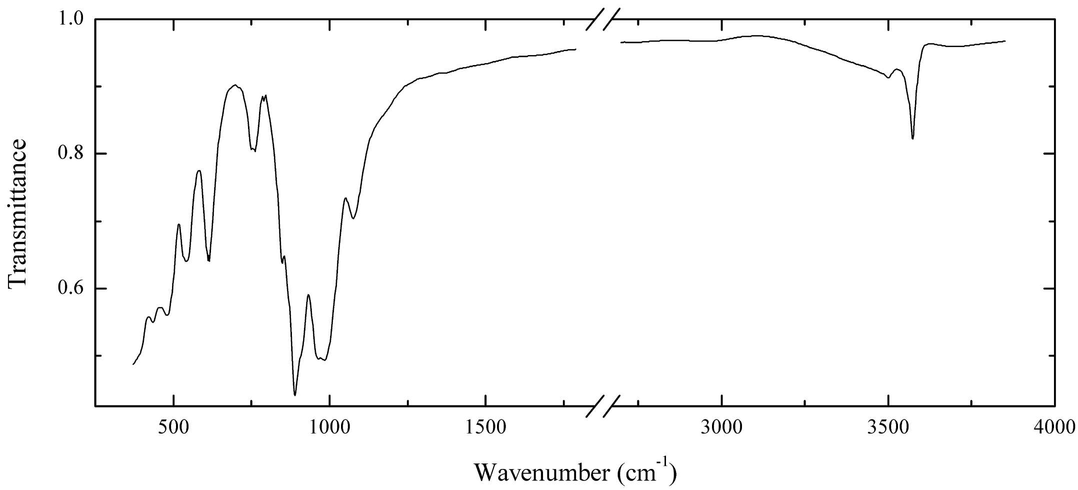


Locality: Burned dump of the shaft No. 45, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Colourless grains from the association with "igumnovite", anhydrous $CaCl_2$, troilite, pyrrhotite, cohenite, *etc*. Technogenetic phase, not approved by the IMA CNMNC. Investigated by B.V. Chesnokov. Orthorhombic, $a = 9.555(2)$, $b = 18.860(4)$, $c = 30.569(7)$ Å, $Z = 12$. Optically biaxial (+), $\alpha = 1.676$, $\beta = 1.678$, $\gamma = 1.682$. $D_{calc} = 2.451$ g/cm^3. The empirical formula is $Ca_{6.98}Fe_{0.04}Si_{1.94}Al_{0.06}O_{8.00}Cl_{5.94}Cl_{0.08}$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 3.32 (66) (128), 3.095 (100) (138), 2.870 (54) (237), 2.853 (75) (139), 2.734 (73) (157), 2.495 (89) (344), 2.475 (87) (1.4.10).

Wavenumbers (cm^{-1}): 3540w, 3320w, 1060w, 975s, 952s, 944s, 881s, 840, 793w, 680, 555, 473.

Sio113 Humite $Mg_7(SiO_4)_3(F,OH)_2$

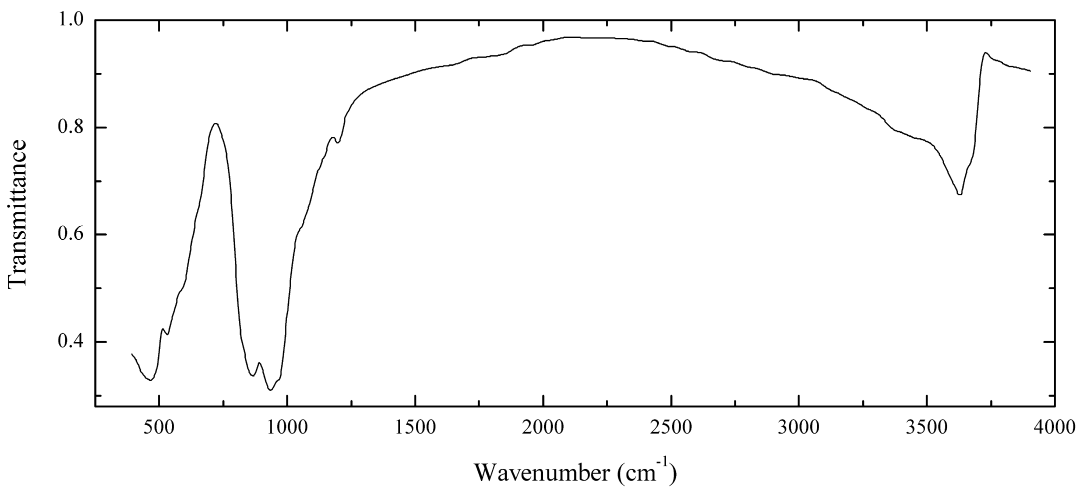


Locality: Tilley Foster iron mine, Brewster, Southeast Township, Putnam Co., New York, USA.

Description: Yellow grains. Specimen No. 88246 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. The crystal structure is solved. The empirical formula is (electrom nicroprobe) $Mg_{6.3}Fe_{0.7}[(SiO_4)_{2.0}(BO_3)_{0.1}]F_{1.0}(OH,O)_{1.0}$.

Wavenumbers (cm^{-1}): 3685w, 3560, 3485w, 1076, 985s, 964s, 915sh, 888s, 847, 757, 749, 611, 538, 476s, 434s.

Sio114 Hibschite $Ca_3Al_2(SiO_4)_{3-x}(OH)_{4x}$ (x = 0.2–1.5)

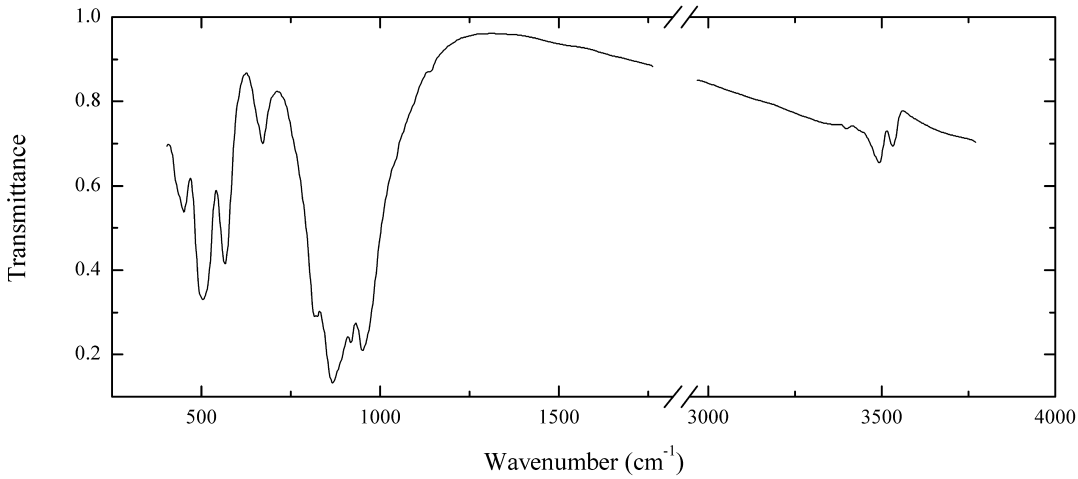


Locality: Kel'skoe plateau, South Ossetia.

Description: Pink transparent grains from the association with calcite and pectolite. The empirical formula is (electron microprobe, OH calculated) $(Ca_{2.98}Mn_{0.02})(Al_{1.91}Fe_{0.09})(SiO_4)_{1.92}(OH)_{4.32}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3575, 909s, 895sh, 833s, 645sh, 580sh, 515, 473s, 450sh, 390sh.

Sio116 Alleghanyite $Mn^{2+}{}_5(SiO_4)_2(OH)_2$

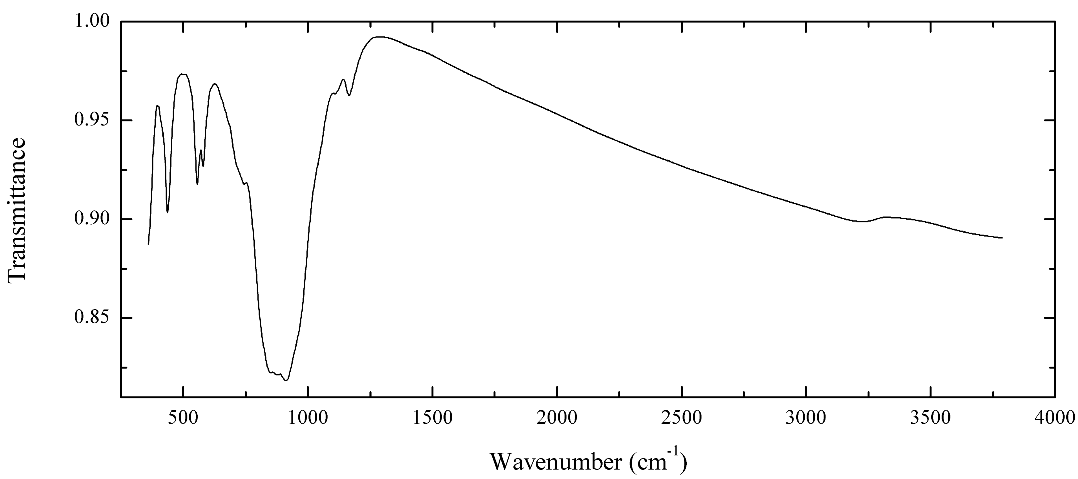


Locality: Razoare Mn deposit, Preluca massif, Eastern Carpathians, Romania.

Description: Red grains in rock, in the association with tephroite. Investigated by P. Hirtopanu. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3523, 3482, 3388w, 960sh, 950s, 919s, 890sh, 867s, 823s, 816s, 676, 655sh, 566, 503s, 449, 430sh.

Sio117 Stetindite $Ce(SiO_4)$

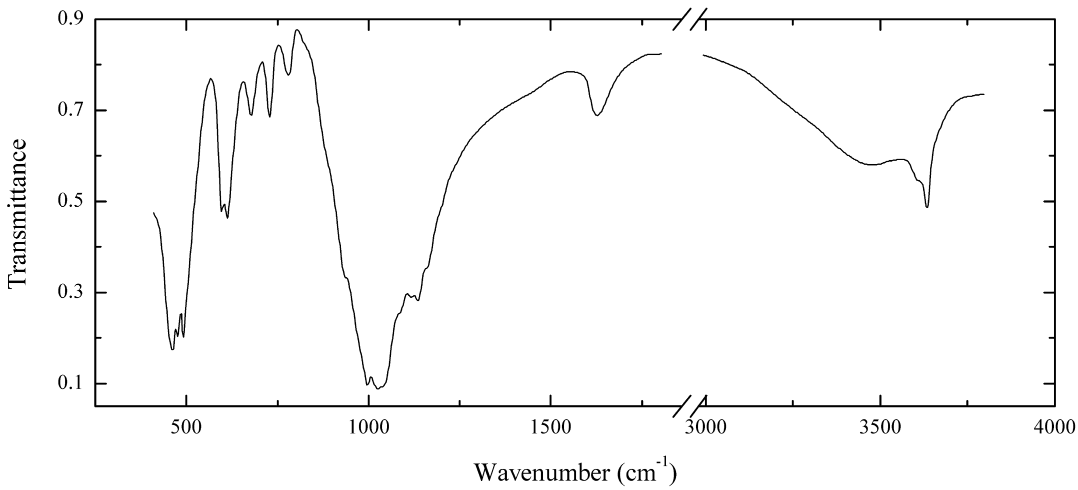


Locality: Stetind Mt., near Tysfjord, Nordland, Norway.

Description: Radial growth of acicular crystals from Y-rich fluorite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3220w, 1165, 1111w, 912s, 876s, 855s, 745, 730sh, 579, 556, 437.

Sil1 Reyerite $(Na,K)_2Ca_{14}Si_{22}Al_2O_{58}(OH)_8·6H_2O$

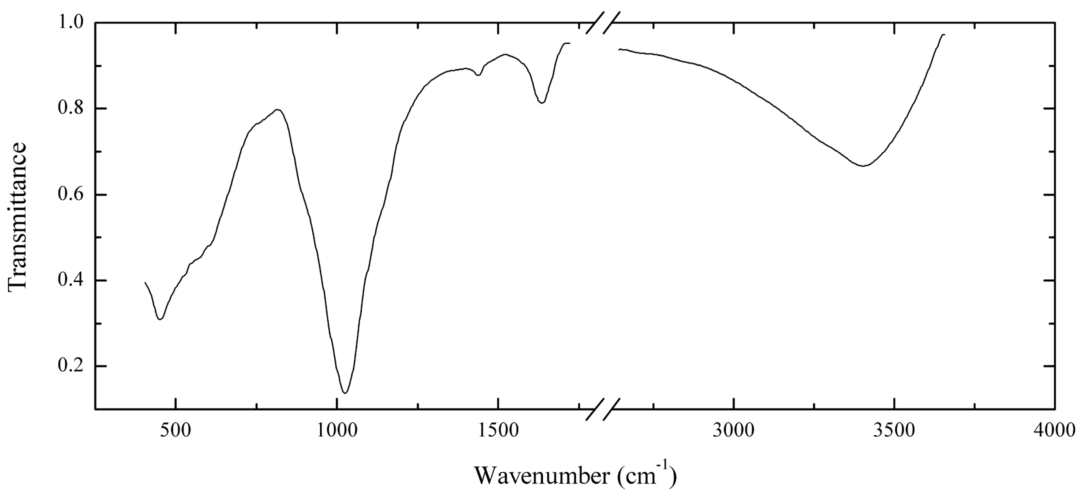


Locality: Skye island, Scotland, Great Britain.

Description: White, platy, from the association with analcime and calcite. Investigated by A.E. Zadov. Identified by the powder X-ray diffraction pattern, qualitative electron microprobe analysis and density.

Wavenumbers (cm^{-1}): 3644, 3620sh, 3480, 1635, 1160sh, 1148, 1120, 1085sh, 1042sh, 1028s, 999s, 975sh, 937, 785w, 727, 676, 609, 593, 490, 475, 456s.

Sil2 Neotocite $Mn^{2+}SiO_3·H_2O$?

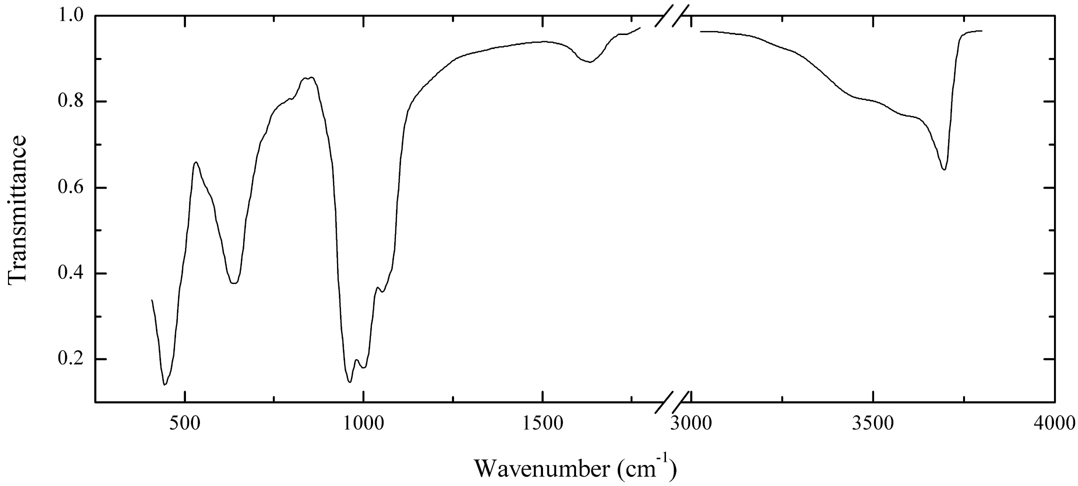


Locality: N'Chwaning-II mine, northwest of Kuruman, Kalahari Manganese Fields, Republic of South Africa.

Description: Brown, semitransparent, colloform. Botryoidal aggregate from the association with rhodochrosite. Amorphous.

Wavenumbers (cm^{-1}): 3385, 1630, 1435w, 1130sh, 1023s, 885sh, 600sh, 570sh, 450s.

Sil3 Chrysotile $Mg_3Si_2O_5(OH)_4$

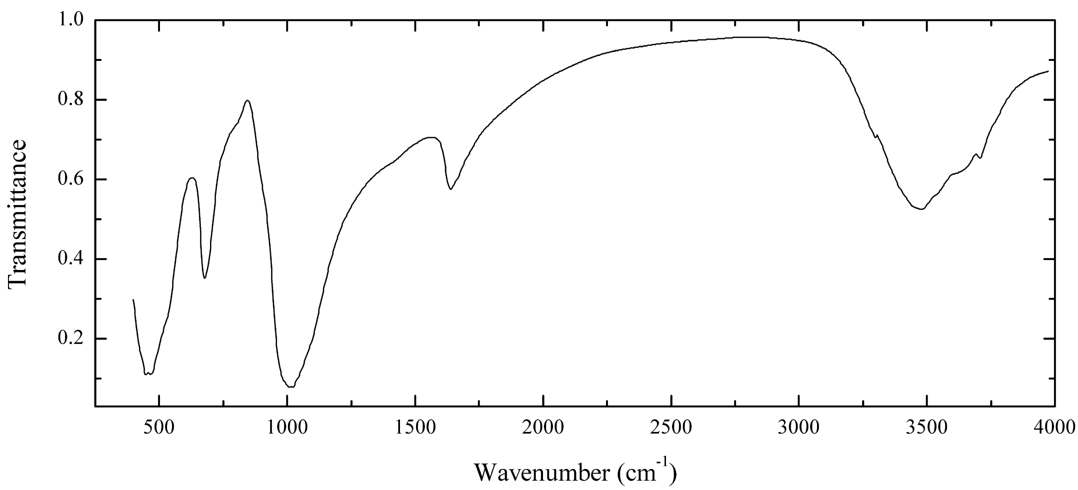


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Bluish-green, massive, from the association with magnetite. Contains adsorbed water.

Wavenumbers (cm^{-1}): 3687, 3580sh, 3470sh, 1630w, 1080sh, 1057, 1002s, 961s, 640, 629, 595sh, 565sh, 450sh, 439s.

Sil4 Stevensite $Ca_xMg_3[(Si,Al)_4O_{10}](OH)_2\cdot nH_2O$ ($x \approx 0.15$, $n \approx 2$)

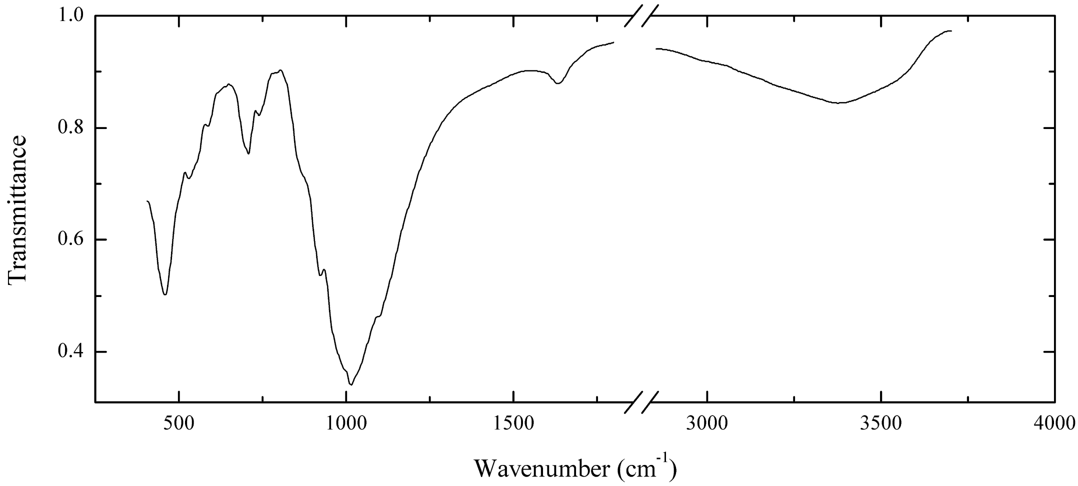


Locality: Mica mine, Kovdor, Kovdor massif, Kola peninsula, Murmansk region, Russia.

Description: Grey, massive, from the association with scolecite, calcite and aqualite. Identified by IR spectrum, chemical composition and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Ca_{0.12}Na_{0.03}K_{0.03})Mg_{2.95}(Si_{4.00}O_{10})(OH)_{1.9}\cdot nH_2O$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 12.63 (80), 4.53 (100), 2.55 (100), 2.281 (30), 1.523 (90), 1.311 (60).

Wavenumbers (cm^{-1}): 3450, 1638, 1023s, 669, 525sh, 470s, 453s.

Sil5 "Hydronaujakasite" $(Na,H)_6(Fe^{2+},Mn^{2+})Al_4Si_8O_{26}\cdot nH_2O$?

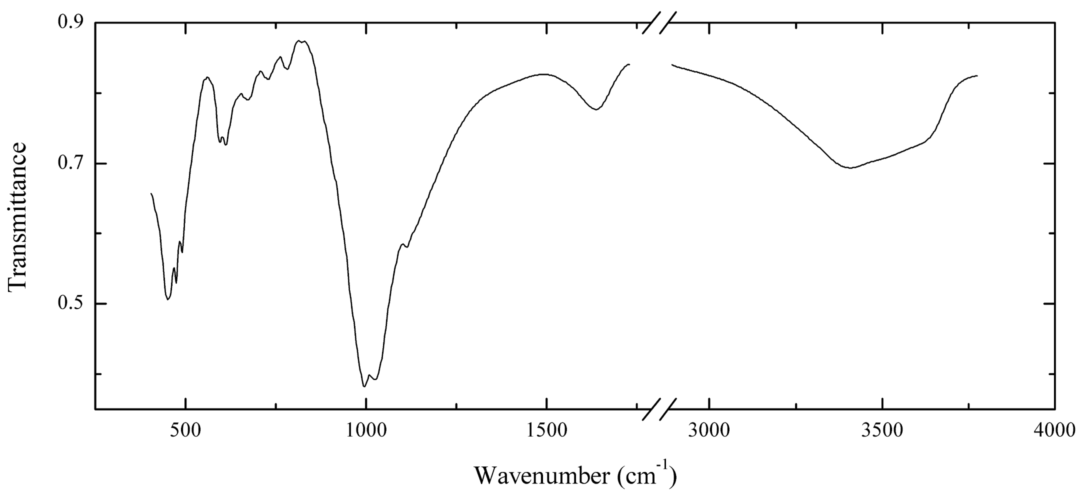


Locality: Lillelv, Kangerdluarssuq, Ilimaussaq, Greenland.

Description: Single-crystal grains with perfect mica-like cleavage from alkaline pegmatite. Product of natural hydration of naujakasite.

Wavenumbers (cm^{-1}): 3575sh, 3390, 3250sh, 1640, 1100sh, 1035sh, 1017s, 1000sh, 917s, 860sh, 741, 707, 690sh, 589, 555sh, 533, 452s.

Sil6 Gyrolite $(NaCa_2)Ca_{14}(Si_{23}Al)O_{60}(OH)_8\cdot nH_2O$ ($n \approx 14$–15)

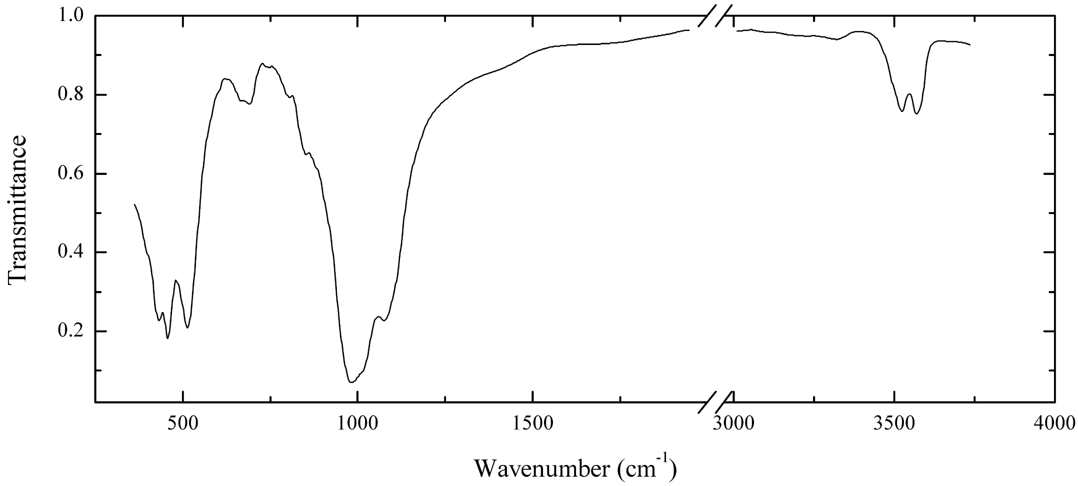


Locality: Mull island, Scotland, Great Britain.

Description: Colourless, transparent crystal. Investigated by A.E. Zadov. Identified by the powder X-ray diffraction pattern. Optically negative, $\beta = 1.551(2)$.

Wavenumbers (cm^{-1}): 3600sh, 3400, 1636, 1120, 1045sh, 1028s, 1000s, 785w, 729w, 671, 608, 594, 490, 474, 448s.

Sil7 "Chromphengite" $K(Cr,Mg,Fe)_2[Al_xSi_{4-x}O_{10}](OH)_2$ ($x > 0.5$)

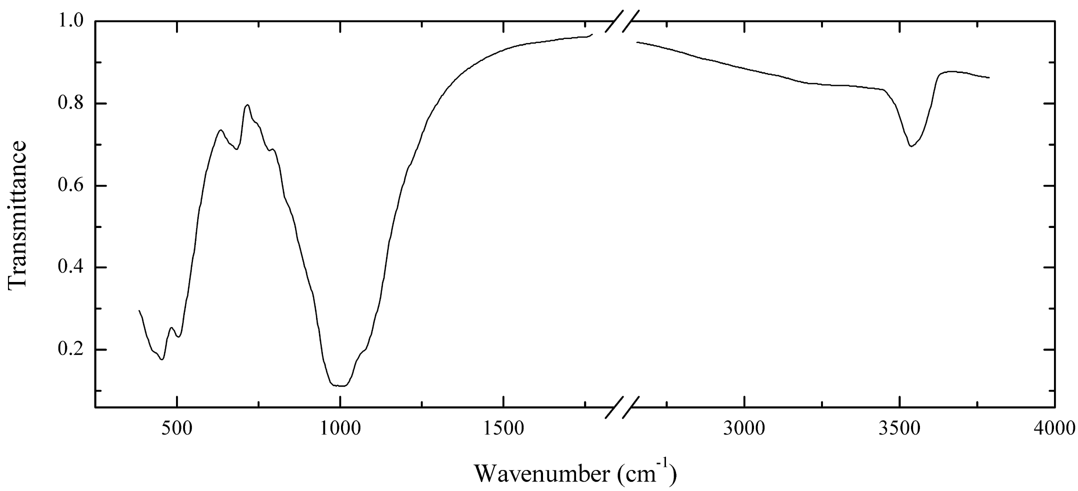


Locality: U deposit Srednyaya Padma, Zaonezhskii peninsula, Onega sea, Karelia, Russia.

Description: Green scaly, from the association with dolomite and roscoelite. Intermediate member of the series chromphyllite-chromceladonite. The empirical formula is (electron microprobe) $(K_{0.94}Na_{0.01})(Cr_{0.75}Mg_{0.69}Fe_{0.31}V_{0.18}Ti_{0.02}Li_x)$ $(Si_{3.44}Al_{0.56}O_{10})(OH)_{1.9}F_{0.1}$. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3563, 3517, 3315w, 1078s, 1010sh, 989s, 880sh, 855, 800, 775w, 681, 670sh, 508s, 453s, 428s.

Sil8 "Vanadiophengite" $K(V,Mg,Al,Fe)_2[Al_xSi_{4-x}O_{10}](OH)_2$ ($x > 0.5$)

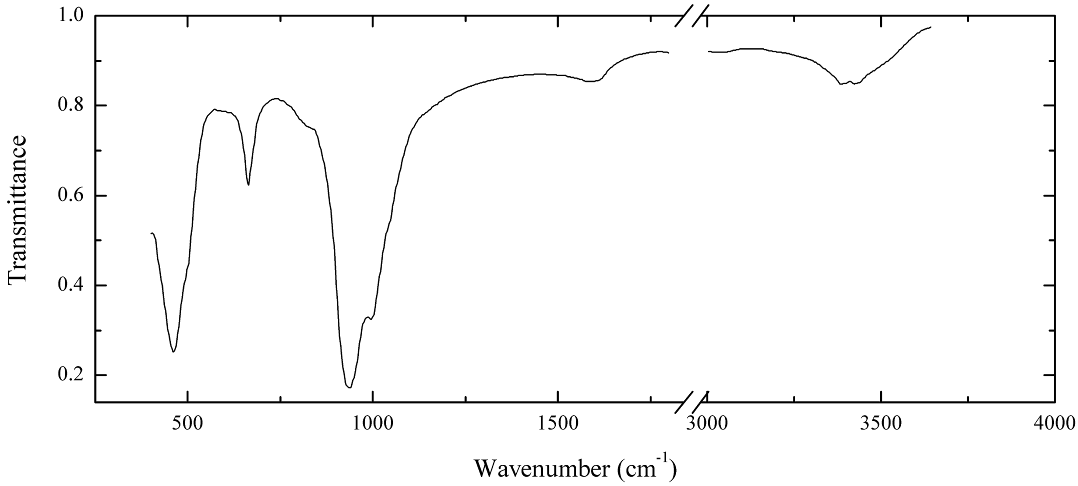


Locality: U deposit Srednyaya Padma, Zaonezhskii peninsula, Onega sea, Karelia, Russia.

Description: Brownish-grey scaly, from the association with dolomite and chromceladonite. The empirical formula is (electron microprobe) $(K_{0.90}Na_{0.02})(V_{0.80}Mg_{0.79}Al_{0.26}Fe_{0.22}Cr_{0.05}Ti_{0.01}Zn_{0.01})$ $(Si_{3.42}Al_{0.58}O_{10})(OH)_{1.8}F_{0.2}$. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3550sh, 3518, 1070sh, 1017s, 998s, 840sh, 784w, 740sh, 682w, 665sh, 501s, 450s, 425sh.

Sil9 Kinoshitalite $BaMg_3(Si_2Al_2O_{10})(OH)_2$

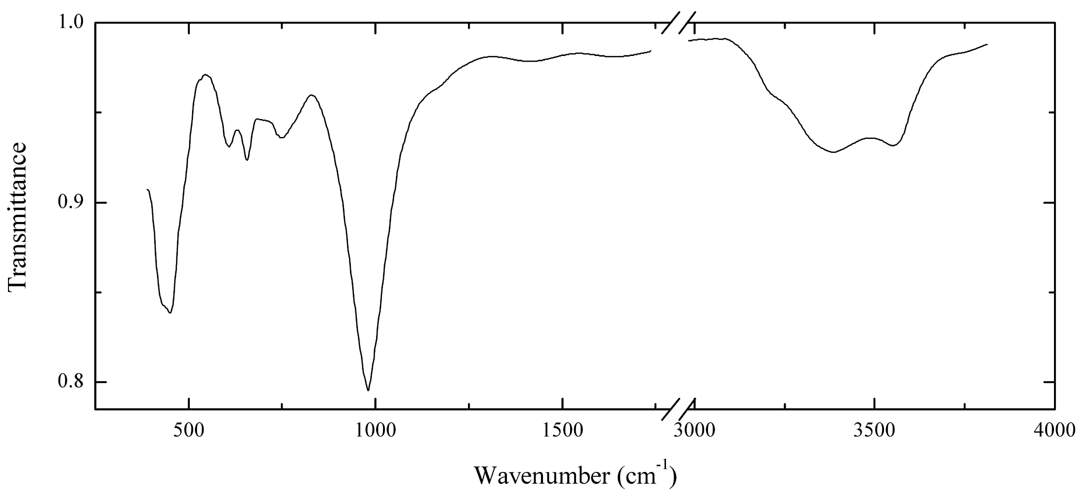


Locality: Rascoala Valley, Sebes Mts., S. Carpathians, Romania.

Description: Brownish scaly, from the association with alleghanyite. Investigated by P. Hirtopanu. The empirical formula is (electron microprobe) $(Ba_{0.93}K_{0.07})(Mg_{1.76}Fe_{0.92}Mn_{0.32})[(Si_{2.13}Al_{1.82}Fe_{0.05})O_{10}](OH)_2$. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3500sh, 3430, 3390, 1600w, 996s, 937s, 830sh, 661, 490sh, 458s.

Sil10 Chamosite $(Fe,Al,Mg)_6(Si,Al)_4O_{10}(OH)_8$

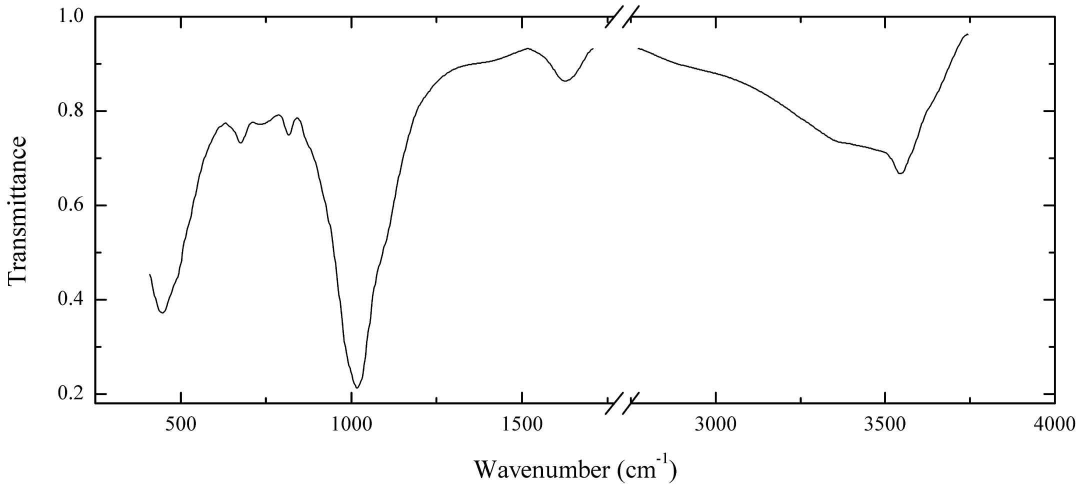


Locality: Döbschütz, near Lausitz, Saxony, Germany.

Description: Dark green plates with perfect cleavage. The empirical formula is (electron microprobe) $(Fe_{4.18}Al_{1.46}Mg_{0.36})(Si_{2.91}Al_{1.09})O_{10}(OH)_8$.

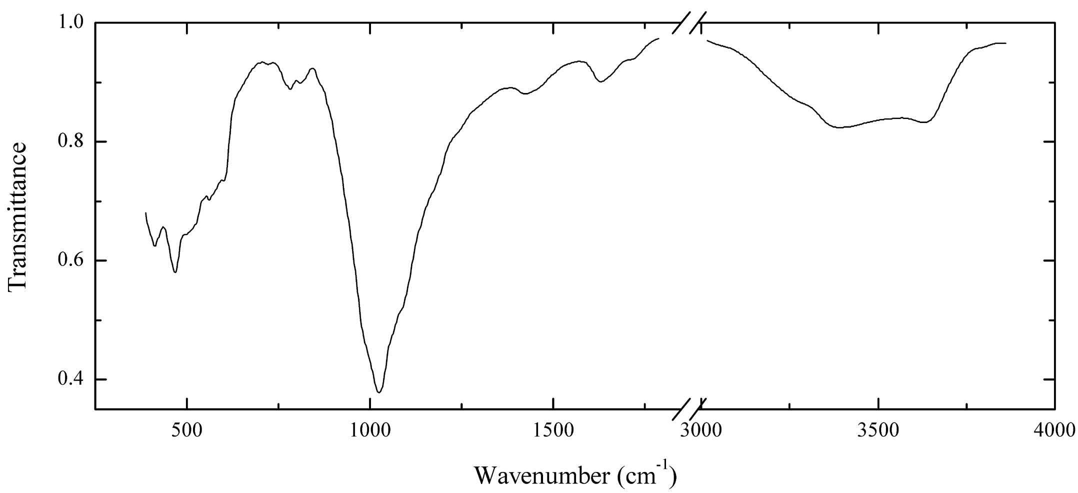
Wavenumbers (cm^{-1}): 3540, 3360, 3220sh, 981s, 746, 659, 610, 446s, 420sh.

Sil11 Tuperssuatsiaite $NaFe^{3+}{}_3Si_8O_{20}(OH)_2 \cdot 4H_2O$



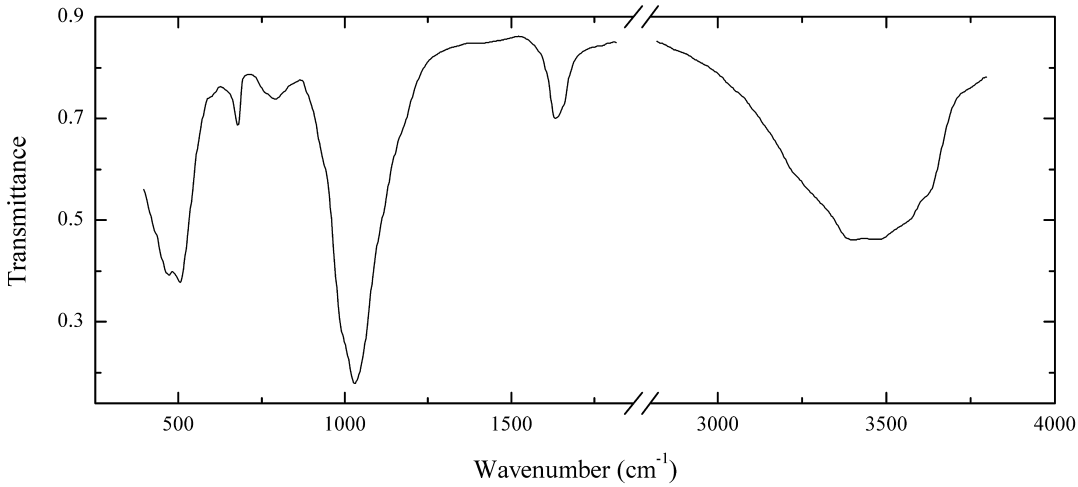
Locality: Ariskop Quarry, Aris, near Windhoek, Windhoek district, Khomas Region, Namibia.
Description: Greenish-brown, fibrous, from the association with aegirine, microcline and zircon. The empirical formula is (electron microprobe) $(Na_{0.62}K_{0.34}Ca_{0.05})(Fe_{2.64}Mg_{0.25}Zn_{0.19})(Si_{5.70}Al_{1.93}Fe_{0.37}O_{20})(H_2O,OH)_n$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3545, 3430sh, 1635, 1415w, 1016s, 815, 733w, 673, 490sh, 445s.

Sil13 Swinefordite $(Ca,Na)_{0.3}(Li,Mg)_2[(Si,Al)_4O_{10}](OH,F)_2 \cdot 2H_2O$



Locality: Foote Mineral Company mine, King’s Mountain, North Carolina, USA (type locality).
Description: Grey scaly, from the association with eakerite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3630, 3385, 3290sh, 1720w, 1660sh, 1632, 1455, 1423, 1090sh, 1030s, 1000sh, 814, 785, 602, 580sh, 567, 510sh, 496, 467s, 411.

Sil14 Chrysocolla $Cu_2H_2Si_2O_5(OH)_4{\cdot}nH_2O$

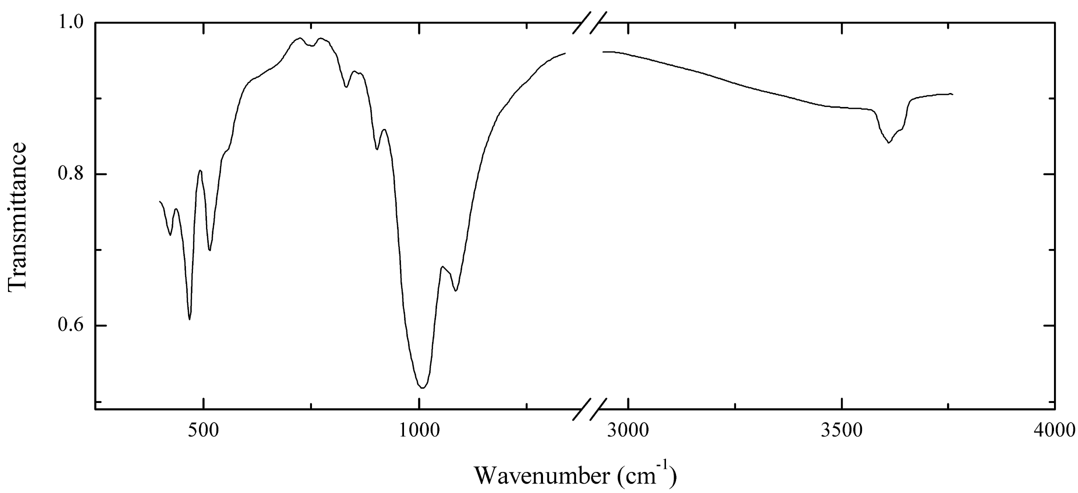


Locality: Mindouli, Mindouli district, Pool department, Republic of Congo-Brazzaville.

Description: Greenish-blue colloform crust from the association with malachite and azurite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3600sh, 3460s, 3530sh, 3395s, 3250sh, 1665sh, 1642, 1025s, 1000sh, 788w, 765sh, 676, 500s, 470s.

Sil15 Aluminoceladonite $K(AlMg\square)(Si_4O_{10})(OH)_2$

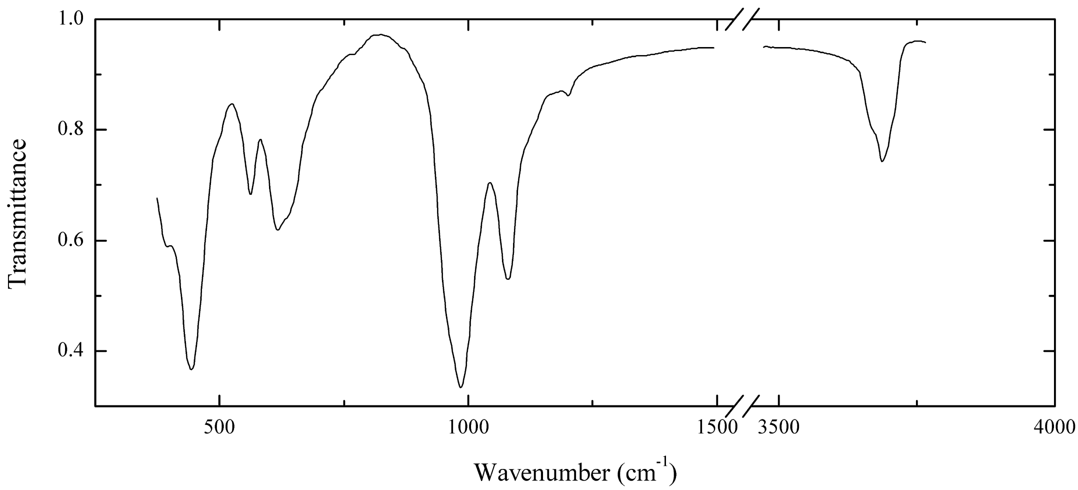


Locality: Outcrop near Martiniana Po village, Dora-Maira massif, Piedmont, Italy.

Description: Colourless plates with pearly lustre in pyrope, in the association with ellenbergerite, magnesio staurolite and rutile. Intermediate member of the solid-solution series aluminoceladonite–muscovite. The empirical formula is (electron microprobe) $K_{0.93}Na_{0.02}(Al_{1.41}Mg_{0.59})$ $(Si_{3.60}Al_{0.40}O_{10})$ $(OH)_2$.

Wavenumbers (cm^{-1}): 3600, 1090s, 1009s, 900, 834, 750w, 550sh, 514, 470s, 422.

Sil17 Antigorite $Mg_3(Si_2O_5)(OH)_4$

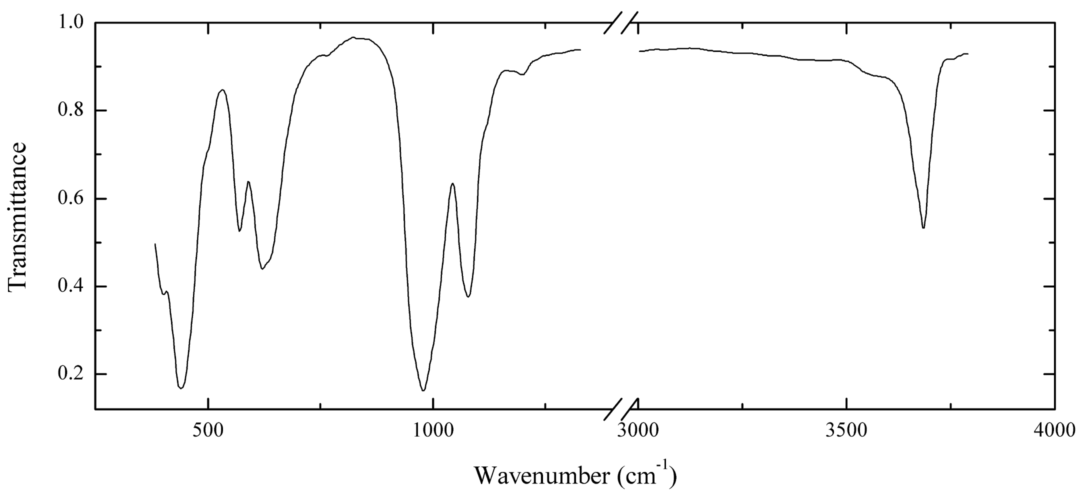


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.

Description: Greenish-grey clusters of elongated plates from the association with chrysotile and magnesite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Mg_{2.91}Fe_{0.04}Ni_{0.02})(Si_{2.00}O_5)(OH)_4$

Wavenumbers (cm^{-1}): 3690sh, 3673, 3660sh, 1204w, 1083s, 987s, 970sh, 635sh, 619, 563, 447s, 401.

Sil18 Antigorite $Mg_3(Si_2O_5)(OH)_4$

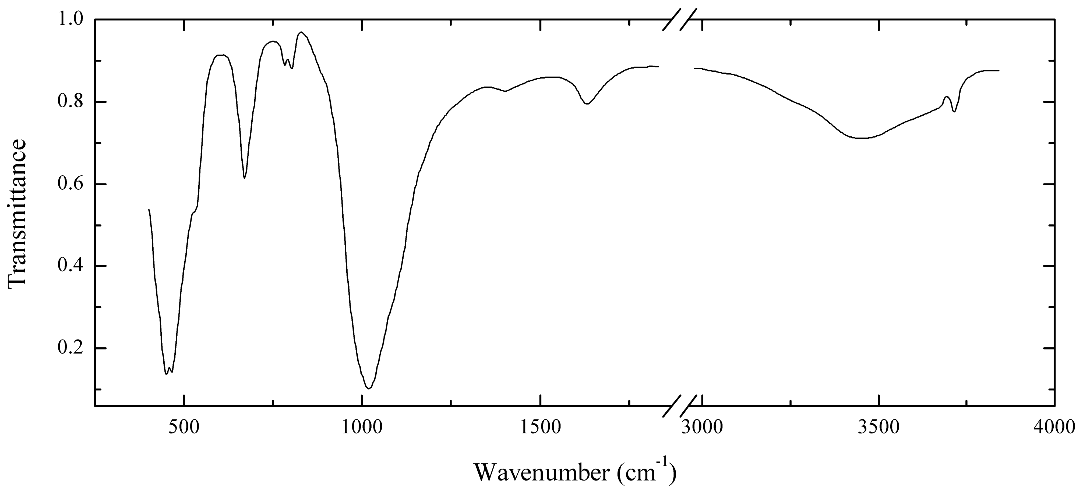


Locality: Saranovskoe chromium deposit, Perm region, Middle Urals, Russia.

Description: Greenish-grey thinly laminated aggregate from the association with brucite and magnesite. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3682, 3660sh, 3570sh, 1205w, 1081s, 981s, 640sh, 624, 571, 438s, 405s.

Sil19 Aliettite Regular 1:1 interstratification of talc and saponite

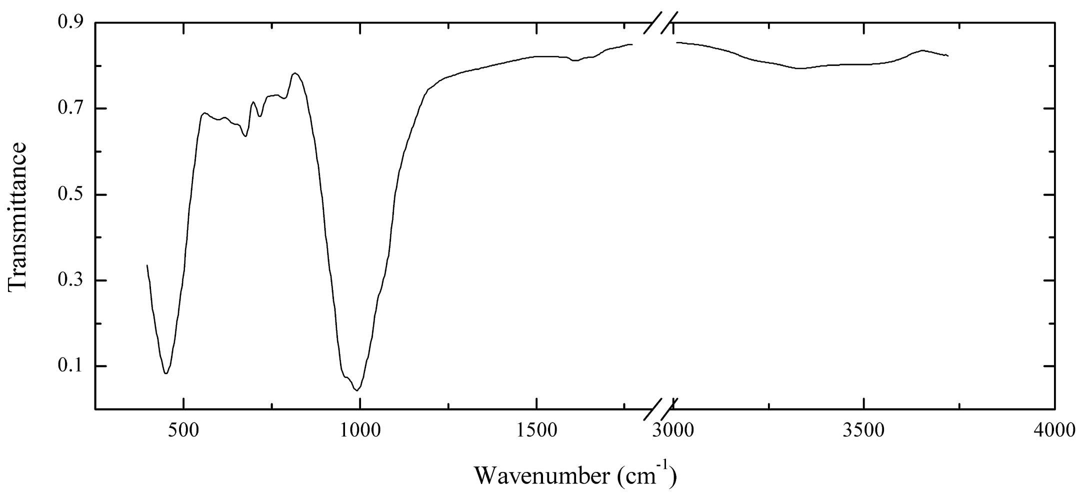


Locality: Ingichke deposit, 90 km W of Samarkand, Uzbekistan.

Description: Beige pseudomorph after wollastonite crystals. Identified by the powder X-ray diffraction pattern. The empirical formula is (wet chemical analysis) $(Ca_{0.13}Na_{0.09}K_{0.01})(Mg_{5.33}Fe_{0.35}Mn_{0.17})Si_{7.98}O_{20}(OH)_4{\cdot}nH_2O$

Wavenumbers (cm^{-1}): 3675, 3638sh, 3577sh, 3550sh, 3425, 1628, 1400w, 1080sh, 1055sh, 1017s, 800, 780, 671, 537, 470s, 455s, 430sh.

Sil20 Annite $KFe^{2+}{}_3(Si_3AlO_{10})(OH)_2$

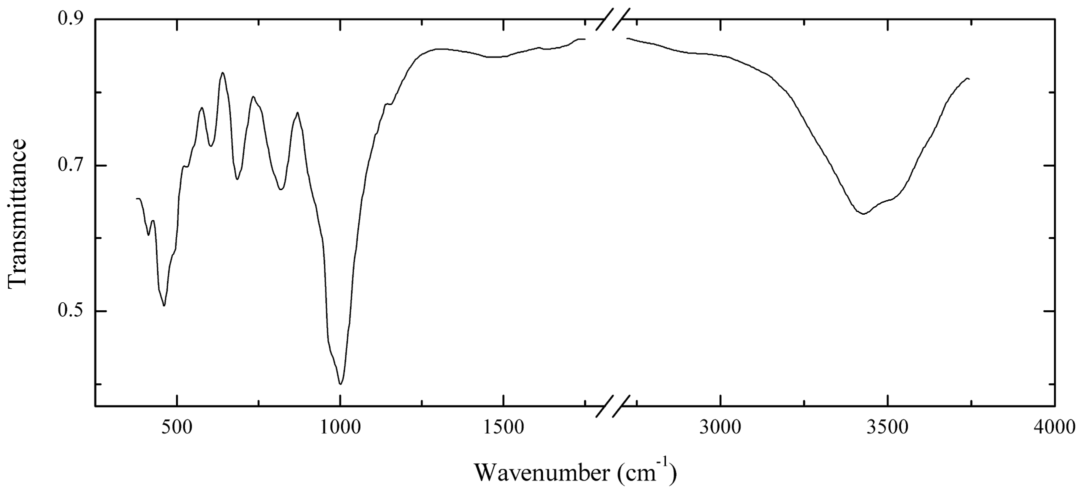


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Plates up to several cm in alkaline pegmatite. The empirical formula is (electron microprobe) $(K_{0.95}Na_{0.09})(Fe_{1.51}Mg_{1.27}Ti_{0.10}Mn_{0.08})(Si_{3.13}Al_{0.87}O_{10})(OH)_2$.

Wavenumbers (cm^{-1}): 3500, 3320, 3230sh, 1650w, 1608w, 1070sh, 991s, 959s, 784, 716, 677, 650sh, 597, 470sh, 446s.

Sil21 Amesite $(Mg,Al)_3[(Si,Al)_2O_5](OH)_4$

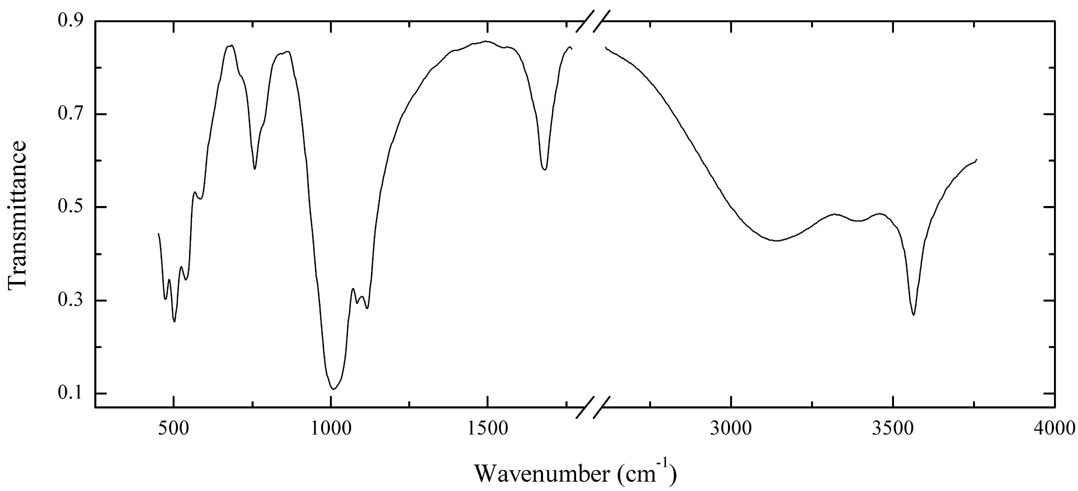


Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light green trigonal platy crystals and spherulites growing on natrolite crystals. Identified by the powder X-ray diffraction pattern and qualitative electron microprobe analysis. A disordered variety.

Wavenumbers (cm^{-1}): 3500, 3420, 1150sh, 1004s, 975sh, 925sh, 821, 800sh, 685, 605, 524, 485sh, 457s, 447sh, 397.

Sil22 Apophyllite-(KOH) $KCa_4(Si_8O_{20})(OH,F)\cdot 8H_2O$

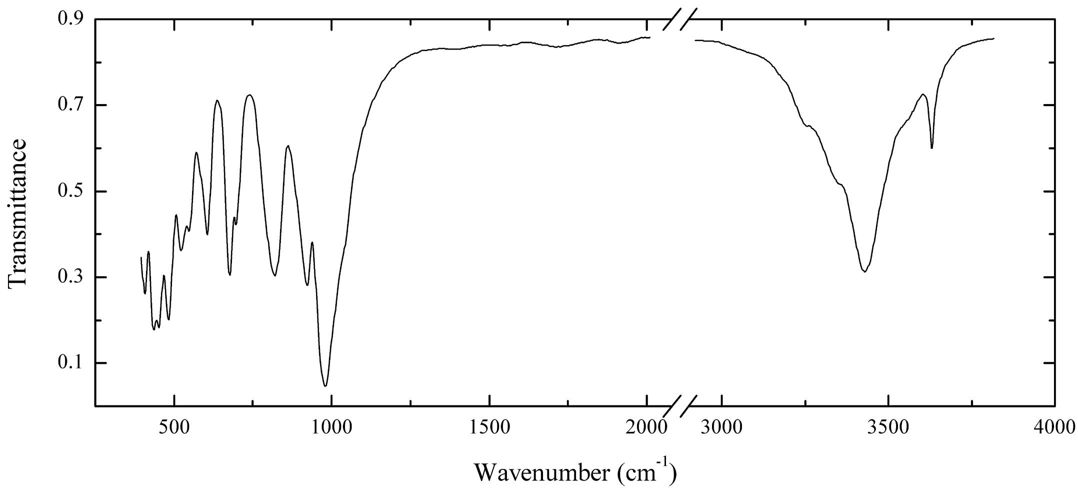


Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White spherulites from the association with zeolites. Identified by IR spectrum and semiquantitative electron microprobe analysis. Al-rich variety.

Wavenumbers (cm^{-1}): 3560s, 3390, 3135, 1686, 1116s, 1075s, 1010s, 780sh, 758, 710sh, 587, 539s, 502s, 473s.

Sil23 Amesite $Mg_2Al(SiAlO_5)(OH)_4$

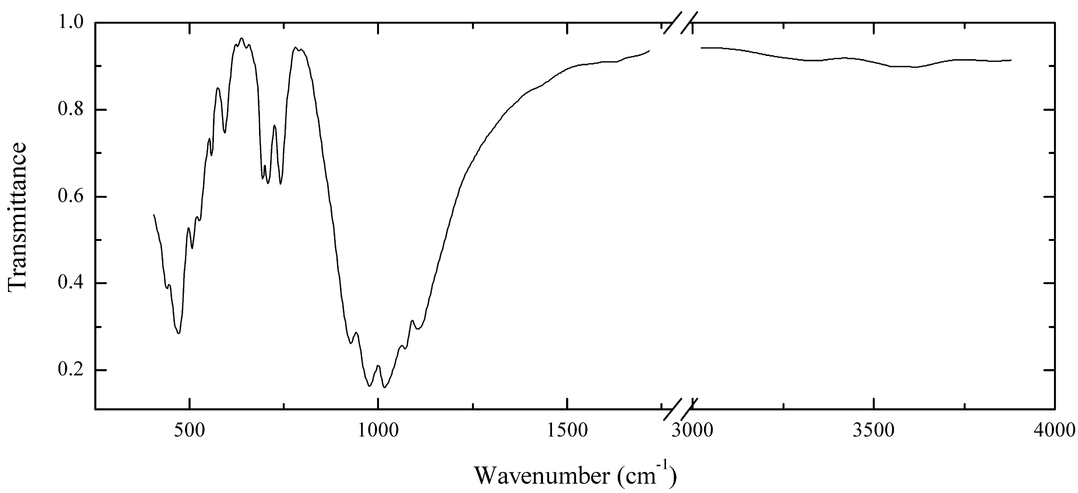


Locality: Saranovskoye chromium deposit, Middle Urals, Russia.

Description: Violet prismatic crystals with triangle cross section in a late vein crossing chromitite. Associated minerals are calcite, perovskite and Cr-bearing titanite. A cation-ordered variety. The empirical formula is (electron microprobe) $Mg_{1.98}Al_{0.93}Cr_{0.05}Fe_{0.02}Ti_{0.01}(Si_{0.99}Al_{1.01}O_{10})(OH)_4$.

Wavenumbers (cm^{-1}): 3620, 3420, 3360sh, 3260sh, 1030sh, 985s, 928, 825, 699, 679, 609, 549, 524, 484s, 454s, 435s, 410.

Sil24 Naujakasite $Na_6Fe^{2+}Al_4Si_8O_{26}$

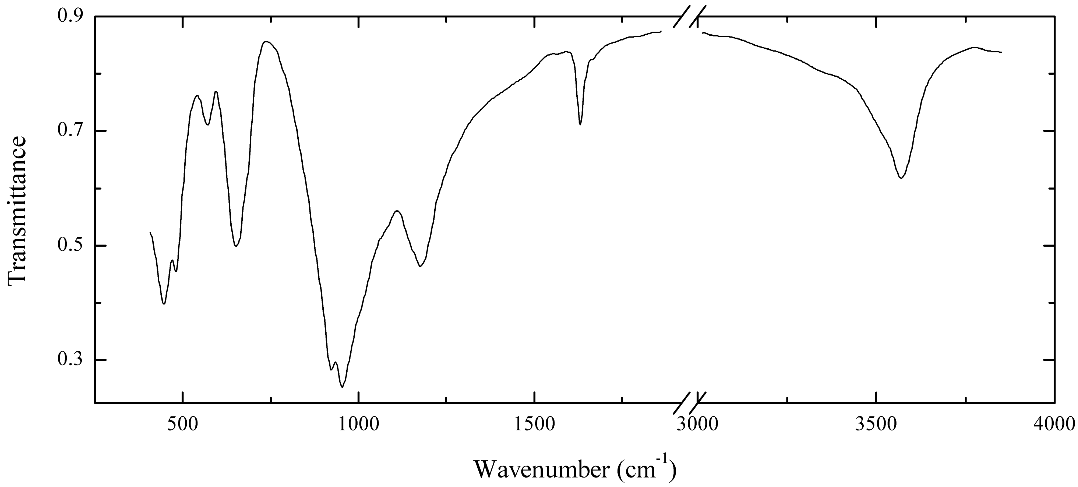


Locality: Kvanefjeld plateau, Ilimaussaq complex, Greenland.

Description: Rhombus-shaped plate (1 × 2 mm) in naujakasite lujavrite, in the association with villiaumite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3620w, 3550w, 3330w, 1632w, 1112s, 1073s, 1050sh, 1021s, 980s, 930s, 741, 708, 695, 648w, 625w, 593, 558, 524, 504, 469s, 460sh, 437s.

Sil25 Cymrite $BaAl_2Si_2O_8 \cdot H_2O$

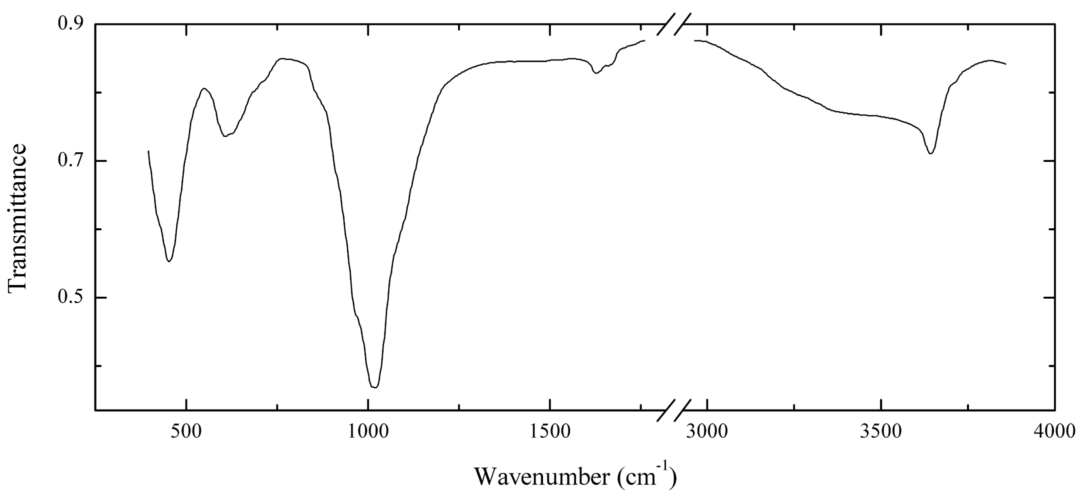


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Yellowish spherulites to 3 mm in diameter in hydrothermal vein crossing melilite rock. Associated minerals are calcite and Sr-bearing thomsonite-Ca. Identified by the powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Ba_{1.01}Al_{1.99}Si_{2.00}O_8 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3552, 1626, 1178, 954s, 923s, 650, 569w, 476, 443.

Sil26 Kellyite $(Mn,Mg,Al)_3[(Si,Al)_2O_5](OH)_4$

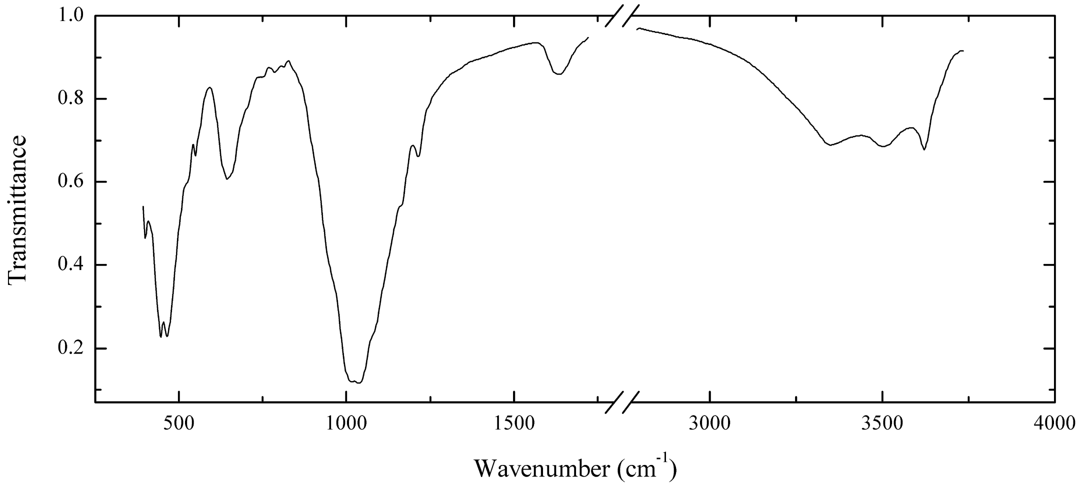


Locality: Gambatesa mine, near Reppia, Val Graveglia, eastern Liguria, Italy.

Description: Orange-brown veinlet in rock. The empirical formula is (electron microprobe) $(Mn_{1.20}Mg_{0.91}Al_{0.76}Fe_{0.06})(Si_{1.44}Al_{0.56}O_5)(OH,O)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3625, 3420sh, 1660w, 1630w, 1105sh, 1080sh, 1027s, 1015s, 975sh, 915sh, 870sh, 710sh, 650sh, 619, 456s, 430sh.

Sil27 Bannisterite $(K,Na,Ca)(Mn,Fe,Mg)_{10}(Si,Al)_{16}O_{38}(OH)_8 \cdot 4H_2O$

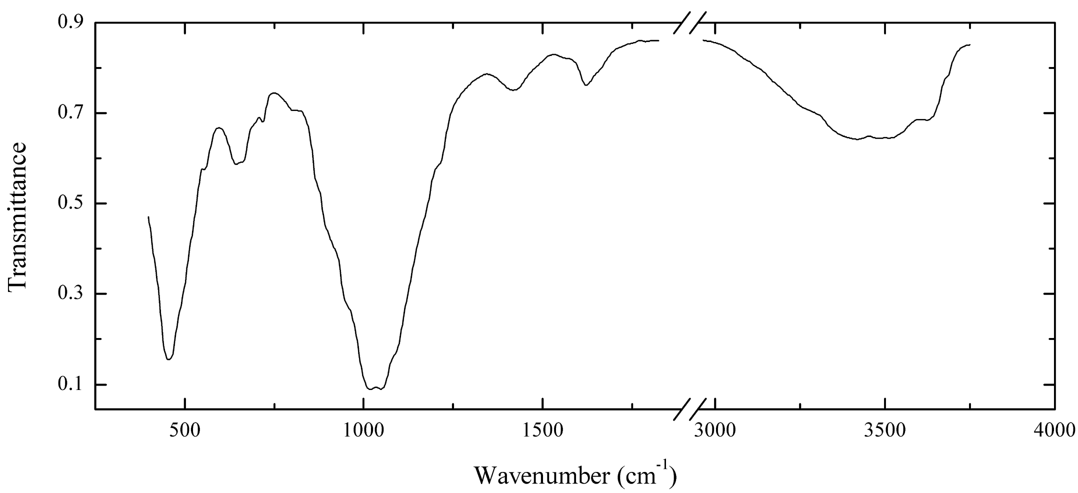


Locality: Broken Hill, New South Wales, Australia.

Description: Dark brown brittle plates in the association with rhodonite, rhodochrosite and pyrosmalite. Mn:Fe ≈ 60:40 (in atomic proportions).

Wavenumbers (cm^{-1}): 3630, 3510, 3355, 1635, 1217, 1165sh, 1080sh, 1041s, 1014s, 960sh, 814w, 786w, 740sh, 670sh, 644, 548, 565sh, 461s, 446s, 396.

Sil28 Bannisterite $(K,Na,Ca)(Mn,Fe,Mg)_{10}(Si,Al)_{16}O_{38}(OH)_8 \cdot 4H_2O$

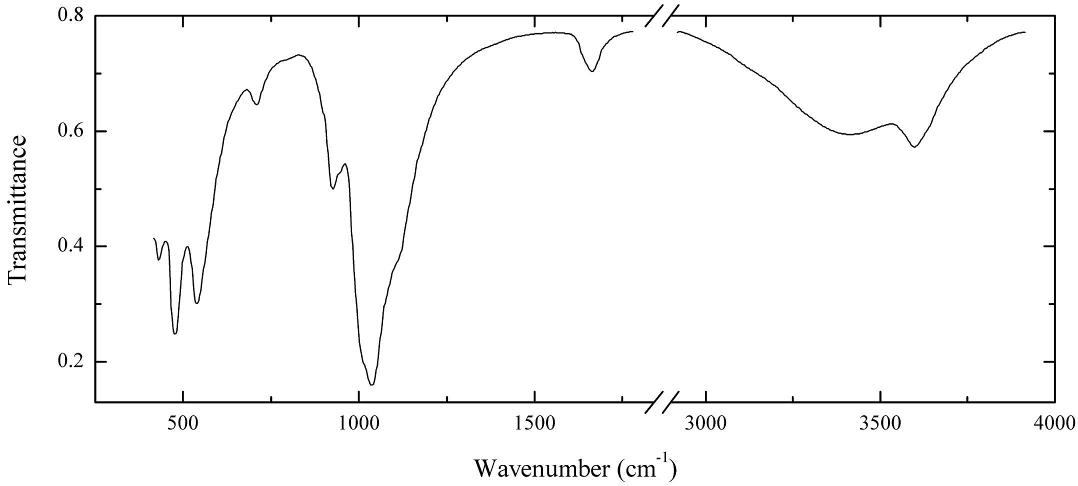


Locality: Kurganovskoe Mn deposit, Middle Urals, Russia.

Description: Dark brown brittle plates to 30 mm in veinlets crossing rhodochrosite, from the association with quartz. Investigated by A.I. Brusnitsyn. A Ca-rich variety. The empirical formula is (electron microprobe) $(Ca_{0.4}Na_{0.1}K_{0.1})(Mn_{6.0}Fe_{3.4}Al_{0.3}Mg_{0.3})_{10}(Si_{14.4}Al_{1.6})O_{38}(OH)_8 \cdot nH_2O$. Contains admixture of rhodochrosite (the band at 1,420 cm^{-1}). H_2O content is 7.95 wt.%.

Wavenumbers (cm^{-1}): 3660w, 3610, 3470, 3405, 3250sh, 1655sh, 1620, 1420, 1210sh, 1170sh, 1090sh, 1050s, 1015s, 955sh, 900sh, 800w, 716w, 661, 645, 557, 485sh, 457s.

Sil29 Beidellite $(Na,Ca_{0.5},K)_xAl_2[(Si,Al)_4O_{10}](OH)_2 \cdot nH_2O$ ($x \approx 0.3$)

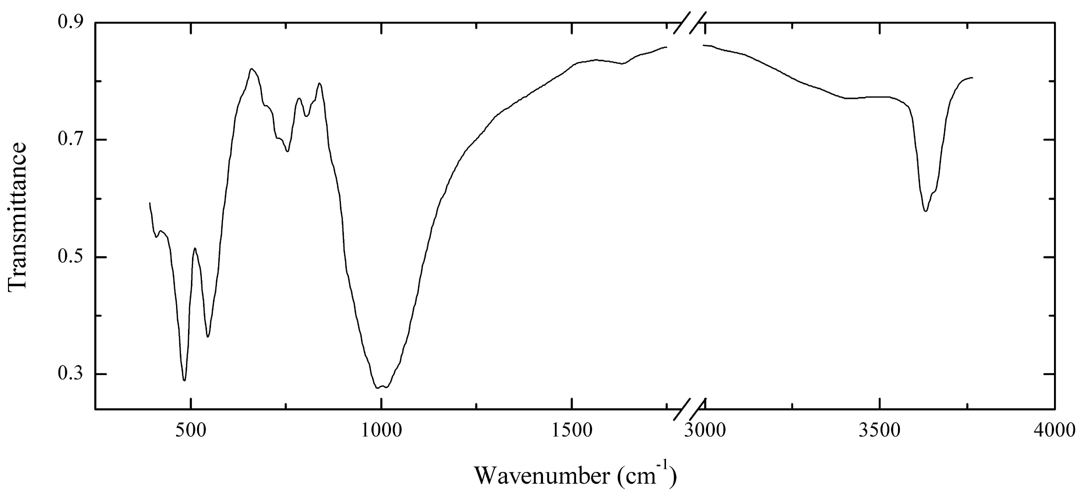


Locality: Akmaya W deposit, Central Kazakhstan.

Description: Light grey, massive. Identified by V.I. Stepanov.

Wavenumbers (cm^{-1}): 3590, 3415, 1640w, 1110sh, 1033s, 1010sh, 935sh, 912, 697w, 534s, 473s, 423s.

Sil30 Brammalite $Na_{1-x}Al_2[(Si,Al)_4O_{10}](OH)_2$

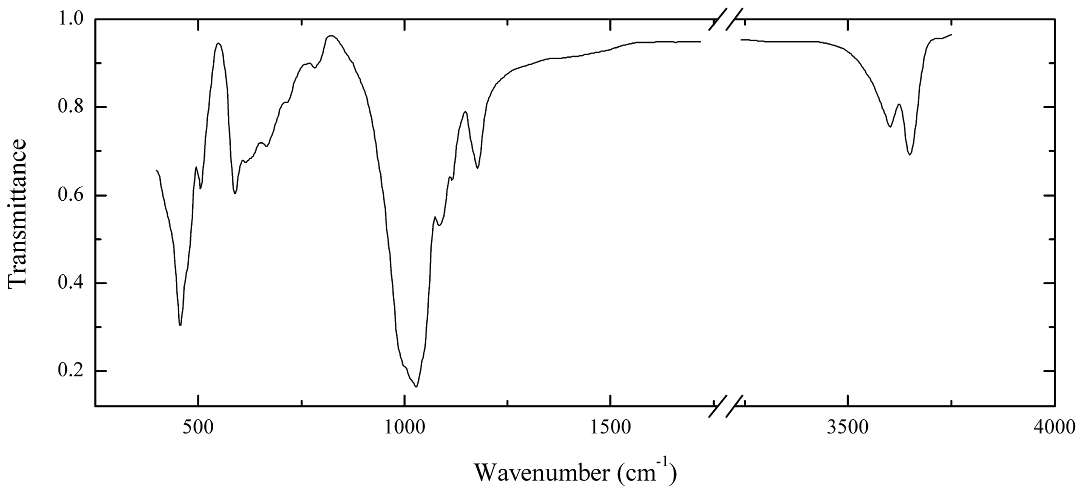


Locality: Vostok deposit, Shan-Tube, Kokchetav region, Kazakhstan.

Description: White fibrous aggregate (a vein in argillite). The empirical formula is (electron microprobe) $(Na_{0.56}K_{0.19}Ca_{0.01})(Al_{1.93}Fe_{0.05}Mg_{0.02})(Si_{3.19}Al_{0.81}O_{10})(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3665sh, 3640, 3420w, 1640w, 1065sh, 1040sh, 1010s, 992s, 960sh, 830sh, 804w, 755, 729, 695w, 540s, 479s, 403.

Sil31 Bementite $Mn^{2+}{}_7(Si_6O_{15})(OH)_8$

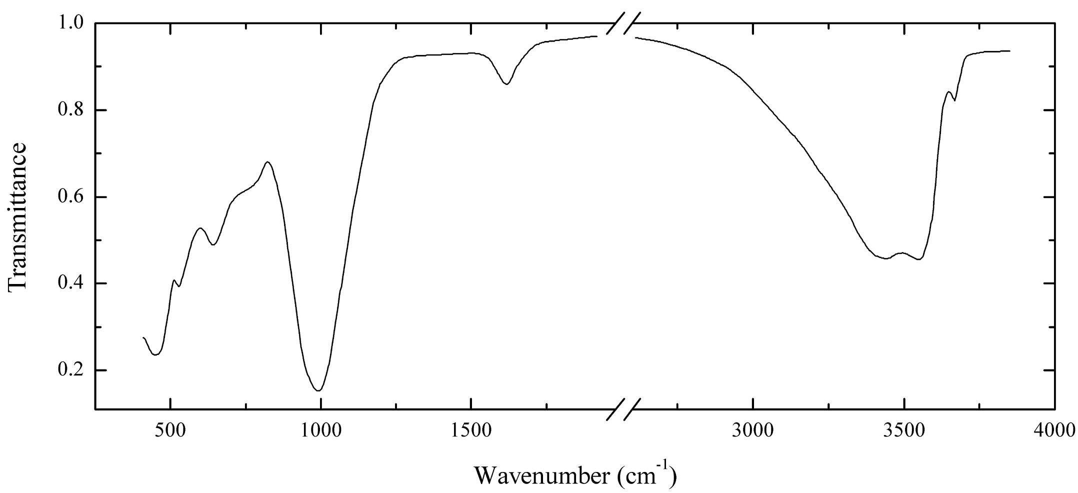


Locality: Parnuk (Parnok) Mt., Subpolar Urals, Russia.

Description: Brownish-yellow parallel-columnar aggregate (a vein in Mn-bearing calcite). Identified by powder X-ray diffraction pattern. The chemical composition is (electron microprobe, by the data of A.I. Brusnitsyn, wt.%) MnO 46.54, FeO 2.69, MgO 1.97, Al_2O_3 0.79, SiO_2 39.27. H_2O content is 7.87 %; total 99.14%.

Wavenumbers (cm^{-1}): 3630, 3585, 1176, 1160sh, 1116, 1087, 1045sh, 1028s, 1020sh, 997s, 980sh, 781w, 715w, 664, 630sh, 616, 590, 504, 470sh, 453s, 415sh.

Sil32 Berthierine $(Fe,Al)_3[(Si,Al)_2O_5](OH)_4$

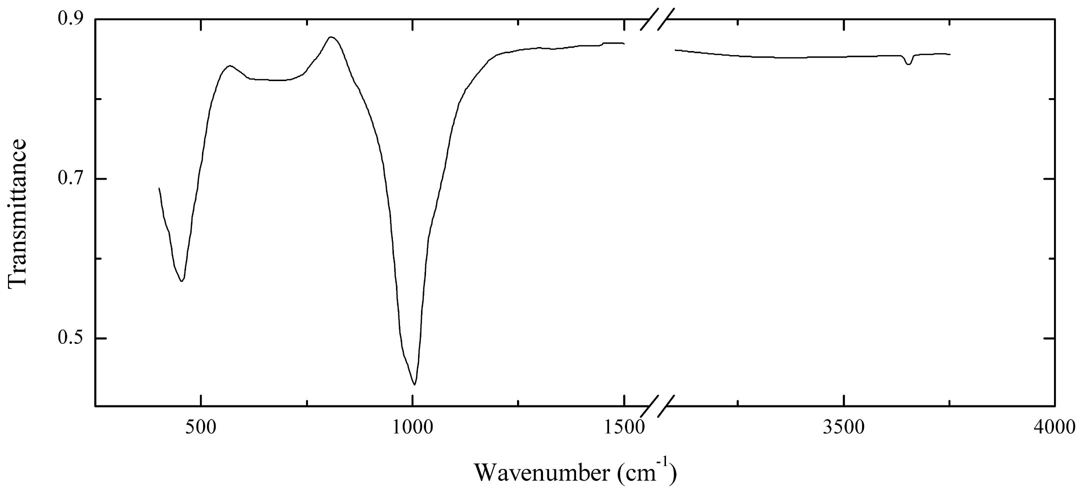


Locality: Mikhailovskiy quarry, near Zheleznogorsk, Kursk Magnetic Anomaly, Russia.

Description: Dark green colloform concretion. Associated minerals: quartz, pyrite and goethite. Identified by powder X-ray diffraction pattern. Contains admixtures of chamosite and smectite. The empirical formula is (electron microprobe) $(Fe_{2.2}Al_{0.6}Mg_{0.1})$ $(Si_{1.6}Al_{0.4}O_5)(OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3680w, 3550, 3440, 1620w, 995s, 750sh, 650, 528, 454s.

Sil33 Annite $KFe^{2+}_3(Si_3AlO_{10})(OH)_2$

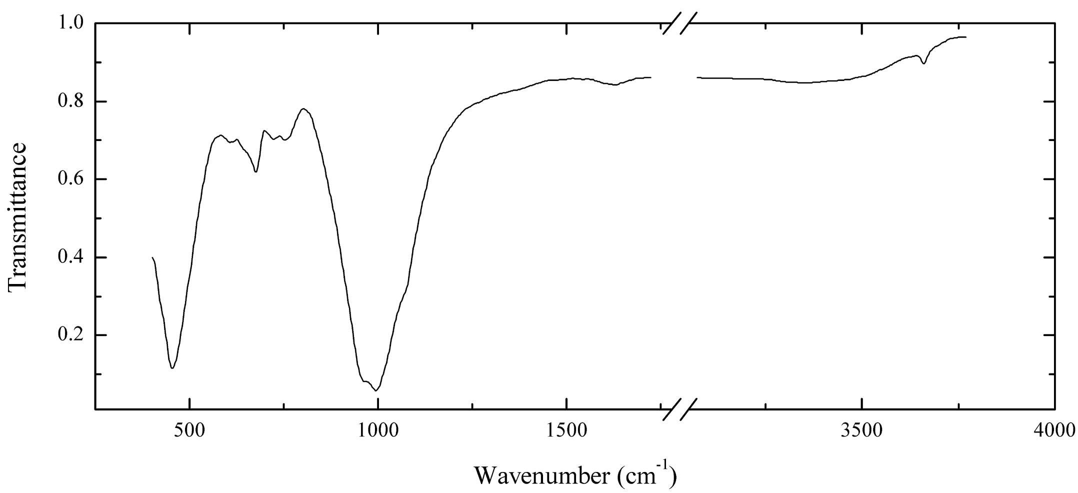


Locality: An outcrop near the headstream of Yuksporyok river, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Dark brown plates in trachyte vein. Identified by electron microdiffraction patterns. OH-deficient variety. The empirical formula is (calculated on the basis of electron microprobe and wet chemical analyses, by the data of B.E. Borutskiy) $(K_{0.98}Na_{0.07})(Fe^{2+}_{1.42}Mg_{0.46}Ti_{0.41}Al_{0.30}Mn_{0.11}Fe^{3+}_{0.11})$ $(Si_{2.73}Al_{1.27}O_{10})[(OH)_{0.96}O_{0.83}F_{0.21}]$.

Wavenumbers (cm^{-1}): 3655w, 1006s, 980sh, 755sh, 706, 620w, 455s, 420sh.

Sil34 Fluorannite $KFe^{2+}_3(Si_3AlO_{10})F_2$

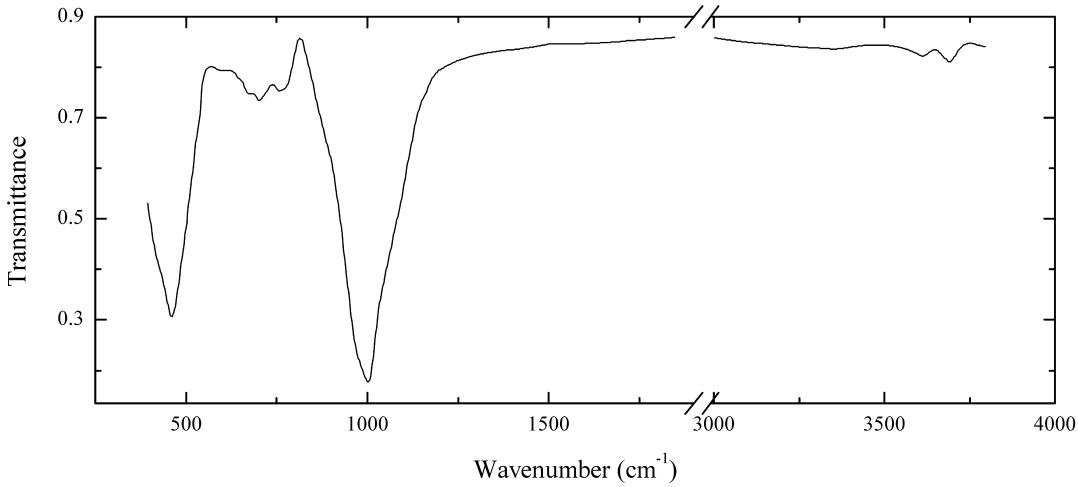


Locality: Katugin, SSE of Chara, Kalarskii range, Transbaikal Region, Russia.

Description: Black tabular crystals to 1 cm in massive thomsenolite.

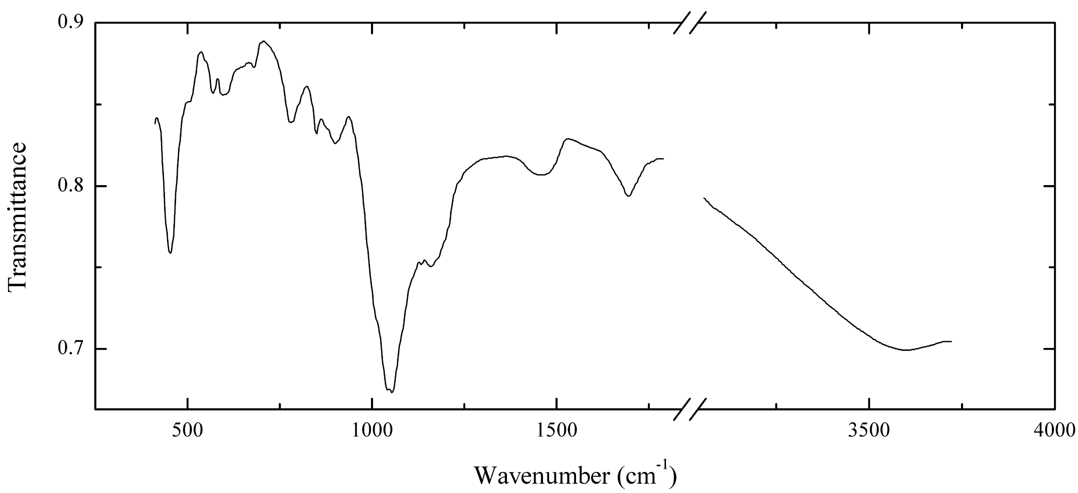
Wavenumbers (cm^{-1}): 3645w, 1065sh, 996s, 967s, 756w, 723w, 673, 650sh, 608w, 449s, 420sh.

Sil35 Annite $KFe^{2+}_3(Si_3AlO_{10})(OH)_2$



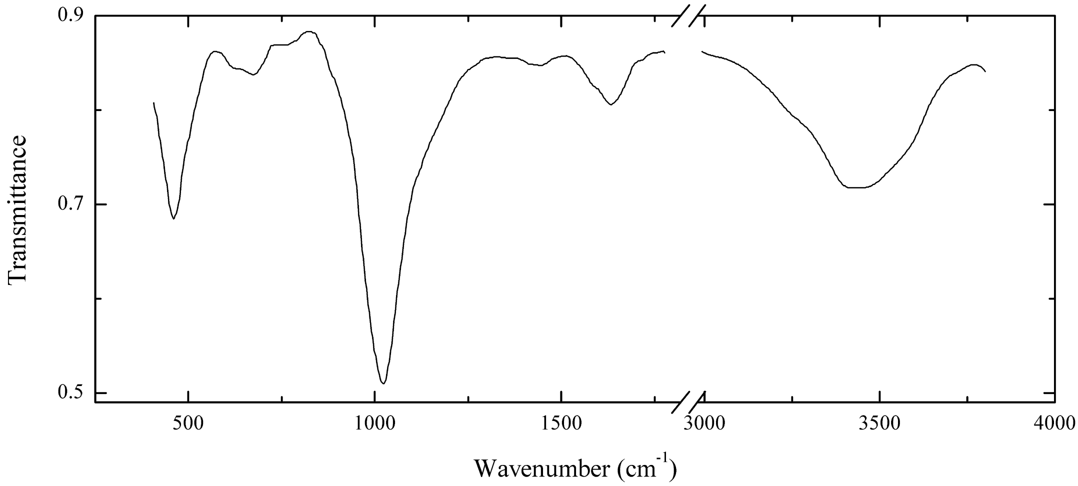
Locality: Plotina mine, northern Karelia, Russia.
Description: Black plates up to 8 cm in ceramic granite pegmatite. The empirical formula is (electron microprobe) $(K_{0.86}Na_{0.07}Ca_{0.02})(Fe_{1.64}Mg_{0.98}Al_{0.24}Ti_{0.11}Mn_{0.03})$ $(Si_{2.77}Al_{1.23}O_{10})(OH)_2$.
Wavenumbers (cm^{-1}): 3670w, 3585w, 1060sh, 1001s, 970sh, 775sh, 759, 706, 682, 660sh, 600w, 530sh, 459s, 440sh.

Sil36 Kanemite $NaHSi_2O_5 \cdot 3H_2O$



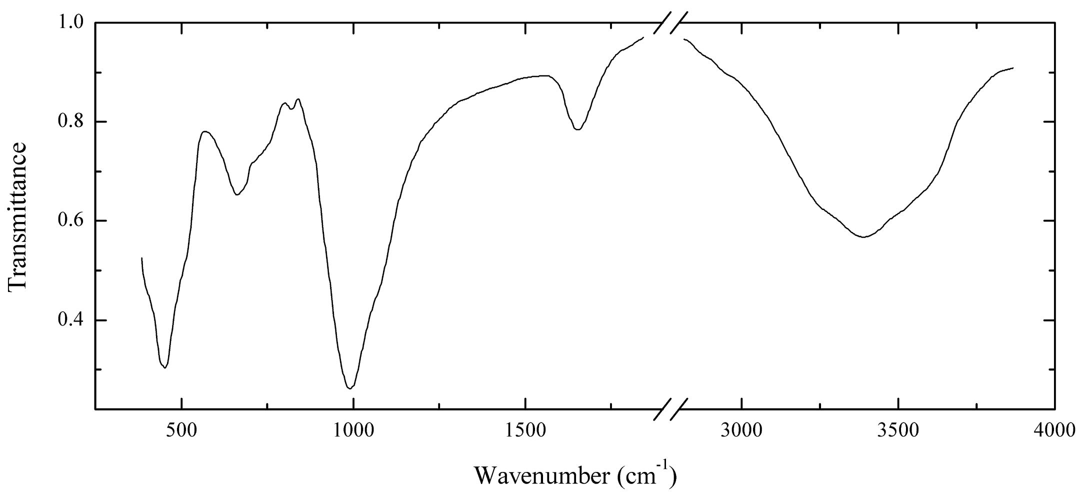
Locality: Lake Chad, Kanem region, Andaija, Chad (type locality).
Description: White spherical aggregate about 0.5 mm in diameter from the association with trona. Specimen No. 74003 from the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow. Confirmed by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3570, 1695, 1470, 1160s, 1054, 1040, 1010sh, 900, 848, 777, 680w, 600, 570, 500sh, 454s.

Sil37 Varennesite $Na_8Mn^{2+}_2Si_{10}O_{25}(OH,Cl)_2 \cdot 12H_2O$



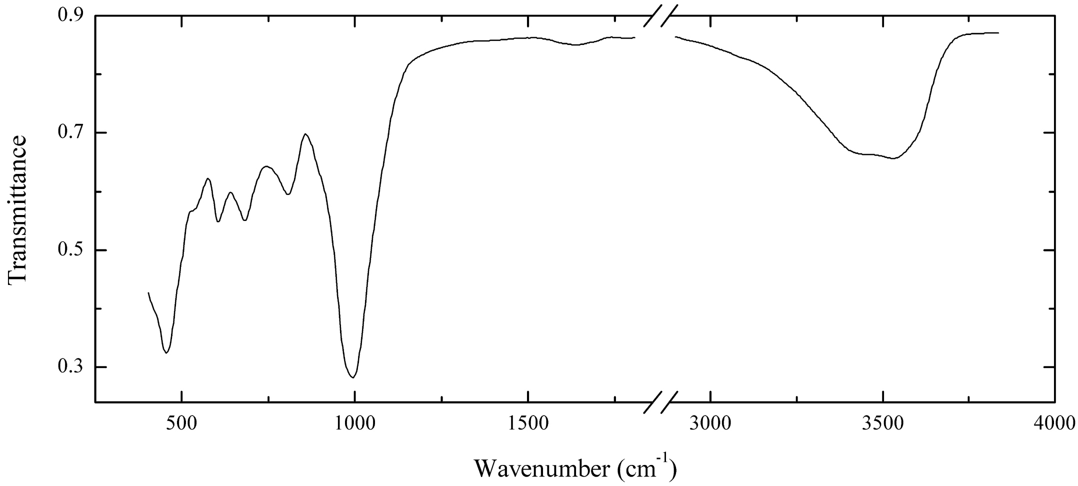
Locality: Demix-Varennes quarry, Verchères county, Québec, Canada (type locality).
Description: Pale orange-brown tabular crystals.
Wavenumbers (cm^{-1}): 3450, 1635, 1590sh, 1027s, 755w, 670, 625sh, 461.

Sil38 Vermiculite $(Mg,Fe,Al)_3[(Si,Al)_4O_{10}](OH)_2 \cdot 4H_2O$



Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Bronze-coloured pseudomorph after a large (about 10 cm) phlogopite crystal, in the association with calcite and clay minerals. The empirical formula is (electron microprobe) $(Ca_{0.06}K_{0.02}Na_{0.02})(Mg_{2.13}Fe_{0.52}Al_{0.30}Ti_{0.05})$ $(Si_{3.18}Al_{0.82}O_{10})(OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3550sh, 3375, 3250sh, 1657, 1070sh, 991s, 819w, 730sh, 710sh, 680sh, 657, 510sh, 450s, 420sh.

Sil39 Amesite $(Mg,Al)_3[(Si,Al)_2O_5](OH)_4$

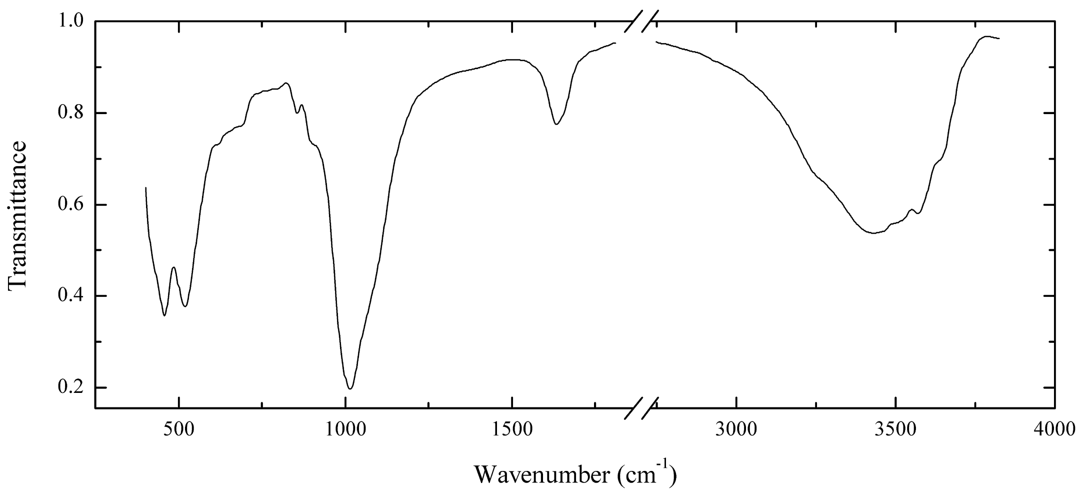


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.

Description: Pseudomorphs after perfect crystals of quintinite, in the association with phillipsite-K. A disordered variety. Identified by powder X-ray diffraction pattern (only basal reflections are observed at 6.98, 3.51, 2.35, 1.77 and 1.41 Å). The empirical formula is (electron microprobe) $(Mg_{2.10}Al_{0.88}Fe_{0.02})(Si_{1.22}Al_{0.78}O_5)(OH,O)_4$.

Wavenumbers (cm^{-1}): 3620sh, 3550, 3460sh, 1003s, 980sh, 809, 679, 611, 530sh, 453s, 415sh.

Sil40 Volkonskoite $Ca_{0.3}(Cr,Mg,Fe)_2[(Si,Al)_4O_{10}](OH)_2{\cdot}4H_2O$

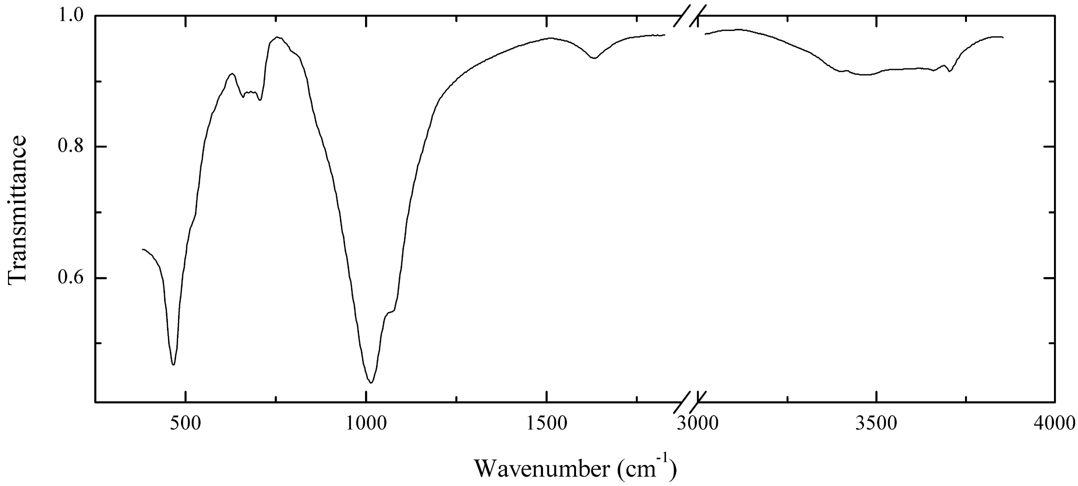


Locality: Efimyatskaya Mt., Efimyaty village, near Okhansk, Perm oblast, Russia (type locality).

Description: Green massive, pseudomorph after wood. The empirical formula is (electron microprobe) $(Ca_{0.29}K_{0.03}Na_{0.02})(Cr_{1.58}Mg_{0.59}Fe_{0.17})$ $(Si_{3.63}Al_{0.37}O_{10})(OH)_2{\cdot}nH_2O$.

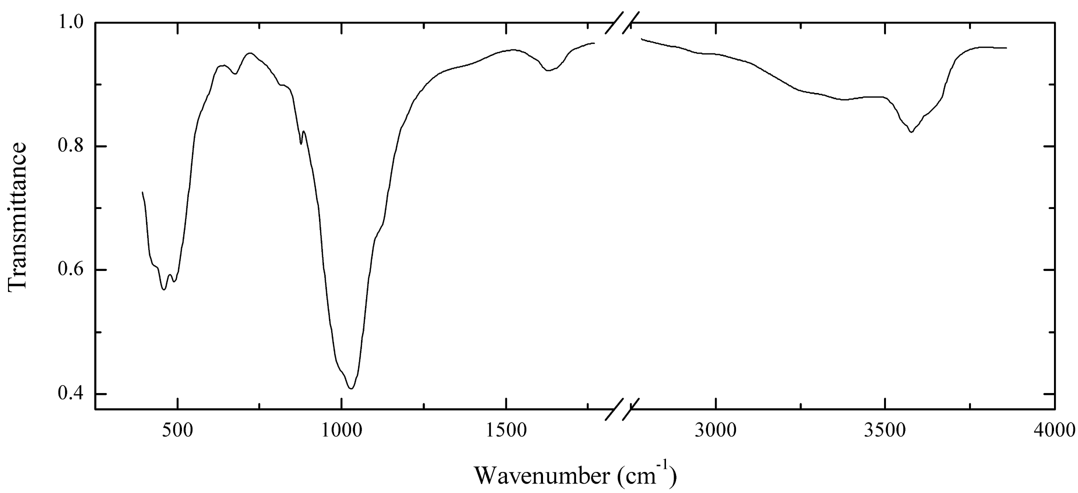
Wavenumbers (cm^{-1}): 3620sh, 3555, 3495sh, 3420, 3250sh, 1638, 1070sh, 1017s, 910sh, 856w, 675sh, 610sh, 520s, 459s, 430sh.

Sil41 Hectorite $Na_{0.3}(Mg,Li)_3(Si_4O_{10})(F,OH)_2$



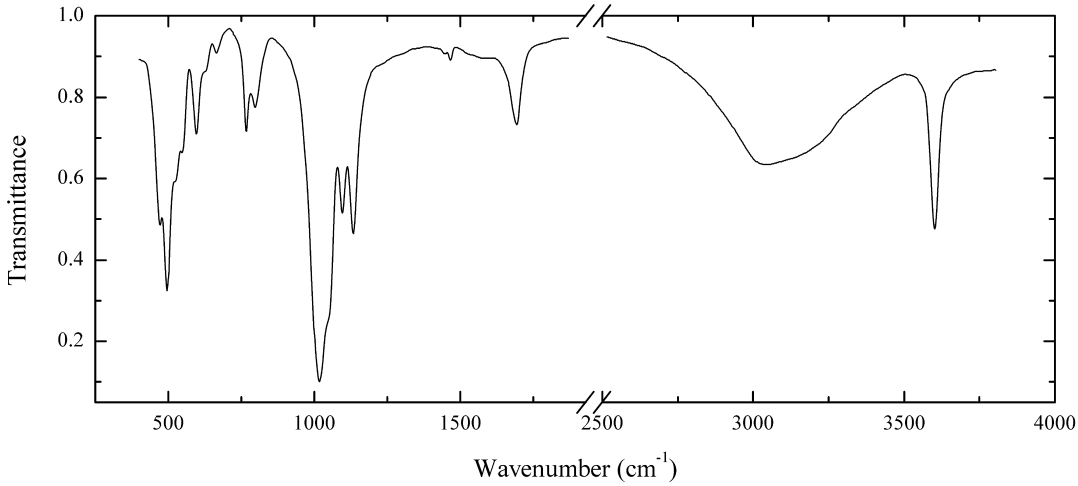
Locality: Hector, San Bernardino Co., California, USA (type locality).
Description: White, massive. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3682w, 3640w, 3450w, 1625w, 1065sh, 1010s, 900sh, 701, 687, 677, 656, 520sh, 464s.

Sil42 Glauconite $K_{1-x}(Fe^{3+},Mg,Fe^{2+},Al)_2[Si_3(Si,Al)O_{10}](OH)_2$



Locality: Egor'evsk phosphorite deposit, Moscow region, Russia.
Description: Dark green powdery, in the association with carbonate-fluorapatite and pyrite. A variety transitional to nontronite by composition. The empirical formula is (electron microprobe) $(K_{0.3}Na_{0.1}Ca_{0.1})(Fe_{1.0}Al_{0.6}Mg_{0.4})$ $(Si_{3.9}Al_{0.1}O_{10})(OH)_2{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3645sh, 3600sh, 3560, 3540sh, 3365, 3240sh, 1630w, 1120sh, 1029s, 995sh, 877, 819w, 677w, 489s, 460s, 431sh.

Sil43 Apophyllite-(KOH) $KCa_4Si_8O_{20}(OH){\cdot}8H_2O$

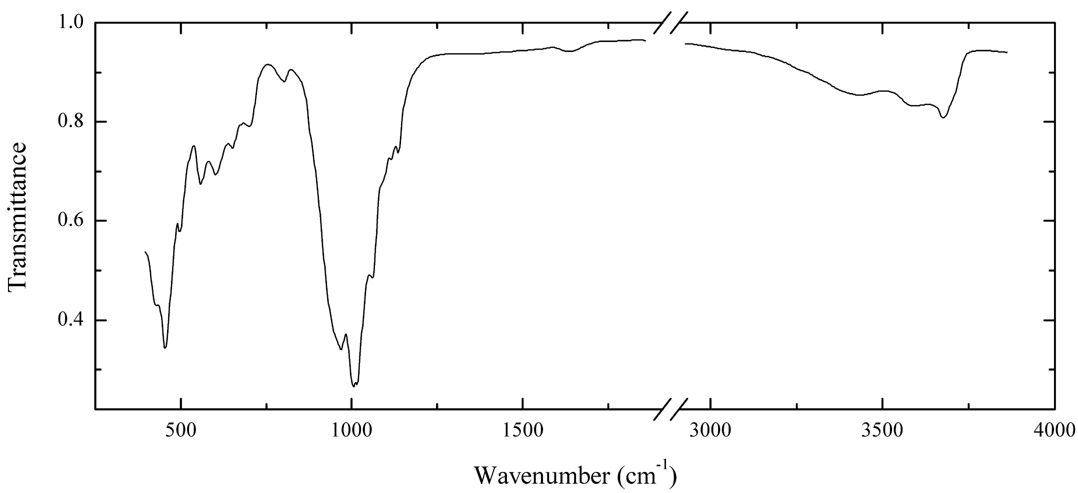


Locality: Trudolyubovka, Crimea, Ukraine.

Description: Short-prismatic colourless crystals in the association with okenite, prehnite, pumpellyite-(Mg) and lomontite. Identified by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3565, 3200sh, 3090sh, 3010, 1689, 1460w, 1445w, 1130, 1093, 1040sh, 1013s, 799, 766, 662w, 625sh, 595, 551, 522, 495s, 472, 415sh.

Sil44 Gonyerite $(Mn^{2+},Mg,Fe)_6(Si_4O_{10})(OH)_8$

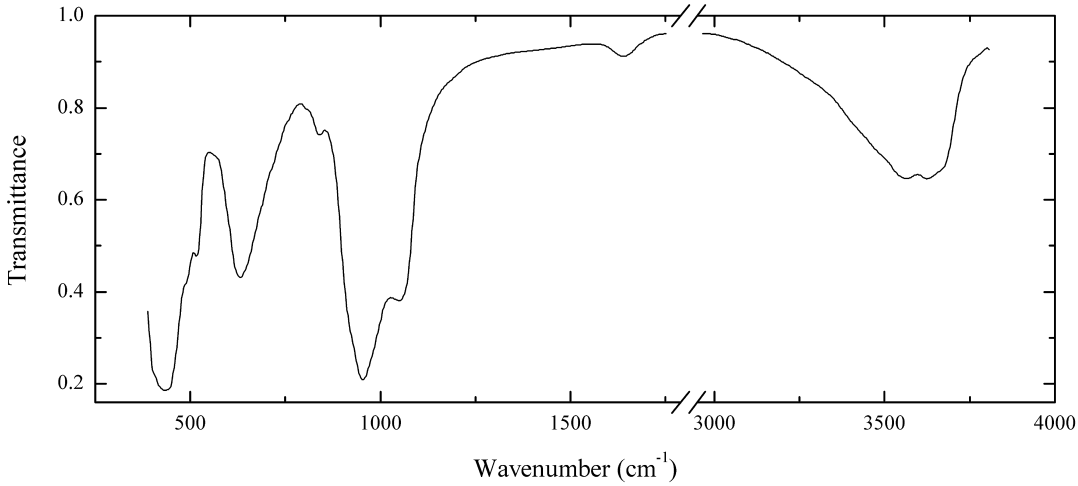


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Brown radiated aggregates.

Wavenumbers (cm^{-1}): 3680sh, 3645, 3555, 3405, 1635w, 1136, 1115, 1090sh, 1058, 1012s, 1000s, 966s, 950sh, 801w, 700, 651, 602, 557, 498, 453s, 427.

Sil45 Glagolevite $NaMg_6(Si_3AlO_{10})(OH,O)_8 \cdot H_2O$

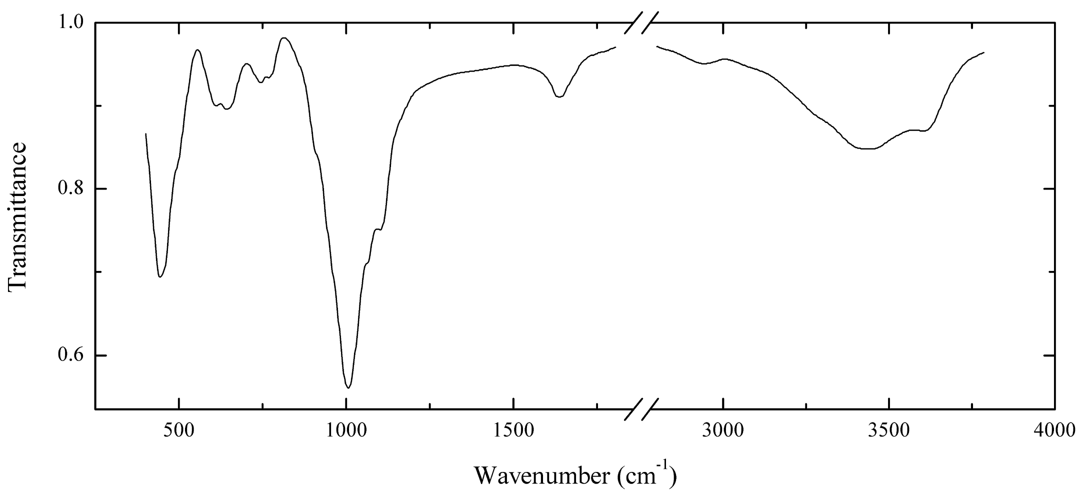


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless plates with mica-like cleavage in the association with vesuvianite, andradite, pectolite and calcite. Holotype sample. The crystal structure is solved. Triclinic, space group *C*1, $a = 5.354$, $b = 9.263$, $c = 14.653$ Å, $\alpha = 89.86°$, $\beta = 96.984°$, $\gamma = 90.03°$. The empirical formula is $Na_{0.76}(Mg_{5.50}Fe_{0.03}Mn_{0.01}Al_{0.46})(Si_{2.90}Al_{1.10}O_{10})(OH_{7.88}O_{0.12}) \cdot 0.85H_2O$. $D_{meas} = 2.66(4)$ g/cm^3. Optically biaxial (+), $\alpha \approx \beta \approx 1.569$ (2), $\gamma = 1.571$ (2), $2V_{meas} = 17.3°$.

Wavenumbers (cm^{-1}): 3655sh, 3615, 3560, 1645w, 1051s, 955s, 844w, 635, 518, 485sh, 442s, 405sh.

Sil46 Ganophyllite $(K,Na)_6(Mn,Al)_{24}[(Si,Al)_{40}O_{96}](OH)_{16} \cdot 21H_2O$

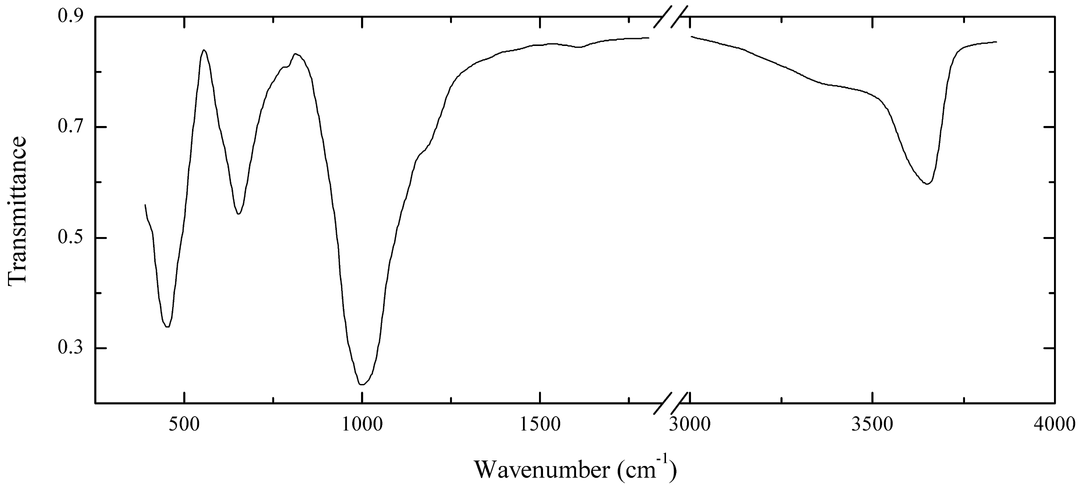


Locality: Harstigen mine, Värmland, Sweden (type locality).

Description: Light reddish-brown transparent brittle plates in skarn. A K- and Na-rich variety. The empirical formula is (electron microprobe) $(K_{8.4}Na_{3.1}Ca_{0.9})(Mn_{23.3}Al_{0.4}Mg_{0.3})(Si_{32.4}Al_{7.6}O_{96})(OH)_{16} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3585, 3410, 3260sh, 2925w, 1633, 1104, 1065sh, 1004s, 960sh, 910sh, 771, 747, 640, 605, 490sh, 450sh, 436s.

Sil47 Greenalite $(Fe^{2+},Fe^{3+})_{6-x}(Si_4O_{10})(OH)_8$

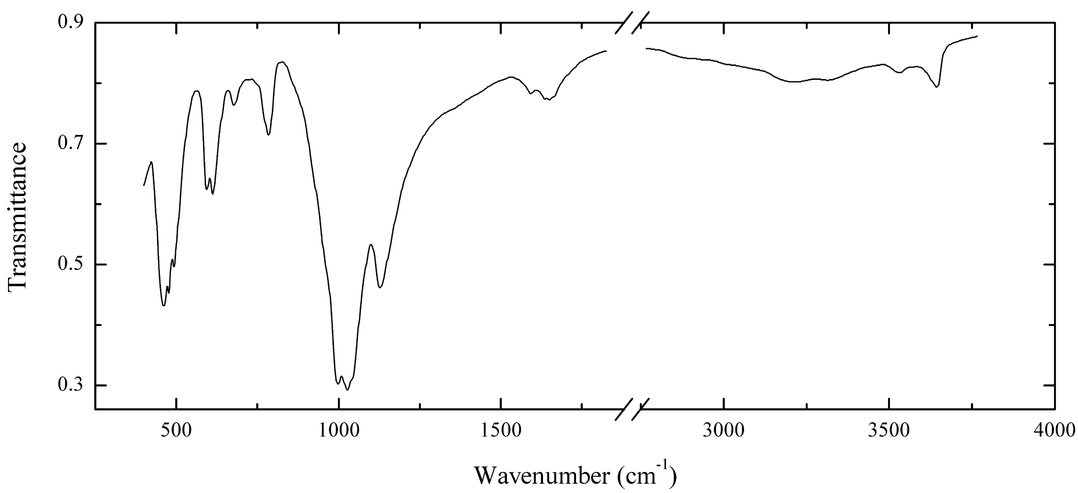


Locality: La Union mines, Sierra de Cartagena, Spain.

Description: Black-green massive. The empirical formula is (electron microprobe) $(Fe_{4.1}Mg_{0.25}Al_{0.2}Mn_{0.1})(Si_4O_{10})(OH)_8{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3620, 3320sh, 1607w, 1170sh, 1020sh, 999s, 784w, 655, 625sh, 490sh, 456s, 410sh.

Sil48 Gyrolite $(NaCa_2)Ca_{14}(Si_{24}AlO_{60})(OH)_8{\cdot}(14 + x)H_2O$

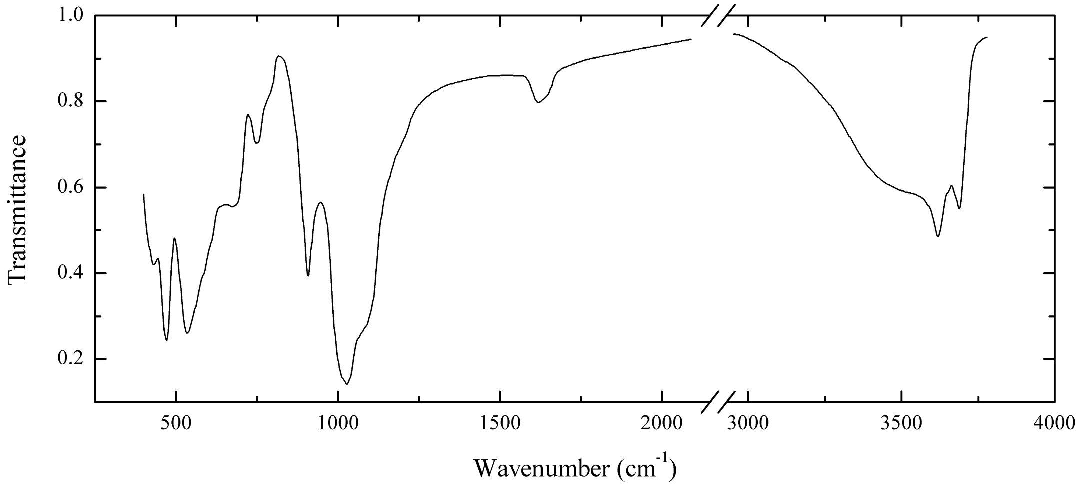


Locality: Poona, Maharashtra, India.

Description: White spherulites in the association with calcite, okenite and apophyllite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3630, 3515w, 3300, 3200, 1650, 1600w, 1131s, 1045sh, 1029s, 1000s, 790, 678w, 613, 594, 505sh, 494, 477, 463s.

Sil49 Halloysite-10 Å $Al_2Si_2O_5(OH)_4 \cdot 2H_2O$

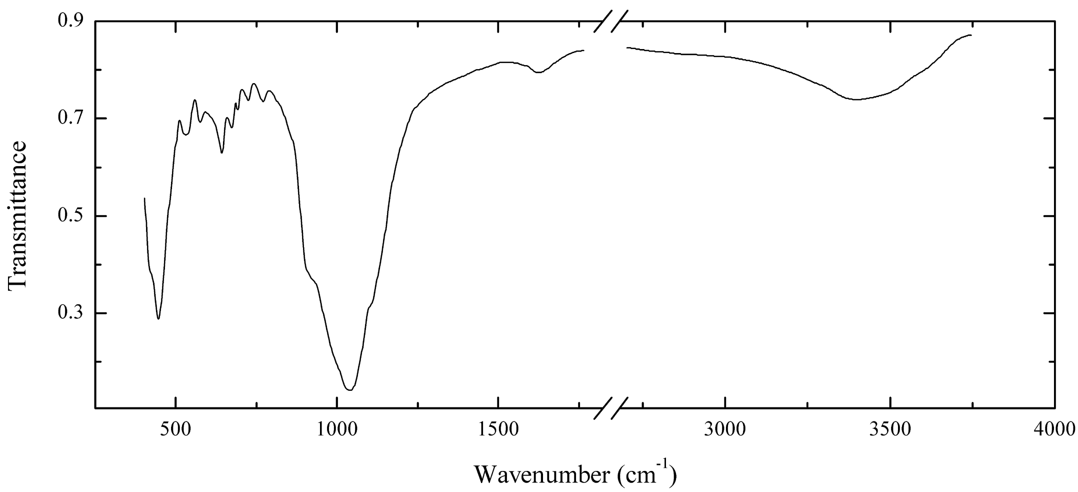


Locality: Northern quarry, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Blue massive, with conchoidal fracture, in peralkaline pegmatite, in the association with zeolites. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3690, 3617, 3550sh, 1640sh, 1625, 1080sh, 1030s, 911, 790sh, 751, 678, 595sh, 536s, 469s, 430.

Sil51 Delhayelite $K_4Na_2Ca_2[Si_7AlO_{19}]F_2Cl$

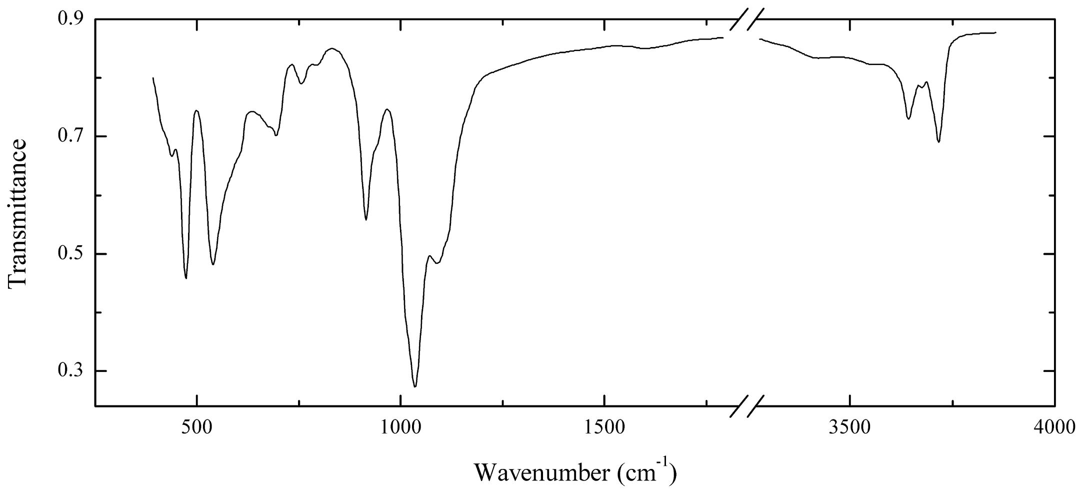


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White platy, with pink fluorescence under UV radiation. Hydrated variety transitional to fivegite.

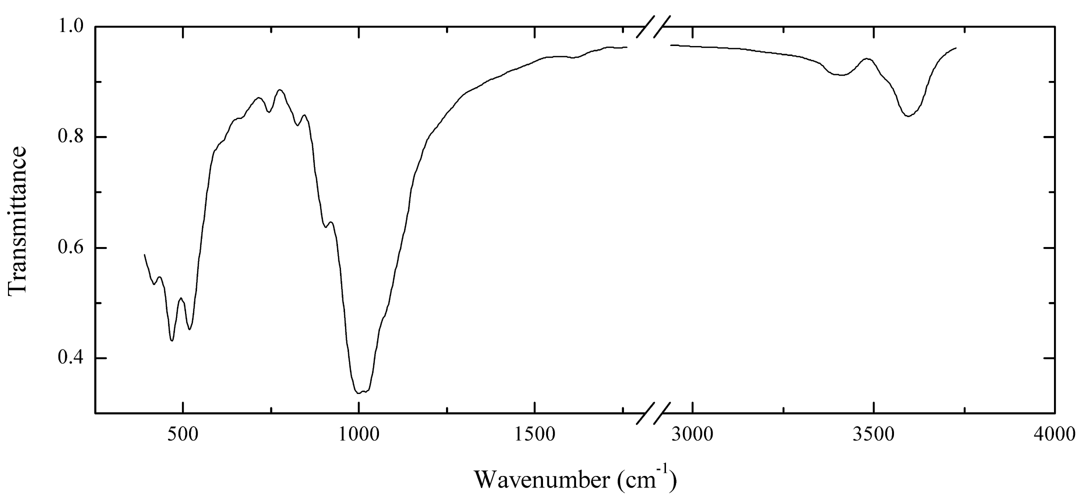
Wavenumbers (cm^{-1}): 3450sh, 3390, 1630, 1120sh, 1043s, 925sh, 770w, 727w, 690w, 672, 643, 579, 528, 444s, 420sh.

Sil52 Halloysite-7 Å $Al_2Si_2O_5(OH)_4$



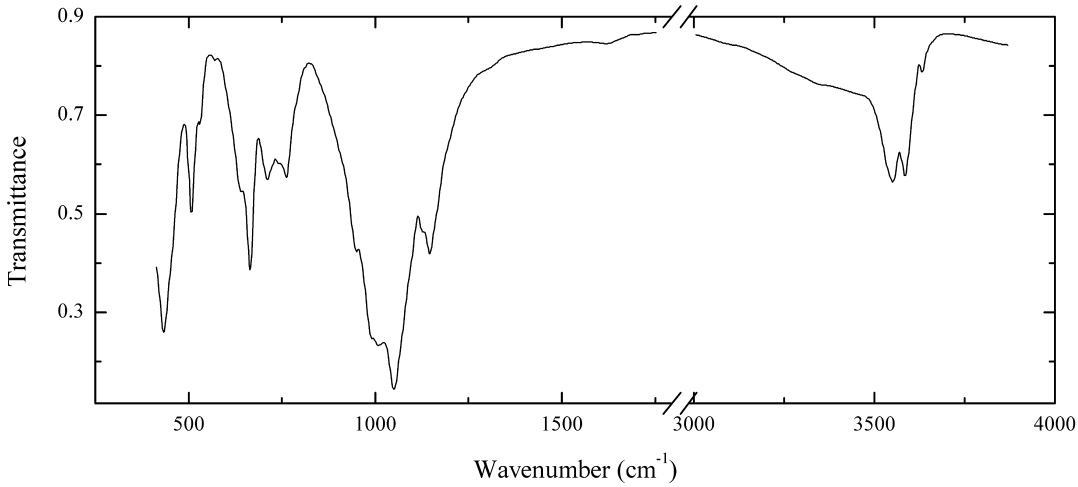
Locality: Baynazar, near Batystau deposit, Central Kazakhstan.
Description: White concretion. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3690, 3650w, 3620, 3520w, 3400w, 1110sh, 1086s, 1031s, 1010sh, 935sh, 912, 790w, 753w, 692, 680sh, 600sh, 536s, 470s, 434, 415sh.

Sil54 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$



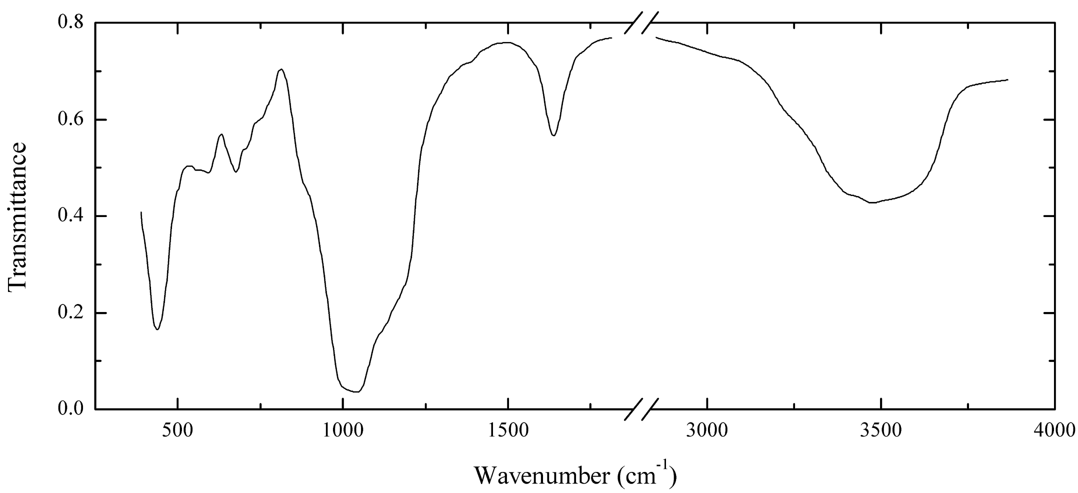
Locality: Saranovskoe chromium deposit, Middle Urals, Russia.
Description: Clusters of light green needles on chromite. Cr-bearing hydrated variety. The empirical formula is (electron microprobe) $K_{0.89}(Al_{1.20}Cr_{0.49}Mg_{0.35}Ti_{0.04})$ $(Si_{3.25}Al_{0.75}O_{10})(OH)_2$.
Wavenumbers (cm^{-1}): 3570, 3385, 1610w, 1070sh, 1023s, 999s, 906, 826, 744w, 660w, 600sh, 520s, 469s, 417.

Sil55 Pyrosmalite-(Mn) $(Mn^{2+},Fe^{2+})_8(Si_6O_{15})(OH,Cl)_{10}$



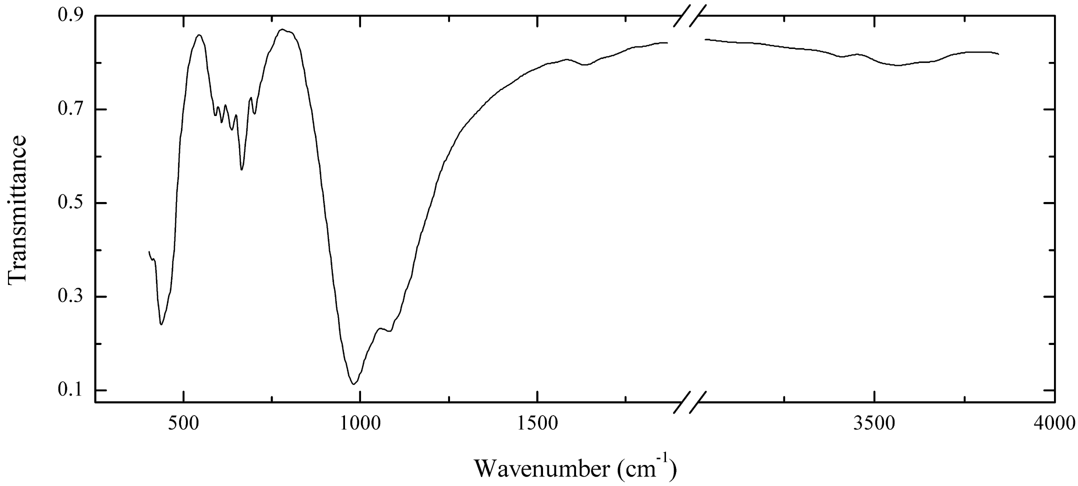
Locality: Nordmark, near Filipstad, Värmland, Sweden.
Description: Greenish-brown crystals on skarn.
Wavenumbers (cm^{-1}): 3625w, 3580, 3545, 3400sh, 1625w, 1151, 1130, 1055s, 1009s, 995s, 953, 765, 745sh, 716, 666, 640, 572w, 535, 509, 433s.

Sil56 Hydrodelhayelite $KCa_2AlSi_7O_{17}(OH)_2{\cdot}6H_2O$



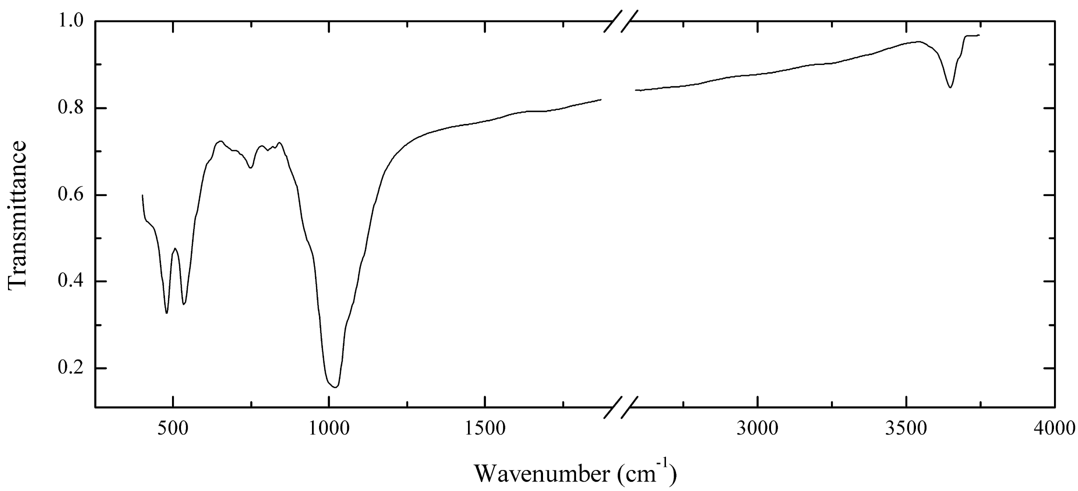
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Light grey pseudomorphs after delhayelite from peralkaline pegmatite, from the association with lamprophyllite, eudialyte, hisingerite, aegirine, orthoclase and pectolite. Holotype sample. Orthorhombic, space group Pnm21: $a = 6.6483$, $b = 23.8462$, $c = 7.0727$ Å. Optically biaxial, $\alpha = 1.503$, $\gamma = 1.518$. $D_{calc} = 2.22$ g/cm^3, $D_{meas} = 2.168$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 6.79 (38), 3.319 (43), 3.069 (75), 2.923 (100), 2.800 (55). The empirical formula is $Ca_{1.66}K_{0.94}Na_{0.05}Sr_{0.02}Mg_{0.04}Mn_{0.02}Fe_{0.06}Al_{1.22}Si_{6.78}(O,OH)_{16.97}Cl_{0.03}{\cdot}nH_2O$. The content of H_2O is 15.2 wt.%.
Wavenumbers (cm^{-1}): 3520sh, 3455, 3390, 3325sh, 3210sh, 1640, 1150sh, 1042s, 1010sh, 890sh, 790sh, 752, 705sh, 676, 597, 576, 438s.

Sil57 Delhayelite $K_4Na_2Ca_2(Si_7AlO_{19})FCl$



Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Dark grey crystals (to 2 mm) in coarse-crystalline fenaksite aggregate from ristschorrite. Orthorhombic, $a = 6.52(1)$; $b = 24.83(6)$; $c = 7.07(1)$ Å. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.10 (100), 3.03 (90), 2.87 (90), 1.910 (100), 1.630(100). Low-hydrated variety. The empirical formula is (wet chemical analysis; H_2O was not determined) $(K_{3.81}Na_{2.07}Ca_{2.01}Sr_{0.03}Fe_{0.02}Mn_{0.01}Mg_{0.01})(Si_{6.98}Al_{1.02}O_{19})F_{1.06}Cl_{0.97}(OH,H_2O)_x$ ($x \ll 1$).
Wavenumbers (cm^{-1}): 3535w, 3375w, 1635w, 1077s, 982s, 702, 663, 635, 608, 590, 440s, 410.

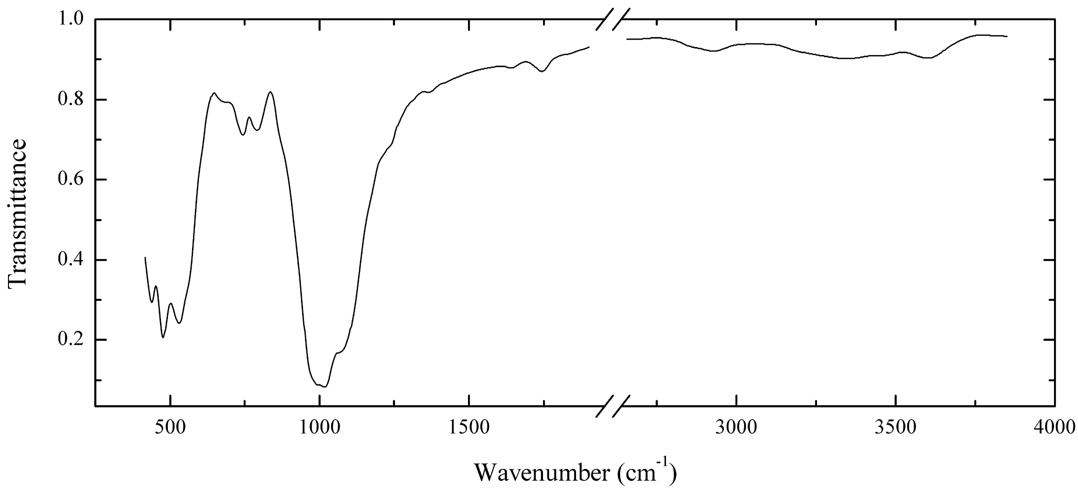
Sil58 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$



Locality: Lipovka, Middle Urals, Russia.
Description: Greenish core of a large mica crystal with lilac lepidolite in outer zone. Investigated by I.V. Pekov. The empirical formula is (electron microprobe; wet analysis for Li) $K_{0.84}(Al_{1.94}Li_{0.06}Fe_{0.05}Mn_{0.04})(Si_{3.08}Al_{0.92}O_{10})(OH,F)_2$.
Wavenumbers (cm^{-1}): 3625, 1090sh, 1060sh, 1021s, 1005sh, 930sh, 825w, 797w, 750, 690sh, 534s, 479s, 420sh.

Sil59 Trilithionite (lepidolite)

Intermediate member of the series “fluormuscovite” – polylithionite



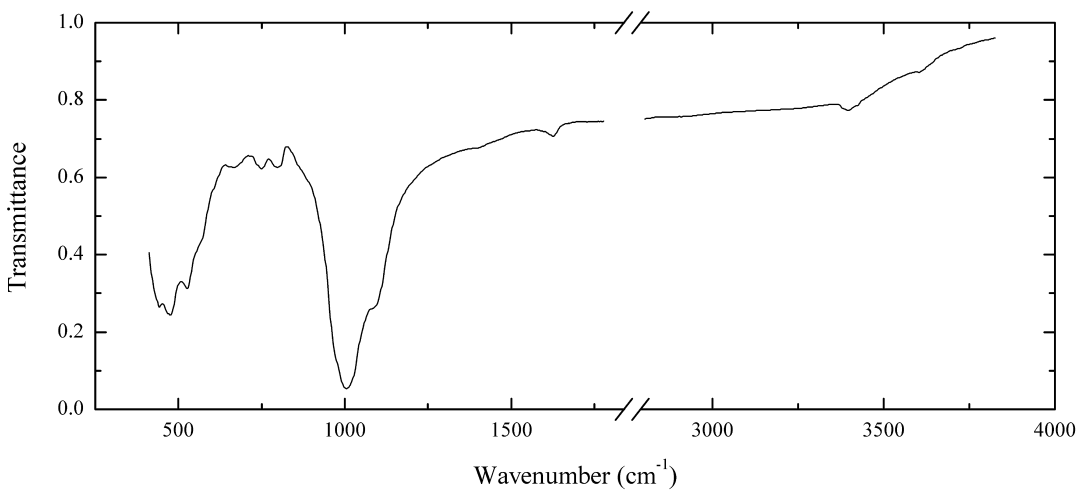
Locality: Lipovka, Middle Urals, Russia.

Description: Lilac outer zone of a large mica crystal with greenish muscovite core. Investigated by I.V. Pekov. The empirical formula is (electron microprobe; wet analysis for Li) $(K_{0.89}Cs_{0.03})(Al_{1.46}Li_{0.67}Mn_{0.25}Fe_{0.01})(Si_{3.49}Al_{0.51}O_{10})(F,OH)_2$.

Wavenumbers (cm^{-1}): 3595, 3350, 2930w, 1750w, 1650w, 1375w, 1230sh, 1067s, 1021s, 1000s, 788, 744, 685sh, 555sh, 529s, 478s, 437s.

Sil60 Trilithionite (lepidolite)

Intermediate member of the series “fluormuscovite”–polylithionite.

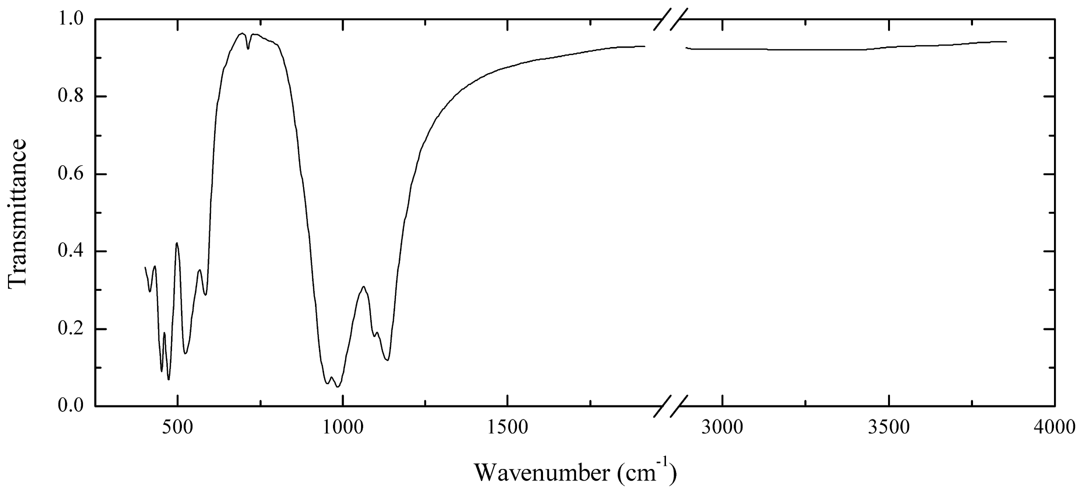


Locality: Lipovka, Middle Urals, Russia.

Description: Lilac fine-scaly aggregate. Investigated by I.V. Pekov. The empirical formula is (electron microprobe; wet analysis for Li) $(K_{0.82}Na_{0.04}Rb_{0.02}Cs_{0.01})(Li_{1.55}Al_{1.43}Mn_{0.02})(Si_{3.23}Al_{0.77}O_{10})F_{1.23}(OH)_{0.77}$. It corresponds to Al-rich analogue of polylithionite.

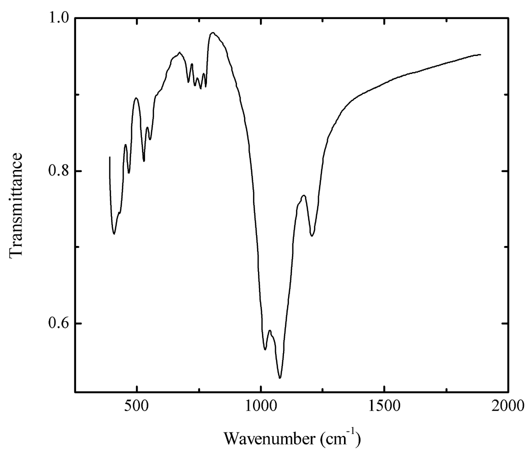
Wavenumbers (cm^{-1}): 3585w, 3330, 1627w, 1085sh, 1020sh, 1004s, 800, 748, 659, 565sh, 527, 478s, 445s.

Sil61 Sokolovaite $CsLi_2Al(Si_4O_{10})F_2$



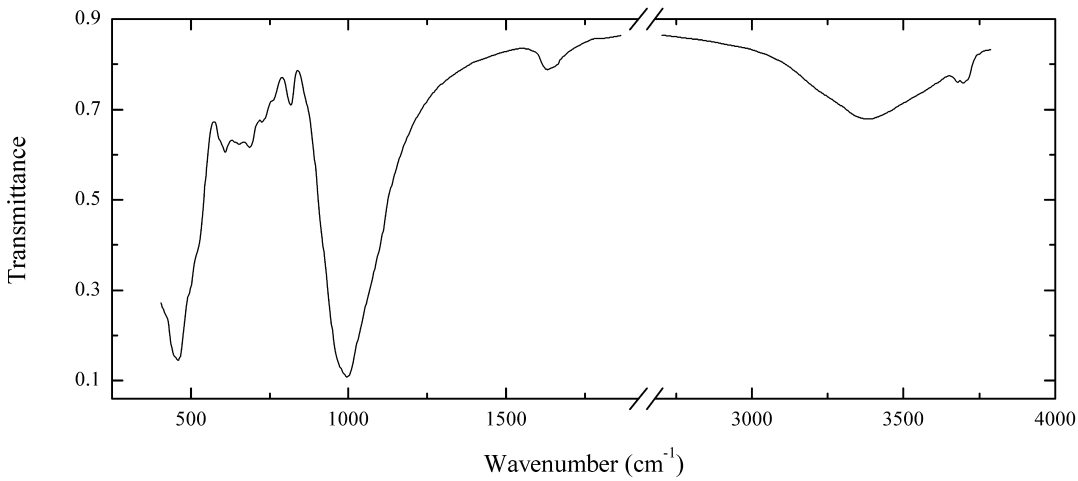
Locality: Dara-i Pioz massif, Alaiskii range, Tien Shan Mts., Tajikistan.
Description: Colourless scales in alkaline pegmatite. Cs-analogue of polylithionite. Holotype sample.
Wavenumbers (cm^{-1}): 1139s, 1095, 985s, 956s, 779w, 585, 535sh, 523, 471s, 449s, 408.

Sil62 Petalite $LiAl(Si_4O_{10})$



Locality: Lipovka, Middle Urals, Russia.
Description: Colourless grains from granite pegmatite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1207, 1076s, 1050sh, 1016s, 780, 757, 734, 707, 552, 526, 470, 435, 420.

Sil64 Phlogopite $KMg_3(Si_4AlO_{10})(OH)_2$

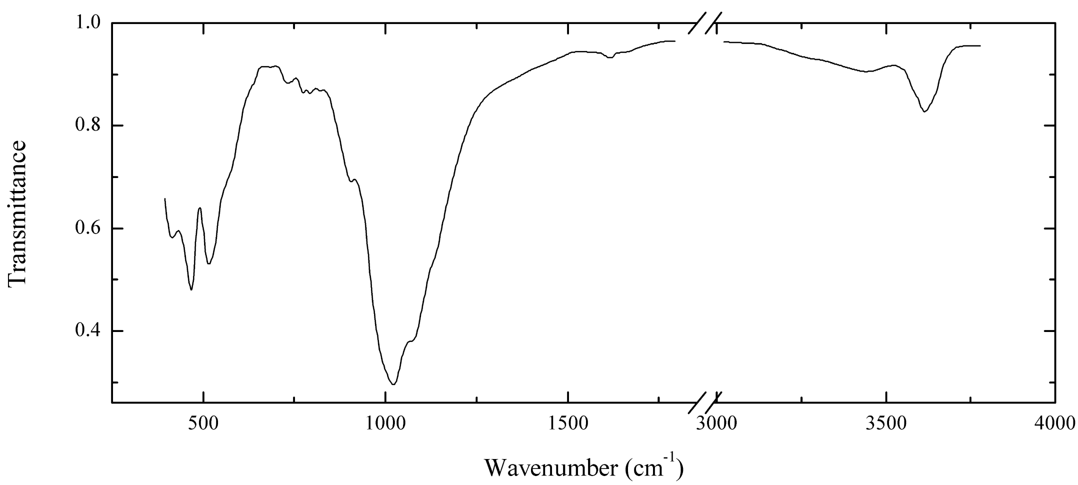


Locality: Kukh-i Lal, 45 km S of Khorog, Pamir, Tajikistan.

Description: Yellow-brown plates, from the contact zone of a pegmatite with dravite, apatite and magnocolumbite. Hydrated variety. Presumably contains vermiculite layers (the bands at 3,375, 1,660, 1,640, 650, 520 cm^{-1}).

Wavenumbers (cm^{-1}): 3695, 3675, 3375, 1740w, 1660sh, 1640, 995s, 818, 760sh, 726, 689, 650, 606, 520sh, 490sh, 459s, 430sh.

Sil65 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$

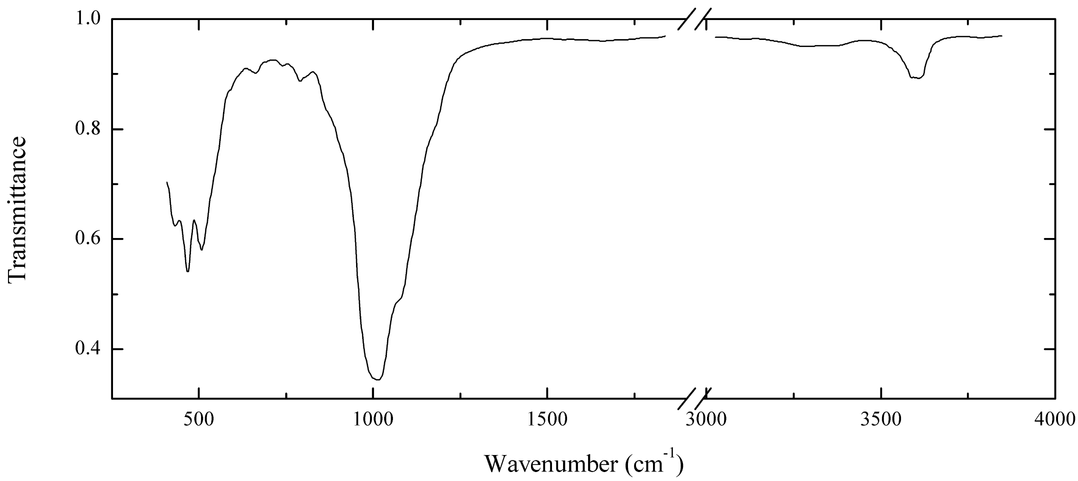


Locality: Bölet (Bohlet), Vastergotland, Västergotland, Sweden.

Description: Scales in the association with corrensite. Confirmed by IR spectrum and electron microprobe analysis. A Mg- and Fe- bearing variety ("phengite").

Wavenumbers (cm^{-1}): 3600, 3440w, 1635w, 1072s, 1021s, 905, 825w, 796, 776, 735, 516s, 470s, 415.

Sil66 Ferro-aluminoceladonite $KFe^{2+}Al(Si_4O_{10})(OH)_2$

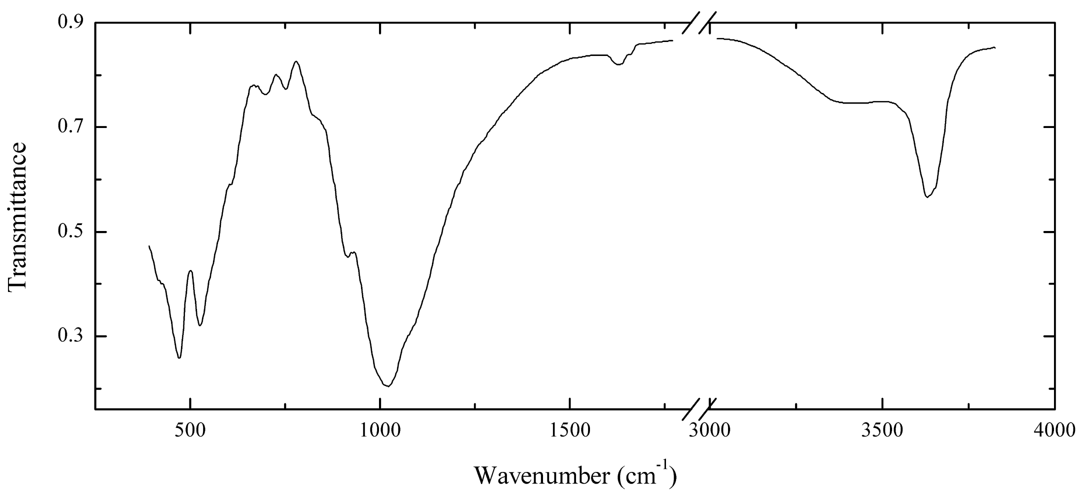


Locality: Taikeu, Ray-Iz ridge, Polar Urals, Russia.

Description: Green scales in quartz. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $K_{0.89}(Fe_{0.57}Mg_{0.34}Al_{1.22})$ $(Si_{3.62}Al_{0.38}O_{10})(OH)_2$.

Wavenumbers (cm^{-1}): 3585, 1175sh, 1070sh, 1014s, 1000sh, 870sh, 794, 745w, 656w, 575sh, 540sh, 505s, 464s, 428.

Sil67 Illite $K_{0.65}Al_2(Si_{3.35}Al_{0.65}O_{10})(OH)_2$

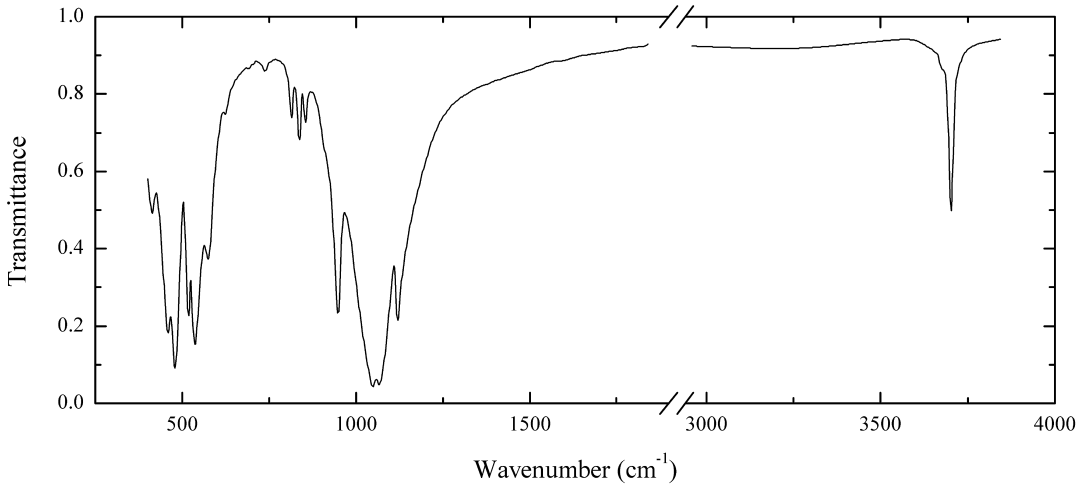


Locality: Bölet (Bohlet), Vastergotland, Västergotland, Sweden.

Description: Pink massive, from the association with muscovite and corrensite. The empirical formula is (electron microprobe) $H_xK_{0.69}Na_{0.06}(Al_{1.83}Mg_{0.09}Fe_{0.05}Mn_{0.03})(Si_{2.93}Al_{1.07}O_{10})$ $(OH)_2{\cdot}nH_2O$. Contains water molecules (the bands at 3,420, 1,665, 1,635 cm^{-1}).

Wavenumbers (cm^{-1}): 3620, 3420, 1665w, 1635w, 1080sh, 1023s, 1000sh, 915, 825sh, 754w, 700w, 605sh, 525s, 471s, 425sh.

Sil68 Pyrophyllite $Al_2Si_4O_{10}(OH)_2$



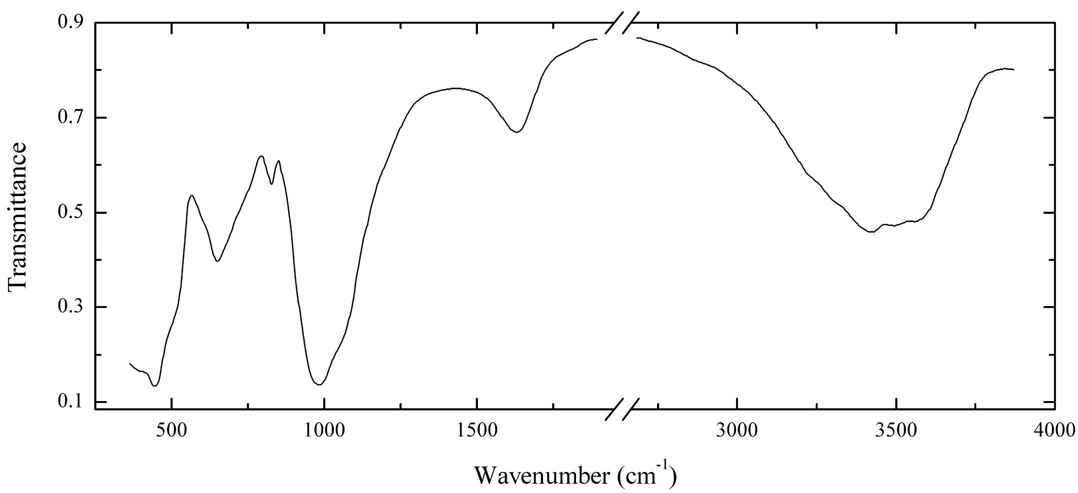
Locality: Piramida Mt., Subpolar Urals, Russia.

Description: Beige radiated aggregates (to 1 cm in diameter) in quartz. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3678, 1120s, 1068s, 1050s, 950s, 854, 836, 814, 737w, 620, 578, 539s, 519, 481s, 458, 414.

Sil69 "Hydrochlorite"

Interstratification of clinochlore and vermiculite layers.

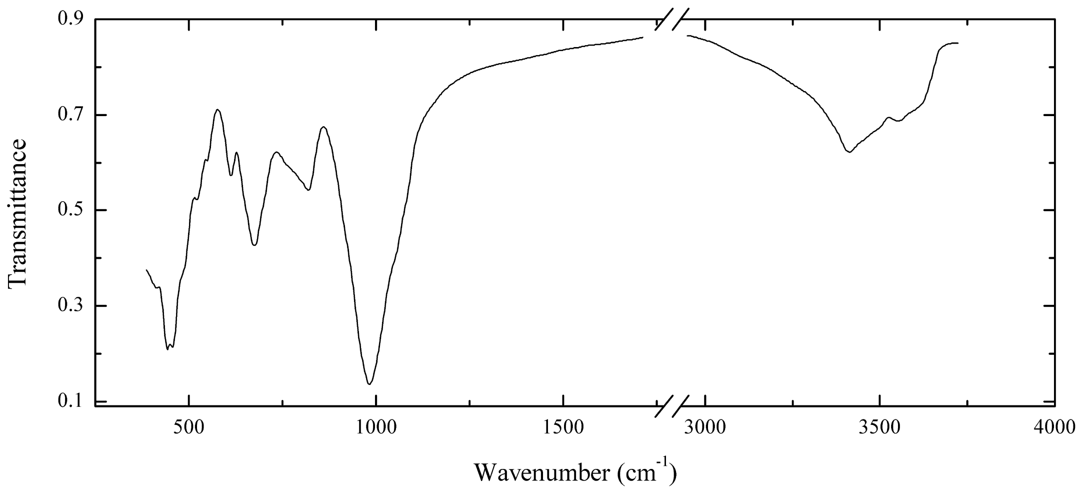


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Pale yellow scales with pearly lustre from the association with vesuvianite, glagolevite and andradite. Pseudomorph after clinochlore.

Wavenumbers (cm^{-1}): 3550, 3480, 3400, 1638, 1050sh, 987s, 827, 647, 520sh, 447s, 415sh.

Sil70 Clinochlore $(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$

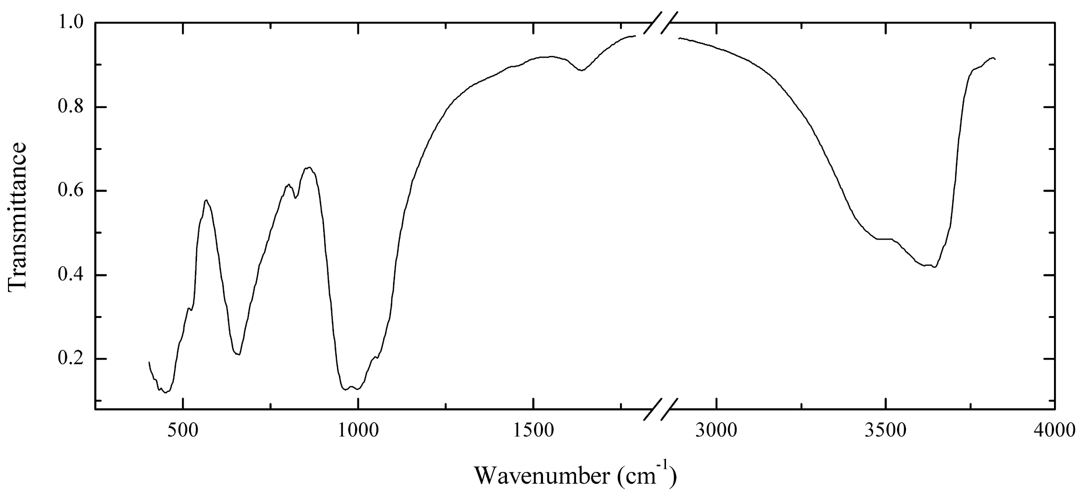


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Green crystals (up to 5 mm) from the association with calcite and magnetite. The empirical formula is (electron microprobe) $Na_{0.08}(Mg_{4.23}Fe_{0.85}Al_{0.92})(Si_{2.97}Al_{1.03})O_{10}(OH)_8$.

Wavenumbers (cm^{-1}): 3600sh, 3540, 3400, 1050sh, 985s, 822, 678, 615, 552w, 485sh, 456s, 442s, 410sh.

Sil71 Clinochlore $(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$

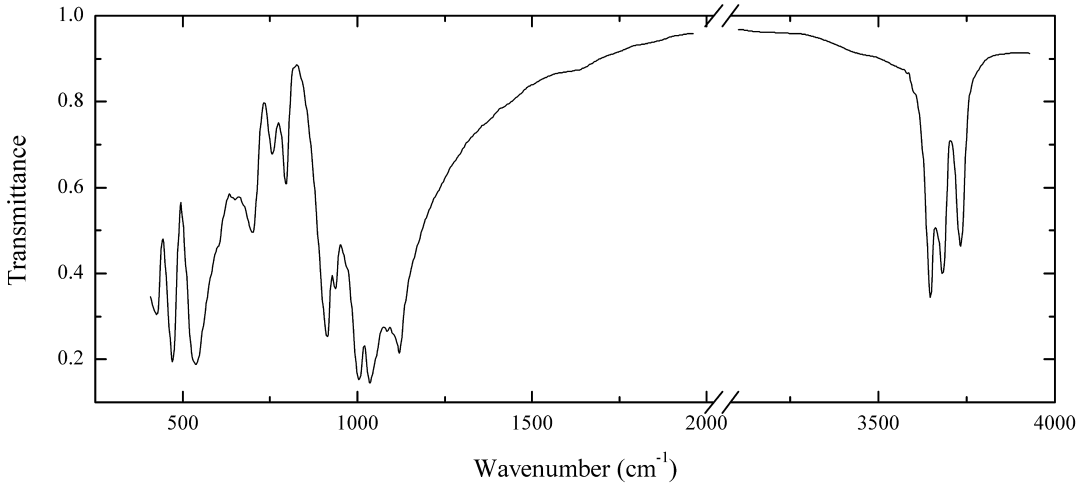


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Light green crystals (up to 5 mm) from the association with calcite and magnetite. The empirical formula is (electron microprobe) $(Mg_{4.34}Fe_{0.57}Al_{1.09})(Si_{2.87}Al_{1.13})O_{10}(OH)_8$.

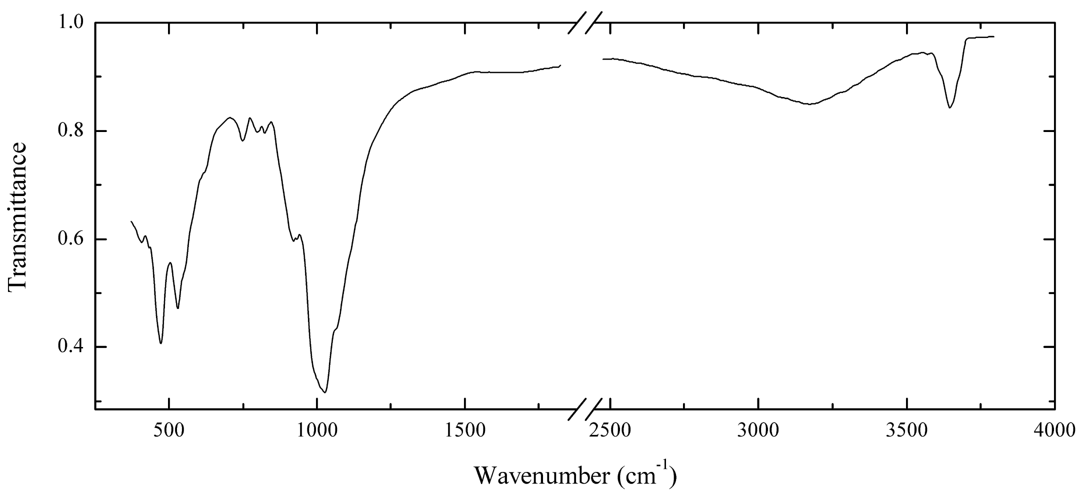
Wavenumbers (cm^{-1}): 3630, 3600sh, 3475, 1638w, 1050sh, 997s, 965s, 820w, 655, 520, 490sh, 452s.

Sil72 Dickite $Al_2Si_2O_5(OH)_4$



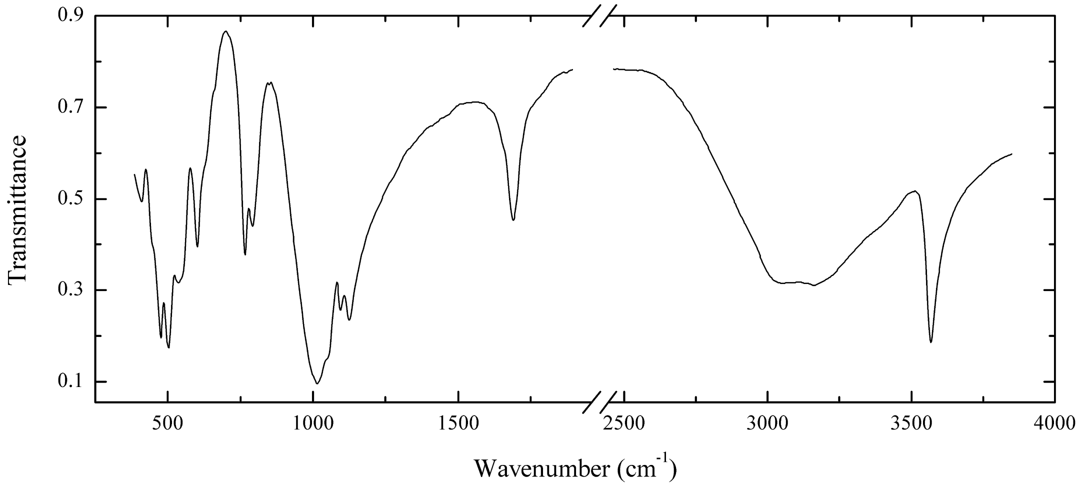
Locality: Ishme, Khaidarkan, Kyrgyzstan.
Description: White, powdery. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3708, 3655, 3625, 1118s, 1080, 1033s, 1004s, 965sh, 937, 914, 795, 755w, 697, 600sh, 534s, 467s, 425.

Sil73 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$



Locality: Hagendorf-Süd, near Waidhaus, Oberpfalz, Bavaria, Germany.
Description: Bronze-brown plates. The broad band at 3,150 cm^{-1} indicates that the sample contains acid groups (presumably Si–OH or H_3O^+).
Wavenumbers (cm^{-1}): 3620, 3150, 1067, 1025s, 990sh, 930, 920, 825w, 800w, 750w, 615sh, 550sh, 530, 473s, 410.

Sil74 Apophyllite-(NaF) $NaCa_4(Si_8O_{20})F{\cdot}8H_2O$



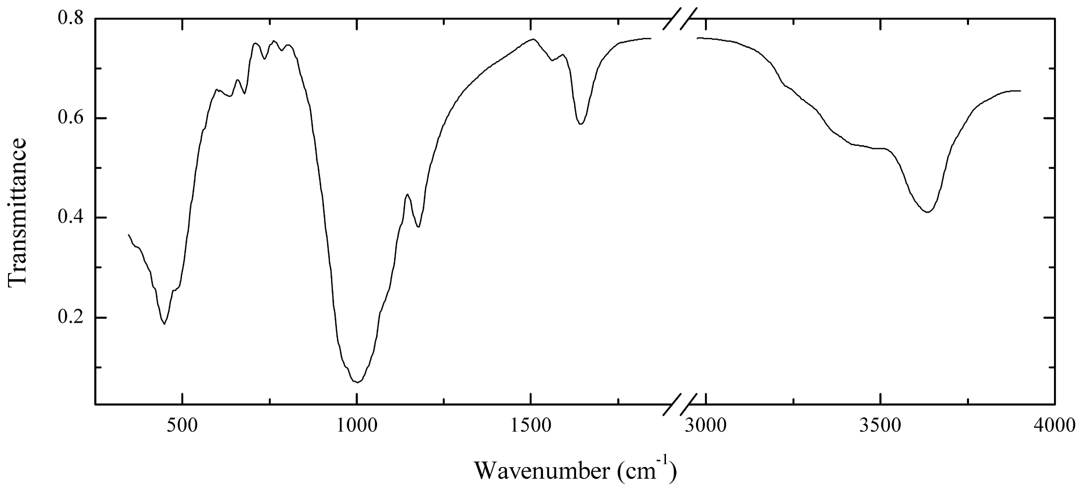
Locality: Fengjianshan mine, Daye Co., Huangshi prefecture, Hubei province, China.

Description: Light brown crystals (about 0.5 mm) forming crust, in the association with quartz, calcite, pyrite and inesite. The empirical formula is (electron microprobe) $(Na_{0.60}K_{0.40})Ca_{4.02}Si_{8.00}O_{20.02}F_{1.0}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3550s, 3150, 3055, 1690, 1125s, 1095s, 1040sh, 1013s, 793, 766, 660sh, 630sh, 599, 545sh, 535, 500s, 473s, 445sh, 407.

Comments:

Sil75 Tuperssuatsiaite $NaFe^{3+}_3(Si_8O_{20})(OH)_2{\cdot}4H_2O$

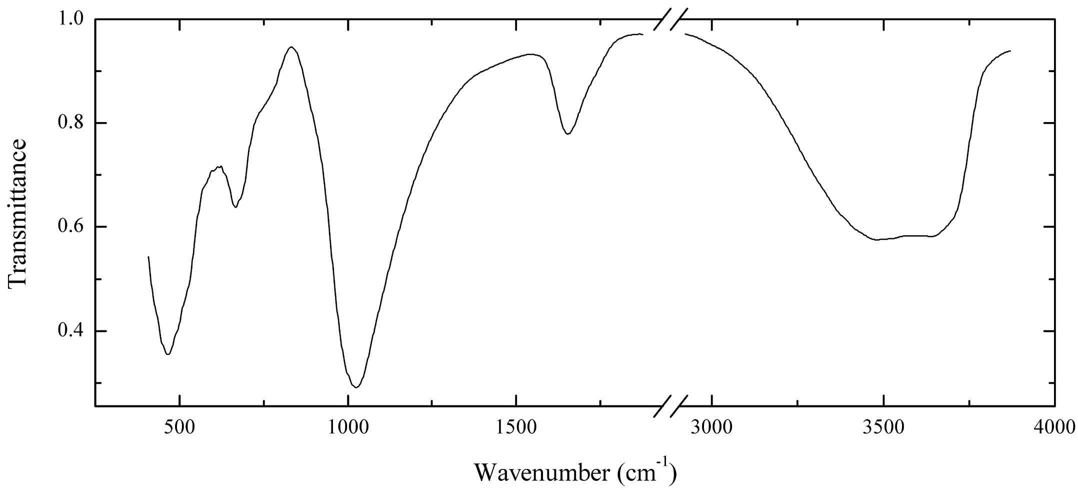


Locality: Ariskop Quarry, near Windhoek, Namibia.

Description: Dark green acicular crystals in cavities of alkaline rock, in the association with fluorapophyllite, aegirine and microcline. Na-rich variety. The empirical formula is (electron microprobe) $(Na_{2.59}Ca_{0.05}Fe_{2.22}Mn_{0.29}Ti_{0.07})$ $(Si_{7.95}Al_{0.05}O_{20})(OH)_2{\cdot}nH_2O$.

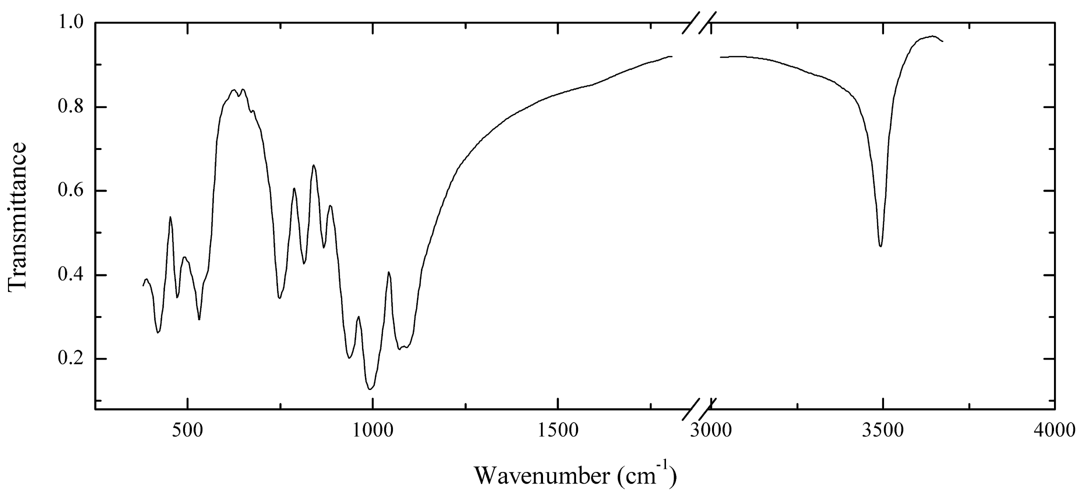
Wavenumbers (cm^{-1}): 3610, 3455, 3250sh, 1640, 1560w, 1178s, 1130sh, 1075sh, 1004s, 960sh, 787w, 737w, 682, 635, 565sh, 480sh, 448s, 420sh, 375sh.

Sil76 Saponite $(Ca_{0.5},Na)_{0.3}(Mg,Fe^{2+})_3[(Si,Al)_4O_{10}](OH)_2{\cdot}4H_2O$



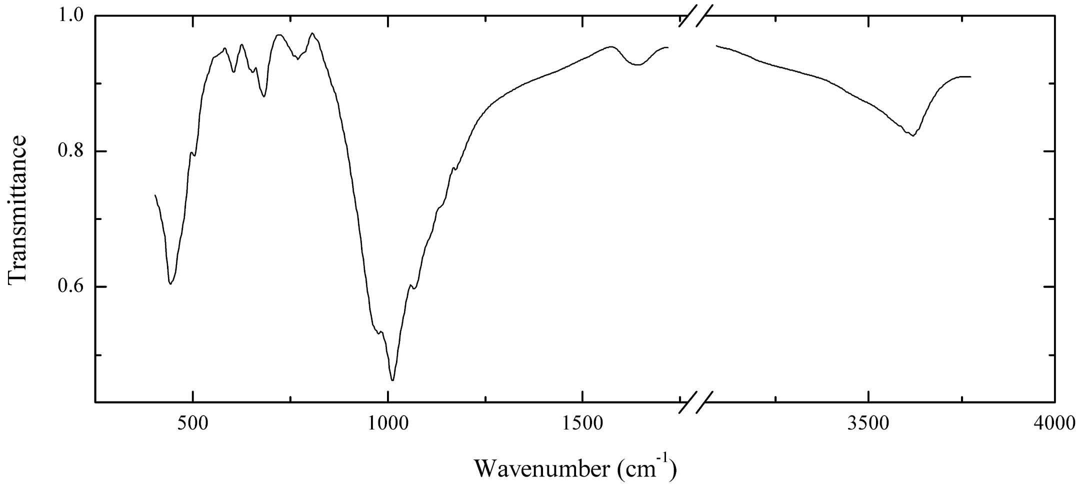
Locality: Lakargi Mt., Kabardino-Balkaria, Russia.
Description: Yellow colloform aggregate from the association with calcium hydrosilicates. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3627, 3470, 1650, 1018s, 750sh, 665, 525sh, 464s, 425sh.

Sil77 Prehnite $Ca_2Al(Si_3AlO_{10})(OH)_2$



Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless. Split prismatic crystals from metasomatic rock, from the association with vesuvianite. The empirical formula is (electron microprobe) $(Na_{0.04}Ca_{1.92}Fe_{0.04})(Al_{0.97}Fe_{0.03})(Si_{3.03}Al_{0.97}O_{10})(OH)_2$.
Wavenumbers (cm^{-1}): 3480, 1094s, 1070s, 994s, 939s, 868, 814, 747, 633w, 550sh, 529s, 470, 418s.

Sil78 Middendorfite $K_3Na_2Mn_5Si_{12}(O,OH)_{36}{\cdot}2H_2O$

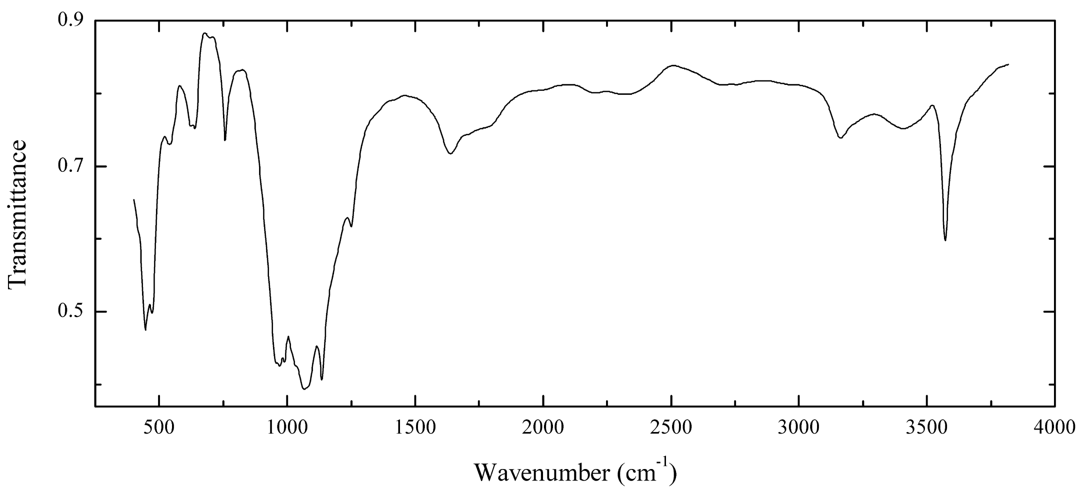


Locality: Hilairitovoye peralkaline pegmatite, Kirovskiy apatite mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark-orange coarse rhomb-like tabular crystals from the association with microcline, sodalite, cancrisilite, aegirine, calcite, natrolite, fluorite, narsarsukite, labuntsovite-Mn, mangan-neptunite and donnayite. Holotype sample. Monoclinic, space group $P2_1/m$ or $P2_1$, $a = 12.55$, $b = 5.721$, $c = 26.86$ Å, $\beta = 114.04°$. Optically biaxial (−), $\alpha = 1.534$, $\beta = 1.562$, $\gamma = 1.563$, $2V_{meas} = 10°$. $D_{meas} = 2.60$ g/cm^3, $D_{calc} = 2.65$ g/cm^3. The empirical formula is $K_{3.04}(Na_{2.07}Ca_{0.03})(Mn_{4.95}Fe_{0.13}Mg_{0.06}Ti_{0.03}Zn_{0.03})(Si_{11.94}Al_{0.06})O_{27.57}(OH)_{8.26}F_{0.17}{\cdot}1.92H_2O$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 12.28 (100) (002), 4.31 (81) (11-4), 3.555 (62) (301, 212), 3.063 (52) (008, 31-6), 2.840 (90) (312, 021, 30-9), 2.634 (88) (21-9, 1.0.-10, 12-4), 2.366 (76) (22-6, 3.1.-10, 32-3), 2.109 (54) (42-3, 42-4, 51-9, 414), 1.669 (64) (2.2.-13, 3.2.-13, 62-3, 6.1.-13), 1.614 (56) (5.0.-16, 137, 333, 71-1).

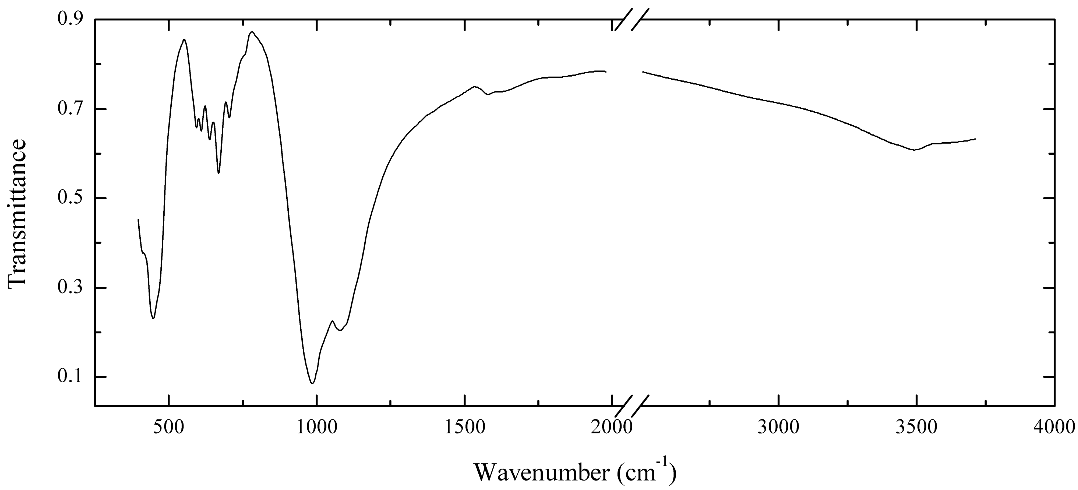
Wavenumbers (cm^{-1}): 3630, 1650, 1630sh, 1180sh, 1150sh, 1115sh, 1079, 1014s, 980s, 780sh, 764w, 682, 648, 601, 500, 438s.

Sil79 Grumantite $NaSi_2O_4(OH){\cdot}H_2O$



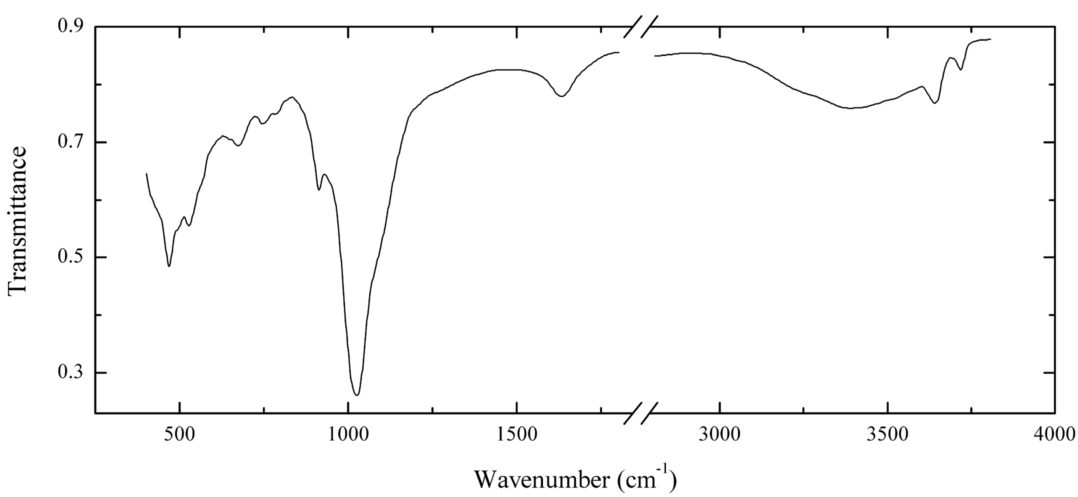
Locality: Northern quarry, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Coarse white lamellar crystals from the association with makatite. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3545, 3390w, 3145, 2700w, 2300w, 2200w, 2000w, 1185sh, 1700sh, 1652, 1250, 1137s, 1070s, 1025sh, 989s, 970s, 955s, 757, 642, 623, 583, 472s, 444s, 415sh.

Sil80 Delhayelite $(Na,K)_{10}Ca_5Al_6Si_{32}O_{80}(Cl_2,F_2,SO_4)_3 \cdot 18H_2O$



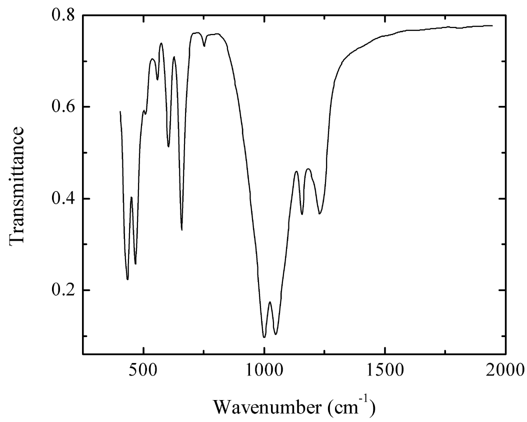
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Light grey platy crystals with perfect cleavage from rischorrite, from the association with fenaksite. A fresh (low hydrated) sample. Identified by powder X-ray diffraction pattern. Orthorhombic, $a = 6.52(1)$, $b = 24.83(6)$, $c = 7.07(1)$ Å.
Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.10 (100), 3.03 (90), 2.87 (90), 1.910 (100), 1.630(100). The empirical formula based on structural data is (electron microprobe, Z = 4) $(Na_{2.04}K_{3.84})Ca_{2.04}Sr_{0.02}Mg_{0.01}Mn_{0.02}Fe_{0.06}(Si_{7.03}Al_{0.97}O_{19})F_{1.14}Cl_{0.99} \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3495w, 1625w, 1575w, 1086s, 1020sh, 987s, 750sh, 701, 663, 636, 607, 590, 460sh, 440s, 406.

Sil82 Halloysite $Al_2Si_2O_5(OH)_4 \cdot nH_2O$



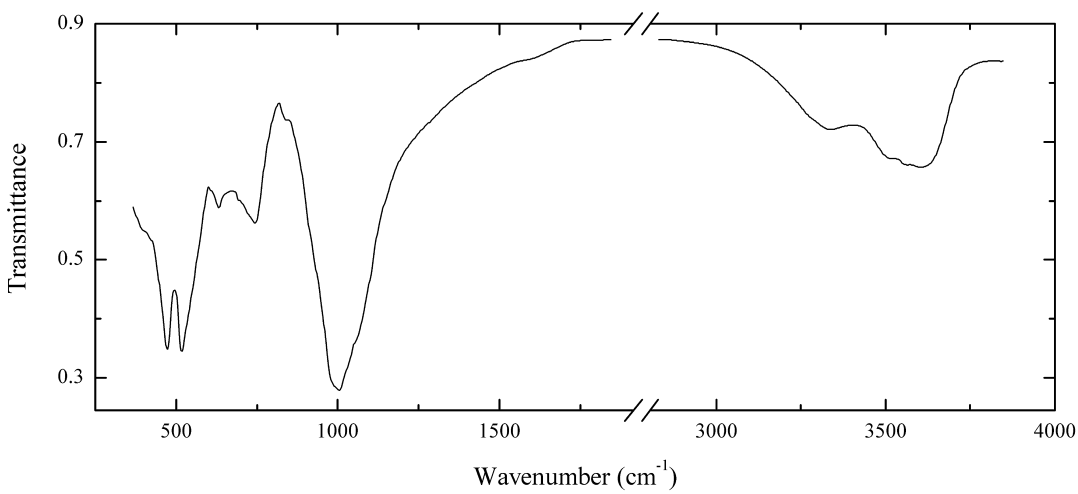
Locality: Khaidarkan Sb–Hg deposit, northern slope of the Alai ridge, Kyrgyzstan.
Description: Light blue massive (partly fibrous) aggregate in the association with khaidarkanite, chrysocolla and fluorite. Identified by powder X-ray diffraction pattern and IR spectrum. Contains about 12 wt.% CuO (by electron microprobe data).
Wavenumbers (cm^{-1}): 3697w, 3620, 3380, 1630w, 1090sh, 1028s, 1020sh, 913, 790sh, 750w, 671, 533, 495sh, 471s, 435sh.

Sil83 Gillespite $BaFe^{2+}Si_4O_{10}$



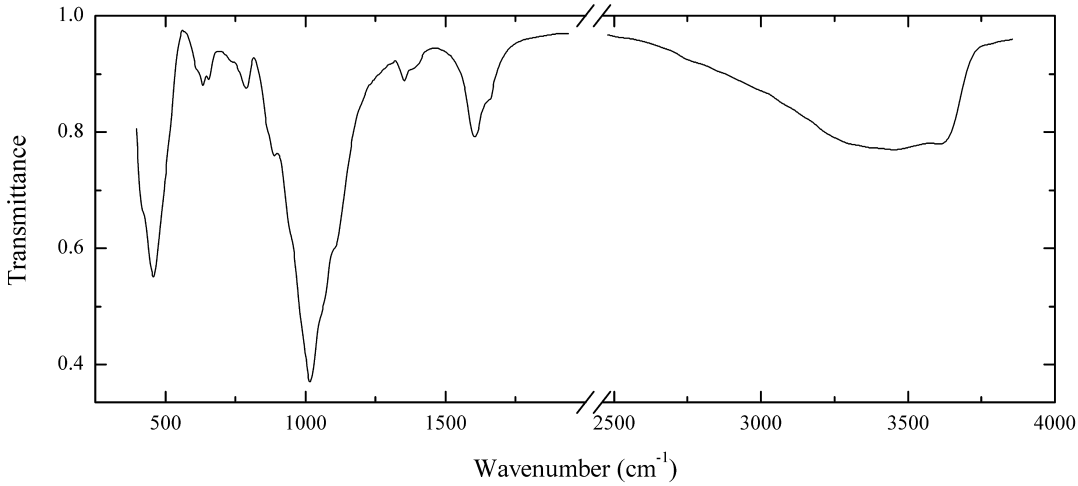
Locality: Big Creek area, Fresno Co., California, USA.
Description: Red plates from the association with sanbornite and quartz. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1236, 1160, 1049s, 1001s, 753w, 657, 603, 557, 505, 463s, 430s.

Sil84 Sudoite $Mg_2Al_3(Si_3AlO_{10})(OH)_8$



Locality: Middle Urals, Russia.
Description: Pale green pseudomorph after pyrophyllite from the association with quartz. Confirmed by IR spectrum and semiquantitative electron microprobe analysis. Mg-deficient variety (“donbassite”).
Wavenumbers (cm^{-1}): 3610, 3560, 3490, 3320, 1060, 1008s, 920sh, 844w, 748, 633, 540sh, 520s, 472s.

Sil85 Zakharovite $Na_4Mn^{2+}{}_5Si_{10}O_{24}(OH)_6{\cdot}6H_2O$

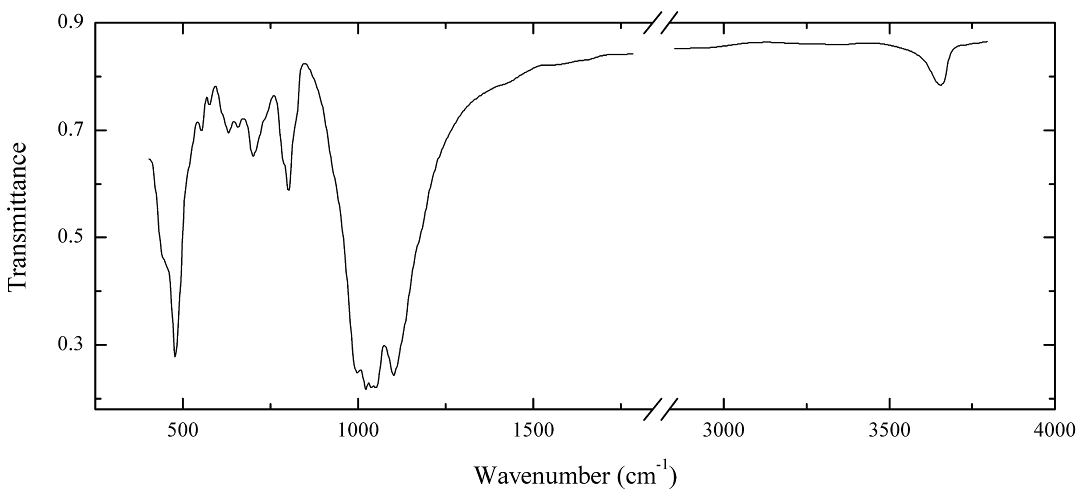


Locality: Karnasurt Mt., Lovozero alkaline complex alkaline, Kola peninsula, Murmansk region, Russia (type locality).

Description: Yellow massive from the association with ussingite. Holotype sample. Hexagonal, space group $P3_1m$ (?): $a = 14.58$ $c = 37.71$ Å. Optically uniaxial (−), $\omega = 1.565(2)$, $\varepsilon = 1.535(2)$. $D_{meas} = 2.58$-2.64 g/cm^3. The empirical formula is $(Na_{3.16}Ca_{0.46}K_{0.11}Sr_{0.01})(Mn^{2+}{}_{4.45}Fe^{3+}{}_{0.42}Mg_{0.02})Si_{10.00}O_{24.40}(OH)_{5.60}{\cdot}5.59H_2O$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 12.57 (100), 3.986 (10), 3.427 (15), 3.160 (40), 3.064 (15), 2.820 (15), 2.631 (15).

Wavenumbers (cm^{-1}): 3590, 3440, 3330sh, 1650sh, 1603, 1380sh, 1345w, 1110sh, 1055sh, 1016s, 950sh, 890, 865sh, 790, 740sh, 655w, 635, 620sh, 510sh, 457s, 420sh.

Sil86 Zussmanite $K(Fe^{2+},Mg,Mn^{2+})_{13}(Si,Al)_{18}O_{42}(OH)_{14}$

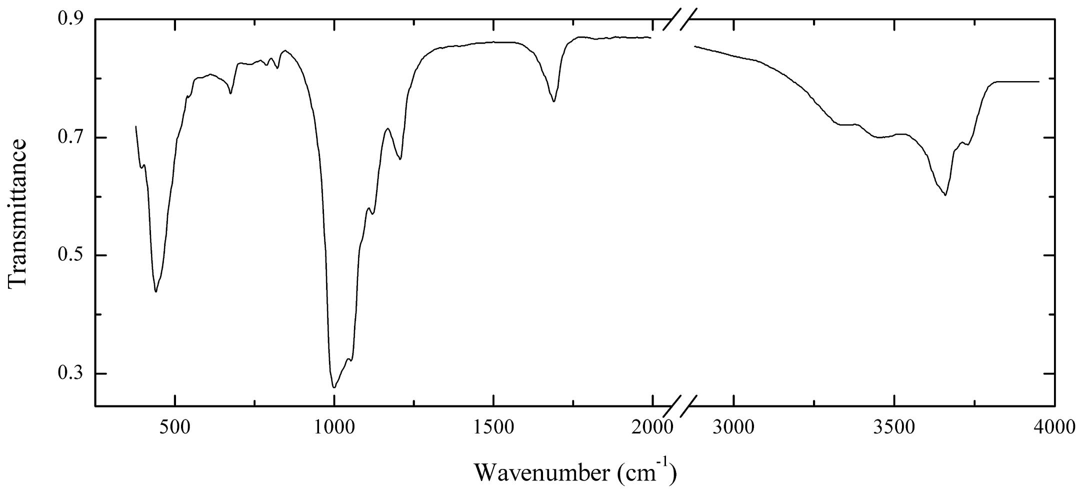


Locality: Laytonville, Mendocino Co., California, USA (type locality).

Description: Greenish-grey grains with perfect cleavage. The empirical formula is (electron microprobe) $(K_{0.80}Na_{0.16}Ba_{0.01})(Fe_{10.79}Mg_{1.28}Mn_{0.78}Al_{0.12}V_{0.03})(Si_{17.08}Al_{0.92})O_{42}(OH)_{14}$.

Wavenumbers (cm^{-1}): 3625, 1095s, 1047sh, 1040s, 1020s, 992s, 820sh, 798, 780sh, 710sh, 697, 655, 625, 569w, 546, 474s, 450sh, 435sh.

Sil87 Yofortierite $Mn_5Si_8O_{20}(OH)_2·9H_2O$



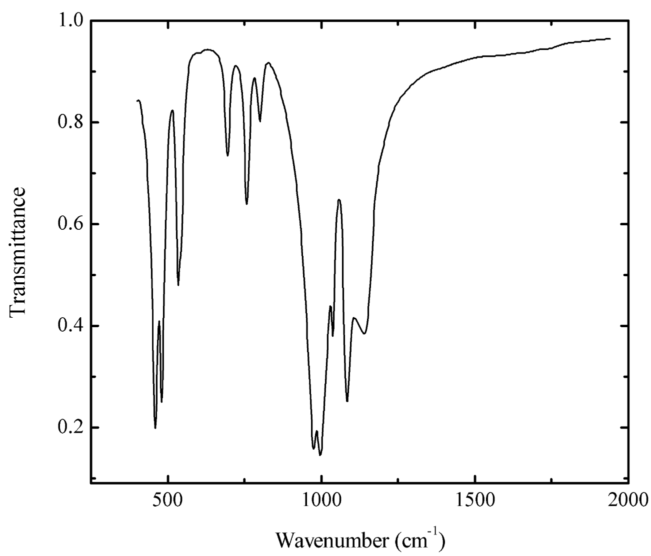
Locality: Flora Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Beige fibrous aggregate from the association with quartz, albite, narsarsukite and Fe-dominant analogue of sepiolite. Identified by powder X-ray diffraction pattern.

The empirical formula is (electron microprobe) $(Mn_{1.77}Fe^{2+}_{1.14}Fe^{3+}_{0.38}Zn_{0.51}Mg_{0.25})(Si_{8.00}O_{20})(OH)_2·nH_2O$.

Wavenumbers (cm^{-1}): 3610, 3550s, 3360, 3240, 1660, 1196, 1112, 1080sh, 1044s, 992s, 822w, 787w, 741w, 680, 559w, 470sh, 451s, 420.

Sil88 Sanbornite $BaSi_2O_5$

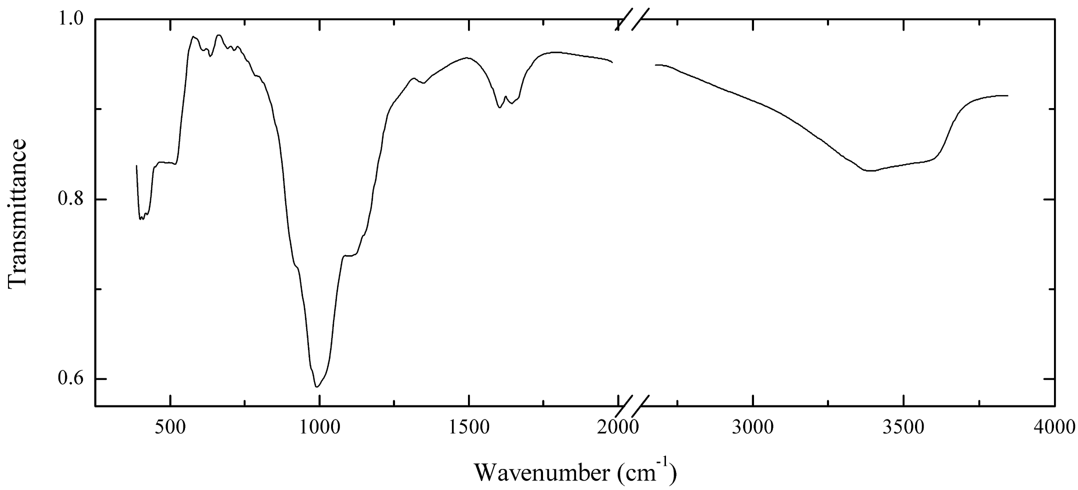


Locality: Rush Creek, Fresno Co., California, USA.

Description: Colourless plate with perfect mica-like cleavage from the association with krauskopfite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): (3400w), 1143s, 1086s, 1037, 997s, 975s, 800, 758, 695, 540sh, 533, 479s, 458s.

Sil89 Kalifersite $(K,Na)_5Fe^{3+}{}_7(Si_{20}O_{50})(OH)_6\cdot 12H_2O$

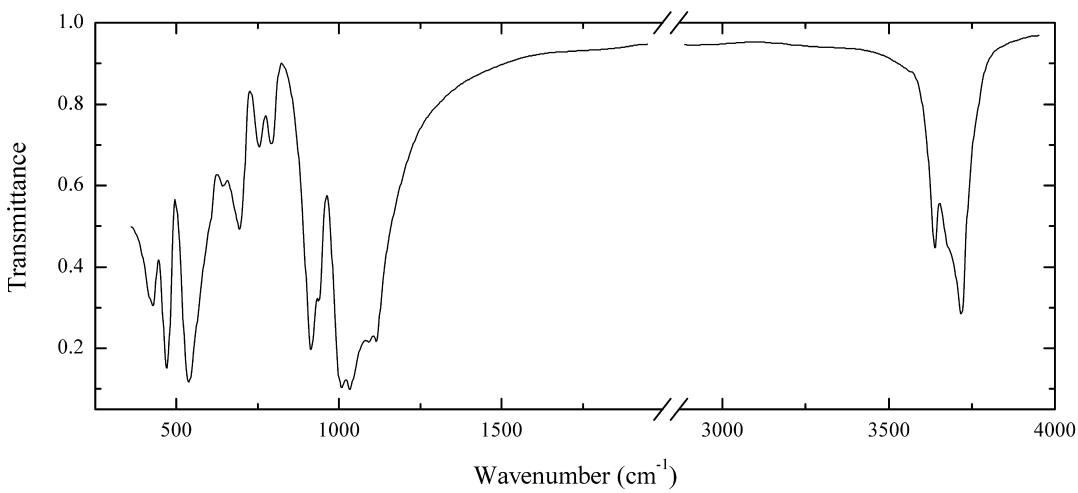


Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Brown fibrous aggregate. Holotype sample.

Wavenumbers (cm^{-1}): 3450sh, 3360, 1645w, 1603w, 1350w, 1025sh, 998s, 920sh, 692w, 633w, 612w, 515, 500sh, 420sh, 402.

Sil90 Kaolinite $Al_2Si_2O_5(OH)_4$

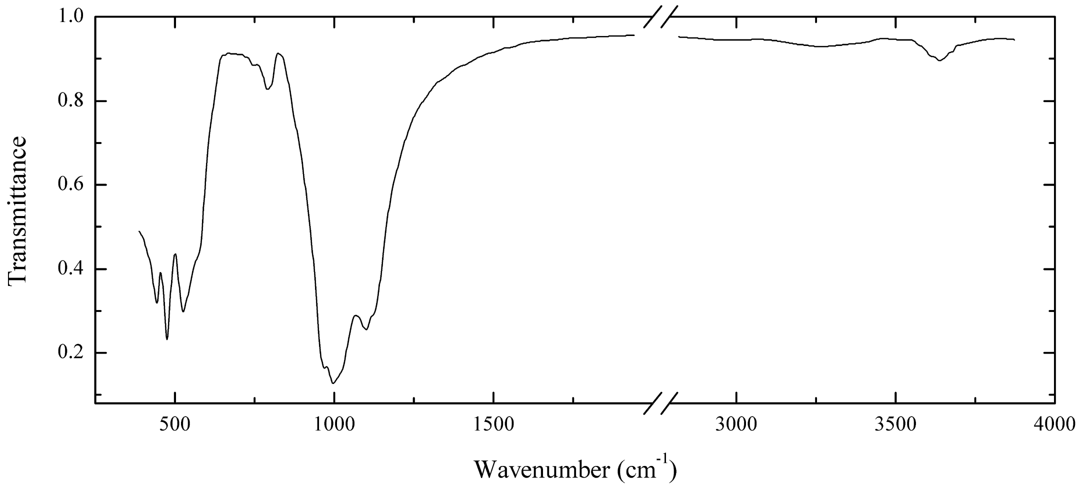


Locality: Margaritas mine, Pena Blanca uranium distr., W of Chihuahua, Mexico.

Description: White powdery aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3693s, 3655sh, 3620, 1115s, 1090s, 1032s, 1006s, 939, 914s, 792, 753, 696, 642, 600sh, 536s, 470s, 429.

Sil91 Trilithionite $KLi_{1.5}Al_{1.5}(Si_3AlO_{10})F_2$

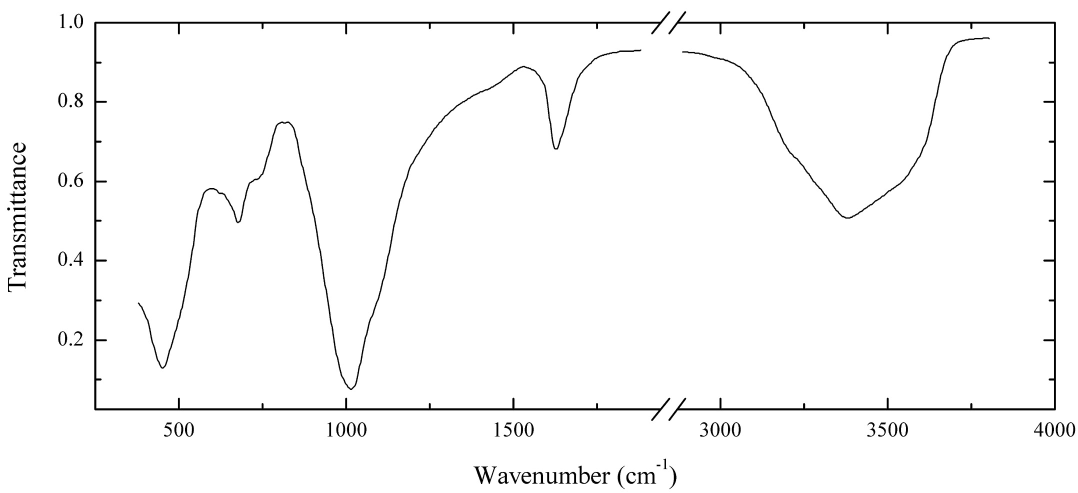


Locality: Ugurchan Mt., Borshchyovochnyi ridge, Transbaikal Region, Russia.

Description: Yellow platy crystals from granite pegmatite, from the association with quartz, albite and elbaite. The empirical formula is (electron microprobe; Li estimated by stoichiometry) $(K_{0.8}Rb_{0.1}Na_{0.1})(Li_{1.3}Al_{1.1}Fe_{0.4}Mn_{0.1}Mg_{0.1})(Si_{3.3}Al_{0.7}O_{10})F_{1.3}(OH)_{0.7}$

Wavenumbers (cm^{-1}): 3615, 1115sh, 1097s, 1020sh, 993s, 965s, 790, 750w, 570sh, 525s, 474s, 445s.

Sil92 Saponite $(Ca_{0.5},Na)_{0.3}(Mg,Fe^{2+})_3[(Si,Al)_4O_{10}](OH)_2\cdot 4H_2O$

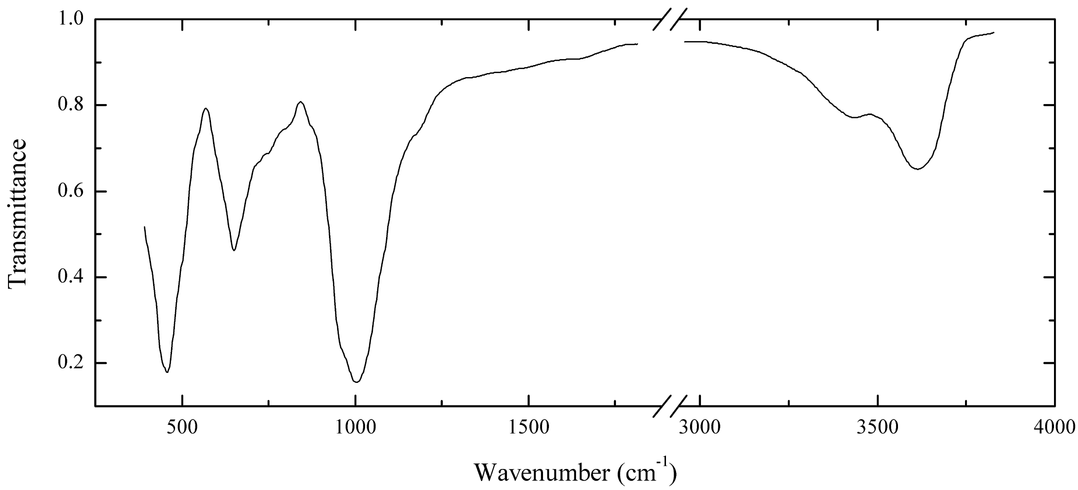


Locality: Zlatolist village, near Kyrdzhali, Eastern Rodops, Bulgaria.

Description: Brown massive, from the association with chalcedony and clinoptilolite. Fe-rich variety. The empirical formula is (electron microprobe) $(Ca_{0.22}Na_{0.02}K_{0.01})(Mg_{1.70}Fe_{1.14}Al_{0.17})(Si_{3.44}Al_{0.56}O_{10})(OH,O)_2\cdot nH_2O$.

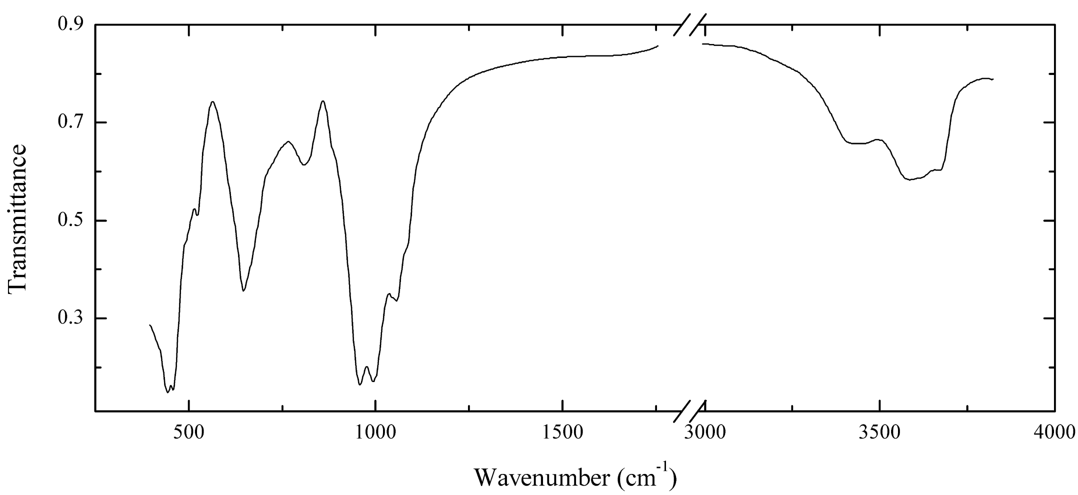
Wavenumbers (cm^{-1}): 3525sh, 3375s, 3220sh, 1635, 1075sh, 1015s, 730sh, 677, 450s.

Sil93 Clinochlore $(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$



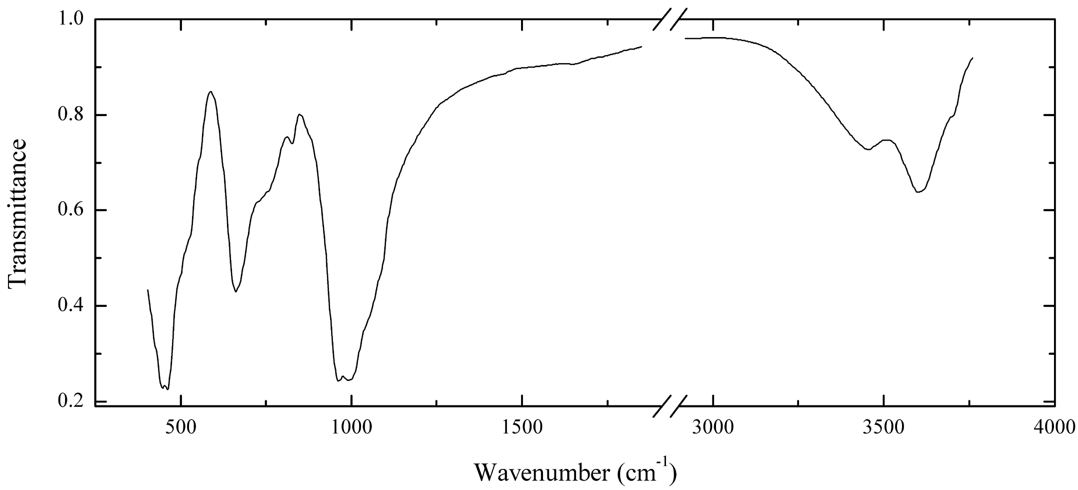
Locality: Southern Feizulinskoe deposit, Bashkortostan, Russia.
Description: Scaly aggregate. Mn-rich variety. The approximate empirical formula calculated from semiquantitative electron microprobe analysis is $(Mg_3MnFeAl)(Si_3AlO_{10})(OH)_8$.
Wavenumbers (cm^{-1}): 3585, 3410, 1635w, 1170sh, 1000s, 960sh, 795sh, 745sh, 715sh, 649, 495sh, 455s, 440sh, 395sh.

Sil94 Clinochlore $(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$



Locality: N'Chwaning II Mine, Kalahari Manganese Fields, Cape province, Republic of South Africa.
Description: Light green scales in the association with calcite and ettringite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3670, 3615sh, 3580, 3440, 1085sh, 1061, 996s, 961s, 815, 648, 526, 490sh, 455s, 437s, 415sh.

Sil95 Clinochlore $(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$

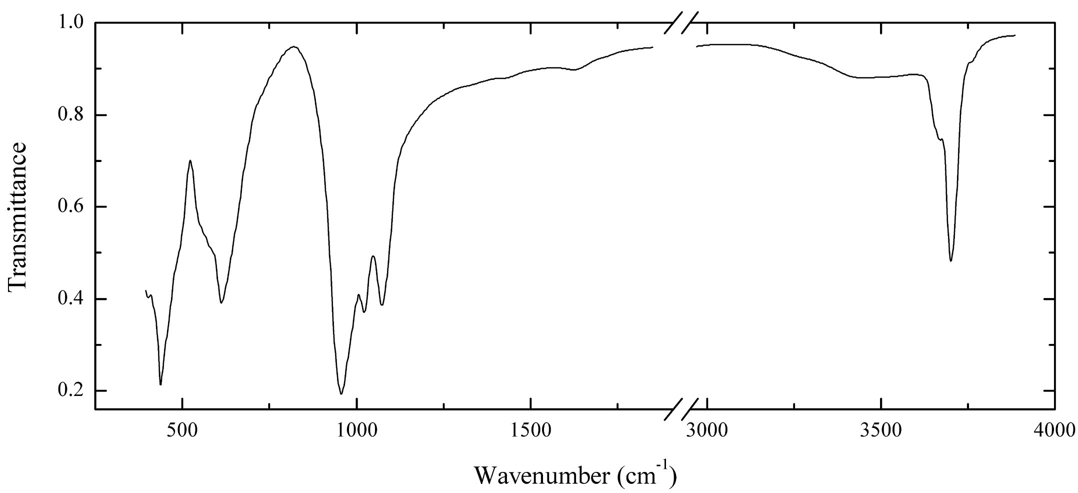


Locality: Akhmatovskaya kop' (Akhmatovskaya pit), north of Zlatoust, South Urals, Russia.

Description: Colourless platy crystal in skarn, in the association with grossular and calcite. The empirical formula is (electron microprobe) $(Mg_{4.80}Fe_{0.11}Al_{1.09})(Si_{2.91}Al_{1.09})O_{10}(OH)_8$.

Wavenumbers (cm^{-1}): 3680sh, 3600, 3450, 1638w, 1085sh, 1040sh, 994s, 962s, 823w, 755sh, 725sh, 659, 550sh, 520sh, 490sh, 457s, 442s, 420sh.

Sil96 Clinochrysotile (chrysotyle-2*M*$_{c1}$) $Mg_3Si_2O_5(OH)_4$

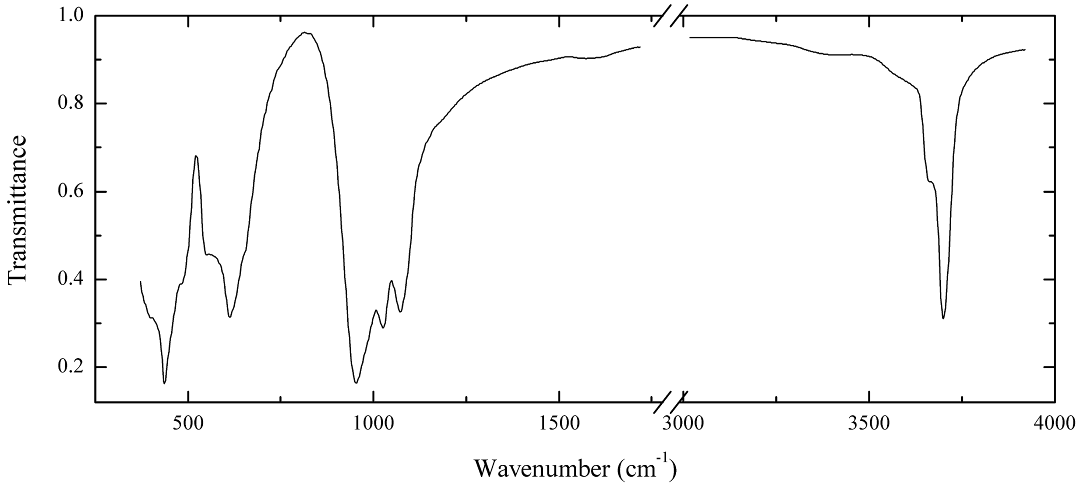


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Olive green, massive, from the association with magnetite and phlogopite. Identified by powder X-ray diffraction pattern. Contains adsorbed water.

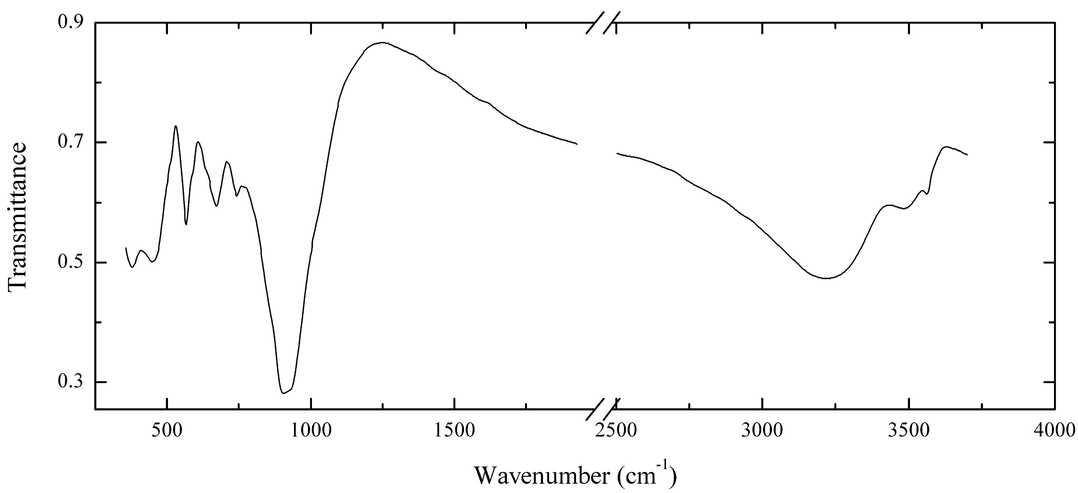
Wavenumbers (cm^{-1}): 3690, 3660, 3640sh, 3450w, 1625w, 1074, 1026, 957s, 660sh, 612, 580sh, 560sh, 490sh, 436s, 405.

Sil97 Clinochrysotile (chrysotyle-2M_{c1}) $Mg_3Si_2O_5(OH)_4$



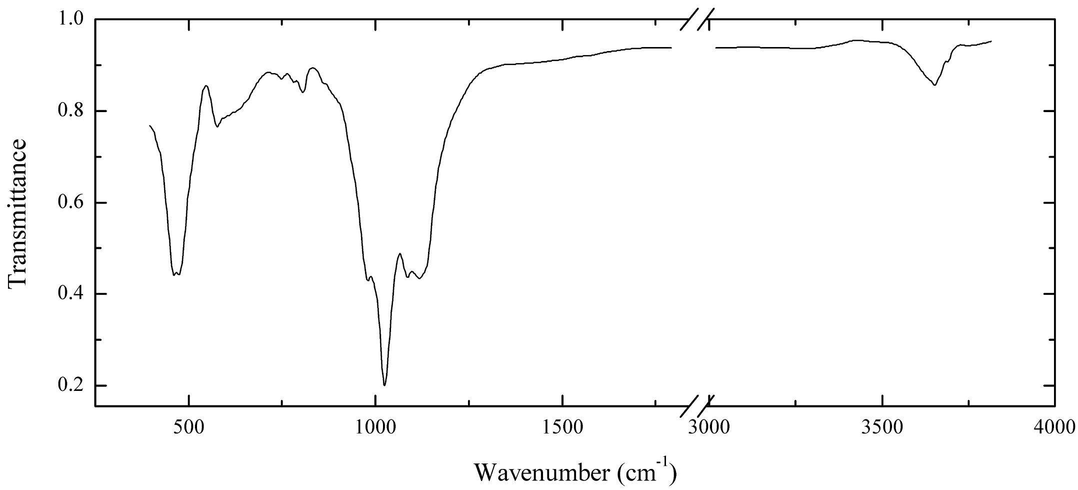
Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.
Description: Olive green, coarse-columnar aggregate forming vein in serpentinite. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3691, 3653, 1072, 1028s, 954s, 650sh, 612, 580sh, 550, 480sh, 436s, 398.

Sil98 Cronstedtite $Fe^{2+}{}_2Fe^{3+}[(Si,Fe^{3+})_2O_5](OH)_4$



Locality: Gernrode, Harz, Germany.
Description: Black crystals (up to 2 mm) growing on pyrite. The empirical formula is (electron microprobe) $(Fe_{2.89}Mg_{0.09}Mn_{0.02})$ $(Si_{1.13}Fe_{0.87}O_5)(OH)_4$.
Wavenumbers (cm^{-1}): 3550w, 3475w, 3210, 925sh, 902s, 743, 675, 660sh, 590sh, 567, 455s, 399s.

Sil100 Coombsite $K(Mn^{2+},Fe^{2+},Mg)_{13}(Si,Al)_{18}O_{42}(OH)_{14}$

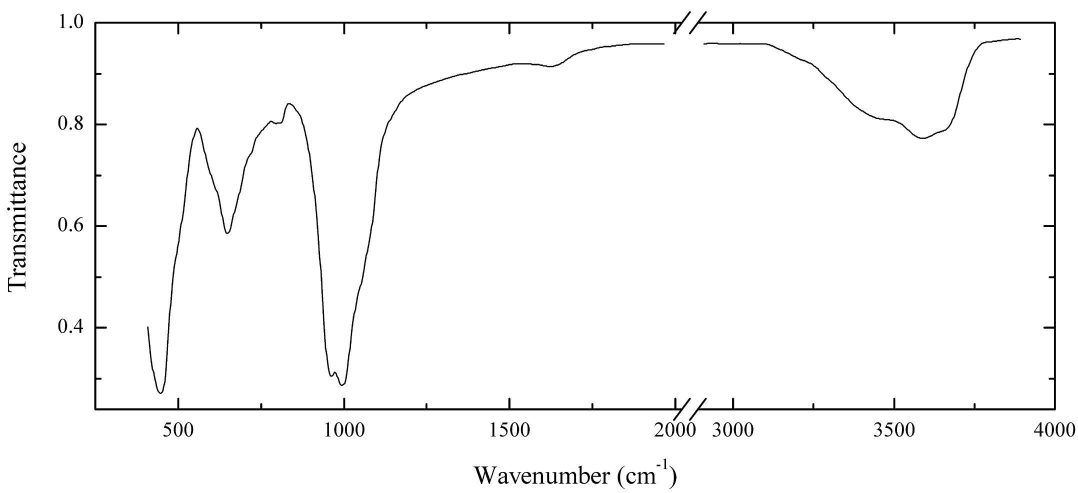


Locality: Kozhaevskoe deposit, South Urals, Russia.

Description: Yellowish grains in rhodonite rock. Identified by powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3645, 3615sh, 1122s, 1088s, 1026s, 982s, 806, 785w, 752w, 660sh, 635sh, 605sh, 577, 472s, 460s.

Sil103 Clinochlore $(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$

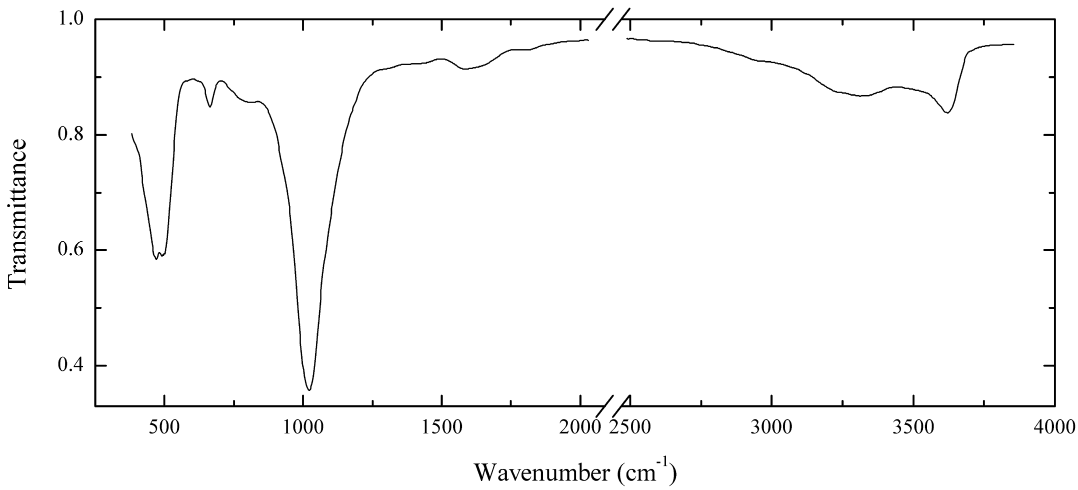


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Dark green scales in cavities of dolomite carbonatite. The empirical formula is (electron microprobe) $(Mg_{4.03}Fe_{1.01}Al_{0.96})(Si_{3.02}Al_{0.98})O_{10}(OH)_8$.

Wavenumbers (cm^{-1}): 3630sh, 3570, 3440sh, 1635w, 1045sh, 993s, 962s, 812w, 795w, 710sh, 650, 610sh, 446s.

Sil104 Chrysocolla $(Cu,Al)_2H_2Si_2O_5(OH)_4 \cdot nH_2O$

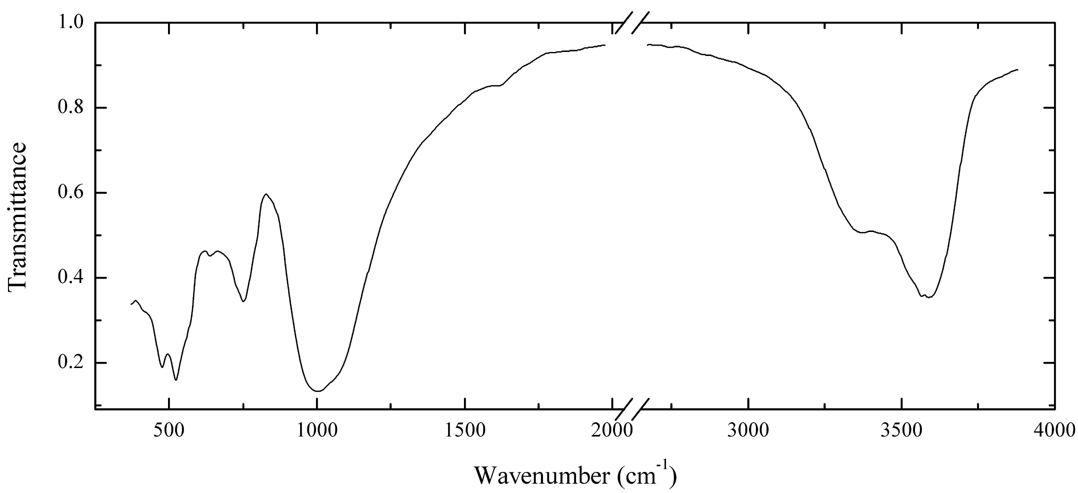


Locality: Novoveská Huta, Spisska Nova Ves, Slovakia.

Description: Colloform crust in the association with malachite, tyrolite and chalcophyllite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3615, 3310, 1650sh, 1590, 1022s, 800, 665, 495s, 472s.

Sil105 Cookeite $LiAl_4(Si_3AlO_{10})(OH)_8$

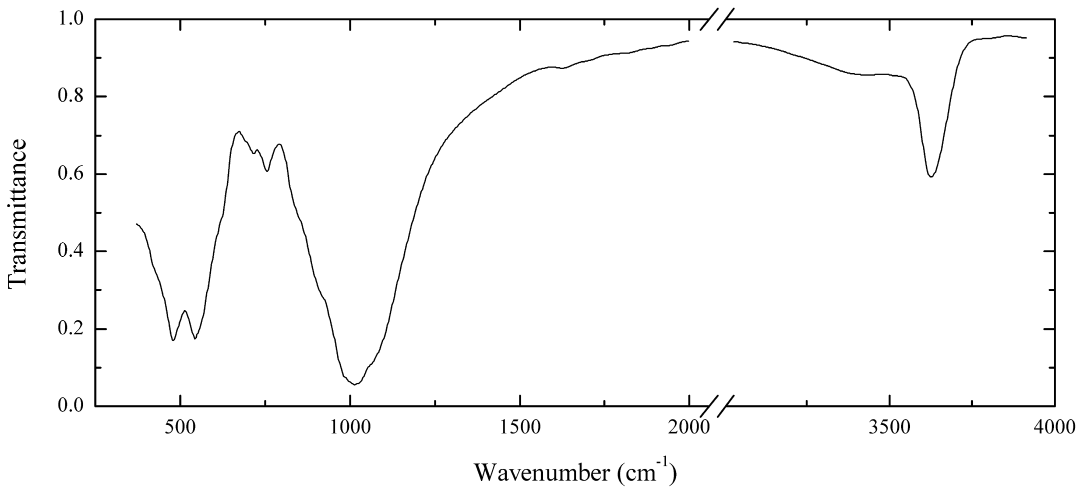


Locality: Muiane mine, near Alto Ligonha, Gile, Mozambique.

Description: Yellow plates with pearly lustre, in the association with quartz, albite, elbaite and lepidolite. The empirical formula is (calculated on Si_3; electron microprobe) $Ca_{0.03}Li_xAl_{4.91}Mn_{0.03}Si_{3.00}(OH)_8 \cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3590, 3565, 3530sh, 3365, 1623w, 1050sh, 1000s, 750, 638w, 570sh, 523s, 475s, 420sh.

Sil106 Boromuscovite $KAl_2(Si_3BO_{10})(OH)_2$

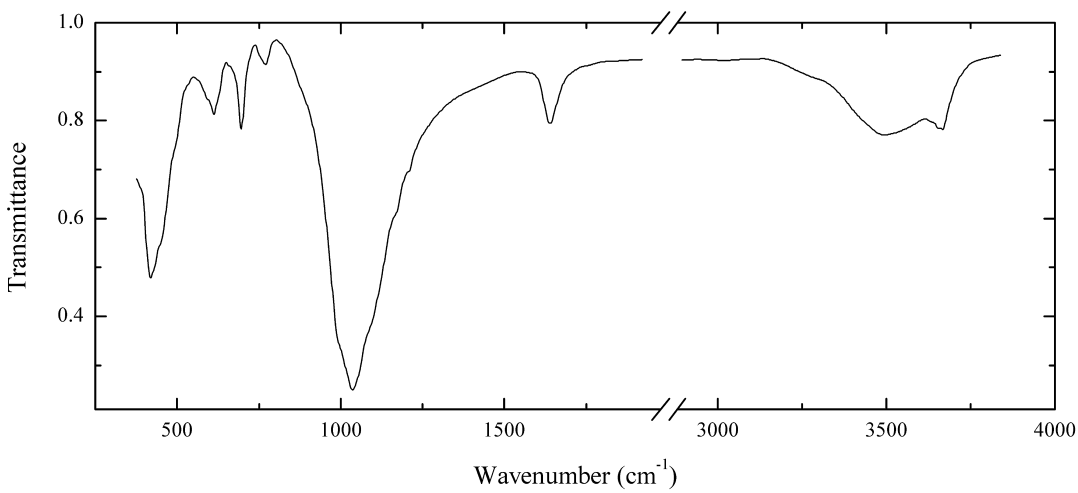


Locality: Mokrusha pit, Murzinka region, Middle Urals, Russia.

Description: Beige crusts on crystals of masutomilite. Al-rich variety (intermediate member of the series muscovite-boromuscovite). The empirical formula is (electron microprobe; B calculated by stoichiometry) $K_{0.94}Al_{2.00}(Si_{3.09}Al_{0.45}B_{0.46}O_{10})(OH)_2{\cdot}nH_2O$ ($n \ll 1$).

Wavenumbers (cm^{-1}): 3604, 3390w, 1623w, 1065sh, 1016s, 920sh, 855sh, 757, 715w, 547s, 480s, 430sh.

Sil107 Monteregianite-(Y) $Na_4Ca_2Y_2(Si_{16}O_{38})(OH)_2{\cdot}10H_2O$

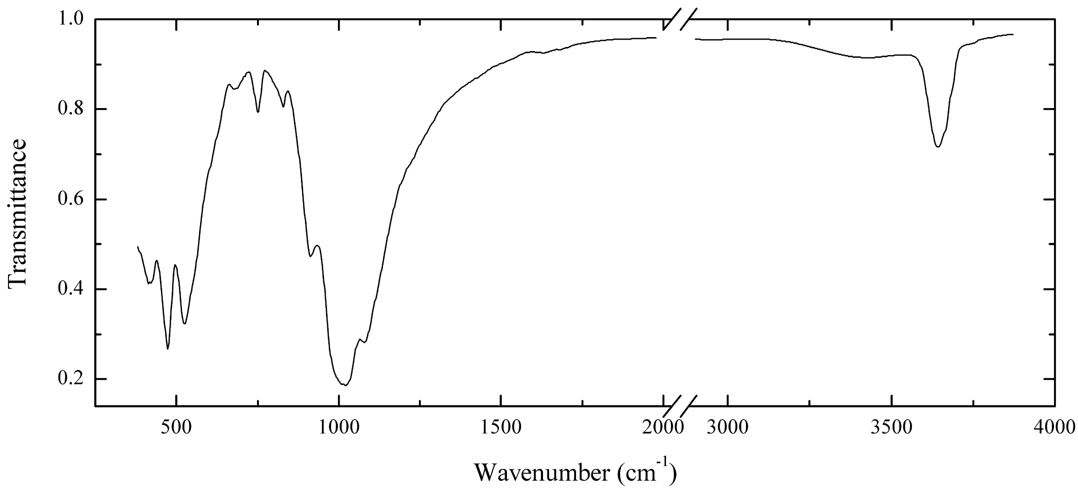


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Grey prismatic crystal with pearly lustre. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3635, 3470, 1637, 1205sh, 1165sh, 1085sh, 1037s, 995sh, 765w, 693, 610, 600sh, 495sh, 450sh, 422s.

Sil109 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$

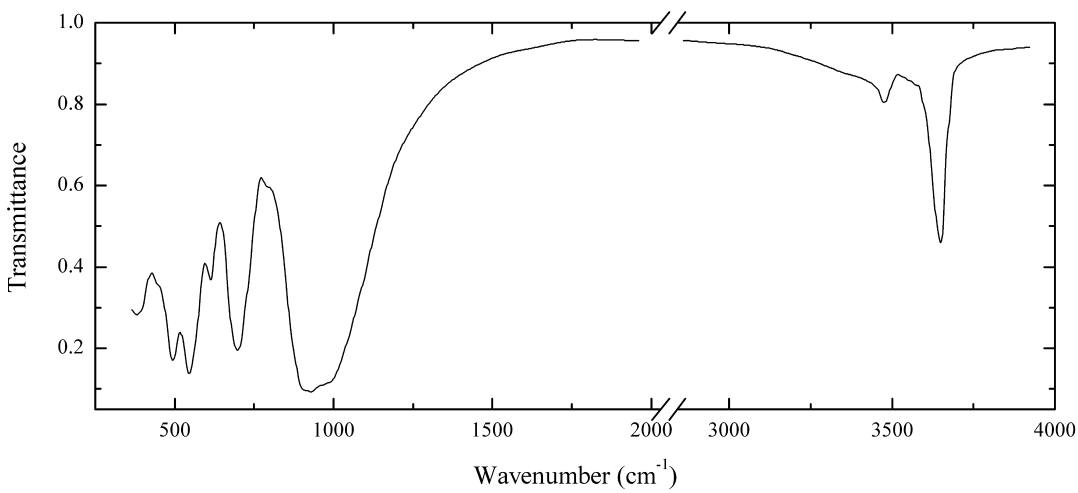


Locality: Greifenstein, Saxony, Germany.

Description: Brown crust consisting of split crystals in the association with fluorapatite. A Fe- and possibly Li-bearing variety (by the data of semiquantitative electron microprobe analysis).

Wavenumbers (cm^{-1}): 3610, 3430w, 1079s, 1023s,1000sh, 914, 830, 753, 682w, 526s, 473s, 417s.

Sil110 Margarite $CaAl_2(Si_2Al_2O_{10})(OH)_2$

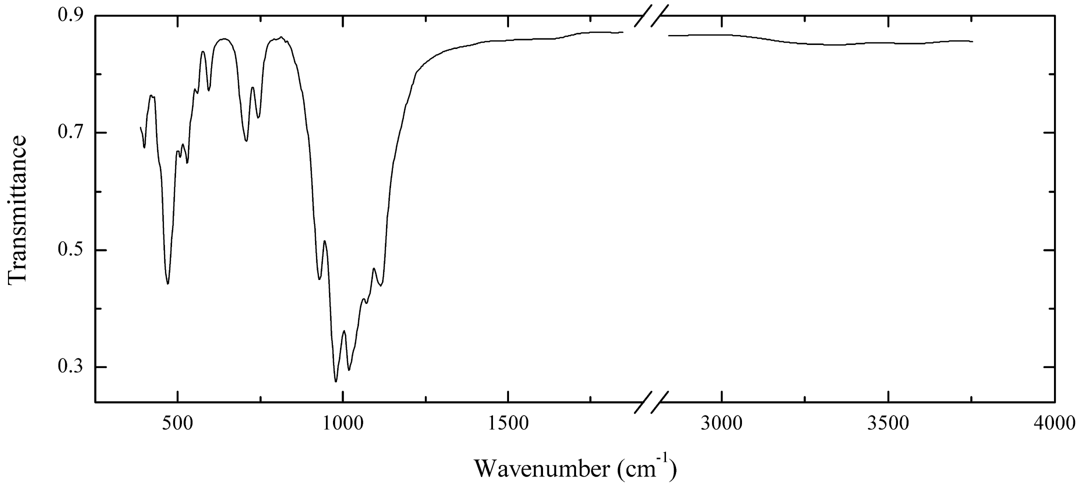


Locality: Malyshevskoe emerald deposit, Middle Urals, Russia.

Description: Colourless tabular crystals in phlogopite-rich rock. The empirical formula calculated on Si_2 is (electron microprobe) $(Ca_{0.93}Na_{0.11}K_{0.02})Al_{2.00}(Si_{2.00}Al_{1.52}Be_{0.48}O_{10})(OH,F)_2$ (Be calculated by stoichiometry). The band at 3,450 cm^{-1} corresponds to stretching vibrations of BeO_4 tetrahedra.

Wavenumbers (cm^{-1}): 3623, 3450w, 980sh, 923s, 908s, 800sh, 702s, 615, 548s, 495s, (380).

Sil111 Manganonaujakasite $Na_5(Mn,Fe)Al_4Si_8O_{26}$

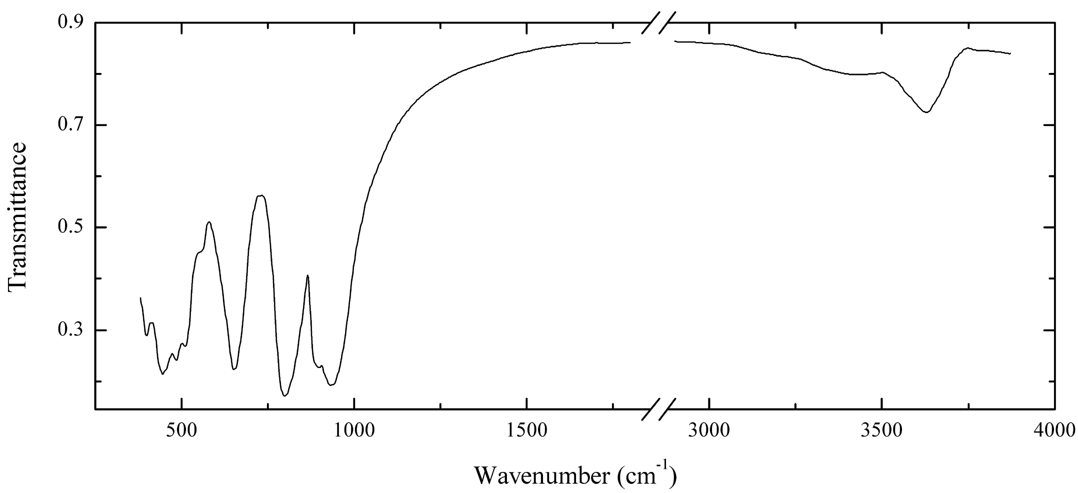


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Blue grains with mica-like cleavage in the association with manaksite, nordite-(Ce), tisinalite, vuonnemite. Holotype sample. Monoclinic, space group *C*2/*m*, $a = 15.033$, $b = 8.001$, $c = 10.478$ Å, $\beta = 113.51°$, $Z = 2$. Optically biaxial (–), $\alpha = 1.539$, $\beta = 1.551$, $\gamma = 1.554$, $2V_{meas} = 54°$. $D_{calc} = 2.71$ g/cm^3, $D_{meas} = 2.67$ g/cm^3. The empirical formula is $(Na_{5.96}Ca_{0.01})(Mn_{0.53}Fe_{0.49})Al_{3.95}Si_{8.03}O_{26.00}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 3.995 (65) (020, 310), 3.623 (92) (112), 3.552 (56) (-402), 3.485 (58) (-203, -221), 3.362 (33) (202), 3.068 (100) (022, -313, 221), 2.613 (39) (420).

Wavenumbers (cm^{-1}): 1114, 1073, 1035sh, 1019s, 980s, 930, 746, 709, 595w, 559w, 540sh, 530, 506, 471s, 398.

Sil112 Clintonite $CaMg_2Al(SiAl_3O_{10})(OH)_2$

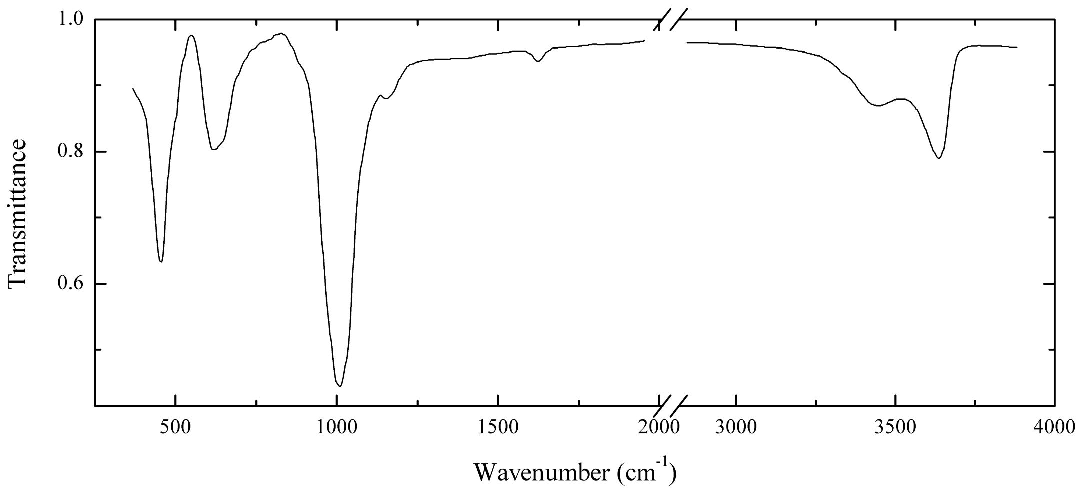


Locality: Nikolae-Maximilianovskaya pit, near Zlatoust, South Urals, Russia.

Description: Green brittle plate with perfect cleavage in skarn. The empirical formula is (electron microprobe) $Ca_{1.0}Mg_{2.0}Fe_{0.3}Al_{0.7}$ $(Si_{1.15}Al_{2.85}O_{10})(OH)_2$.

Wavenumbers (cm^{-1}): 3630, 3430w, 936s, 898, 799s, 652s, 555sh, 505, 479, 450s, 395.

Sil113 Caryopilite $Mn^{2+}{}_6Si_4O_{10}(OH)_8$

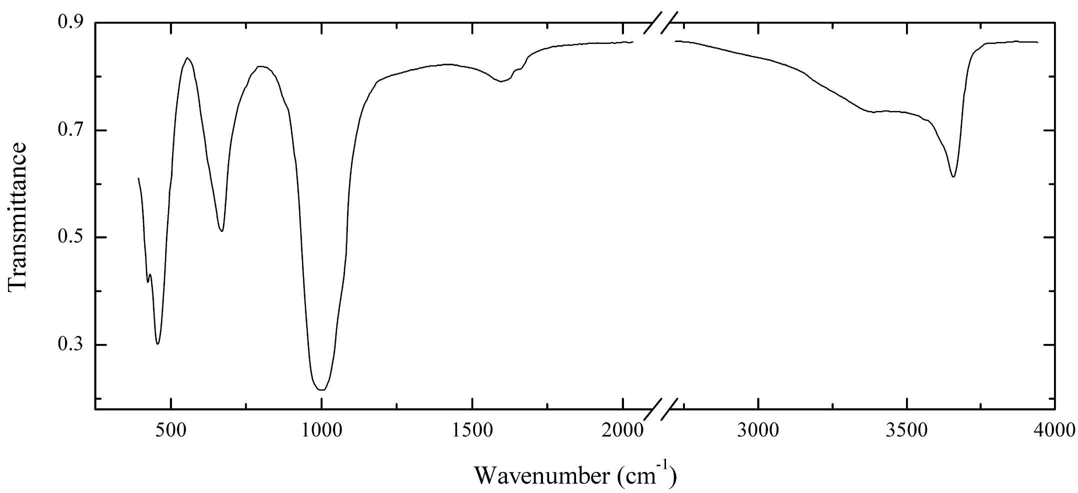


Locality: Kyzyl Tash deposit, Bashkortostan, South Urals, Russia.

Description: Red-brown massive in the association with tephroite, rhodochrosite, kutnohorite and rhodonite. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Mn_{5.12}Fe_{0.12}Al_{0.11}Mg_{0.09})$ $(Si_{4.00}O_{10})(OH)_8{\cdot}nH_2O$.

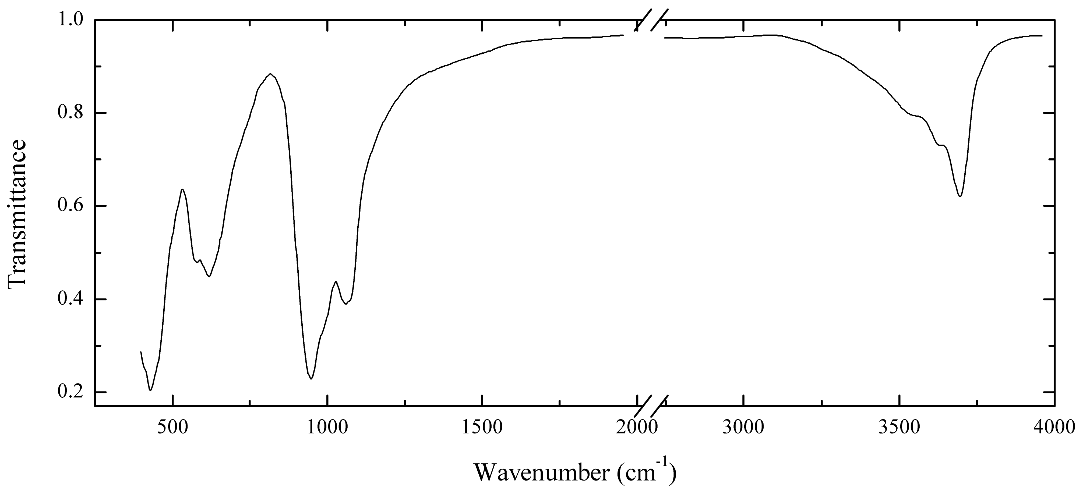
Wavenumbers (cm^{-1}): 3608, 3420, 1617w, 1163, 1007s, 890sh, 650sh, 617, 490sh, 452s, 420sh.

Sil114 Pecoraite $Ni_3(Si_2O_5)(OH)_4$



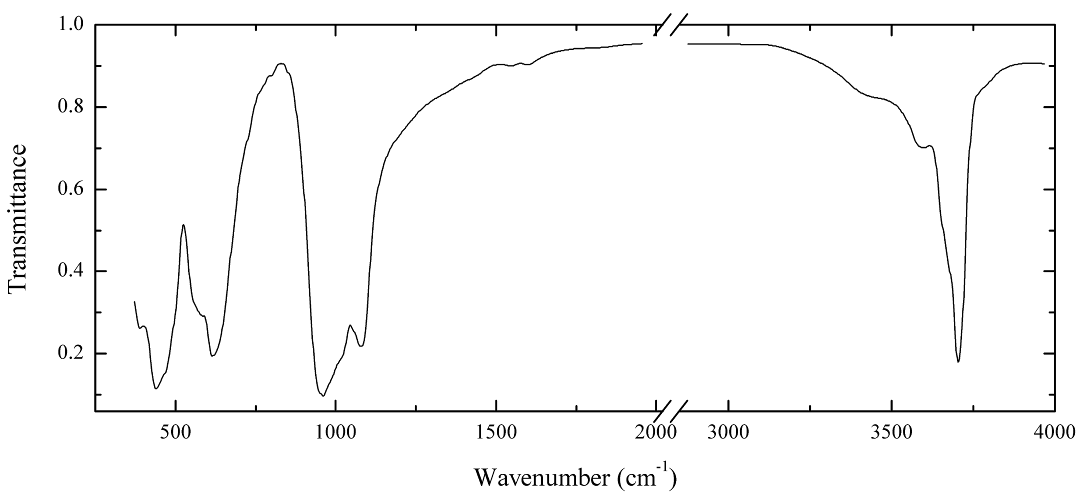
Locality: Kayseri-Develi, Central Anatolia, Turkey.
Description: Light green, massive. Identified by powder X-ray diffraction pattern.
Zn-rich hydrated variety. The empirical formula is (electron microprobe) $(Ni_{1.8}Zn_{0.9}Fe_{0.3})(Si_{1.9}Al_{0.1}O_5)(OH)_4 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3635, 3370, 1655sh, 1600w, 1065sh, 1001s, 668, 625sh, 457s, 425.

Sil115 Lizardite $Mg_3(Si_2O_5)(OH)_4$



Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Light grey-green lamellar, with mica-like cleavage. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3685, 3615, 3540w, 1075sh, 1060, 985sh, 947s, 619, 578, 430s, 410sh.

Sil116 Lizardite $Mg_3(Si_2O_5)(OH)_4$

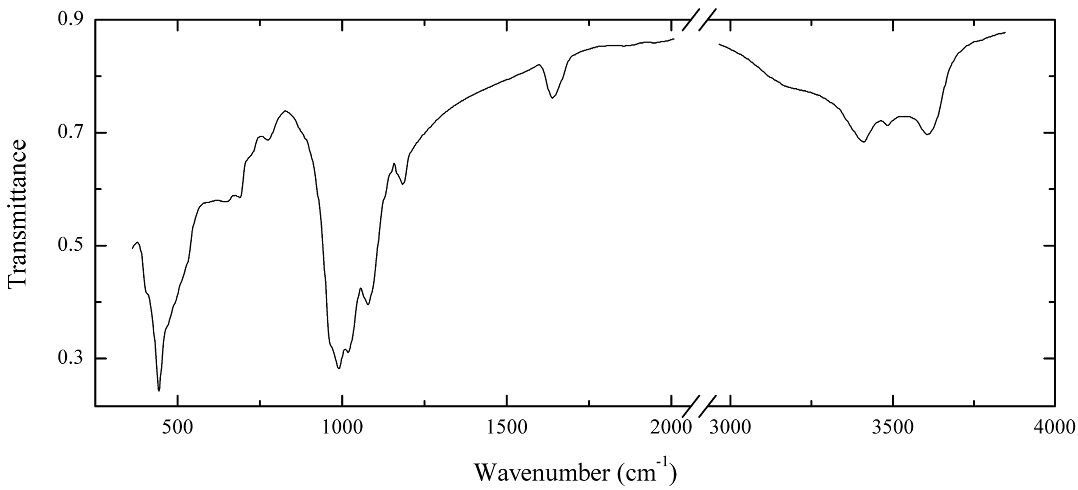


Locality: Snarum, Modum, Buskerud, Norway.

Description: Light olive green massive from the association with hydrotalcite. Identified by IR spectrum and powder X-ray diffraction pattern. A mixture of 1*T* and 2*H* polytypes.

Wavenumbers (cm^{-1}): 3693, 3655sh, 3590w, 3425sh, 1610w, 1550sh, 1077s, 1015sh, 958s, 619s, 584, 570sh, 550sh, 440s, 392.

Sil117 Loughlinite $Na_2Mg_3(Si_6O_{15})(OH)_2{\cdot}6H_2O$

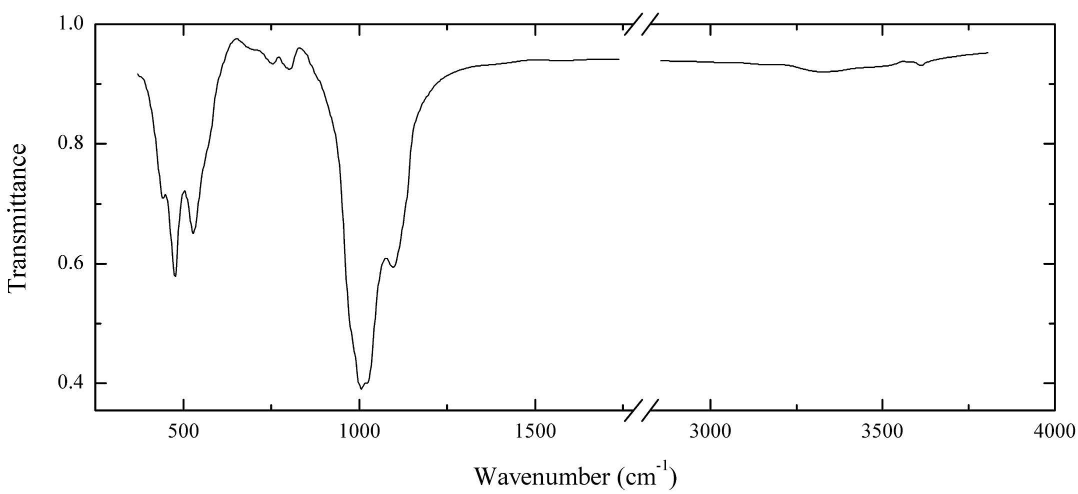


Locality: Green River, Sweetwater Co., Wyoming, USA.

Description: White fibrous aggregate from the association with shortite and searlesite. Confirmed by qualitative electron microprobe analysis and IR spectrum.

Wavenumbers (cm^{-1}): 3605, 3490w, 3410, 3230sh, 1640w, 1185, 1081, 1019s, 990s, 970sh, 767w, 715sh, 683, 634, (605), 515sh, 480sh, 440s, 420sh.

Sil118 Trilithionite $KLi_{1.5}Al_{1.5}(Si_3AlO_{10})F_2$

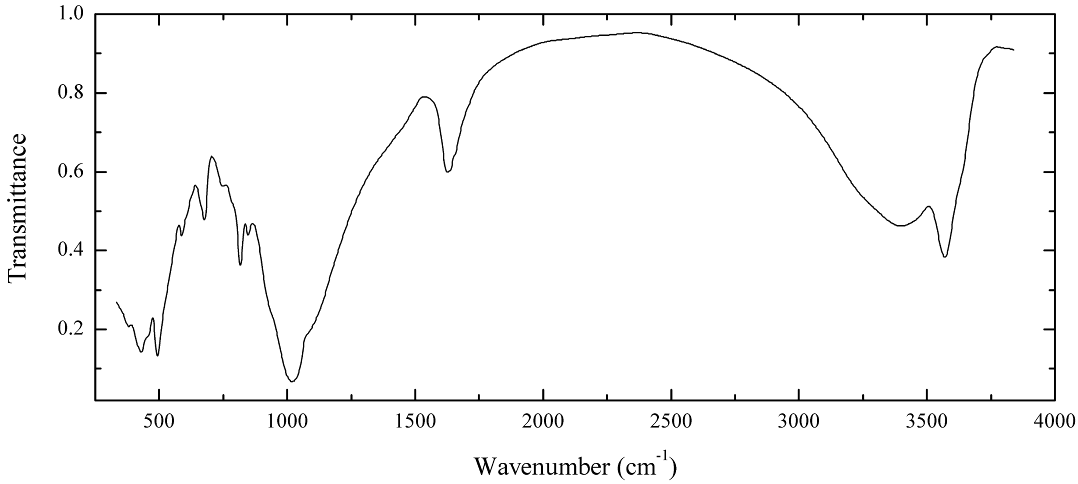


Locality: Vasin-Myl'k Mt., Voron'i Tundras massif, Kola peninsula, Murmansk region, Russia.

Description: Grey-lilac plates (about 0.5 cm) in albite, in the association with holtite and stibiotantalite. Rb-rich variety. The empirical formula is (electron microprobe, Li calculated by charge balance) $(K_{0.63}Rb_{0.19}Cs_{0.07}Na_{0.02})(Li_{1.62}Al_{1.34})(Si_{3.45}Al_{0.55}O_{10})(F,OH)_2$.

Wavenumbers (cm^{-1}): 3613w, 1097s, 1022s, 1004s, 975sh, 800w, 754w, 695sh, 570sh, 529, 476s, 443.

Sil119 Nontronite $(Na,Ca)_x(Fe^{3+},Al,Mg)_2[(Si,Al)_4O_{10}](OH)_2\cdot nH_2O$ ($x \approx 0.3$, $n \approx 4$)

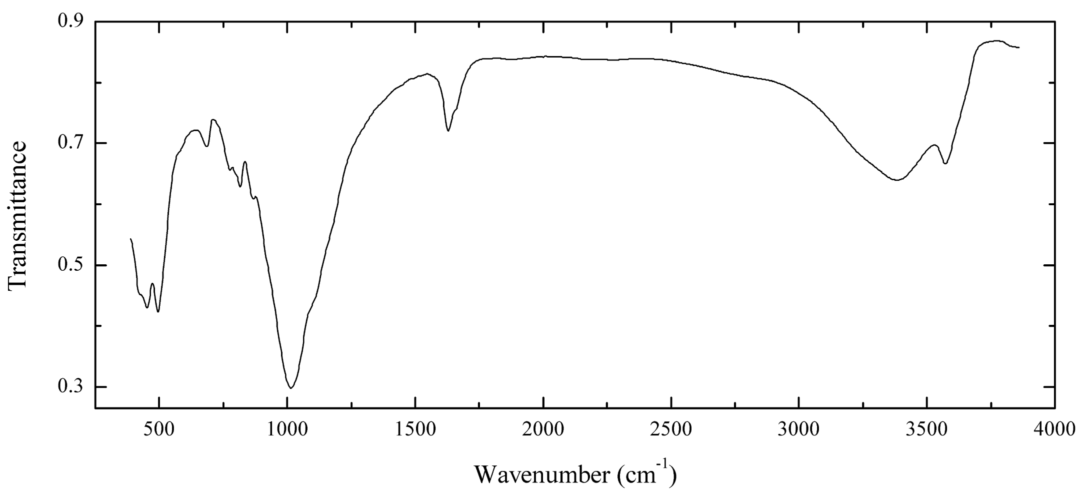


Locality: Cínovec (former Zinnwald), Krušné Hore Mts. (Erzgebirge), Czech Republic.

Description: Olive green powdery aggregate from the association with quartz. The empirical formula is (electron microprobe) $Ca_{0.2}Fe_{2.0}(Si_{3.6}Al_{0.3}Fe_{0.1}O_{10})(OH)_2\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3557, 3390, 3240sh, 1650sh, 1632, 1100sh, 1021s, 940sh, 847, 817, 745w, 675, 585, 492s, 450sh, 430s, 380s.

Sil120 Nontronite $(Na,Ca)_x(Fe^{3+},Al,Mg)_2[(Si,Al)_4O_{10}](OH)_2\cdot nH_2O$ ($x \approx 0.3$, $n \approx 4$)



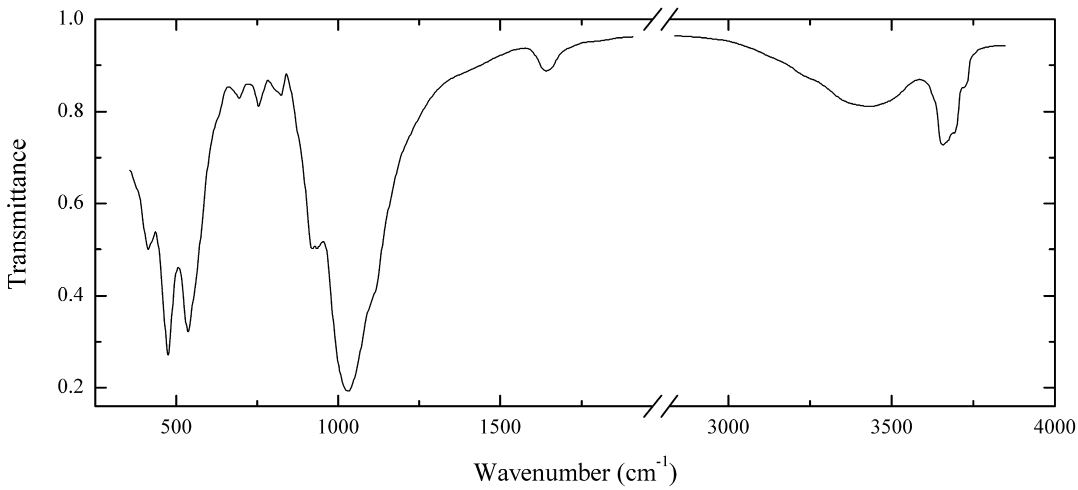
Locality: Northern shaft, Ingichke deposit, 90 km W of Samarkand, Uzbekistan.

Description: Olive green powdery aggregate. The empirical formula is (electron microprobe) $(Ca_{0.22}Mg_{0.08}Na_{0.01})(Fe_{1.90}Mg_{0.10})(Si_{3.49}Fe_{0.44}Al_{0.07}O_{10})(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3555, 3370, 3230sh, 1655sh, 1632, 1100sh, 1017s, 870, 815, 780sh, 765, 685w, 580sh, 493s, 454s, 427s.

Sil121 Kaolinite–montmorillonite (2:1)

Kaolinite–montmorillonite (2:1 regular interstratification)

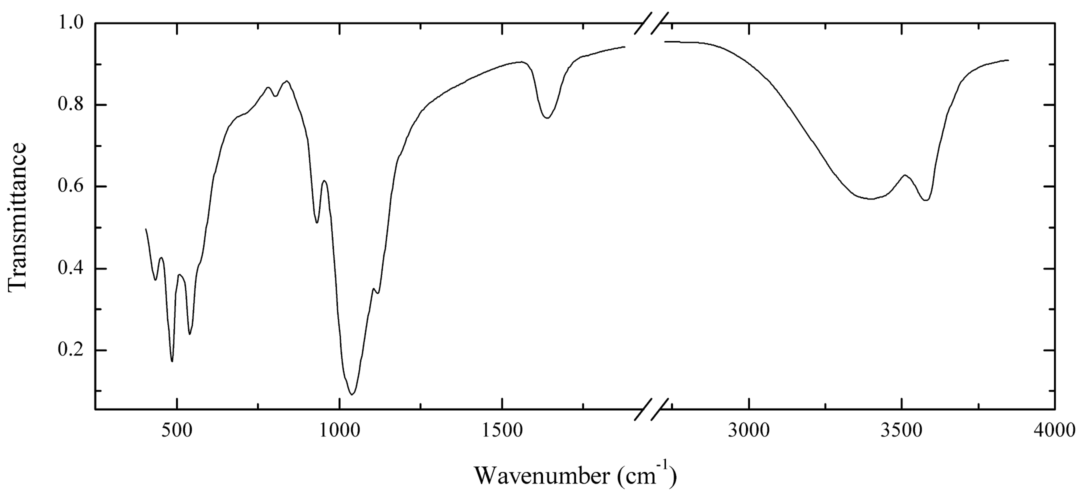


Locality: An unknown locality in Indonesia.

Description: Light grey powdery aggregate. Investigated by O.V. Kuzmina. The main basal reflection of the powder X-ray diffraction pattern is observed at 26.4 Å.

Wavenumbers (cm^{-1}): 3700sh, 3665sh, 3632, 3415, 1640, 1110sh, 1028s, 1018sh, 927, 918, 824w, 805sh, 753w, 654w, 630sh, 560sh, 532s, 471s, 411.

Sil122 Montmorillonite $(Na,Ca)_{0.3}(Al,Mg)_2(Si_4O_{10})(OH)_2{\cdot}nH_2O$

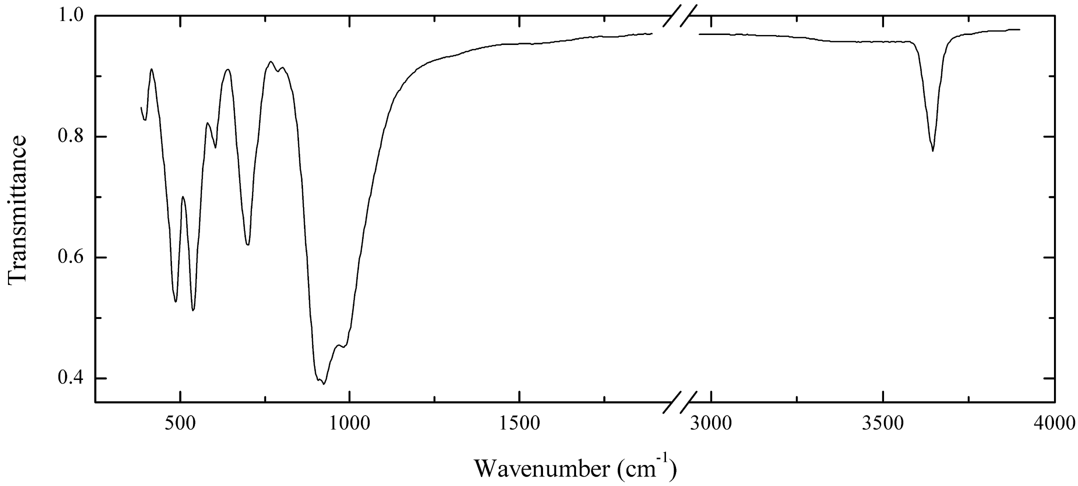


Locality: Akmaya W deposit, Shet region, Central Kazakhstan.

Description: White powdery aggregate. Investigated by V.I. Stepanov. Identified by powder X-ray diffraction pattern and wet chemical analysis.

Wavenumbers (cm^{-1}): 3600, 3415, 1640, 1120s, 1040s, 927, 797w, 695sh, 570sh, 533s, 476s, 426.

Sil123 Margarite $CaAl_2(Si_2Al_2O_{10})(OH)_2$



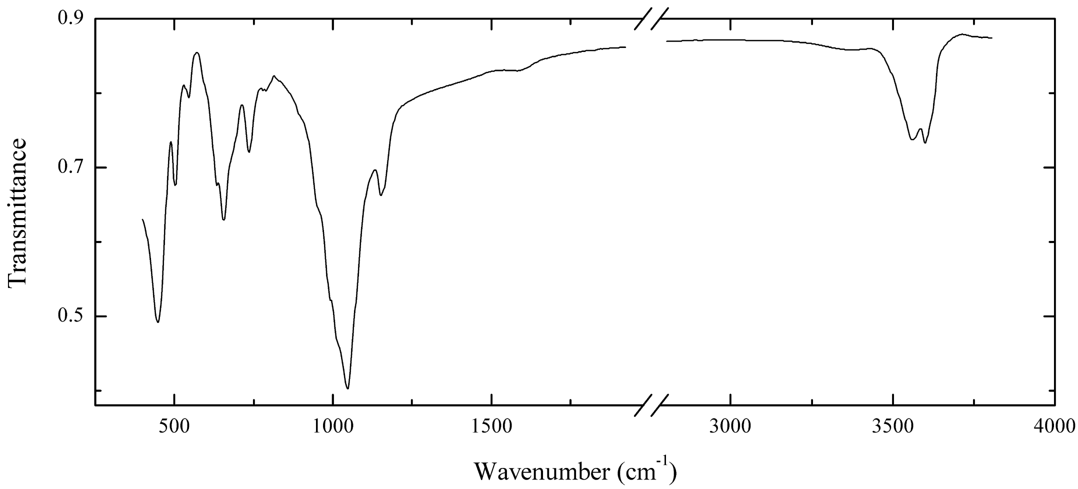
Locality: Malyshevskoe emerald deposit, Middle Urals, Russia.

Description: Massive, light green, from the association with beryl. Na-rich variety.

The empirical formula is (electron microprobe) $(Ca_{0.65}Na_{0.35})(Al_{0.96}Mg_{0.03}Fe_{0.01})(Si_{2.23}Al_{1.77}O_{10})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3620, 3430w, 1620w, 989, 923s, 912s, 800w, 701s, 607, 540s, 486s, (390).

Sil124 Mcgillite $Mn^{2+}{}_8(Si_6O_{15})(OH)_8Cl_2$

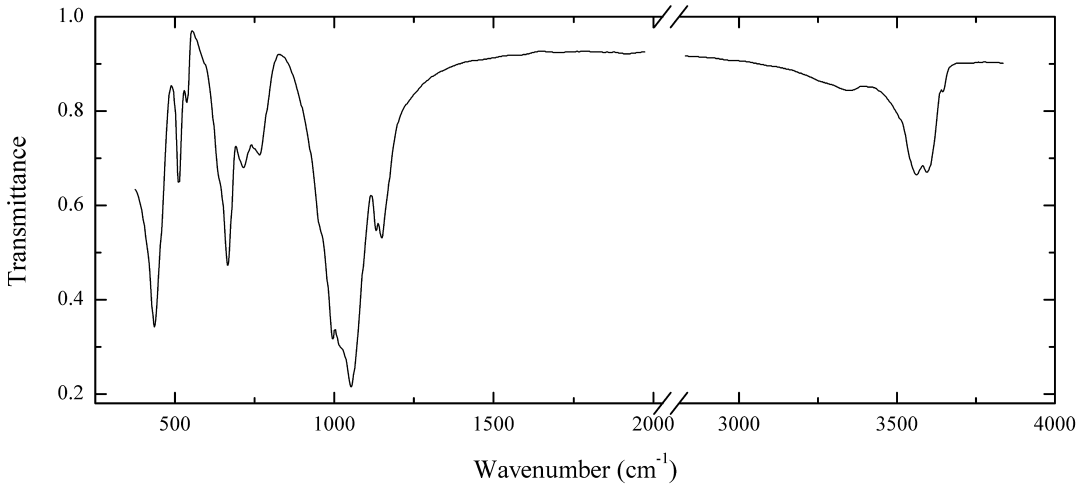


Locality: Sullivan mine, Kimberley, Kootenay district, British Columbia, Canada (type locality).

Description: Pink, massive.

Wavenumbers (cm^{-1}): 3580, 3540, 3400w, 1610w, 1149, 1041s, 1020sh, 987, 955sh, 777w, 733, 690sh, 670sh, 653, 631, 595sh, 543w, 499, 443s, 420sh.

Sil125 Pyrosmalite-(Mn) $Mn^{2+}_8(Si_6O_{15})(OH,Cl)_{10}$

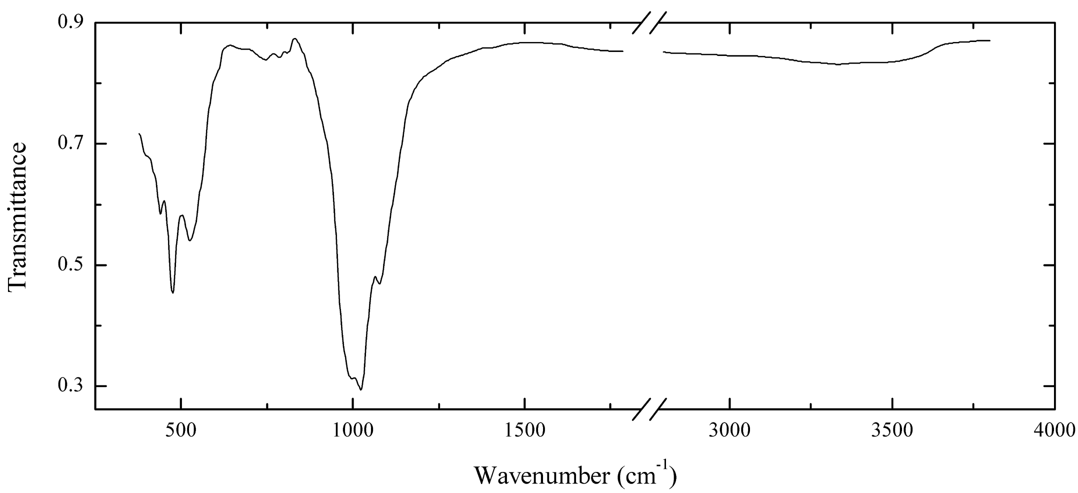


Locality: Nordmark, 14 km N of Filipstad, Värmland, Sweden.

Description: Greenish-brown, with perfect cleavage. Tabular crystal from skarn. The empirical formula is (electron microprobe; OH calculated) $(Mn_{4.03}Fe_{3.91}Ca_{0.06})(Si_{5.92}Al_{0.08}O_{15})(OH_{8.8}Cl_{1.2})$.

Wavenumbers (cm^{-1}): 3620w, 3570, 3540, 3320w, 1160sh, 1145, 1127, 1050s, 1010sh, 995s, 955sh, 763, 712, 670sh, 664s, 635sh, 536w, 514, 433s, 415sh.

Sil126 Masutomilite $K(LiAlMn^{2+})(Si_3AlO_{10})F_2$

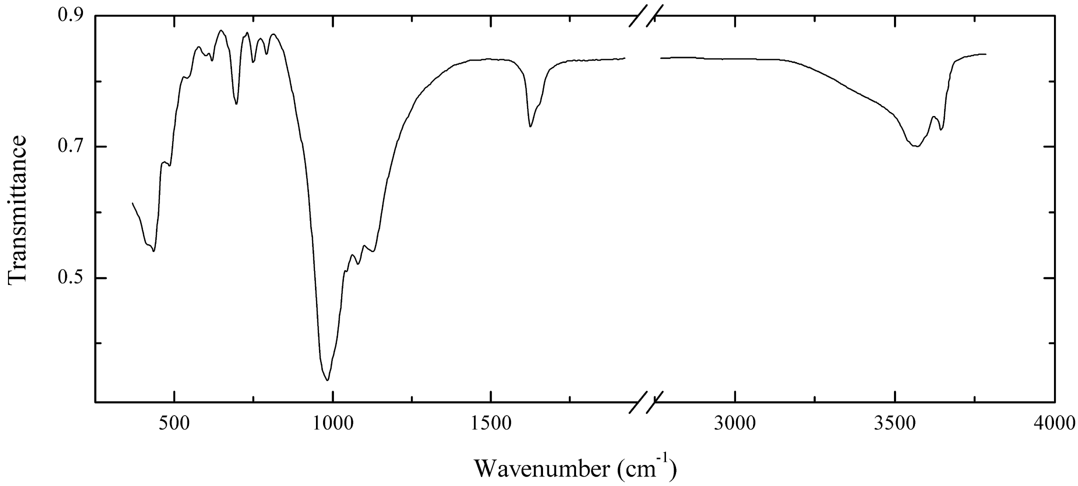


Locality: Pit No. 255, Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Lilac platy crystal from the association with quartz, microcline, albite, topaz and elbaite. The empirical formula is (electron microprobe) $(K_{0.85}Rb_{0.04}Cs_{0.02}Na_{0.02})(Li_{1.36}Mn_{0.46}Fe_{0.06}Al_{1.09})(Si_{3.41}Al_{0.59}O_{10})(F,OH)_2$.

Wavenumbers (cm^{-1}): 1074s, 1023s, 998s, 970sh, 805w, 781w, 743w, 605sh, 529s, 476s, 440s, 390sh.

Sil127 Mountainite $KNa_2Ca_2Si_8O_{19}(OH){\cdot}6H_2O$

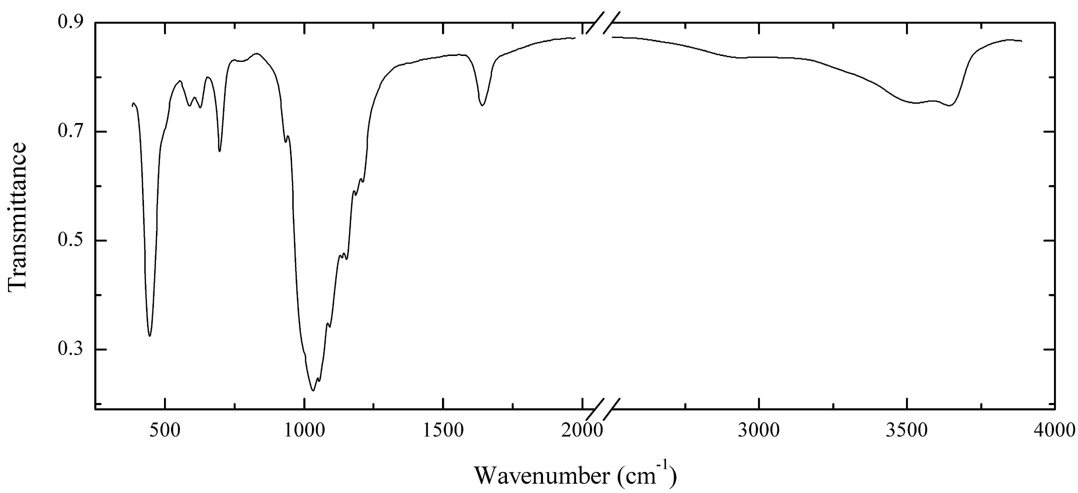


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: White scaly aggregate from the association with natrolite, raite and zorite. Na-rich variety (Na prevails over Ca in atomic units).

Wavenumbers (cm^{-1}): 3632, 3555, 1655sh, 1630, 1129s, 1083s, 1047s, 1010sh, 988s, 793w, 751w, 696, 619w, 598w, 544w, 486, 437s, 425sh.

Sil128 Macdonaldite $BaCa_4Si_{16}O_{36}(OH)_2{\cdot}10H_2O$

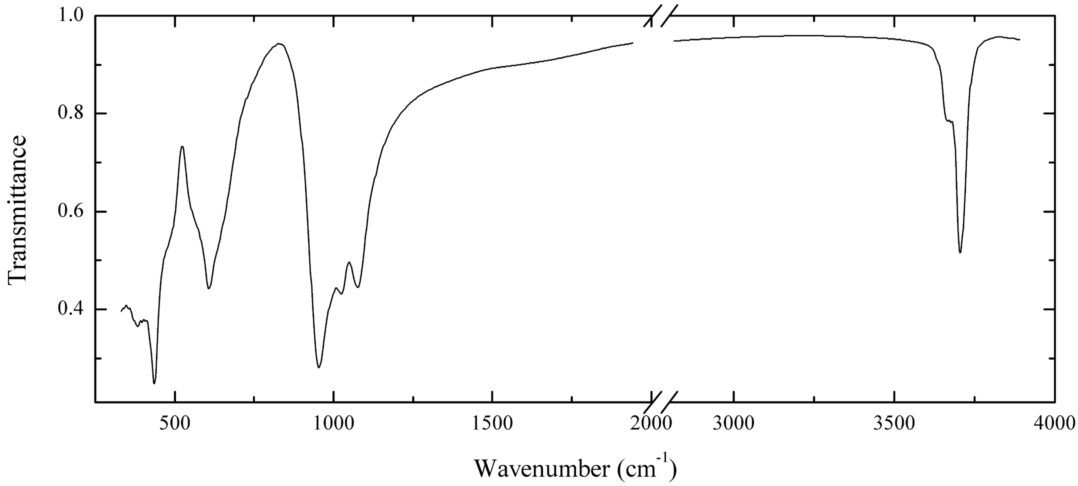


Locality: Big Creek, Fresno Co., California, USA (type locality).

Description: White columnar aggregate. The empirical formula is (electron microprobe) $Ba_{1.11}Ca_{4.02}Si_{16}O_{36}(OH,O)_2{\cdot}nH_2O$.

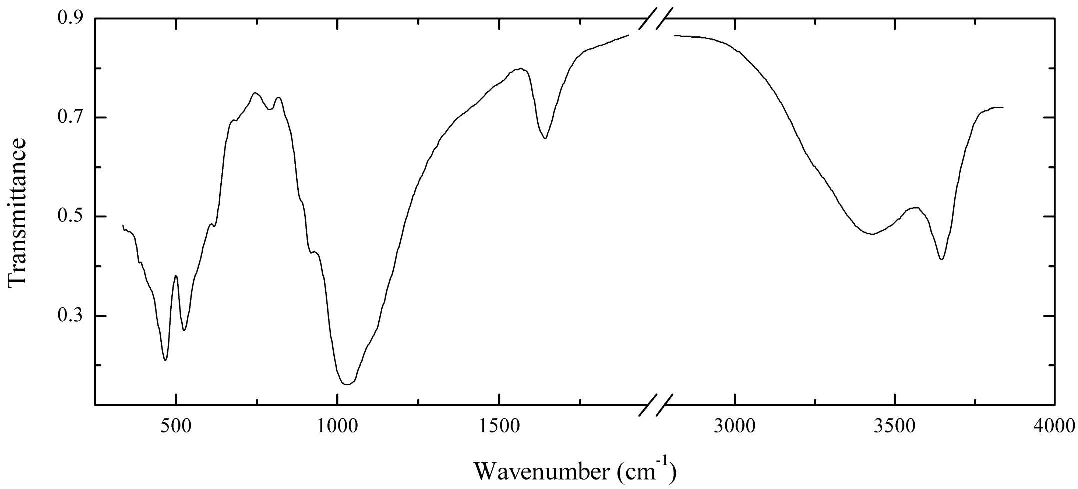
Wavenumbers (cm^{-1}): 3610, 3490, 2950sh, 1639, 1215, 1183, 1151, 1129, 1089s, 1065sh, 1050s, 1029s, 995sh, 930, 773w, 693, 624w, 585w, 495sh, 440s.

Sil129 Orthochrysotile (chrysotile-*Or$_{c1}$*) $Mg_3(Si_4O_5)(OH)_4$



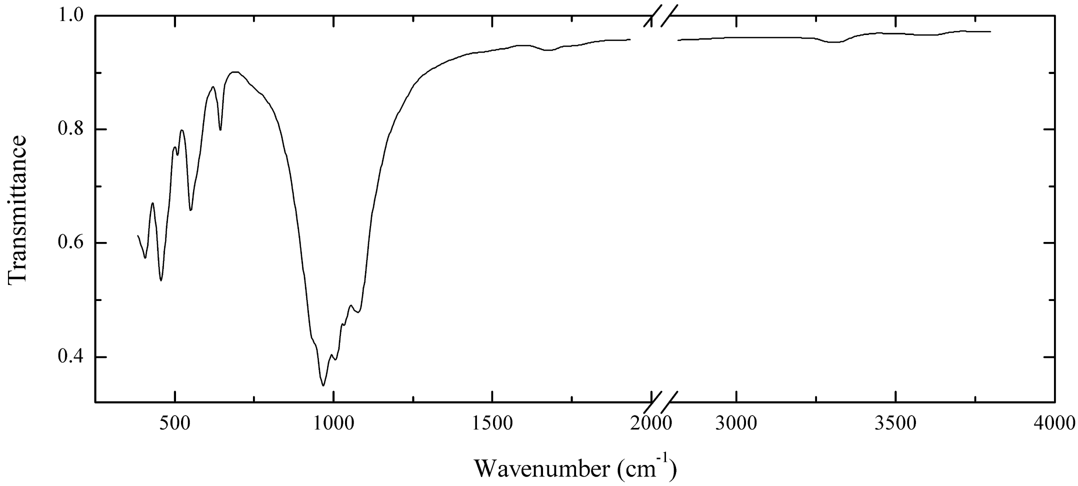
Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.
Description: Grey-green parallel-columnar aggregate. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3697s, 3654, 1075s, 1024s, 952s, 645sh, 608s, 560sh, 485sh, 437s, 402s.

Sil130 Beidellite $(Na,Ca_{0.5})_{0.3}Al_2[(Si,Al)_4O_{10}](OH)_2 \cdot nH_2O$



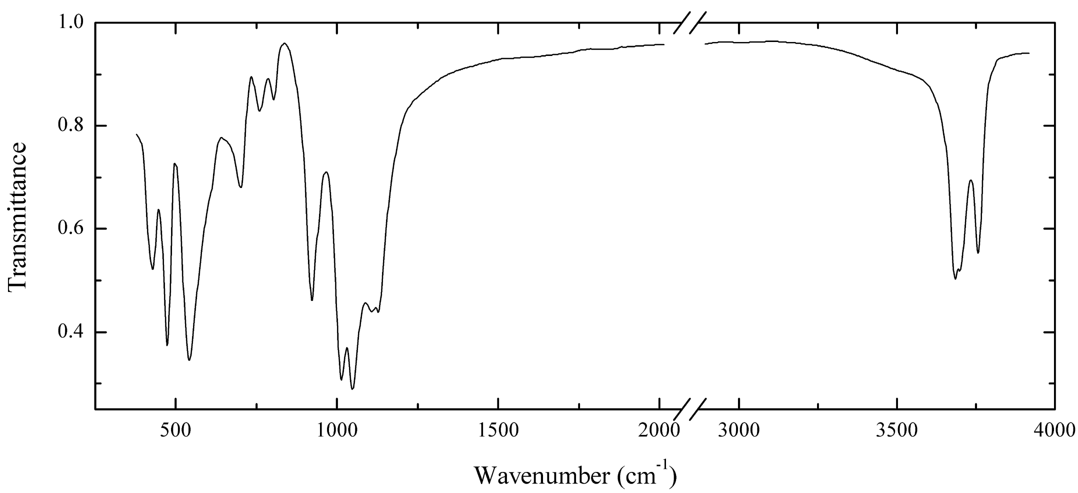
Locality: Shchyolkovo dolomite quarry, Moscow region, Russia.
Description: Grey, massive; fills cavity in dolomitized limestone. Confirmed by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Ca_{0.29}Na_{0.11}K_{0.04})(Al_{1.87}Fe_{0.10}Mg_{0.03})(Si_{3.38}Al_{0.62}O_{10})(OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3635, 3410, 1640, 1105sh, 1031s, 914, 885sh, 790w, 680sh, 617, 526s, 465s, 390sh.

Sil131 Norrishite $KLiMn^{3+}_2(Si_4O_{10})O_2$



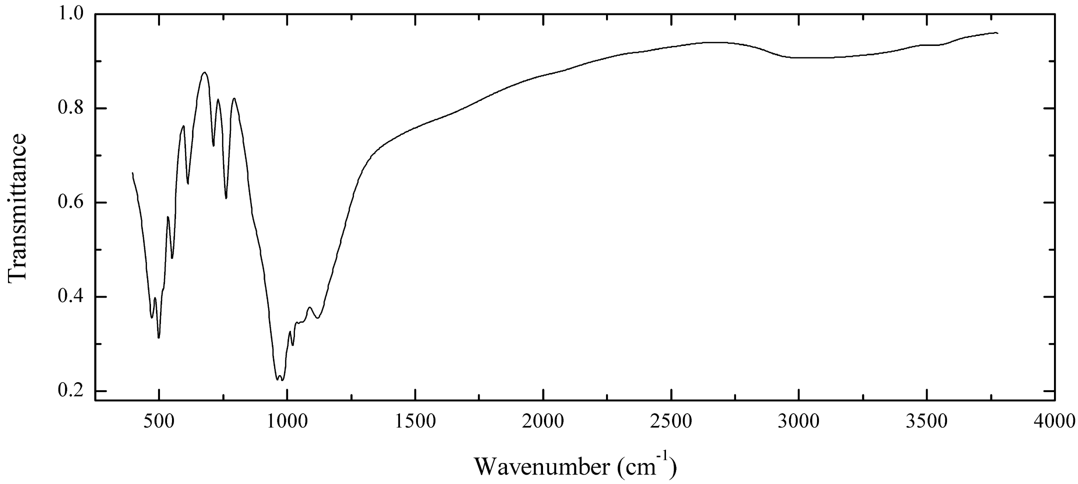
Locality: Hoskins mine, 3 km west of Grenfell, New South Wales, Australia (type locality).
Description: Dark red-brown plates with perfect cleavage.
Wavenumbers (cm^{-1}): 3275w, (1675w), 1075s, 1028s, 1003s, 962s, 935sh, 640w, 565sh, 548, 505w, 475sh, 456s, 407.

Sil132 Nacrite $Al_2(Si_2O_5)(OH)_4$



Locality: Kunnerstein, Saxony, Germany.
Description: White plates (to 0.5 cm) with perfect mica-like cleavage and pearly lustre.
Wavenumbers (cm^{-1}): 3710, 3660, 3640, 1120s, 1100s, 1036s, 1003s, 930sh, 913, 799w, 754w, 696, 600sh, 535s, 468s, 424.

Sil133 Natrosilite $Na_2Si_2O_5$

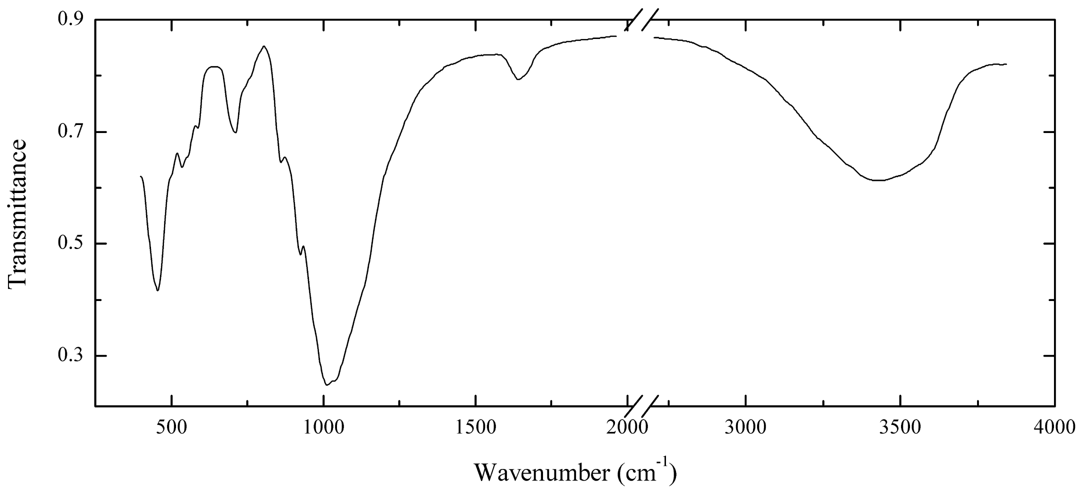


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless single-crystal plate with mica-like cleavage, from the association with ussingite and analcime. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3550w, 3000w, 1136s, 1071s, 1053s, 1023s, 983s, 967s, 880sh, 758, 710w, 605, 548, 510, 488s, 459s.

Sil134 "Hydronaujakasite" $(Na,H)_6FeAl_4Si_8O_{26}\cdot nH_2O$?

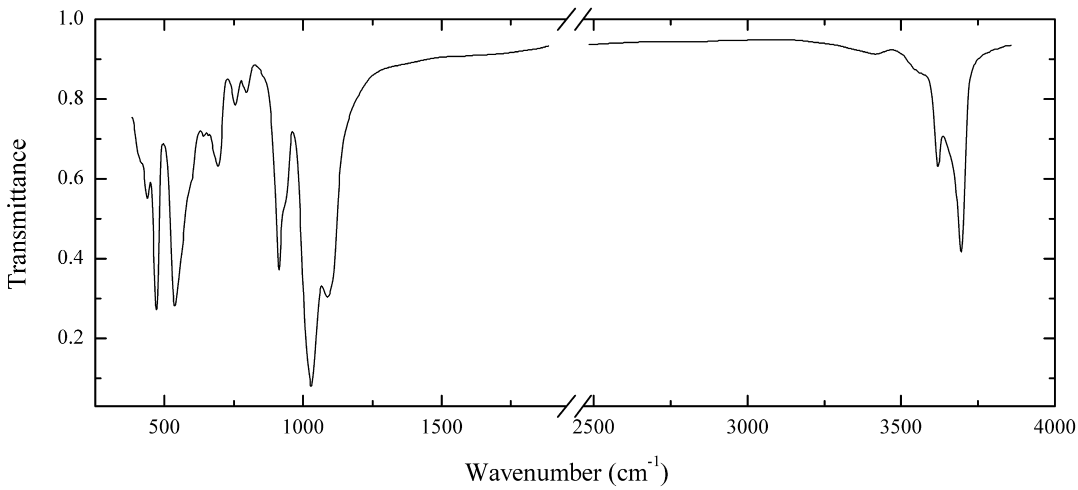


Locality: Kangerdluarssuq, Ilímaussaq alkaline complex, Greenland.

Description: Grey, with mica-like cleavage; pseudomorph after a large (about 1 cm) crystal of naujakasite. Contains 7–8 wt.% Na_2O (by electron microprobe data with rastered electron beam).

Wavenumbers (cm^{-1}): 3575sh, 3400, 3250sh, 1635, 1130sh, 1038s, 1015s, 1000sh, 970sh, 924, 860, 760sh, 740sh, 709, 586, 555sh, 533, 450s.

Sil135 Kaolinite $Al_2Si_2O_5(OH)_4$

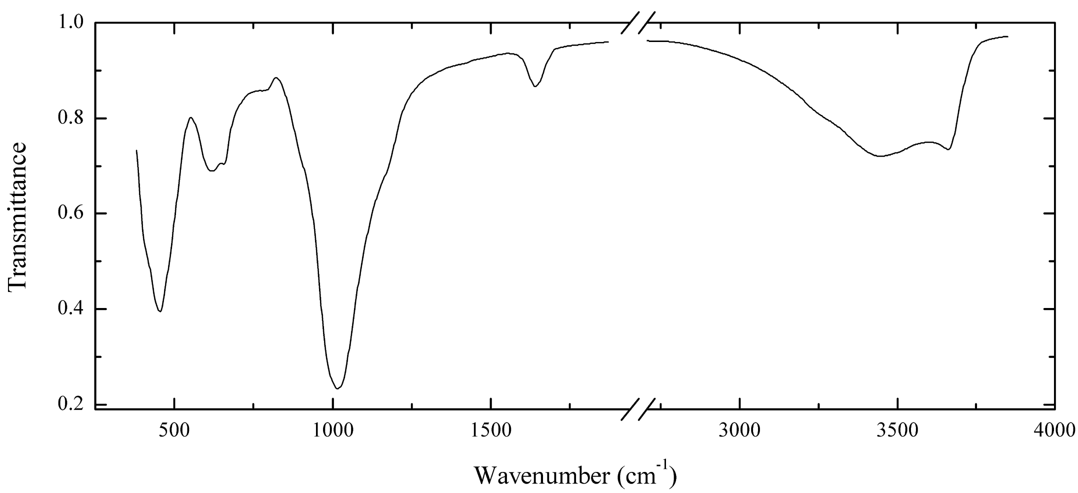


Locality: Ivigtut cryolite deposit, Ivittuut (Ivigtut), Arsuk Firth, Kitaa (West Greenland) province, Greenland.

Description: White powdery aggregate on cryolite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3695s, 3620, 3350sh, 3410w, 1115sh, 1090s, 1029s, 1015sh, 935sh, 913s, 794, 753, 692, (642), 600sh, 537s, 470s, 434, 410sh.

Sil136 Neotocite $Mn^{2+}SiO_3 \cdot H_2O$ (?)

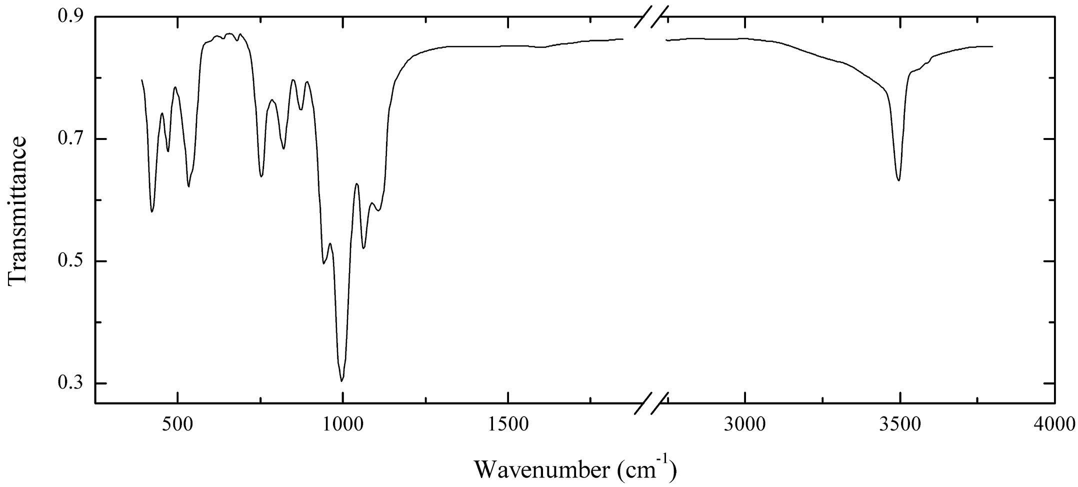


Locality: Southern Faizulinskoe deposit, South Urals, Russia.

Description: Brown, semitransparent, colloform in Mn-rich metamorphic rock. Amorphous. The empirical formula is (electron microprobe) $K_{0.04}Ca_{0.02}Mn_{0.74}Mg_{0.22}\ SiO_3 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3640, 3420, 3250sh, 1633, 1165sh, 1015s, 900sh, 780w, 659, 618, 454s, 405sh.

Sil137 Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$

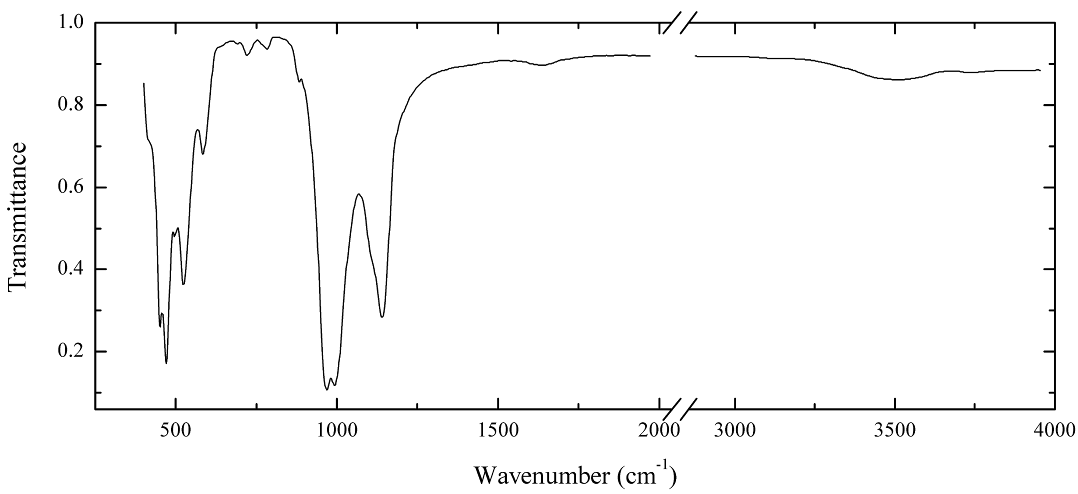


Locality: Jakobsberg, Bergslagen, Sweden.

Description: White spherulites in a veinlet crossing skarn, in the association with calcite and margarosanite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3488, 1112, 1064s, 997s, 944s, 872, 810, 752, 678w, 632w, 540sh, 529, 467, 416s.

Sil138 Polylithionite $KLi_2Al(Si_4O_{10})F_2$

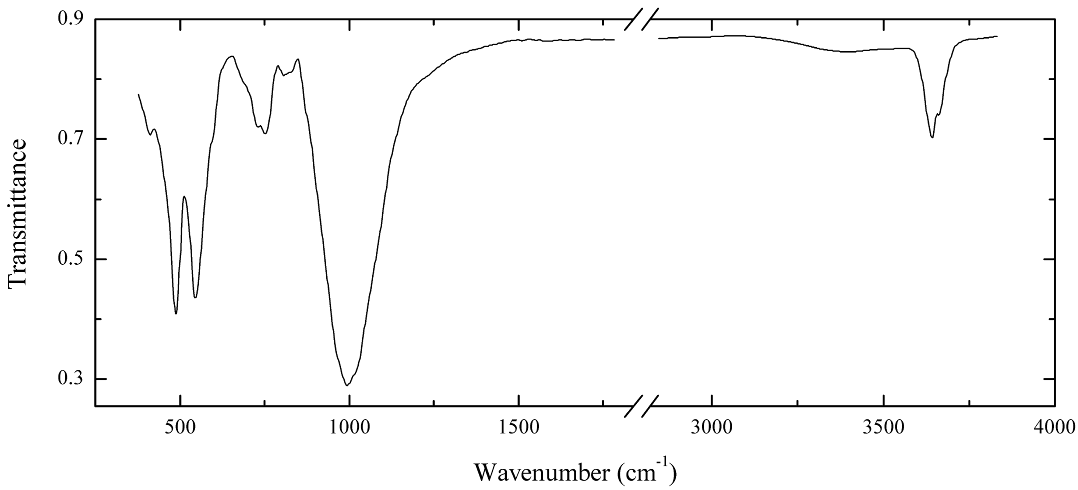


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pink powdery aggregate in peralkaline pegmatite, in the association with albite, aegirine and lorenzenite. A Mg,Ti-bearing variety. The empirical formula is (electron microprobe, Li calculated) $K_{0.9}(Li_{1.8}Al_{0.8}Mg_{0.3}Ti_{0.1})$ $(Si_4O_{10})(F,OH,O)_2 \cdot nH_2O$ ($n \ll 1$).

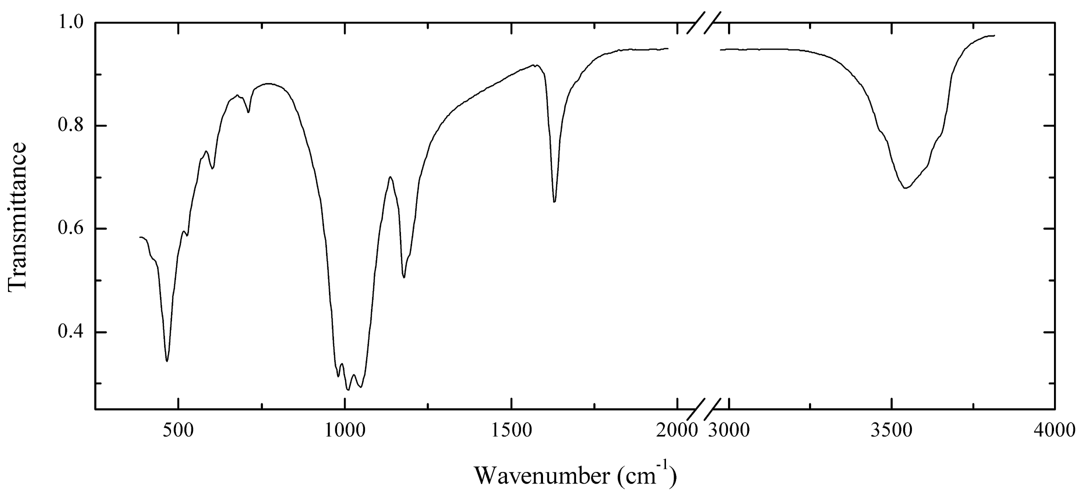
Wavenumbers (cm^{-1}): 3450w, 1626w, 1137s, 1100sh, 988s, 964s, 877, 785w, 718w, 587, 523s, 495, 468, 448.

Sil139 Paragonite $NaAl_2(Si_3AlO_{10})(OH)_2$



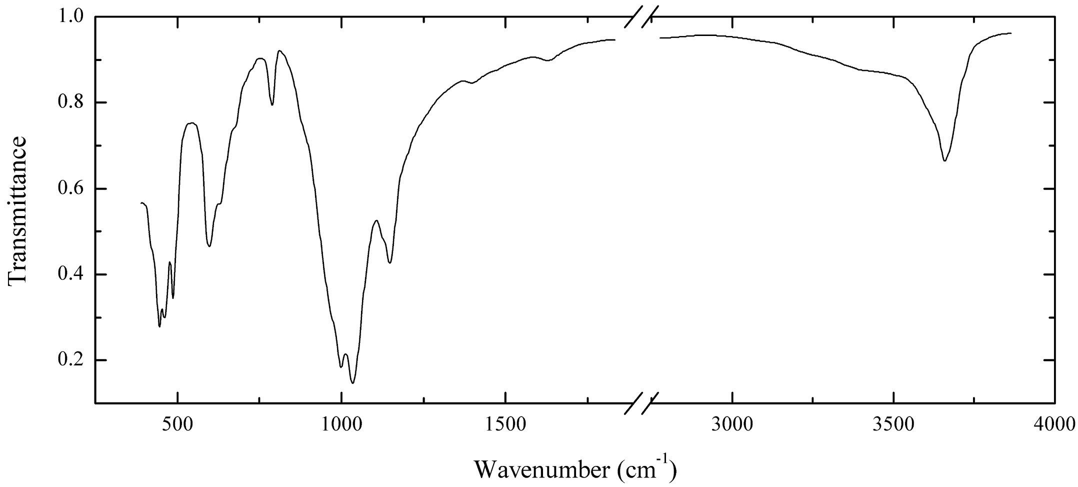
Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Light lilac crystal from the association with corundum, monazite and biotite. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3660, 3640, 1030sh, 996, 830sh, 808w, 753, 730, 700sh, 595sh, 544s, 486s, 408.

Sil140 Pentagonite $Ca(V^{4+}O)Si_4O_{10}·4H_2O$



Locality: Wagholi quarries, 20 km northeast of Poona, Maharashtra, India.
Description: Light blue radiated aggregates in the association with zeolites. Confirmed by IR spectrum. Compare with IR spectrum of cavansite, the dimorph of pentagonite.
Wavenumbers (cm^{-1}): 3630sh, 3580sh, 3525, 3450sh, 1630, 1195sh, 1182, 1048s, 1009s, 981s, 975sh, 713w, 606, 545sh, 527, 465s, 430sh.

Sil141 Orlymanite $Ca_4Mn^{2+}_3(Si_8O_{20})(OH)_6{\cdot}2H_2O$

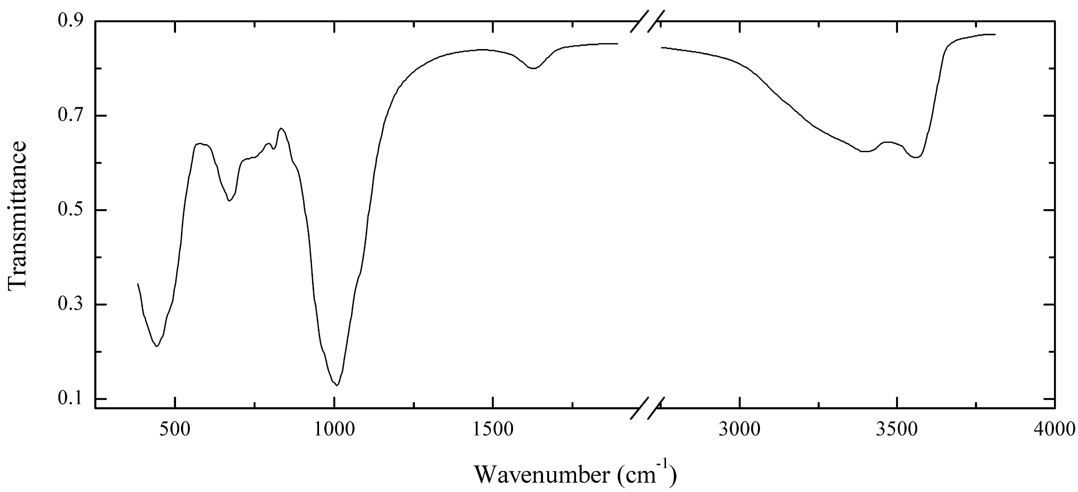


Locality: Wessels mine, Kalahari manganese fields, Cape province, Republic of South Africa (type locality).

Description: Brown spherulites (to 0.3 mm) from the association with inesite. The empirical formula is (electron microprobe) $(Ca_{3.8}Mn_{2.7}Mg_{0.3}Fe_{0.3})(Si_{8.0}O_{20})(OH)_6{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3630, 3400sh, 1640w, 1400w, 1148s, 1125sh, 1033s, 997s, 970sh, 880sh, 790, 675sh, 627, 598, 487s, 462s, 446s, 420sh.

Sil142 Orthochamosite $(Fe,Al,Mg,Mn)_6[(Si,Al)_4O_{10}](OH)_8$

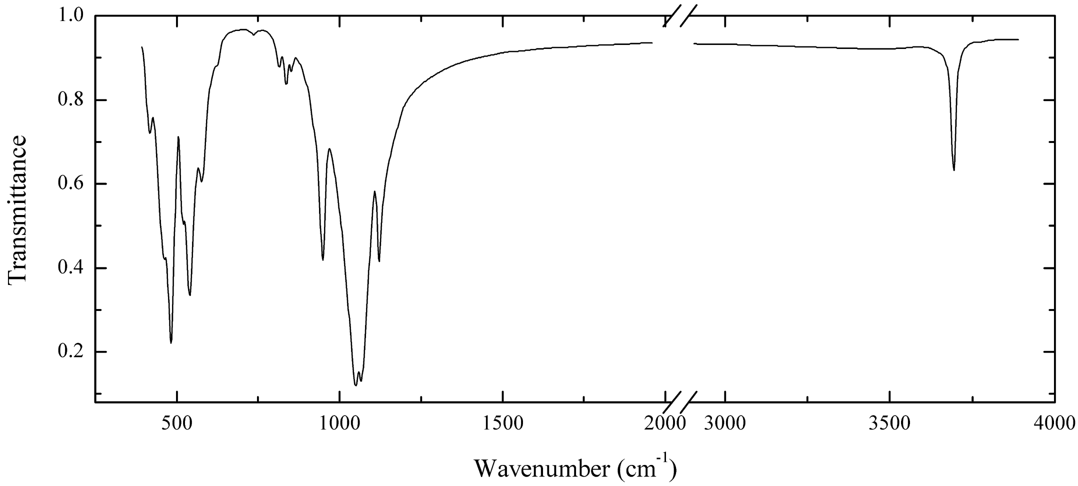


Locality: Karnasurt mine, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown radiated aggregates forming veinlet in alkaline rock. The empirical formula is (electron microprobe) $(Fe_{2.4}Mg_{2.2}Al_{1.4})(Si_{4.0}O_{10})(OH,O)_8{\cdot}nH_2O$.

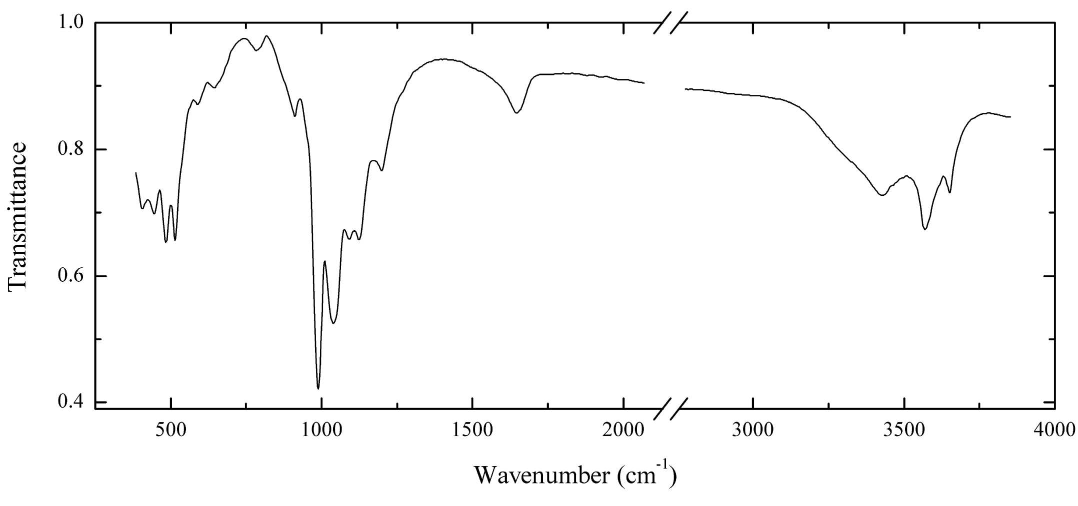
Wavenumbers (cm^{-1}): 3545, 3400, 3270sh, 1630w, 1080sh, 1011s, 975sh, 890sh, 815w, 750w, 676, 485sh, 448s, 430sh.

Sil143 Pyrophyllite $Al_2Si_4O_{10}(OH)_2$



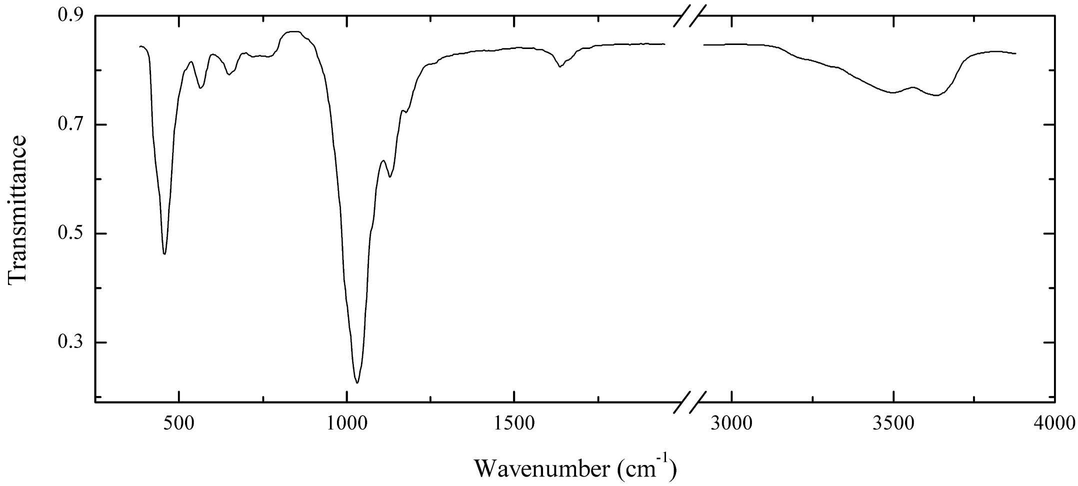
Locality: Verkhnyaya Pyshma, Middle Urals, Russia.
Description: Light green radiated aggregates (to 1 cm in diameter) from the association with dravite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3675, 1119s, 1067s, 1049s, 948s, 853, 835, 814, 737w, 624, 577, 538s, 518, 480s, 459, 414.

Sil144 Palygorskite $(Mg,Al)_{2+x}(Si_4O_{10})(OH)\cdot 4H_2O$



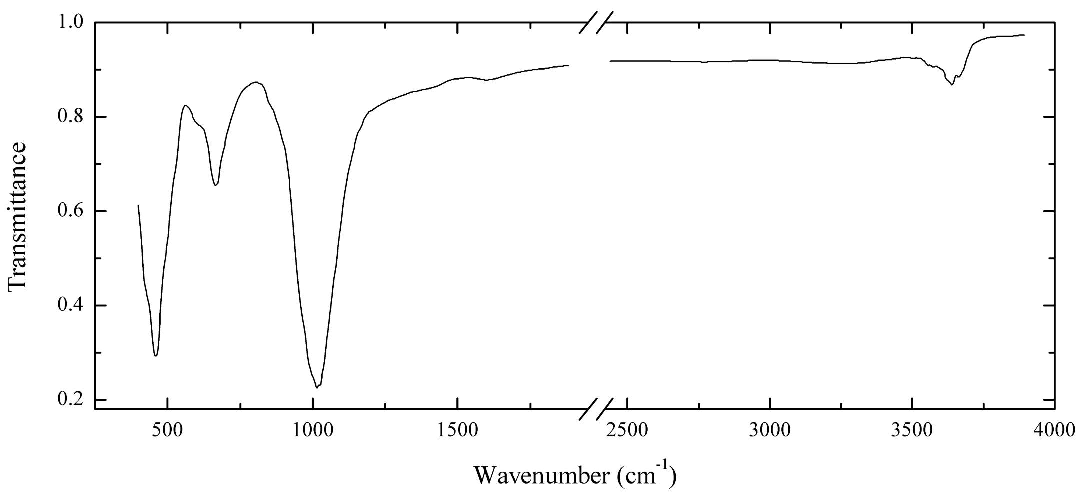
Locality: Podolsk, Moscow region, Russia.
Description: Yellowish fibrous aggregate from limestone. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Na_{0.08}K_{0.08}Ca_{0.11}(Mg_{1.03}Al_{0.98}Fe_{0.09})(Si_{4.00}O_{10})(OH)_x\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3620, 3540, 3400, 3280sh, 1643, 1195, 1122, 1094, 1041s, 987s, 912, 794w, 652, 580, 511s, 485s, 442, 401.

Sil145 Parsettensite $(K,Na,Ca)_{7.5}Mn_{49}(Si,Al)_{72}O_{168}(OH)_{50}\cdot nH_2O$



Locality: Gambatesa mine, near Reppia, Val Graveglia, Genoa, Liguria, Italy.
Description: Reddish-brown scaly aggregate. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3610, 3485, 3280sh, 3220sh, 1640sh, 1625w, 1169, 1129, 1075sh, 1040sh, 1025s, 995sh, 769w, 722w, 643, 559, 451s, 430sh.

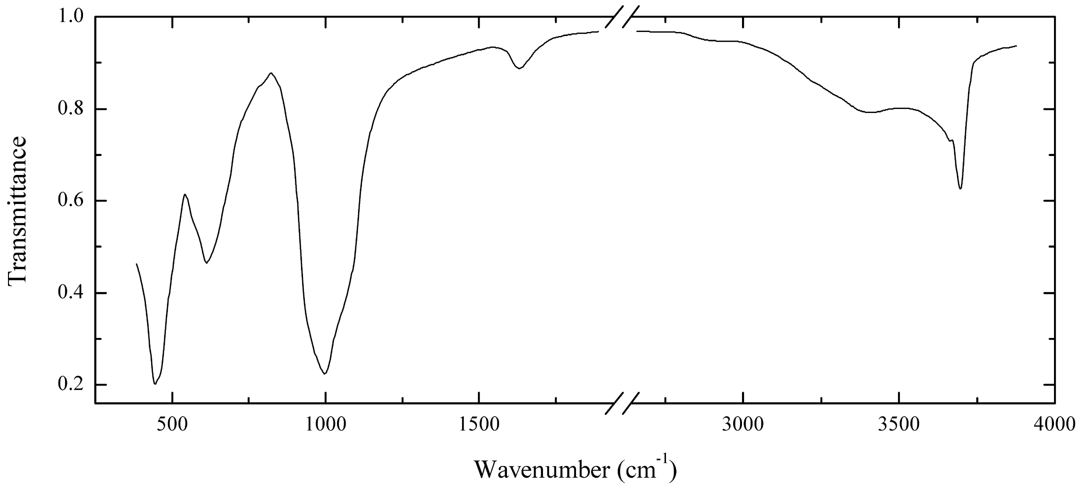
Sil146 Willemseite $Ni_3(Si_4O_{10})(OH)_2$



Locality: Grube Hans Georg, Plauen, Sachsen, Germany.
Description: Apple-green massive aggregate. Identified by powder X-ray diffraction pattern. Contains admixture of a serpentine-group mineral. The empirical formula is (electron microprobe) $Ni_{2.85}Mg_{0.29}Al_{0.04}Si_{3.89}O_{9.94}(OH)_{1.47}F_{0.53}$.
Wavenumbers (cm^{-1}): 3670w, 3645, 3570sh, (3300), 1620w, 1016s, 855sh, 667, 610sh, 457s, 420sh.

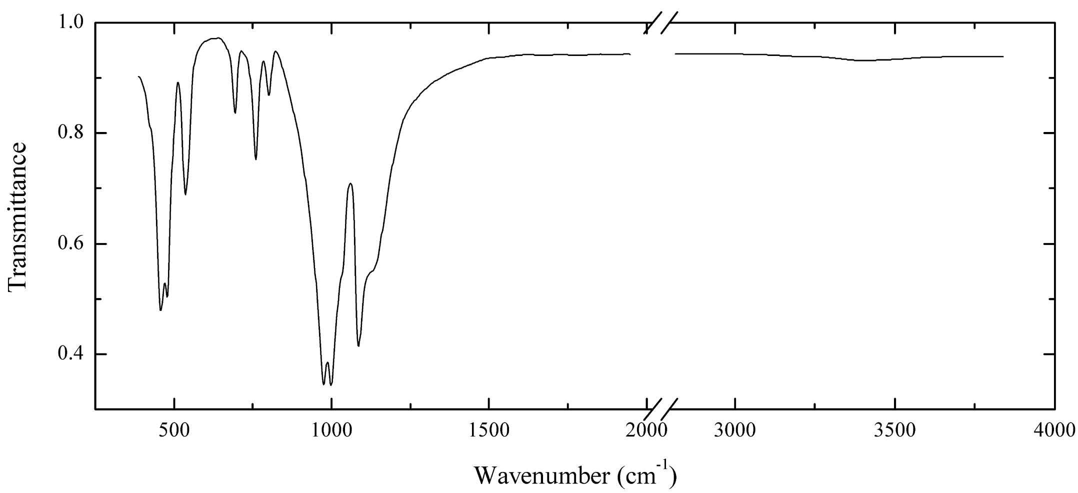
Sil147 Serpentine–smectite (2:1)

2:1 regular interstratification of serpentine and trioctahedral smectite



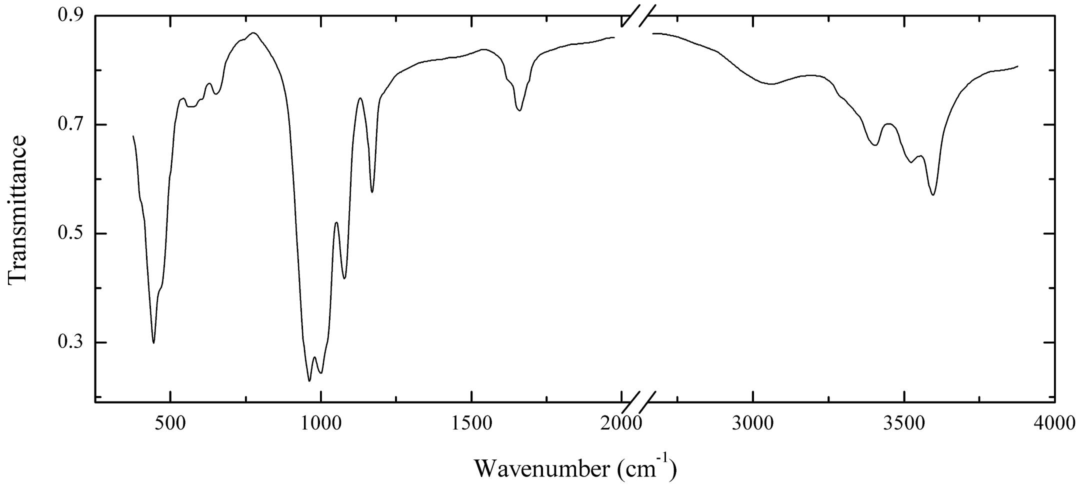
Locality: An unknown locality in Angola.
Description: Massive. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3697, 3655, 3410, 1637, 1060sh, 998s, 680sh, 613, 580sh, 455sh, 443s.

Sil148 Sanbornite $Ba(Si_2O_5)$



Locality: Rush Creek, Fresno Co., California, USA.
Description: Colourless plate with mica-like cleavage. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1143, 1086s, 1037, 997s, 975s, 800, 758, 695, 540sh, 533, 479s, 458s.

Sil149 Raite $Na_3Mn_3Ti_{0.25}(Si_2O_5)_4(OH)_2 \cdot 10H_2O$

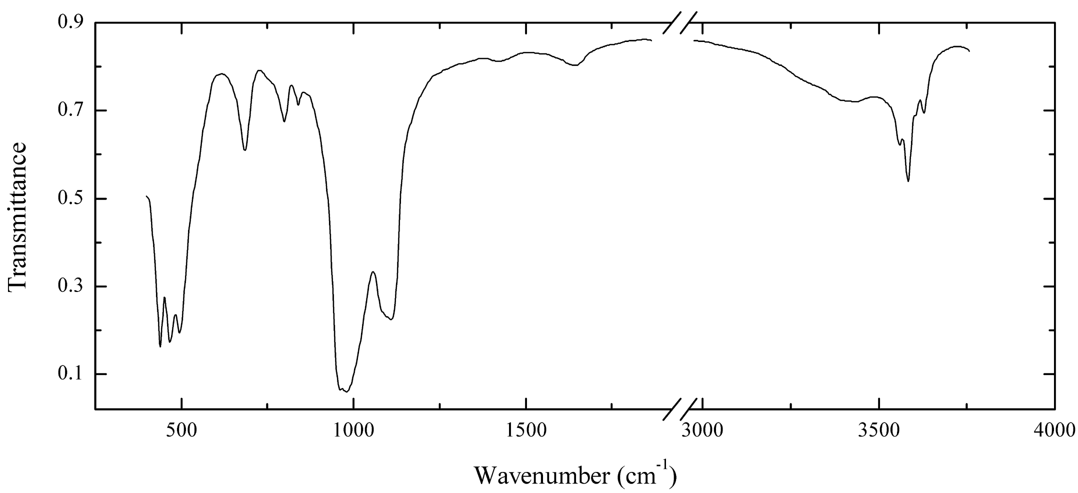


Locality: Umbozero underground mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown radiated aggregates of acicular crystals in the association with nastrophite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3585, 3512, 3390, 3270sh, 3040, 1663, 1625sh, 1173, 1075, 1020sh, 997s, 962s, 805sh, 755w, 656, 615sh, 580, 460sh, 443s, 400sh.

Sil150 Celadonite $K(Fe^{3+}Mg\square)(Si_4O_{10})(OH)_2$

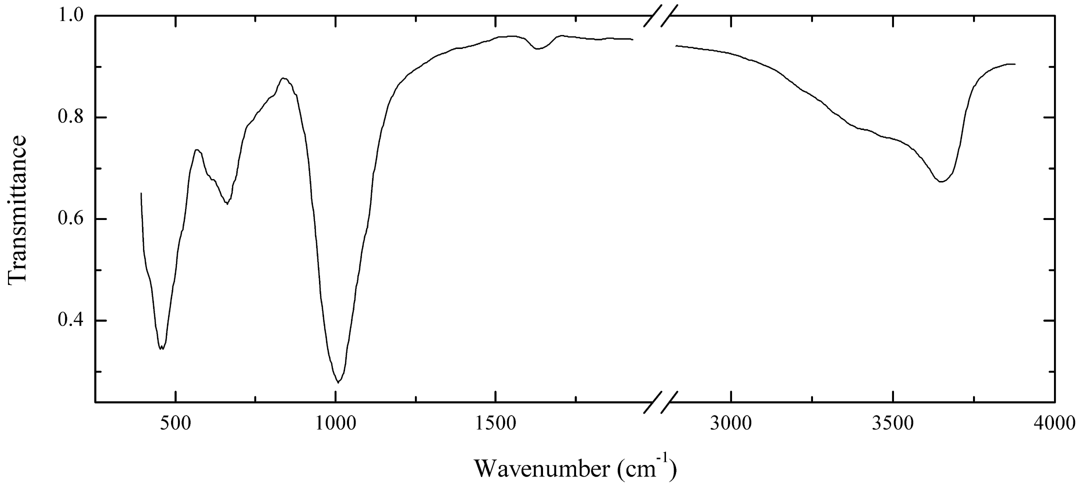


Locality: Srednyaya Padma U deposit, Zaonezhskii peninsula, Onega sea, Karelia, Russia.

Description: Bluish-green veinlet in rock. The empirical formula is (electron microprobe) $K_{0.91}(Mg_{0.55}Fe_{0.45})(Fe_{0.54}Al_{0.46})(Si_{3.88}Al_{0.12}O_{10})(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3605, 3580, 3560, 3535, 3410, 1645w, 1420w, 1108s, 1090sh, 977s, 958s, 838w, 797, 682, 492s, 463s, 437s.

Sil152 Saponite $(Ca_{0.5},Na)_{0.3}(Mg,Fe^{2+})_3[(Si,Al)_4O_{10}](OH)_2{\cdot}4H_2O$

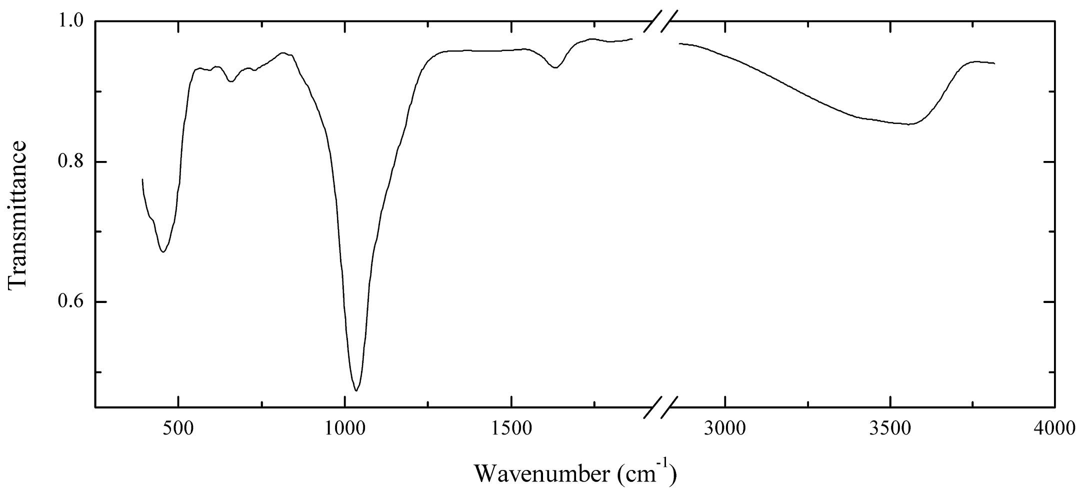


Locality: Pegmatite No. 62, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pale yellow spherulites forming crust on natrolite–sodalite aggregate. The empirical formula is (electron microprobe) $(Mg_{0.28}Ca_{0.02})(Mg_{2.63}Al_{0.36}Zn_{0.01})$ $(Si_{2.84}Al_{1.16}O_{10})(OH)_2{\cdot}nH_2O$.
Presumably contains admixture of clinochlore layers (as unordered interstratification).

Wavenumbers (cm^{-1}): 3650, 3400sh, 1630w, 1100sh, 1011s, 800sh, 750sh, 661, 620sh, 520sh, 460s, 450s, 405sh.

Sil153 Stilpnomelane $K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27}$

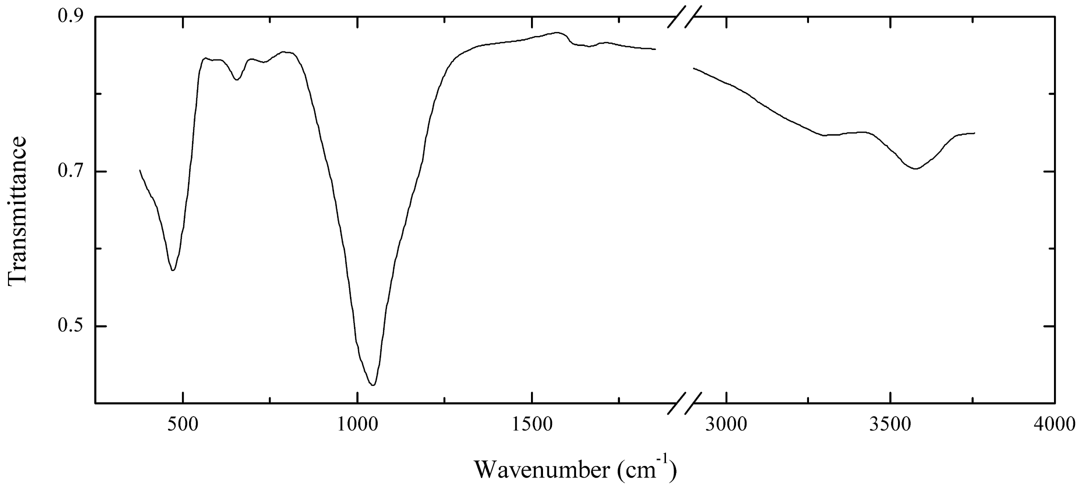


Locality: Tyrnyauz, 50 km west of Nalchik, North Caucasus, Russia.

Description: Brown scaly aggregate. Identified by powder X-ray diffraction pattern.
A hydrated variety.

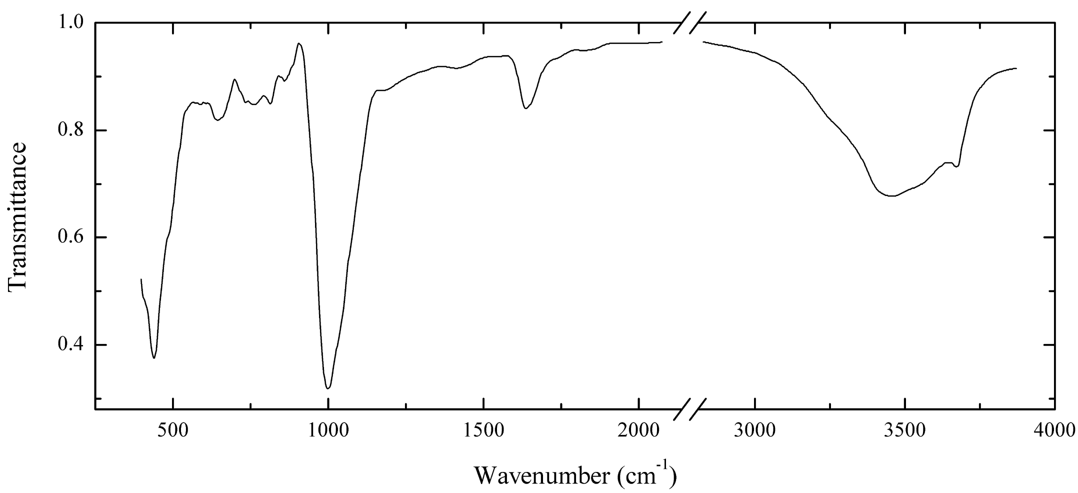
Wavenumbers (cm^{-1}): 3550, 3480sh, 1637, 1160sh, 1100sh, 1038s, 730w, 668, 600w, 458s, 400sh.

Sil154 Stilpnomelane $K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27}$



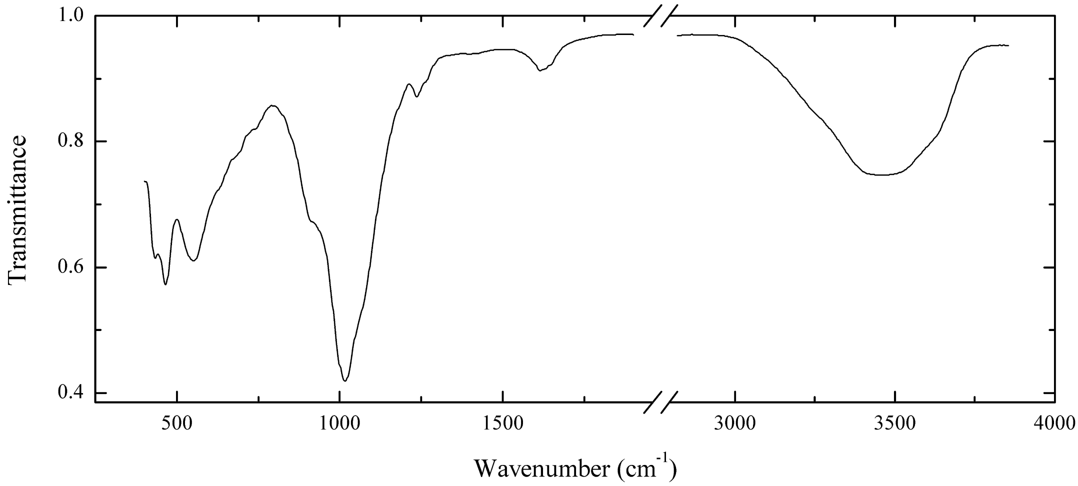
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Brown plate (3 cm long) with mica-like cleavage from the association with microcline and quartz. Compare with IR spectrum of bannisterite.
Wavenumbers (cm^{-1}): 3560, 3300, 1665w, 1640w, 1150sh, 1048s, 1010sh, 732w, 659, 595w, 472s, 405sh.

Sil155 Zincsilite $Zn_3(Si_4O_{10})(OH)_2{\cdot}4H_2O$



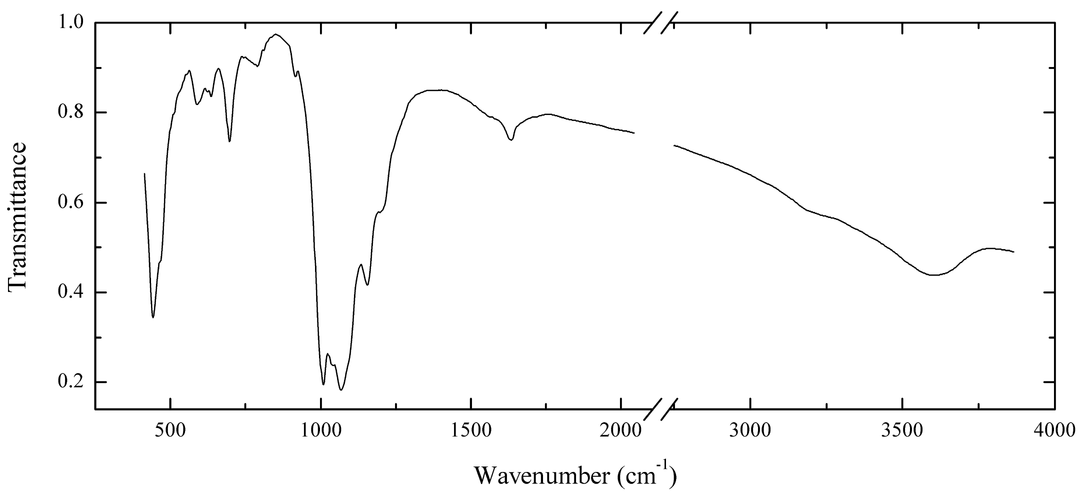
Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Greenish-yellow. Earthy aggregate (a pseudomorph after sphalerite) in peralkaline pegmatite. The empirical formula is (electron microprobe) $(Na_{0.3}Ca_{0.2})(Zn_{1.4}Fe_{0.5}Al_{0.5}Mg_{0.5}Li_x)(Si_{4.0}O_{10})(OH)_2{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3640, 3515sh, 3430, 1635, 1185w, 999s, 860w, 813, 760, 733, 643, 441s, 410sh.

Sil156 Beidellite $(Na,Ca_{0.5})_{0.3}Al_2[(Si,Al)_4O_{10}](OH)_2 \cdot nH_2O$



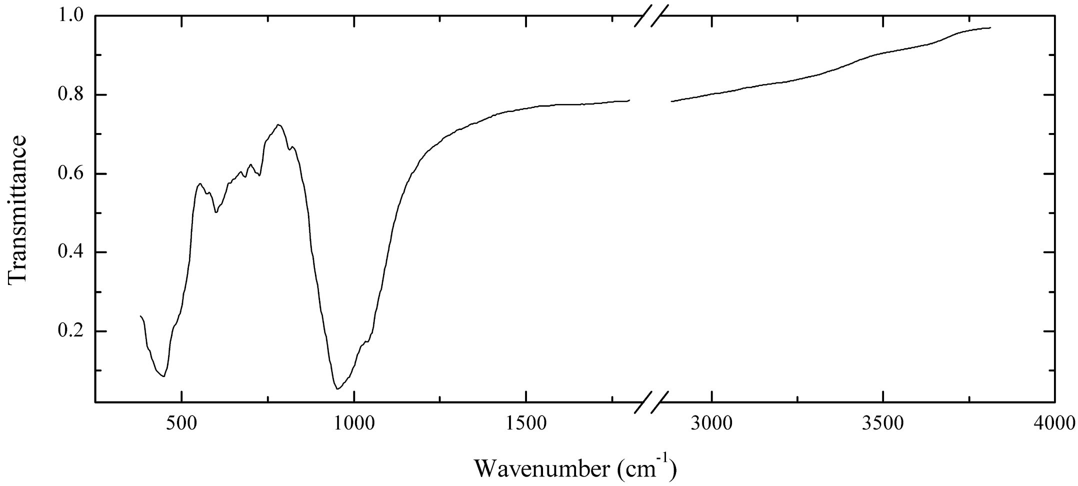
Locality: Chrom-Tau, 90 km east of Aktobe, Kazakhstan.
Description: Light blue wax like. A nest in altered serpentine. The empirical formula is (electron microprobe) $(Mg_{0.3}Ca_{0.1})(Al_{1.8}Ni_{0.5})(Si_{2.9}Al_{1.1}O_{10})(OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3600sh, 3460, 1620, 1240w, 1016s, 915sh, 550, 465s, 432.

Sil157 Rhodesite $KHCa_2Si_8O_{19} \cdot 5H_2O$



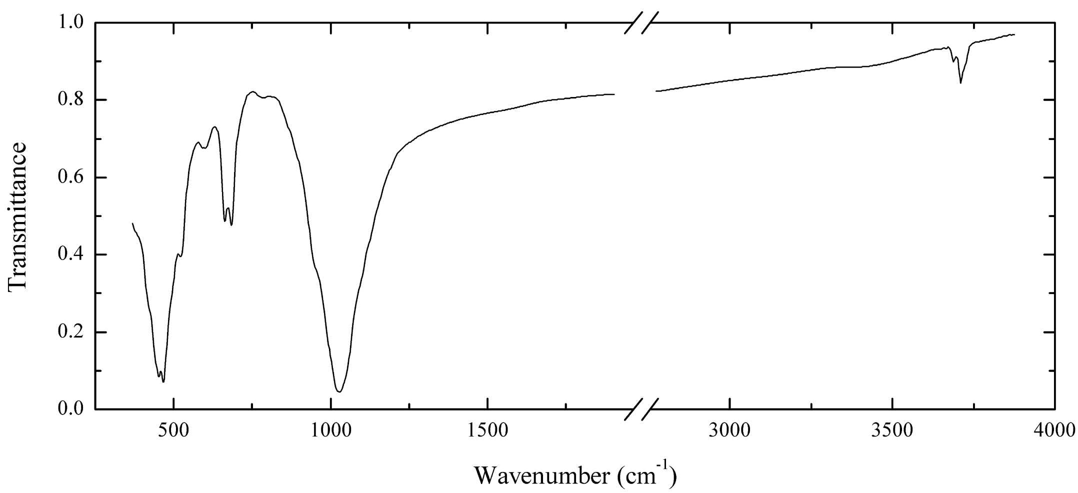
Locality: 3 miles north of Trinity lake, California, USA.
Description: White crust on rock. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3625, 3240sh, 1638w, 1200sh, 1157, 1090sh, 1070s, 1044s, 1009s, 915w, 783w, 691, 629, 587, 454, 435s.

Sil158 Tetraferriphlogopite $KMg_3(Si_3Fe^{3+}O_{10})(OH)_2$



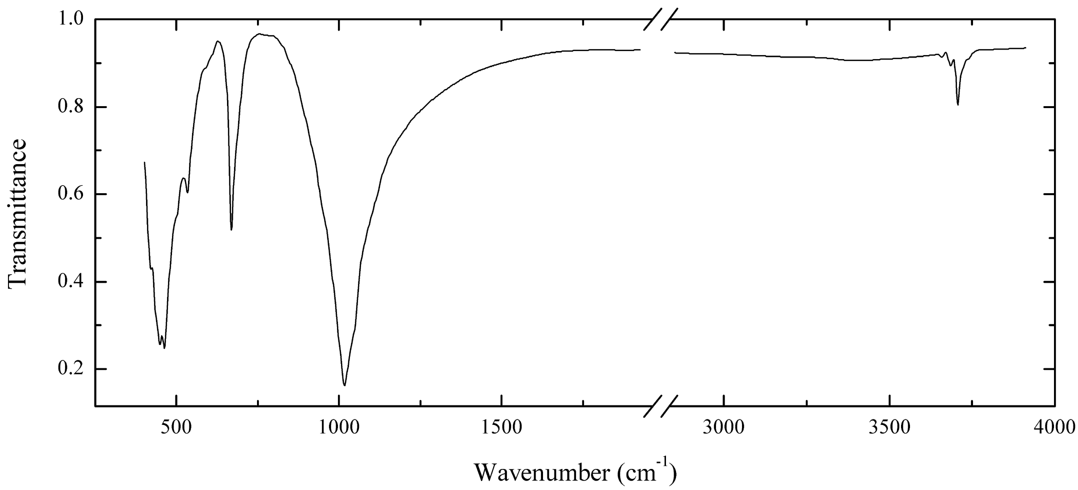
Locality: Turii (Turiy) massif, Turii Mys, Kola peninsula, Kola peninsula, Murnansk region, Russia.
Description: Brown plates in calcite carbonatite. The empirical formula is (electron microprobe) $(K_{0.85}Na_{0.02})(Mg_{2.73}Fe_{0.27})(Si_{2.96}Fe_{1.74}Al_{0.30}O_{10})(OH)_2$.
Wavenumbers (cm^{-1}): 3580w, 1035sh, 985sh, 954s, 812w, 724w, 684w, 620sh, 602, 573w, 485sh, 448s, 420sh.

Sil159 Talc $Mg_3(Si_4O_{10})(OH)_2$



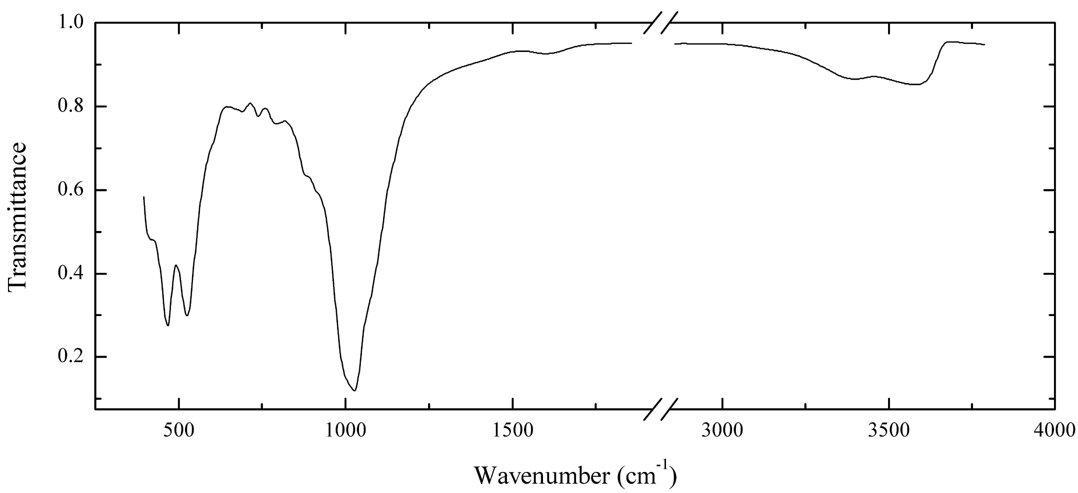
Locality: Malyshevskoe emerald deposit, Middle Urals, Russia.
Description: Scaly aggregate. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis. A F-rich variety.
Wavenumbers (cm^{-1}): 3680, 3658w, 1023s, 950sh, 790w, 687, 667, 609w, 528, 468s, 453s, 440sh.

Sil160 Talc $Mg_3(Si_4O_{10})(OH)_2$



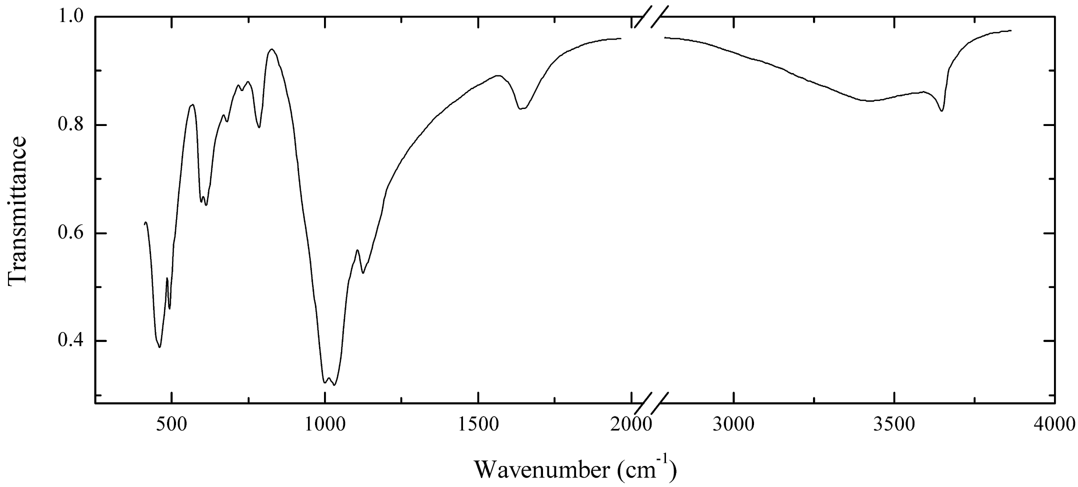
Locality: Zöblitz, Erzgebirge, Saxony, Germany.
Description: Grey scaly aggregate. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3685, 3660w, 3645w, 1040sh, 1017s, 950sh, 685sh, 669, 535, 500sh, 462s, 449s, 422.

Sil161 Roscoelite $KV_2(Si_3AlO_{10})(OH)_2$



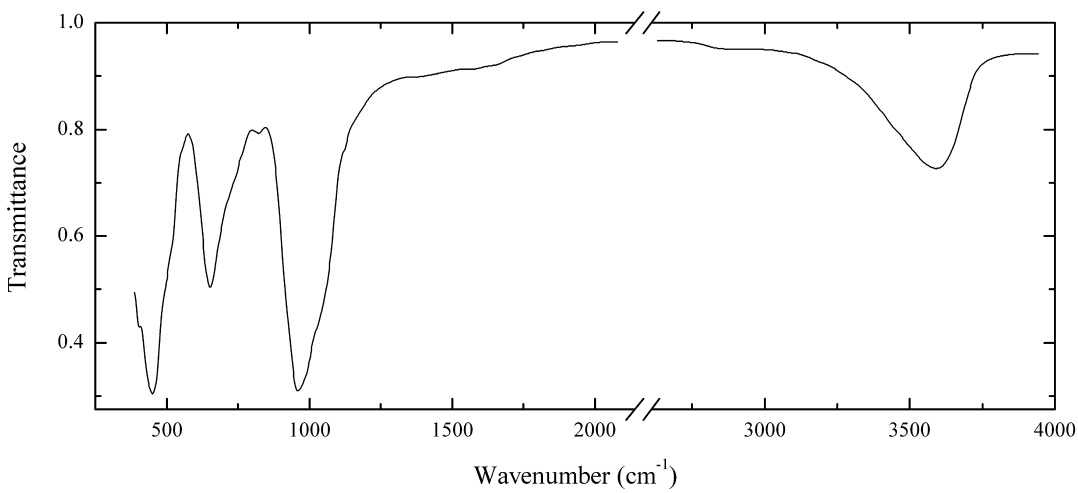
Locality: Big Bear creek, near Telluride, Colorado, USA.
Description: Scaly aggregate. Specimen No. 12053 from Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow.
Wavenumbers (cm^{-1}): 3575, 3380, 1620, 1028s, 1010sh, 920sh, 884, 800w, 745w, 693w, 522s, 465s, 425.

Sil162 Reyerite $(Na,K)_2Ca_{14}Si_{22}Al_2O_{58}(OH)_8 \cdot 6H_2O$



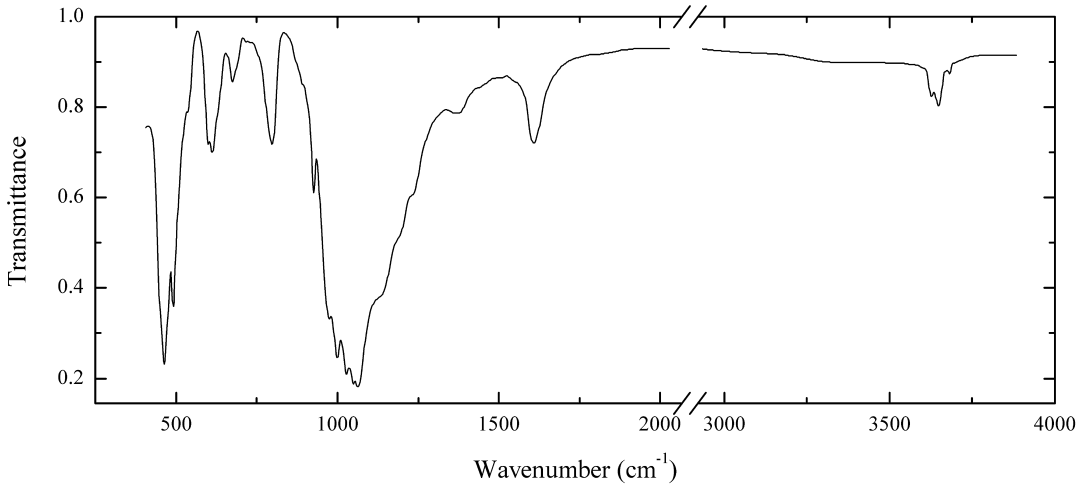
Locality: Drynoch, Scotland, UK.
Description: White split platy crystals in the association with zeolites. The empirical formula is (electron microprobe) $K_{0.8}Na_{0.65}Ca_{13.3}Fe_{0.05}Al_{2.47}Si_{22.0}(O,OH)_{66} \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3640, 3430, 1640, 1131, 1028s, 1002s, 786, 729w, 680, 613, 593, 492, 458s.

Sil163 Glagolevite $NaMg_6(Si_3AlO_{10})(OH,O)_8 \cdot H_2O$



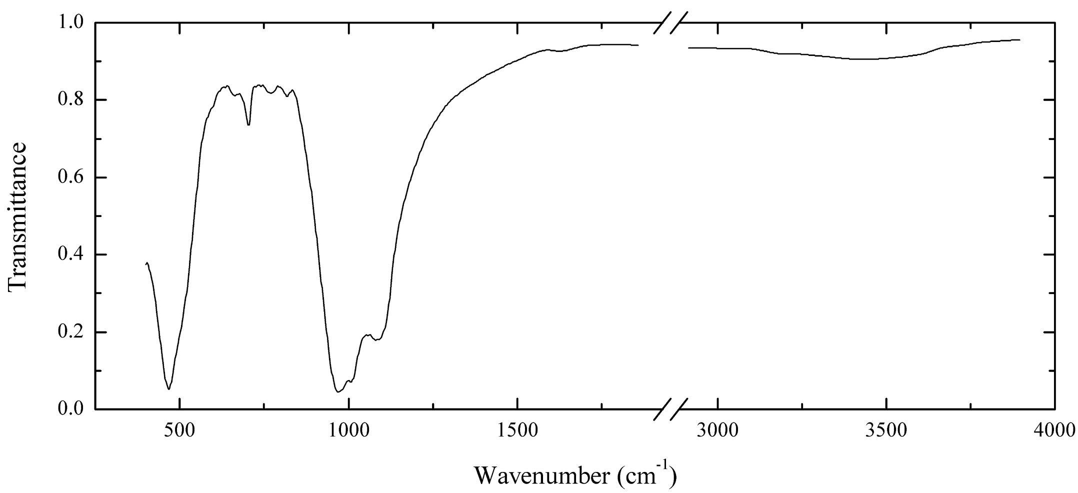
Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Pale green plates with mica-like cleavage in the association with magnetite and humite. A Na-deficient variety. The empirical formula is (electron microprobe) $Na_{0.5}(Mg_{5.1}Al_{0.7}Fe_{0.2})(Si_{2.8}Al_{1.2}O_{10})(OH)_8$.
Wavenumbers (cm^{-1}): 3590, 1020sh, 960s, 825w, 730sh, 650, 450s, 403.

Sil164 Truscottite $Ca_{14}Si_{24}O_{58}(OH)_8 \cdot xH_2O$



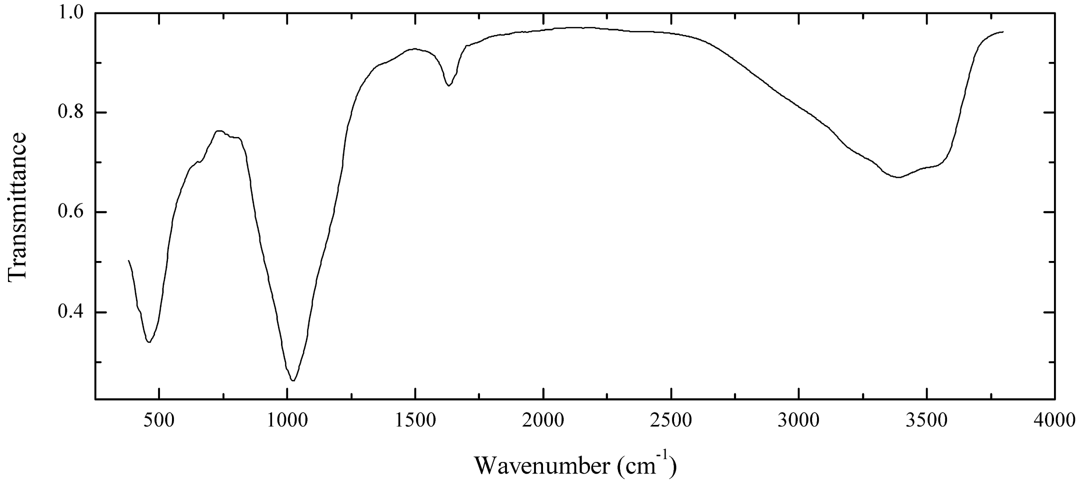
Locality: Redjang Lebong Donok mine, Benkulen, Sumatra, Indonesia (type locality).
Description: White scales with pearly lustre. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3675w, 3645, 3620, 1605, 1360w, 1230sh, 1195sh, 1135sh, 1064s, 1050s, 1029s, 999s, 925, 796, 671w, 625sh, 610, 599, 530sh, 505sh, 492, 475sh, 461s, 450sh.

Sil165 Tainiolite $KLiMg_2(Si_4O_{10})F_2$



Locality: Burpala massif, basin of Mama river, 120 km north of the northern extremity of the lake Baikal, Siberia, Russia.
Description: Brown plates from alkaline pegmatite. Al-rich variety. The empirical formula is (electron microprobe, Li calculated) $K_{0.9}(Mg_{1.6}Zn_{0.1}Fe_{0.1}Al_{0.1}Ti_{0.1})Li_{1.1}(Si_{3.6}Al_{0.4}O_{10})(F,OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3440, 1630w, 1088s, 1006s, 973s, 818w, 766w, 704, 660w, 510sh, 467s.

Sil166 Stilpnomelane $K(Fe^{2+},Mg,Fe^{3+})_8(Si,Al)_{12}(O,OH)_{27}$

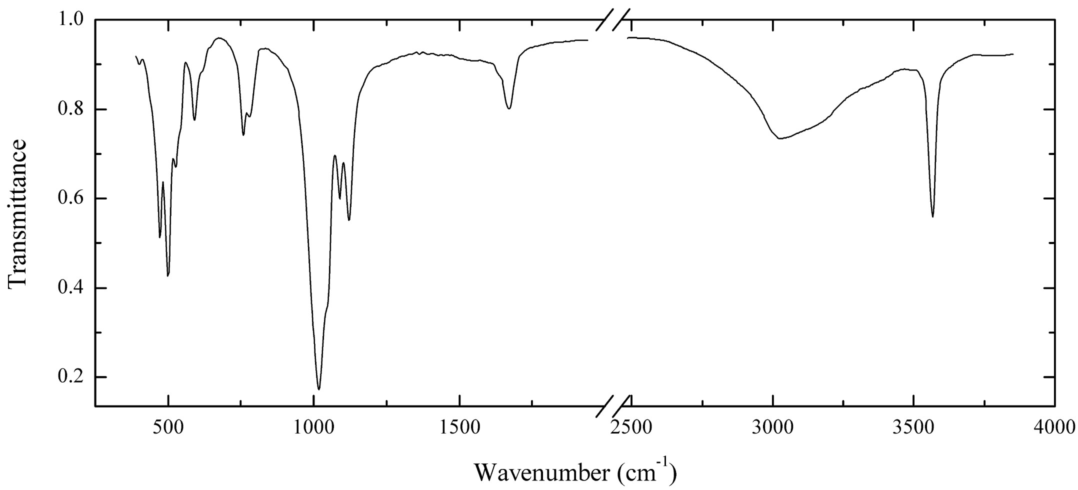


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.

Description: Brown plates with mica-like cleavage from the association with microcline and quartz. Confirmed by powder X-ray diffraction data. Oxidized variety (Fe^{3+} prevails over Fe^{2+}).

Wavenumbers (cm^{-1}): 3535, 3375, 3200sh, 1633, 1170sh, 1022s, 940sh, 790w, 695sh, 650w, 464s, 420sh.

Sil167 Apophyllite-(KF) $KCa_4Si_8O_{20}F{\cdot}8H_2O$

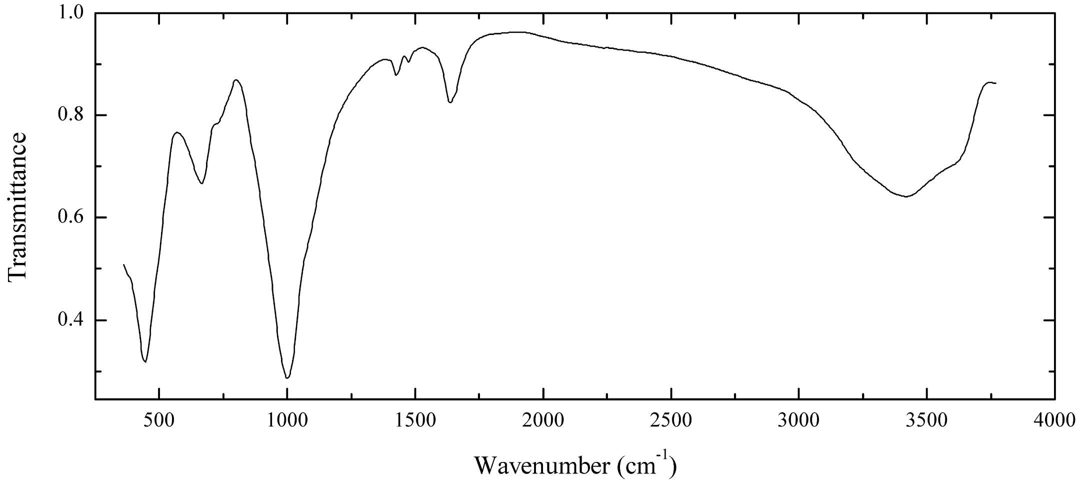


Locality: Dal'negorskoye boron deposit, Primorskiy Krai, Far East, Russia.

Description: Colourless dipyramidal crystals growing on datolite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3560, 3180sh, 3110sh, 3030, 1691, 1127, 1094, 1045sh, 1014s, 789, 765, 660w, 625sh, 599, 551, 532, 501s, 474, 445sh, 409.

Sil168 Ferrosaponite $Ca_{0.3}(Fe^{2+},Mg,Fe^{3+})_3(Si,Al)_4O_{10}(OH)_2\cdot 4H_2O$

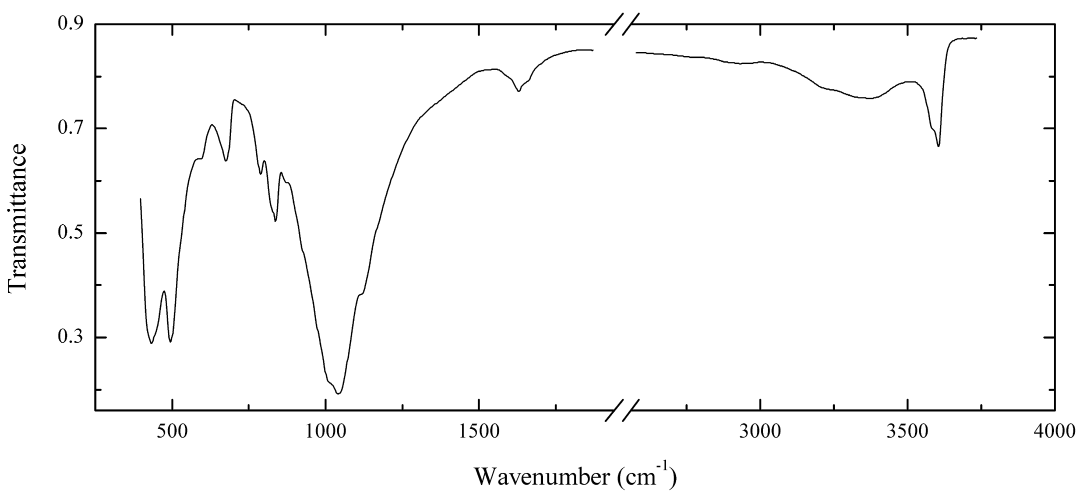


Locality: Levoberezhye Iceland spar deposit, Nizhnyaya Tunguska river, Evenkiya, Siberia, Russia (type locality).

Description: Brownish-green spherical aggregates included into crystals of transparent calcite (Iceland spar). Associated minerals are pyrite, quartz-chalcedony, mordenite, heulandite-Ca and stilbite-Ca. Holotype sample. Monoclinic *P* cell dimensions are $a = 5.365(2)$, $b = 9.337(4)$, $c = 14.65(2)$ Å, $\beta = 94.9(1)°$; $V = 731(1)$ Å^3, $Z = 2$. Optically biaxial (−), $\alpha = 1.448$, $\beta = 1.641(2)$, $\gamma = 1.642(2)$; $2V_{meas} = -5(3)°$. $D_{meas} = 2.49(5)$ g/cm^3. The empirical formula is $(Ca_{0.31}Na_{0.04}K_{0.01})_{\Sigma 0.36}(Fe^{2+}{}_{1.56}Mg_{0.87}Fe^{3+}{}_{0.52})_{\Sigma 2.95}[(Si_{2.91}Al_{1.03}Fe^{3+}{}_{0.06})_{\Sigma 4}O_{10}](OH)_2\cdot 4.24\ H_2O$.
The strongest lines of the powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 7.37 (90) (002), 4.72 (90) (020), 3.80 (80) (112), 3.03 (100) (031), 2.585 (90) (201, 210), 2.429 (90) (006), 1.549 (90) (060).

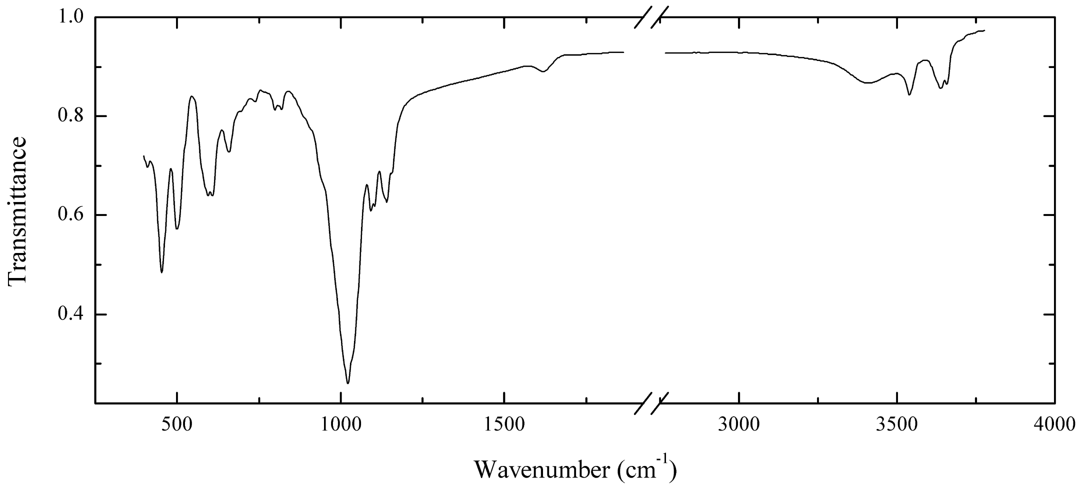
Wavenumbers (cm^{-1}): 3510sh, 3400, 3220sh, 1632, 1476w, 1425w, 1080sh, 1005s, 920sh, 735w, 670, 655sh, 446s, 415sh.

Sil169 Ferripyrophyllite $Fe^{3+}{}_2(Si_4O_{10})(OH)_2$



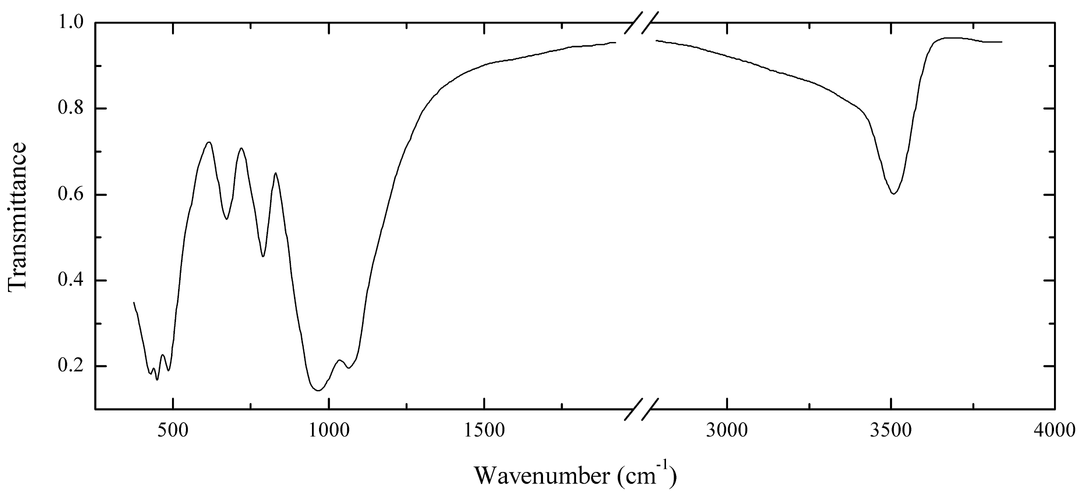
Locality: Talagay Mt., near Akchatau, Central Kazakhstan region, Kazakhstan.
Description: Brown plate with perfect cleavage. Specimen No. 84129 from the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow.
Wavenumbers (cm^{-1}): 3568, 3550sh, 3330, 3190w, 1628w, 1121, 1044s, 1015sh, 875sh, 837, 825sh, 789, 674, 588w, 496s, 445sh, 432s.

Sil170 Friedelite $Mn^{2+}_8(Si_6O_{15})(OH,Cl)_{10}$



Locality: Mangan Prospect, near Mt. Hamilton, Santa Clara Co., California, USA.
Description: Pink grains from the association with rhodochrosite. The empirical formula is (electron microprobe) $(Mn_{7.96}Ca_{0.03})(Si_{6.00}O_{15})(OH)_2{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3635, 3615, 3520, 3390, 1615w, 1420w, 1157, 1141, 1104, 1092, 1035sh, 1021s, 821, 799, 742w, 700sh, 662, 609, 596, 501s, 454s, 410.

Sil171 Ferroceladonite $KFe^{3+}(Fe^{2+},Mg)(Si_4O_{10})(OH)_2$

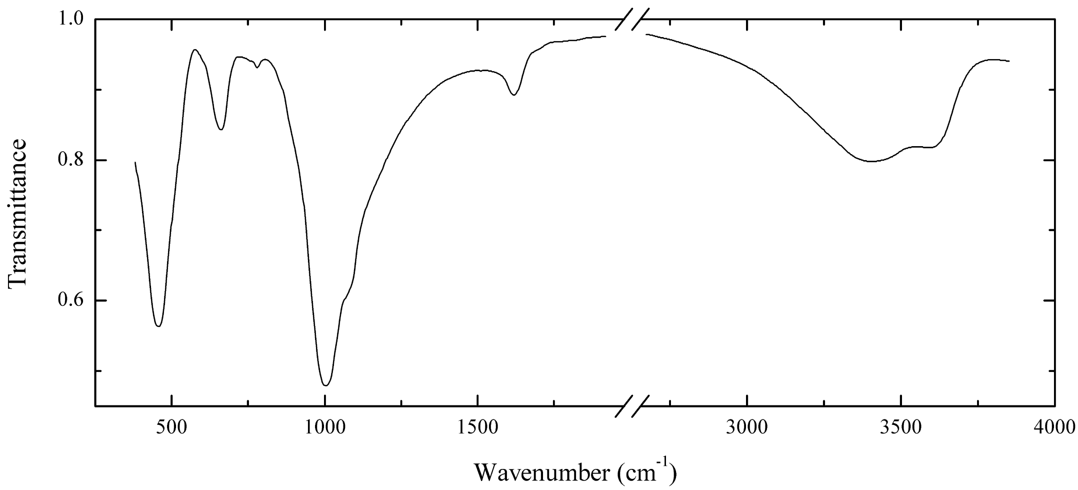


Locality: Mikhailovskii mine, near Zheleznogorsk, 90 km northwest of Kursk, Russia.

Description: Dark green scaly aggregate from the association with pyrite and hematite. Identified by powder X-ray diffraction pattern and chemical composition. The empirical formula is (electron microprobe) $K_{1.01}Fe_{1.00}(Fe_{0.59}Mg_{0.41})(Si_{3.86}Al_{0.10}Fe_{0.04}O_{10})(OH)_2$.

Wavenumbers (cm^{-1}): 3540, 1081s, 974s, 795, 760sh, 674, 484s, 445s, 430s.

Sil172 Zincsilite $Zn_3(Si_4O_{10})(OH)_2{\cdot}4H_2O$

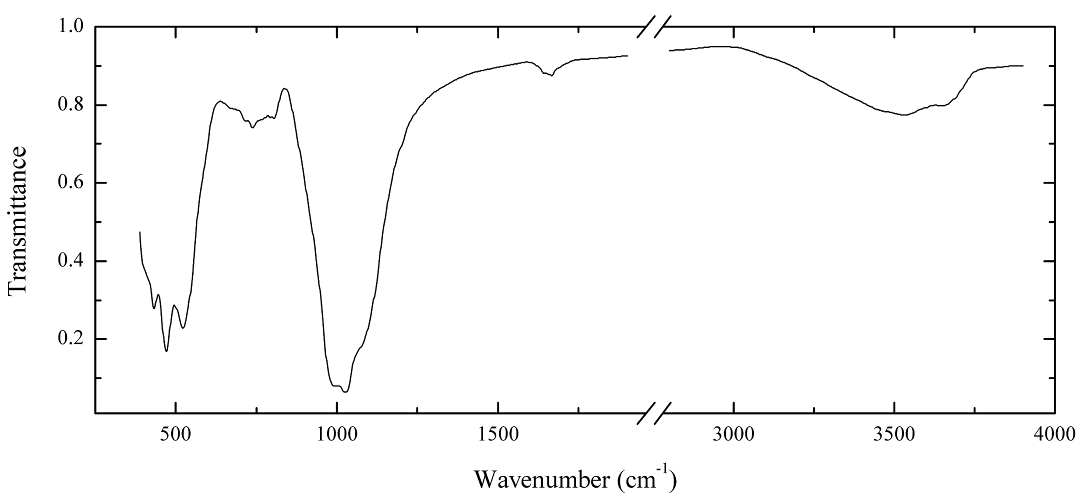


Locality: Batystau polymetallic deposit, Balkhash district, Karagandy region, Central Kazakhstan (type locality).

Description: Blue-green scaly aggregate forming pseudomorph after diopside. Specimen No. 61517 from the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow. The empirical formula is (electron microprobe) $Ca_{0.1}Zn_{2.4}Mg_{0.2}Cu_{0.2}Fe_{0.1}(Si_{3.9}Al_{0.1}O_{10})(OH,O)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3610, 3400, 1635, 1085sh, 1009s, 789w, 663, 457s.

Sil173 Zinnwaldite $KLiAlFe^{2+}(Si_3AlO_{10})F_2$



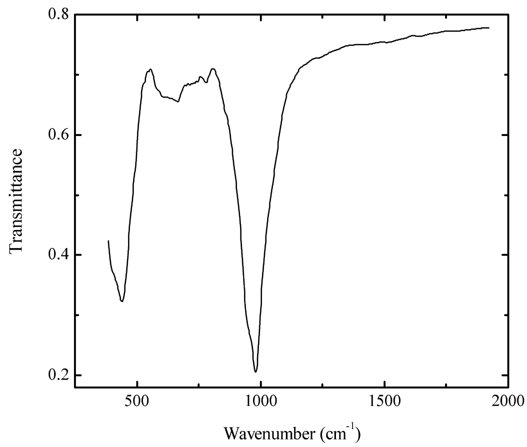
Locality: Orlovskoye deposit, Transbaikal territory, Siberia, Russia.

Description: Grey, coarse-scaly aggregate. An analogue of masutomilite with Fe^{2+} > Mn.

The empirical formula is (electron microprobe; wet analysis for Li) $(K_{0.91}Rb_{0.03}Na_{0.02})(Li_{1.03}Al_{1.12}Fe^{2+}_{0.51}Mn_{0.08}Zn_{0.01})(Si_{3.43}Al_{0.57}O_{10})F_{2.0}·nH_2O$.

Wavenumbers (cm^{-1}): 3595, 3490, 1640w, 1075sh, 1022s, 996s, 801, 770sh, 744, 715w, 529s, 475s, 439, 395sh.

Sil174 Hendricksite $KZn_3(Si_3AlO_{10})(OH)_2$

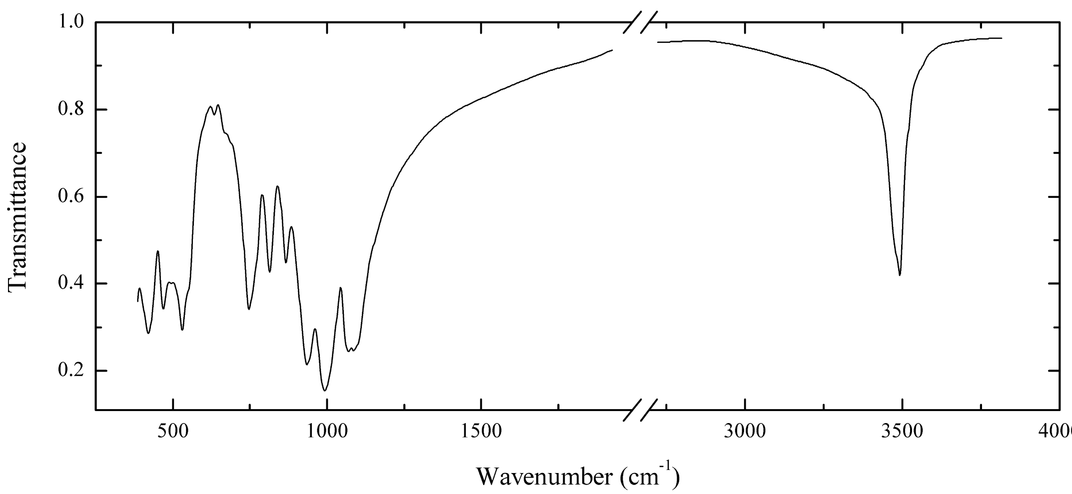


Locality: Franklin, Sussex Co., New Jersey, USA.

Description: Brown plates with perfect cleavage in the association with calcite, garnet and willemite. The empirical formula is (electron microprobe) $K_{1.0}(Zn_{1.3}Mn_{1.2}Fe_{0.4}Mg_{0.2})(Si_{2.9}Al_{1.1}O_{10})(OH,F)_2$.

Wavenumbers (cm^{-1}): 982s, 950sh, 786w, 666, 640sh, 620sh, 441s, 405sh.

Sil175 Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$

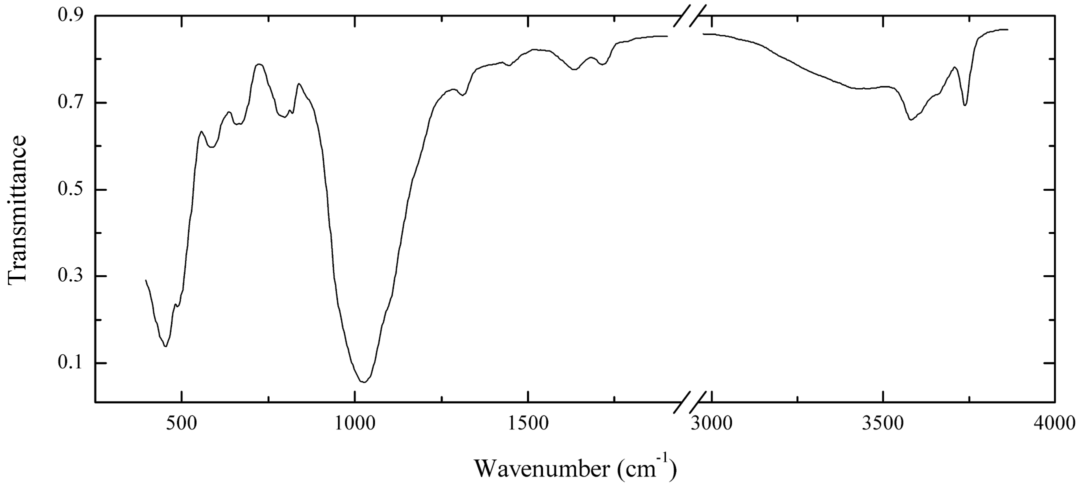


Locality: Mt. Ohsa, Ohsa-osakabe, Niimi, Okayama prefecture, Japan.

Description: Light grey columnar aggregate from rodingite, from the association with grossular. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{1.95}Fe_{0.05})(Al_{0.94}Fe_{0.03}Mg_{0.03})(Si_{3.04}Al_{0.96}O_{10})(OH)_2$.

Wavenumbers (cm^{-1}): 3480, 1090s, 1072s, 994s, 937s, 867, 814, 747, 633w, 550sh, 529s, 470, 417s.

Sil176 Yakhontovite $(Ca,Na)_{0.5}(Cu,Fe,Mg)_2(Si_4O_{10})(OH)_2 \cdot 3H_2O$

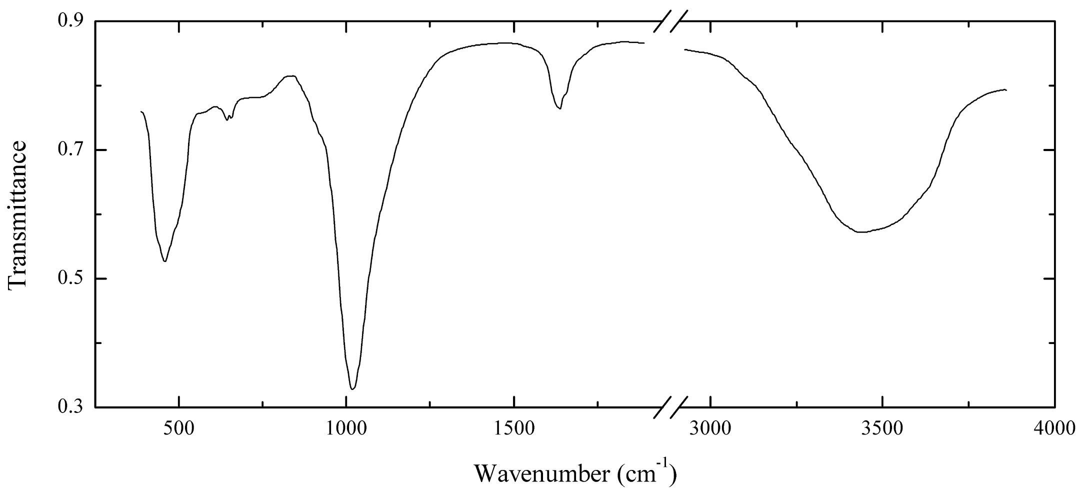


Locality: Pridorozhnoye tin deposit, near Komsomol'sk-on-Amur, Khabarovsk territory, Russia (type locality).

Description: Pistachio-green fine-grained aggregate, in the association with chrysocolla, malachite, pseudomalachite, goethite and quartz. Investigated by the author (V.P. Postnikova).

Wavenumbers (cm^{-1}): 3705, 3625sh, 3550, 3410, 1710w, 1630w, 1435w, 1310w, 1090sh, 1021s, 955sh, 817, 796, 780sh, 690sh, 676, 657, 595, 487s, 448s, 435sh, 420sh.

Sil177 Yakhontovite $(Ca,Na)_{0.5}(Cu,Fe,Mg)_2(Si_4O_{10})(OH)_2 \cdot 3H_2O$

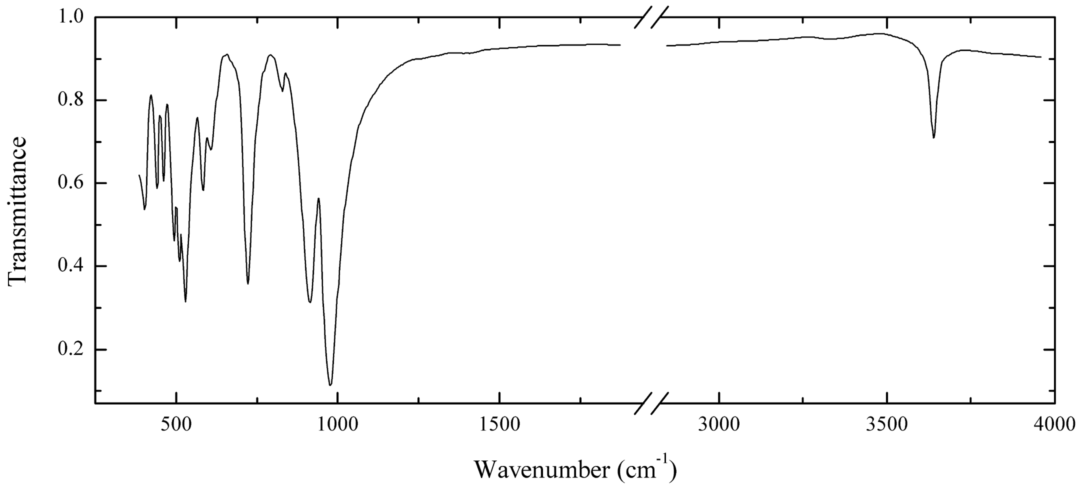


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Light blue fine-grained aggregate forming pseudomorph after unidentified mineral in peralkaline pegmatite, in the association with feldspar, aegirine, organovaite-Mn, calcite and rhabdophane. The empirical formula is (electron microprobe) $(Mg_{0.22}Ca_{0.14}K_{0.01})(Cu_{1.22}Zn_{0.47}Al_{0.37}Mg_{0.16}Fe_{0.03}Ti_{0.03})(Si_{3.91}Al_{0.09}O_{10})(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3620sh, 3420, 1640, 1020s, 744w, 670, 645, 495sh, 458s, 435sh.

Sil178 Ephesite $Na(LiAl_2)(Si_2Al_2O_{10})(OH)_2$



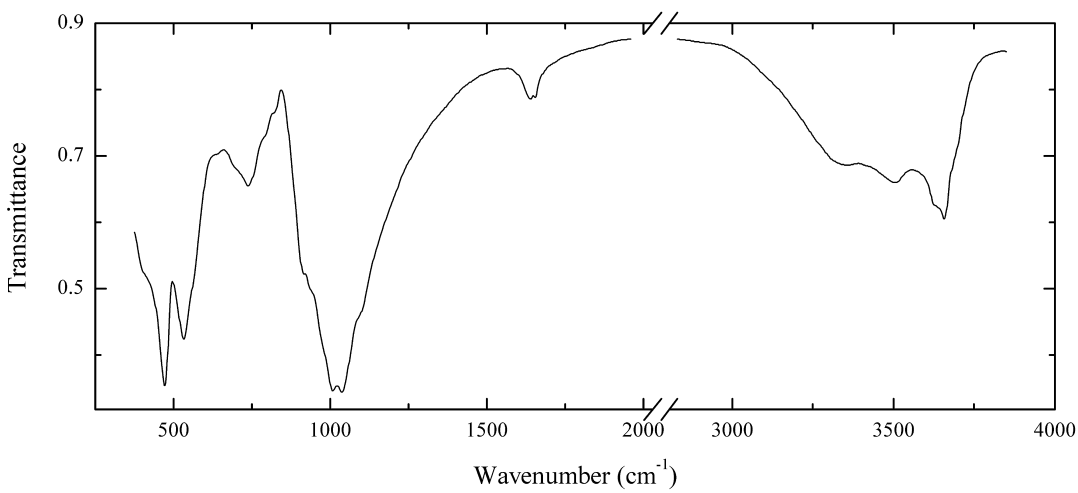
Locality: Martha's Kloof, Postmasburg district, west of Kimberley, Republic of South Africa.

Description: Pink, coarse-scaly aggregate, in the association with braunite. Identified by IR spectrum. The empirical formula is (electron microprobe, Li calculated) $(Na_{0.96}Sr_{0.01})(Li_{0.99}Al_{2.01})(Si_{2.03}Al_{1.97}O_{10})(OH)_2$.

Wavenumbers (cm^{-1}): 3605, 976s, 914s, 828w, 770sh, 721s, 608, 584, 530s, 510, 493, 462, 441, 401.

Sil179 Tosudite

1:1 regular interstratification of chlorite and dioctahedral smectite

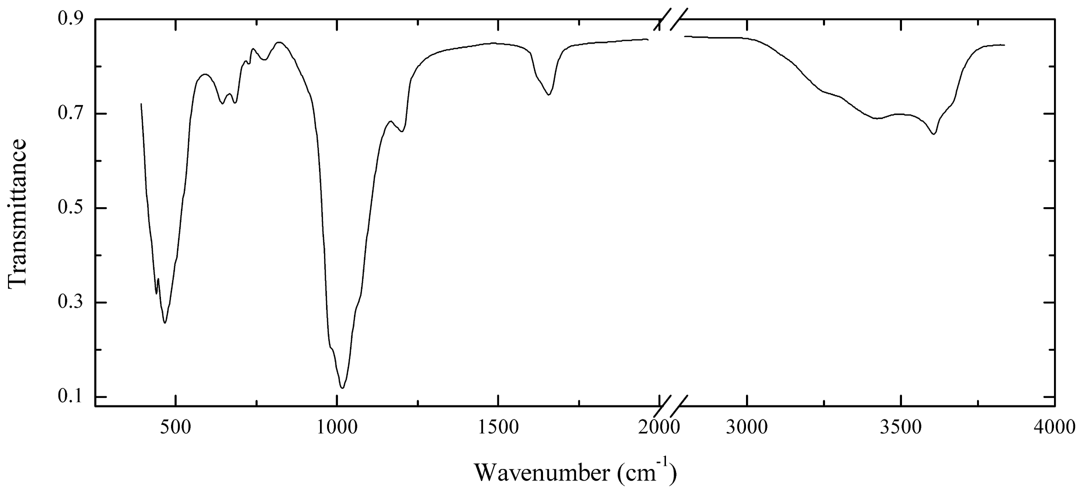


Locality: Kastel Mt., Alushta, Crimea, Ukraine.

Description: Light blue earthy crust from the association with dickite. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3700sh, 3680sh, 3658, 3625sh, 3500, 3355, 1655w, 1640w, 1110sh, 1041s, 1011s, 970sh, 940sh, 916, 830sh, 790sh, 743, 710sh, 560sh, 531s, 471s, 415sh.

Sil180 Sepiolite $Mg_4(Si_6O_{15})(OH)_2{\cdot}6H_2O$

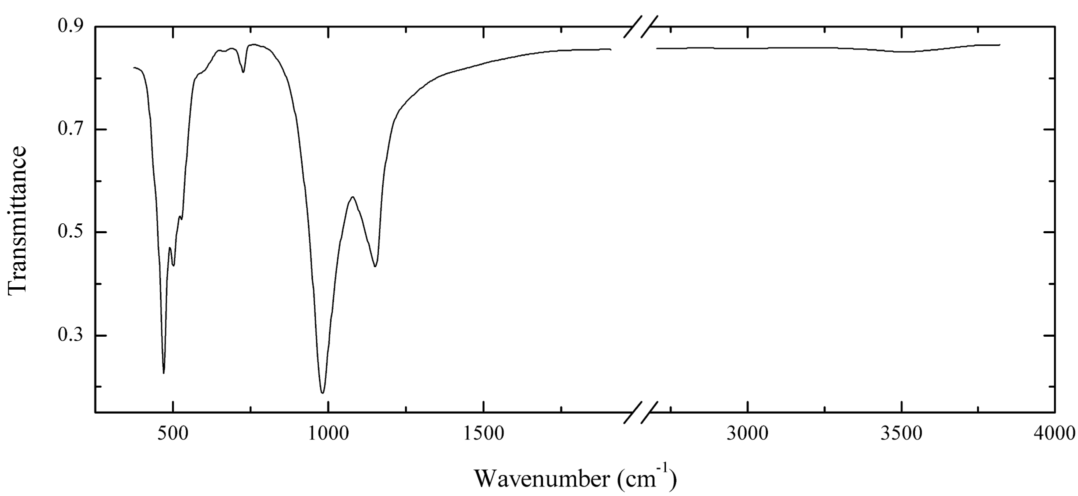


Locality: Dashkesan iron deposit, Azerbaidzhan.

Description: Grey, massive, porous. Identified by powder X-ray diffraction pattern and IR spectrum. The empirical formula is (electron microprobe) $(Mg_{3.3}Mn_{0.6}Fe_{0.3})(Si_{6.0}O_{15})(OH,O)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3625sh, 3577, 3395, 3230sh, 1654, 1625sh, 1205, 1065sh, 1019s, 980sh, 782w, 728w, 686, 643, 530sh, 495sh, 466s, 440sh, 420sh.

Sil181 Tainiolite $KLiMg_2(Si_4O_{10})F_2$

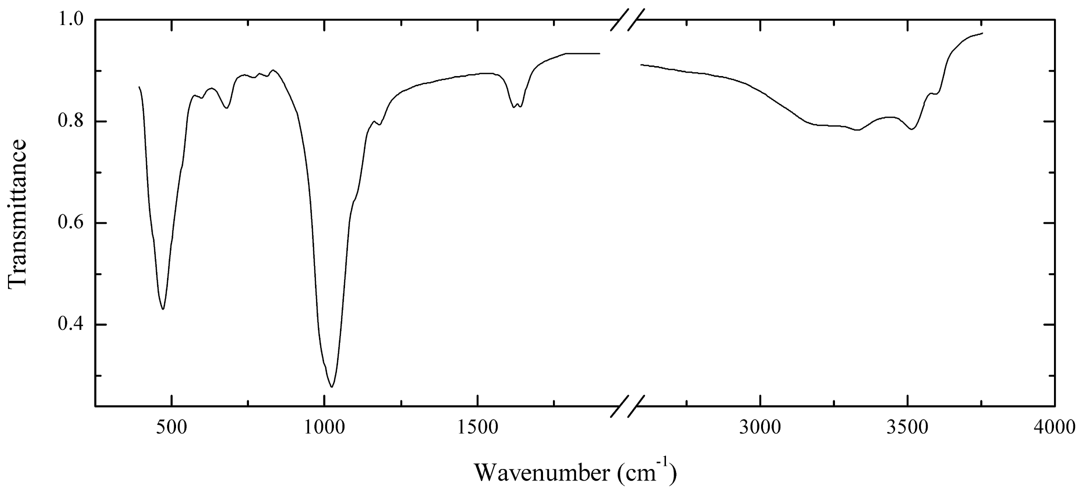


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Aggregate of colourless scales in peralkaline pegmatite. Associating minerals are natrolite, aegirine and catapleiite. Identified by IR spectrum. The empirical formula calculated on $(Si,Al)_4$ is (electron microprobe) $(K_{0.92}Na_{0.03}Ca_{0.02})Li_x(Mg_{1.82}Mn_{0.07}Fe_{0.04}Ti_{0.03})(Si_{3.83}Al_{0.17}O_{10})(F,OH)_2$ ($x \approx 1$).

Wavenumbers (cm^{-1}): 1131s, 1100sh, 966s, 714, 660w, 590sh, 519, 494s, 464s, 445sh.

Sil182 Tuperssuatsiaite $NaFe^{3+}{}_3(Si_8O_{20})(OH)_2{\cdot}4H_2O$

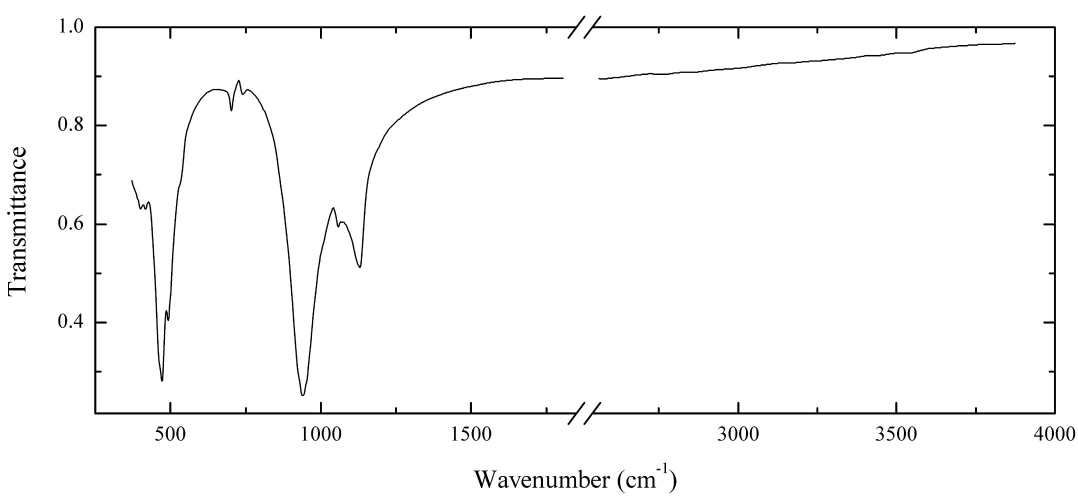


Locality: Kangerdluarssuk, Ilimaussaq massif, Greenland.

Description: Brown acicular crystals in cavities of alkaline rock. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3630, 3555, 3370, 3280, 1655, 1630, 1187, 1110sh, 1020s, 819w, 779w, 680, 597w, 525sh, 465s, 453sh.

Sil183 Shirokshinite $K(NaMg_2)(Si_4O_{10})F_2$

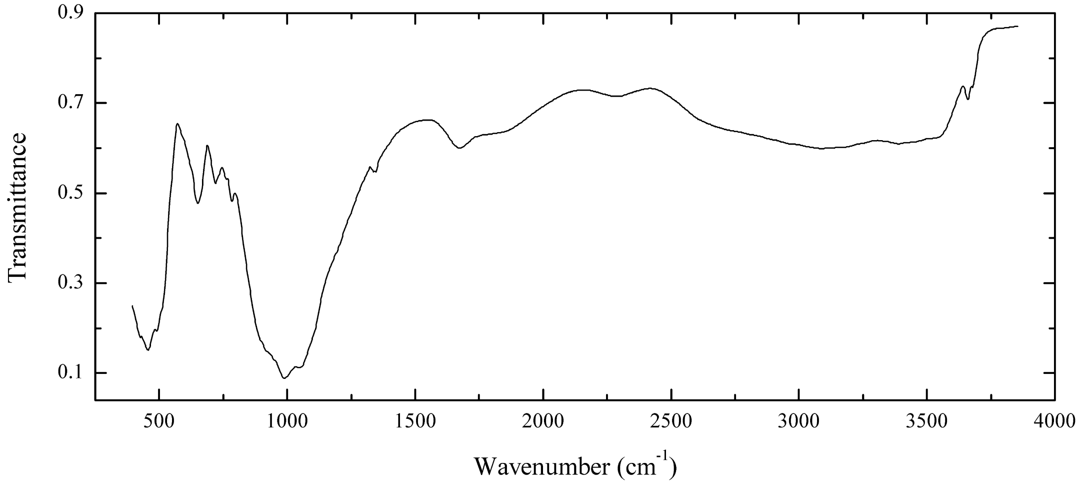


Locality: Level +252 m, Kirovskiy Mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Coarse prismatic crystals. Associated minerals are microcline, kupletskite, aegirine, galena, natrolite, lorenzenite, calcite, remondite-(Ce), donnayite-(Y) and mckelveyite-(Y). Holotype sample. Monoclinic, space group *C*2/*m*; $a = 5.269(2)$, $b = 9.071(2)$, $c = 10.178(4)$ Å, $\beta = 100.03(3)°$. Optically biaxial (−), $\alpha = 1.526(1)$, $\beta = 1.553(2)$, $\gamma = 1.553(2)$, $2V_{meas} = -5(5)°$. $D_{calc} = 2.922$ g/cm^3. The empirical formula is (electron microprobe) $K_{0.90}(Na_{0.94}Mg_{1.97}Fe_{0.09}Mn_{0.01}Ti_{0.01})_{\Sigma 3.02}(Si_{3.98}Al_{0.02})_{\Sigma 4.00}O_{9.995}F_{2.01}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 10.0 (70), 3.67 (60), 3.36 (90), 2.59 (90), 2.41 (100), 2.14 (60), 1.665 (80), 1.522 (100).

Wavenumbers (cm^{-1}): 1130s, 1060, 945s, 742w, 702w, 530sh, 493s, 471s, 460sh, 410, 400.

Sil184 Shafranovskite $(Na,K)_2(Mn^{2+},Fe^{2+})Si_3O_8 \cdot 2H_2O$

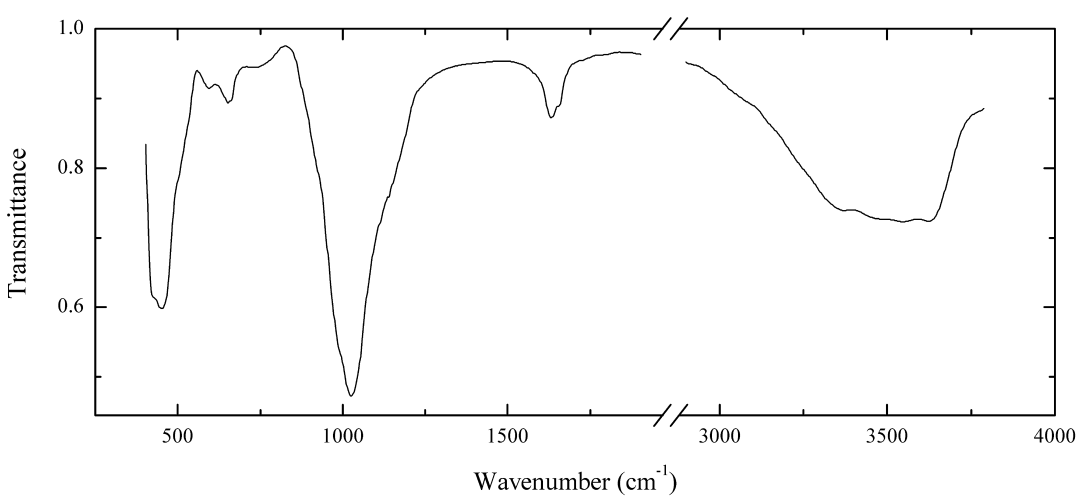


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Greenish-beige massive from peralkaline pegmatite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3657, 3535, 3390, 3100, 2750sh, 2300w, 1800sh, 1670, 1343, 1050s, 991s, 945sh, 920sh, 895sh, 784, 764, 720, 649, 505sh, 483s, 451s, 420sh.

Sil185 Na-Mn silicate $Na_2Mn_2(Si_4O_{10})(OH)_2 \cdot 4H_2O$ (?)

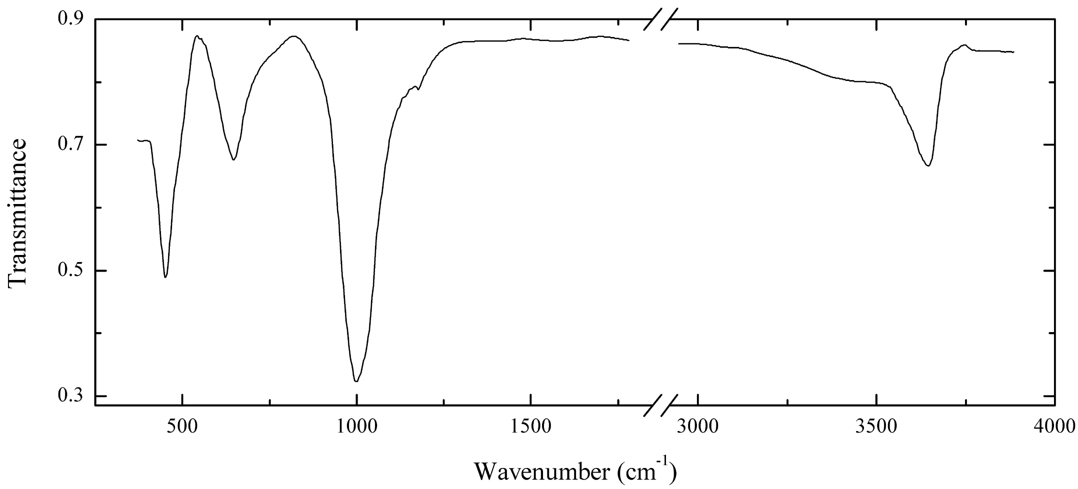


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown radial fibrous aggregates from the association with gonnardite. Related to raite and probably identical to the "mineral M19" by A.P. Khomyakov. The empirical formula is (electron microprobe) $Na_{1.6}Mn_{1.5}Fe_{0.5}Mg_{0.1}(Si_{3.75}Al_{0.25}O_{10})(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3625, 3540, 3475, 3350, 1660sh, 1635, 1195sh, 1150sh, 1026s, 990sh, 749w, 658, 600, 520sh, 449s, 425sh.

Sil186 Chamosite $(Fe,Al,Mg)_6(Si,Al)_4O_{10}(OH)_8$

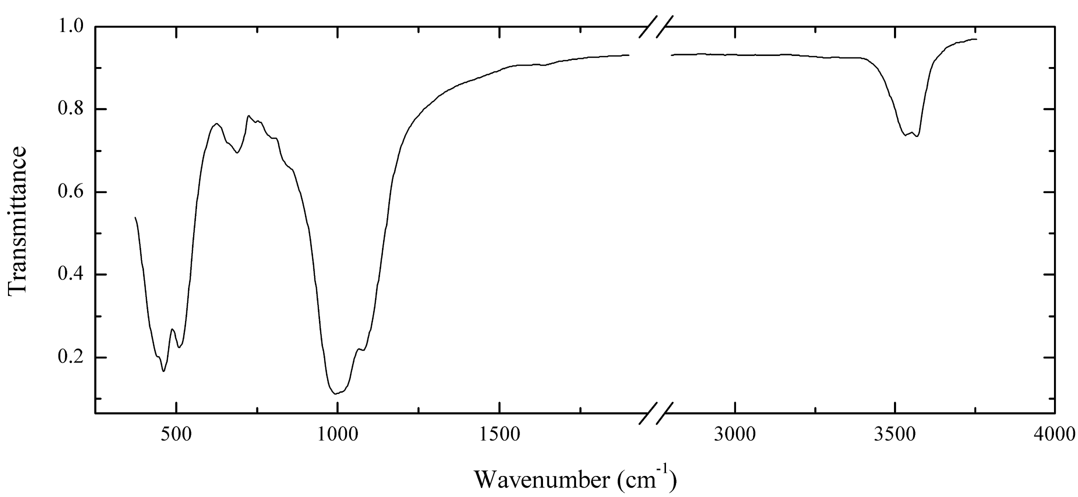


Locality: Dal'negorskoye polymetallic deposit, Far East, Russia.

Description: Dark grey-green radiated aggregates forming pseudomorph after hedenbergite. Associated minerals are ilvaite and quartz. Mn-rich variety. The empirical formula is (electron microprobe) $(Fe_{3.85}Mn_{1.65}Mg_{0.2}Al_{0.1})(Si_{4.0}O_{10})(OH)_8$.

Wavenumbers (cm^{-1}): 3635, 3460w, 1175w, 1002s, 652, 490sh, 454.

Sil187 Chromceladonite $KCrMg(Si_4O_{10})(OH)_2$

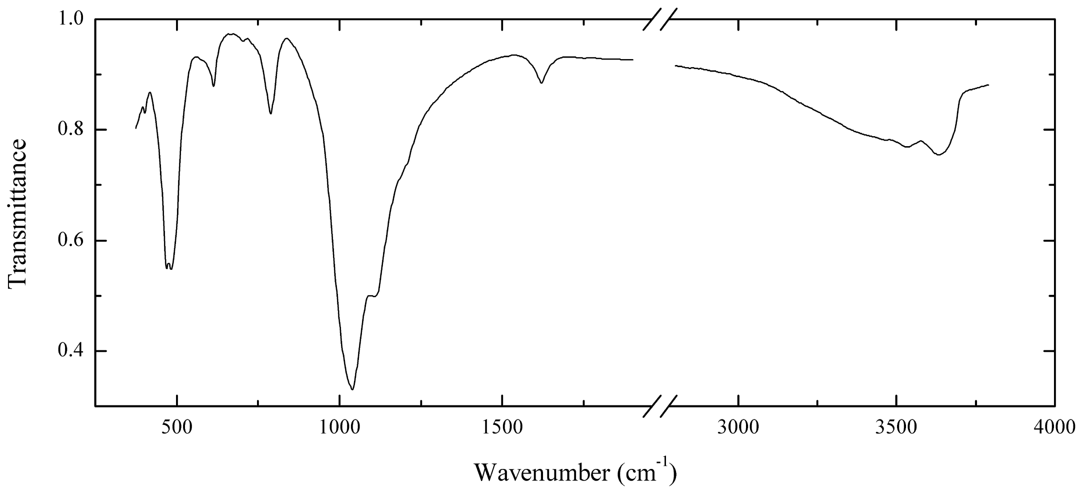


Locality: U deposit Srednyaya Padma, Zaonezhskii peninsula, Onega sea, Karelia, Russia (type locality).

Description: Deep green. Scaly aggregate from the association with dolomite, quartz, roscoelite, chromphyllite, calcite, hematite, uraninite and zincochromite. Holotype sample. Monoclinic, space group *C*2, $a = 5.267$, $b = 9.101$, $c = 10.162$ Å, $\beta = 100.67°$. Optically biaxial (−), $\alpha = 1.605$, $\beta = 1.648$, $\gamma = 1.654$, $2V_{meas} = 12(10)$. $D_{meas} = 2.90$ g/cm^3, $D_{calc} = 2.95$ g/cm^3. The empirical formula is $(K_{0.94}Na_{0.02})(Cr_{0.95}V_{0.10}Al_{0.05}Fe^{3+}{}_{0.03}Ti_{0.01})(Mg_{0.83}Fe^{2+}{}_{0.04}Li_{0.04}Zn_{0.01}Mn_{0.01})(Si_{3.78}Al_{0.22}O_{10})$ $(OH)_{1.60}F_{0.13}O_{0.13}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.54 (93) (020), 3.638 (64) (11-2), 3.097 (51) (112), 2.588 (100) (13-1), 2.409 (87) (13-2), 1.518 (56) (33-1).

Wavenumbers (cm^{-1}): 3552, 3513, 1069s, 1010sh, 992s, 840sh, 787, 736w, 710sh, 686, 675sh, 501s, 451s, 430sh.

Sil188 Fedorite $(Na,K)_{2\text{–}3}(Ca,Na)_7(Si,Al)_{16}O_{38}(F,Cl,OH)_2 \cdot nH_2O$

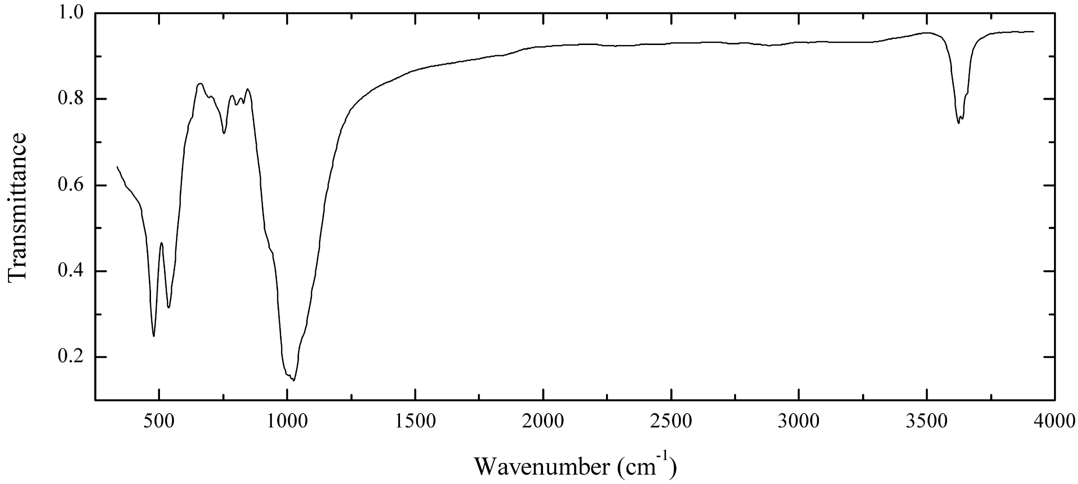


Locality: Murun massif (Murunskii alkaline complex), Aldan Shield, southwest Yakutia, Siberia, Russia.

Description: Colourless plates with mica-like cleavage from the association with charoite, aegirine and quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3630, 3520, 3460sh, 1622, 1190sh, 1109s, 1039s, 790, 709w, 615, 484s, 468s, 400w.

Sil189 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$

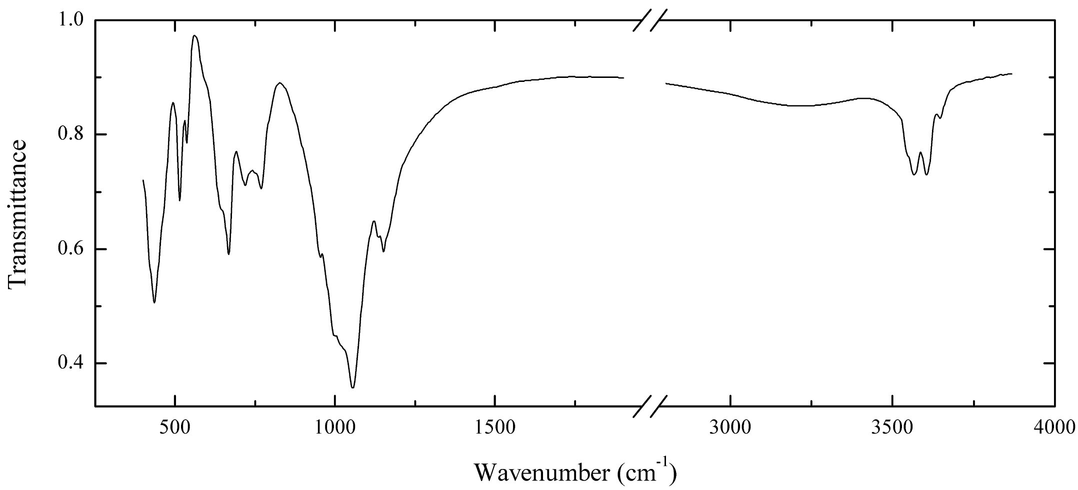


Locality: An unknown locality in Saxony, Germany.

Description: Light yellow scaly aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3660sh, 3642, 3628, 1065sh, 1028s, 1005s, 930sh, 828w, 800w, 751, 694w, 650sh, 536s, 476s, 400sh.

Sil190 Pyrosmalite-(Fe) $Fe^{2+}_8(Si_6O_{15})(OH,Cl)_{10}$

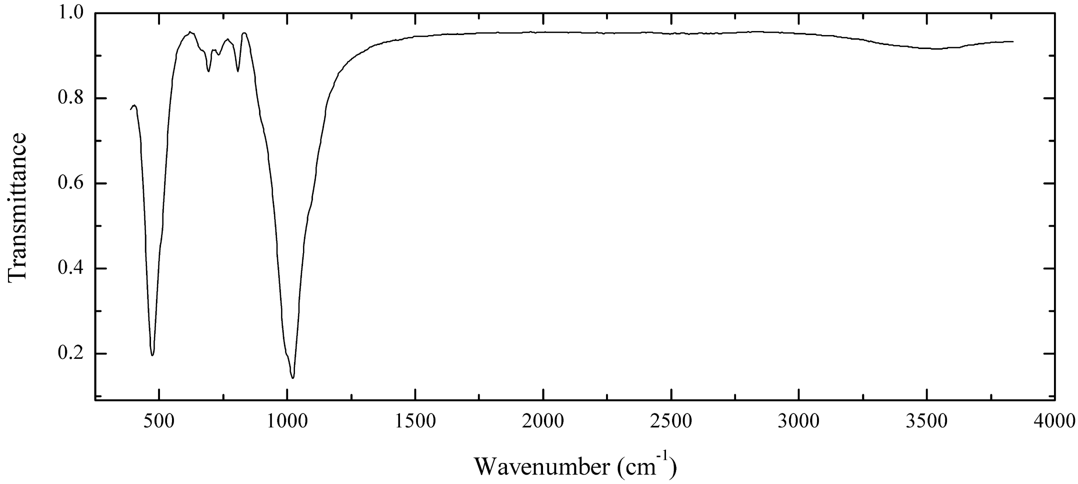


Locality: Haborshyttan, Sweden.

Description: Greenish-brown crystals with perfect cleavage. The empirical formula is (electron microprobe; OH calculated) $(Fe_{4.18}Mn_{3.81}Al_{0.01})(Si_{5.94}Al_{0.06}O_{15})(OH_{8.9}Cl_{1.1})$.

Wavenumbers (cm^{-1}): 3620w, 3570, 3540, 3320w, 1160sh, 1145, 1127, 1050s, 1010sh, 995s, 955sh, 763, 712, 670sh, 664s, 635sh, 536w, 514, 433s, 415sh.

Sil191 Fluorphlogopite $KMg_3(Si_3AlO_{10})F_2$

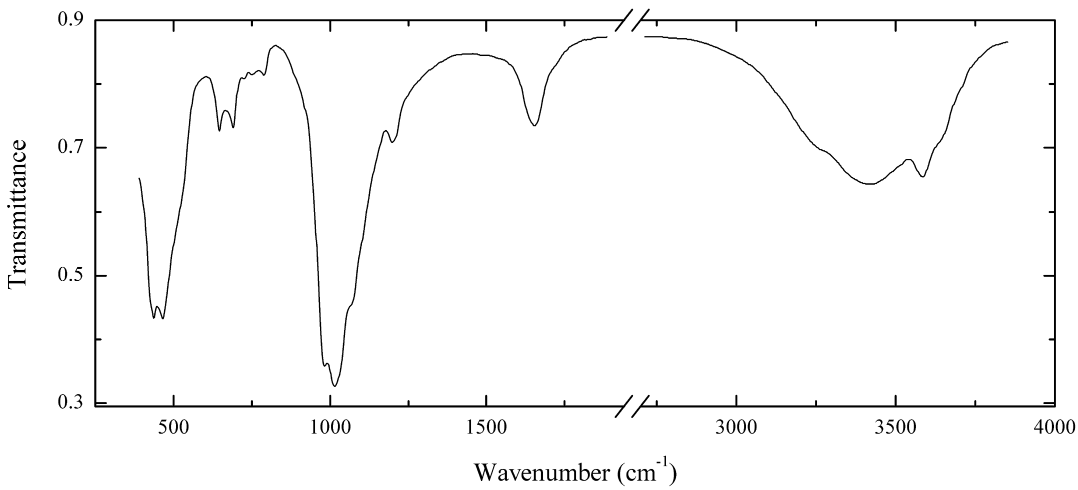


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Bluish platy crystals to 2 mm. Investigated by B.V. Chesnokov. Contains 8.4 wt.% F. Confirmed by powder X-ray diffraction pattern and IR spectrum.

Wavenumbers (cm^{-1}): 1090sh, 1020s, 995sh, 910sh, 807, 729w, 690, 660sh, 505sh, 471s.

Sil192 Sepiolite $Mg_4(Si_6O_{15})(OH)_2{\cdot}6H_2O$

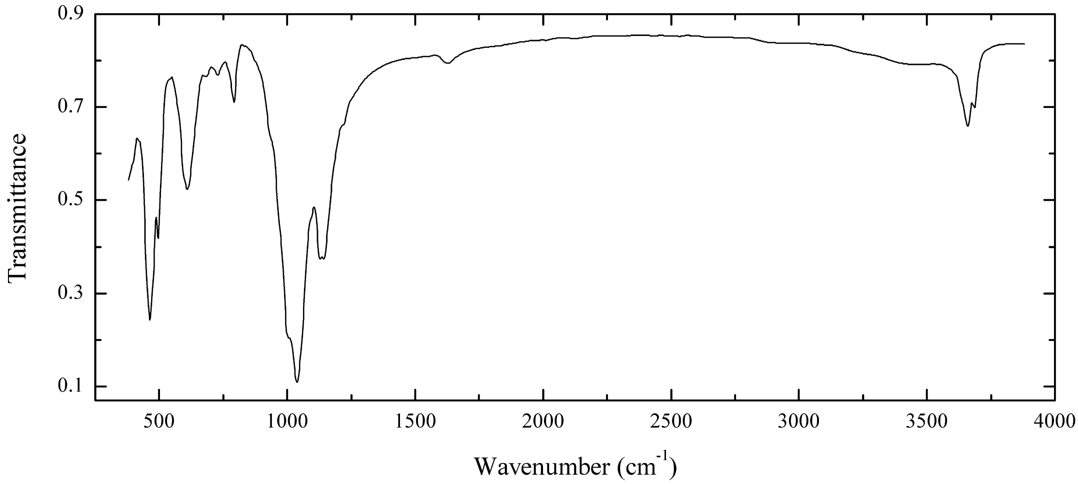


Locality: Korshunovskoe iron deposit, Irkutsk region, Siberia, Russia.

Description: Grey parallel-fibrous aggregate from the association with calcite and magnetite. The empirical formula is (electron microprobe) $(Mg_{3.5}Fe_{0.6}Mn_{0.1})(Si_{5.9}Al_{0.1}O_{15})(OH,O)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3620sh, 3565, 3400, 3250sh, 1655, 1209, 1070sh, 1017s, 980s, 784w, 763w, 724w, 689, 644, 530sh, 400sh, 467s, 438s, 425sh.

Sil193 Tungusite $Ca_{14}Fe^{2+}{}_9(Si_{24}O_{60})(OH)_{22}$



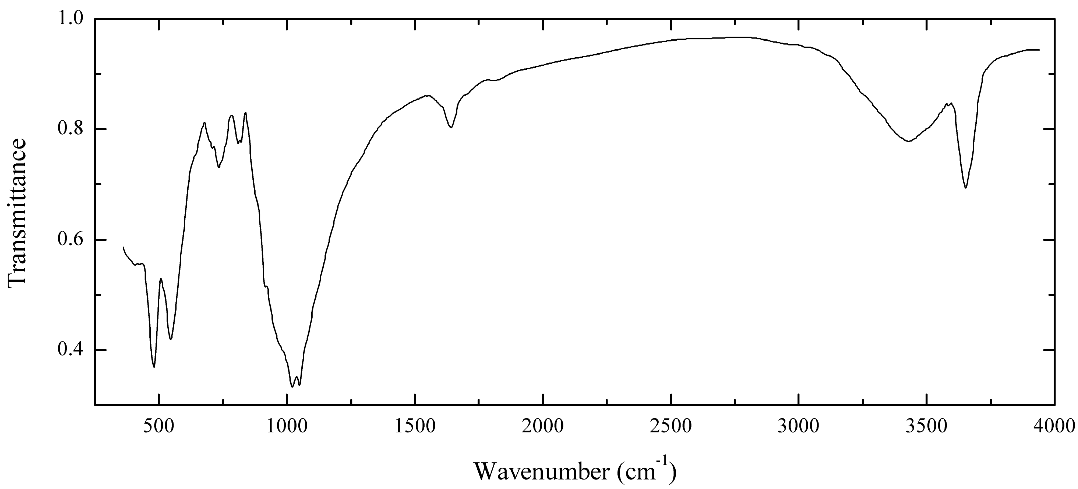
Locality: Tura, Evenkiya, Eastern Siberia, Russia (type locality).

Description: Greenish-grey scales from the association with hydroxyapophyllite. K,Na-bearing, Fe-poor variety. The empirical formula is (electron microprobe) $K_{0.5}Na_{1.0}Ca_{15.1}Fe_{3.5}Al_{0.8}Mn_{0.7}Mg_{0.3}(Si_{24}O_{60})(OH,H_2O)_{14}$.

Wavenumbers (cm^{-1}): 3660, 3635, 3450w, 1625w, 1220sh, 1144s, 1127s, 1037s, 1005sh, 935sh, 791, 728, 685w, 608, 494, 460s.

Sil194 Na-rectorite

1:1 regular interstratification of a dioctahedral Na-mica and dioctahedral smectite

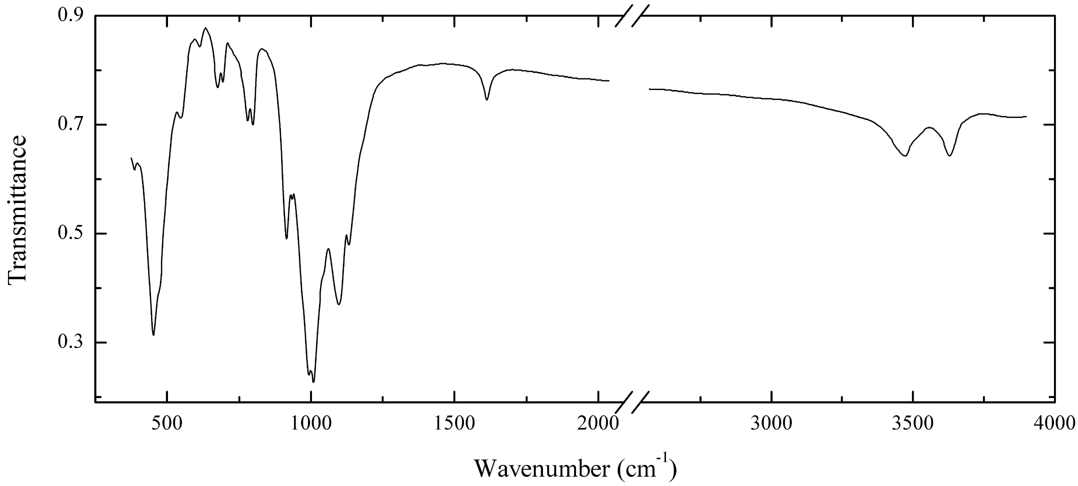


Locality: Bestyube gold field, 180 km northeast of Astana, Kazakhstan.

Description: Soil fraction <0.001 mm. The chemical composition is (wet chemical analysis, wt. %) Na_2O 3.5, K_2O 0.7, CaO 1.5, Al_2O_3 32.6, SiO_2 43.6, H_2O^- 7.4, H_2O^+ 6.9. Confirmed by powder X-ray diffraction pattern and IR spectrum.

Wavenumbers (cm^{-1}): 3660sh, 3640, 3415, 1645, 1120sh, 1080sh, 1047s, 1021s, 990sh, 920, 870sh, 821, 808, 745sh, 737, 705sh, 640sh, 543s, 477s, 415.

Sil195 Wickenburgite $Pb_3CaAl_2Si_{10}O_{27}·3H_2O$

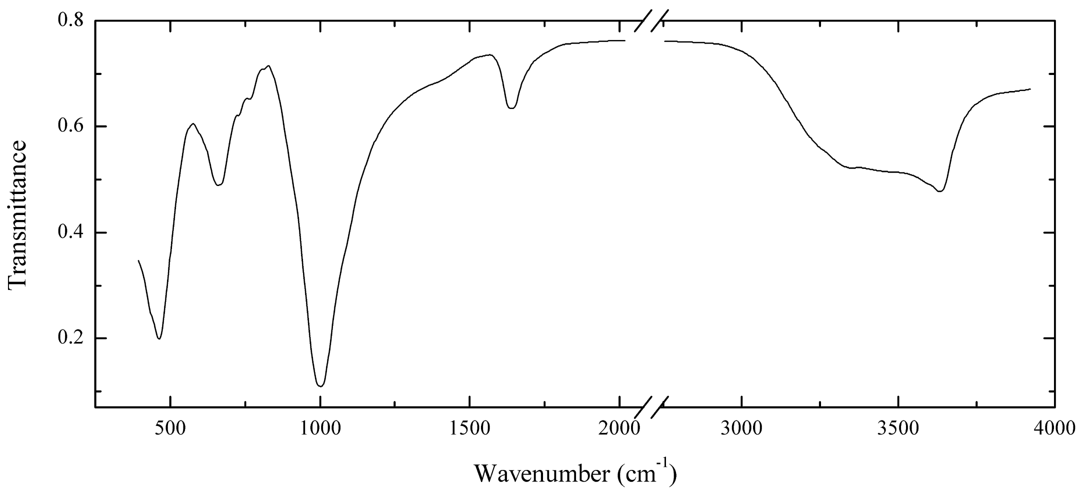


Locality: Rat Tail mine, Wickenburg, Arizona, USA.

Description: White massive. The empirical formula is (electron microprobe) $Pb_{2.86}Ca_{0.96}Sr_{0.09}Al_{1.91}Fe_{0.16}Si_{10.00}O_{27}·nH_2O$.

Wavenumbers (cm^{-1}): 3622, 3467, 1617, 1137, 1101s, 1009s, 993s, 935, 916, 800, 780, 695, 677, 610w, 548, 475sh, 453s, 387.

Sil196 Saponite $(Ca_{0.5},Na)_{0.3}(Mg,Fe^{2+})_3[(Si,Al)_4O_{10}](OH)_2·4H_2O$



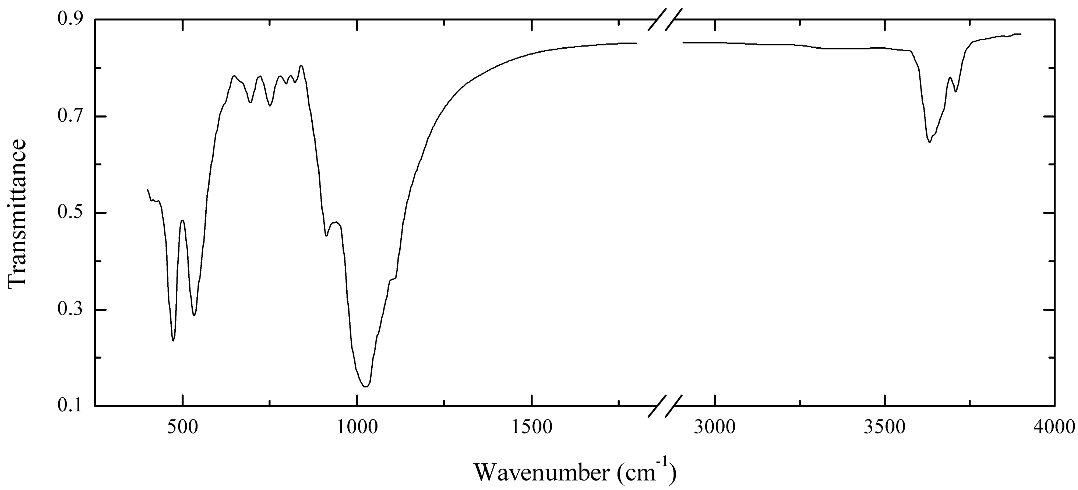
Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Crust on altered sphalerite, in the association with natrolite. Zn-rich variety.

The empirical formula is (electron microprobe) $(Na_xCa_{0.12})(Mg_{1.35}Zn_{1.32}Al_{0.33})(Si_{3.05}Al_{0.95}O_{10})(OH)_2·nH_2O$.

Wavenumbers (cm^{-1}): 3635, 3430sh, (3330), 1650w 1002s, 770w, 730w, 665, 459s.

Sil197 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$

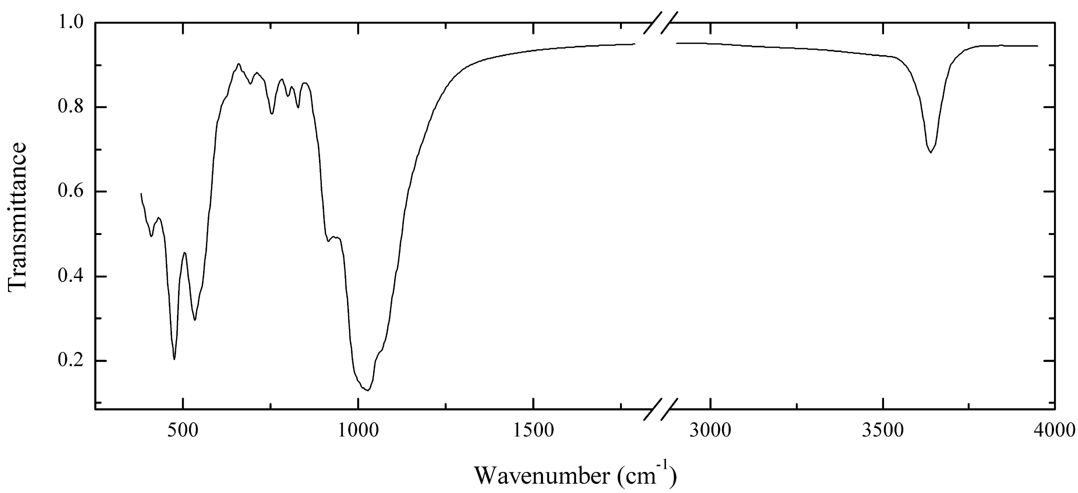


Locality: Unknown.

Description: Lilac massive. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3695, 3650sh, 3620, 1105sh, 1023s, 912, 822w, 795w, 750, 695, 533s, 472s, 420.

Sil198 Muscovite $KAl_2(Si_3AlO_{10})(OH)_2$

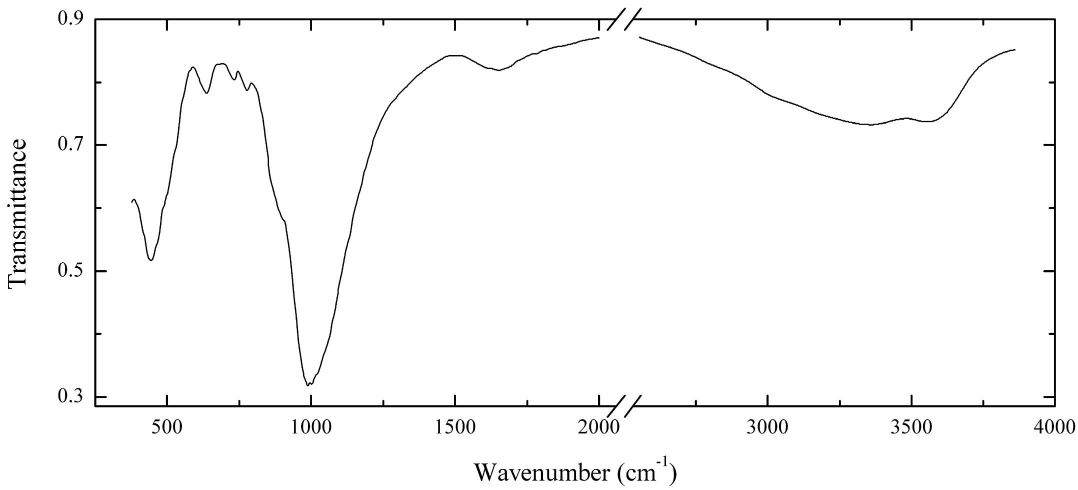


Locality: Khankaiskiy massif, Primorskiy Kray, Far East, Russia.

Description: Light grey, friable scaly aggregate from the contact zone of basalt dike. The empirical formula is (semiquantitative electron microprobe analysis) $K_{0.95}(Al_{1.6}Mg_{0.3}Fe_{0.1})(Si_{3.3}Al_{0.7}O_{10})(OH)_2$.

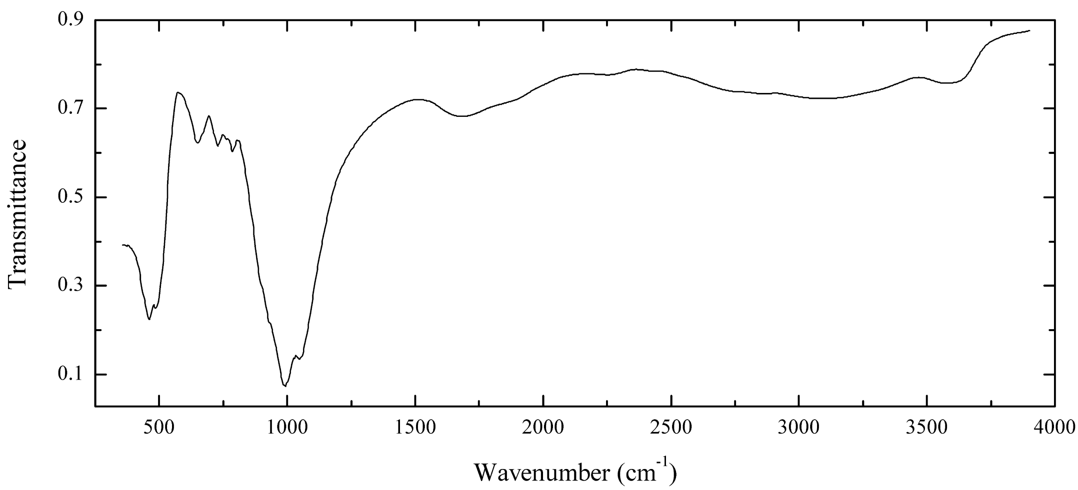
Wavenumbers (cm^{-1}): 3630, 1060sh, 1023s, 913, 830, 802w, 765, 694w, 620sh, 550sh, 533s, 473s, 409.

Sil199 Shafranovskite $(Na,K)_2(Mn^{2+},Fe^{2+})Si_3O_8 \cdot 2H_2O$



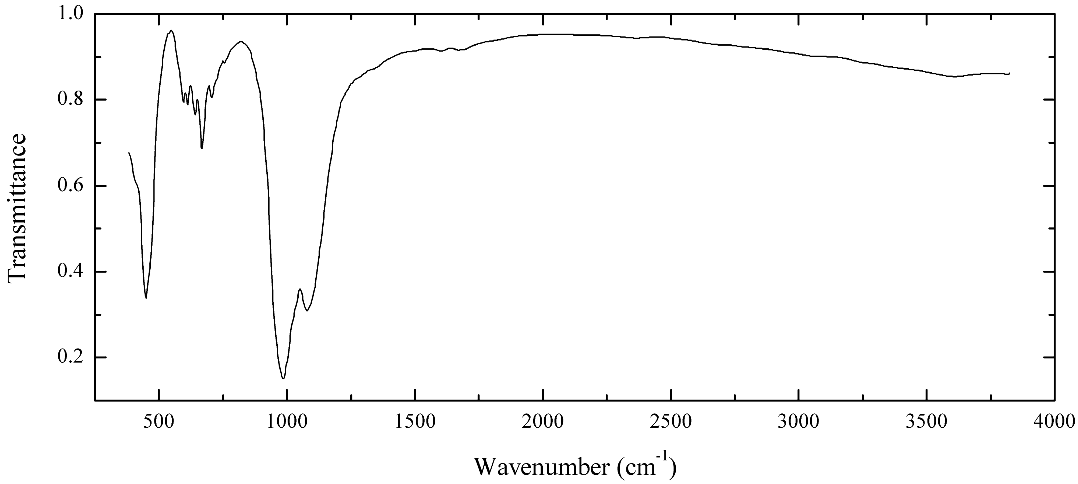
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brownish-yellow massive from peralkaline pegmatite. Altered (oxidized and disordered) variety, transitional to hisingerite.
Wavenumbers (cm^{-1}): 3550, 3350, 3200sh, 1650, 990s, 900sh, 775w, 723w, 635, 444s.

Sil200 Shafranovskite $(Na,K)_2(Mn^{2+},Fe^{2+})Si_3O_8 \cdot 2H_2O$



Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Greenish-beige massive from peralkaline pegmatite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3665, 3100, 2800sh, 2340w, 1770sh, 1675, 1255sh, 1048s, 990s, 950sh, 925sh, 784, 760w, 724, 649, 483s, 458s.

Sil201 Delhayelite $K_4Na_2Ca_2(Si_7AlO_{19})FCl$

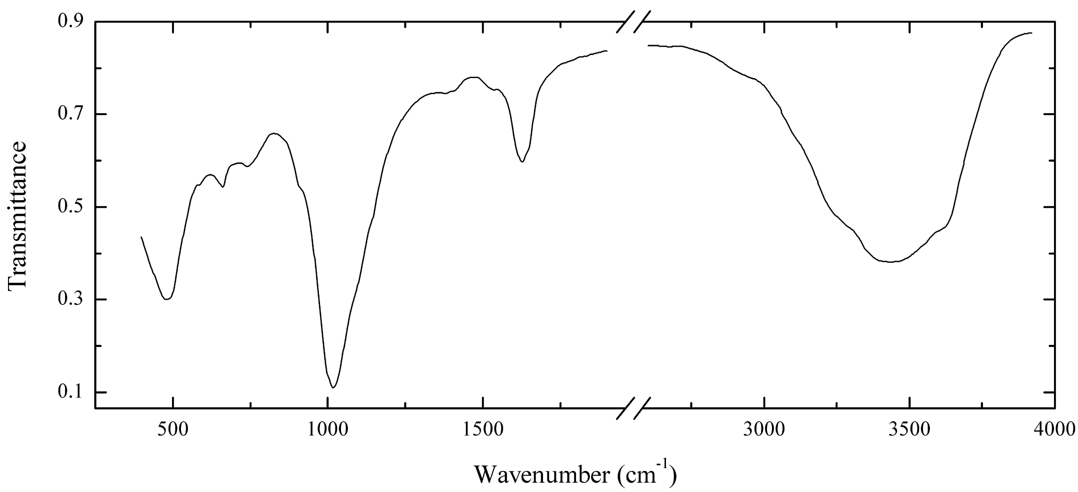


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Grey platy crystals with pearly lustre from peralkaline pegmatite. A fresh (low hydrated) sample. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 1685w, 1615w, 1082s, 1020sh, 987s, 753w, 702, 663, 638, 608, 591, 460sh, 444s, 405sh.

Sil202 Chrysocolla $Cu_2H_2Si_2O_5(OH)_4{\cdot}nH_2O$

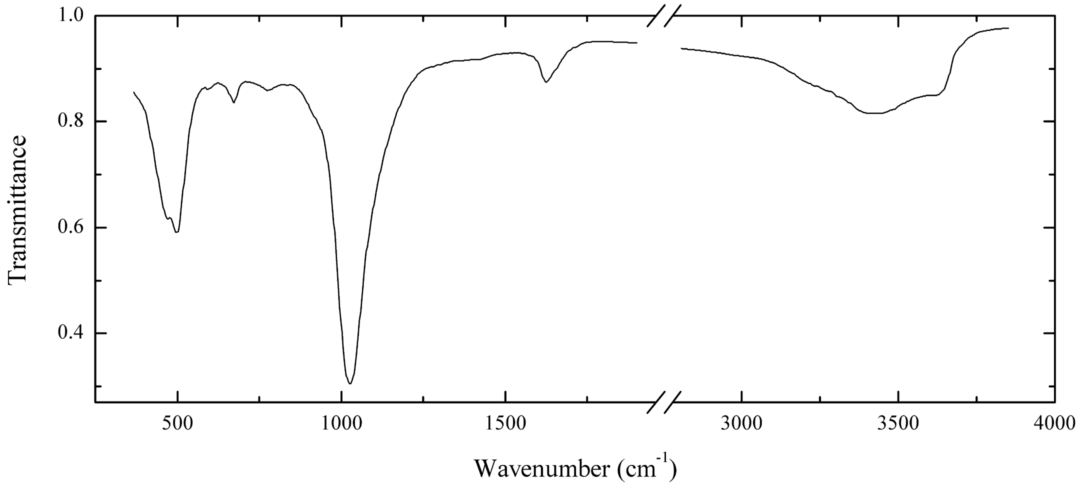


Locality: Khaidarkan deposit, 60 km southwest of Fergana, Kyrgyzstan.

Description: Green colloform crust from the association with khaidarkanite and fluorite. Al-rich, F-bearing variety. The empirical formula is (electron microprobe) $(Ca_{0.1}Cu_{1.6}Al_{0.3})H_x(Si_{1.7}Al_{0.3}O_5)(OH)_{3.6}F_{0.4}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3630sh, 3430s, 3340sh, 1660sh, 1640, 1550w, 1420w, 1391w, 1150sh, 1017s, 920sh, 752, 670, 590, 495sh, 480s.

Sil203 Chrysocolla $Cu_2H_2Si_2O_5(OH)_4 \cdot nH_2O$

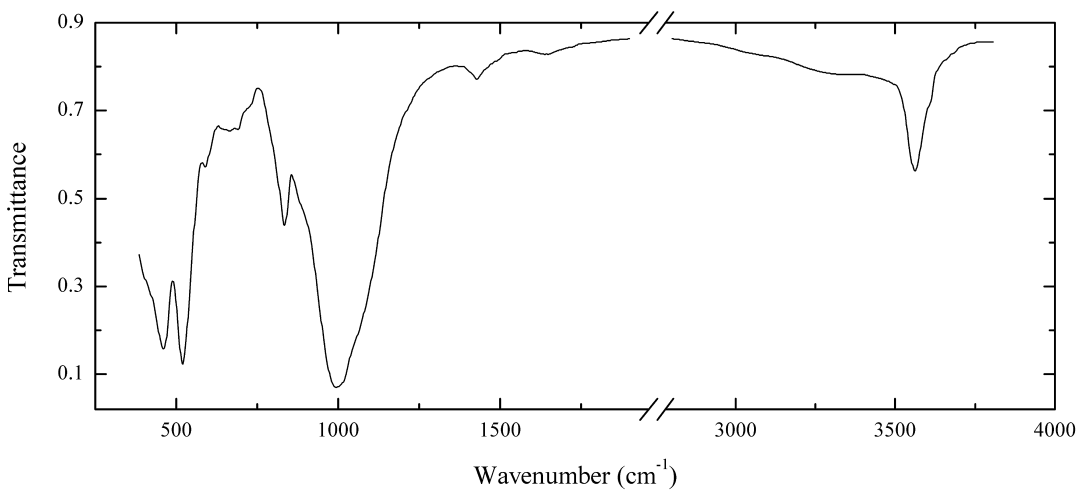


Locality: North Dzhezkazgan Quarry, Dzhezkazgan deposit, Central Kazakhstan.

Description: Light blue colloform crust, in the association with azurite and quartz. The empirical formula is (electron microprobe) $(Ca_{0.05}Cu_{1.9}Al_{0.1})H_2(Si_{2.0}O_5)(OH,O)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3600, 3405, 3350, 3240sh, 1660sh, 1633, 1037s, 965sh, 767, 670, 600w, 495s, 471s.

Sil204 Chernykhite $BaV_2(Si_2Al_2O_{10})(OH)_2$

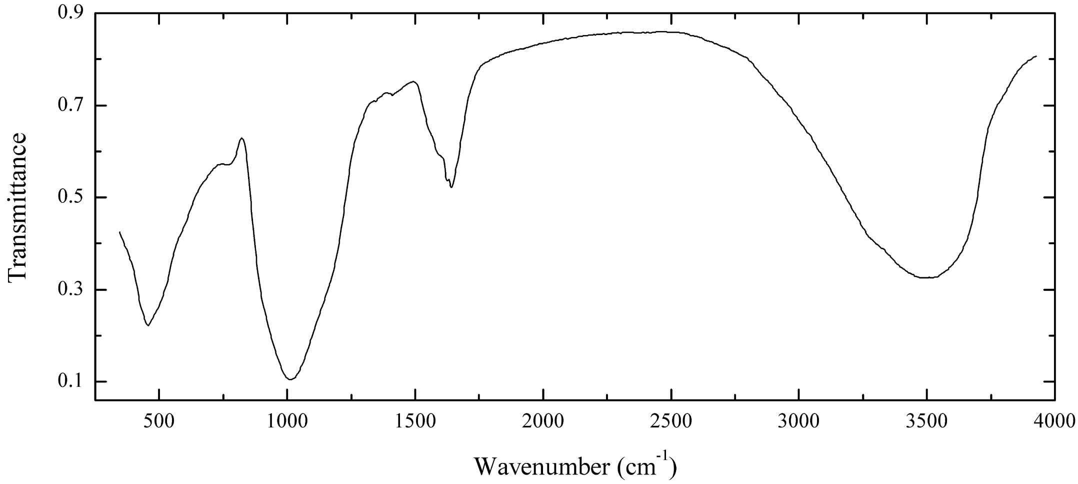


Locality: Balasauskandyk, Karatau range, southern Kazakhstan (type locality).

Description: Dark green coarse-scaly aggregate. Holotype sample. Monoclinic, space group *C*2/*c* or *Cc*; $a = 5.29$, $b = 9.18$, $c = 20.02$ Å, $\beta = 95.41°$, $Z = 4$. Optically biaxial (−), $\alpha = 1.641$, $\beta = 1.688$, $\gamma = 1.703$. $D_{calc} = 3.15$ g/cm^3, $D_{meas} = 3.10$ g/cm^3. The empirical formula is $(Ba_{0.28}Ba_{0.20}K_{0.07})(V_{1.43}Al_{0.65}Mg_{0.18}Fe_{0.02})(Si_{2.30}Al_{1.70}O_{10})(OH)_2$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.33 (100), 3.01 (50), 2.887 (40), 2.607 (70), 1.996 (60), 1.660 (60), 1.530 (50). Contains admixture of carbonate (the band at 1,420 cm^{-1}).

Wavenumbers (cm^{-1}): 3580sh, 3525, 3290, 1630w, 1420, 1055sh, 989s, 880sh, 832, 710sh, 684, 655, 640, 590, 518s, 461s, 410sh.

Sil205 "Chinglusuite" $Na_x(Fe^{3+},Mn)_2(Si_2O_5)(OH)_4 \cdot nH_2O$?

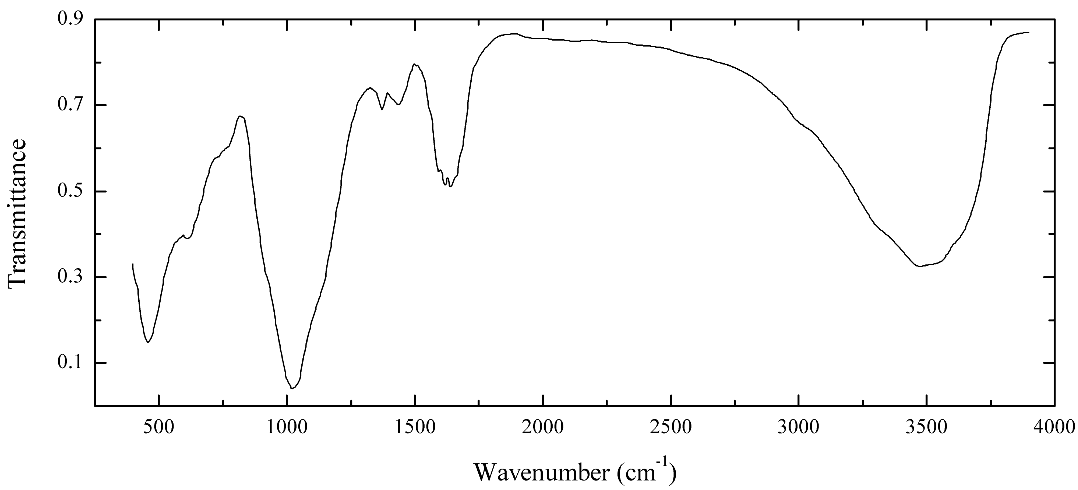


Locality: Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark brown, colloform. Amorphous. Probably corresponds to Na-rich variety of hisingerite.

Wavenumbers (cm^{-1}): 3540sh, 3450, 3270sh, 1640, 1622, 1590sh, 1418w, 1349w, 1150sh, 1011s, 920, 773w, 610sh, 500sh, 462s.

Sil206 "Manganchinglusuite" $Na_x(Mn,Fe)_2(Si_2O_5)(O,OH)_2 \cdot nH_2O$?

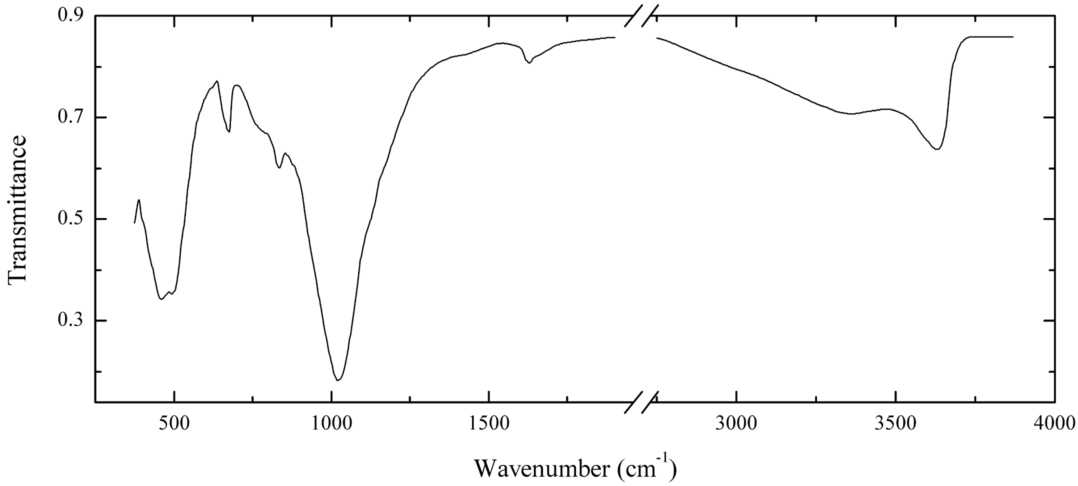


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Dark brown, colloform. Amorphous. Probably corresponds to Na-rich variety of neotockite.

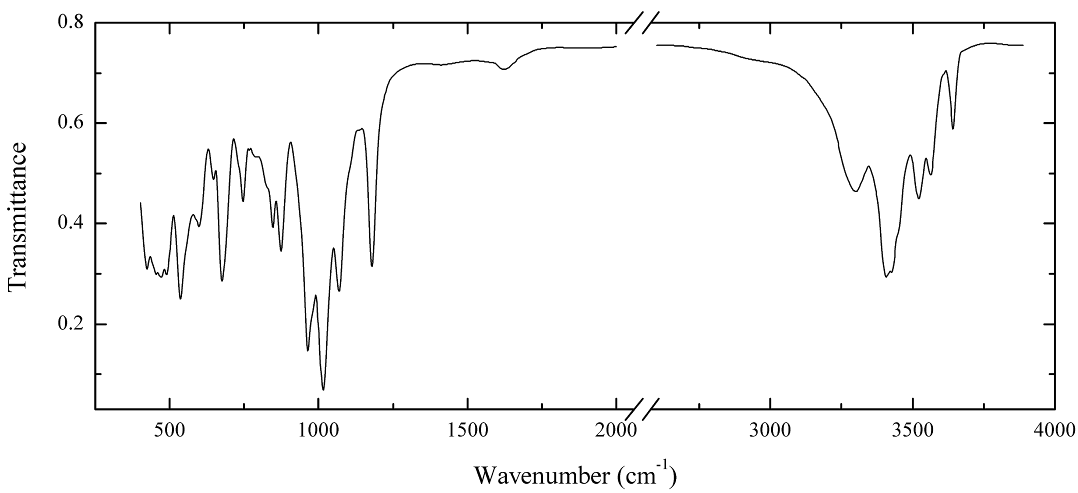
Wavenumbers (cm^{-1}): 3540sh, 3480sh, 3400, 3250sh, 1639, 1618, 1592, 1560sh, 1416w, 1352w, 1120sh, 1013s, 910, 760sh, 740sh, 608, 462s, 410sh.

Sil207 Clinochlore $(Mg,Al)_6(Si,Al)_4O_{10}(OH)_8$



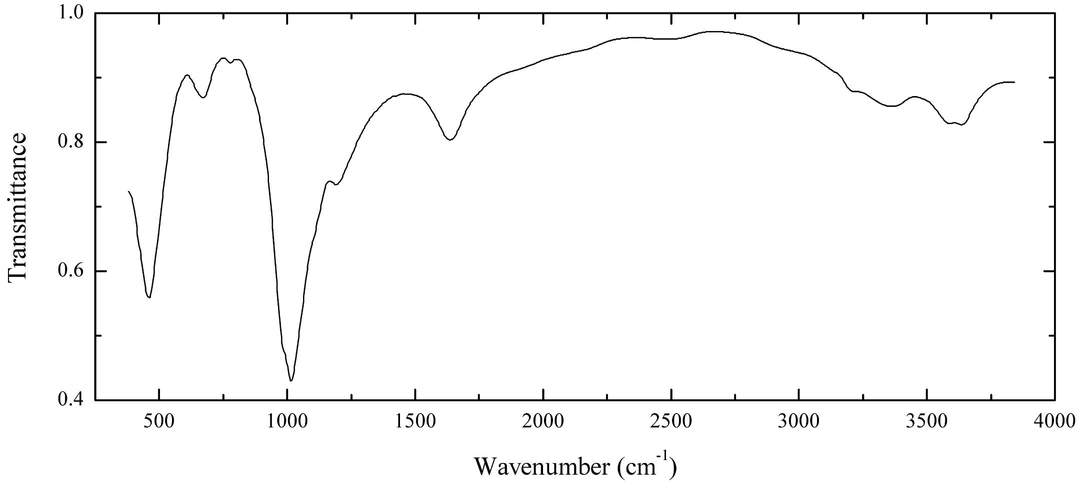
Locality: Munigvasa, near Alamos, Sonora, Mexico.
Description: Dark green scales with mica-like cleavage. Altered (nontronitized) sample.
Wavenumbers (cm^{-1}): 3615, 3350, 1685sh, 1630w, 1022s, 833, 765sh, 672, 495s, 460s.

Sil208 Rudenkoite $Sr_3Al_3[(Si,Al)_4O_{10}](OH)_8Cl_2{\cdot}H_2O$



Locality: Emel'dzhak deposit, 80 km SEE of Aldan, Yakutia, Russia (type locality).
Description: Spheroidal fibrous aggregates up to 7 mm, in the association with prehnite, calcite, spinel, apatite and diopside in prehnitized metasomatic pyroxene-scapolite rock. Holotype sample. Monoclinic, space group $P2/m$, $P2$ or Pm; $a = 5.893(5)$, $b = 7.262(5)$, $c = 10.288(8)$ Å, $\beta = 97.23(3)°$, $V = 436.8(6)$ Å^3, $Z = 1$. The empirical formula is (electron microprobe, H_2O determined by Penfield method) $(Sr_{2.83}Ca_{0.13}Ba_{0.03})_{\Sigma 2.99}(Al_{3.49}Si_{3.48})_{\Sigma 6.97}H_{9.48}Cl_{2.16}O_{18.84}$. Biaxial (+), $\alpha = 1.639(2)$, $\beta = 1.648(2)$, $\gamma = 1.665(2)$. $D_{meas} = 3.17(1)$ g/cm^3. The strongest lines of the powder diffraction pattern [d, Å (I, %) (hkl)] are 10.13 (100) (001), 3.23 (80) (112), 2.96 (100) (022), 2.90 (100) (121), 2.505 (100) (-212), 2.182 (80) (032, 221).
Wavenumbers (cm^{-1}): 3639, 3560, 3520, 3445sh, 3420sh, 3403s, 3294, 1627w, 1183s, 1071s, 1015s, 980sh, 964s, 874, 845, 825sh, 790w, 748, 735sh, 676s, 646w, 598, 555sh, 537s, 488, 468, 435sh, 418.

Sil209 Sepiolite $Mg_4(Si_6O_{15})(OH)_2{\cdot}6H_2O$

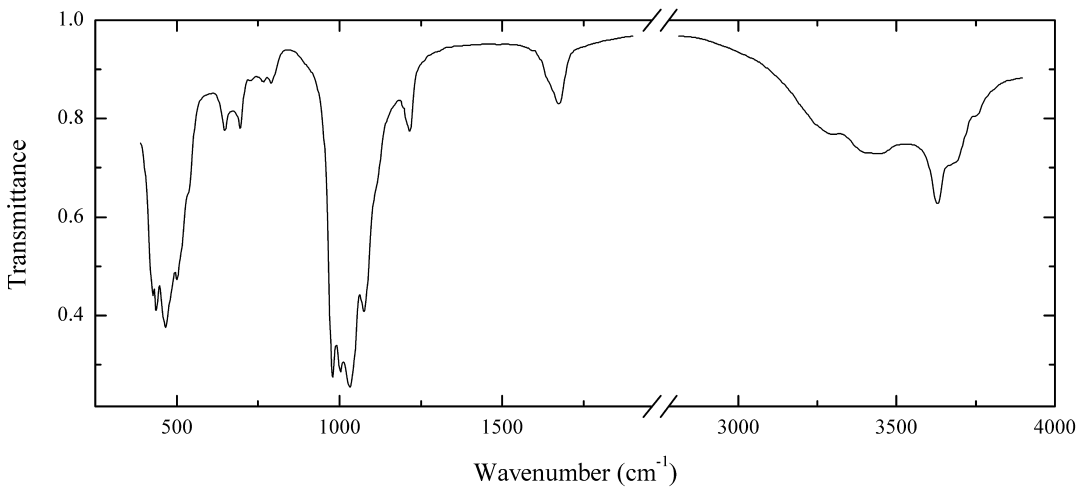


Locality: Northern mine, Ingichke, Uzbekistan.

Description: Brown fibrous aggregate. Identified by powder X-ray diffraction pattern. Fe-rich variety. The empirical formula is (wet chemical analysis) $Ca_{0.06}Na_{0.02}K_{0.01}(Mg_{2.66}Fe^{3+}{}_{0.91}Fe^{2+}{}_{0.41}Mn_{0.07})(Si_{5.63}Fe^{3+}{}_{0.32}Al_{0.05}O_{15})(OH)_{1.45}O_{0.27}{\cdot}6.15H_2O$.

Wavenumbers (cm^{-1}): 3625, 3575, 3350, 3200sh, 1638, 1192, 1015s, 990sh, 775w, 677, 650sh, 460s.

Sil210 Sepiolite $Mg_4(Si_6O_{15})(OH)_2{\cdot}6H_2O$



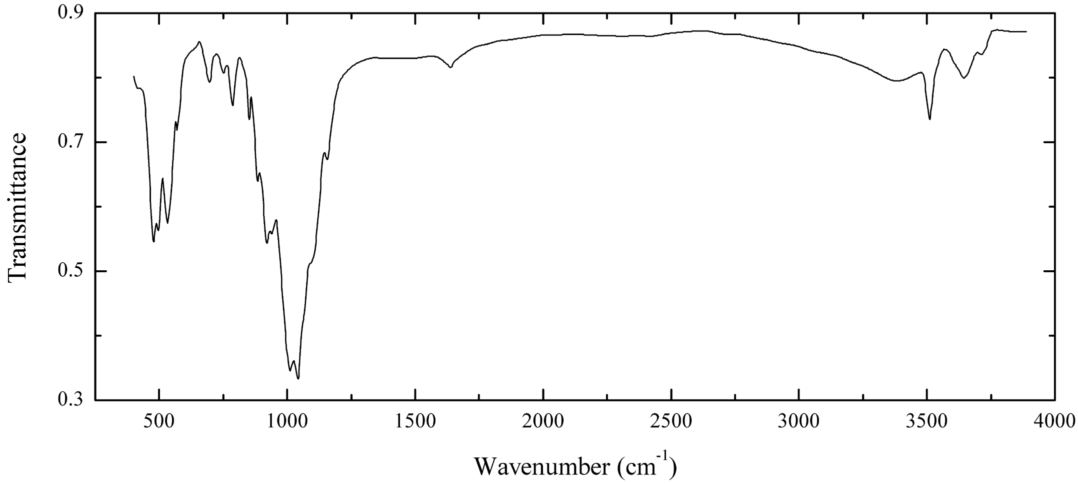
Locality: Malka river, North Caucasus.

Description: White, long-fibrous aggregate. The empirical formula is (electron microprobe) $(Mg_{3.78}Fe_{0.38}Ti_{0.02})(Si_{6.00}O_{15})(OH,O)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3690sh, 3620sh, 3575, 3400, 3250, 1663, 1630sh, 1212, 1195sh, 1105sh, 1072, 1029s, 1002s, 977s, 786w, 763w, 719w, 691, 644, 535sh, 501, 490sh, 469s, 438s, 427.

Sil211 K-rectorite

1:1 regular interstratification of dioctahedral K-mica and dioctahedral smectite

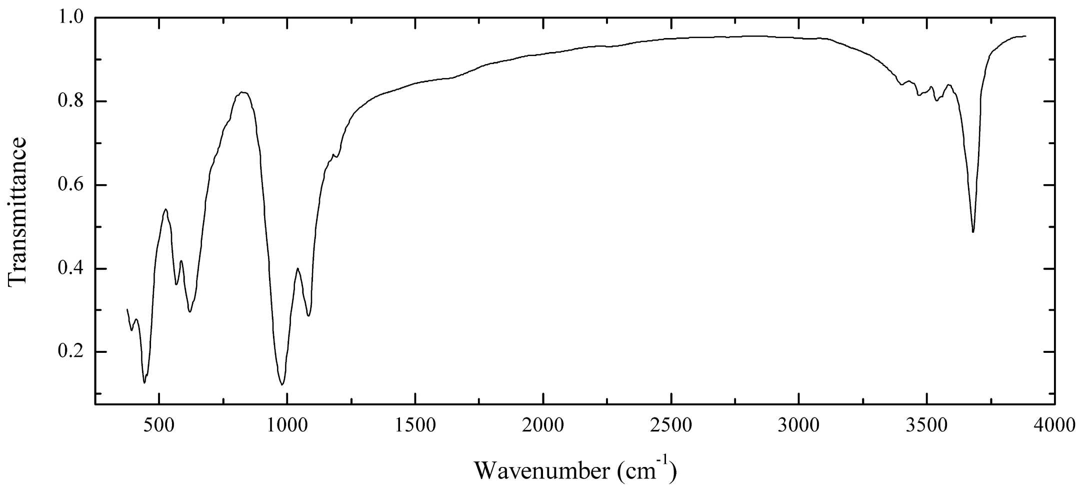


Locality: Shchelkovskiy dolomite quarry, Moscow region, Russia.

Description: Scales (up to 0.3 mm) in clay. Pseudomorphs after muscovite. The empirical formula is (electron microprobe) $H_xK_{0.56}Na_{0.06}(Al_{1.96}Fe_{0.05}Mg_{0.05}Ti_{0.04})(Si_{3.12}Al_{0.88}O_{10})(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3660w, 3620, 3490, 1620w, 1155, 1095sh, 1060sh, 1036s, 1010s, 943, 918s, 883, 851w, 785w, 753w, 692w, 568, 529s, 495s, 470s, 420w.

Sil212 Antigorite $Mg_3(Si_2O_5)(OH)_4$

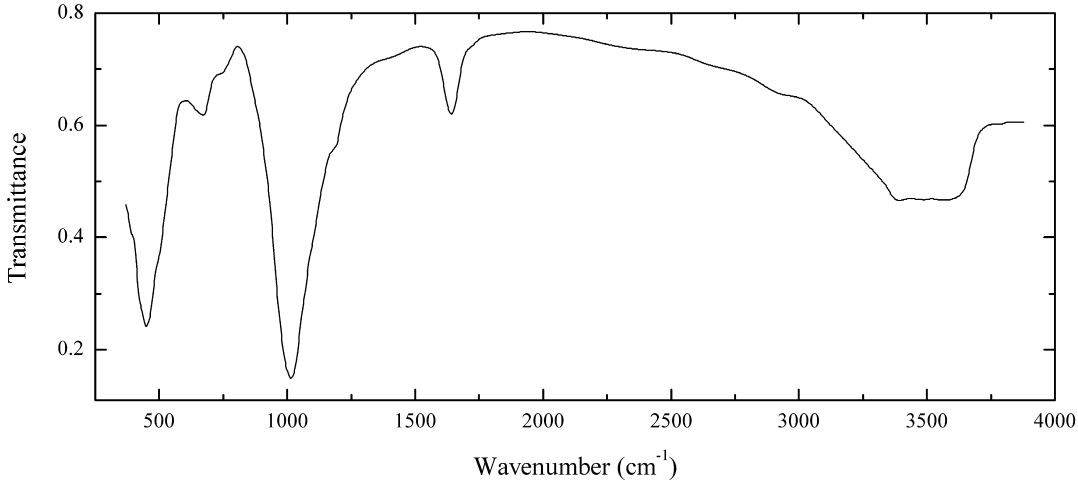


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Black columnar aggregate from the association with calcite and pyrrhotite. Identified by IR spectrum. Fe-bearing variety. The empirical formula is (electron microprobe) $(Mg_{2.81}Fe_{0.13}Al_{0.03}Cr_{0.01})(Si_{2.00}O_{5.00})(OH)_4$

Wavenumbers (cm^{-1}): 3675, 3545w, 3470w, 3405w, 1195w, 1083, 982s, 635sh, 618, 565, 443s, 389.

Sil213 Sepiolite $Mg_4(Si_6O_{15})(OH)_2 \cdot 6H_2O$

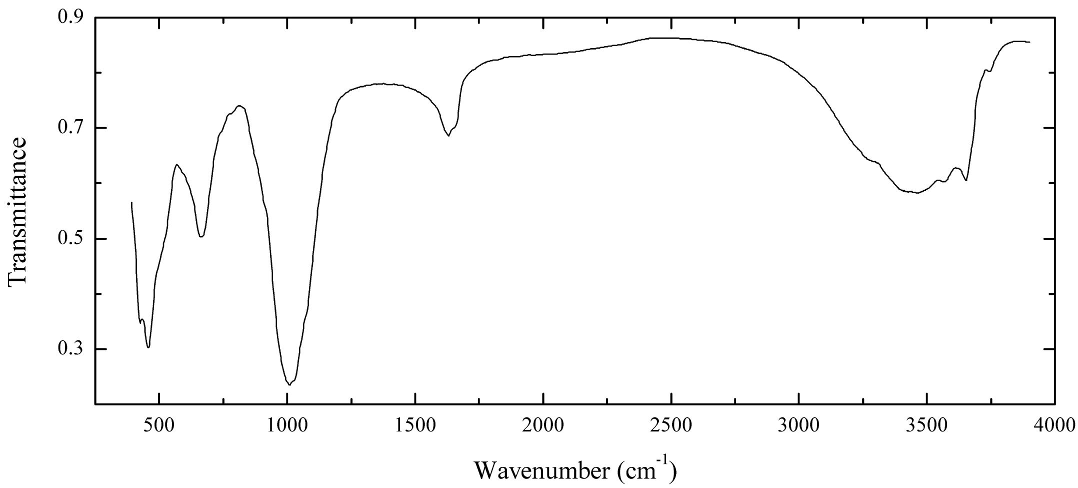


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Brown fibrous aggregate from fenite, from the association with aegirine and labuntsovite-Mg. Ca-bearing, Fe-rich variety. The empirical formula is (electron microprobe) $Ca_{0.6}(Mg_{1.9}Fe_{1.8})(Si_{5.7}Al_{0.3}O_{15})(OH,O)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3570, 3470, 3385, 1645, 1190sh, 1013s, 747w, 675, 500sh, 449s.

Sil214 Ni-smectite $(Na,K,Ca_{0.5},Mg_{0.5})_{0.3}(Ni,Fe^{2+})_3[(Si,Al)_4O_{10}](OH)_2 \cdot 4H_2O$

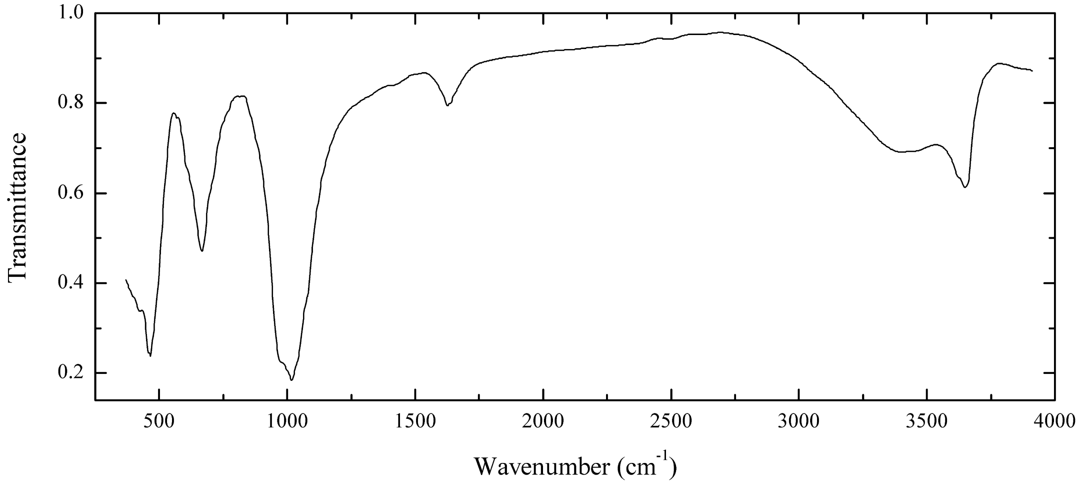


Locality: Weathered Dronino ataxite iron meteorite, Dronino village, Kasimov District, Ryazan' region, Russia.

Description: Olive green crust from the association with goethite and aragonite. Ni-analogue of saponite. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $(Na_{0.1}K_{0.1}Ca_{0.05}Mg_{0.05})(Ni_{2.6}Fe_{0.3}Co_{0.1})(Si_{3.2}Al_{0.8}O_{10})(OH)_2 \cdot nH_2O$.

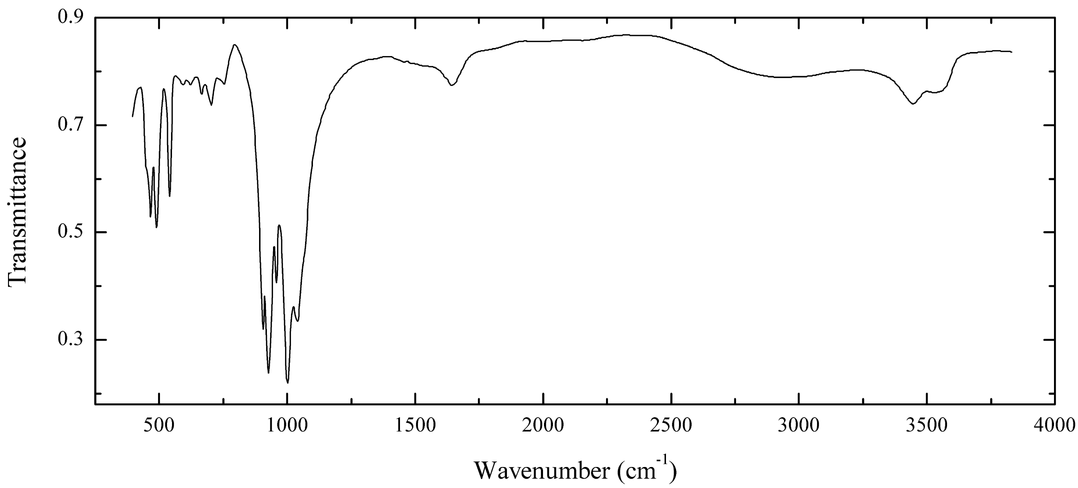
Wavenumbers (cm^{-1}): 3630, 3545, 3420, 3260sh, 1650sh, 1630, 1010s, 677, 510sh, 456s, 424.

Sil215 Pecoraite $Ni_3(Si_2O_5)(OH)_4$



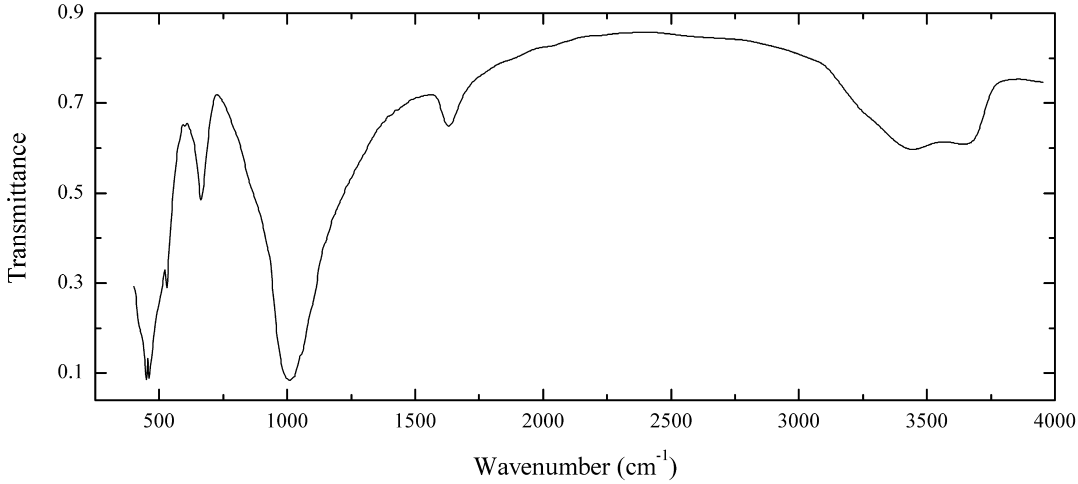
Locality: Loma Peguera, Bonao, Dominican Republic.
Description: Green massive. Identified by IR spectrum and qualitative electron microprobe analysis. A hydrated variety.
Wavenumbers (cm^{-1}): 3640, 3400, 1630w, 1017s, 980sh, 690sh, 665, 605sh, 458s, 425.

Sil216 Zeophyllite $Ca_{13}Si_{10}O_{28}F_8(OH)_2 \cdot 6H_2O$



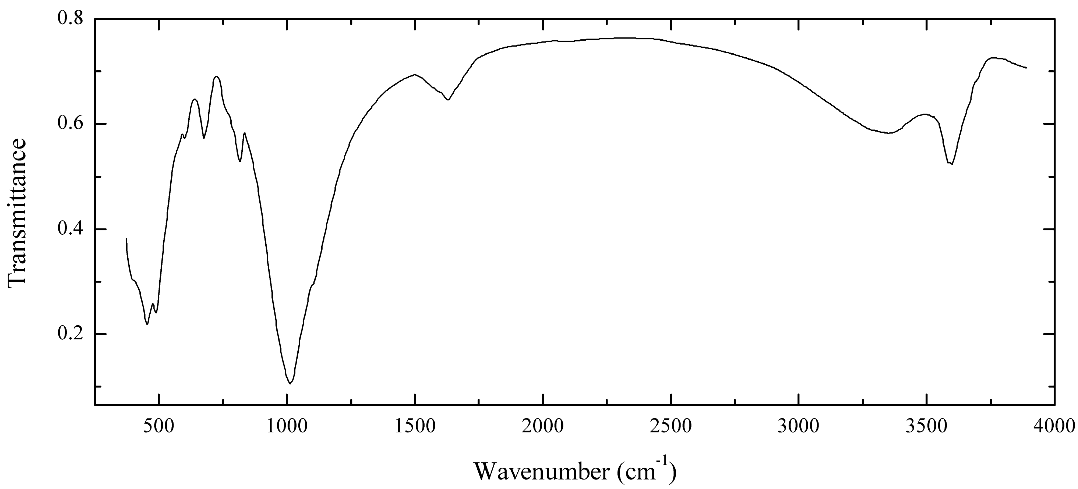
Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White radial aggregates of elongated platy crystals from the association with calcite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3540, 3440, 2900, 1650, 1070sh, 1042s, 1003s, 957, 929s, 907s, 757w, 707, 667, 625w, 595w, 539, 488, 465, 450sh.

Sil217 Spadaite $MgSiO_2(OH)_2 \cdot H_2O$ (?)



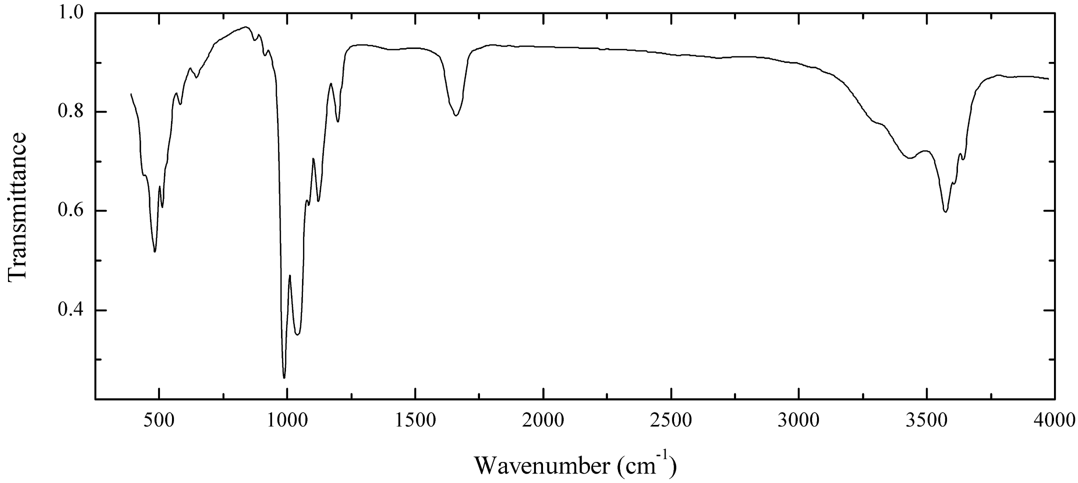
Locality: Alvarado mine, Tooele Co., Utah, USA.
Description: Cream-coloured crusts from the association with calcite and wollastonite. Insufficiently investigated mineral species. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3620, 3400, 1633, 1007s, 662, 528, 468s, 453s.

Sil218 Nontronite $(Na,Ca)_x(Fe^{3+},Al,Mg)_2[(Si,Al)_4O_{10}](OH)_2 \cdot nH_2O$ ($x \approx 0.3$, $n \approx 4$)



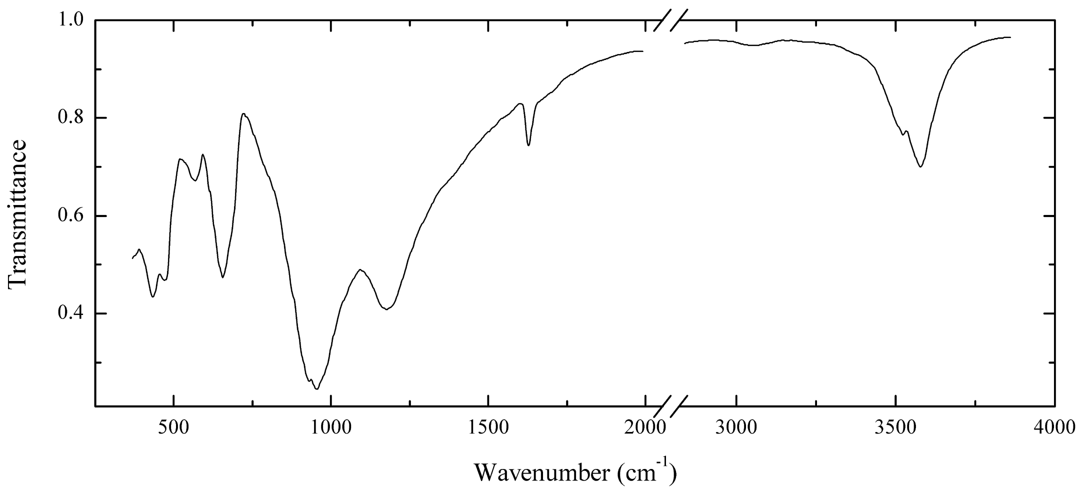
Locality: Andreasberg, Harz, Lower Saxony, Germany.
Description: Olive green earthy aggregate from the association with quartz and opal. The empirical formula is (electron microprobe) $(Na_{0.15}Ca_{0.15})(Fe_{1.7}Al_{0.2}Mg_{0.1})(Si_{3.6}Al_{0.2}Fe_{0.2}O_{10})(OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3560, 3330, 1627, 1100sh, 1013s, 815, 770sh, 685, 600. 490s, 455s, 405sh.

Sil219 Palygorskite $(Mg,Al)_{2+x}(Si_4O_{10})(OH)\cdot 4H_2O$



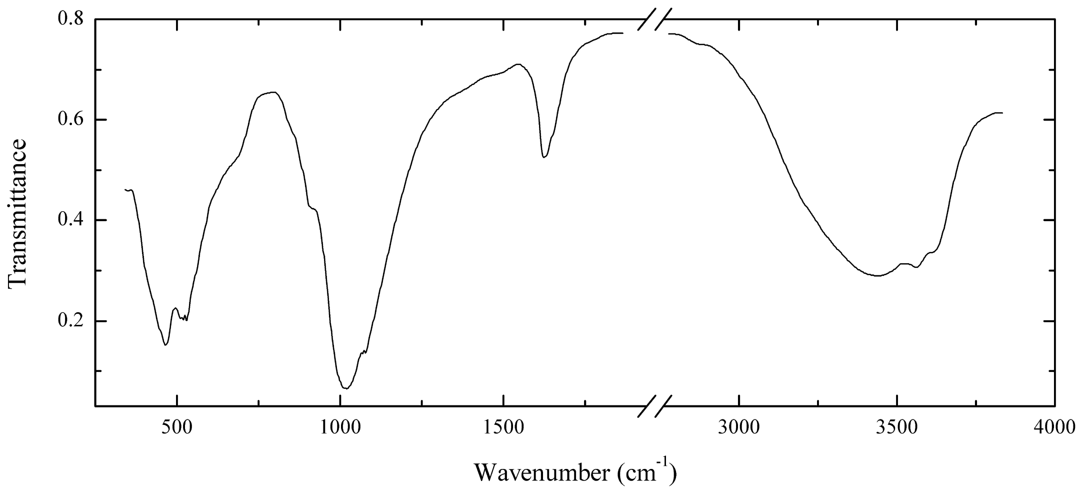
Locality: Oberhohndorf, near Zwickau, Saxony, Germany.
Description: White fibrous aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3615, 3580, 3415, 3280sh, 1660, 1197, 1119, 1083, 1040s, 986s, 909w, 870w, 680sh, 643w, 570, 540sh, 511, 484s, 438.

Sil220 Cymrite $BaAl_2Si_2O_8\cdot nH_2O$ (n = 0.5–1.0)



Locality: “Mixed Series” formation, near Nežilovo village, Jacupica Mountains, Macedonia.
Description: Coarse-grained aggregate from the association with quartz. The empirical formula is (electron microprobe) $(Ba_{0.96}K_{0.02})Si_{2.05}Al_{1.95}O_8\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3550, 3500, 1626, 1177s, 954s, 929s, 652, 565, 473, 440.

Sil221 "Mg,Cr-smectite" $Ca_{0.5}MgCr(Si_4O_{10})(OH)_2{\cdot}nH_2O$ (?)

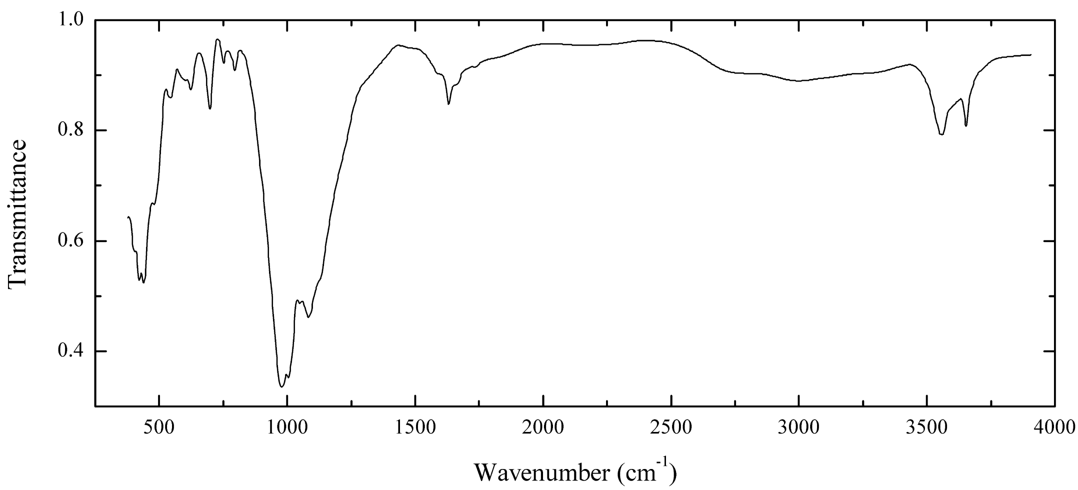


Locality: Hatrurim formation, Israel.

Description: Green fine-grained aggregate. The empirical formula is (electron microprobe) $(Ca_{0.4}Na_{0.1})Mg_{1.1}Cr_{0.8}Al_{0.3}Fe_{0.1}(Si_{3.9}Al_{0.1}O_{10})(OH)_2{\cdot}nH_2O$. Related to volkonskoite. Needs further investigation.

Wavenumbers (cm^{-1}): 3610, 3555, 3440, 3220sh, 1632, 1070sh, 1019s, 910sh, 875sh, 675sh, 615sh, 521, 461s.

Sil222 Mountainite $KNa_2Ca_2[Si_8O_{19}(OH)]{\cdot}6H_2O$

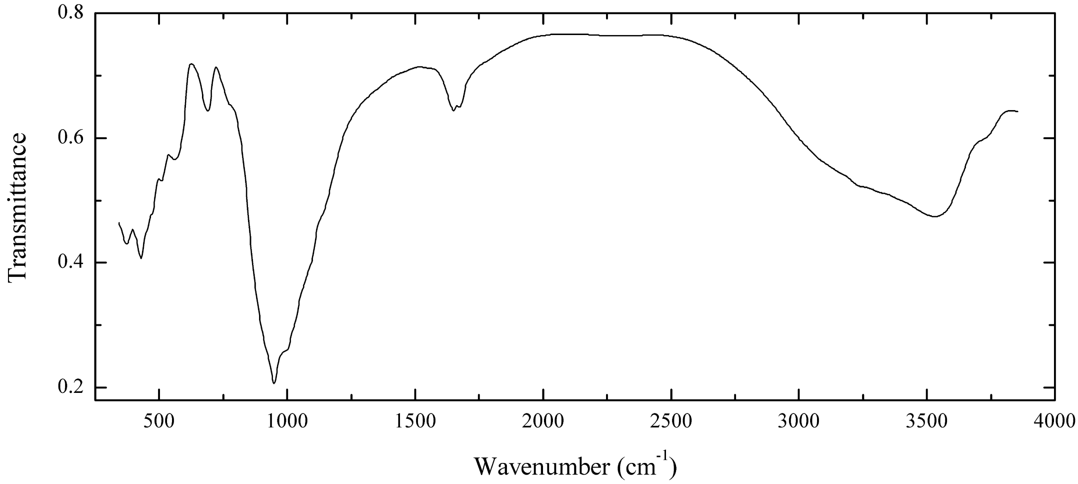


Locality: Yubileinaya pegmatite, Karnasurt Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: White scaly aggregate in the association with zorite, raite and natrolite. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3638, 3540, 2990w, 2800w, 1735w, 1660sh, 1630, 1595w, 1210sh, 1130sh, 1085s, 1050, 1006s, 981s, 795w, 752w, 696, 623, 595sh, 544, 486, 440s, 423s, 405sh.

Sil223 Shlykovite $KCa[Si_4O_9(OH)]\cdot 3H_2O$

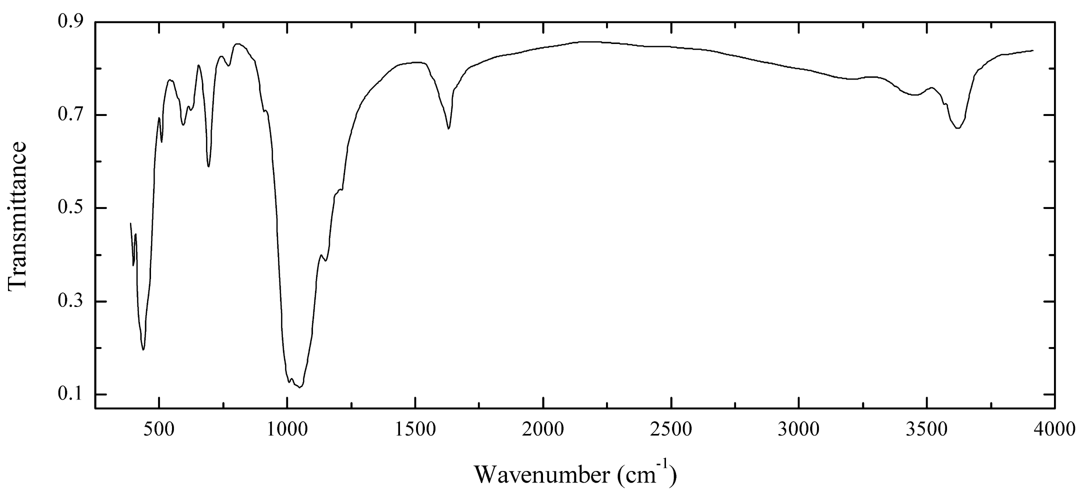


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Fibrous aggregate in the association with aegirine, potassic feldspar, nepheline, lamprophyllite, eudialyte, lomonosovite, lovozerite, tisinalite, shcherbakovite, shafranovskite, ershovite and megacyclite. Intergrowth with cryptophyllite. Holotype sample. Monoclinic, space group $P2_1/c$, $a = 6.4897(4)$, $b = 6.9969(5)$, $c = 26.714(2)$ Å, $\beta = 94.597(8)^o$, $Z = 4$. Optically biaxial (+), $\alpha = 1.500(3)$, $\beta = 1.509(2)$, $\gamma = 1.515(2)$. $D_{calc} = 2.244$ g/cm^3. The empirical formula is $(K_{0.96}Na_{0.09})Ca_{1.00}Si_{4.07}O_{9.32}(OH)_{0.68}\cdot 3H_2O$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are shlykovite: 13.33 (100) (002), 6.67 (76) (004), 6.47 (55) (100), 3.469 (45) (021), 3.068 (57) (-121), 3.042 (45) (121), 2.945 (62) (-123), 2.912 (90) (025, -212, 211).

Wavenumbers (cm^{-1}): 3670sh, 3525, 3250sh, 3080sh, 1660sh, 1640, 1140sh, 1080sh, 990sh, 949s, 910h, 785sh, 688, 552, 505, 470sh, 426, 372.

Sil224 Rhodesite $KNa_xCa_2[Si_8O_{18}(OH)]\cdot nH_2O$

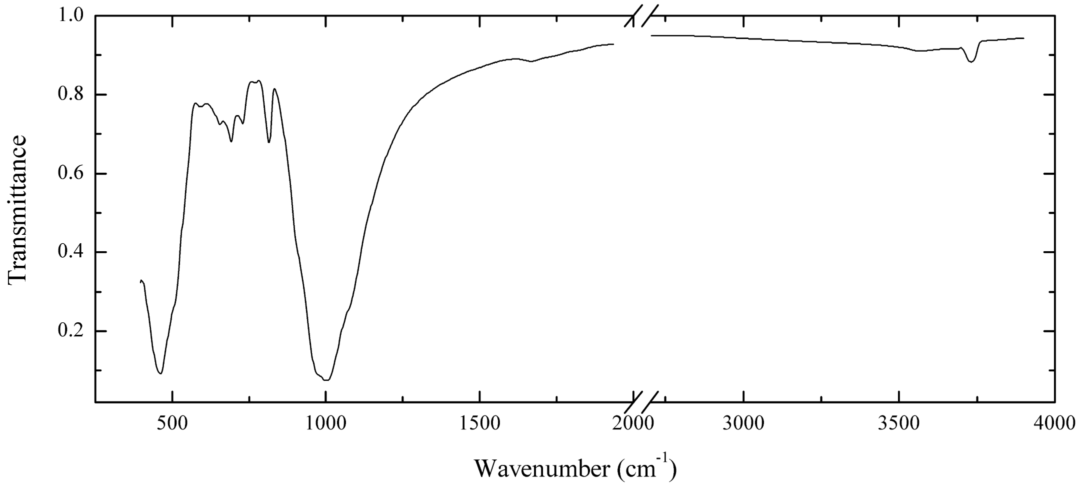


Locality: Bultfontein diamond mine, Kimberley, South Africa (type locality).

Description: White massive from the association with mountainite. Specimen No. 68722 from the Fersman Mineralogical Museum of the Russian Academy of Sciences. Confirmed by IR spectrum. The empirical formula is $(K_{0.93}Na_{0.66}Ca_{1.94})Si_{8.00}F_{0.03}Cl_{0.01}O_{18.47}(OH)_{0.53}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3605, 3440, 3200w, 1665sh, 1635, 1212, 1150, 1048s, 1035sh, 1006s, 908, 770w, 693, 625, 595, 510w, 436s, 400.

Sil225 Phlogopite $KMg_3(Si_4AlO_{10})(OH)_2$

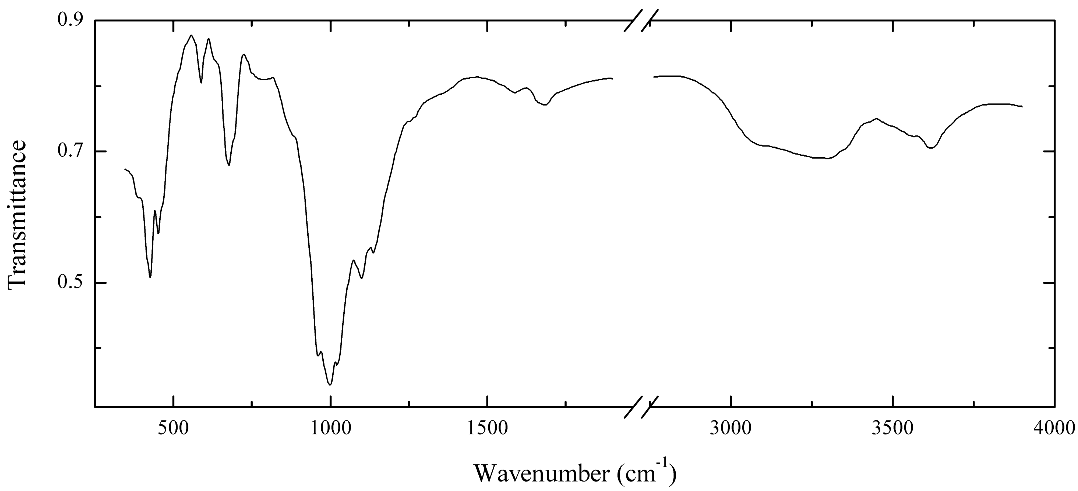


Locality: Wet Loo mine, Mogok, Myanmar.

Description: Yellowish platy crystals from the association with diopside. F-rich, B-bearing variety. Identified by IR spectrum and WDS-mode electron microprobe analysis. The empirical formula is $K_{0.93}(Mg_{2.74}Al_{0.25}Fe_{0.01})(Si_{2.81}Al_{1.07}B_{0.12}O_{10})(OH)_{1.44}F_{0.55}$.

Wavenumbers (cm^{-1}): 3690, 1655w, 1001s, 975sh, 813, 767w, 728, 691, 653, 521w, 505sh, 464s, 410sh.

Sil226 Shlykovite $KCa[Si_4O_9(OH)]\cdot 3H_2O$

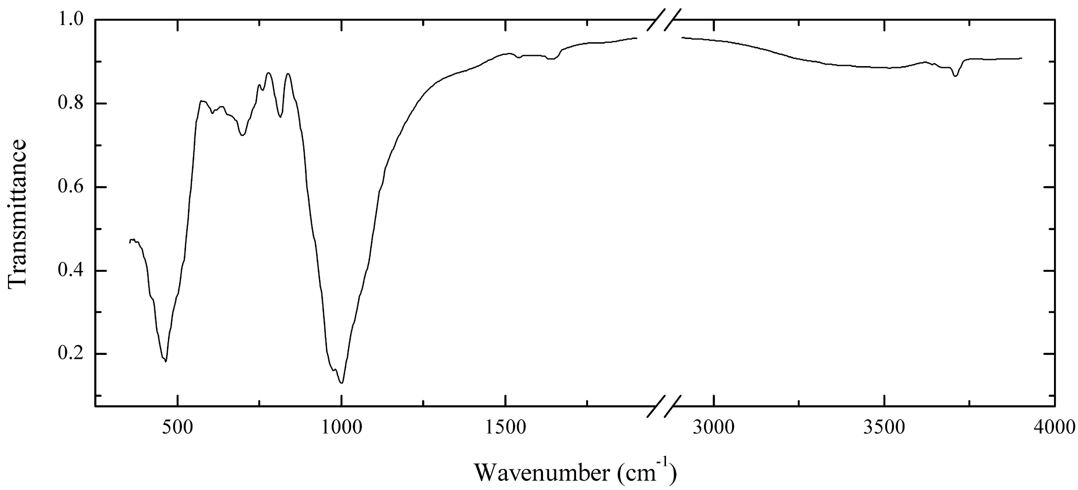


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Fibrous aggregate in the association with aegirine, potassic feldspar, nepheline, lamprophyllite, eudialyte, lomonosovite, lovozerite, tisinalite, shcherbakovite, shafranovskite, ershovite, megacyclite and cryptophyllite. Identified by the powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3585, 3250, 3090sh, 1680w, 1660sh, 1585w, 1135, 1097s, 1024s, 999s, 962s, 880sh, 795w, 760sh, 690sh, 680, 590, 470sh, 455, 432s, 420sh.

Sil227 Phlogopite $KMg_3(Si_4AlO_{10})(OH)_2$

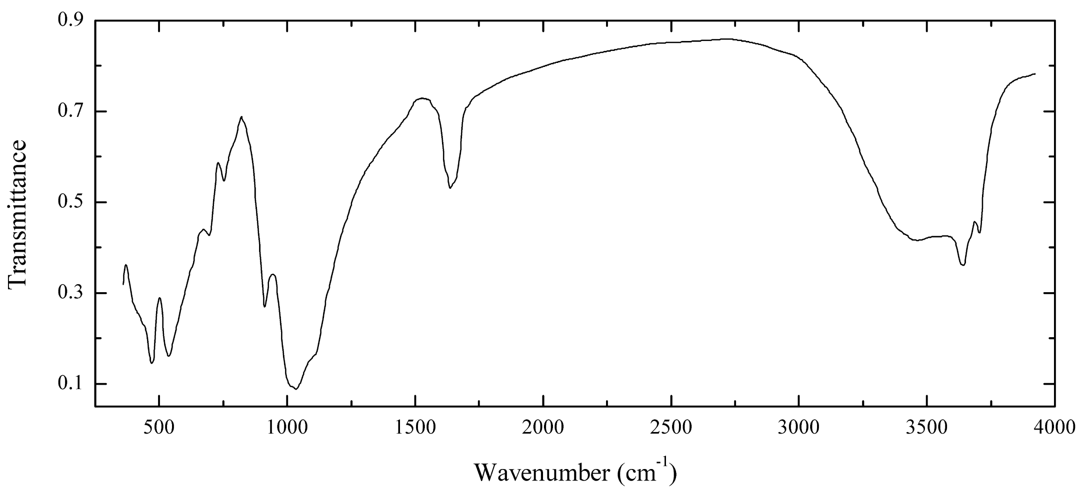


Locality: Wet Loo mine, Mogok, Myanmar.

Description: Yellowish platy crystal from the association with clinohumite. F- and B-rich variety. Identified by IR spectrum and electron microprobe analysis. The empirical formula calculated on $K_{1.00}$ is $K_{1.00}(Mg_{2.63}Al_{0.32}Fe_{0.04}Mn_{0.01})(Si_{2.60}Al_{0.83}B_xO_{10})(OH)_{1.36}F_{0.64}$.

Wavenumbers (cm^{-1}): 3690w, 3470w, 1643w, 1542w, 999s, 975s, 817, 758w, 697, 655sh, 607w, 500sh, 462s, 420sh.

Sil228 Halloysite-10 Å $Al_2Si_2O_5(OH)_4{\cdot}2H_2O$

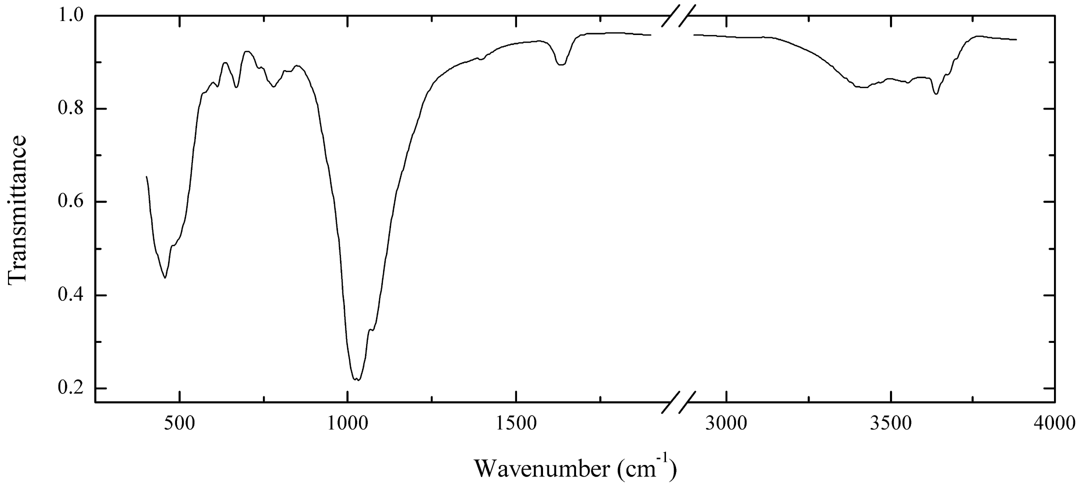


Locality: Uchaly, Bashkortostan Republic, South Urals, Russia.

Description: White massive. Identified by IR spectrum.

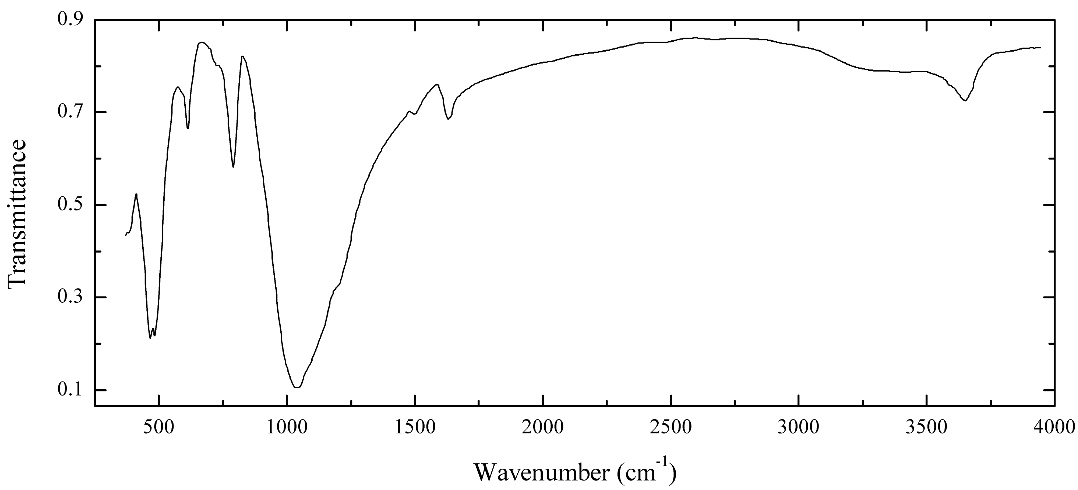
Wavenumbers (cm^{-1}): 3685, 3600, 3500, 3425s, 3360sh, 1635, 1088s, 1030s, 913, 797, 754, 655, 550sh, 535s, 468s.

Sil229 Ajoite $(K,Na)_3Cu_{20}Al_3Si_{29}O_{76}(OH)_{16}\cdot nH_2O$ ($n \approx 8$)



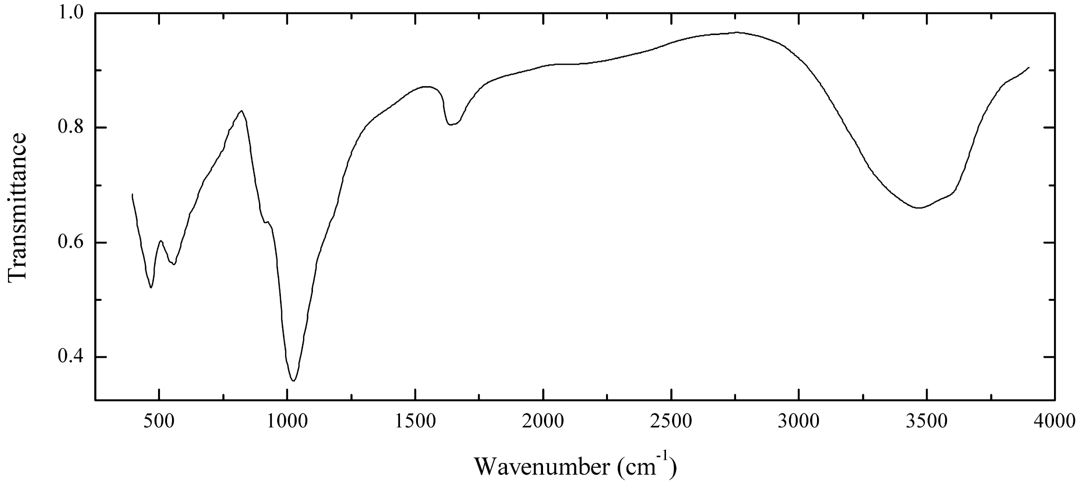
Locality: New Cornelia (Ajo) mine, Ajo, Little Ajo Mts., Ajo district, Pima Co., Arizona, USA (type locality).
Description: Green radial aggregates from the association with quartz and muscovite.
Wavenumbers (cm^{-1}): 3615, 3525w, 3395, 1630w, 1075s, 1037s, 1023s, 827w, 788, 743w, 676, 617w, 590sh, 490sh, 468s.

Sil230 Fedorite $(Na,K)_{2-3}(Ca,Na)_7(Si,Al)_{16}O_{38}(F,Cl,OH)_2\cdot nH_2O$



Locality: Turii alkaline massif, Turii cape, Kola peninsula, Murmansk region, Russia (type locality).
Description: Pale raspberry-red platelets with mica-like cleavage from the association with narsarsukite, quartz and apophyllite. Triclinic, space group C-1, $a = 9.676(2)$, $b = 16.706(1)$, $c = 13.233(2)$ Å, $\alpha = 93.35°, \beta = 114.96°, \gamma = 90.03°, Z = 2$. $D_{meas} = 2.43$ g/cm^3. The empirical formula is $(K_{1.65}Na_{0.83})(Ca_{4.52}Na_{2.48})Si_{16.00}O_{38}(OH,F)_2\cdot H_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3630, 3400, 1632, 1501w, 1200sh, 1100sh, 1040s, 790, 725sh, 615, 485s, 467s, 380.

Sil231 Beidellite $(Na,Ca_{0.5},K)_xAl_2[(Si,Al)_4O_{10}](OH)_2 \cdot nH_2O$ ($x \approx 0.3$)

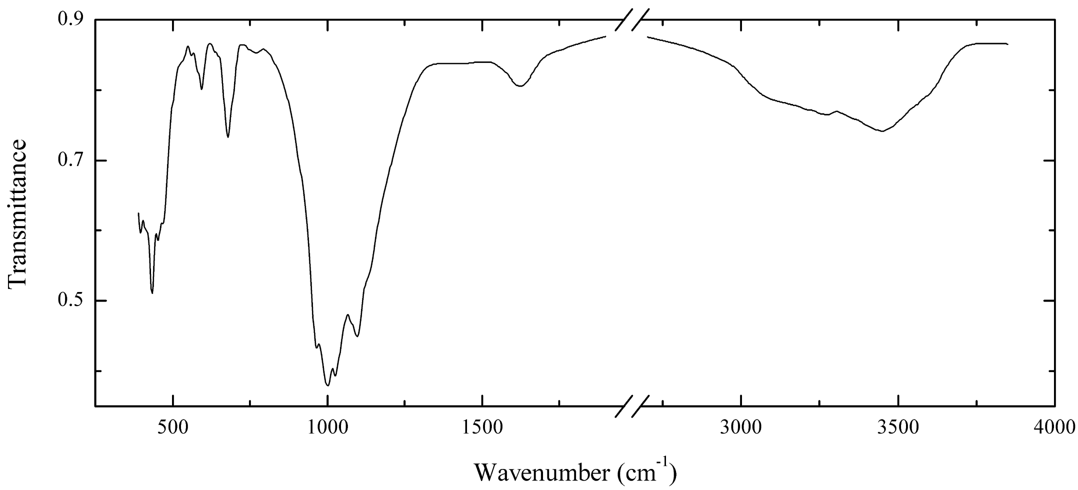


Locality: Kahlenberg, Zilsdorf, near Hillesheim, Eifel, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Orange-brown pseudomorphs after melilite crystals from the association with nepheline, leucite and augite. Fe-rich disordered variety. The empirical formula is $(K_{0.17}Ca_{0.14}Na_{0.02})(Al_{1.35}Fe_{0.52}Mg_{0.12}Ti_{0.01})(Si_{3.35}Al_{0.65}O_{10})(OH)_2 \cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3580sh, 3460, 1645, 1175sh, 1025s, 915, 670sh, 555, 468.

Sil232 Shlykovite $KCa[Si_4O_9(OH)] \cdot 3H_2O$

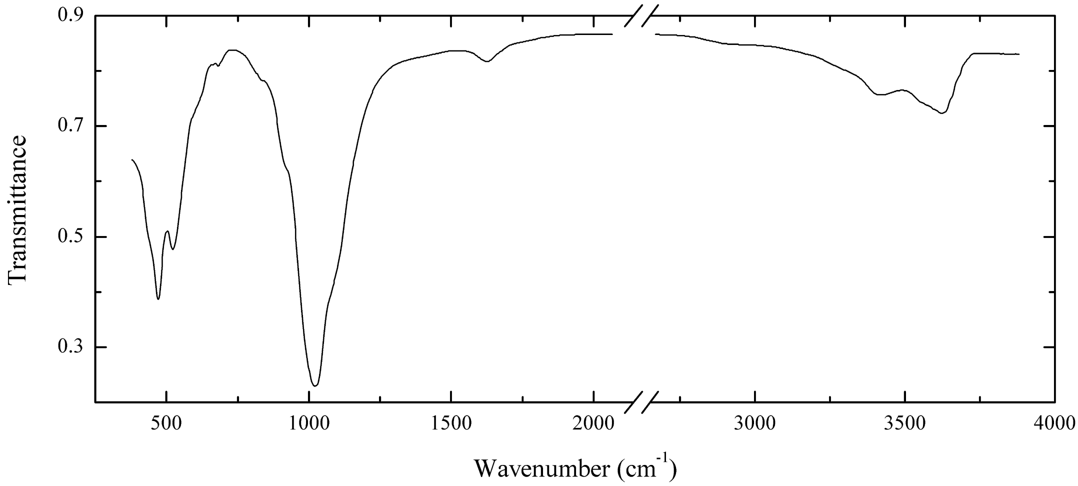


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: White radial aggregates from the association with aegirine, potassic feldspar, nepheline, lamprophyllite and paraershovite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3575sh, 3425, 3240, 3070sh, 1625, 1130sh, 1096s, 1025s, 1001s, 962s, 770w, 679, 593, 580sh, 470, 455, 433, 405.

Sil233 Illite $K_{1-x}Al_2[(Si,Al)_4O_{10}](OH)_2 \cdot nH_2O$ ($x \approx 0.3$, $n << 1$)

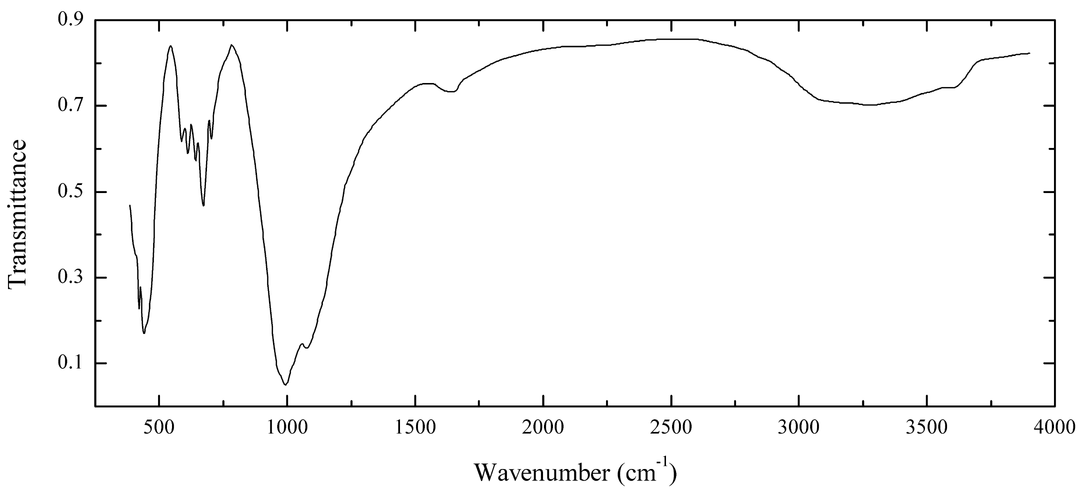


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Green massive, porcelain-like from the association with natrolite. The empirical formula is (electron microprobe) $K_{0.75}Al_{1.95}Fe_{0.05}(Si_{3.1}Al_{0.9})(OH,O)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3602, 3400, 1630w, 1080sh, 1022s, 920sh, 825w, 677w, 600sh, 520, 470s, 435sh.

Sil235 Fivegite $K_4Ca_2[AlSi_7O_{17}(O_{2-x}OH_x)][(H_2O)_{2-x}OH_x]Cl$

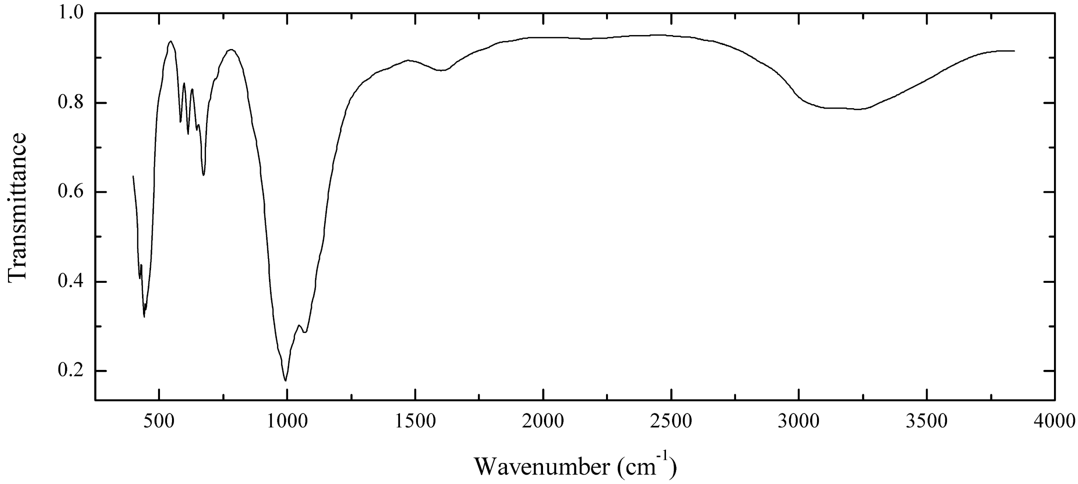


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Colourless platelets forming homoaxial pseudomorph after delhayelite crystal. Associated minerals are aegirine, potassic feldspar, nepheline, sodalite, magnesium astrophyllite, lamprophyllite, lomonosovite, shcherbakovite, natisite, lovozerite, tisinalite, ershovite, megacyclite, shlykovite and cryptophyllite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3575, 3250, 3120, 1632w, 1072s, 991s, 960sh, 701w, 671, 644, 610, 584, 439s, 420, 410sh.

Sil236 Fivegite $K_4Ca_2[AlSi_7O_{17}(O_{2-x}OH_x)][(H_2O)_{2-x}OH_x]Cl$

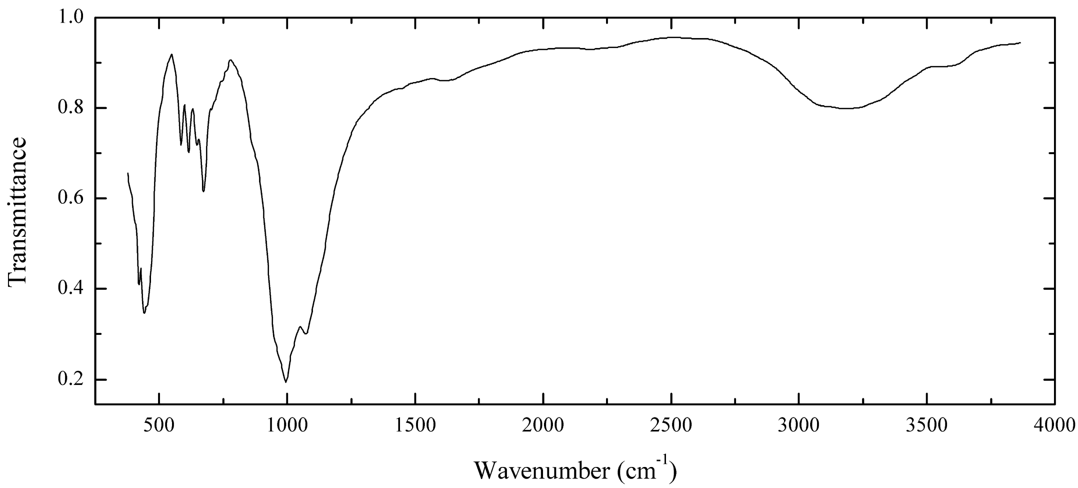


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Colourless platelets forming homoaxial pseudomorph after delhayelite crystal. Associated minerals are hydrodelhayelite and pectolite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3220, 3110, 1620w, 1130sh, 1070s, 994s, 970sh, 720sh, 700sh, 673, 647, 612, 583, 447s, 439s, 423.

Sil237 Fivegite $K_4Ca_2[AlSi_7O_{17}(O_{2-x}OH_x)][(H_2O)_{2-x}OH_x]Cl$



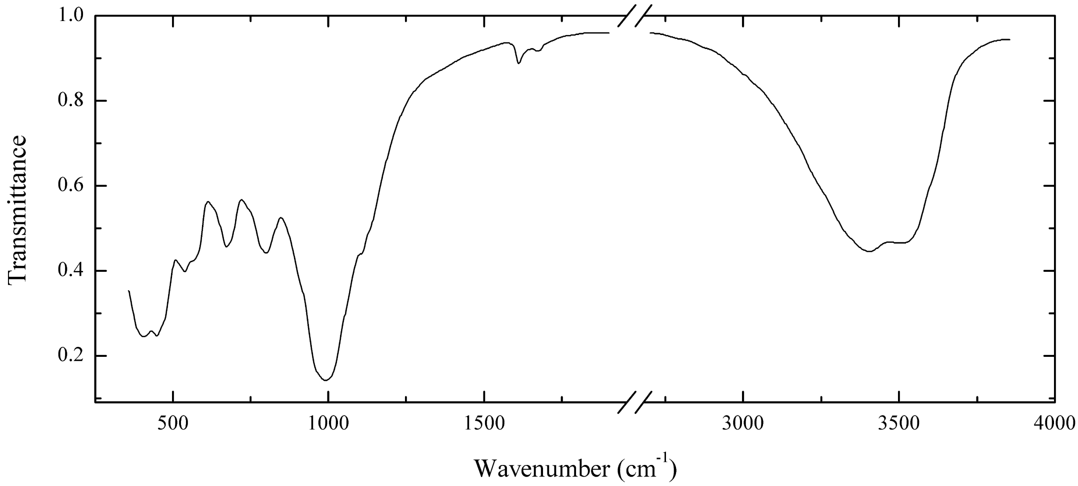
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Colourless platelets forming homoaxial pseudomorph after delhayelite crystal. Associated minerals are aegirine, potassic feldspar, nepheline, sodalite, magnesium astrophyllite, lamprophyllite, lomonosovite, shcherbakovite, natisite, lovozerite, tisinalite, ershovite, megacyclite, shlykovite and cryptophyllite. Holotype sample. Orthorhombic, space group $Pm2_1n$, $a = 24.335(2)$, $b = 7.0375(5)$, $c = 6.5400(6)$ Å, $Z = 2$. Optically biaxial (+), $\alpha = 1.540(1)$, $\beta = 1.542(2)$, $\gamma = 1.544(2)$,

$2V_{meas} = 60(10)$. $D_{meas} = 2.42(2)$ g/cm^3, $D_{calc} = 2.449$ g/cm^3. The empirical formula is $H_{4.22}K_{3.44}Na_{0.39}Ca_{2.07}Sr_{0.01}Fe_{0.01}Al_{1.00}Si_{6.99}O_{21.15}F_{0.06}Cl_{0.82}(SO_4)_{0.02}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 3.517 (38) (020), 3.239 (28) (102), 3.072 (100) (121, 701), 3.040 (46) (420, 800, 302), 2.943 (47) (112), 2.893 (53) (321), 2.880 (24) (212, 402), 1.759 (30) (040, 12.2.0).

Wavenumbers (cm^{-1}): 3550w, 3160, 1625w, 1450w, 1069s, 993s, 950sh, 870sh, 740sh, 715sh, 700w, 672, 646, 611, 582, 450sh, 438s, 420sh.

Sil238 Baileychlore $Zn_6(Si_4O_{10})(OH)_8$

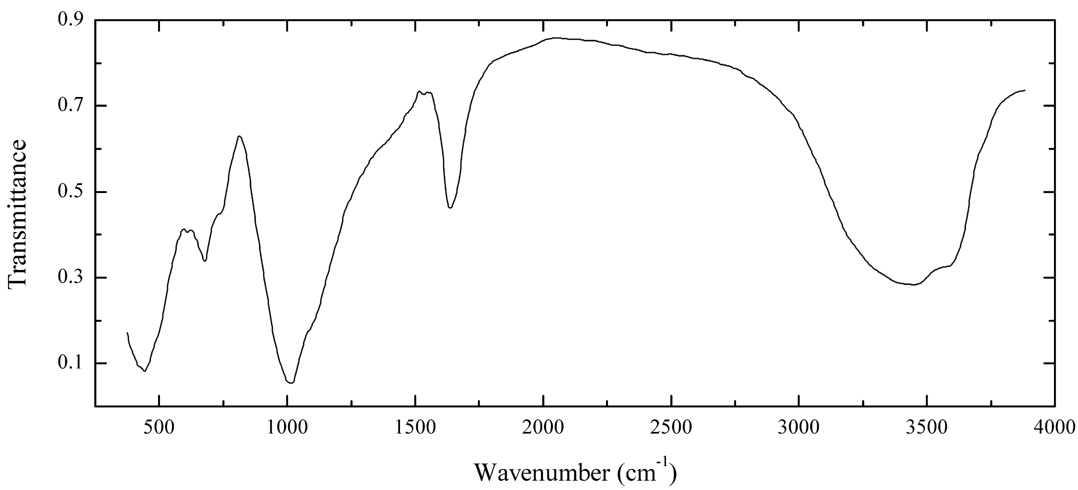


Locality: Christiana mine, Kamariza (Kamareza) Mines, Agios Konstantinos, Lavrion, mining district, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light green massive from the association with allophane and glaucocerinite. Al-rich, Cu-bearing variety. The empirical formula is (electron microprobe) $(Zn_{3.53}Al_{1.51}Cu_{0.73}Fe_{0.18}Mg_{0.05})(Si_{2.48}Al_{1.52}O_{10})(OH)_8 \cdot nH_2O$ ($n \ll 1$).

Wavenumbers (cm^{-1}): 3600sh, 3510, 3390, 3320sh, 1680w, 1620w, 1110sh, 997s, 798, 685sh, 670, 560sh, 537, 447s, 410s.

Sil239 Saponite $(Ca_{0.5},Na)_{0.3}(Mg,Fe^{2+})_3[(Si,Al)_4O_{10}](OH)_2 \cdot 4H_2O$

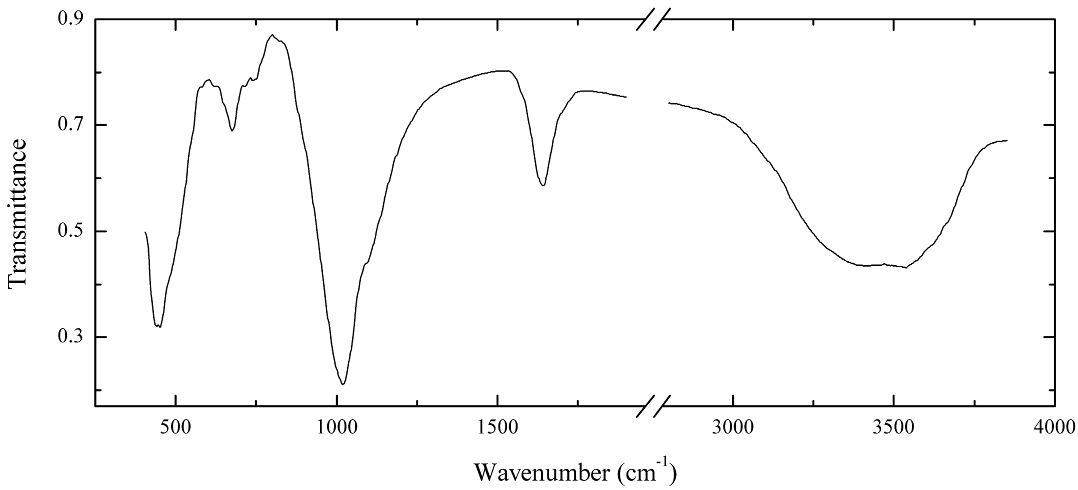


Locality: Zlatolist village, Kardzali (Kurdjali) region, Bulgaria.

Description: Greenish-brown scaly aggregate from the association with analcime. Fe-rich variety. The empirical formula is (electron microprobe) $Ca_{0.3}(Mg_{1.6}Fe_{1.4})(Si_{3.2}Al_{0.7}Fe_{0.1}O_{10})(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3575, 3430, 1638, 1080sh, 1015s, 730sh, 677, 445s.

Sil240 Saponite $(Ca_{0.5},Na)_{0.3}(Mg,Fe^{2+})_3[(Si,Al)_4O_{10}](OH)_2 \cdot 4H_2O$

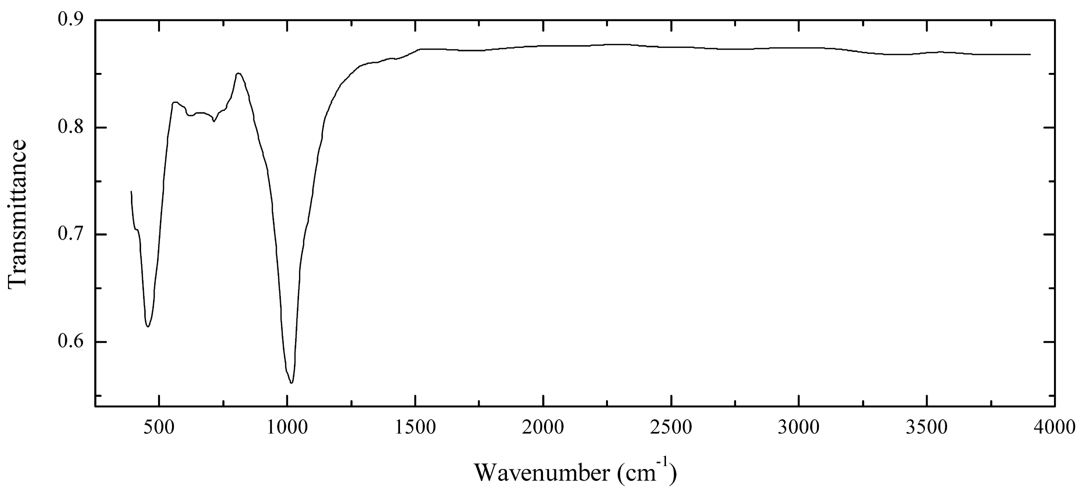


Locality: Zlatolist village, Kardzali (Kurdjali) region, Bulgaria.

Description: Brown scaly aggregate from the association with mordenite and chalcedony. Fe-rich variety. The empirical formula is (electron microprobe) $Ca_{0.2}(Mg_{1.6}Fe_{1.2}Al_{0.2})(Si_{3.3}Al_{0.7}O_{10})(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3500, 3400, 1640, 1090sh, 1020s, 735w, 710w, 674, 490sh, 450s, 440s.

Sil241 Oxyphlogopite $K(Mg,Ti,Fe)_3[(Si,Al)_4O_{10}](O,F)_2$



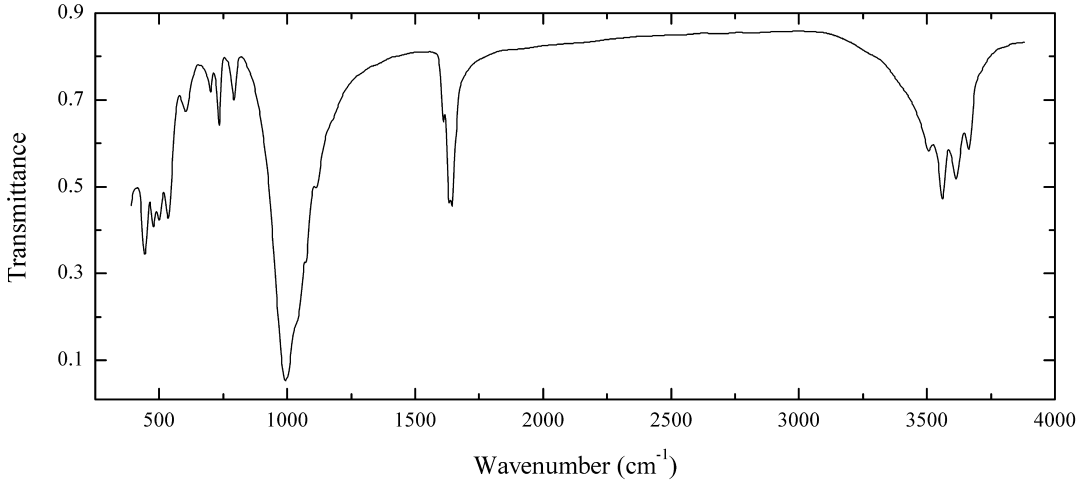
Locality: Rothenberg basalt quarry, Rothenberg Mt., near Mendig, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Brown lamellar crystals from the association with nepheline, plagioclase, sanidine, augite, diopside and magnetite. Holotype sample. Monoclinic, space group $C2/m$, $a = 5.3165(1)$, $b = 9.2000(2)$, $c = 10.0602(2)$ Å, $\beta = 100.354(2)°$. Optically biaxial (–), $\alpha = 1.625(3)$,

$\beta = 1.668(1), \gamma = 1.669(1), 2V_{meas} = -16(2)$. $D_{meas} = 3.06(1)$ g/cm^3, $D_{calc} = 3.086$ g/cm^3. The empirical formula is $(K_{0.72}Na_{0.14}Ca_{0.02})(Mg_{1.64}Ti_{0.73}Fe^{2+}{}_{0.30}Fe^{3+}{}_{0.27}Cr_{0.04})(Si_{2.59}Al_{1.27}Fe^{3+}{}_{0.14}O_{10})O_{1.20}F_{0.73}(OH)_{0.07}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 9.91 (32) (001), 4.53 (11) (110), 3.300 (100) (003), 3.090 (12) (112), 1.985 (21) (005), 1.659 (12) (-135), 1.527 (16) (-206, 060).

Wavenumbers (cm^{-1}): 1080sh, 1017s, 1005sh, 900sh, 750sh, 715, 623, 456s, 410.

Sil242 Cavansite $Ca(V^{4+}O)(Si_4O_{10})\cdot 4H_2O$

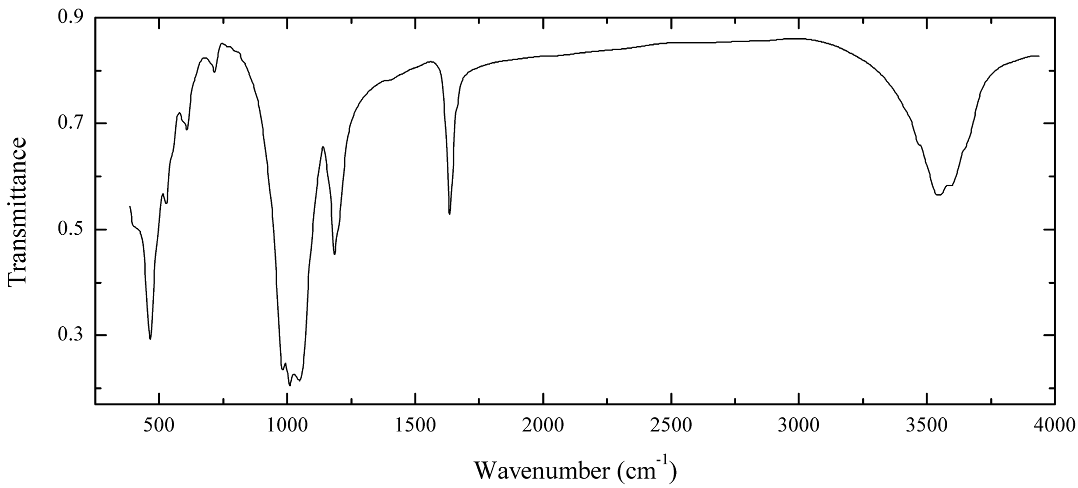


Locality: Wagholi quarry, Pune complex, Maharashtra, India.

Description: Blue radial aggregate from the association with stilbite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3655, 3605, 3550, 3495, 1647, 1635, 1611, 1115, 1071, 1035sh, 994s, 791, 733, 698, 600, 533, 497, 474, 442s.

Sil243 Pentagonite $Ca(V^{4+}O)(Si_4O_{10})\cdot 4H_2O$

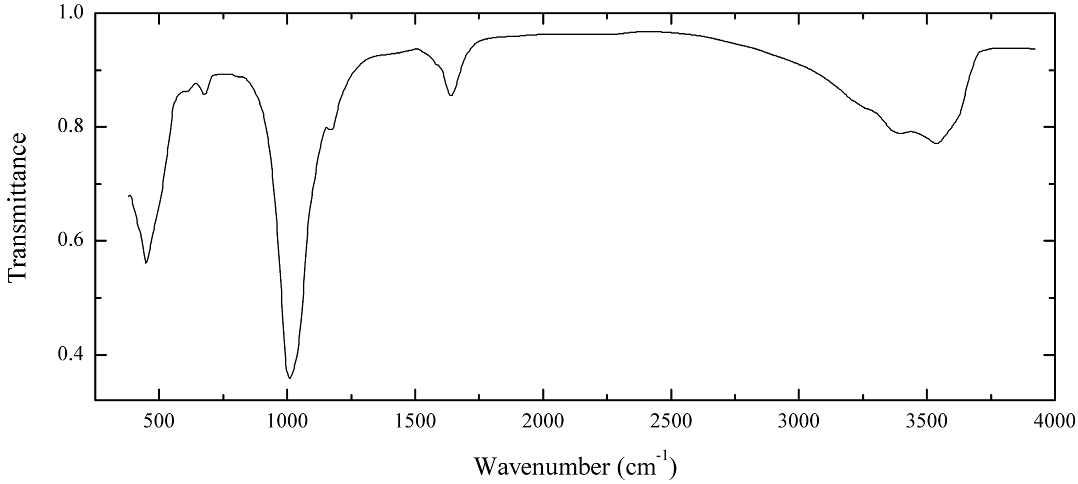


Locality: Wagholi quarry, Pune complex, Maharashtra, India.

Description: Blue radial aggregate from the association with stilbite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3630sh, 3567, 3523, 3445sh, 1645sh, 1632, 1195sh, 1183, 1048s, 1009s, 982s, 713w, 607, 550sh, 526, 490sh, 465s, 420sh.

Sil244 Windhoekite $Ca_2Fe^{3+}{}_{3-x}(Si_8O_{20})(OH)_4{\cdot}10H_2O$

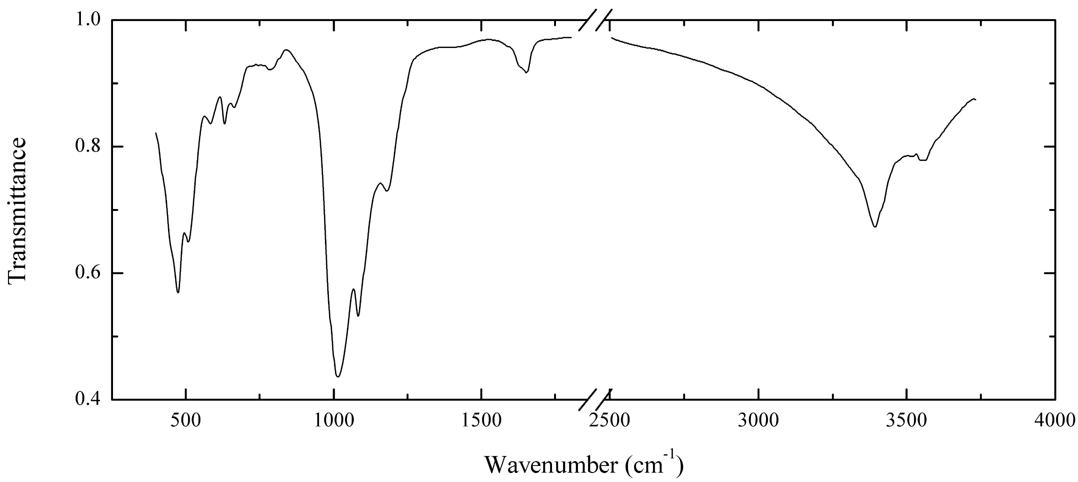


Locality: Ariskop Quarry, near Windhoek, Namibia (type locality).

Description: Yellow-brown long-prismatic crystals from in cavities in phonolite, from the association with fluorapophyllite, aegirine, microcline, arisite-(Ce) and arisite-(La). Holotype sample. Monoclinic, space group *C*2/*m*, $a = 14.319(5)$, $b = 17.825(4)$, $c = 5.242(1)$ Å, $\beta = 103.5(2)°$, $Z = 2$. Optically biaxial (−), $\alpha = 1.610(3)$, $\beta = 1.662(3)$, $\gamma = 1.671(3)$, $2V_{meas} = -50(10)$. $D_{meas} = 2.62(2)$ g/cm^3, $D_{calc} = 2.630$ g/cm^3. The empirical formula is $(Ca_{1.68}Mn_{0.12})Fe^{3+}{}_{2.96}(Si_{7.87}Al_{0.08}O_{20})(OH)_4{\cdot}10H_{1.98}O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.04 (100) (110), 4.432 (10) (021), 4.133 (6) (22-1), 3.754 (4) (240), 3.486 (11) (400), 2.636 (8) (35-1), 2.551 (4) (002), 2.505 (6) (26-1).

Wavenumbers (cm^{-1}): 3600sh, 3535, 3380, 3250sh, 1640, 1590sh, 1168, 1100sh, 1007s, 800w, 674w, 600sh, 500sh, 446s, 420sh.

Sil245 Ferrosepiolite $(Fe^{2+},Fe^{3+},Mn,Mg)_4(Si_6O_{15})(OH,O)_2{\cdot}nH_2O$



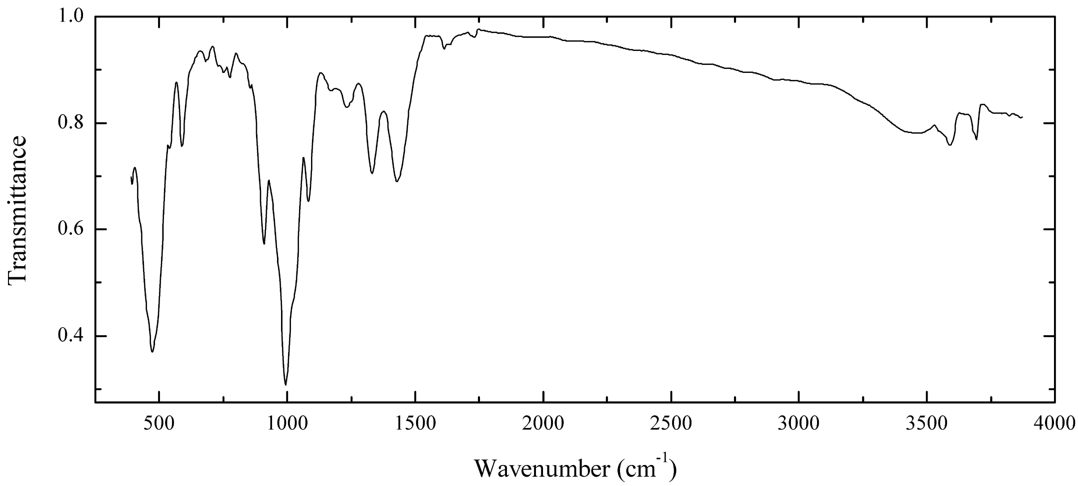
Locality: Flora Mt., the contact aureole of the Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Beige fibrous aggregate from the association with yofortierite, narsarsukite, aegirine, opal and quartz. Orthorhombic, $a = 13.53$, $b = 26.70$, $c = 5.130$ Å. Optically biaxial (+),

$\alpha = 1.557$, $\beta = 1.560$, $\gamma = 1.597$. The empirical formula is (electron microprobe) $Ca_{0.02}(Fe_{2.24}Mn_{1.06}Mg_{0.52}Zn_{0.17}Ti_{0.08})(Si_{5.94}Al_{0.06}O_{15})(OH,O)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3540, 3382, 3250sh, 1662, 1640sh, 1181, 1086s, 1019s, 1010sh, 788w, 675sh, 662, 631, 583, 510s, 474s, 450sh, 420sh.

Sil246 Molybdophyllite $Pb_8Mg_9Si_{10}O_{30}(CO_3)_3(OH)_8 \cdot H_2O$

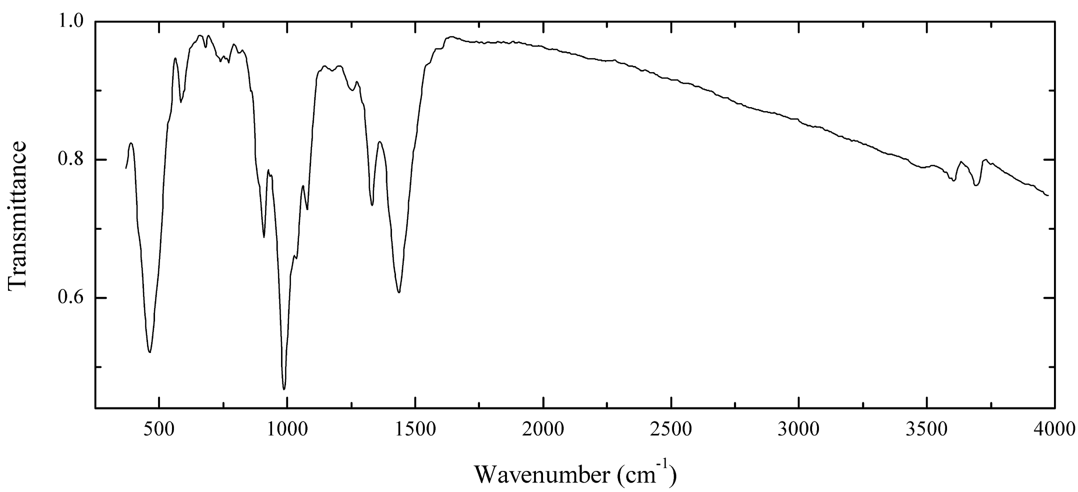


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Colourless platelets from skarn. The empirical formula is (electron microprobe) $Pb_{8.8}Mg_{9.6}Mn_{0.1}Si_{9.8}Al_{0.2}O_{30}(CO_3,BO_3)_x(OH)_y \cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3680, 3585, 3450, 1735w, 1640sh, 1620w, 1433, 1332, 1236, 1170w, 1084, 1025sh, 995s, 965sh, 912, 854w, 773, 748w, 727w, 678w, 586, 540, 471s.

Sil247 Molybdophyllite $Pb_8Mg_9Si_{10}O_{30}(CO_3)_3(OH)_8 \cdot H_2O$

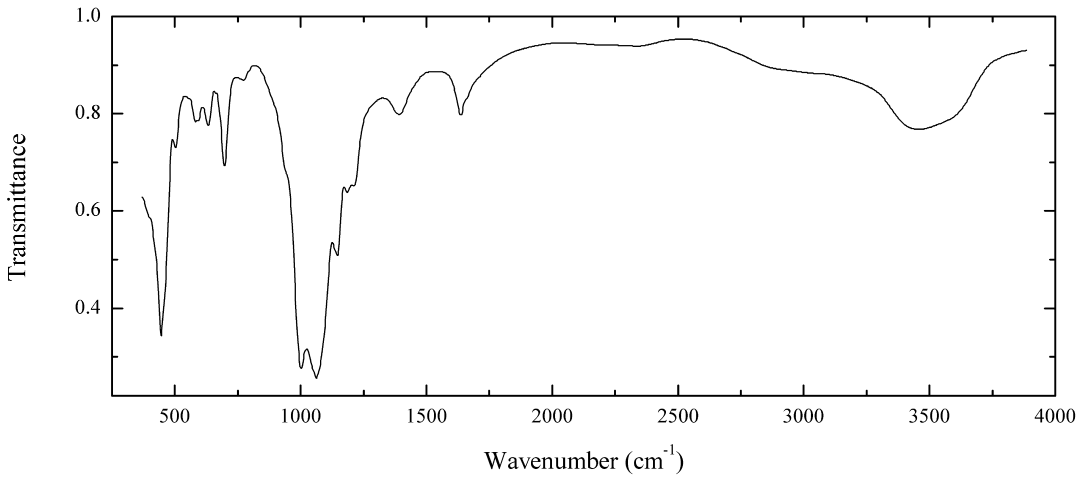


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Yellowish platelets from the association with hausmannite and calcite. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3680, 3590, 3460w, 1437, 1334, 1240w, 1170w, 1083, 1035, 992s, 912, 890sh, 860sh, 773w, 740w, 679w, 585, 540sh, 466s.

Sil248 Rhodesite $KHCa_2Si_8O_{19}\cdot 5H_2O$

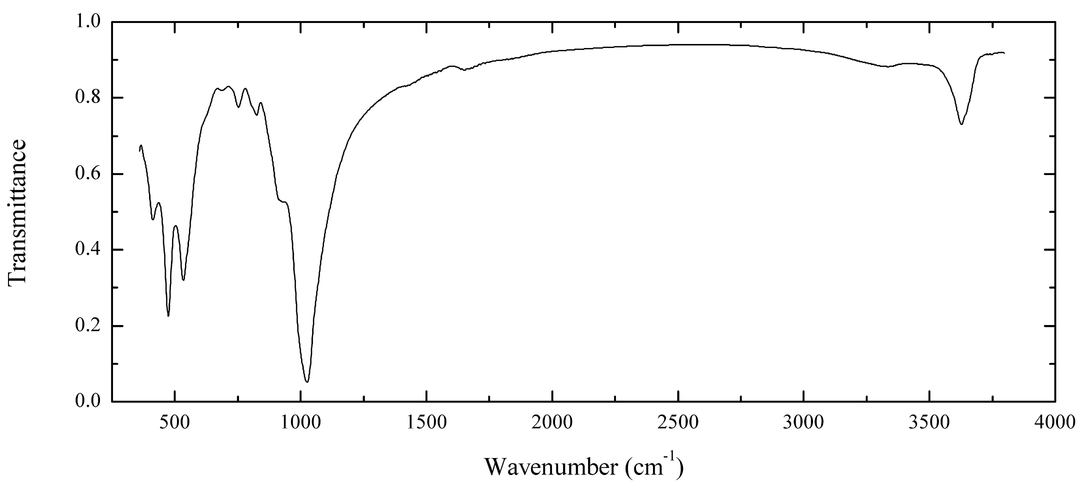


Locality: Graulay (other versions of spelling: Graulai, Graulei), near Hillesheim, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: White aggregate from a low-temperature hydrothermal assemblage related to alkaline basalt. NH_4-bearing variety. The bands at 3,440 and 1,392 cm^{-1} correspond to stretching and bending vibrations of NH_4^+ groups, respectively. Orthorhombic, $a = 6.566$, $b = 7.085$, $c = 23.33$ Å.

Wavenumbers (cm^{-1}): 3560sh, 3440, 3000sh, 2300w, 1637, 1392, 1210, 1185, 1145, 1057s, 997s, 940sh, 770w, 693, 628, 595, 580, 498, 439s, 395sh.

Sil251 "Hydromuscovite" $K_{1-x}Al_2[(Si,Al)_4O_{10}](OH)_2\cdot nH_2O$

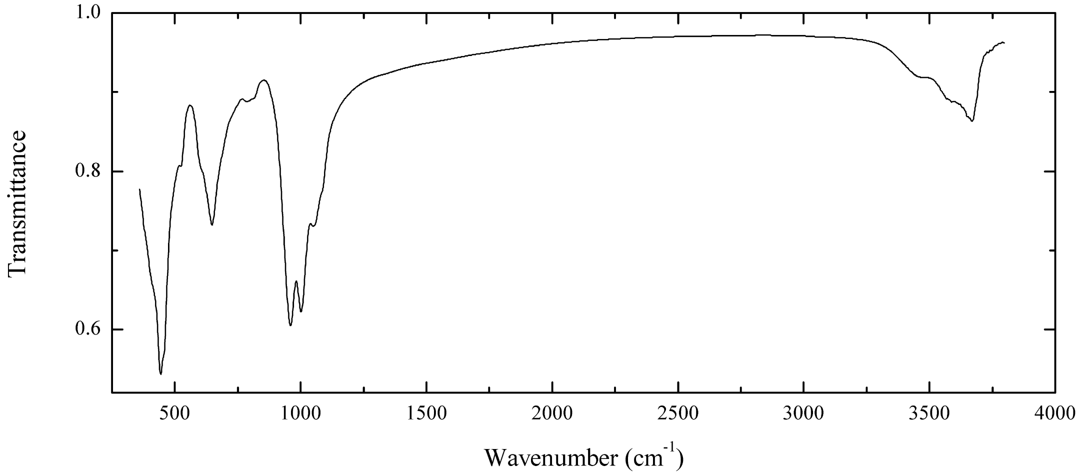


Locality: Passa Limani, near Lavrion, Attikí (Attika, Attica) prefecture, Greece.

Description: Bright green veinlet in clay. The empirical formula is (electron microprobe) $K_{0.8}(Al_{1.8}Mg_{0.1}Fe_{0.1})(Si_{3.35}Al_{0.65}O_{10})(OH)_2\cdot nH_2O$.

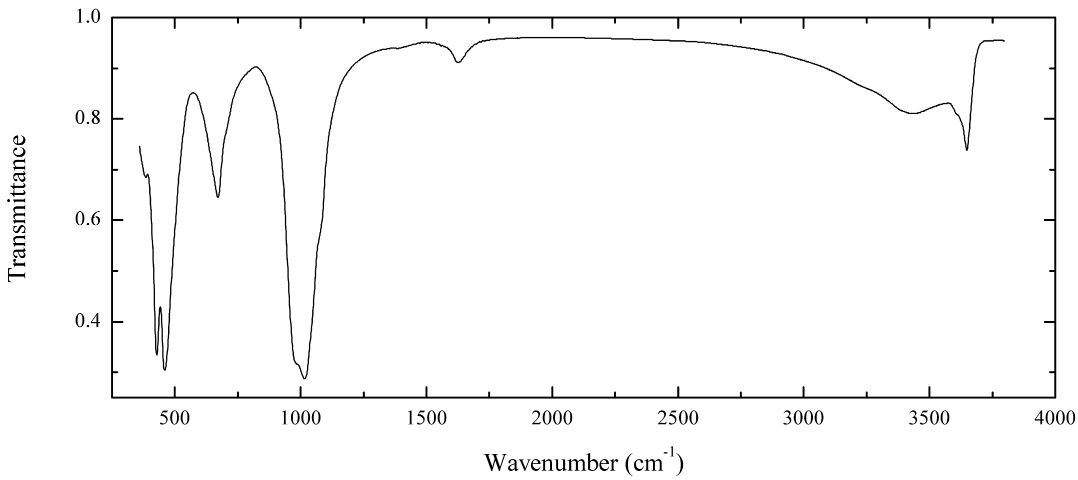
Wavenumbers (cm^{-1}): 3638, 3333w, 1649w, 1425sh, 1026s, 932, 826, 810sh, 753, 689w, 620sh, 534s, 473s, 412.

Sil252 **Dozyite** $(Mg_7Al_2)(Si_4Al_2)O_{15}(OH)_{12}$



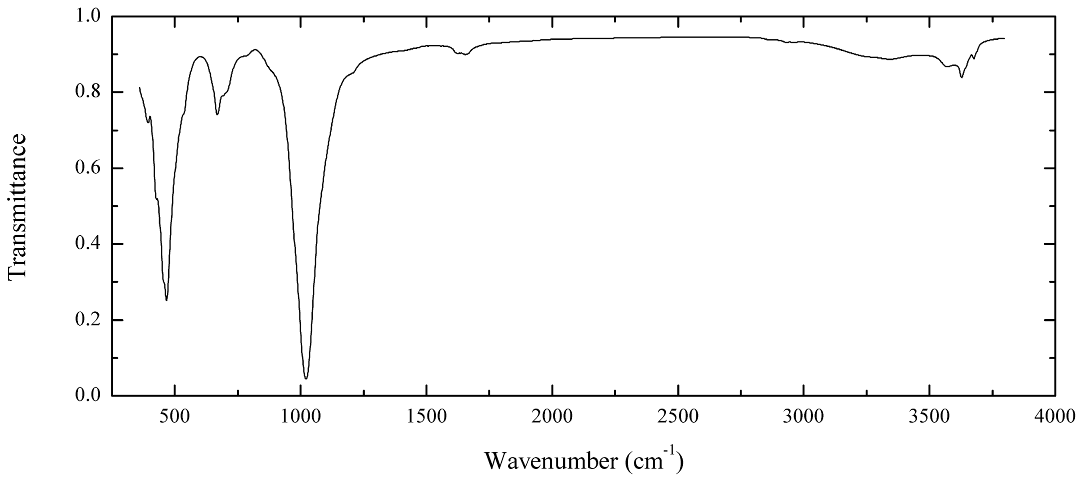
Locality: Wood's chrome mine, State Line Chromite District, Lancaster Co., Pennsylvania, USA.
Description: Violet scaly aggregate.
Wavenumbers (cm^{-1}): 3669, 3595sh, 3470, 1085sh, 1050, 1002s, 960s, 810sh, 789, 647, 610sh, 523, 455sh, 444s, 415sh.

Sil253 **Pecoraite** $Ni_3(Si_2O_5)(OH)_4$



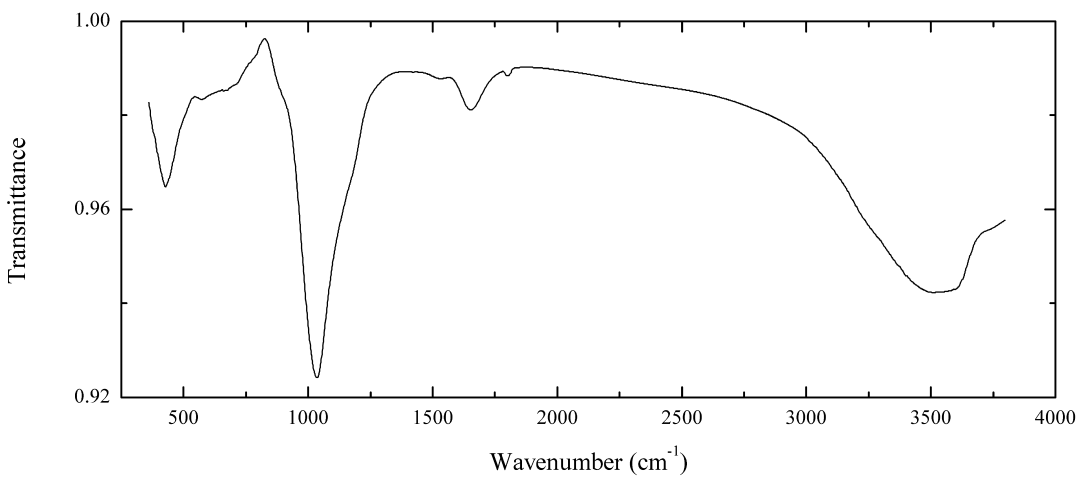
Locality: Archived Km-3 mine, Lavrion mining district, Agios Konstantinos, Attikí (Attika, Attica) Prefecture, Greece.
Description: Black massive from the association with annabergite and dolomite. Hydrated variety. The empirical formula is (electron microprobe) $Na_{0.06}Ca_{0.03}(Ni_{2.19}Zn_{0.24}Mn_{0.24}Mg_{0.15}Fe_{0.07}Al_{0.05}Sb_{0.04})(Si_{2.0}O_5)(OH)_{3.7}F_{0.3}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3649, 3440, 3250sh, 1625, 1390w, 1075sh, 1015s, 985sh, 671, 459s, 428s, 388.

Sil254 Falcondoite $(Ni,Mg)_4(Si_6O_{15})(OH)_2{\cdot}6H_2O$



Locality: Loma Peguera laterite deposit, Bonao, Dominican Republic (type locality).
Description: Apple-green massive. Investigated by A.V. Kasatkin. The empirical formula is (electron microprobe) $Ni_{3.40}Mg_{0.68}(Si_{5.90}O_{15})(OH)_2{\cdot}nH_2O$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 12.28 (100), 3.34 (42), 3.20 (17), 2.61 (10), 2.57 (12), 2.45 (9), 2.39 (6).
Wavenumbers (cm^{-1}): 3677w, 3628, 3575w, 3344w, 3260sh, 1654w, 1625w, 1195sh, 1021s, 880sh, 775w, 695sh, 668, 530sh, 467s, 455sh, 435sh, 394.

Sil255 Hillesheimite $(K,Ca,\square)_2(Mg,Fe,Ca,\square)_2[(Si,Al)_{13}O_{23}(OH)_6](OH){\cdot}8H_2O$

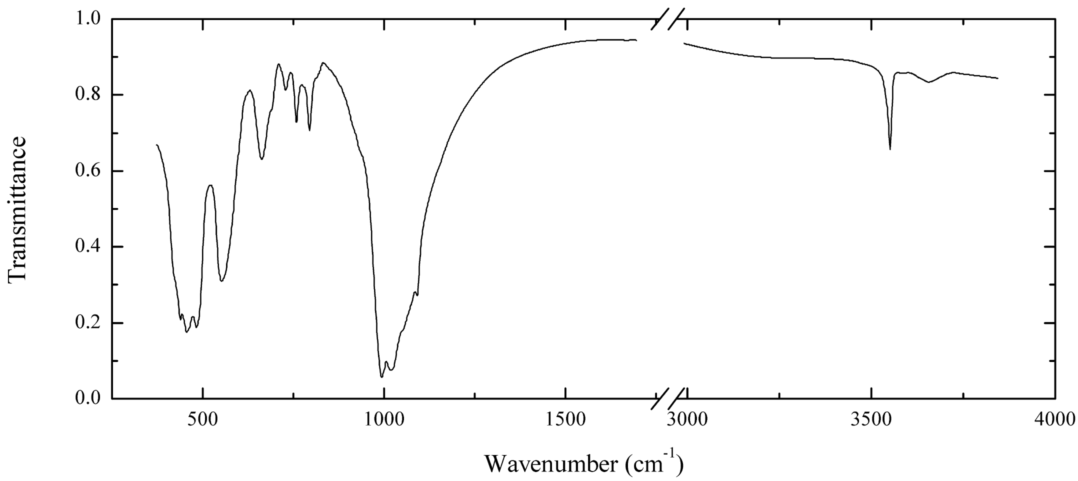


Locality: Basalt quarry Graulai, near the town of Hillesheim, Eifel Mountains, Rheinland-Pfalz, Germany (type locality).
Description: Flattened yellow crystals from cavities in basalt, from the association with nepheline, augite, fluorapatite, magnetite, perovskite, priderite, götzenite, lamprophyllite-group minerals and åkermanite. Holotype sample. The crystal structure is solved. orthorhombic, space group *Pmmn*, $a = 6.979(11)$, $b = 37.1815(18)$, $c = 6.5296(15)$ Å; $V = 1694(3)$ Å^3, $Z = 2$. Optically biaxial (−), $\alpha = 1.496(2)$, $\beta = 1.498(2)$, $\gamma = 1.499(2)$, $2V_{meas} = 80°$. $D_{meas} = 2.16(1)$ g/cm^3, $D_{calc} = 2.174$ g/cm^3. The empirical formula is $K_{0.96}Na_{0.08}Ba_{0.16}Ca_{0.56}Mg_{0.58}Fe^{2+}_{0.37}[Si_{9.62}Al_{3.32}O_{23}(OH)_6][(OH)_{0.82}(H_2O)_{0.18}]{\cdot}8H_2O$. The strongest lines of the powder X-ray

diffraction pattern [*d*, Å (*I*, %)] are 6.857 (58), 6.545 (100), 6.284 (53), 4.787 (96), 4.499 (59), 3.065 (86), 2.958 (62), 2.767 (62).

Wavenumbers ($\mathbf{cm^{-1}}$): 3535, 3290sh, 1800w, 1650, 1165sh, 1035s, 900sh, 780sh, 675sh, 580, 450s, 390sh.

Sil256 Bismutoferrite $BiFe^{3+}{}_2Si_2O_8(OH)$

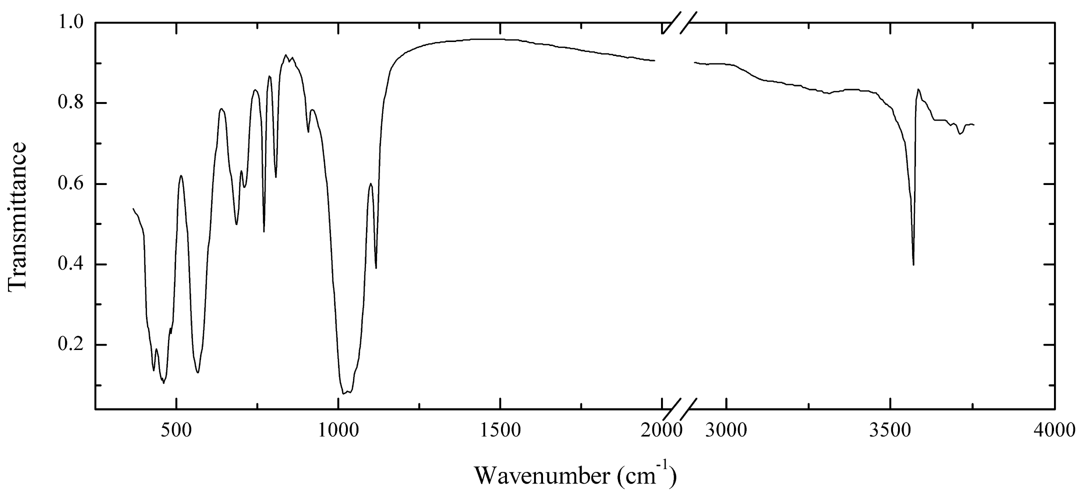


Locality: Old dumps near As-U deposit Smrkovec, Slavovsky Les Mts., near Mariánské Lázně, Czech Republic.

Description: Olive green powdery, from the association with bismuth and bismutite.

Wavenumbers ($\mathbf{cm^{-1}}$): 3650w, 3550, 1095, 1050sh, 1020s, 993s, 796, 760, 728w, 690sh, 662, 553, 482s, 456s, 440.

Sil257 Chapmanite $Sb^{3+}Fe^{3+}Si_2O_8(OH)$

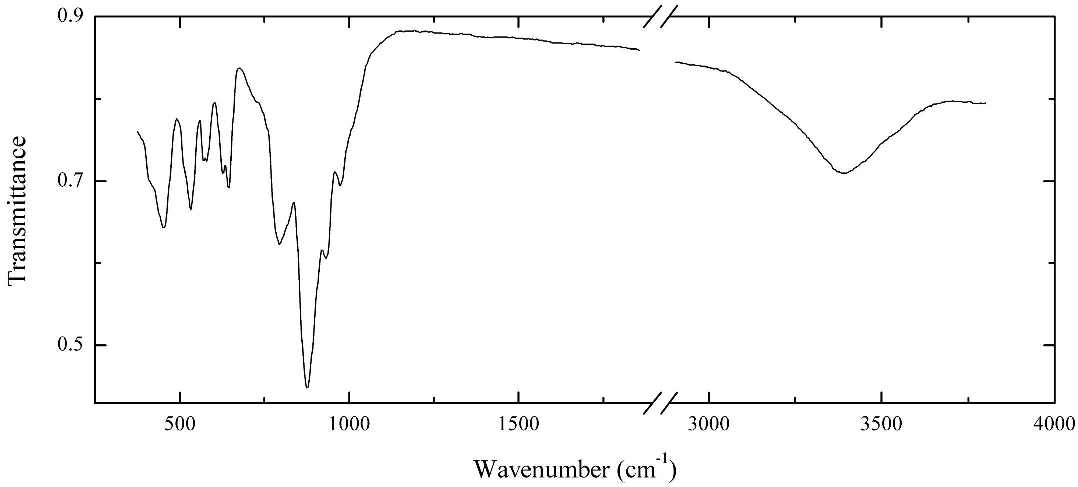


Locality: Smilkov, near Votice, Benešov, Central Bohemia, Czech Republic.

Description: Pistachio green earthy aggregate. Identified by IR spectrum and qualitative electron microprobe analysis. Contains admixture of dickite (?).

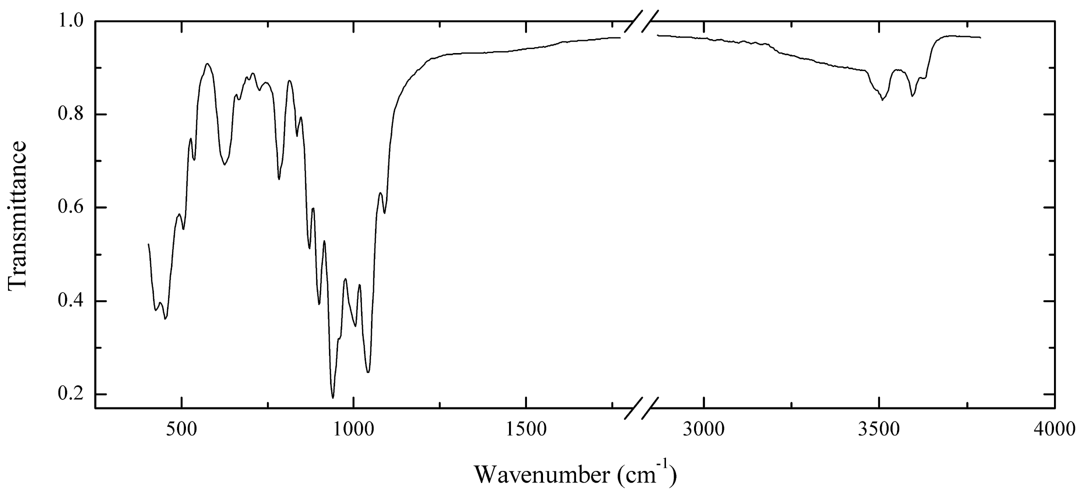
Wavenumbers ($\mathbf{cm^{-1}}$): 3700w, 3670w, 3630w, 3558, 1117, 1060sh, 1039s, 1018s, 1000sh, 910, 849w, 810, 773, 715, 692, 567s, 487, 460s, 431s, 415sh.

AsSi1 Kraisslite $(Mn^{2+},Mg)_{24}Zn_3Fe^{3+}(SiO_4)_6(AsO_4)_3(AsO_3)_2(OH)_{18}$



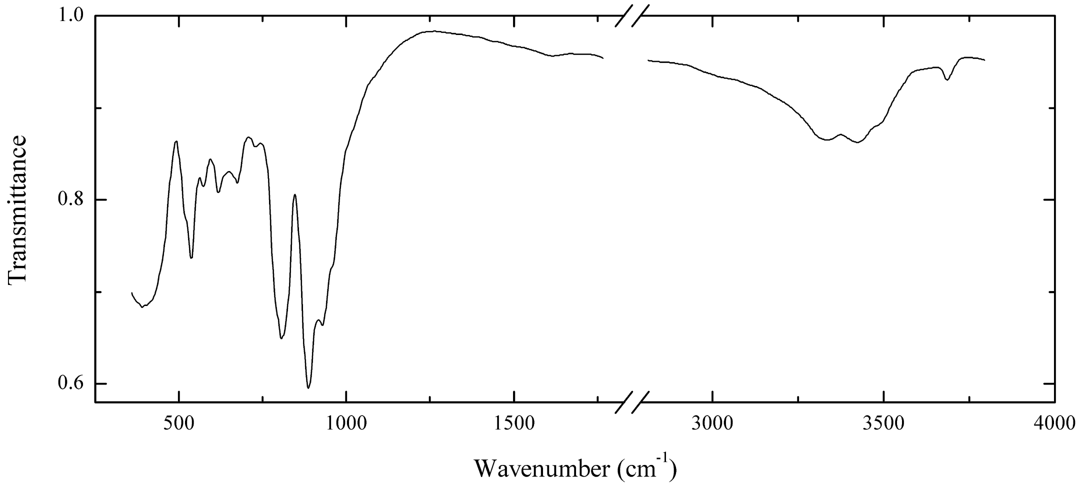
Locality: Sterling Hill mine, Ogdensburg, Sussex Co., New Jersey, USA (type locality).
Description: Deep red-brown grains from the association with zincite, willemite, franklinite and Mn carbonates. The empirical formula is (electron microprobe) $Mn_{18.6}Mg_{6.0}Zn_{2.4}Fe_{0.4}Al_{0.3}(SiO_4)_{5.3}[(AsO_4),(AsO_3)]_{5.0}(OH,O)_{18}$.
Wavenumbers (cm^{-1}): 3370, 1000sh, 974, 933s, 877s, 795s, 785sh, 720sh, 644, 626, 584, 572, 533, 515sh, 450s, 430sh, 405sh.

AsSi2 Johninnesite $Na_2Mn^{2+}{}_9(Mg,Mn^{2+})_7(Si_6O_{17})_2(AsO_4)_2(OH)_8$



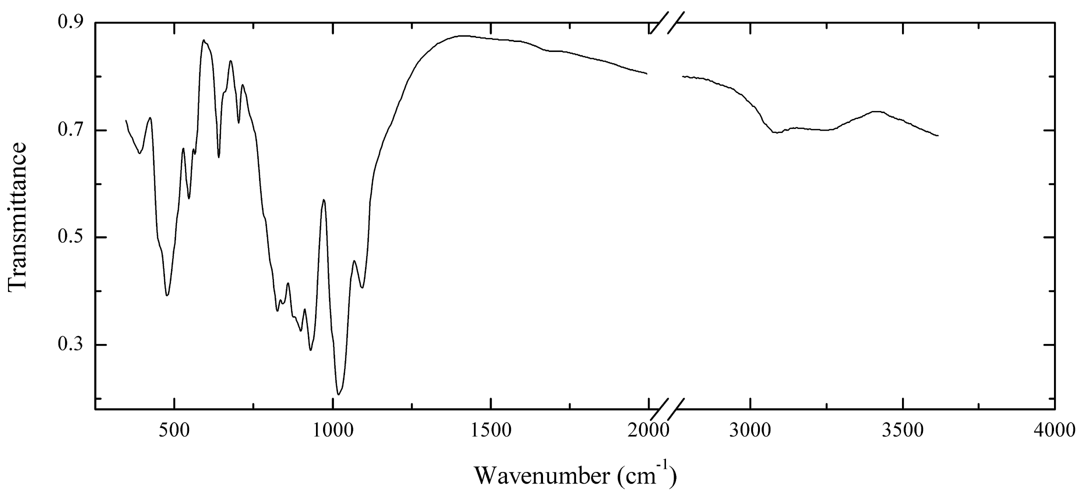
Locality: Ausserferrera, Grischun, Switzerland.
Description: Yellow veinlet. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3635w, 3600, 3515, 3500sh, 1094, 1044s, 1006s, 962s, 939s, 900s, 872, 835, 790sh, 783, 722w, 696w, 665w, 635sh, 622, 534, 503, 449s, 425s.

AsSi3 Mcgovernite $(Mn^{2+},Mg,Zn,Fe^{3+})_{45}(SiO_4)_7(AsO_4)_5(AsO_3)_2(OH)_{42}$



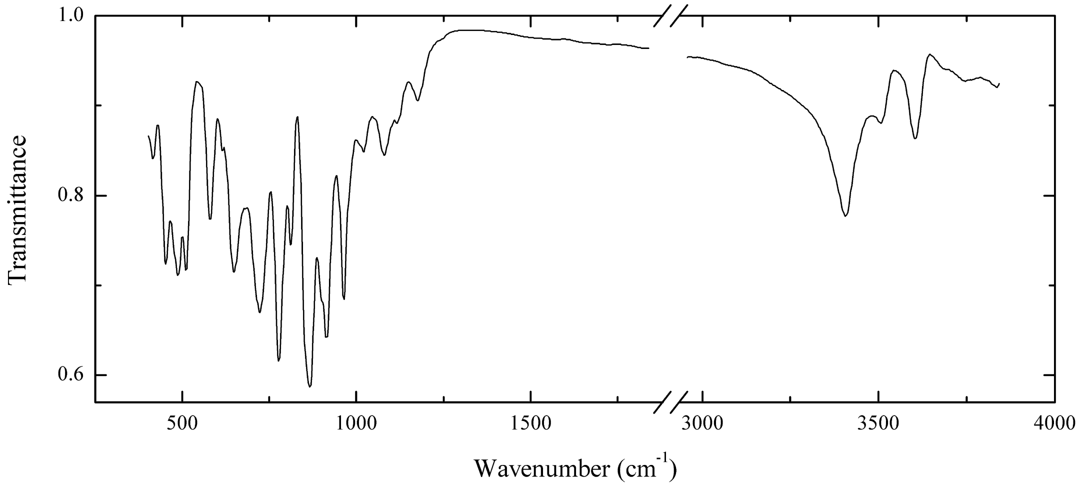
Locality: Sterling Hill mine, Ogdensburg, Sussex Co., New Jersey, USA (type locality).
Description: Deep red-brown grains from the association with willemite, franklinite and calcite. Identified by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3655w, 3450sh, 3400, 3310, 960sh, 930s, 888s, 810s, 790sh, 728w, 672, 614, 572, 535, 525sh, 420sh, 397.

AsSi4 Tiragalloite $Mn^{2+}{}_4As^{5+}Si_3O_{12}(OH)$



Locality: Molinello manganese mine, Val Graveglia, near Chiavari, Liguria, Italy (type locality).
Description: Orange grains from the association with quartz, calcite and parsettensite.
Wavenumbers (cm^{-1}): 3230, 3070, 1094, 1019s, 933s, 901s, 880sh, 845, 826, 805sh, 785sh, 701, 660sh, 639, 562, 544, 479, 455sh, 400.

AsSi5 Holdenite $(Mn^{2+},Mg,Zn,Fe^{3+})_{45}(SiO_4)_7(AsO_4)_5(AsO_3)_2(OH)_{42}$

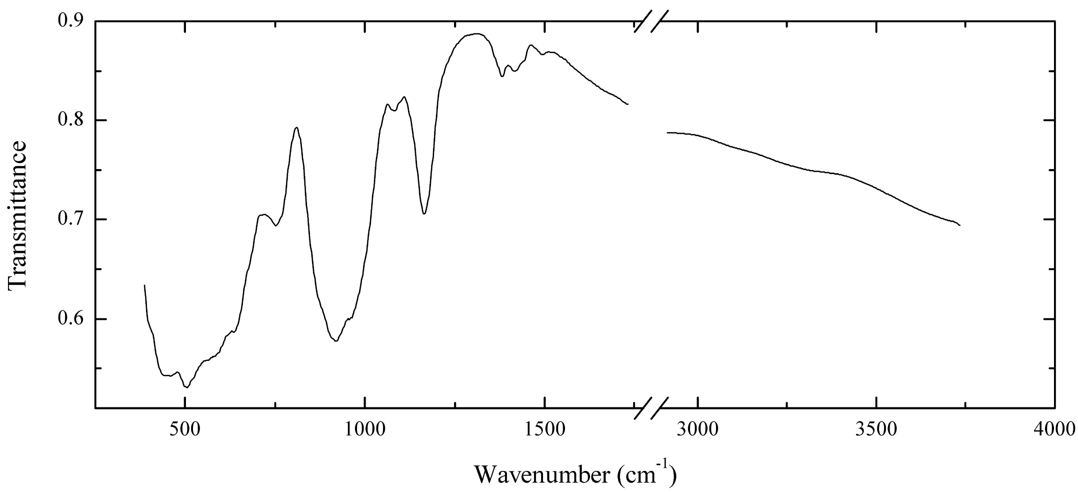


Locality: Sterling Hill mine, Ogdensburg, Sussex Co., New Jersey, USA (type locality).

Description: Pink fine-grained aggregate from the association with willemite and carbonates. Identified by semiquantitative electron microprobe analysis. Contains admixture of a carbonate mineral (the band at 1,440 cm^{-1}).

Wavenumbers (cm^{-1}): 3597, 3508, 3405, (1440), 1180w, 1110w, 1080w, 1020w, 963s, 914s, 900sh, 867s, 855sh, 810, 776s, 722s, 648, 614w, 579, 510, 486, 450, 415w.

AsSi6 Cervandonite-(Ce) $(Ce,Nd,La)\ (Fe^{3+},Ti,Fe^{2+},Al)_3(Si,As)_3O_{13}$

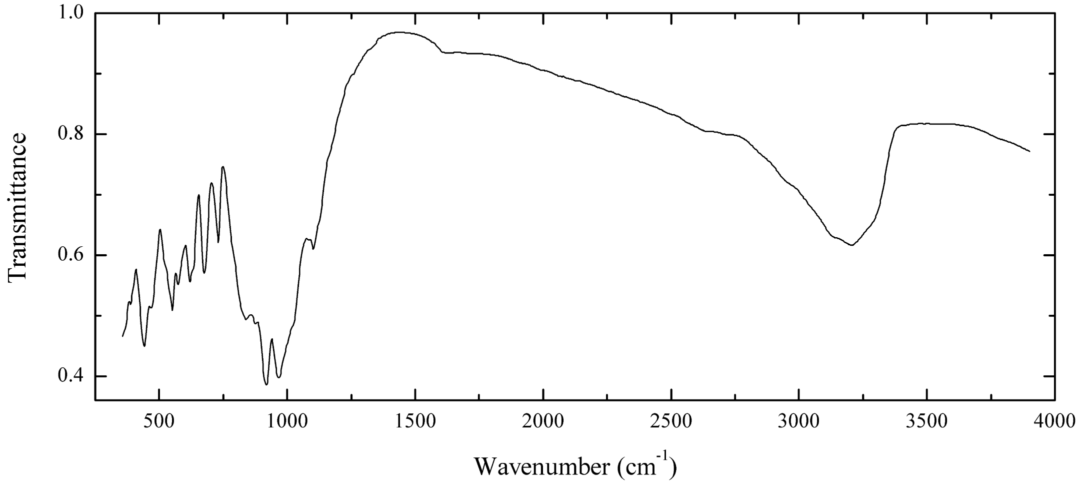


Locality: Pizzo Cervandone,Alpe Devero, Binntal, Wallis, Switzerland (type locality).

Description: Black spherulites from the association with quartz, muscovite, albite and rutile. Contains CO_3^{2-} groups (the bands at 1,415 and 1,390 cm^{-1}). The empirical formula is (electron microprobe) $(Ce_{0.42}Nd_{0.19}La_{0.18}Y_{0.06}Th_{0.05}Ce_{0.02})(Fe_{1.70}Ti_{0.92}Al_{0.39}Mg_{0.12})Si_{1.61}As_{1.30}O_{13}(CO_3)_x$.

Wavenumbers (cm^{-1}): 1495w, 1415w, 1390w, 1169, 1086w, 962s, 921s, 885sh, 757, 630sh, 570sh, 513s, 460s, 390sh.

AsSi7 Ardennite-(As) $(Mn^{2+},Ca)_4(Al,Mg,Fe^{3+})_6(SiO_4)_2(Si_3O_{10})(AsO_4,VO_4)(OH)_6$

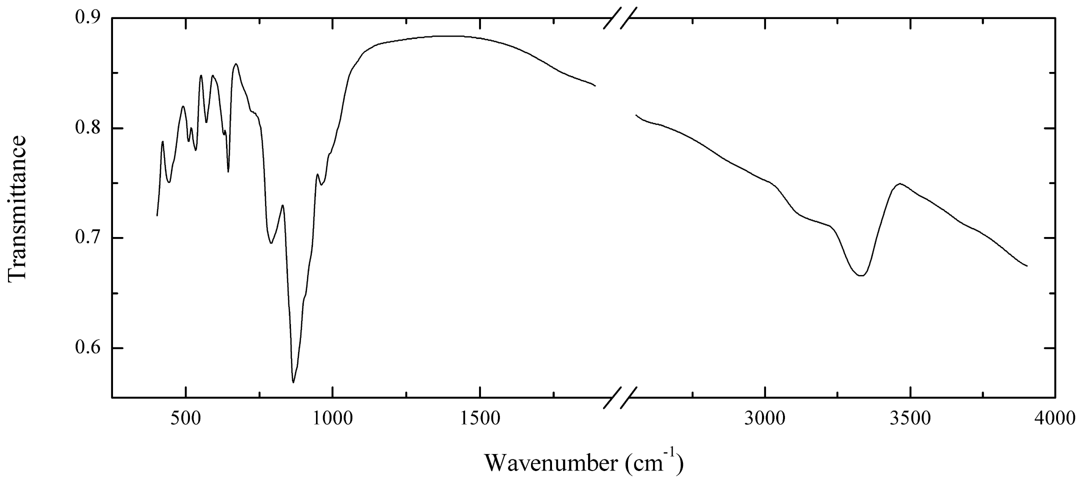


Locality: Salm-Château, Vielsalm, Stavelot massif, Ardennes, Luxembourg province, Belgium (type locality).

Description: Aggregate of reddish-brown prismatic crystals from the association with quartz, albite and pyrolusite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Mn_{3.33}Ca_{0.46})(Al_{4.82}Mg_{1.22}Fe_{0.16})(SiO_4)_2(Si_3O_{10})(AsO_4)_{0.55}(VO_4)_{0.43}(OH)_6$.

Wavenumbers (cm^{-1}): 3265sh, 3170s, 3115, 1620w, 1102, 1020sh, 968s, 919s, 877, 843, 785sh, 731, 677, 630sh, 623, 578, 554, 540sh, 525sh, 472, 443s, 395.

AsSi8 Kolicite $Mn^{2+}{}_7Zn_4(SiO_4)_2(AsO_4)_2(OH)_8$

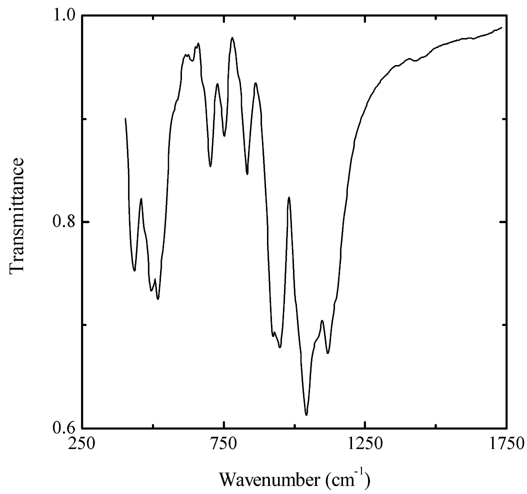


Locality: Sterling Hill mine, Ogdensburg, Sussex Co., New Jersey, USA (type locality).

Description: Orange-brown crust on willemite. Other associated minerals are zincite, franklinite and Mn carbonates. The empirical formula is (electron microprobe) $Mn_{7.5}Zn_{2.7}Mg_{0.6}Fe_{0.2}(SiO_4)_{1.6}(AsO_4)_{2.3}(OH)_8$.

Wavenumbers (cm^{-1}): 3320, 3170sh, 1000sh, 962, 866s, 792, 730sh, 646, 630sh, 567w, 534, 508, 443.

BeSi1 Pezzottaite $Cs(Be_2Li)Al_2Si_6O_{18}$

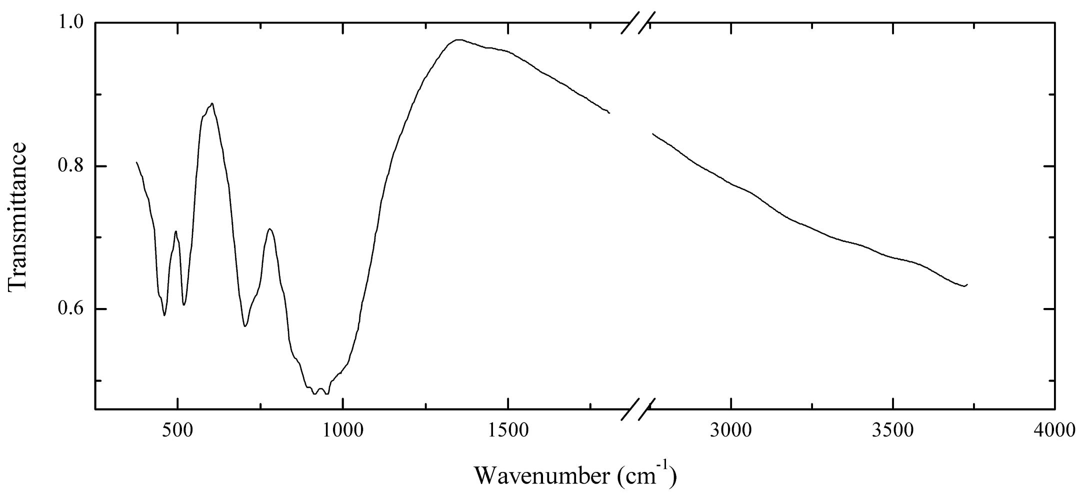


Locality: Sakavalana pegmatite, Ambatovita, near Mandrosonore village, Fianarantsoa province, Madagascar (type locality).

Description: Raspberry-coloured crystal from the association with albite and tourmaline. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1116s, 1085sh, 1040s, 948s, 928s, 831, 748, 699, 670sh, 636w, 580sh, 512, 490, 431.

BeSi2 Gadolinite-(Y) $Y_2Fe^{2+}Be_2Si_2O_{10}$

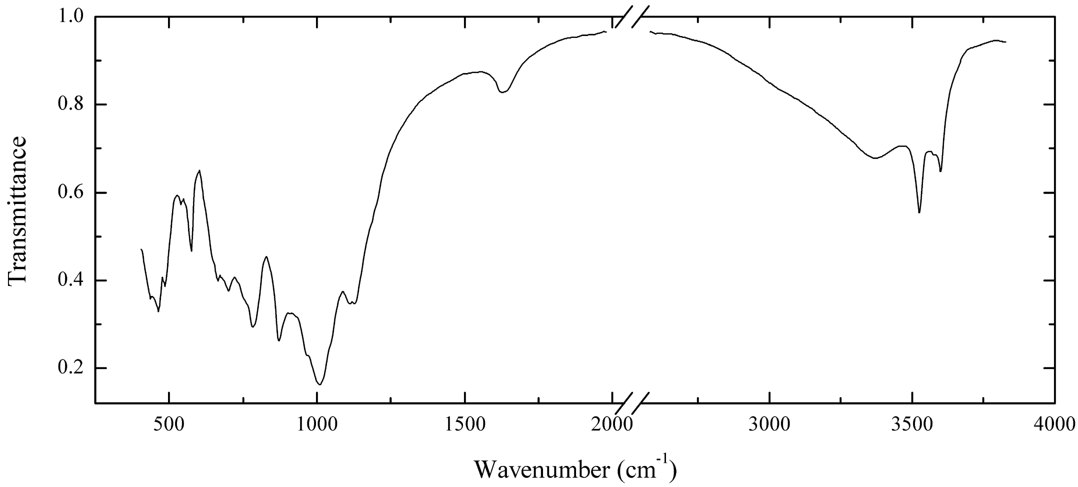


Locality: Åskagen quarry, at the former mining settlement Torskebäcken, near Filipstad, Värmlands län, Sweden.

Description: Black grains in pegmatite, in the association with thalenite-(Y), allanite-(Y), iimoriite-(Y), keiviite-(Y), yttrocrasite-(Y) and tengerite-(Y). Identified by IR spectrum and semiquantitative electron microprobe analysis.

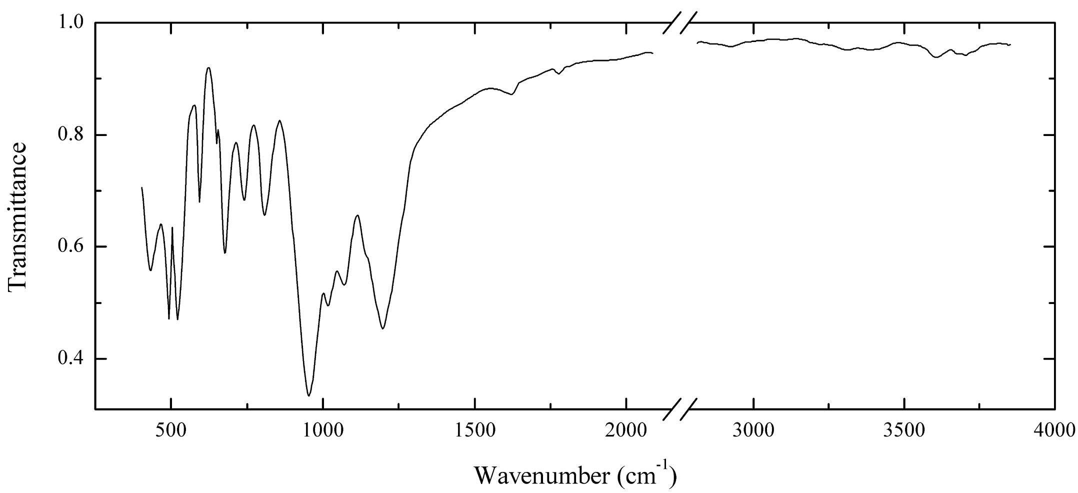
Wavenumbers (cm^{-1}): 995sh, 951s, 912s, 850sh, 810sh, 740sh, 701, 513, 454, 440sh.

BeSi3 Tvedalite $(Ca,Mn^{2+})_4Be_3Si_6O_{17}(OH)_4 \cdot 3H_2O$



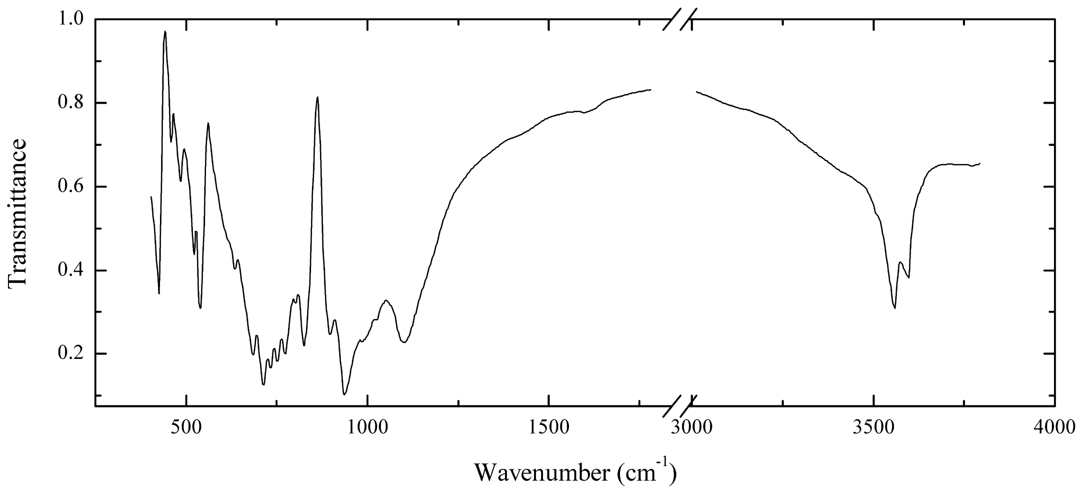
Locality: Vevja quarry, Tvedalen area, Brunlanes, Vestfold Co., Norway (type locality).
Description: Spherulites of platy crystals from the association with natrolite, analcime and calcite. Identified by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3598, 3024, 3370, 1633w, 1133, 1119, 1040sh, 1008s, 968s, 873s, 788s, 760sh, 697, 662, 577, 540w, 486, 463, 441.

BeSi4 Beryl $Be_3Al_2Si_6O_{18}$



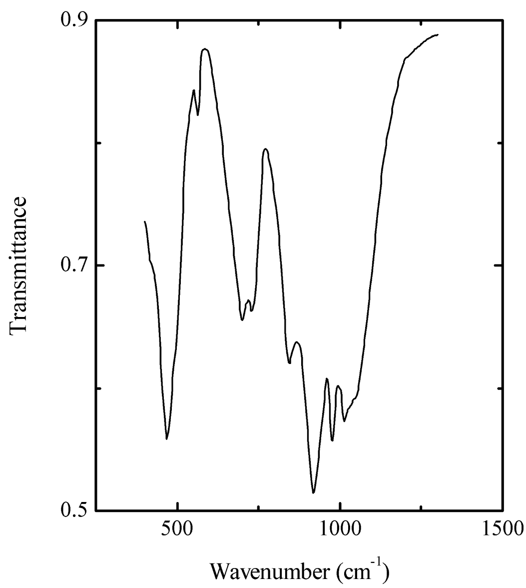
Locality: Lipovka mine, Lipovka pegmatite field, Rezh district, Middle Urals, Russia.
Description: Pink crystal from pegmatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Na_{0.10}Cs_{0.03}Rb_{0.01})Li_xBe_3Al_2(Si_{5.85}Al_{0.15})O_{18} \cdot nH_2O$. Weight loss on heating up to 950 °C is 0.15%.
Wavenumbers (cm^{-1}): 3700w, 3670w, 3595w, 3360w, 3295w, 2910w, 1770w, 1628w, 1200s, 1150sh, 1074, 1020s, 958s, 810, 742, 679, 670sh, 650w, 592, 520s, 493s, 436.

BeSi5 Bertrandite $Be_4Si_2O_7(OH)_2$



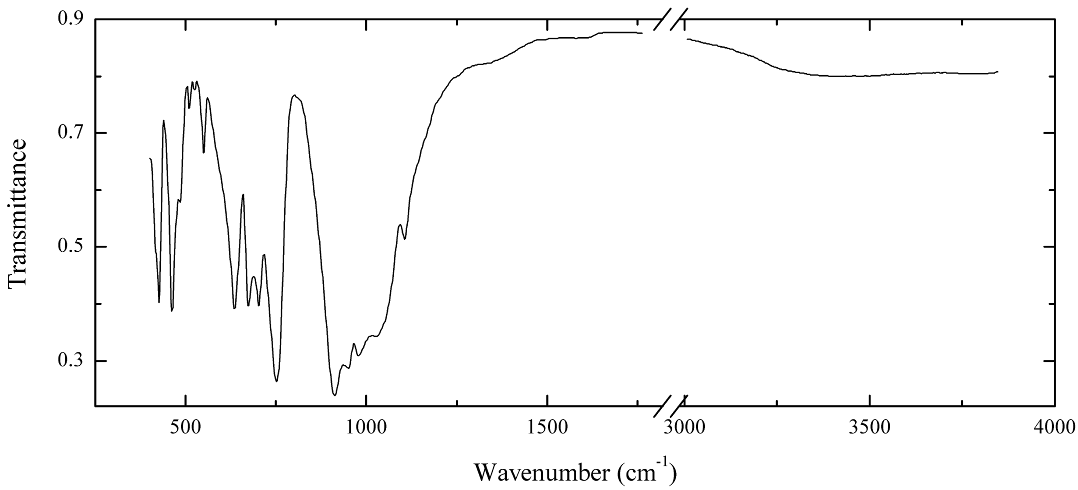
Locality: Oka, Québec, Canada.
Description: White split crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3585, 3545, 1620w, 1590w, 1109, 1025sh, 1091sh, 937s, 898, 827, 802, 774s, 754s, 734s, 715s, 686s, 638, 545sh, 539, 522, 486w, 475sh, 460w, 428.

BeSi6 Gugiaite $Ca_2BeSi_2O_7$



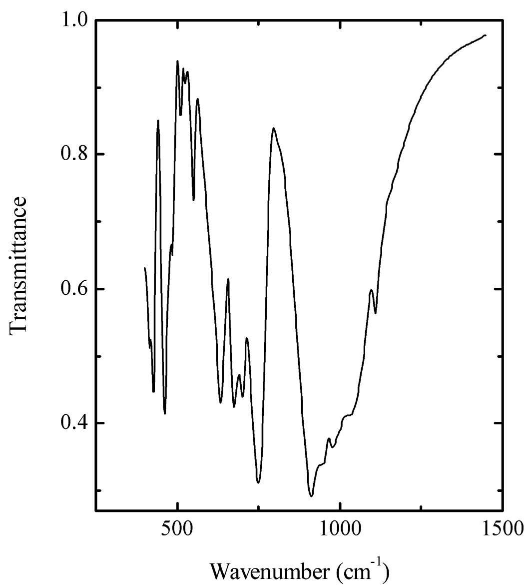
Locality: Dugdu alkaline massif, Tuva Republic, Eastern Siberia, Russia.
Description: White grains in rock. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 1035sh, 1050sh, 1011s, 974s, 916s, 842, 728, 698, 563, 469s, 415sh, 400sh.

BeSi7 Barylite $BaBe_2Si_2O_7$



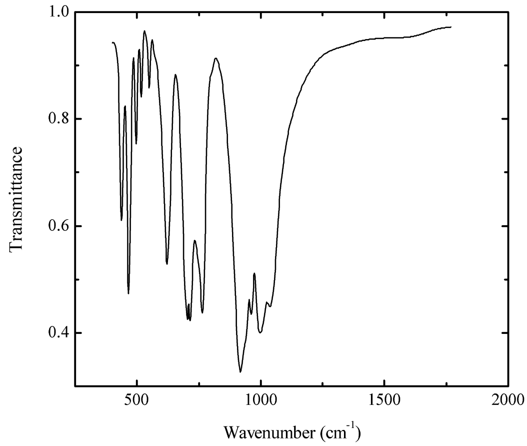
Locality: Suluai river, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White elongated platy crystals from pegmatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ba_{1.03}Be_2Si_{0.98}Al_{0.02}O_{7.02}$
Wavenumbers (cm^{-1}): 1107, 1050sh, 1033s, 1005sh, 980s, 954s, 945sh, 914s, 810w, 752s, 704, 674, 634, 620sh, 552, 525w, 510w, 486, 470sh, 461, 429, 418.

BeSi8 Barylite $BaBe_2Si_2O_7$



Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).
Description: Colourless prismatic crystals from the association with tilasite, barite and hedyphane. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ba_{0.97}Na_{0.05}Sr_{0.01}Pb_{0.01})Be_2(Si_{1.99}Al_{0.01})O_7$.
Wavenumbers (cm^{-1}): 1110, 1050sh, 1035, 1005sh, 977s, 955sh, 942s, 914s, 810w, 751s, 703, 672, 633, 620sh, 551, 524w, 509w, 485, 470sh, 461, 427, 415.

BeSi9 **Clinobarylite** $BaBe_2Si_2O_7$

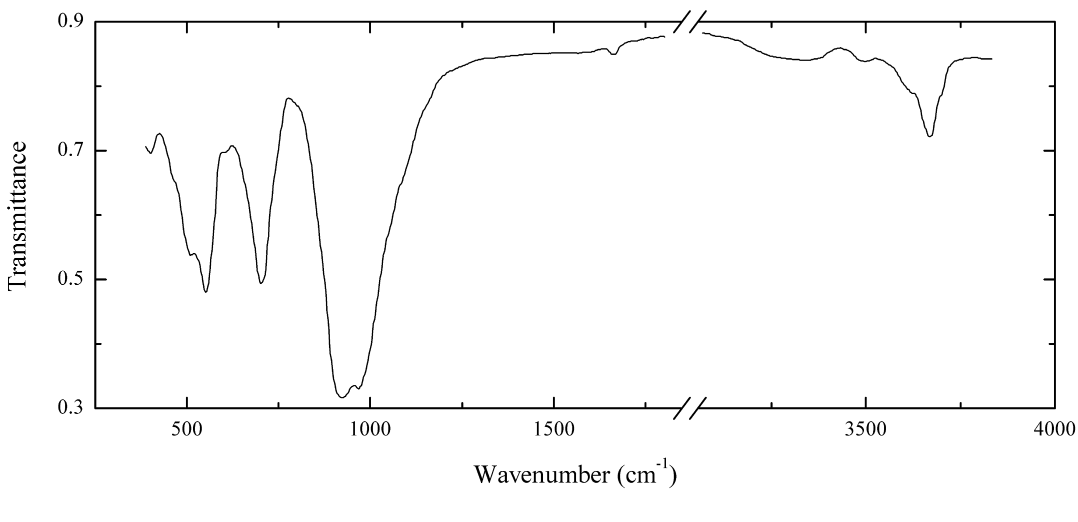


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless coarse lamellar crystals from the association with natrolite, microcline, aegirine, fluorapatite, strontianite, astrophyllite and catapleiite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3460w, 3330w, 1034s, 994s, 958s, 935sh, 914s, 795w, 764s, 715sh, 705s, 623, 553w, 521, 499, 471s, 441.

BeSi10 **Bityite** $CaLiAl_2(BeAlSi_2O_{10})(OH)_2$

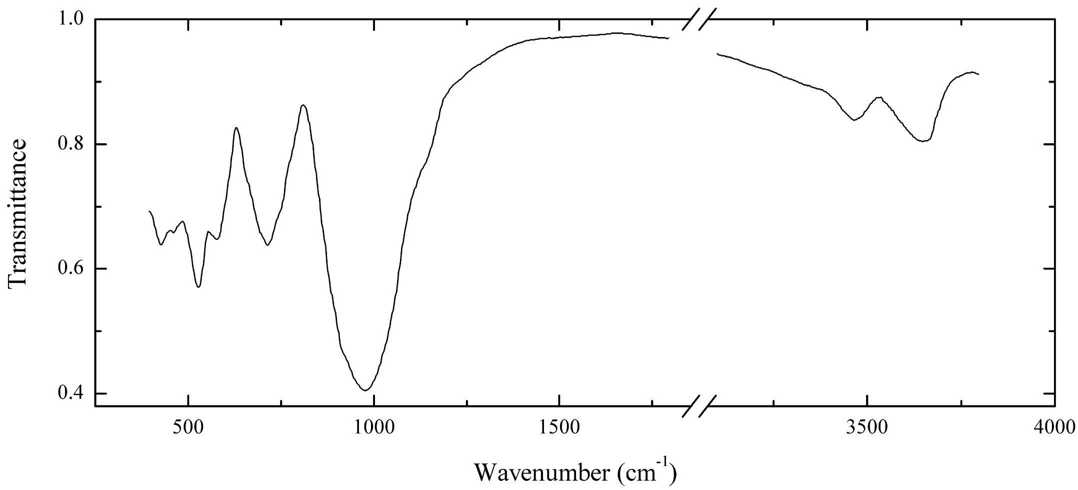


Locality: Harding pegmatite, Harding mine, Picuris district, Taos Co., New Mexico, USA.

Description: Colourless platy crystals from the association with beryl and elbaite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3626, 3585sh, 3450w, 3300w, 1653w, 963s, 926s, 704, 606w, 554, 514, 403w.

BeSi11 Bityite $CaLiAl_2(BeAlSi_2O_{10})(OH)_2$

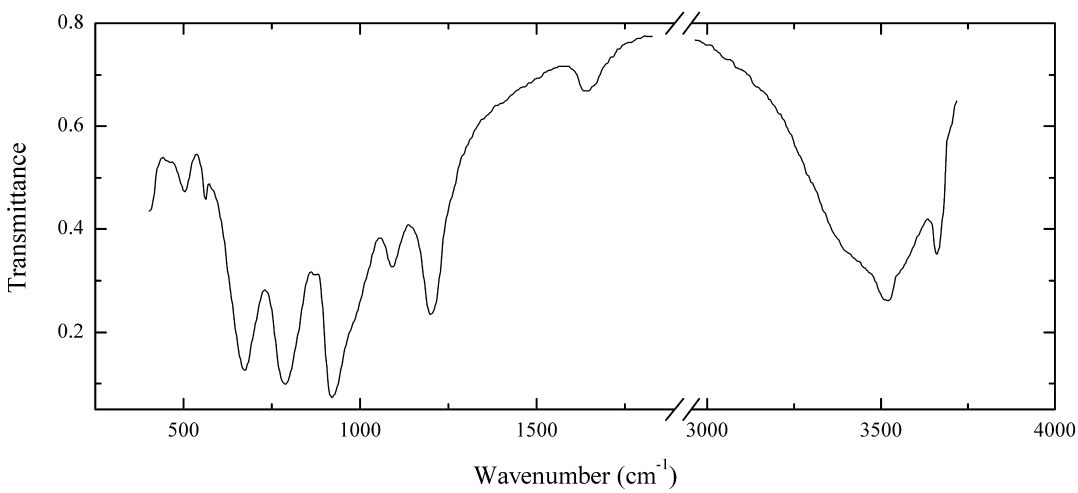


Locality: Cheremshanskoe (Malyshevskoe) Be deposit, Tokovaya river, Middle Urals, Russia.

Description: Colourless platy crystals from the association with beryl and elbaite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{1.00}Li_{1.16}Al_{2.06}Mg_{0.04}Cr_{0.01}(Si_{2.20}Be_{1.65}Al_{0.15}O_{10})(OH)_2$. Li and Be calculated from stoichiometry and charge-balance requirement.

Wavenumbers (cm^{-1}): 3618, 3440, 1130sh, 1080sh, 987s, 925sh, 740sh, 715, 690sh, 575, 530, 462sh, 428.

BeSi12 Beryllite $Be_3SiO_4(OH)_2{\cdot}H_2O$

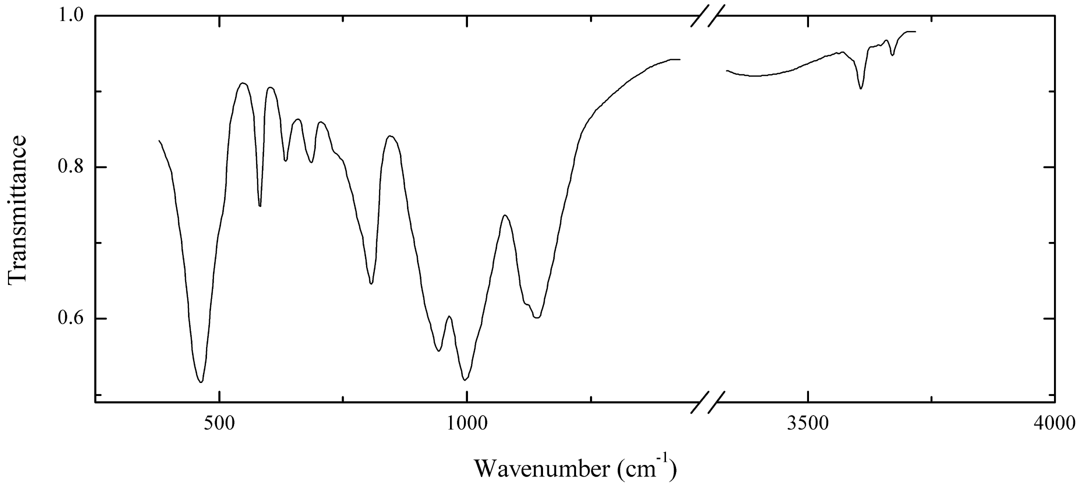


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Soft white spherulites from the association with natrolite, albite and epididymite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3620, 3540sh, 3485, 3400sh, 1625w, 1196, 1087, 980sh, 916s, 867w, 783s, 668s, 554w, 497w, 405.

BeSi13 Bazzite $Be_3(Sc,Fe^{3+})_2Si_6O_{18}\cdot nH_2O$

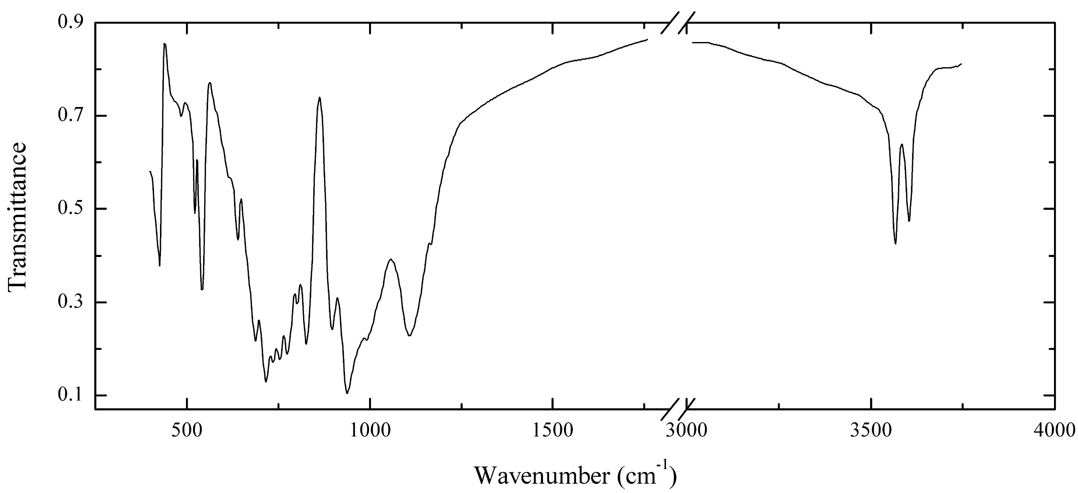


Locality: Kent massif, Karagandy province, Central Kazakhstan.

Description: Light blue transparent prismatic crystals from the association with fluorite, microcline and quartz. The empirical formula is (electron microprobe) $Be_3(Sc_{1.3}Fe_{0.55}Al_{0.1}Mg_{0.05})(Si_{5.9}Al_{0.1})O_{18}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3655w, 3590w, 1142s, 1120sh, 1030sh, 999s, 944s, 925sh, 804, 740sh, 682, 633, 580, 505sh, 461s.

BeSi14 Bertrandite $Be_4Si_2O_7(OH)_2$

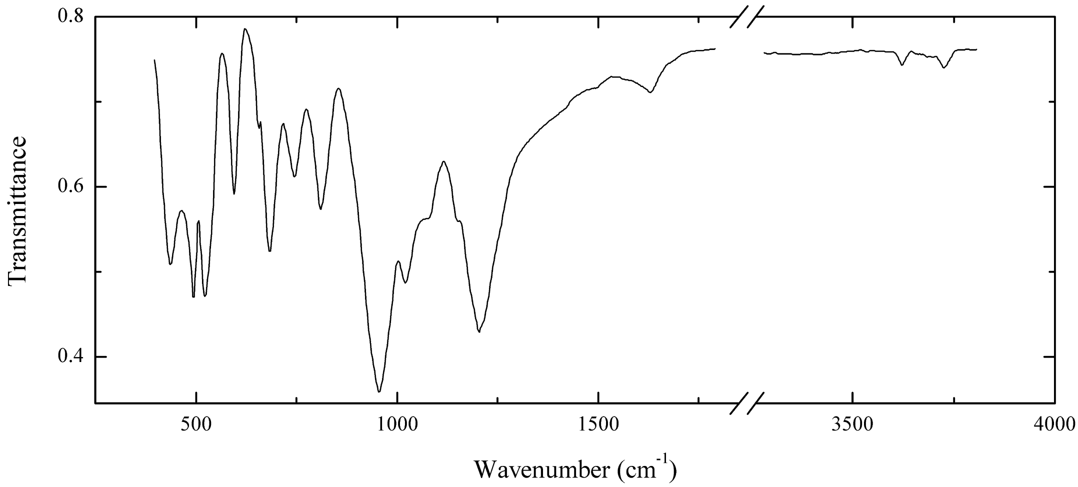


Locality: Kara-Oba W deposit, Betpakdala desert, Karagandy province, Central Kazakhstan.

Description: Colourless short-prismatic crystal from the association with rhodochrosite, wolframite, pyrite and quartz. Identified by IR spectrum.

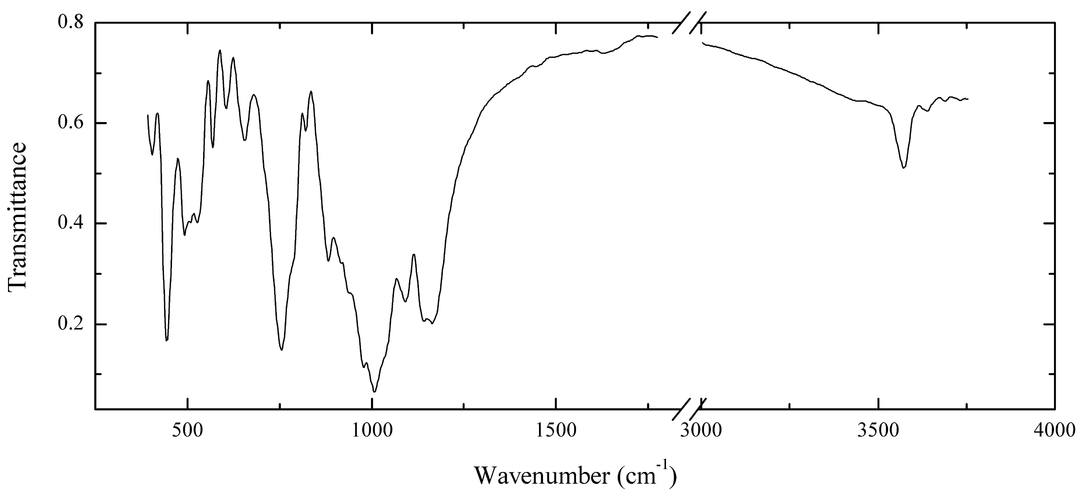
Wavenumbers (cm^{-1}): 3590m 3554, 1170, 1110s, 1025sh, 992s, 939s, 897, 827s, 802, 775s, 753s, 734s, 716s, 688s, 640, 615sh, 542, 523, 490w, 428.

BeSi15 Beryl $Be_3Al_2Si_6O_{18}$



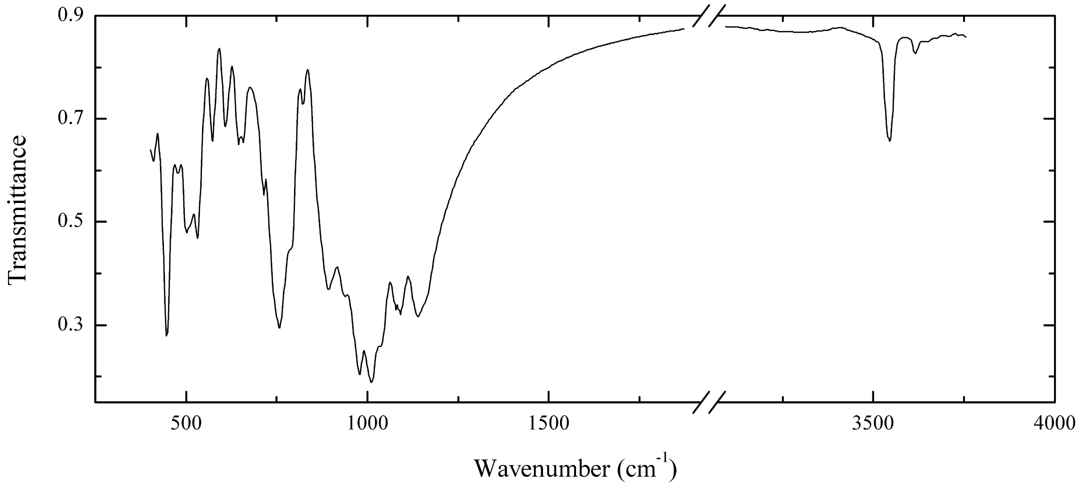
Locality: Cheremshanskoe (Malyshevskoe) Be deposit, Tokovaya river, Middle Urals, Russia.
Description: Colourless crystal from phlogopite glimmerite. The empirical formula is (electron microprobe) $(Na_{0.11}Ca_{0.03})Be_3Al_{1.98}Fe_{0.02}(Si_{5.98}Al_{0.02})O_{18}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3692w, 3590w, 1625w, 1201s, 1150, 1075, 1019s, 957s, 808, 741, 678, 651w, 591, 520s, 492s, 433.

BeSi16 Bohseite $Ca_4Be_3AlSi_9O_{25}(OH)_3$



Locality: Cheremshanskoe (Malyshevskoe) Be deposit, Tokovaya river, Middle Urals, Russia.
Description: White radial aggregate of flattened prismatic crystals from the association with fluorite and plagioclase. The empirical formula is (electron microprobe) $Ca_{3.9}Be_{2.9}Al_{1.1}Si_{9.0}(O,OH)_{28}$.
Wavenumbers (cm^{-1}): 3610w, 3550, 1620w, 1165s, 1142s, 1085s, 1035sh, 1005s, 977s, 940sh, 920sh, 883, 821w, 785sh, 755s, 655, 605w, 568, 529, 509, 495, 445s, 407.

BeSi17 Bavenite $Ca_4Be_2Al_2Si_9O_{26}(OH)_2$

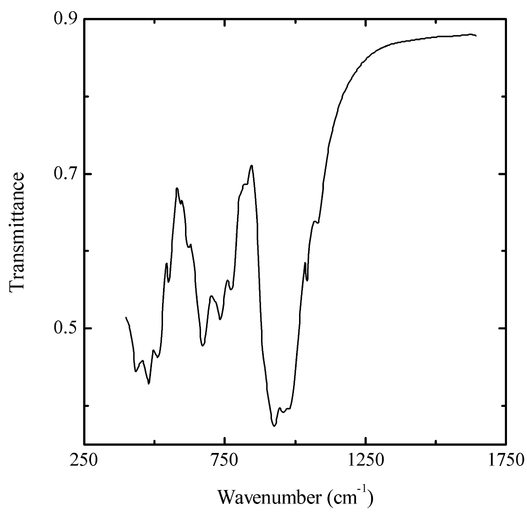


Locality: Cheremshanskoe (Malyshevskoe) Be deposit, Tokovaya river, Middle Urals, Russia.

Description: Platy crystals from the association with prehnite. The empirical formula is (electron microprobe) $Ca_{3.95}Be_{2.45}Al_{1.55}Si_{9.0}(O,OH)_{28}$.

Wavenumbers (cm^{-1}): 3610w, 3545, 1160sh, 1140s, 1088s, 1078s, 1038s, 1007s, 977s, 935s, 889s, 820w, 783, 751s, 708, 649, 639, 601, 563, 524, 500sh, 491, 468, 447s, 405.

BeSi18 Welshite $Ca_4(Mg,Mn,Fe)_9(Sb^{5+},Fe^{3+})_3[(Si,As)_6(Be,Al)_4Al_4O_{36}]O_4$

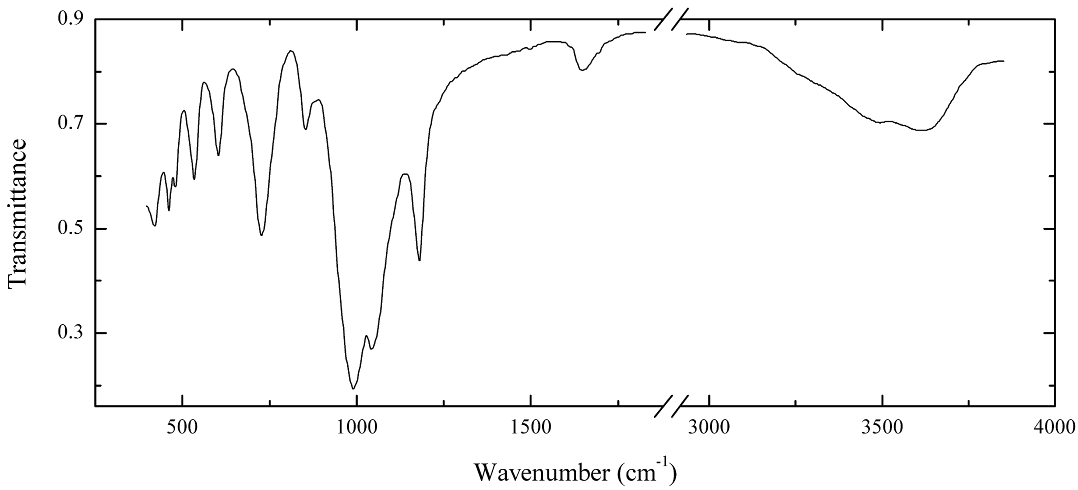


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Dark red crystal from skarn. Identified by IR spectrum and qualitative electron microprobe analysis.

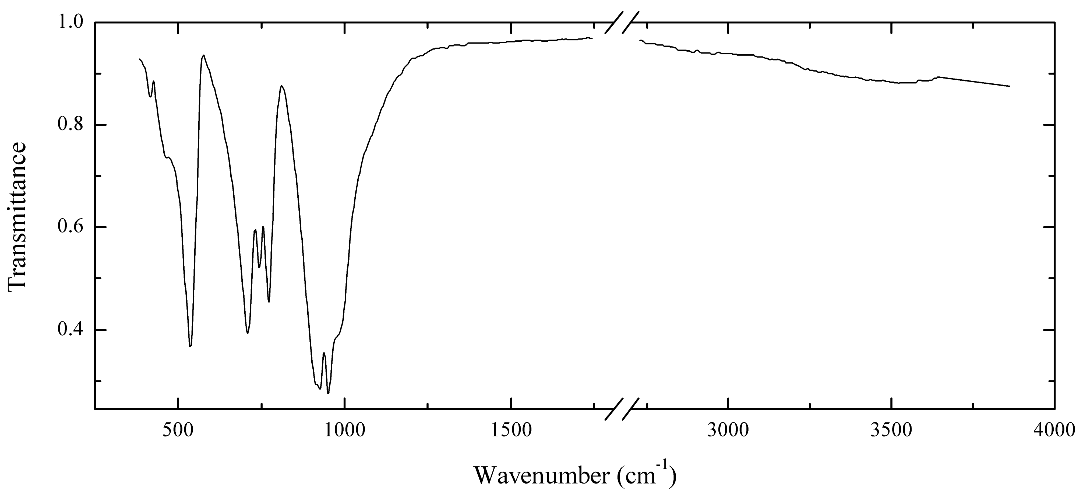
Wavenumbers (cm^{-1}): 1078w, 1042, 975s, 952s, 923s, 885sh, 820w, 800sh, 771, 732, 712, 670, 619w, 591w, 551w, 511, 479s, 435, 410sh.

BeSi19 Roggianite $Ca_2BeAl_2Si_4O_{13}(OH)_2 \cdot 2.5H_2O$



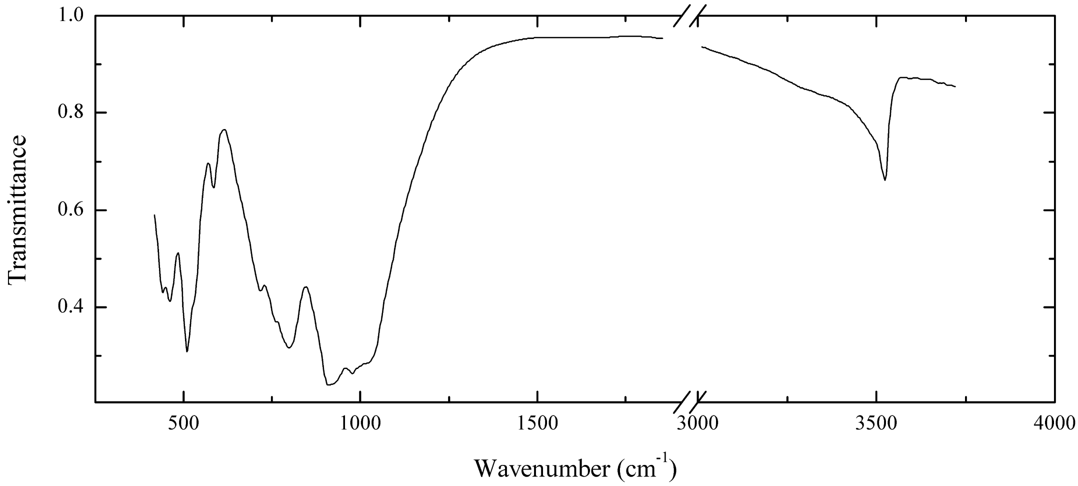
Locality: Cheremshanskoe (Malyshevskoe) Be deposit, Tokovaya river, Middle Urals, Russia.
Description: White radial-fibrous aggregate from plagioclasite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3580, 3455, 3240sh, 1640w, 1175s, 1041s, 988s, 850, 723s, 670sh, 598, 531, 477, 459, 419.

BeSi20 Helvine $Mn^{2+}{}_4Be_3(SiO_4)_3S$



Locality: Lupikko deposit, near Pitkäranta, Ladoga lake, Karelia, Russia.
Description: Yellow-brown grain in skarn. The empirical formula is (electron microprobe) $Mn_{1.9}Fe_{1.3}Zn_{0.8}Be_3Si_{3.0}O_{11.9}S_{1.1}$.
Wavenumbers (cm^{-1}): 985sh, 949s, 924s, 912s, 771, 745, 708, 535s, 465sh, 415w.

BeSi22 Hingganite-(Y) $YBe(SiO_4)(OH)$

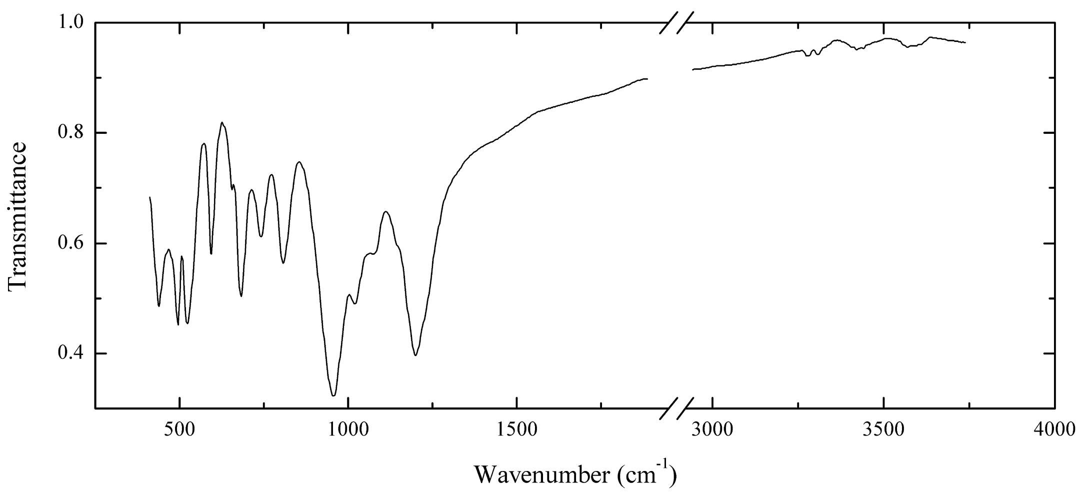


Locality: Ploskaya Mt., Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: White crystals from the association with fluorite, microcline and zircon. The empirical formula is (electron microprobe) $(Y_{0.32}Ce_{0.15}Yb_{0.14}Nd_{0.13}Er_{0.10}Nd_{0.05}La_{0.03}Lu_{0.03}Tm_{0.02}Ca_{0.05})Fe_{0.02}BeSi_{0.97}Al_{0.03}O_4(OH)$.

Wavenumbers (cm^{-1}): 3515, 1020sh, 981s, 918s, 801s, 762, 719, 587w, 525sh, 509s, 460, 443.

BeSi23 Beryl $Be_3Al_2Si_6O_{18}$

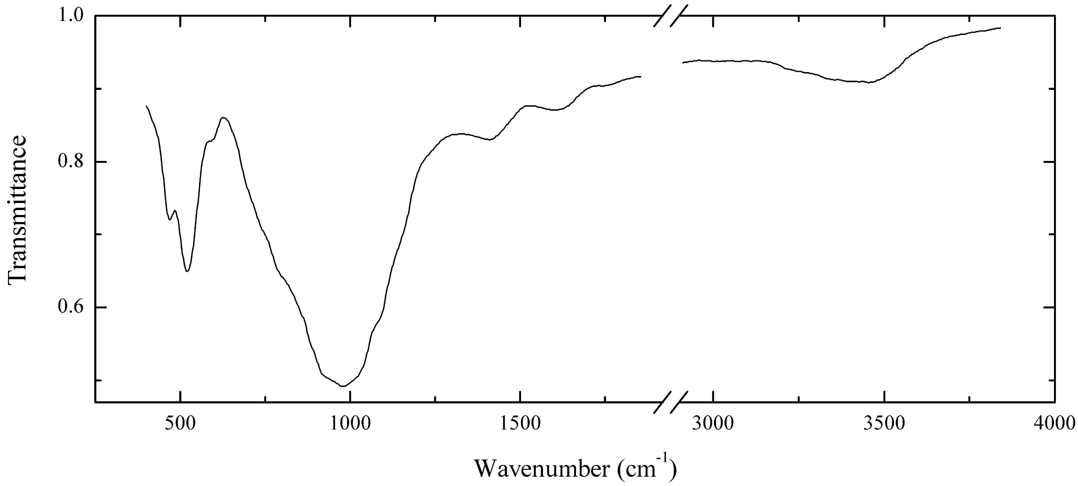


Locality: Lipovka mine, Lipovka pegmatite field, Rezh district, Middle Urals, Russia.

Description: Light green crystal from pegmatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Na_{0.06}Cs_{0.01}Rb_{0.01})Li_xBe_3(Al_{1.88}Fe_{0.09}Mg_{0.03})(Si_{5.95}Al_{0.05})O_{18}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3575w, 3425w, 3295w, 3265w, 1201s, 1145sh, 1079, 1017, 957s, 806, 740, 680, 652w, 591, 540sh, 521s, 494s, 435.

BeSi24 "Calcibeborosilite" $(Ca,Y,REE)_2(\square,Fe^{2+})(Be,B)_2(SiO_4)_2(OH,O)_2$

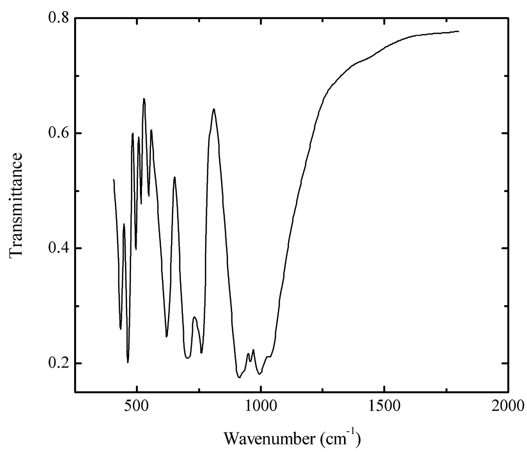


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan.

Description: Greenish-grey grains from the association with arfvedsonite, quartz, microcline, zektzerite, hejtmanite, titanite, sphalerite, astrophyllite, pyrochlore and fluorite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.96}Y_{0.71}Ce_{0.11}La_{0.04}Nd_{0.03}Yb_{0.03}Er_{0.03}Dy_{0.02}Pr_{0.01}Gd_{0.01}U_{0.04}Th_{0.01})(Fe_{0.23}Mg_{0.05})(Be_{1.04}B_{0.96})$ $(SiO_4)_2(OH,O)_2$. The crystal structure is solved. Monoclinic, space group $P2_1/a$; $a = 9.846(4)$, $b = 7.600(2)$, $c = 4.766(2)$ Å, $\beta = 90.11(3)°$. Forms solid-solution series with datolite and hingganite-(Y). Not approved by the IMA CNMNC.

Wavenumbers (cm^{-1}): 3420w, 1600w, 1405w, 1145sh, 1095sh, 1030sh, 983s. 950sh, 930sh, 880sh, 795sh, 720sh, 700sh, 580w, 515, 462, 400sh.

BeSi25 Clinobarylite $BaBe_2Si_2O_7$

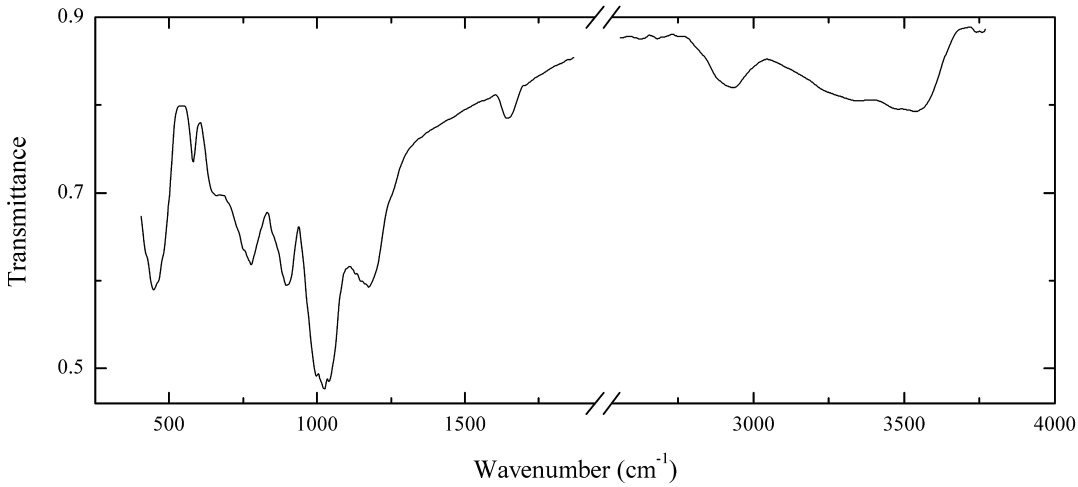


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Radial aggregate of colourless split elongated platy crystals from the association with natrolite, aegirine, microcline, catapleiite, fluorapatite, titanite, strontianite, annite, astrophyllite, lorenzenite and calcite. Holotype sample. The crystal structure is solved. Monoclinic, space group *Pm*, $a = 11.618(3)$, $b = 4.904(1)$, $c = 4.655(1)$ Å, $\beta = 89.94(2)°$. Optically biaxial (+), $\alpha = 1.698(3)$, $\beta = 1.700(3)$, $\gamma = 1.705(5)$. $D_{calc} = 4.05$ g/cm^3, $D_{meas} = 3.97(7)$ g/cm^3. The empirical formula is $Ba_{1.03}Be_{1.97}Si_{2.00}O_{7.00}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.389 (84), 3.249 (45), 3.043 (40), 2.926 (55), 2.458 (100), 2.335 (48).

Wavenumbers (cm^{-1}): 1035sh, 998s, 959s, 935sh, 915s, 790sh, 762s, 709s, 620, 549, 517, 495, 466s, 436.

BeSi26 Chiavennite $CaMn[Be_2Si_5O_{13}(OH)_2]·2H_2O$

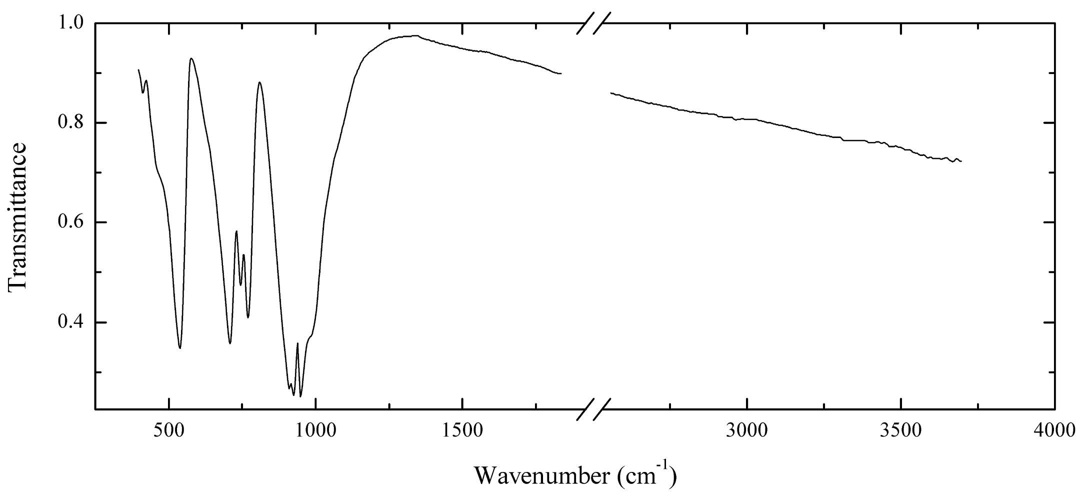


Locality: Tvedalen, Larvik, Vestfold Co., Norway.

Description: Brownish spherulites. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Na_{0.08}Ca_{0.82})(Mn_{0.66}Fe_{0.28}Mg_{0.04})[Be_2(Si_{4.55}Al_{0.45})(O,OH)_{15}]·nH_2O$. Contaminated by an organic substance (the bands at 2,930 and 2,855 cm^{-1}).

Wavenumbers (cm^{-1}): 3580, 3495, 3360, 3260w, 2930w, 2855w, 1640w, 1174, 1040sh, 1011s, 1000sh, 898, 776, 655, 579w, 470sh, 458, 440sh.

BeSi27 Danalite $Fe^{2+}{}_4Be_3(SiO_4)_3S$

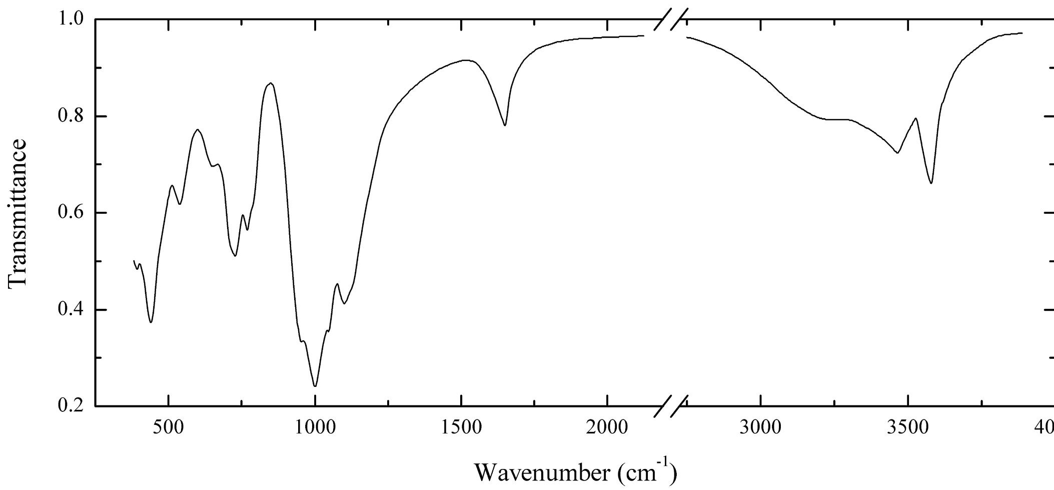


Locality: Lupikko deposit, near Pitkäranta, Ladoga lake, Karelia, Russia.

Description: Dark red grain in skarn. The empirical formula is (electron microprobe) $Mn_{2.9}Zn_{0.6}Mn_{0.5}Be_3Si_{3.0}O_{12.0}S_{1.0}$.

Wavenumbers (cm^{-1}): 985sh, 948s, 923s, 909s, 771, 747, 711, 538s, 465sh, 411w.

BeSi28 Lovdarite $Na_{13}K_4(Be_8AlSi_{27}O_{72})\cdot 20H_2O$

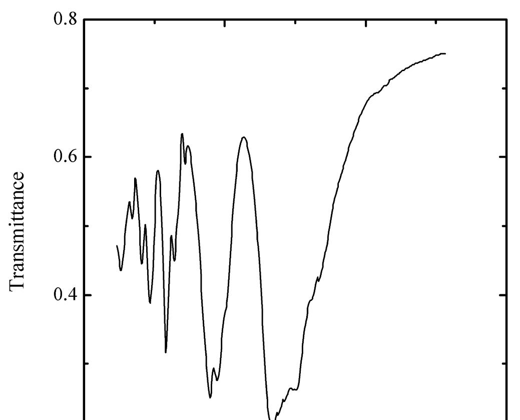


Locality: Yubileynaya pegmatite, Karnasurt Mt., Lovozero alkaline pluton, Kola peninsula, Murnansk region, Russia (type locality).

Description: White fine-grained aggregate. Pseudomorph after chkalovite crystal. Associated minerals are natrolite, mountainite, raite, aegirine and magnesio-arfvedsonite. Identified by IR spectrum.

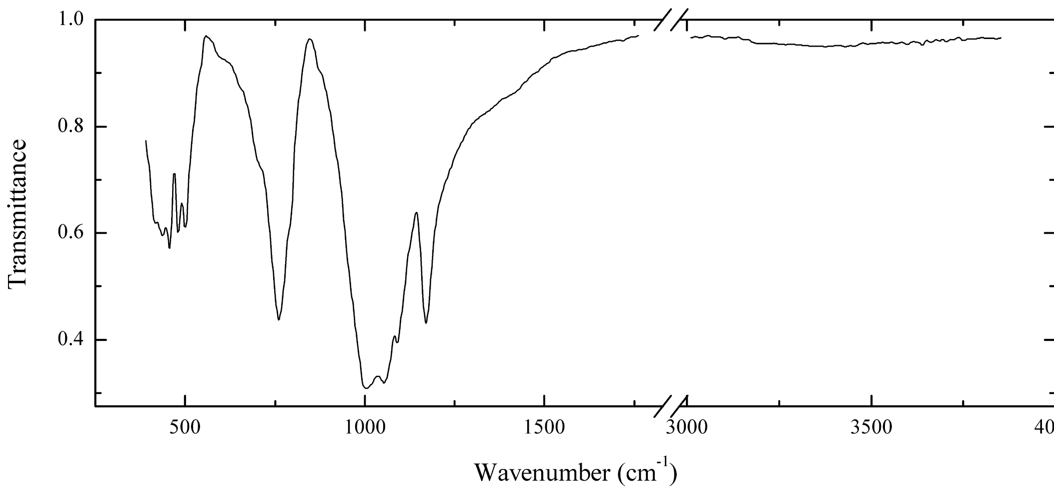
Wavenumbers (cm^{-1}): 3570, 3460, 3230, 1650, 1130sh, 1108, 1045s, 1000s, 956s, 790sh, 772, 729, 655, 535, 439s, 408.

BeSi29 Liberite $Li_2Be(SiO_4)$



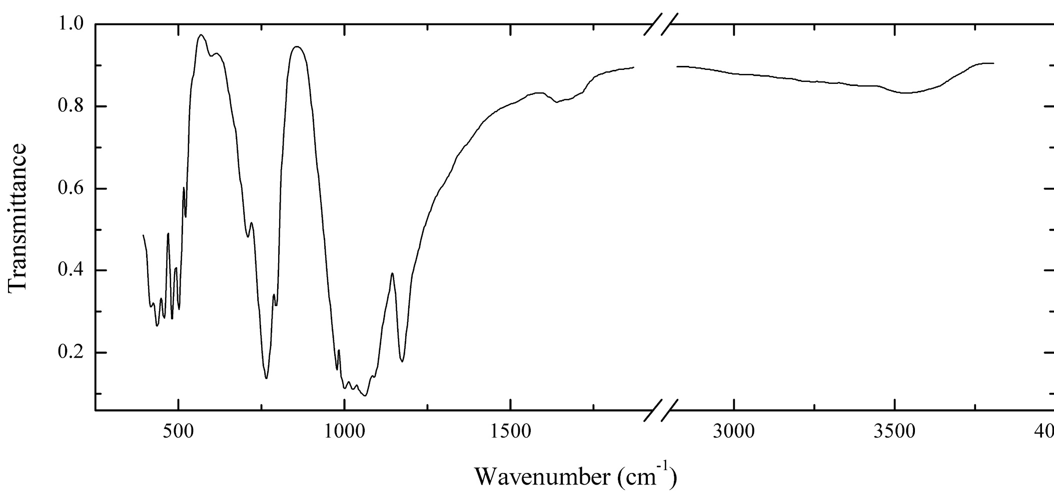
Locality: Hsianghua ridge, Linwu Co., Hunan province, China.
Description: Brown granular aggregate. Identified by IR spectrum and powder X-ray diffraction pattern. Contains admixture of natrolite (the bands at 3,533, 3,350, 3,250, 1,637, 998 and 985 cm^{-1}).
Wavenumbers (cm^{-1}): 1084, 1055sh, 963s, 941s, 919s, 860sh, 755sh, 723s, 697s, 607w, 580sh, 539, 482, 453, 423w, 378.

BeSi30 Telyushenkoite $CsNa_6Be_2(Si,Al,Zn)_{18}O_{39}F_2$



Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan.
Description: Colourless grains in pegmatite. Associated minerals are reedmergnerite and hyalotekite. The empirical formula is (electron microprobe) $Cs_{0.7}K_{0.2}Na_{6.3}Be_2Si_{15.3}Al_{2.5}Zn_{0.2}O_{39.3}F_{1.7}$.
Wavenumbers (cm^{-1}): 1173, 1094s, 1060s, 1020sh, 1004s, 790sh, 764, 710sh, 515sh, 500, 480, 457, 436, 417, 405sh.

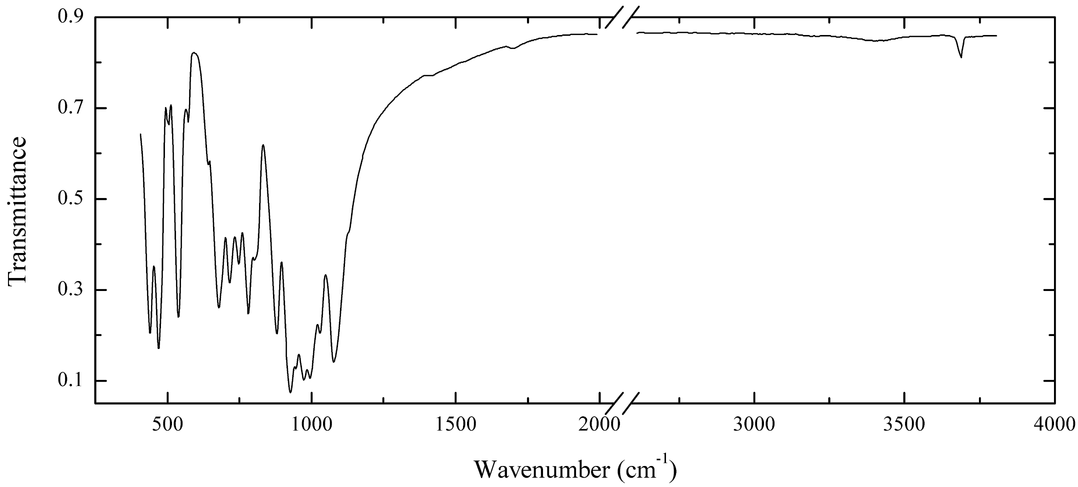
BeSi31 Leifite $NaNa_6Be_2Al_3Si_{15}O_{39}F_2$



Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White radial aggregate. The empirical formula is (electron microprobe) $K_{0.2}Na_{6.4}Be_2Si_{15.8}Al_{2.1}Zn_{0.1}O_{39.0}$ $(F_{1.7}O_{0.3})\cdot nH_2O$.

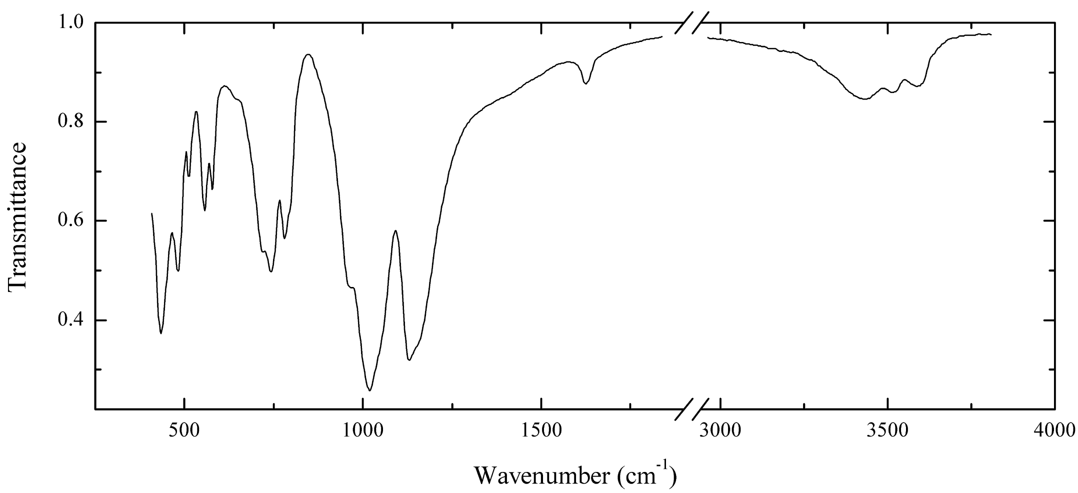
Wavenumbers (cm^{-1}): 3535w, 1700sh, 1645w, 1173s, 1090s, 1060s, 1040sh, 1023s, 1001s, 977s, 794, 763s, 709, 598w, 523, 502, 480, 458, 438, 417.

BeSi32 Leucophanite $NaCaBeSi_2O_6(F,OH)$



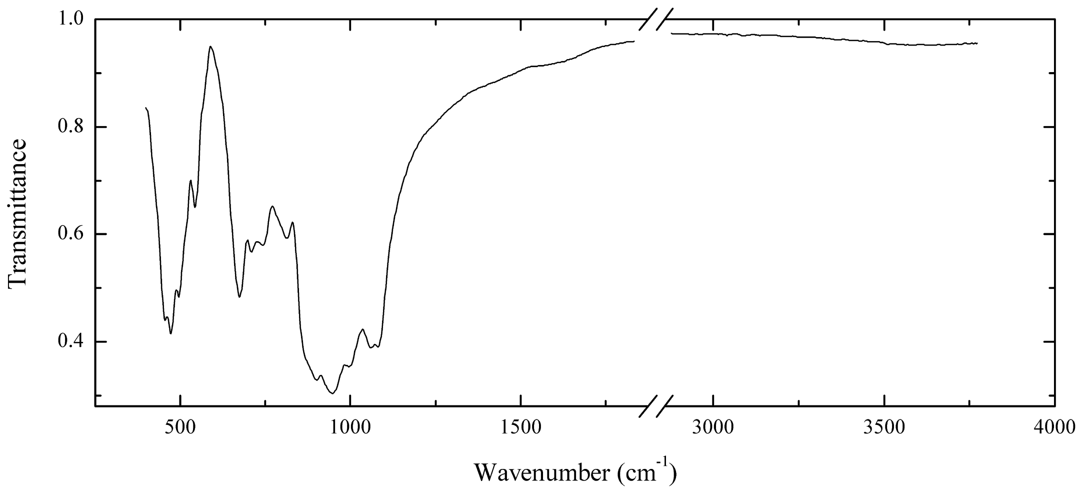
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless platy crystal from the association with natrolite, microcline and fluorapatite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3655w, 1690w, 1415w, 1120sh, 1078s, 1030, 994s, 973s, 947s, 928s, 881, 803, 783, 749, 717, 679, 642w, 575w, 538, 503w, 468s, 440.

BeSi33 Milarite $KCa_2AlBe_2Si_{12}O_{30}\cdot0.5H_2O$



Locality: Ermakovskoe Be deposit, Republic of Buryatia, Transbaikal area, Siberia, Russia.
Description: Greenish prismatic crystal from the association with bavenite and fluorite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3585w, 3505w, 3420, 1625w, 1165sh, 1132s, 1021s, 966, 796sh, 783, 746, 724, 580, 560, 513, 483, 435s.

BeSi34 Meliphanite $(Ca,Na)_2Be(Si,Al)_2(O,OH,F)_7$

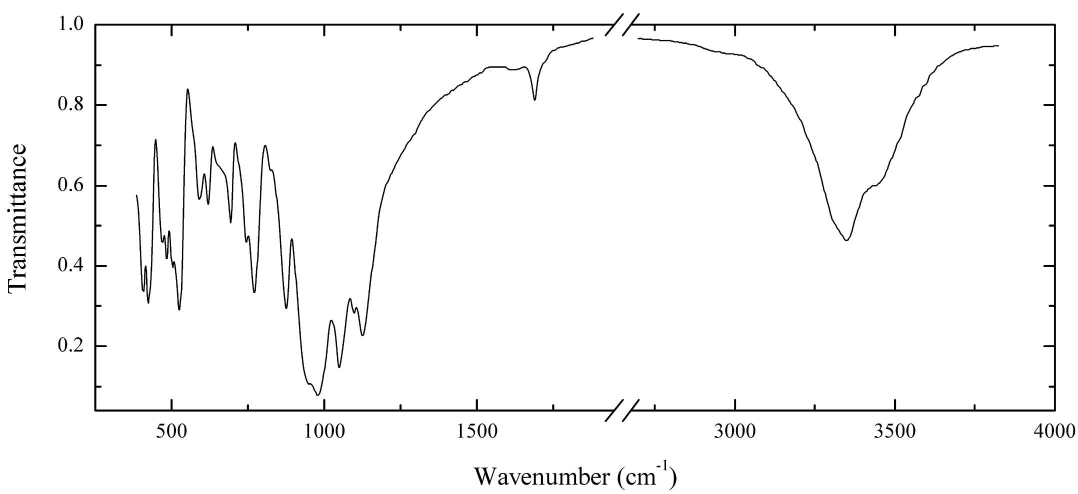


Locality: Sakharyok alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: Greenish-yellow transparent platy crystal from a pegmatoid rock hosted by fenite, from the association with biotite, natrolite, fluorite and britholite-(Ce). Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $Ca_{1.17}Na_{0.69}Y_{0.01}BeSi_{1.79}Al_{0.25}(O,OH)_xF_{0.52}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1081s, 1062s, 999s, 946s, 897s, 875sh, 815, 805sh, 740, 704, 673, 538, 510sh, 491, 469s, 450.

BeSi35 Sørensenite $Na_4Sn^{4+}Be_2(Si_3O_9)_2 \cdot 2H_2O$

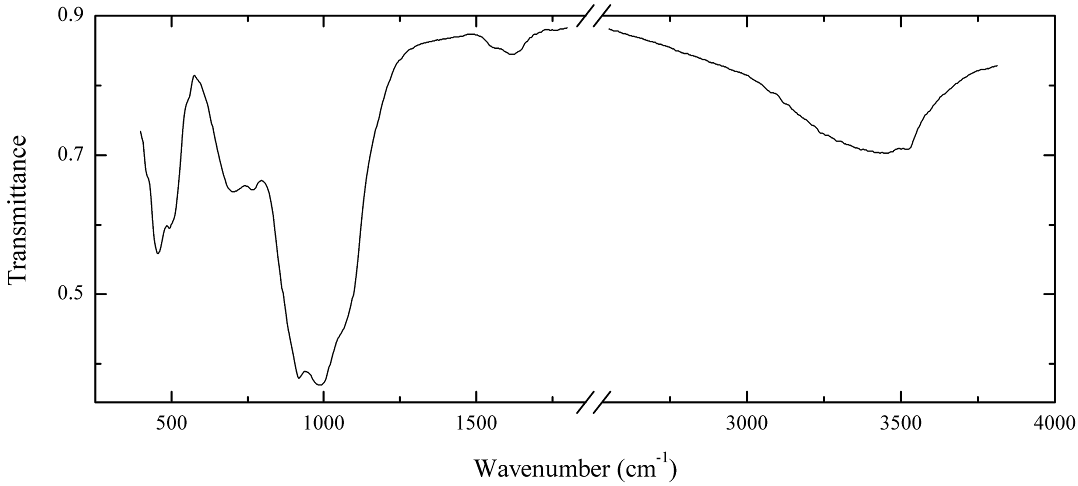


Locality: Kvanefjeld, Ilímaussaq alkaline complex, Narsaq municipality, South Greenland (type locality).

Description: Cream-coloured lath-shaped crystal from the association with analcime, microcline, aegirine, fluorapatite and chkalovite. The empirical formula is (electron microprobe) $(Na_{3.63}Ca_{0.08}K_{0.06})(Sn_{0.98}Nb_{0.04}Ti_{0.03})Be_2\ (Si_{3.00}O_9) \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3415sh, 3330s, 1686w, 1615w, 1124s, 1098s, 1048s, 976s, 948s, 873, 826w, 770, 745, 693, 660sh, 619, 590, 523s, 500, 480, 468, 425sh, 419, 403.

BeSi36 **Semenovite-(Ce)** $Na_{0-2}(Na,Ca)_8(Fe,Mn)(Ce,La)_2(Si,Be)_{20}(O,OH,F)_{48}$

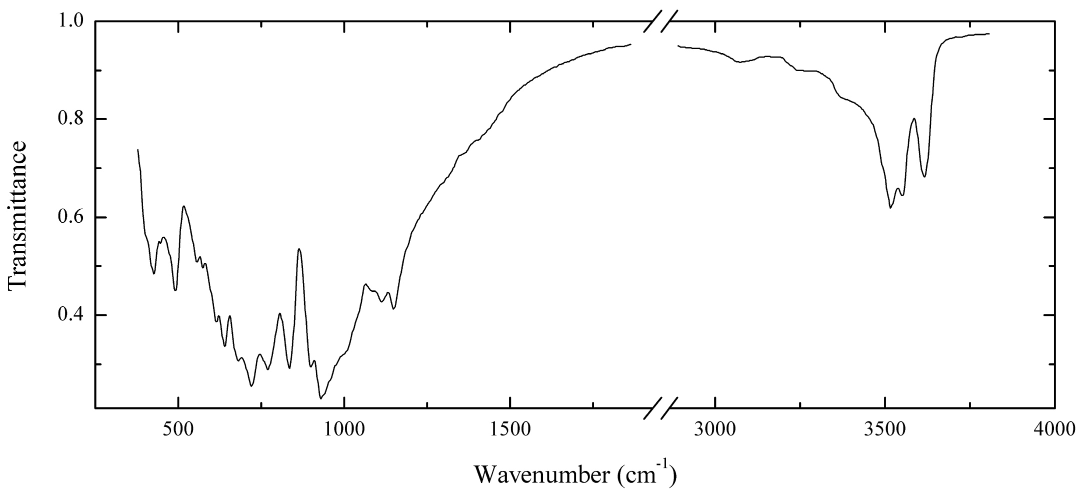


Locality: Taseq slope, Taseq area, Ilímaussaq alkaline complex, Narsaq municipality, South Greenland (type locality).

Description: Light brown crystals from the association with albite, natrolite, aegirine, polylithionite and epididymite. Visually identified by O.V. Petersen.

Wavenumbers (cm^{-1}): 3520, 3455, 1627w, 1580sh, 1080sh, 987s, 929s, 900sh, 770, 700, 520sh, 495, 456, 405sh.

BeSi37 **Sphaerobertrandite** $Be_3SiO_4(OH)_2$

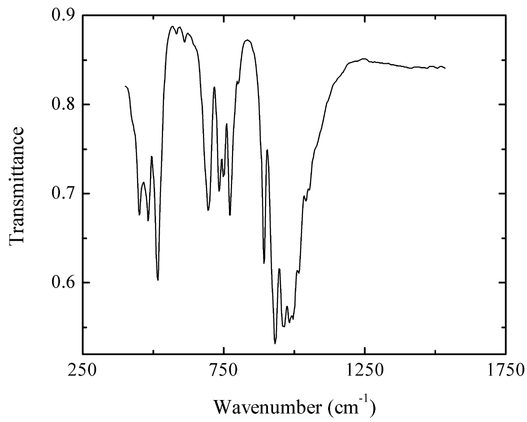


Locality: Sengischorr Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (neotype locality).

Description: Yellowish tabular, prismatic crystals from the association with epididymite, aegirine, natrolite and mangan-neptunite. Neotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/c$; $a = 5.081(3)$, $b = 4.639(1)$, $c = 17.664(9)$ Å, $\beta = 106.09(5)°$. Optically biaxial (−), $\alpha = 1.597(3)$, $\beta = 1.607(4)$, $\gamma = 1.616(3)$. $D_{calc} = 2.52$ g/cm^3, $D_{meas} = 2.50$ g/cm^3. The empirical formula is $Be_{2.97}Si_{1.03}O_{4.06}(OH)_{1.94}{\cdot}0.155H_2O$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 4.885 (90), 4.236 (62), 3.161 (100), 2.836 (70), 2.538 (55), 2.318 (90), 2.174 (55).

Wavenumbers (cm^{-1}): 3605, 3540, 3505, 3370sh, 3250w, 3060w, 1150, 1115, 995sh, 933s, 900s, 835s, 768s, 721s, 680s, 639, 612, 573, 555, 491, 424.

BeSi38 Hsianghualite $Li_2Ca_3(Be_3Si_3O_{12})F_2$

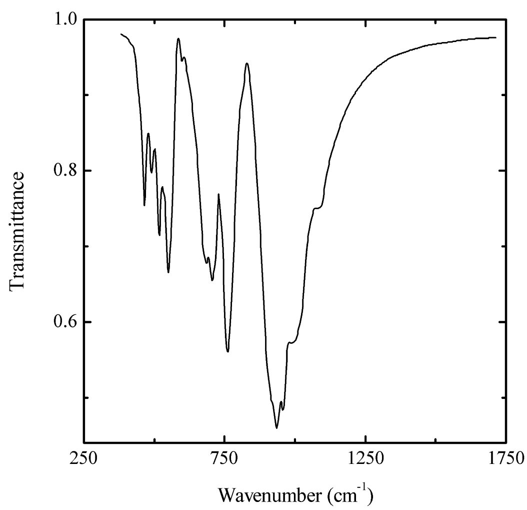


Locality: Hsianghua ridge, Linwu Co., Hunan province, China (type locality).

Description: White granular aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1057, 1047, 1018, 1000s, 984s, 933s, 920sh, 895s, 801w, 770, 747, 730, 693, 685sh, 606w, 576w, 508s, 478, 444.

BeSi39 Trimerite $CaMn^{2+}{}_2(Be_3Si_3O_{12})$

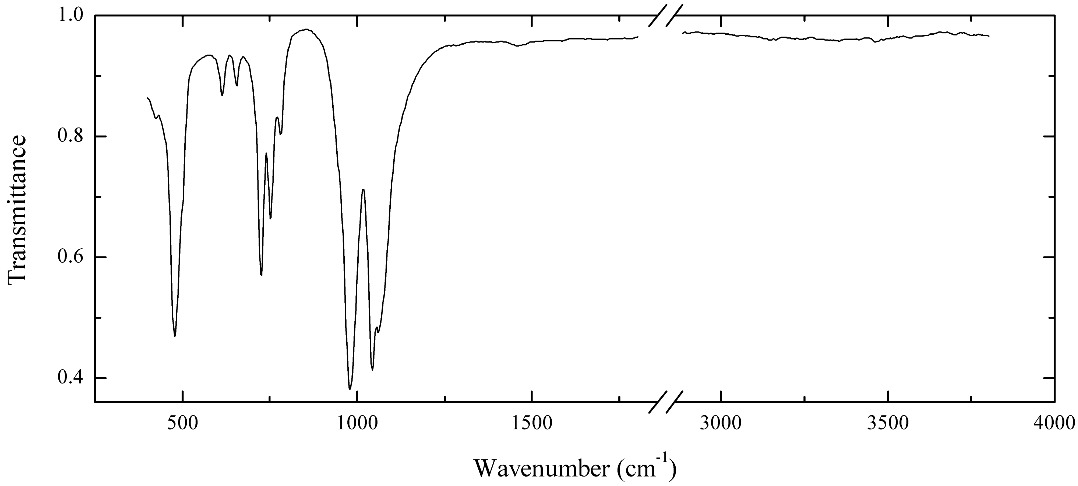


Locality: Harstigen mine, Pajsberg, Värmland, Sweden (type locality).

Description: Light brownish-pink crystals from skarn.

Wavenumbers (cm^{-1}): 1080, 989s, 950s, 927s, 910sh, 753s, 710sh, 697, 680, 596w, 555sh, 545, 529w, 513, 486, 463, 440sh.

BeSi40 **Tugtupite** $Na_4(BeAlSi_4O_{12})Cl$

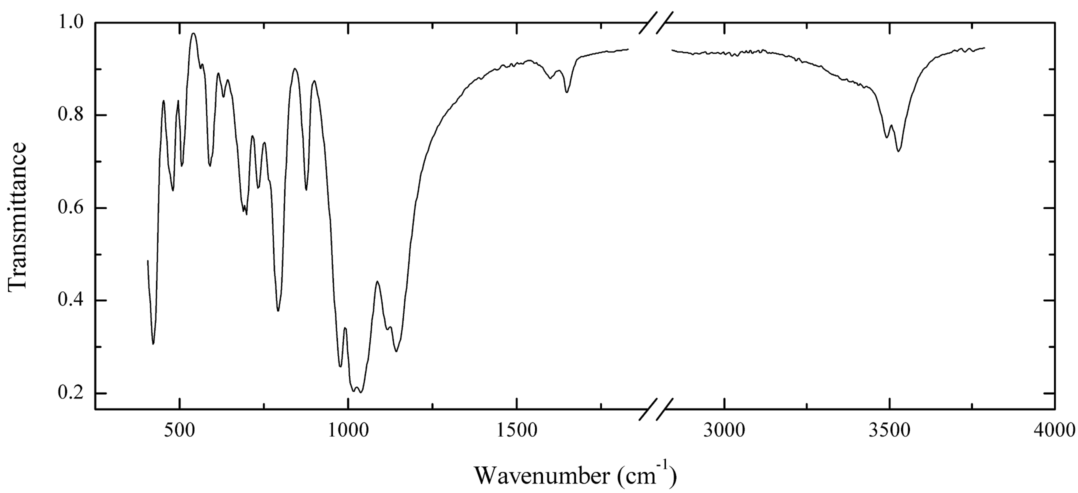


Locality: Tugtup Agtâkorfia, Ilímaussaq alkaline complex, Narsaq municipality, South Greenland (type locality).

Description: Carmine crystals from the association with chkalovite, albite, analcime, aegirine and natrolite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1063s, 1046s, 982s, 950sh, 782, 752, 725, 651w, 614w, 495sh, 473s.

BeSi41 **Eudidymite** $Na_2Be_2Si_6O_{15}{\cdot}H_2O$

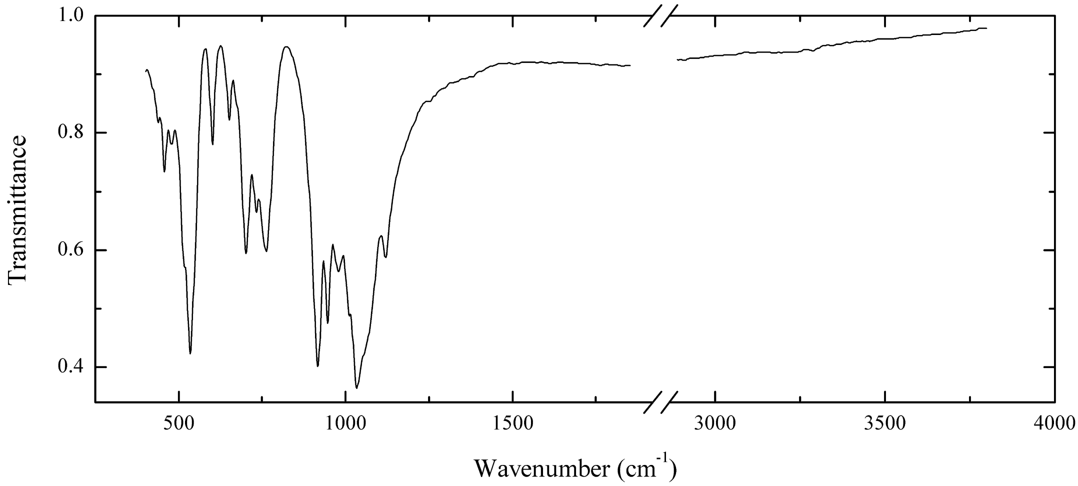


Locality: Tavayok river, Sengischorr Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless lamellar crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3538, 3500, 1652w, 1601w, 1147s, 1119s, 1041s, 1019s, 980s, 880, 794, 767w, 635, 699, 689, 628w, 595, 585, 557w, 511w, 502, 476, 466, 417s.

BeSi42 Chkalovite $Na_2BeSi_2O_6$

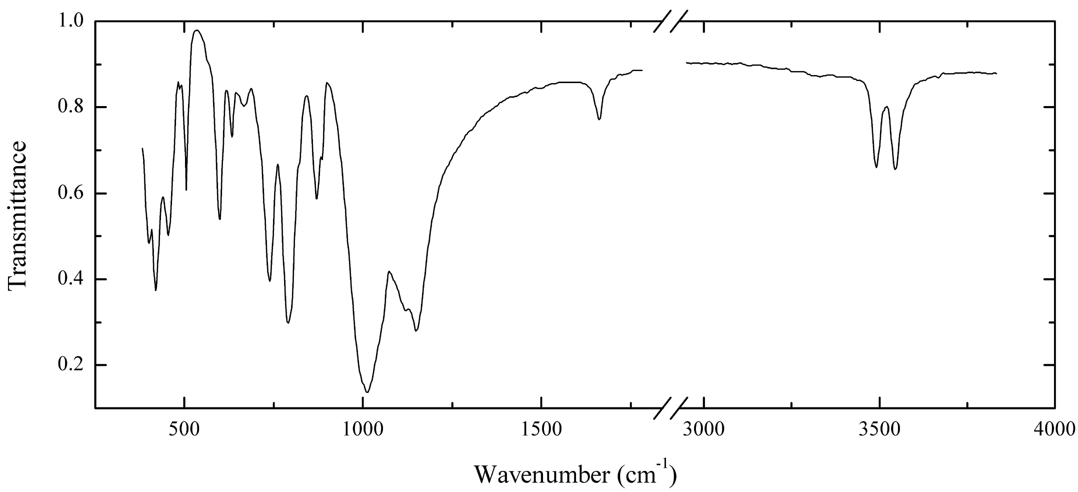


Locality: Yubileynaya pegmatite, Karnasurt Mt., Lovozero alkaline pluton, Kola peninsula, Murnansk region, Russia.

Description: Colourless prismatic crystal from the association with lovdarite, natrolite, mountainite, raite, aegirine and magnesio-arfvedsonite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1121, 1055sh, 1034s, 1010s, 978, 946s, 917s, 764, 733, 703, 652, 602, 550sh, 534s, 519, 483, 459, 440w.

BeSi43 Epididymite $Na_2Be_2Si_6O_{15}{\cdot}H_2O$

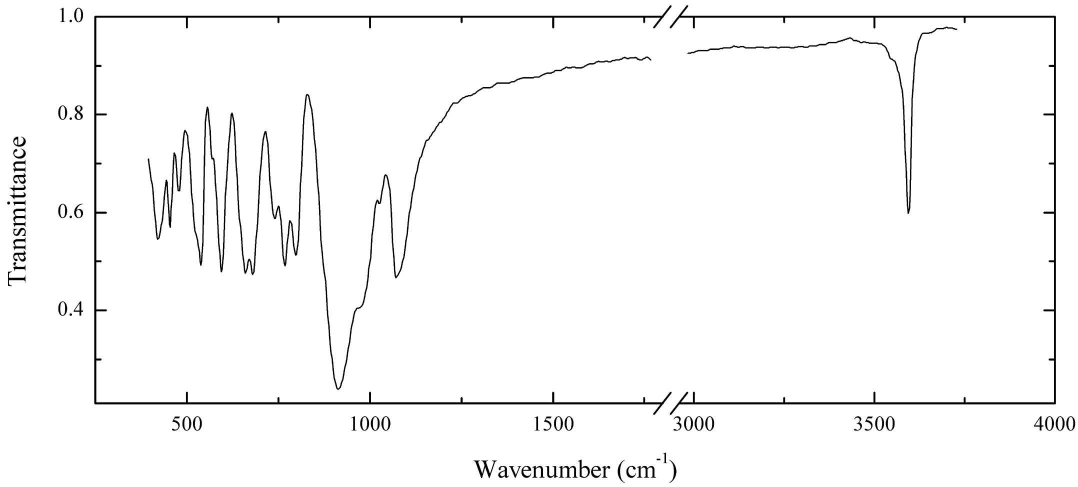


Locality: Malyi Mannepakhk Mt, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White crystals from the association with natrolite and mangan-neptunite. Identified by IR spectrum.

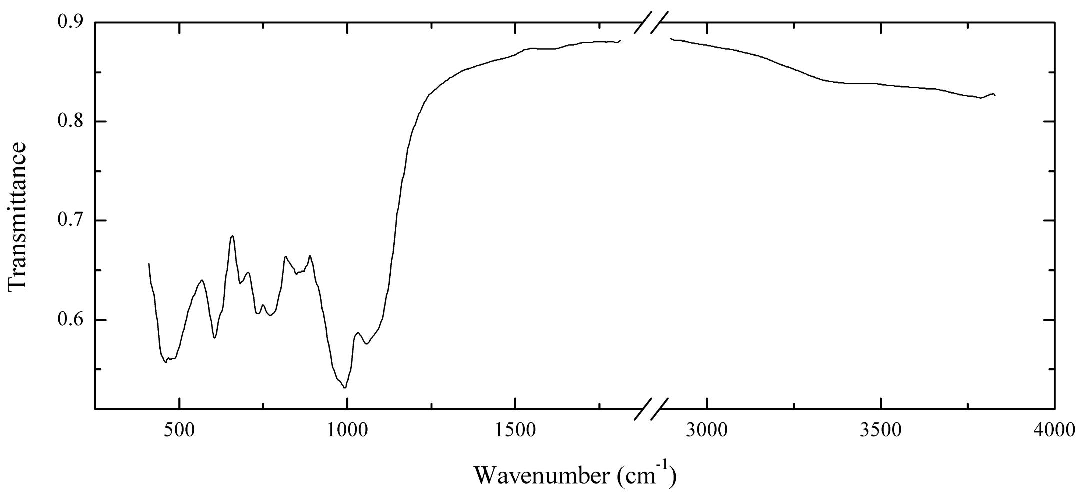
Wavenumbers (cm^{-1}): 3525, 3470, 1663w, 1151s, 1119s, 1013s, 886w, 871, 823w, 792s, 739, 670w, 634w, 599, 505, 454, 420s, 399.

BeSi44 Euclase $BeAlSiO_4(OH)$



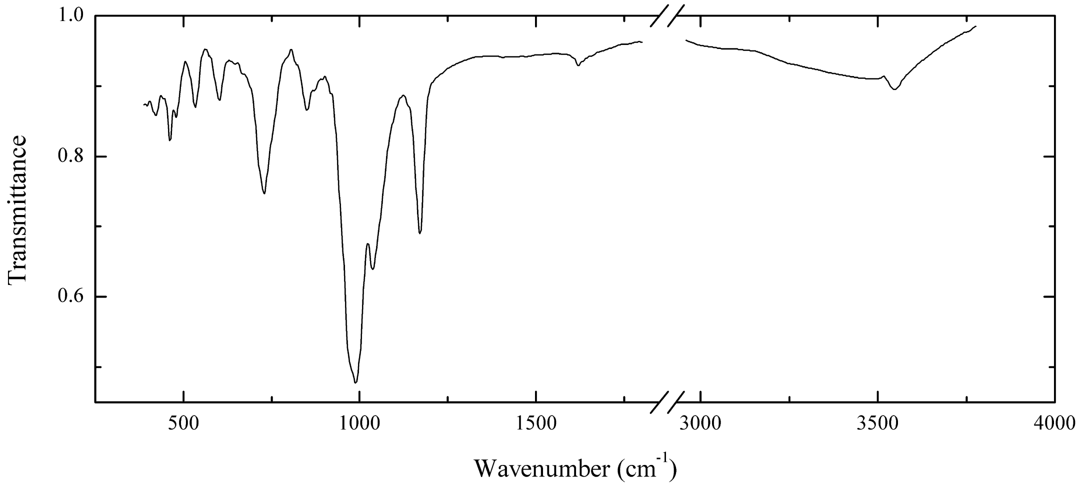
Locality: Cheremshanskoe (Malyshevskoe) Be deposit, Tokovaya river, Middle Urals, Russia.
Description: Colourless crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3580, 3530sh, 1074, 975sh, 915s, 797, 767, 739, 680, 660, 615sh, 594, 568w, 537, 525sh, 477, 452, 420.

BeSi45 Khmaralite $Mg_7Al_9(Be_2Al_5Si_5O_{36})O_4$



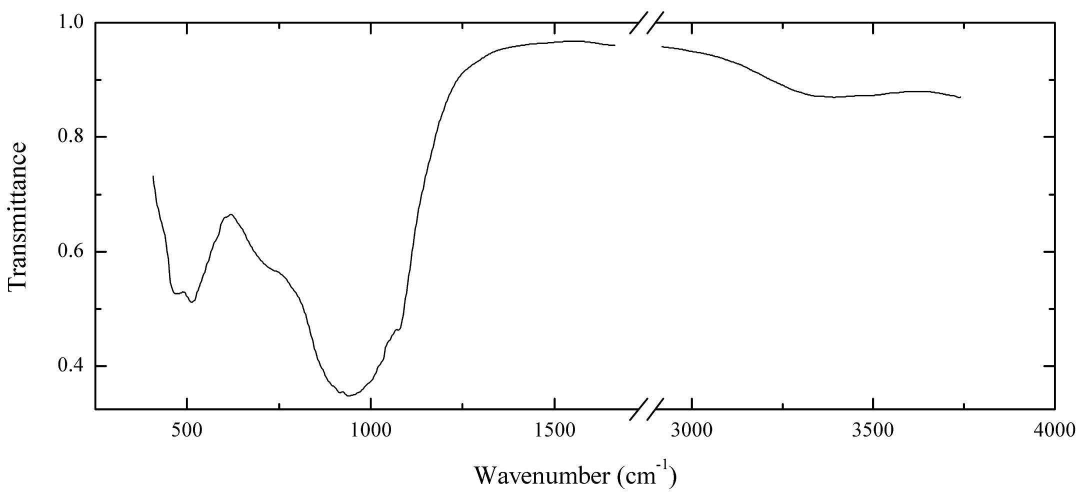
Locality: Khmara bay, Enderby Land, Antarctica (type locality).
Description: Dark greenish-grey grains from metamorphozed pegmatite. Confirmed by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1060s, 993s, 980sh, 864, 775, 733, 690, 625sh, 607s, 470s.

BeSi46 **Roggianite** $Ca_2BeAl_2Si_4O_{13}(OH)_2{\cdot}2.5H_2O$



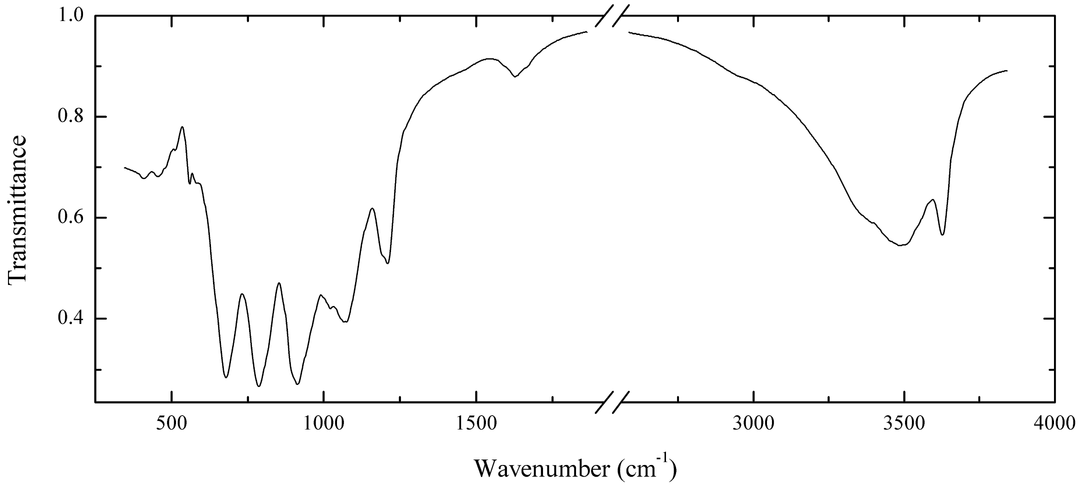
Locality: Alpe Rosso, Val Vigezzo, Novara, Italy (type locality).
Description: White radial-fibrous aggregate from marble. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3525, 3450sh, 1630w, 1173s, 1040s, 991s, 980sh, 851, 729, 604, 534, 479, 462, 421.

BeSi47 **Gadolinite-(Y)** $Y_2Fe^{2+}Be_2Si_2O_{10}$



Locality: Åskagen quarry, at the former mining settlement Torskebäcken, near Filipstad, Värmlands län, Sweden.
Description: Black grains from pegmatite, from the association with allanite-(Y) and iimoriite-(Y). Metamict. The empirical formula is (electron microprobe) $Y_{1.24}Nd_{0.20}Sm_{0.14}Gd_{0.09}Dy_{0.08}Ce_{0.05}Yb_{0.05}Ca_{0.03}Pr_{0.02}La_{0.01}Lu_{0.01}Er_{0.01}U_{0.01}Th_{0.01}(Fe_{0.67}Mg_{0.10}Mn_{0.02})$ $Be_2(Si_{2.00}O_8)(O,OH)_2$.
Wavenumbers (cm^{-1}): 3360w, 1075, 943s, 747sh, 514, 472.

BeSi48 Beryllite $Be_3SiO_4(OH)_2{\cdot}H_2O$

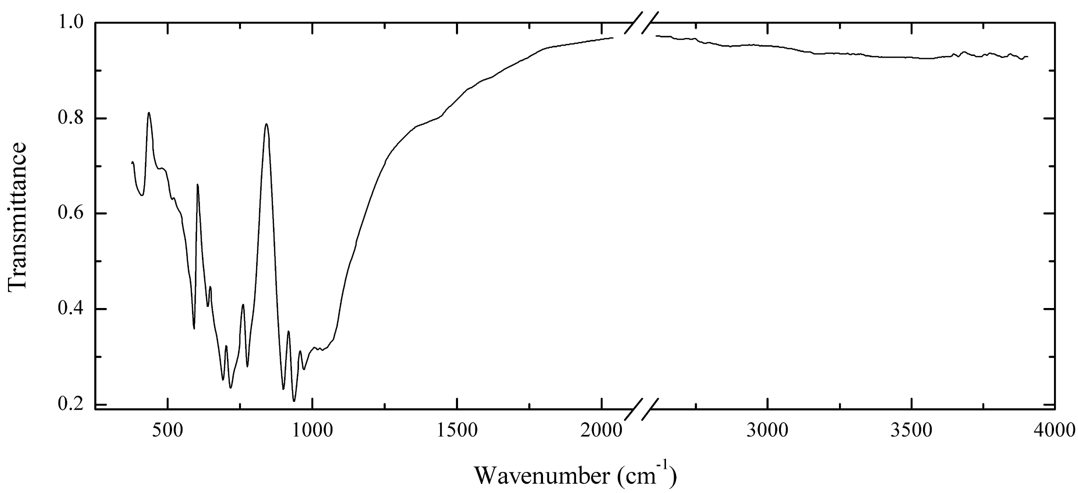


Locality: Kaskasnyunachorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White cellular pseudomorph after an unknown mineral. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3620, 3480, 3370sh, 1630w, 1209, 1196, 1071s, 1025, 914s, 900sh, 785s, 674s, 585w, 560w, 500w, 468w, 406w.

BeSi49 Phenakite Be_2SiO_4

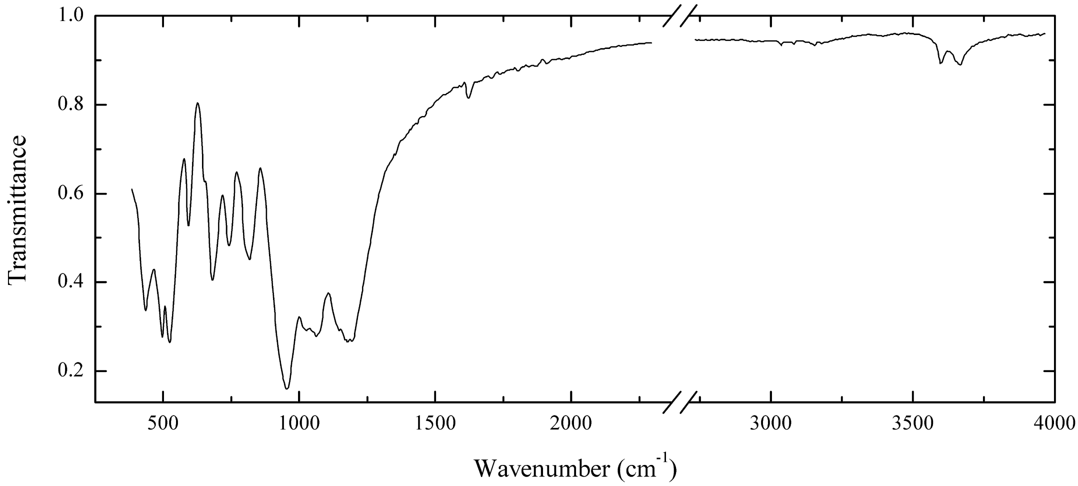


Locality: Wheeler Peak mine, Lincoln district, White Pine Co., Nevada, USA.

Description: Colourless crystal. Identified by IR spectrum.

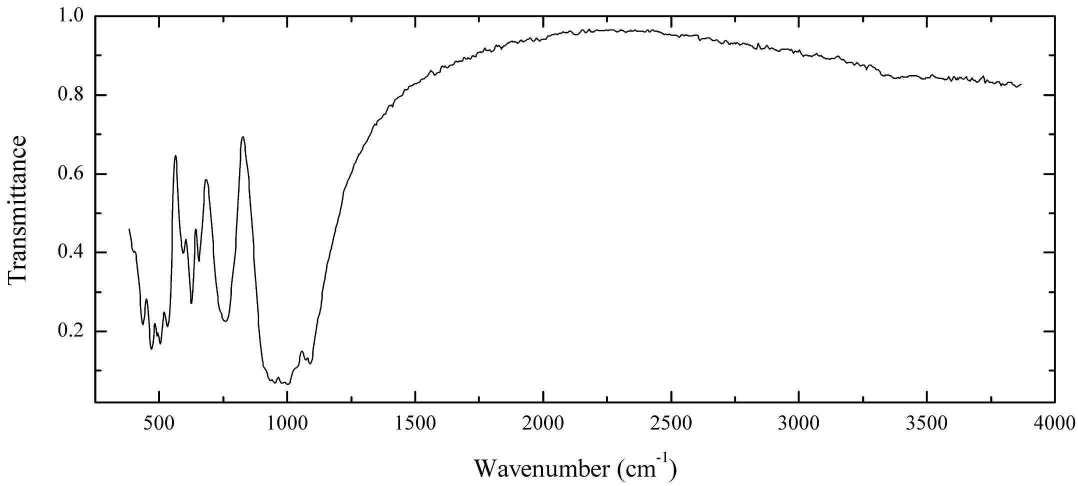
Wavenumbers (cm^{-1}): 1035, 972s, 936s, 902s, 795sh, 776s, 740sh, 721s, 693s, 643, 593, 525sh, 480w, 420w.

BeSi50 Beryl $Be_3Al_2Si_6O_{18}$



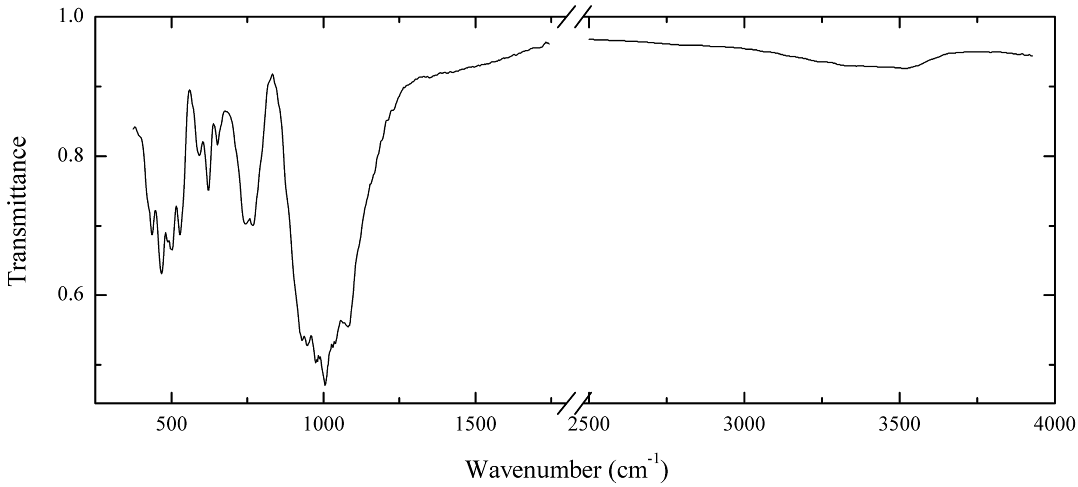
Locality: Mokrusha mine, Alabashka pegmatite field, Yuzhakovo village, Middle Urals, Russia.
Description: Pink tabular crystal from the association with lepidolite and albite. Identified by IR spectrum. High-alkaline variety. The empirical formula is $(Cs_{0.33}Na_{0.31}Rb_{0.01})(Be_{2.57}Li_{0.47})Al_{1.92}Si_{6.00}O_{17.985}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3660w, 3590w, 1626w, 1195sh, 1180s, 1150sh, 1068s, 1023s, 954s, 818, 743, 680, 651w, 594, 521s, 495s, 435.

BeSi51 Odintsovite $K_2Na_4Ca_3Ti_2Be_4Si_{12}O_{38}$



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Pinkish-brown grains from alkaline pegmatite, from the association with microcline, sodalite, aegirine and fluorapatite. Investigated by A.P. Khomyakov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3350w, 1120sh, 1087s, 1065s, 1030sh, 1003s, 977s, 950s, 930s, 910sh, 785sh, 759, 740sh, 665sh, 653, 624, 594, 530, 501s, 488, 467s, 434, 402.

BeSi52 Odintsovite $K_2Na_4Ca_3Ti_2Be_4Si_{12}O_{38}$

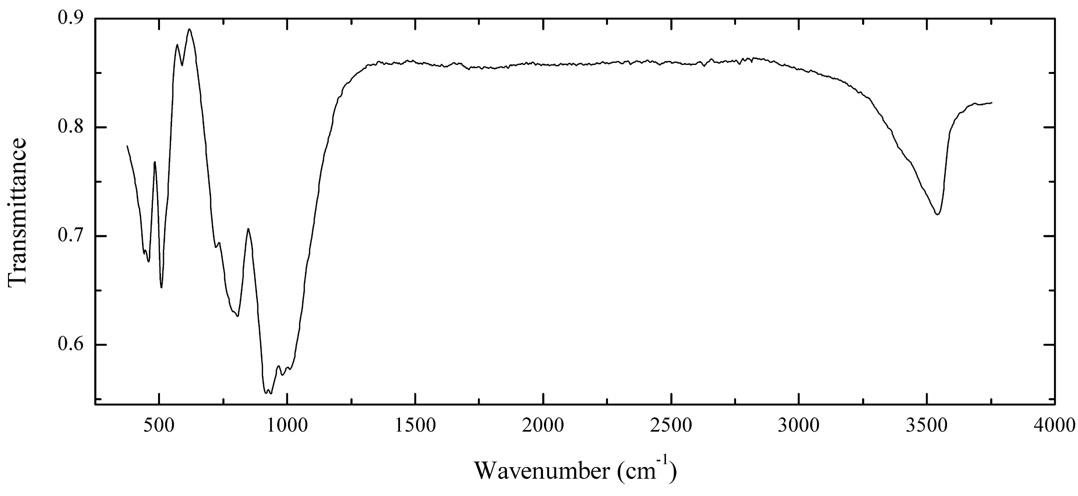


Locality: Malyi Murun (Malomurunskii) alkaline massif, Aldan shield, Sakha Republic, Siberia, Russia.

Description: Brownish-pink grains from alkaline syenite pegmatite. Associated minerals are aegirine, barytolamprophyllite, strontianite, titanite, potash feldspar and wadeite. Identified by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 1080s, 1030sh, 1004s, 977s, 949s, 929s, 770, 745, 651w, 624, 592, 530, 501, 490sh, 468s, 435, 420sh.

BeSi53 Hingganite-(Y) $YBe(SiO_4)(OH)$

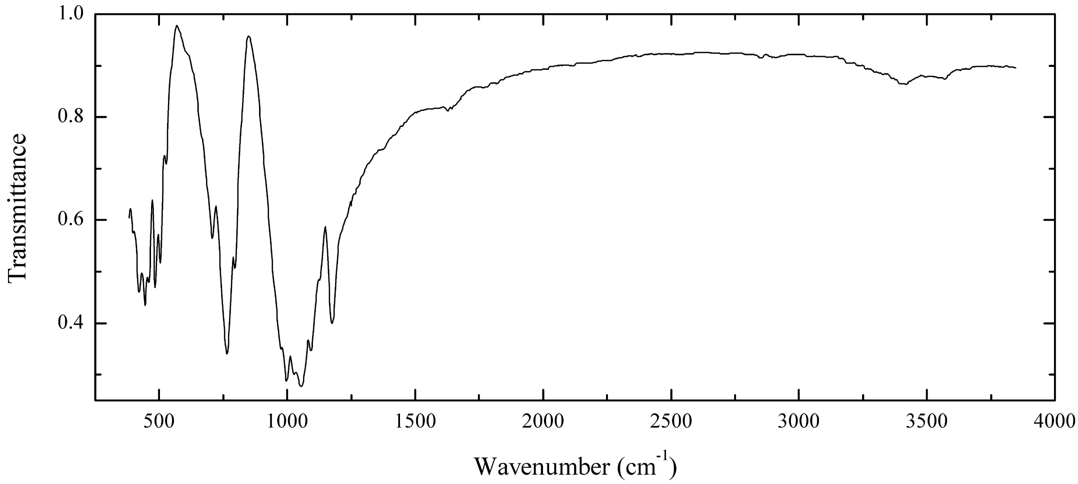


Locality: Ploskaya Mt., Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: White radial aggregate from the association with fluorite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3510, 1009s, 983s, 931s, 911s, 803, 780sh, 760sh, 718, 587w, 530sh, 506, 453, 439, 420sh.

BeSi55 Eirikite $KNa_6Be_2Al_3Si_{15}O_{39}F_2$

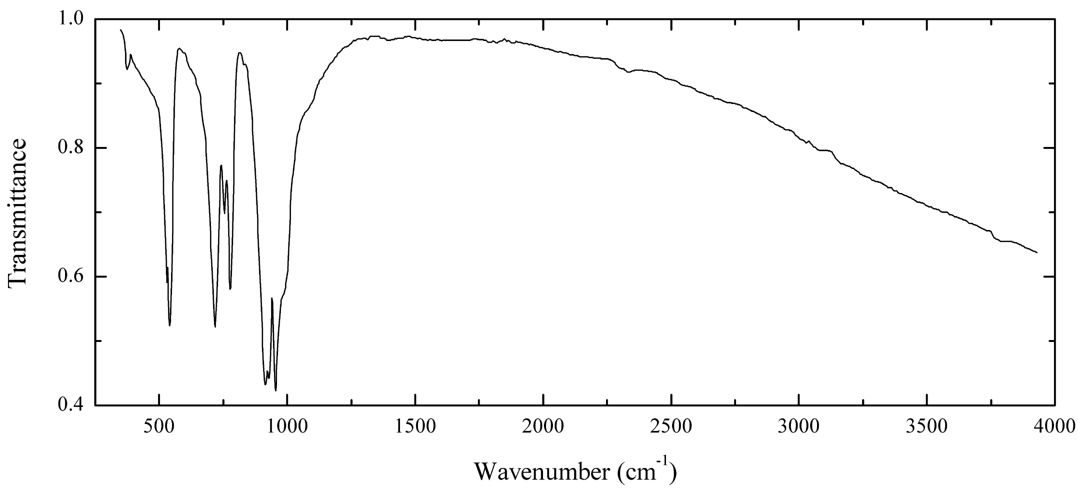


Locality: Vesle Arøya island, Langesundsfjord district, Larvik, Vestfold, Norway (type locality).

Description: White clusters of prismatic crystals from the association with zircon, aegirine, albite and eudialyte. The empirical formula is (electron microprobe) $K_{0.7}Na_{6.0}Be_2Si_{15.3}Al_{2.7}O_{39}F_{1.8}(O,OH)_{0.2}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3550w, 3395w, 1630w, 1173, 1126, 1094s, 1057s, 1025s, 999s, 976s, 795, 764s, 709, 665sh, 600sh, 545sh, 525w, 502, 481, 458, 440, 418.

BeSi56 Genthelvite $Zn_4Be_3(SiO_4)_3S$

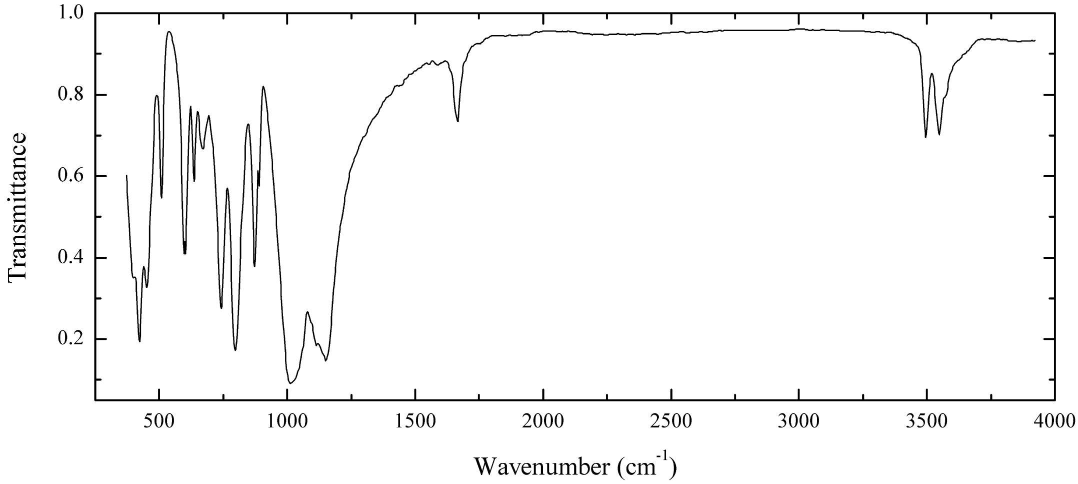


Locality: Tavastila, Kymi, Finland.

Description: Yellow tetrahedral crystals from the association with smithsonite and mica. The empirical formula is (electron microprobe) $Zn_{2.33}Mn_{0.79}Fe_{0.77}Al_{0.10}Be_3Si_{2.99}O_{12}S_{1.02}$.

Wavenumbers (cm^{-1}): 980sh, 952s, 928s, 914s, 776, 753, 716, 700sh, 541, 529, 380w.

BeSi57 Epididymite $Na_2Be_2Si_6O_{15}·H_2O$

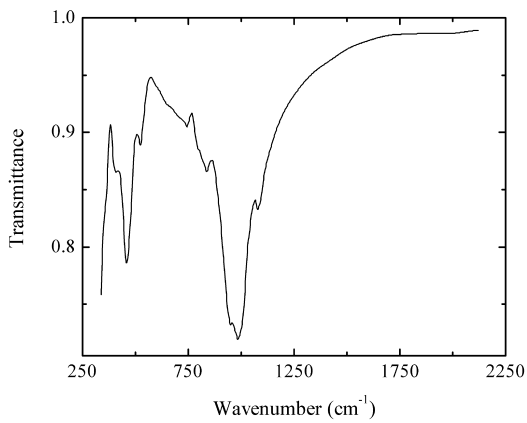


Locality: Shomiokitovoe pegmatite, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White fine-grained aggregate in hydrothermally altered pegmatite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3525, 3470, 1664w, 1151s, 1114s, 1014s, 886w, 872, 825sh, 794s, 741, 670w, 635w, 599, 507, 453, 422s, 400.

BeSi58 Høgtuvaite $(Ca,Na)_2(Fe^{2+},Fe^{3+},Ti)_6(Si,Be,Al)_6O_{20}$

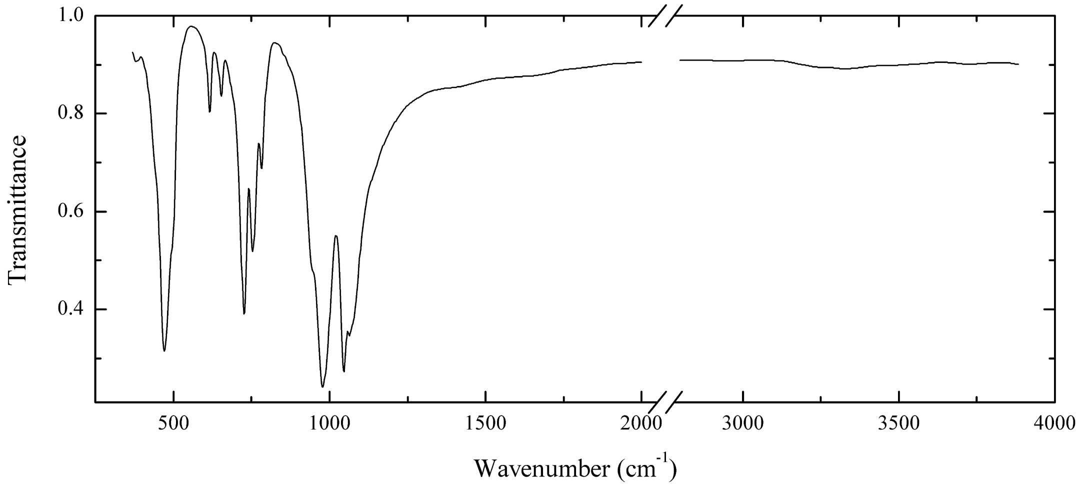


Locality: Near Høgtuva Mt. and Mo i Rama town, Nordland Co., Norway (type locality).

Description: Black grains from the association with amphibole and magnetite. The empirical formula is (electron microprobe) $(Ca_{1.94}Na_{0.17})(Fe_{5.38}Ti_{0.41}Mg_{0.13}Cr_{0.08})(Si_{4.37}Be_xAl_{0.72})O_{20}$.

Wavenumbers (cm^{-1}): 1083, 985s, 960s, 836, 744w, 518, 454, 410.

BeSi59 Tugtupite $Na_4(BeAlSi_4O_{12})Cl$

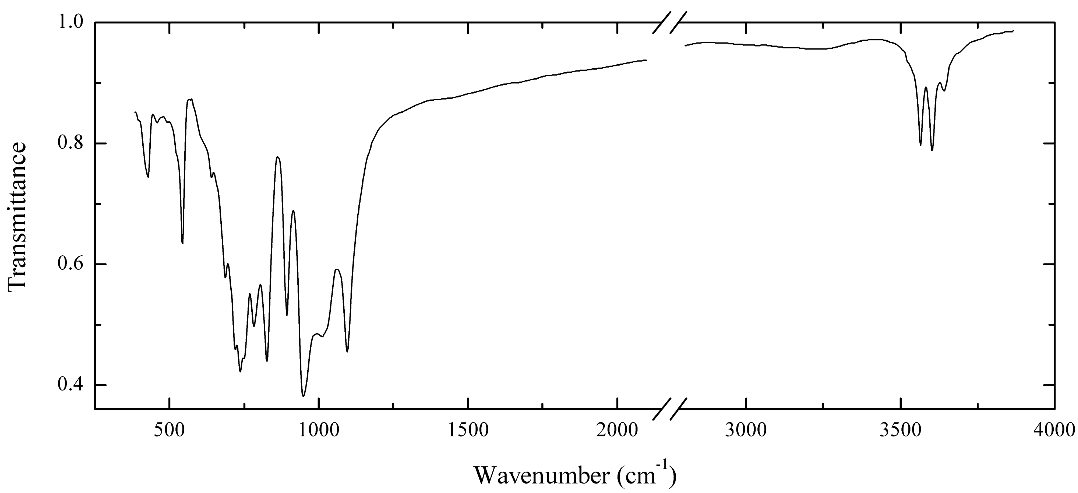


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light green rim around chkalovite crystal. Shows yellow fluorescence under LW UW radiation. Associated mineral is ussingite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3340w, 1685w, 1064s, 1045s, 979s, 945sh, 783, 754, 726s, 652, 615, 495sh, 472s.

BeSi60 Bertrandite $Be_4Si_2O_7(OH)_2$

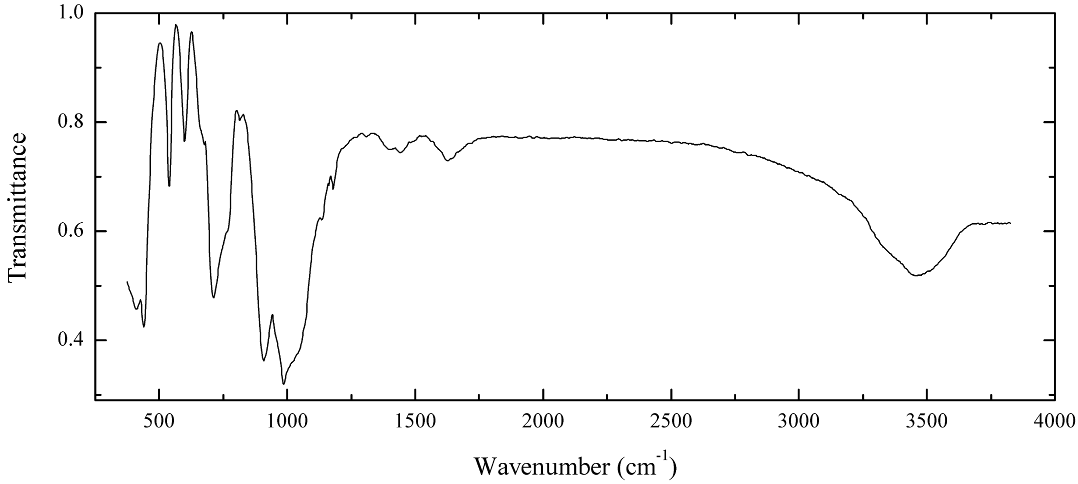


Locality: Tavayok river, Sengischorr Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Aggregate of pale yellow fibrous crystals from the association with epididymite and sphaerobertrandite. Identified by IR spectrum.

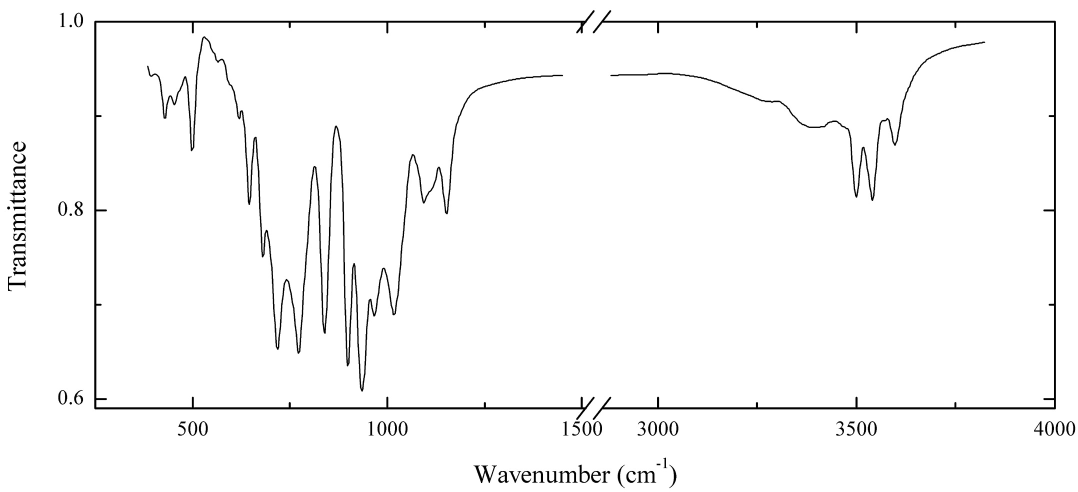
Wavenumbers (cm^{-1}): 3625w, 3585, 3547, 1095s, 1010, 945s, 892, 826s, 772, 748s, 736s, 717s, 688, 640w, 541, 525sh, 450w, 426.

BeSi61 Beryllosilicate BeSi61 $BaBe_2Si_2O_7 \cdot nH_2O$



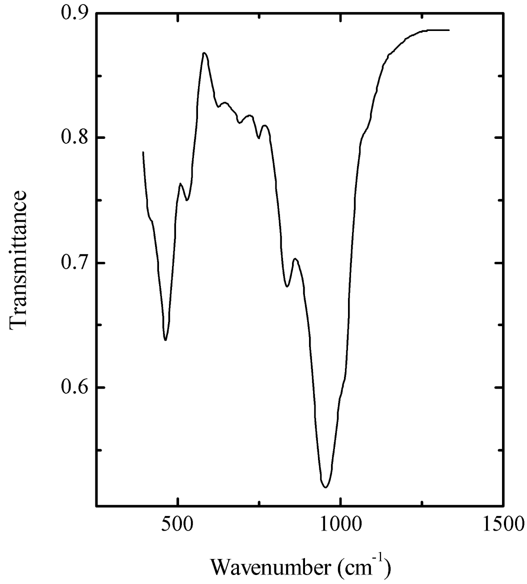
Locality: Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.
Description: White aggregate. Investigated by A.V. Voloshin. Needs further investigation.
Wavenumbers (cm^{-1}): 3500sh, 3445, 3330sh, 1625w, 1550sh, 1450w, 1390w, 1180w, 1142w, 1065sh, 1035sh, 990s, 955sh, 910s, 814w, 769, 750sh, 714, 676w, 660w, 588, 541, 448s, 417.

BeSi62 Sphaerobertrandite $Be_3SiO_4(OH)_2$



Locality: Sengischorr Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (neotype locality).
Description: White fine-grained aggregate from the association with epididymite, aegirine and natrolite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3600w, 3543, 3500, 3400w, 3280sh, 1155, 1115sh, 1095, 1016s, 966s, 935s, 899s, 839s, 773s, 718s, 679, 645, 618w, 499, 453w, 427w.

BeSi63 Makarochkinite $Ca_4(Fe^{2+}{}_8Fe^{3+}{}_2Ti_2)O_4(Si_8Be_2Al_2O_{36})$

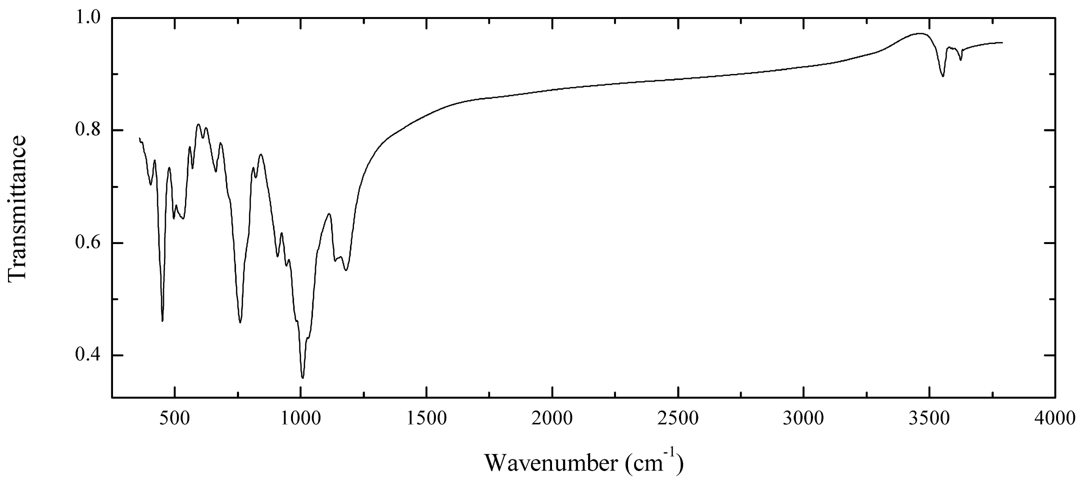


Locality: Lake Ishkul, Ilmeny (Il'menskie) Mts., South Urals, Russia (type locality).

Description: Black grain from the association with danalite, phenakite, titanite, potassian calcic amphiboles, biotite, ilmenite, magnetite, ferrocolumbite, fergusonite-(Y), and samarskite-(Y). Investigated by Yu.S. Kobyashev.

Wavenumbers (cm^{-1}): 1085sh, 1005sh, 951s, 840, 750, 694, 642w, 527, 462, 405sh.

BeSi64 Bohseite $Ca_4Be_3AlSi_9O_{25}(OH)_3$

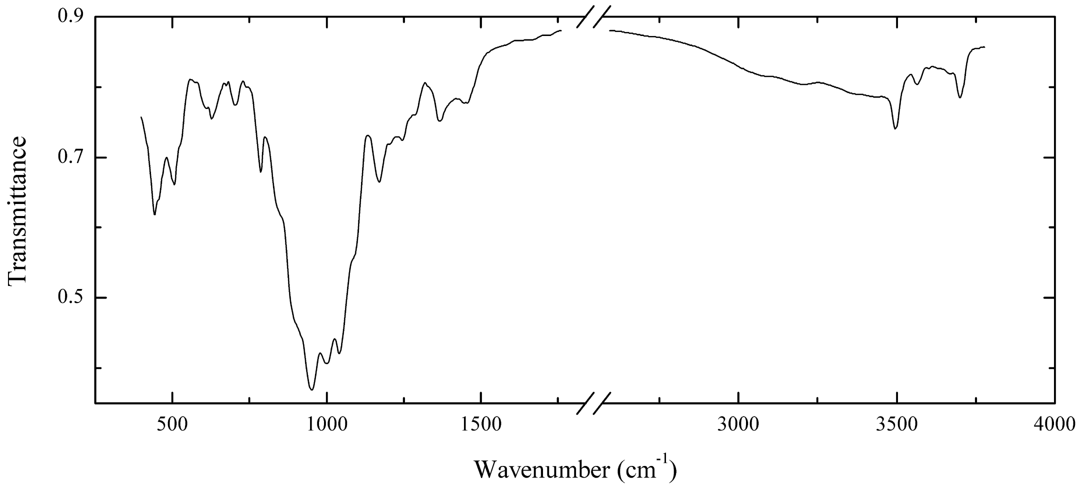


Locality: Ermakovskoe Be deposit, Republic of Buryatia, Transbaikal area, Siberia, Russia.

Description: White radial aggregate of flattened prismatic crystals from the association with fluorite and plagioclase. Al-deficient variety. The empirical formula is (electron microprobe, Be calculated) $(Ca_{3.74}Na_{0.20}Mn_{0.10})(Al_{0.19}Fe_{0.12})Be_{3.69}Si_{9.00}(O,OH)_{28}$.

Wavenumbers (cm^{-1}): 3625w, 3553, 1181, 1143, 1031sh, 1008s, 980sh, 944, 908, 821, 785sh, 760s, 663, 612w, 570, 533, 496, 451s, 404.

BSi1 Bakerite $HCa_4B_5Si_3O_{16}(OH)_4$

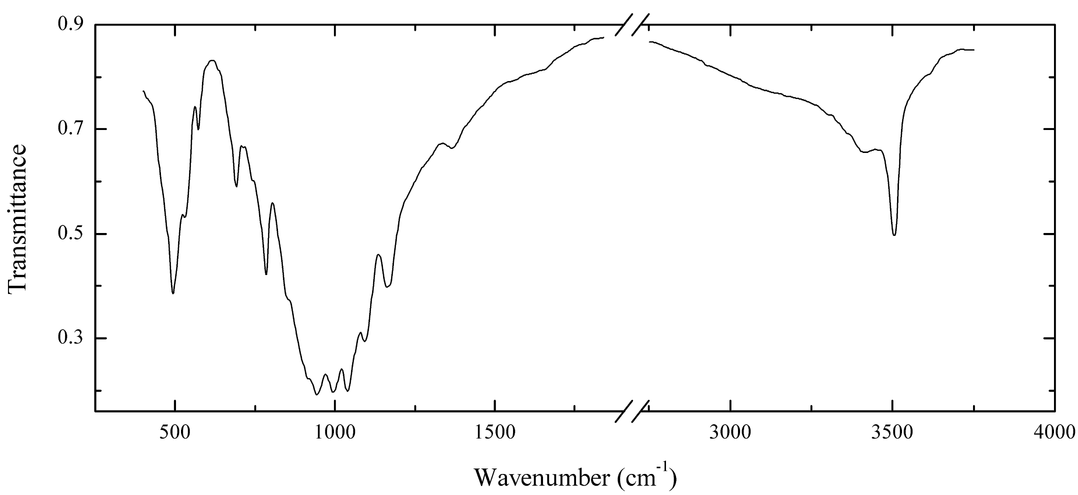


Locality: Borehole at the Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.

Description: White fine-grained aggregate from the association with turneaureite, pentahydroborite and brucite. Identified by IR spectrum and powder X-ray diffraction pattern. Ca:Si = 4:2.9 (in atomic proportions, by electron microprobe data). Contains admixture of Mn-bearing brucite (the bands at 3,680 and 441 cm^{-1}).

Wavenumbers (cm^{-1}): 3680, 3544w, 3478, 3390w, 3310sh, 3200w, 3050w, 1450w, 1370, 1280sh, 1245, 1175, 1090sh, 1043s, 1003s, 953s, 910sh, 854sh, 791, 705w, 635sh, 625, 610sh, 530sh, 505, 441.

BSi2 Bakerite $HCa_4B_5Si_3O_{16}(OH)_4$

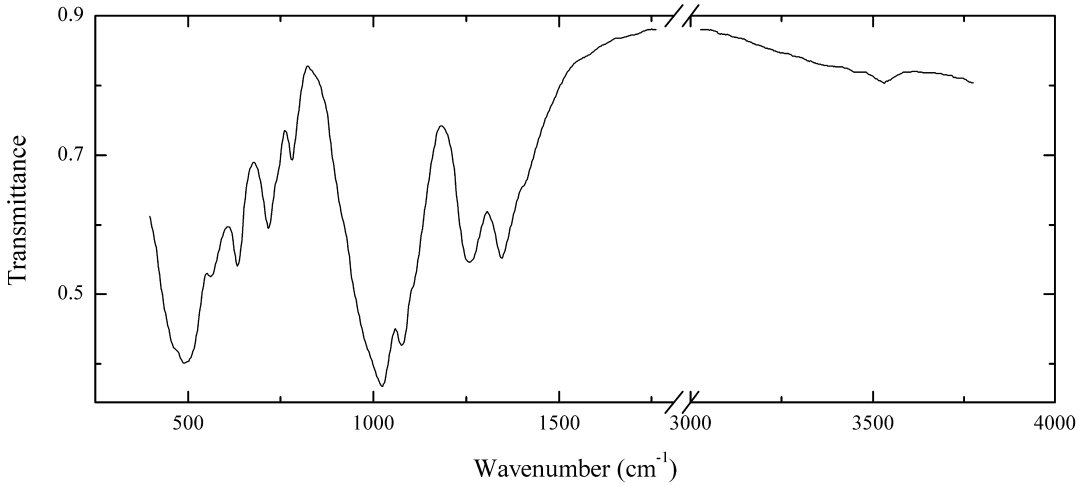


Locality: Corkscrew Canyon, Black Mts., Furnace Creek district, Death Valley, Inyo Co., California, USA.

Description: White porcelain-like. Identified by IR spectrum. Ca:Si = 4:3.1 (in atomic proportions, by electron microprobe data). The band at 1367 cm^{-1} indicates possible presence of H^+ cation.

Wavenumbers (cm^{-1}): 3485, 3400, 3150sh, 1650w, 1367w, 1165, 1095, 1041s, 996s, 946s, 918s, 855sh, 785, 745sh, 692, 573w, 527, 492.

BSi3 **Fluor-buergerite** $NaFe^{3+}_3Al_6(BO_3)_3(Si_6O_{18})O_3F$

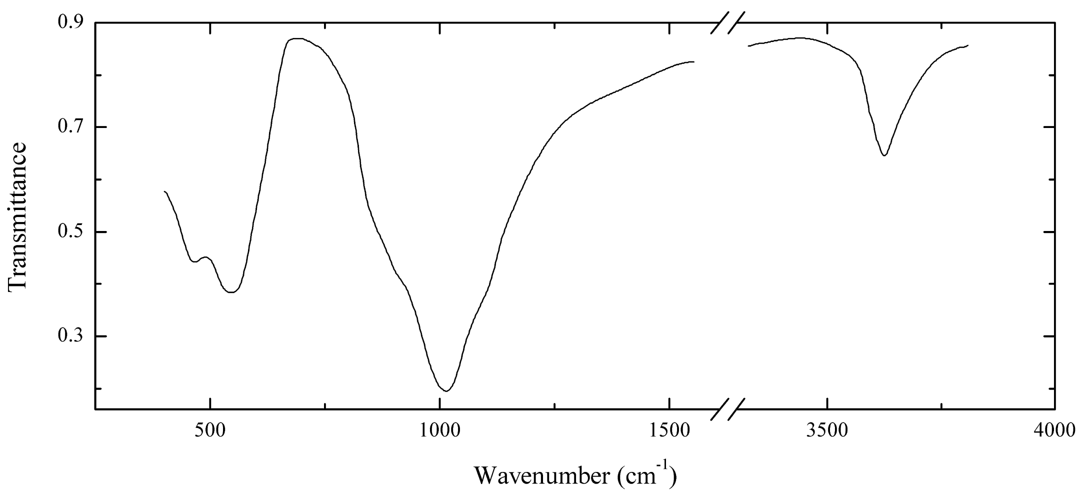


Locality: Mexquitic, San Luis Potosí, Mexico (type locality).

Description: Black crystal. Streak is brown. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500w, 1400sh, 1343, 1257, 1110sh, 1094s, 1019s, 985sh, 779, 735sh, 714, 631, 558, 490s, 470sh.

BSi4 **Boromuscovite** $KAl_2(BSi_3O_{10})(OH)_2$

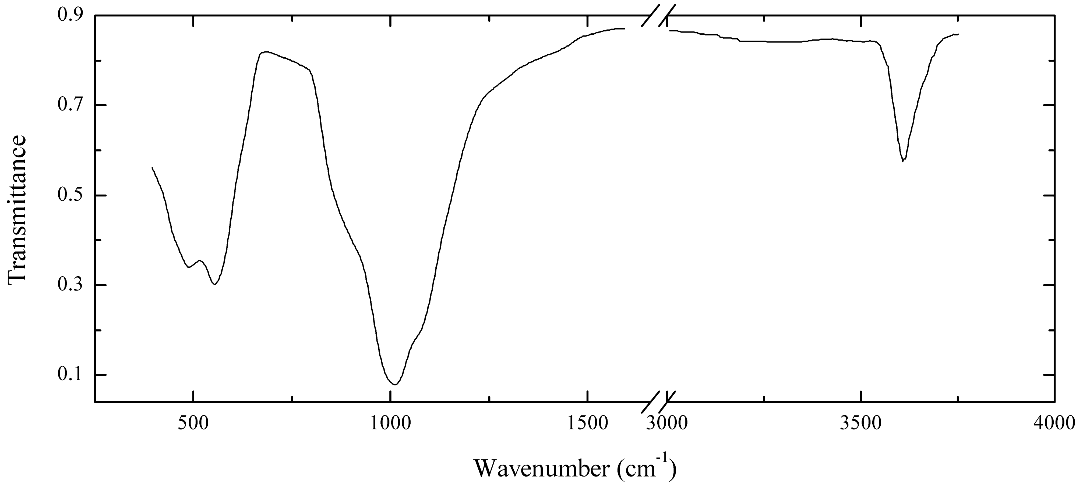


Locality: Little Three mine, Ramona pegmatite district, San Diego Co., California, USA (type locality).

Description: Microcrystalline crust. Identified by IR spectrum. Al:Si ≈ 2:3 (in atomic proportions, by electron microprobe data).

Wavenumbers (cm^{-1}): 3603, 1100sh, 1012s, 915sh, 875sh, 551s, 535s, 468.

BSi5 Boromuscovite $KAl_2(BSi_3O_{10})(OH)_2$

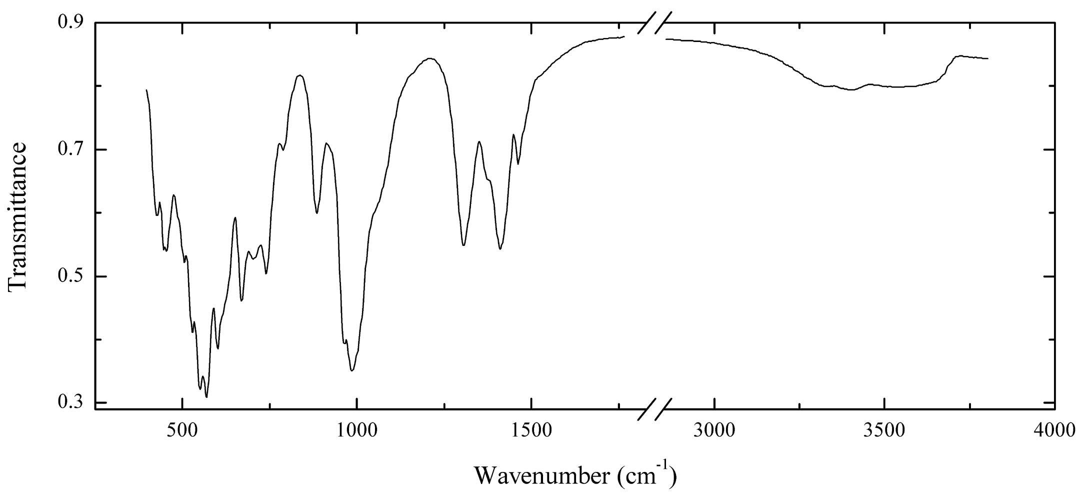


Locality: Mika pegmatite, Kukurt, Pamir Mts., Tajikistan.

Description: Yellow spherulite from the association with lepidolite, microcline, quartz, elbaite and topaz. Identified by IR spectrum and semiquantitative electron microprobe analysis. Al:Si ≈ 2:3 (in atomic proportions).

Wavenumbers (cm^{-1}): 3610, 1070sh, 1012s, 920sh, 885sh, 560s, 490, 460sh, 420sh.

BSi7 Grandidierite $(Mg,Fe^{2+})Al_3(BO_3)(SiO_4)O_2$

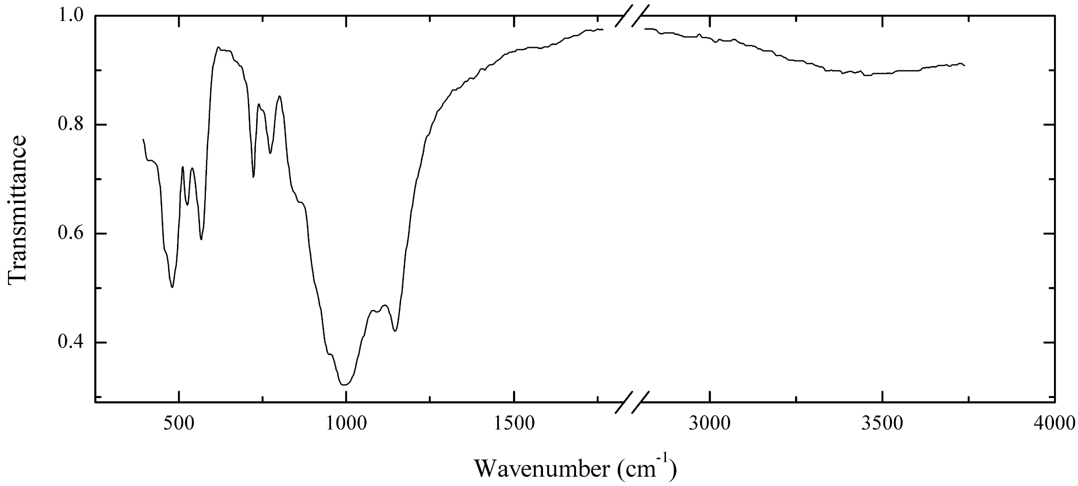


Locality: Andrahomana, Taolanaro (Fort Dauphin), Madagascar (type locality).

Description: Green granular aggregate. Identified by IR spectrum. Contains OH-groups.

Wavenumbers (cm^{-1}): 3620sh, 3525w, 3390w, 3310w, 1465, 1412, 1370sh, 1306, 1055sh, 986s, 962, 884, 791w, 740, 701, 670, 619, 602s, 569s, 550s, 530, 504, 457, 444, 427.

BSi8 Hyalotekite $(Ba,Pb,K)_4(Ca,Y)_2Si_8(B,Be)_2(Si,B)_2O_{28}F$

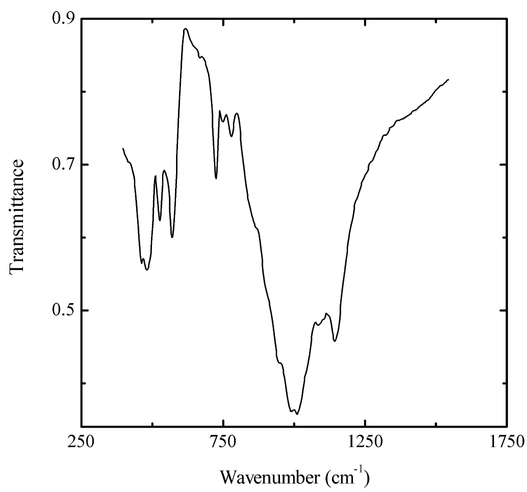


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan.

Description: Colourless grains with light lilac fluorescence under short-wave UV radiation. Associated mineral is reedmergnerite. Identified by IR spectrum and semiquantitative electron microprobe analysis (Ca > Y + *REE* in atomic proportions).

Wavenumbers (cm^{-1}): 1146s, 1097s, 1050sh, 997s, 946s, 910sh, 860, 840sh, 773, 723, 675sh, 566, 527, 480s, 460sh, 410.

BSi9 Hyalotekite $(Ba,Pb,K)_4(Ca,Y)_2Si_8(B,Be)_2(Si,B)_2O_{28}F$

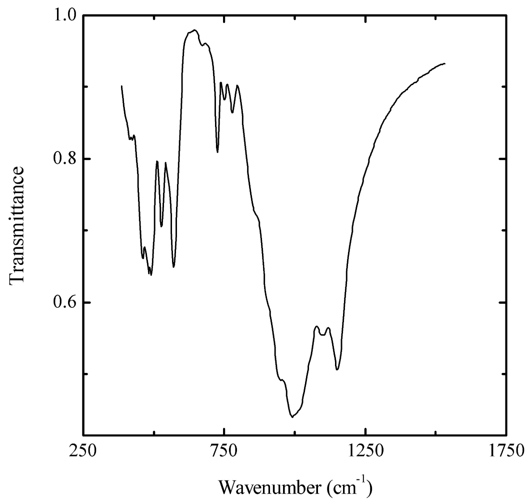


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan.

Description: White grains with yellow to lilac fluorescence under short-wave UV radiation. Associated minerals are kupletskite-(Ce), microcline and quartz. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1148s, 1095s, 1016s, 997s, 952s, 905sh, 870sh, 780w, 752w, 726, 672w, 650sh, 571, 528, 490sh, 480, 462, 420sh.

BSi10 Hyalotekite $(Ba,Pb,K)_4(Ca,Y)_2Si_8(B,Be)_2(Si,B)_2O_{28}F$

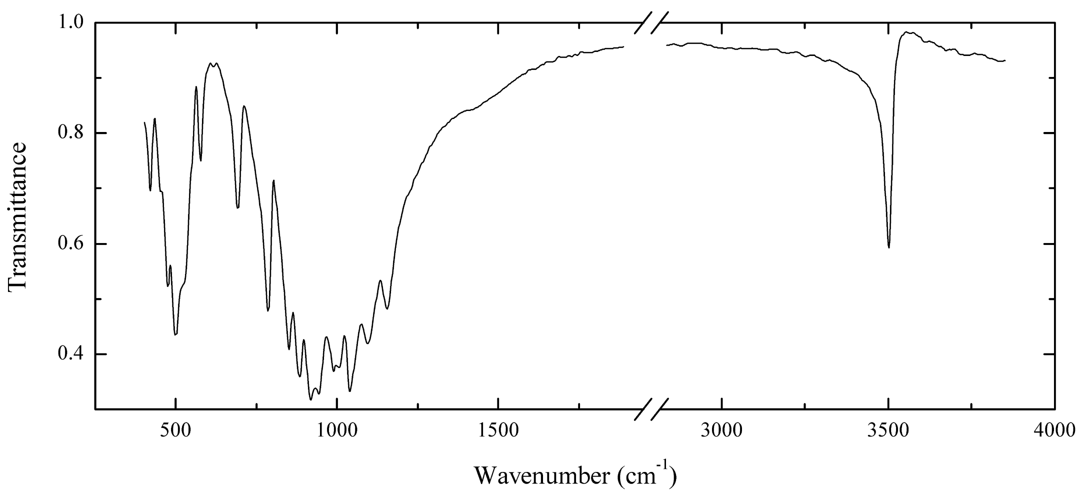


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan.

Description: White grains with lilac fluorescence under short-wave UV radiation. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1149s, 1098s, 1050sh, 1010sh, 998s, 950s, 905sh, 865sh, 781w, 753w, 726, 672w, 570, 529, 494, 485, 463, 427w.

BSi11 Datolite $CaBSiO_4(OH)$

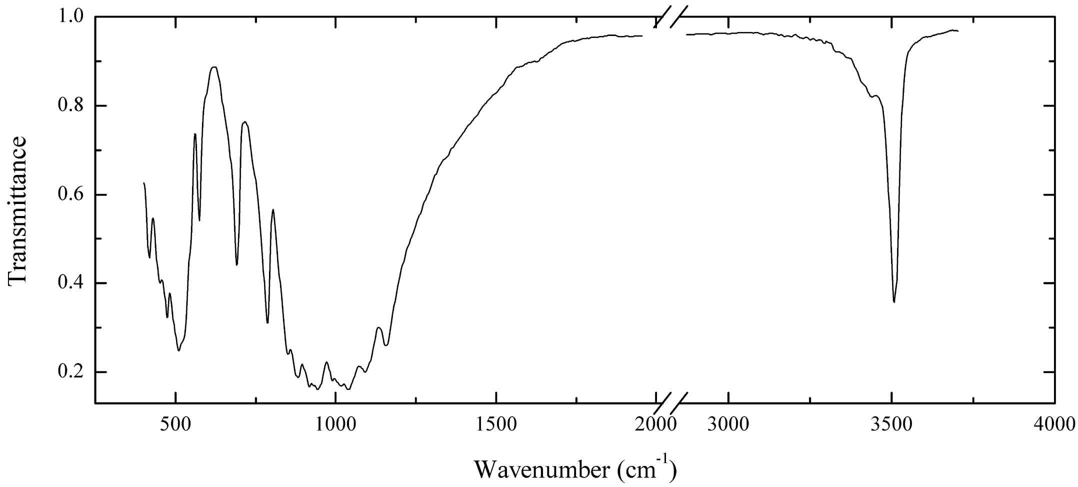


Locality: Bor quarry, Dalnegorsk, Primorskiy Kray, Russia.

Description: Yellowish-green crystal from the association with apophyllite, quartz and calcite. The empirical formula is (electron microprobe) $Ca_{0.99}Mn_{0.02}Fe_{0.01}BSi_{0.98}Al_{0.02}$ (OH,O).

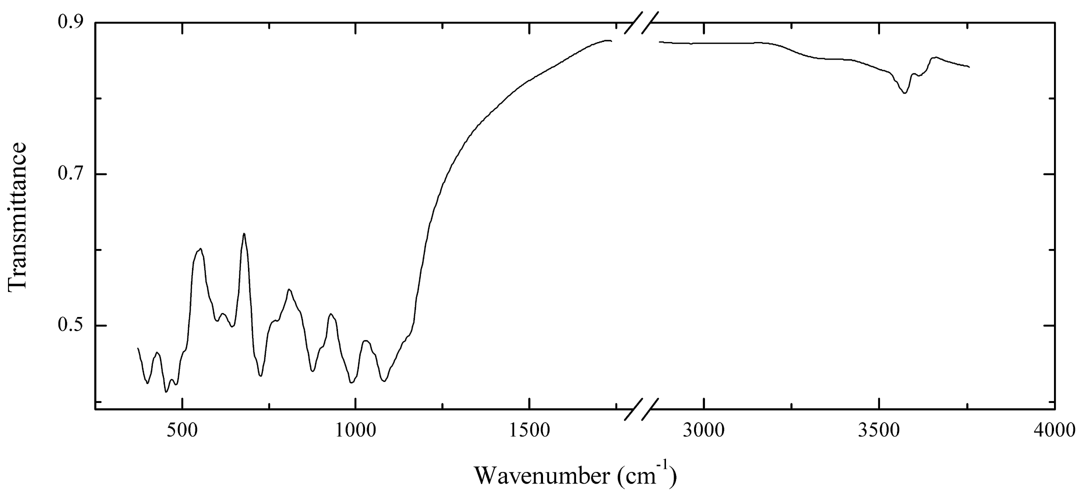
Wavenumbers (cm^{-1}): 3495, 1156, 1098, 1041s, 1006s, 988s, 943s, 918s, 882s, 850, 784, 689, 572, 520sh, 496, 471, 450, 417.

BSi12 Datolite $CaBSiO_4(OH)$



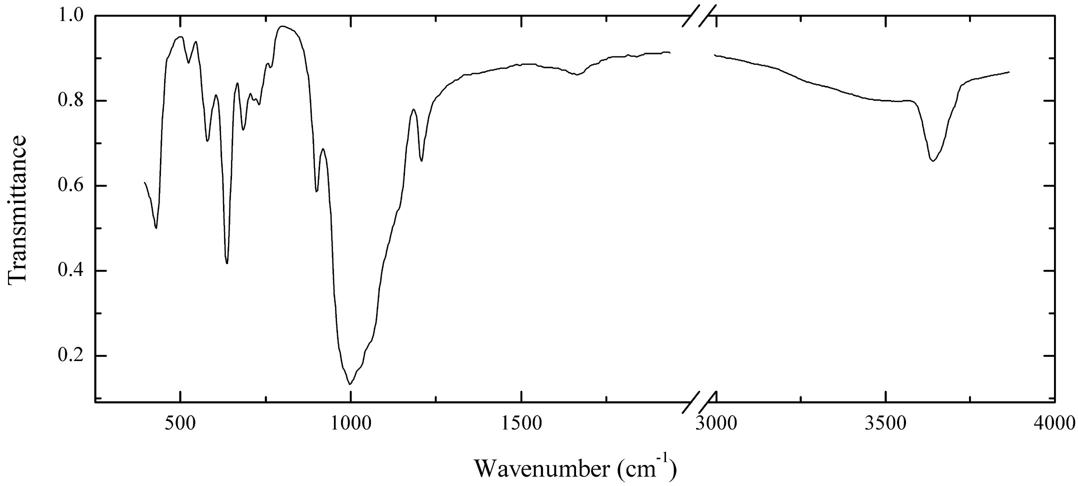
Locality Borehole at the Korshunovskoe iron deposit, Irkutsk region, Siberia, Russia.
Description: White powdery from the association with halite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3495, 3420w, 1157, 1093s, 1040s, 1016s, 992s, 947, 919s, 881s, 852, 785, 690, 572, 525sh, 507, 472, 450, 417.

BSi13 Kornerupine $(\square,Mg,Fe)(Al,Mg,Fe)_9(Si,Al,B)_5(O,OH,F)_{22}$



Locality: Andrahomana, Taolanaro (Fort Dauphin), Madagascar.
Description: Green prismatic crystal. Identified by IR spectrum. Mg:Al:Si:Fe = 26:44:28:2 (in atomic proportions, by electron microprobe data).
Wavenumbers (cm^{-1}): 3595w, 3550w, 1160sh, 1082s, 993s, 970sh, 905sh, 878s, 773, 727s, 710sh, 642, 602, 580sh, 507, 481s, 456s, 402s.

BSi14 Kalborsite $K_6(Al_4Si_6O_{20})[B(OH)_4]Cl$

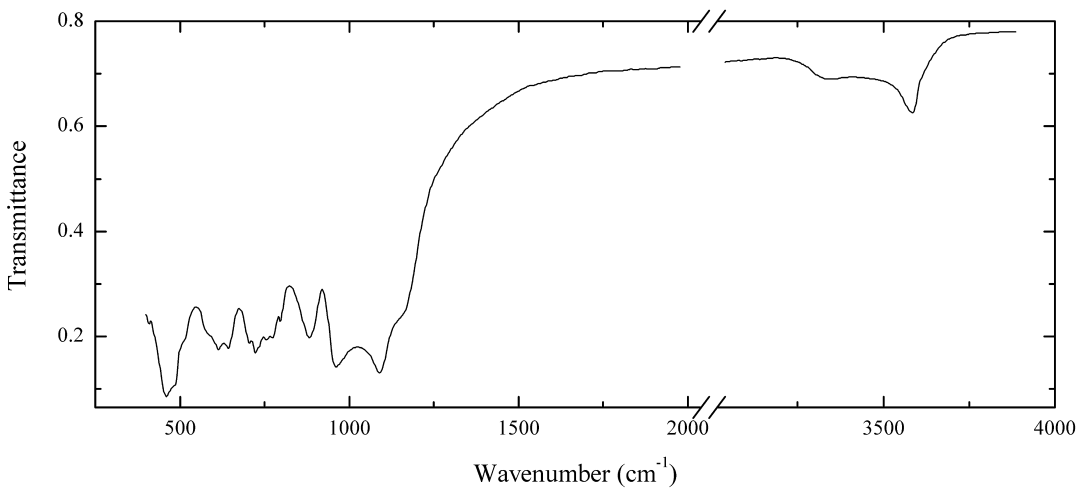


Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless crystal from the association with merlinoite, cancrisilite, orthoclase, sodalite, nepheline, aegirine and lamprophyllite. Identified by chemical composition and powder X-ray diffraction pattern. The empirical formula is $(K_{5.69}Na_{0.0.04}Sr_{0.01})(Al_{4.08}Si_{5.95}O_{20})$ $[B_{1.12}(OH)_{3.98}F_{0.03}]Cl_{1.02}$. Tetragonal, $a = 9.84(1)$, $c = 13.09(1)$ Å.

Wavenumbers (cm^{-1}): 3635sh, 3595sh, 3573, 3560sh, 3400w, 3200sh, 1640w, 1194, 1130sh, 1095sh, 1045sh, 1015sh, 988s, 970sh, 950sh, 891, 757w, 722, 707, 677, 627s, 574, 517w, 424s.

BSi15 Kornerupine $(\square,Mg,Fe)(Al,Mg,Fe)_9(Si,Al,B)_5(O,OH,F)_{22}$

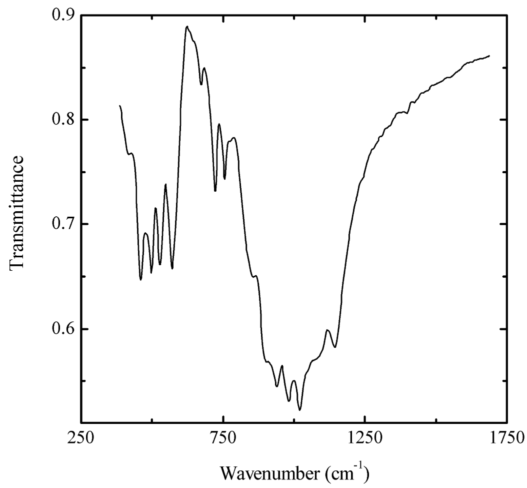


Locality: Dara-i Stazh river, Pyandzh River valley, Pamir Mts., Tajikistan.

Description: White columnar aggregate. Identified by IR spectrum and powder X-ray diffraction pattern. Mg:Al:Si:Fe = 28:42:27:3 (in atomic proportions, by electron microprobe data).

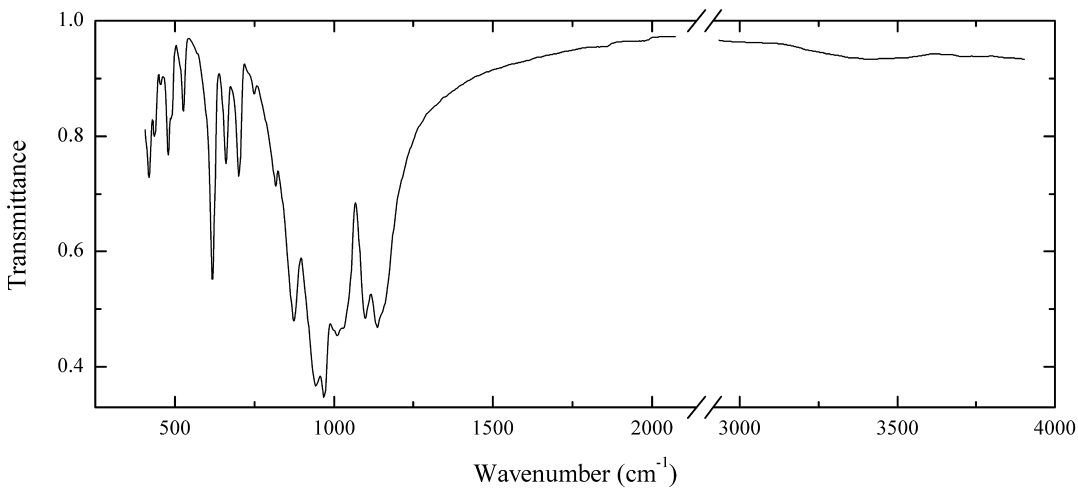
Wavenumbers (cm^{-1}): 3590, 3350, 1164sh, 1090s, 962s, 886, 796, 774, 759, 725s, 700, 638, 613, 580sh, 505sh, 475sh, 456s, 401.

BSi16 Kapitsaite-(Y) $(Ba,K)_4(Y,Ca)_2Si_8(B,Si)_4O_{28}F$



Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan (type locality).
Description: Colourless grains from the association with quartz, reedmergnerite, leucosphenite, polylithionite, pectolite, pyrochlore and aegirine. Holotype sample. The empirical formula is $(Ba_{3.55}K_{0.26}Pb_{0.12}Na_{0.07})(Y_{1.00}Ca_{0.79}Na_{0.14}Gd_{0.05}Dy_{0.05}Nd_{0.03}Sm_{0.03}Er_{0.03}Ce_{0.01}Ho_{0.01}Yb_{0.01})$ $(Si_{7.99}Al_{0.01})(B_{3.55}Si_{0.30})O_{27.95}F_{1.05}$. Triclinic, space group *I*-1; $a = 11.181$, $b = 10.850$, $c = 10.252$ Å, $\alpha = 90.64°$, $\beta = 90.05°$, $\gamma = 89.97°$. Optically biaxial (+), $\alpha = 1.624$, $\beta = 1.628$, $\gamma = 1.637$. $D_{calc} = 3.80$ g/cm^3, $D_{meas} = 3.74(3)$ g/cm^3. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 7.80 (70), 3.77 (100), 3.73 (70), 3.24 (75), 2.93 (80), 2.90 (90), 2.74 (65).
Wavenumbers (cm^{-1}): 1151s, 1088s, 1026s, 987s, 944s, 907s, 856, 783w, 759, 725, 673w, 573, 531, 501, 461, 420w.

BSi17 Danburite $CaB_2Si_2O_8$

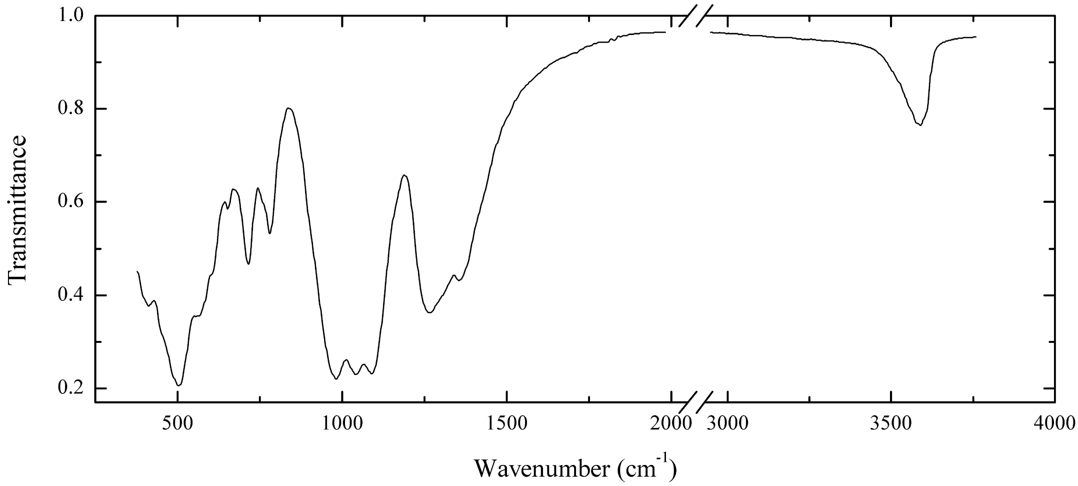


Locality: Dalnegorsk, Primorskiy Kray, Russia.

Description: Colourless prismatic crystal from the association with apophyllite, quartz and calcite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1155sh, 1135s, 1100s, 1025s, 1007s, 968s, 942s, 873s, 816, 749w, 699, 658, 617, 525, 487, 477, 455w, 435, 420.

BSi18 Dravite $NaMg_3Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

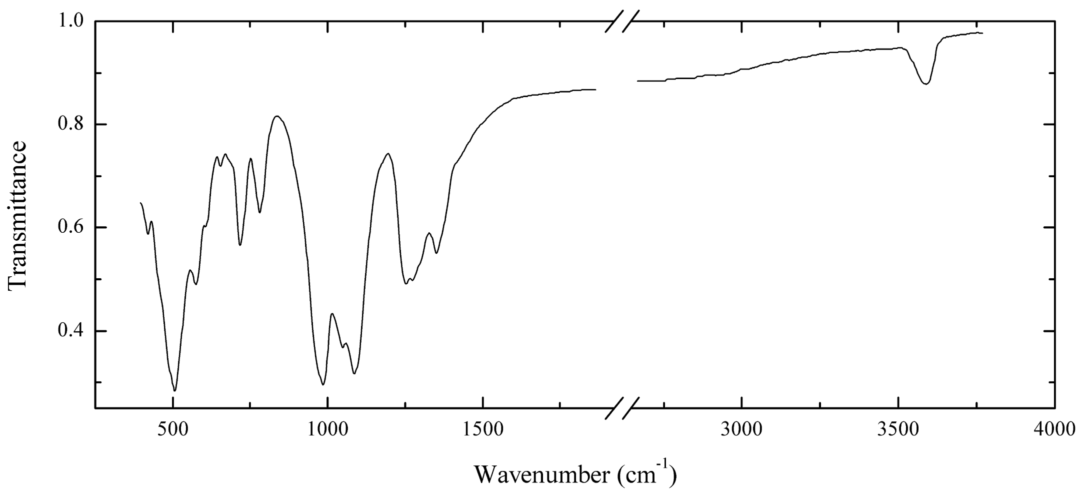


Locality: Placer at the Glubokaya river, near Sysert', Middle Urals, Russia.

Description: Black rubble with conchoidal fracture. Fe-rich variety. The empirical formula is $(Na_{0.84}Ca_{0.14})(Mg_{1.48}Fe_{1.03}Li_{0.27}Ti_{0.14}Mn_{0.04}Al_{0.04})Al_{6.00}(Si_{6.00}O_{18})(BO_3)_3(OH,O)_4$.

Wavenumbers (cm^{-1}): 3555, 1350, 1266s, 1086s, 1037s, 977s, 778, 755sh, 711, 648w, 600sh, 557, 500s, 420.

BSi19 Dravite $NaMg_3Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

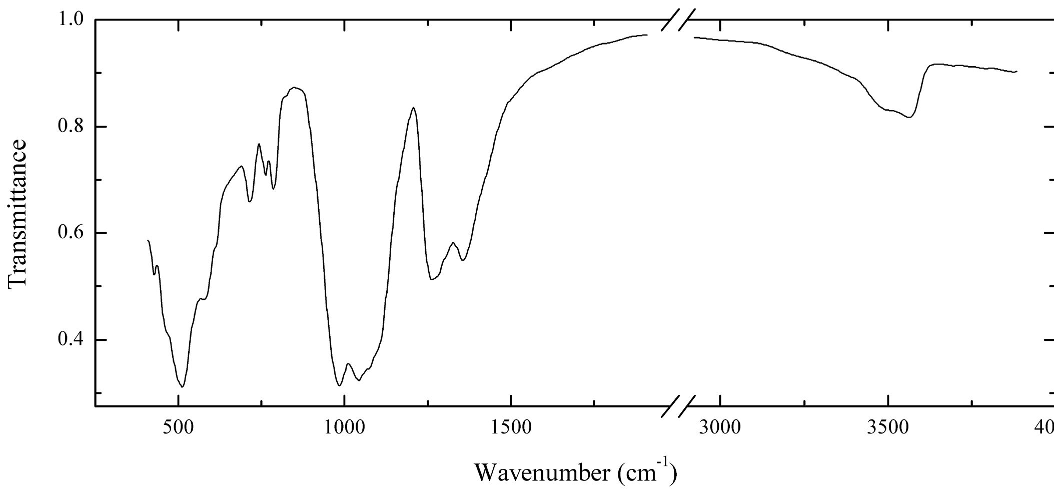


Locality: Luc Yen, Yen Bai Province, Vietnam.

Description: Light green crystal. Ca-rich variety. The empirical formula is (electron microprobe) $(Na_{0.53}Ca_{0.44})(Mg_{2.84}Al_{0.10}Fe_{0.06})Al_{6.00}(Si_{5.93}Al_{0.07}O_{18})(BO_3)_3(OH,O)_4$.

Wavenumbers (cm^{-1}): 3555, 1347, 1254, 1247, 1085s, 1047s, 982s, 790sh, 777, 715, 649w, 604, 571, 504s, 490sh, 460sh, 418.

BSi20 Dravite $NaMg_3Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

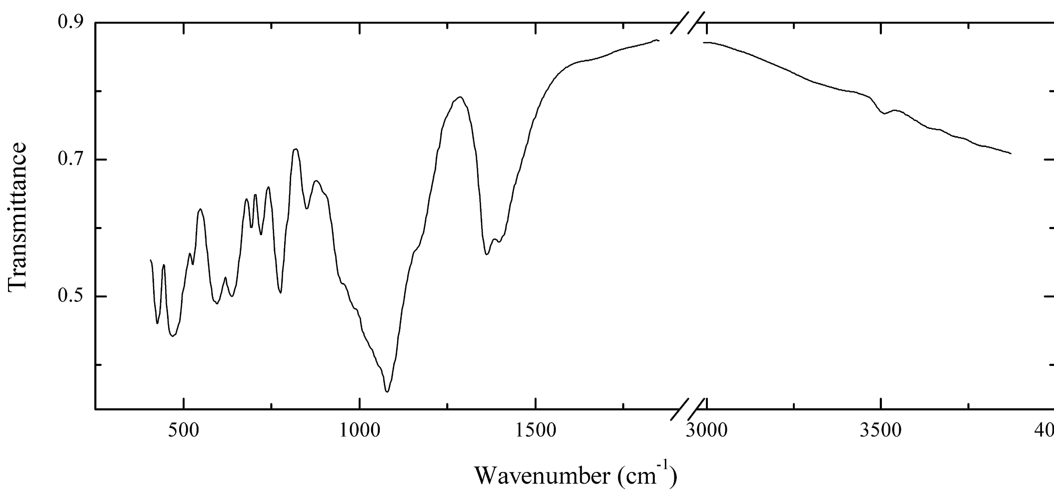


Locality: Kukh-i Lal gem spinel deposit, Pyandzh River valley, Pamir Mts., Tajikistan.

Description: Yellowish-brown long-prismatic crystal. The empirical formula is $(Na_{0.72}Ca_{0.05})(Mg_{2.15}Al_{0.51}Li_{0.18}Fe_{0.11})Al_{6.00}(Si_{6.00}O_{18})(BO_3)_3(OH,O)_4$.

Wavenumbers (cm^{-1}): 3560, 3490sh, 1361, 1269s, 1095sh, 1075s, 1044s, 987s, 785, 761, 714, 610sh, 577, 511s, 465sh, 424.

BSi21 Dumortierite $Al_7(SiO_4)_3(BO_3)O_3$

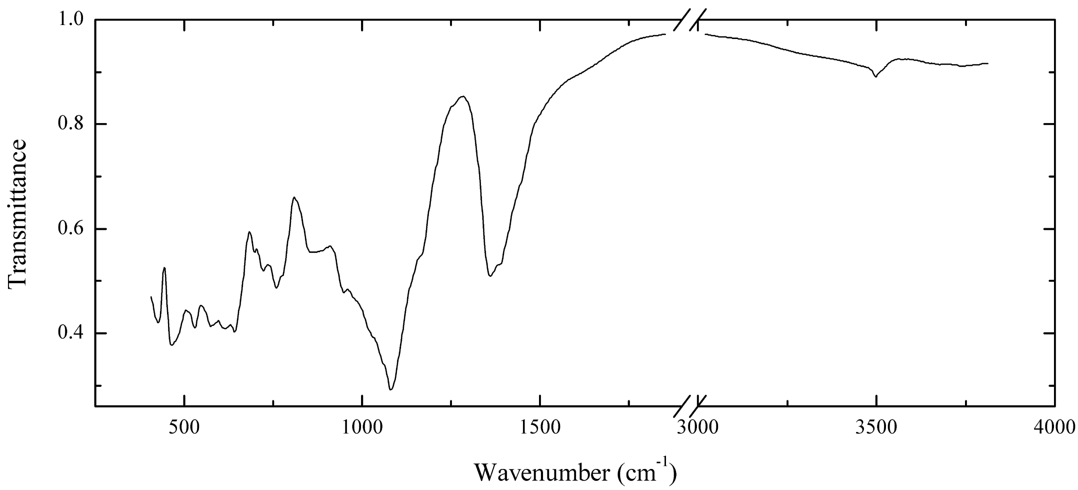


Locality: Sohavina, Madagascar.

Description: Blue fibrous aggregate from the association with chrysoberyl, quartz and garnet. The empirical formula is (electron microprobe) $(Al_{6.78}Fe_{0.01}Mg_{0.02}Ti_{0.02})(SiO_4)_3(BO_3)(O,OH)_3$.

Wavenumbers (cm^{-1}): 3485w, 1455sh, 1397, 1362, 1165sh, 1080s, 1050sh, 980sh, 955sh, 850, 790sh, 776s, 720, 694, 642s, 602s, 526, 472s, 431.

BSi22 Dumortierite $Al_7(SiO_4)_3(BO_3)O_3$

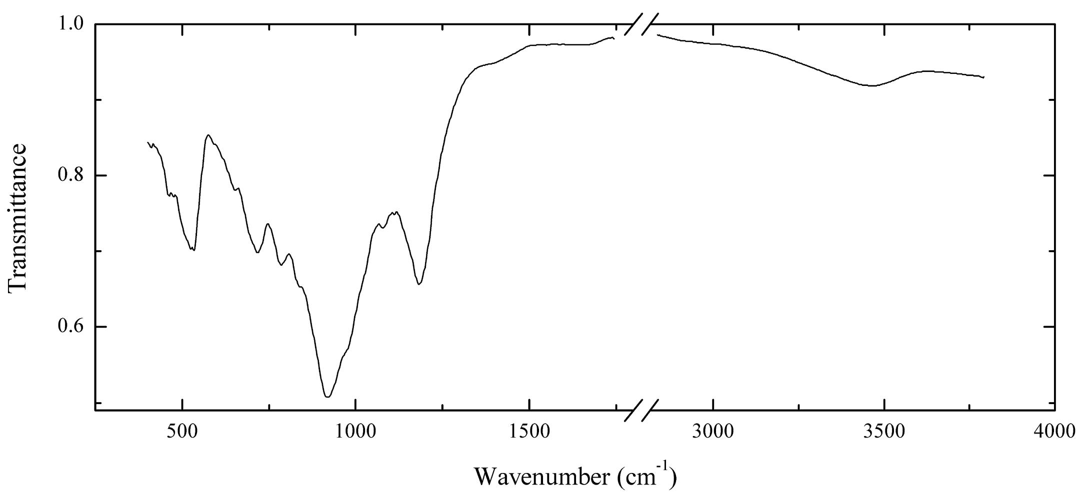


Locality: Uvildy lake, South Urals, Russia.

Description: Honey-yellow fibrous aggregate from the association with olenite. Identified by IR spectrum and qualitative electron microprobe analysis. Contains admixture of quartz.

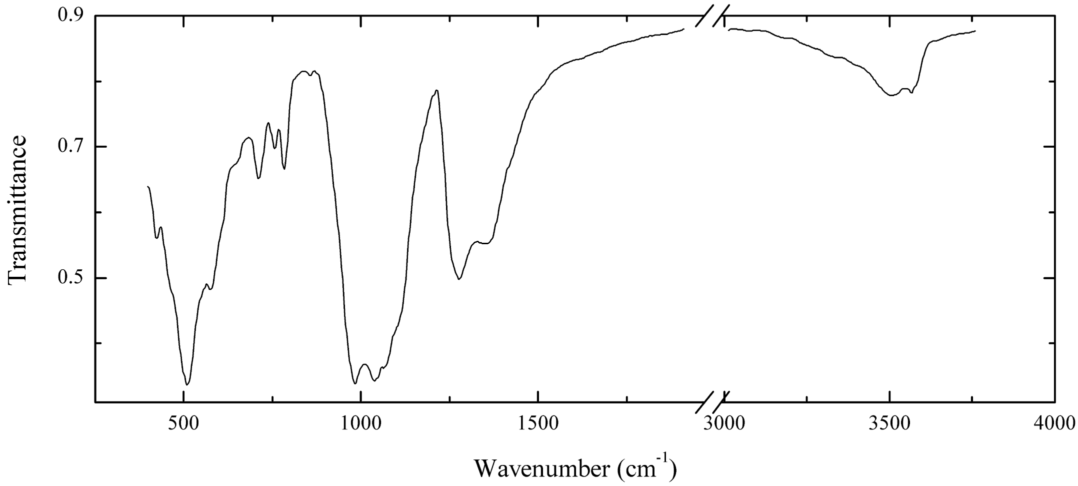
Wavenumbers (cm^{-1}): 3475w, 1385sh, 1361, 1165sh, 1140sh, 1082s, 1045sh, 1010sh, 948, 880sh, 868, 795sh, 776, 760, 723, 697w, 640s, 610s, 580s, 526s, 470s, 425s.

BSi23 Mottanaite-(Ce) $Ca(Ce,Ca)_2AlBe_2Si_4B_4O_{24}$



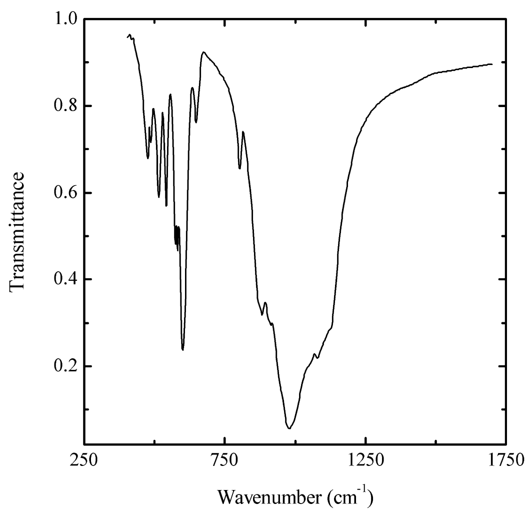
Locality: Monte Cavalluccio, Sacrofano caldera, Campagnano, north of Rome, Italy (type locality).
Description: Brown platy crystals from the association with sanidine and titanite. Confirmed by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3455w, 1172s, 1080, 1010sh, 975sh, 919s, 835sh, 782s, 713, 648, 526, 505sh, 475sh.

BSi24 Magnesiofoitite $\square(Mg_2Al)Al_6(Si_6O_{18})(BO_3)_3(OH)_4$



Locality: Kukh-i Lal gem spinel deposit, Pyandzh River valley, Pamir Mts., Tajikistan.
Description: Brown prismatic crystal. The empirical formula is (electron microprobe) $Na_{0.30}(Mg_{1.74}Al_{0.95}Fe_{0.29}Ti_{0.02})Al_{6.00}(Si_{5.94}Al_{0.06}O_{18})(BO_3)_3(OH)_4$.
Wavenumbers (cm^{-1}): 3545, 3490, 1360, 1278, 1105sh, 1047s, 986s, 860w, 784, 760, 713, 640sh, 610sh, 579, 512s, 426.

BSi25 Malinkoite $NaBSiO_4$

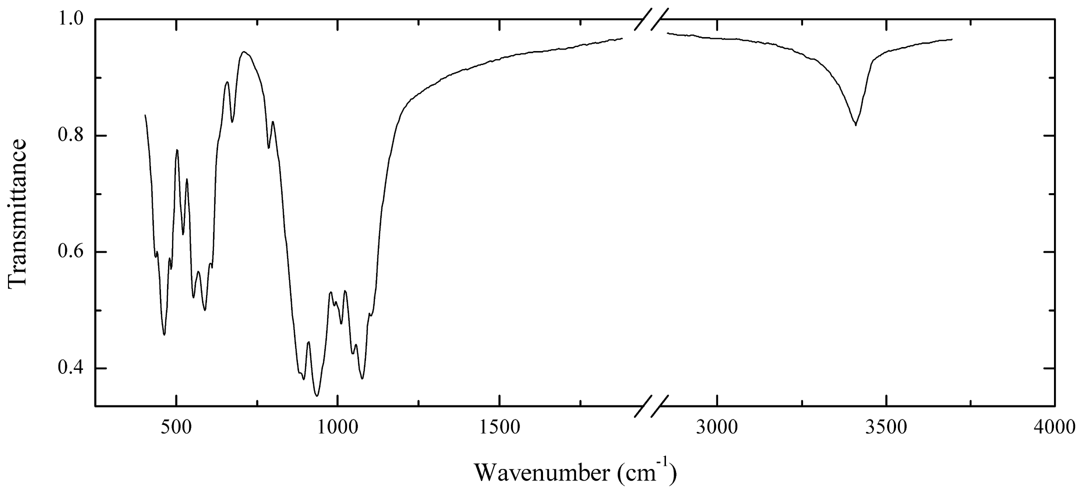


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless grains from the association with ussingite, chkalovite, nordite, gerasimovskite and neptunite. Holotype sample. The empirical formula is $Na_{1.00}B_{0.98}Si_{1.01}O_{4.00}$. Hexagonal, space group $P6_3$, $a = 13.8964$, $c = 7.7001$ Å. Optically uniaxial (–), $\varepsilon = 1.591$, $\omega = 1.582$. $D_{calc} = 2.92$ g/cm^3, $D_{meas} = 2.90$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 3.86 (60), 3.61 (60), 2.780 (100), 2.320 (70), 2.216 (90), 1.928 (50), 1.721 (70).

Wavenumbers (cm^{-1}): 1125sh, 1100sh, 1080s, 1060s, 980s, 950sh, 917s, 910sh, 884s, 870sh, 805, 647w, 599s, 581, 575, 541, 515, 486w, 475.

BSi26 Axinite-(Mn) $Ca_2Mn^{2+}Al_2(Si_2O_7)_2BO(OH)$

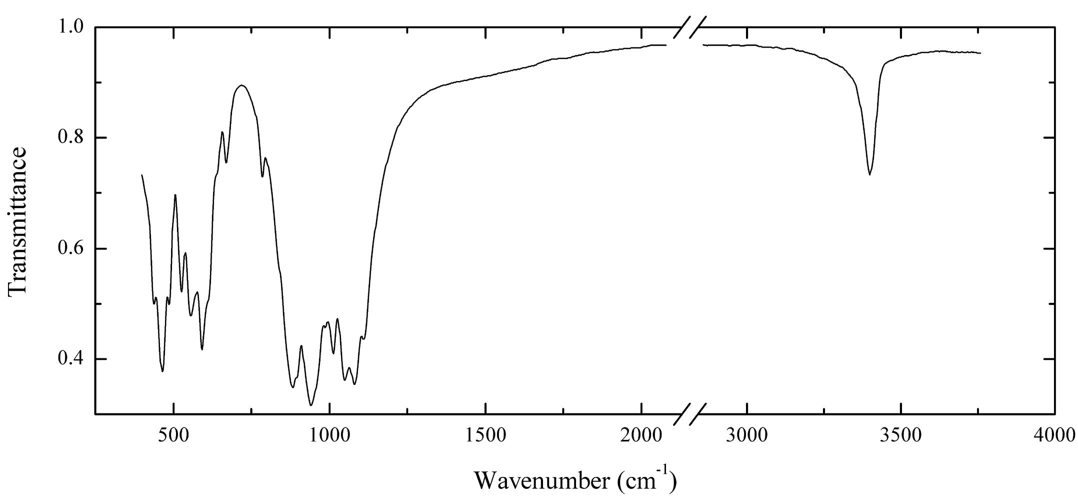


Locality: Uchaly, Bashkortostan, South Urals, Russia.

Description: Yellow granular aggregate. The empirical formula is (electron microprobe) $(Ca_{1.78}Mn_{0.22})(Mn_{0.90}Mg_{0.07}Fe_{0.03})Al_{2.00}(Si_{3.93}Al_{0.07}O_{14})BO(OH)$.

Wavenumbers (cm^{-1}): 3385, 1098, 1069s, 1041s, 1006, 983, 930s, 890s, 876s, 780w, 665w, 602, 580, 549, 515, 496, 455s, 425.

BSi27 Axinite-(Mg) $Ca_2MgAl_2(Si_2O_7)_2BO(OH)$

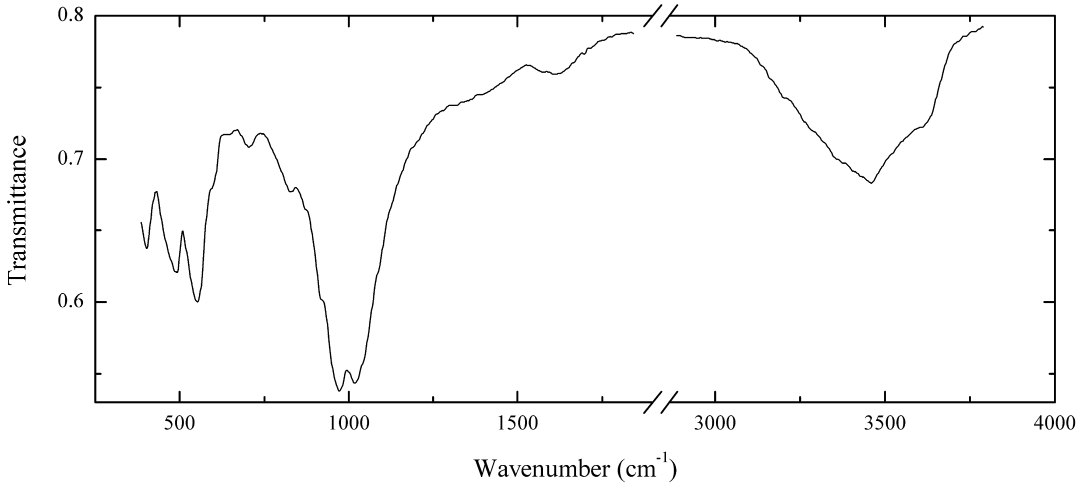


Locality: Quartz Hills, near Aksu, Northern Kazakhstan.

Description: Brown grains. The empirical formula is $(Ca_{2.15}Na_{0.03})(Mg_{0.45}Fe^{2+}_{0.33}Mn_{0.11})(Al_{1.73}Fe^{3+}_{0.20})(Si_{4.02}O_{14})B_{0.98}O_{1.13}(OH)_{0.65}$.

Wavenumbers (cm^{-1}): 3375, 1103, 1074s, 1045s, 1010, 984, 937s, 891s, 879s, 780w, 664w, 630sh, 600sh, 584, 548, 518, 477, 453s, 429.

BSi28 Manandonite $Li_2Al_4(Si_2AlBO_{10})(OH)_8$

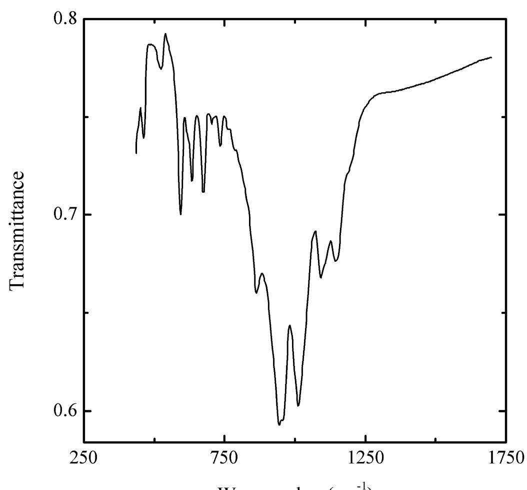


Locality: Antandrokomby pegmatite, Manandona river, near Antsirabe, Madagascar (type locality).

Description: Lamellar aggregate from the association with elbaite, quartz, microcline and albite.

Wavenumbers (cm^{-1}): 3570sh, 3430, 3370sh, 1620w, 1050sh, 1017s, 967s, 920sh, 826, 707w, 600sh, 552, 490, 399.

BSi29 Maleevite $BaB_2Si_2O_8$

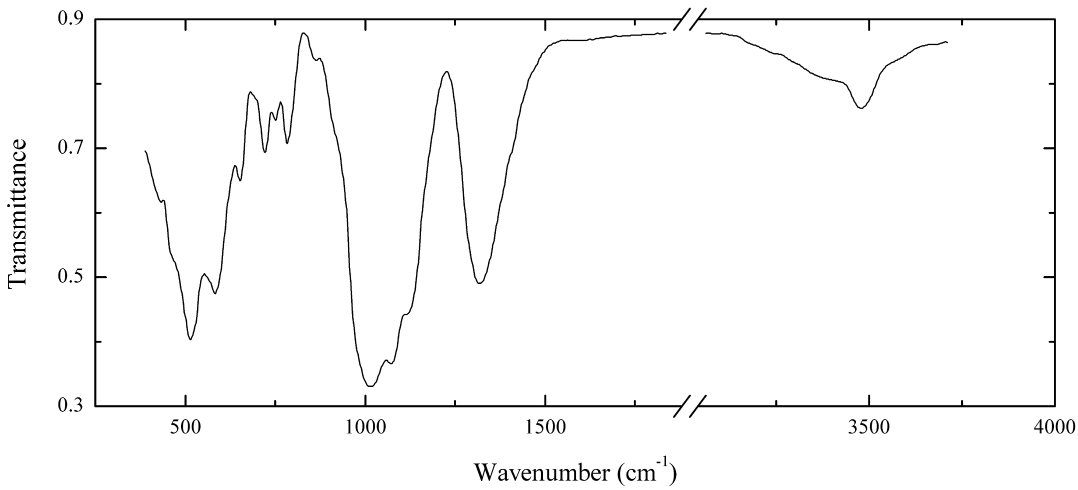


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan (type locality).

Description: White grains from the association with aegirine, microcline, quartz, arfvedsonite, polylithionite, reedmergnerite, kupletskite-(Cs), hyalotekite, albite, *etc*. Holotype sample. The empirical formula is $(Ba_{0.99}Pb_{0.01})B_{1.99}Si_{2.01}O_8$. Orthorhombic, space group *Pmma*, $a = 8.141(2)$, $b = 8.176(2)$, $c = 9.038(2)$ Å. Optically uniaxial (−), $\alpha = 1.649(2)$, $\beta = 1.656(2)$, $\gamma = 1.656(2)$. $D_{calc} = 3.79$ g/cm^3, $D_{meas} = 3.78(1)$ g/cm^3. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.62 (100), 2.021 (70), 6.07 (60), 3.39 (60), 2.83 (50), 2.481 (40), 4.86 (30).

Wavenumbers (cm^{-1}): 1200sh, 1149, 1093, 1012s, 957s, 943s, 865, 735, 702w, 675, 632, 612w, 592, 527w, 517w, 468.

BSi31 Olenite $(Na,\square)Al_3Al_6(Si_6O_{18})(BO_3)_3(O,OH)_4$

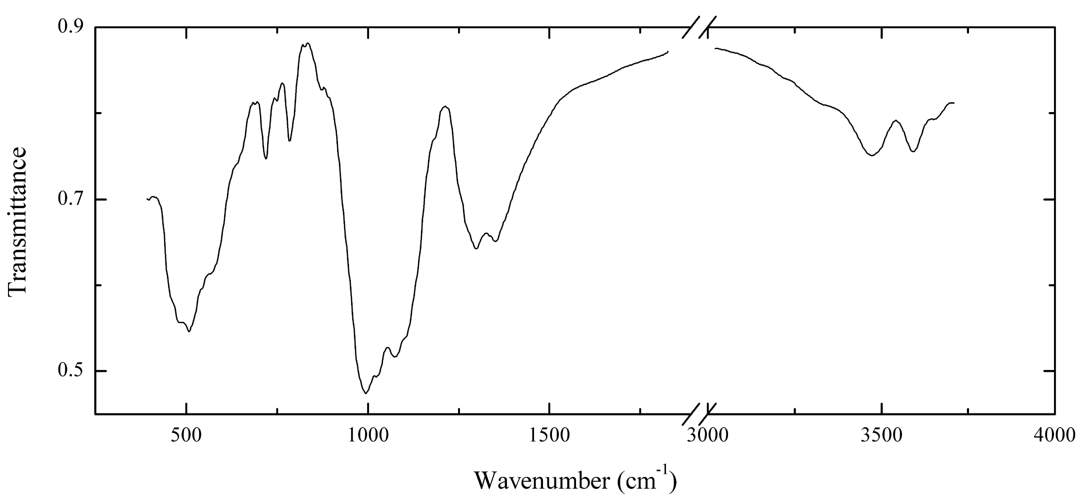


Locality: Uvildy lake, South Urals, Russia.

Description: Blue crystals from the association with dumortierite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

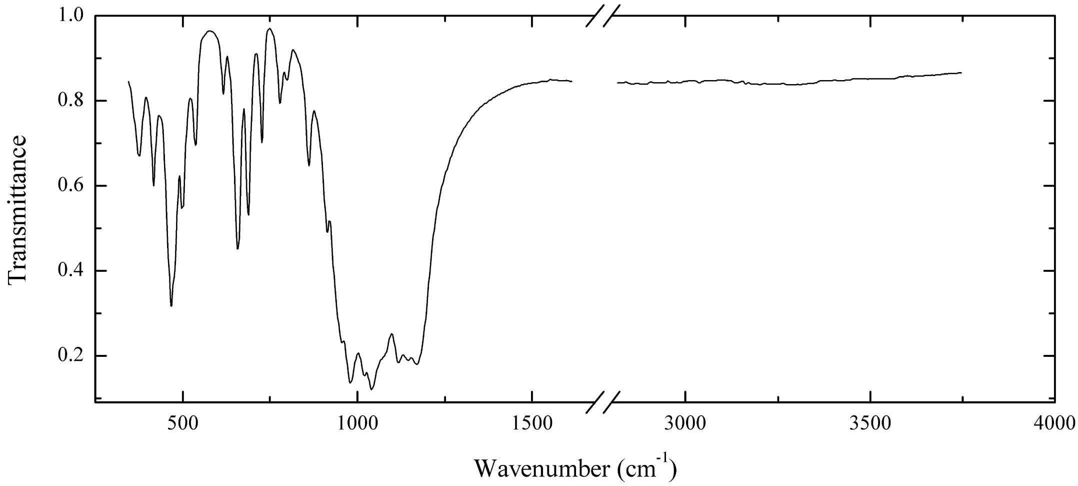
Wavenumbers (cm^{-1}): 3445, 3370sh, 1315s, 1110s, 1074s, 1016s, 865w, 780, 749, 719, 650, 584s, 519s, 465sh, 430.

BSi32 Rossmanite $\square(LiAl_2)Al_6(Si_6O_{18})(BO_3)_3(OH)_4$



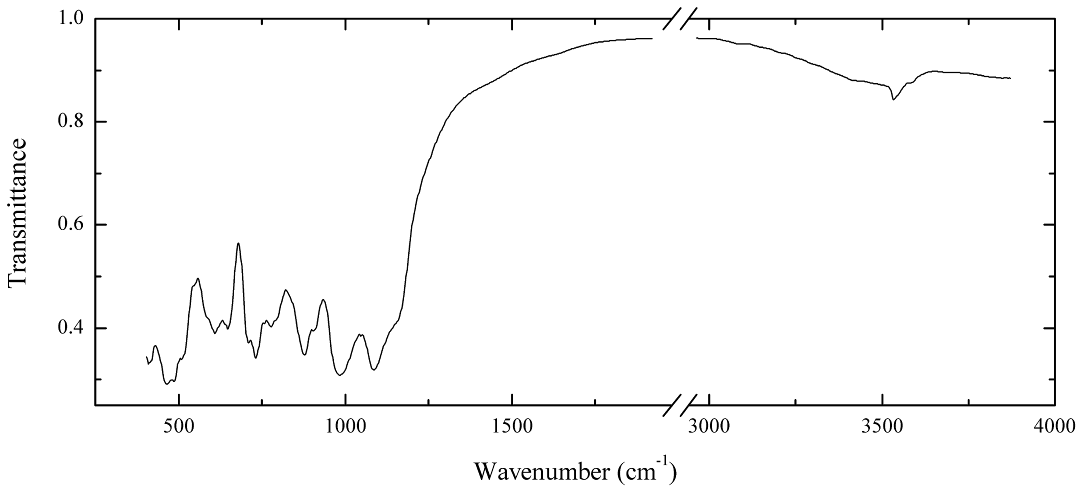
Locality: Turgenevskoe deposit, Primorskiy Kray, Russia.
Description: Pink prismatic crystals from pegmatite. The empirical formula is $Na_{0.4}(Al_{2.0}Li_{1.0})Al_{6.0}(Si_6O_{18})(BO_3)_3(OH,O)_4$.
Wavenumbers (cm^{-1}): 3645w, 3575, 3455, 1358, 1306, 1260sh, 1110sh, 1083s, 1031s, 998s, 880sh, 786, 750w, 720, 655sh, 585sh, 565sh, 511s, 480sh.

BSi33 Reedmergnerite $NaBSi_3O_8$



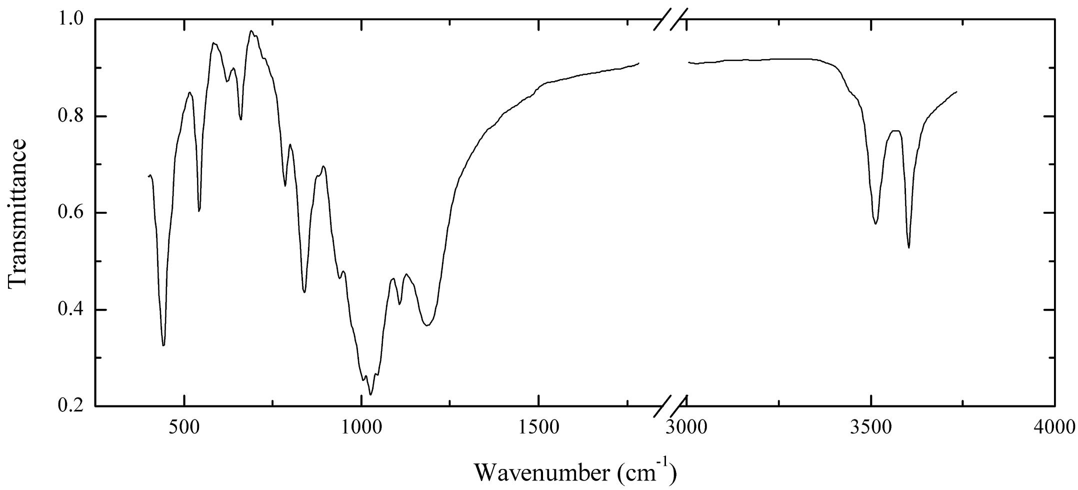
Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan.
Description: Yellow granular aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1172s, 1147s, 1119s, 1070sh, 1043s, 1023s, 982s, 959s, 916, 862, 799w, 778w, 726, 687, 658, 616w, 536, 499, 475sh, 467s, 415, 376.

BSi34 Prismatine $(\square,Fe,Mg)(Mg,Al,Fe)_5Al_4Si_2(Si,Al)_2(B,Si,Al)(O,OH,F)_{22}$



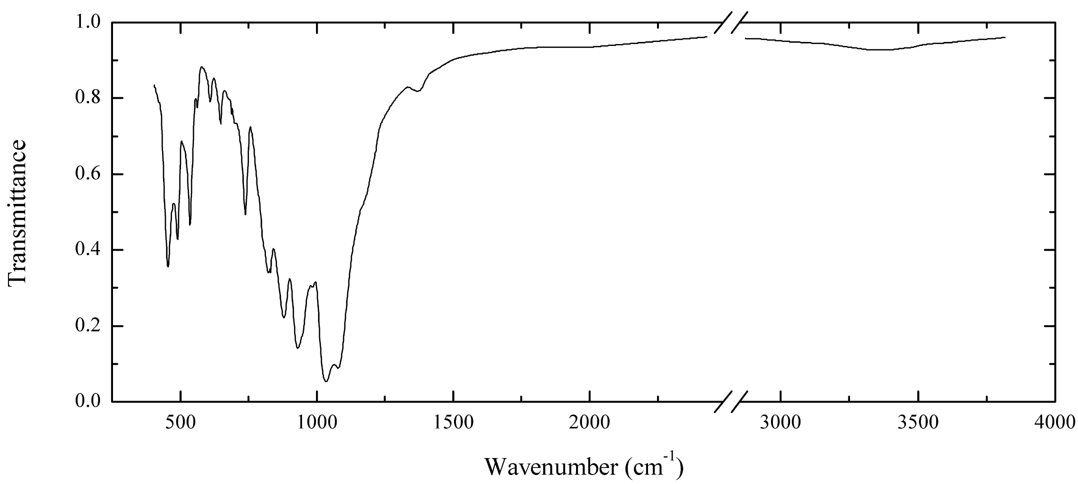
Locality: Granulite outcrop, Waldheim railroad station, Döbeln, Saxony, Germany (type locality).
Description: Grey-green prismatic crystal from granulite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Mg_{3.3}Fe_{0.6}Al_{6.3}Si_{3.8}B_x(OH,O,F)_{22}$.
Wavenumbers (cm^{-1}): 3525w, 1150sh, 1088s, 986s, 904, 877s, 795sh, 775, 730s, 710s, 647, 608, 507s, 485s, 463s, 408s.

BSi35 Searlesite $NaBSi_2O_5(OH)_2$



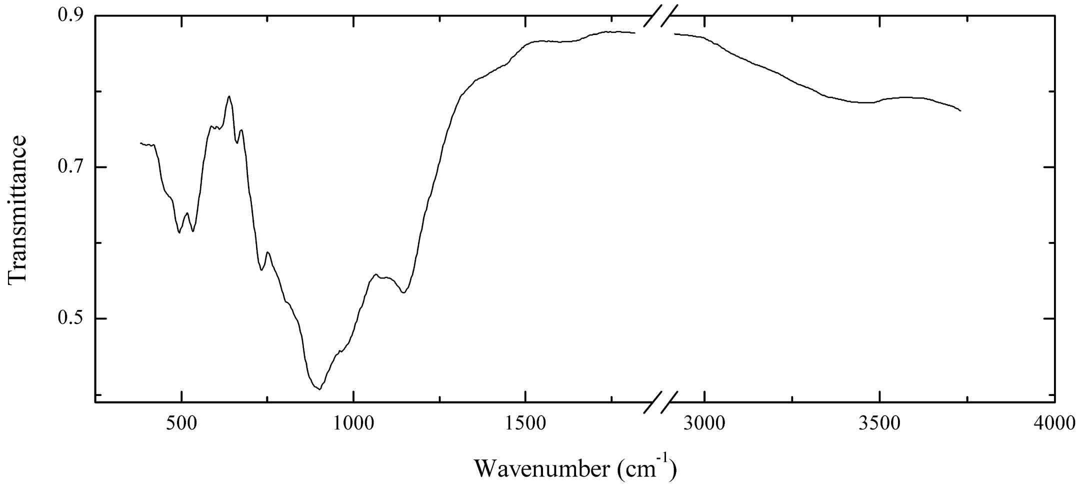
Locality: Searles Lake, San Bernardino Co., California, USA (type locality).
Description: White crystals from the association with trona. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3605, 3515, 1189s, 1113s, 1050s, 1029s, 1008s, 980sh, 944, 885w, 842s, 788, 662, 623w, 545, 460sh, 443s, 420sh.

BSi36 Stillwellite-(Ce) $CeBSiO_5$



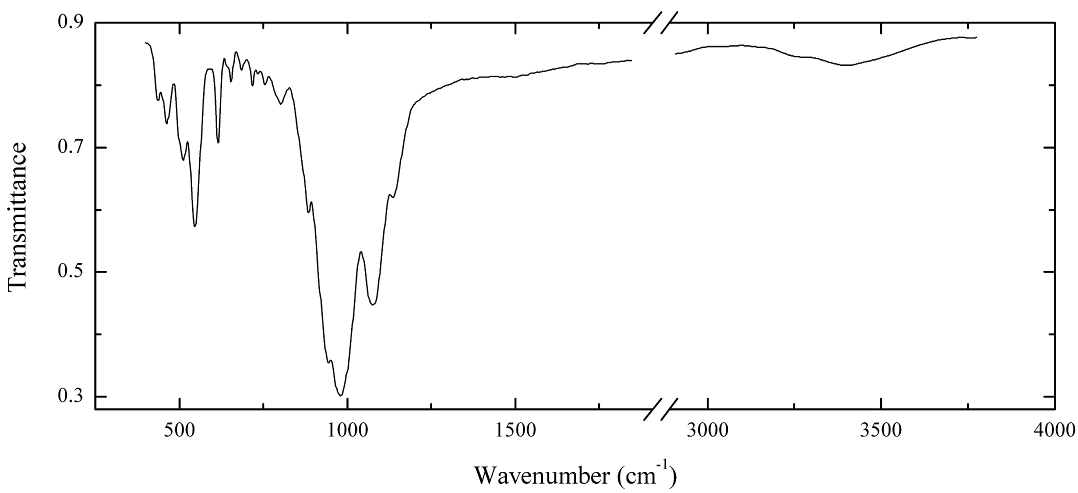
Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan.
Description: Orange crystal from the association with baratovite, aegirine and quartz. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3350w, 1370w, 1165sh, 1075s, 1034s, 1025sh, 983, 940sh, 927s, 878s, 820, 800sh, 736, 695w, 672w, 645, 607w, 560w, 532, 487, 451.

BSi37 Tadzhikite-(Ce) $Ca_2(Ca,Y)_2(Ce,Y,\square)_2(Ti,Fe^{3+},Al)[B_4Si_4O_{16}(O,OH)_6](OH)_2$



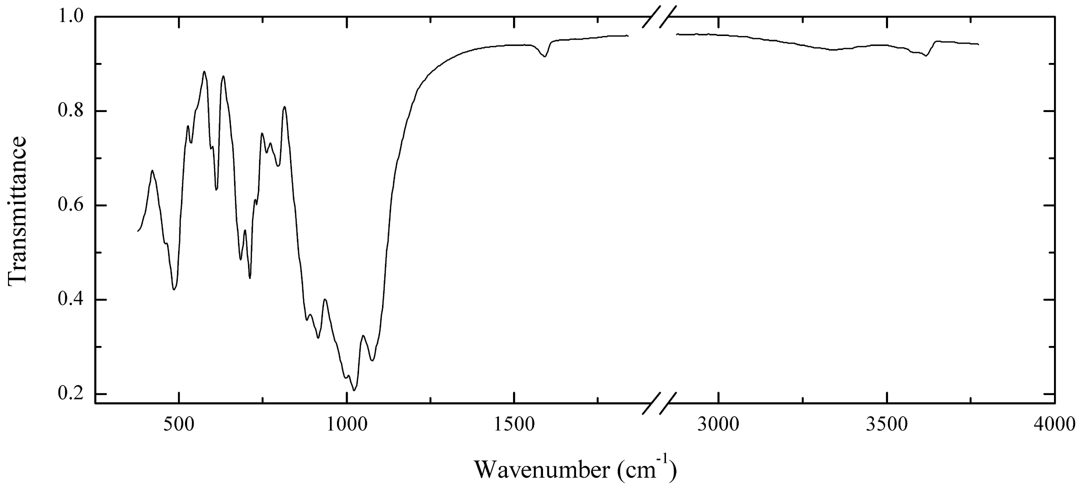
Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan (type locality).
Description: Brown prismatic crystals from granular quartz. Identified by IR spectrum and chemical analysis. The empirical formula is $Ca_{2.00}(Ca_{1.21}Y_{0.79})$ $(Y_{0.64}Ce_{0.58}Nd_{0.24}La_{0.15}Dy_{0.07}Er_{0.05}Sm_{0.03}Ho_{0.01})(Ti_{0.39}Fe_{0.36}Al_{0.24})B_{3.87}Si_{4.13}(O,OH)_8$.
Although tadzhikite-(Y) has been discredited and be renamed into tadzhikite-(Ce), these data show that it could be considered as a valid mineral species.
Wavenumbers (cm^{-1}): 3430w, 1620w, 1400sh, 1148s, 1082, 960sh, 895s, 800sh, 728, 655w, 609w, 527, 487, 445sh.

BSi38 Tienshanite $KNa_3(Na,K,\square)_6(Ca,Y)_2Ba_6Mn_6(Ti,Nb)_6Si_{36}B_{12}O_{114}[O,F,(OH)]_{11}$



Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Tien Shan Mts., Tajikistan (type locality).
Description: Greenish-grey grain from the association with microcline and astrophyllite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3410w, 1136, 1077s, 980s, 944s, 885, 802, 754w, 733s, 716, 682w, 654, 639w, 615, 588w, 546s, 513, 500sh, 461, 434.

BSi39 Taramellite $Ba_4(Fe^{3+},Ti,Fe^{2+},Mg)_4(B_2Si_8O_{27})O_2Cl_x$

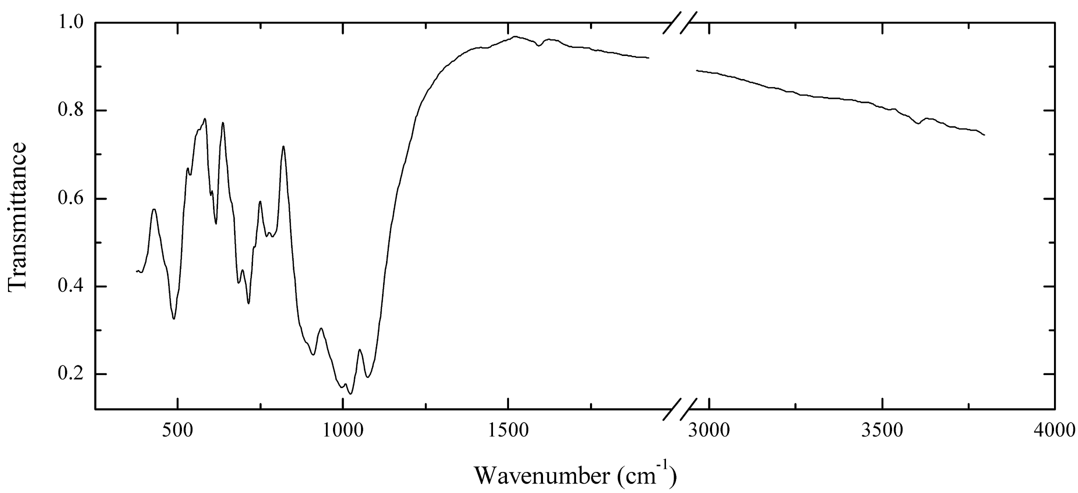


Locality: Candoglia, Piemonte, Italy (type locality).

Description: Brown tabular crystals from the association with calcite, diopside, actinolite and celsian. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3580w, 3550sh, 3315w, 1588w, 1090sh, 1068s, 1017s, 993s, 960sh, 912s, 877s, 794, 762, 734, 711s, 681, 660sh, 650sh, 612, 595, 555sh, 537w, 484s, 457.

BSi40 Titantaramellite $Ba_4(Ti,Fe^{3+},Fe^{2+},Mg)_4(B_2Si_8O_{27})O_2Cl_x$

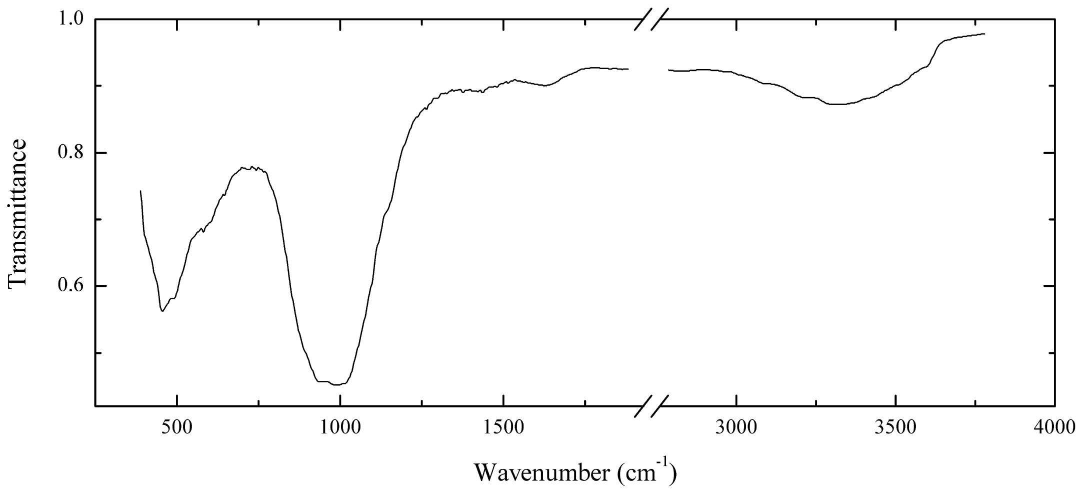


Locality: Esquire #8 Claim, Big Creek, Fresno Co., California, USA.

Description: Dark brown tabular crystals from the association with anandite, bazirite, celsian and quartz. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $(Ba_{3.98}K_{0.01})(Ti_{1.84}Fe_{1.57}Mg_{0.46}Al_{0.07}Cr_{0.03})(B_2Si_{8.00}O_{27})O_2Cl_{0.62}$.

Wavenumbers (cm^{-1}): 3585w, 1592w, 1070s, 1019s, 991s, 906s, 880sh, 787, 765, 731, 711s, 681, 660sh, 612, 596, 565w, 535w, 483s, 390.

BSi41 Tritomite-(Y) $(Y,Ca,REE)_3(Al,Fe^{3+})B_2Si_3(O,OH)_{18}$

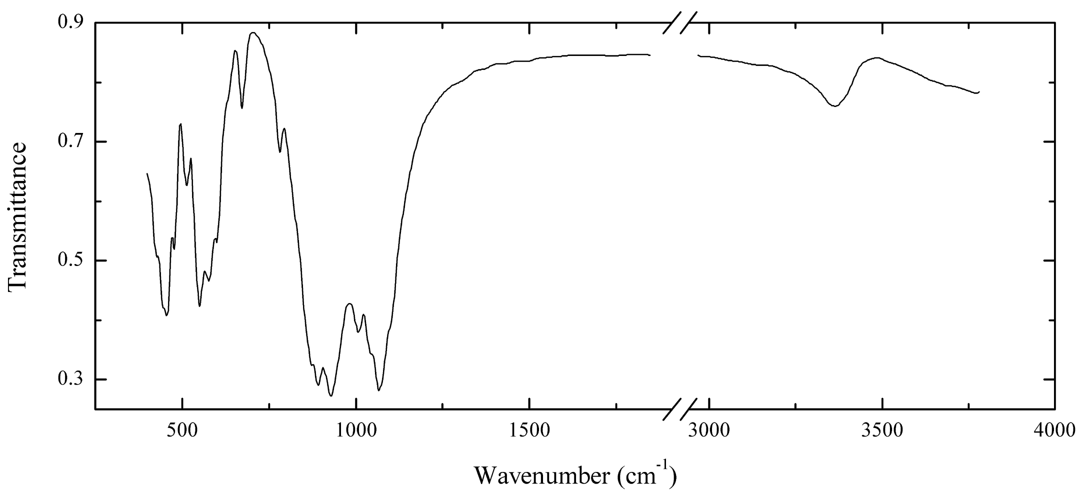


Locality: Cardiff township, Haliburton Co., Ontario, Canada (type locality).

Description: Dark brown. Metamict and hydrated variety. Confirmed by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3300, 1635w, 1140sh, 1015s, 991s, 845s, 580sh, 490, 458, 425sh.

BSi42 Tinzenite $CaMn^{2+}{}_2Al_2(Si_2O_7)_2BO(OH)$

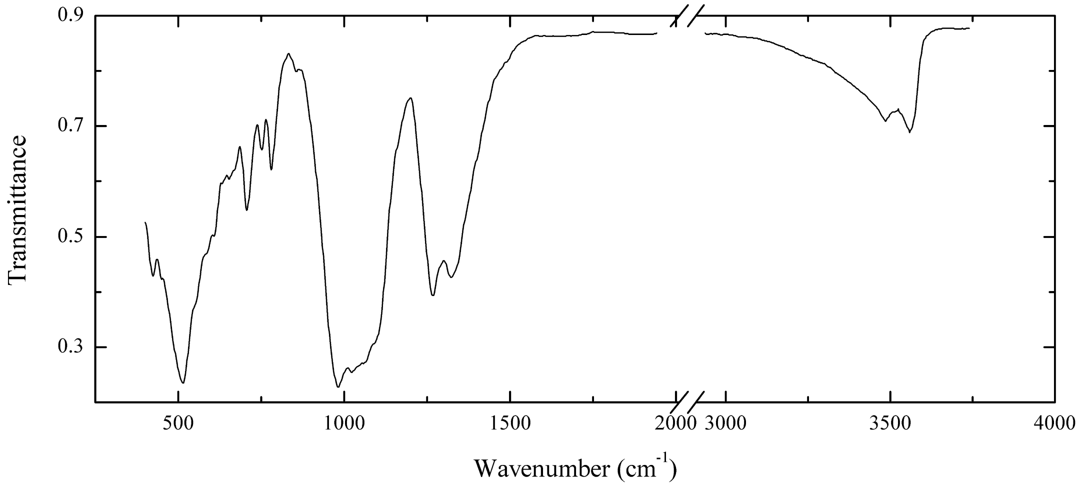


Locality: Falotte, near Tinzen, Oberhalbstein, Albula valley, Grischun, Switzerland.

Description: Yellow aggregate from the association with braunite and quartz. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $Ca_{1.00}(Mn_{1.55}Ca_{0.39}Fe_{0.06})(Al_{1.92}Fe_{0.08})(Si_{3.97}Al_{0.03}O_{14})BO(OH)$.

Wavenumbers (cm^{-1}): 3340, 1095sh, 1066s, 1043s, 1006, 927s, 890s, 872s, 781, 673w, 635sh, 607, 582, 555, 520, 482, 461, 452, 435.

BSi44 Foitite $\square[Fe^{2+}{}_2(Al, Fe^{3+})]Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

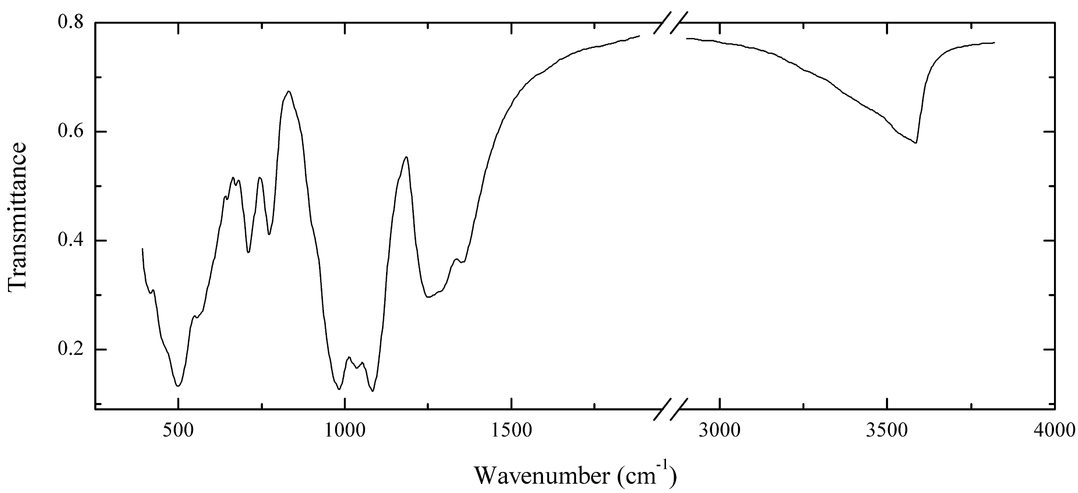


Locality: Mokrusha pegmatite, Murzinka, Middle Urals, Russia.

Description: Black long-prismatic crystal. The empirical formula is (electron microprobe) $(\square_{0.51}Na_{0.46}Ca_{0.03})(Fe_{2.29}Mg_{0.11}Mn_{0.04}Al_{0.56})Al_6(Si_6O_{18})(BO_3)_3(OH)_4$.

Wavenumbers (cm^{-1}): 3555, 3480, 1326, 1270s, 1095sh, 1065sh, 1028s, 982s, 855w, 780, 750, 706, 665sh, 653, 632, 607, 580sh, 550sh, 510s, 448, 420.

BSi45 Uvite $CaMg_3Al_6(Si_6O_{18})(BO_3)_3[(OH)_3O]$

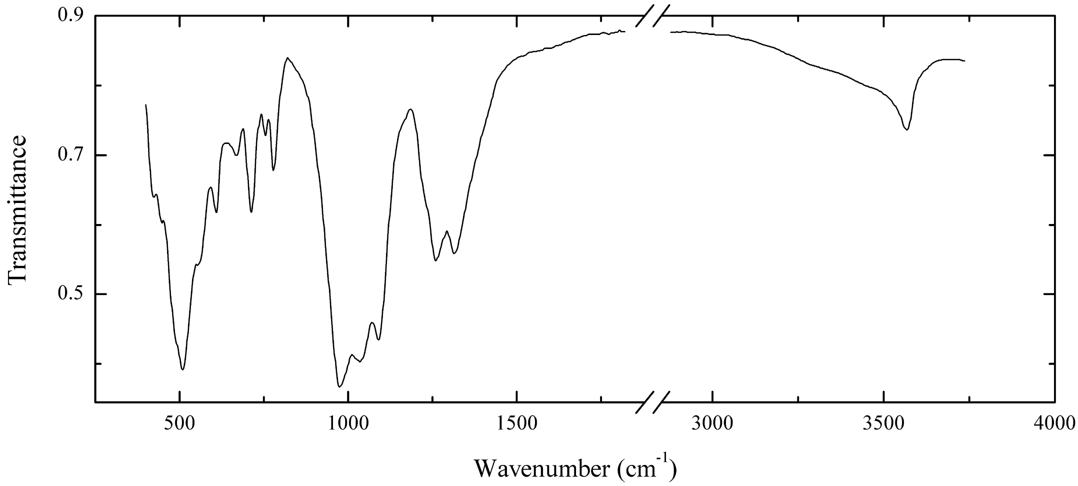


Locality: An unknown locality in China.

Description: Black grains from the association with corundum. The empirical formula is (electron microprobe) $(Ca_{0.80}Na_{0.18})(Mg_{2.38}Fe_{0.50}Al_{0.12})(Al_{5.95}Ti_{0.05})(Si_{5.71}Al_{0.29}O_{18})(BO_3)_3[(OH)_3O]$.

Wavenumbers (cm^{-1}): 3565, 1352, 1290sh, 1254s, 1084s, 1036s, 985s, 777, 713, 680w, 649w, 570sh, 503s, 420.

BSi46 Schorl $NaFe^{2+}{}_3Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

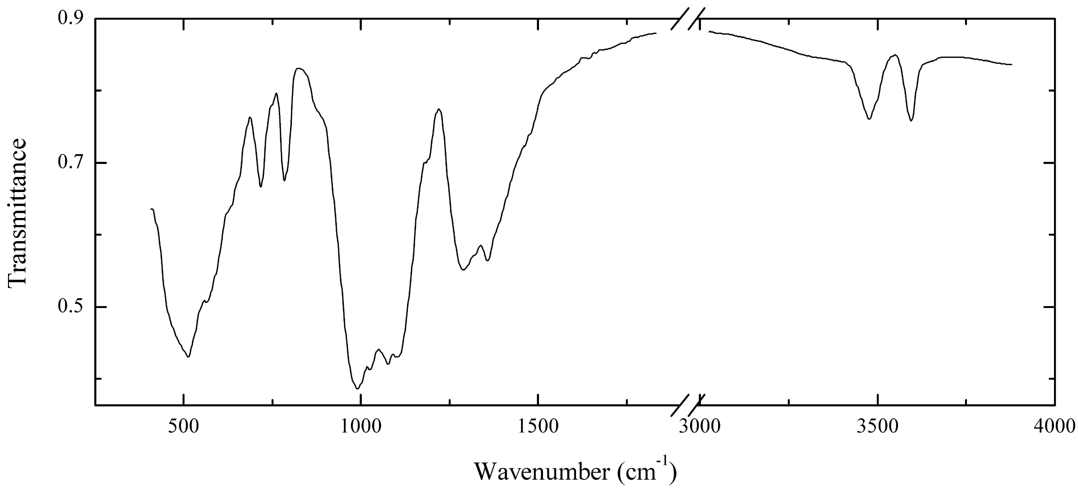


Locality: Amazonitovyi pegmatite, Pamir, Tajikistan.

Description: Dark brown crystal. Li-bearing variety. The empirical formula is (electron microprobe, Li calculated) $(Na_{0.93}K_{0.04})(Fe_{2.06}Li_{0.50}Mn_{0.29}Mg_{0.15})Al_6(Si_{6.00}O_{18})(BO_3)_3(OH)_4$.

Wavenumbers (cm^{-1}): 3558, 1318, 1263s, 1091s, 1039s, 974s, 777, 752, 710, 669, 607, 545sh, 505s, 490sh, 447, 417.

BSi47 Elbaite $Na(Li_{1.5}Al_{1.5})Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

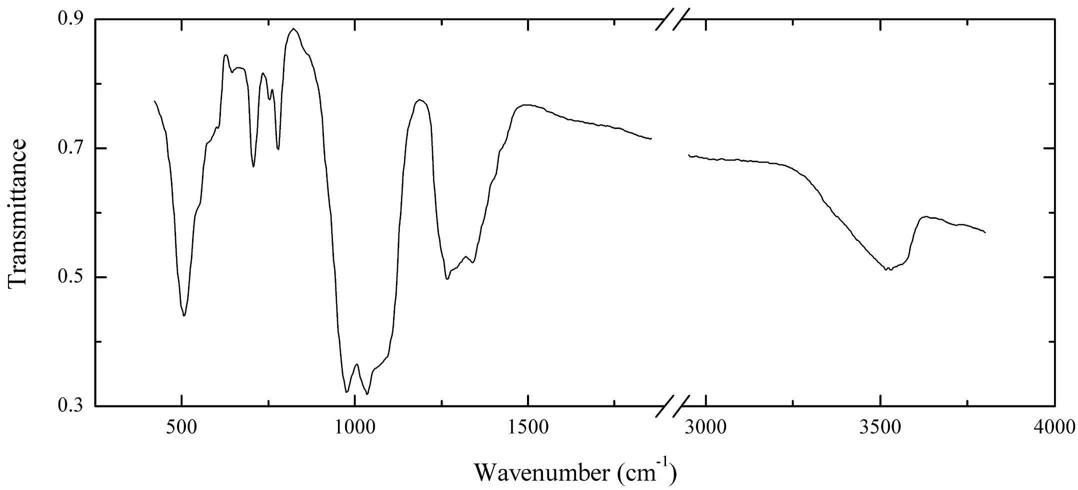


Locality: Vasin-Myl'k Mt., Voron'i Tundry, Kola peninsula, Murnansk region, Russia.

Description: Pink crystal from the association with holtite, albite and quartz.

Wavenumbers (cm^{-1}): 3585, 3465, 1480sh, 1364, 1325sh, 1295, 1185sh, 1109s, 1075s, 1030s, 992s, 875sh, 785, 720, 630sh, 585sh, 564, 508s, 460sh.

BSi48 **Schorl** $NaFe^{2+}{}_3Al_6(Si_6O_{18})(BO_3)_3(OH)_4$

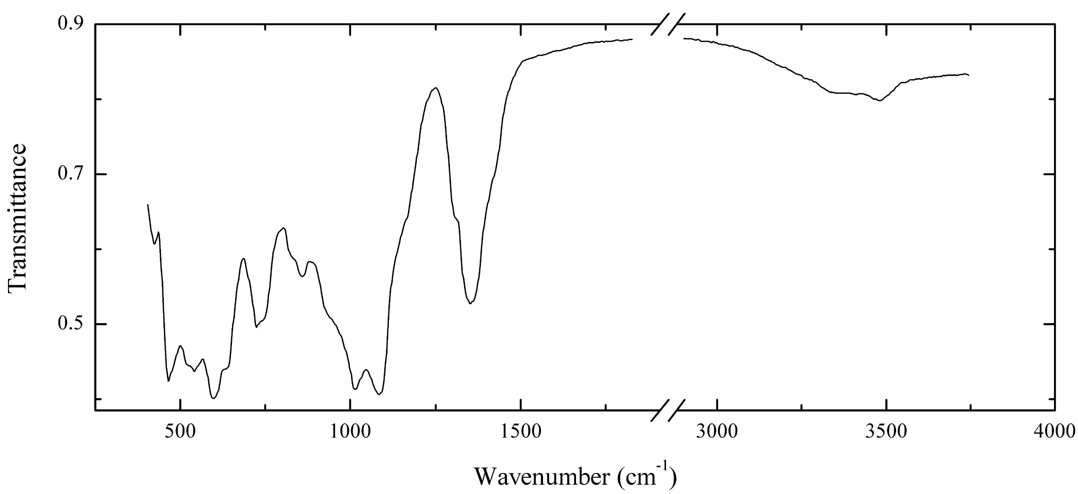


Locality: Sherlovaya Gora, Adun-Cholon range, Chita Oblast', Transbaikal Region, Eastern Siberia, Russia.

Description: Aggregate of black prismatic crystals. The empirical formula is (electron microprobe) $(Na_{0.81}K_{0.03})(Fe_{2.76}Mg_{0.19}Mn_{0.02})(Al_{5.93}Fe_{0.07})(Si_{6.00}O_{18})(BO_3)_3(OH)_4$.

Wavenumbers (cm^{-1}): 3530sh, 3500, 1400sh, 1345, 1290sh, 1270, 1085sh, 1038s, 982s, 865sh, 779, 753w, 707, 652w, 602w, 575sh, 545sh, 506s.

BSi49 **Holtite** $Al_6(Al,Ta)(Si,Sb)_3BO_{15}(O,OH)_2$

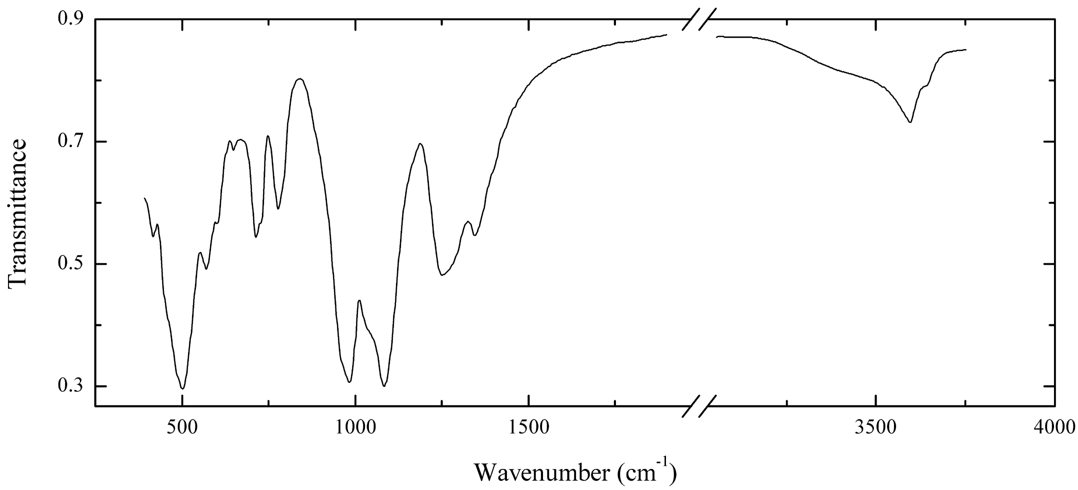


Locality: Vasin-Myl'k Mt., Voron'i Tundras, Kola peninsula, Murnansk region, Russia.

Description: Grey prismatic crystals with blue fluorescence under short-wave UV radiation, from the association with elbaite, albite, quartz and trilithionite. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3480w, 3380w, 1356, 1310sh, 1170sh, 1082s, 1017s, 935sh, 858, 830sh, 745sh, 726, 634s, 600s, 541s, 525sh, 466s, 417.

BSi50 Fluoruvite $(Ca,Na)Mg_3(Al,Mg)_6(Si_6O_{18})(BO_3)_3[(OH)_3(F,O)]$

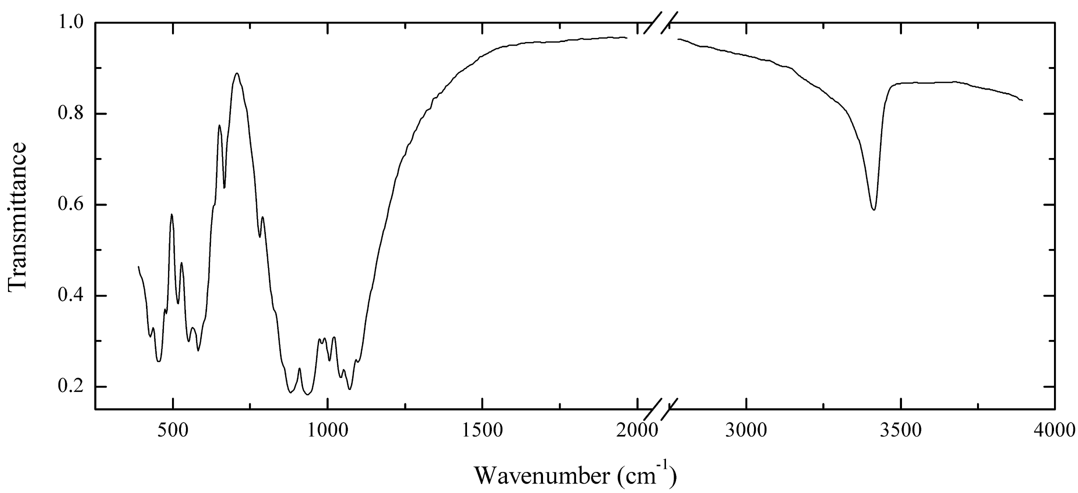


Locality: Kukh-i Lal gem spinel deposit, Pyandzh River valley, Pamir Mts., Tajikistan.

Description: Green lens-like crystals from the association with forsterite, lizardite, spinel, rutile, hydrotalcite and phlogopite. The empirical formula is $(Ca_{0.66}Na_{0.34})(Mg_{3.27}Al_{5.66}Ti_{0.05})(Si_{6.00}O_{18})(BO_3)_3[(OH)_3F_{0.44}O_{0.42}(OH)_{0.14}]$.

Wavenumbers (cm^{-1}): 3620sh, 3575, 1345, 1275sh, 1253s, 1085s, 1040sh, 982s, 960sh, 790sh, 779, 727, 713, 650w, 601, 570, 503s, 485sh, 415.

BSi51 Axinite-(Mn) $Ca_2Mn^{2+}Al_2(Si_2O_7)_2BO(OH)$

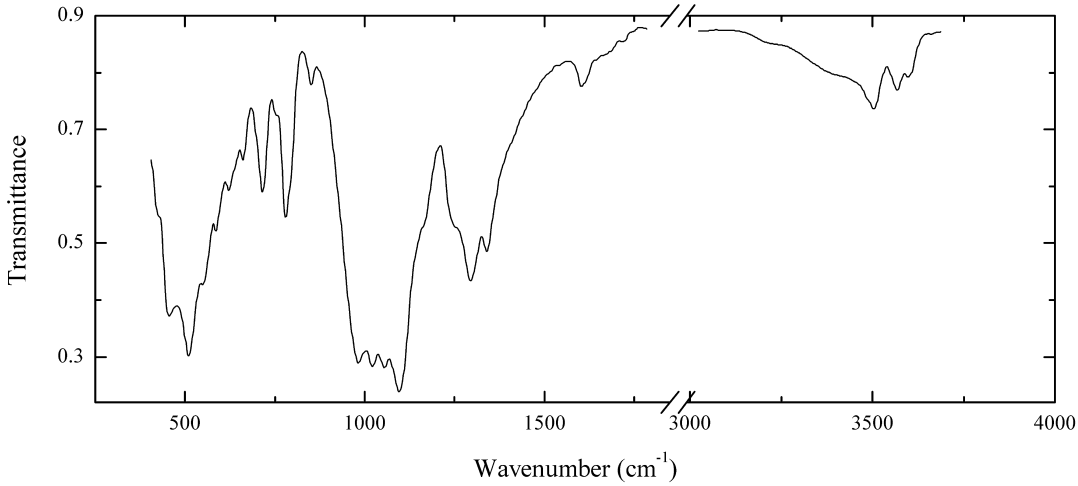


Locality: Bor quarry, Dalnegorsk, Primorskiy Kray, Russia.

Description: Brown crystal. Fe-rich variety. The empirical formula is (electron microprobe) $Ca_{2.06}Mn_{0.66}Fe_{0.35}Al_{1.96}(Si_{3.99}Al_{0.01}O_{14})BO(OH)$.

Wavenumbers (cm^{-1}): 3390, 1098s, 1068s, 1039s, 1004s, 979, 932s, 986s, 855sh, 825sh, 777, 680sh, 664, 629, 600sh, 579s, 547s, 514, 475, 454s, 430s, 410sh.

BSi52 Fluoro-elbaite $Na(Li_{1.5}Al_{1.5})Al_6(Si_6O_{18})(BO_3)_3(OH)_3F$

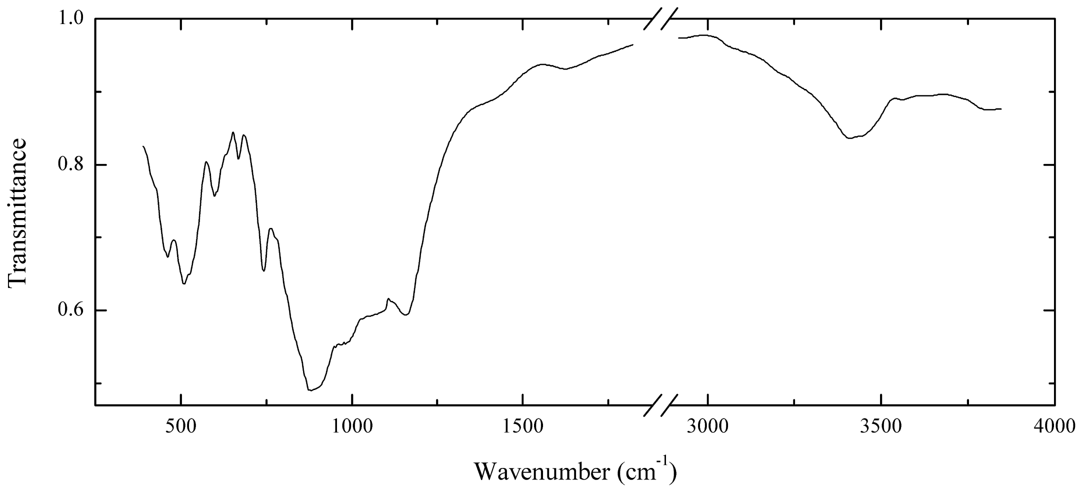


Locality: Viitaniemi pegmatite, Eräjärvi area, Orivesi, Finland.

Description: Light blue crystal from the association with albite, amblygonite and trilithionite. Fe-rich variety. The empirical formula is (electron microprobe) $Na_{0.98}(Al_{0.92}Fe_{0.77}Li_{1.24}Mn_{0.07})(Si_6O_{18})(BO_3)_3(OH,H_2O)_{3.2}F_{0.8}$.

Wavenumbers (cm^{-1}): 3585w, 3555, 3490, 3440sh, 1610w, 1345, 1298, 1260sh, 1099s, 1056s, 1023s, 984s, 851w, 790sh, 781, 755w, 716, 659, 620, 583, 550, 510s, 458s, 425sh.

BSi53 Hellandite-(Y) $(Ca,Y)_4(Y,Ca)_2(Al,Fe^{3+})B_4Si_4O_{22}(OH)_2$

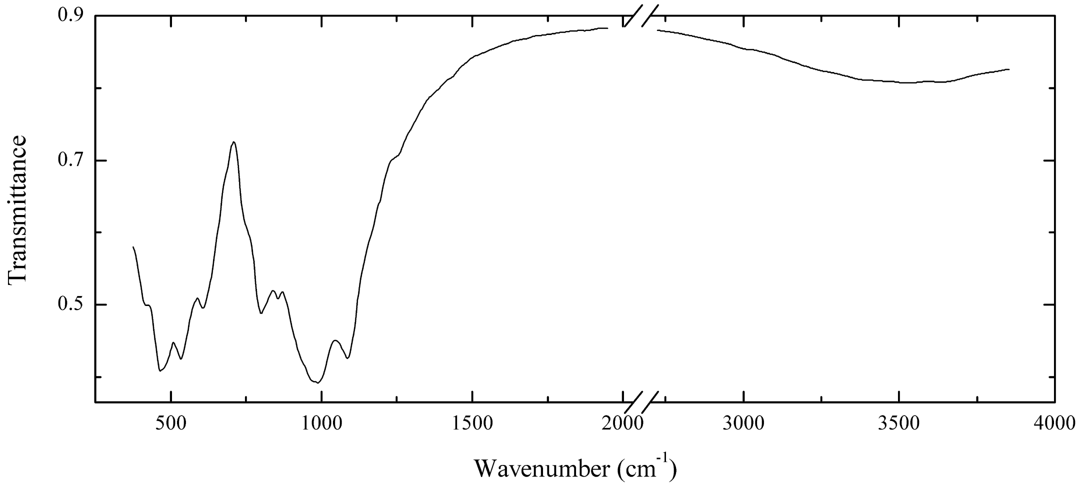


Locality: Tusion River valley, Pamir Mts., Tajikistan.

Description: Brown with conchoidal fracture. Investigated by chemical composition and powder X-ray diffraction pattern.

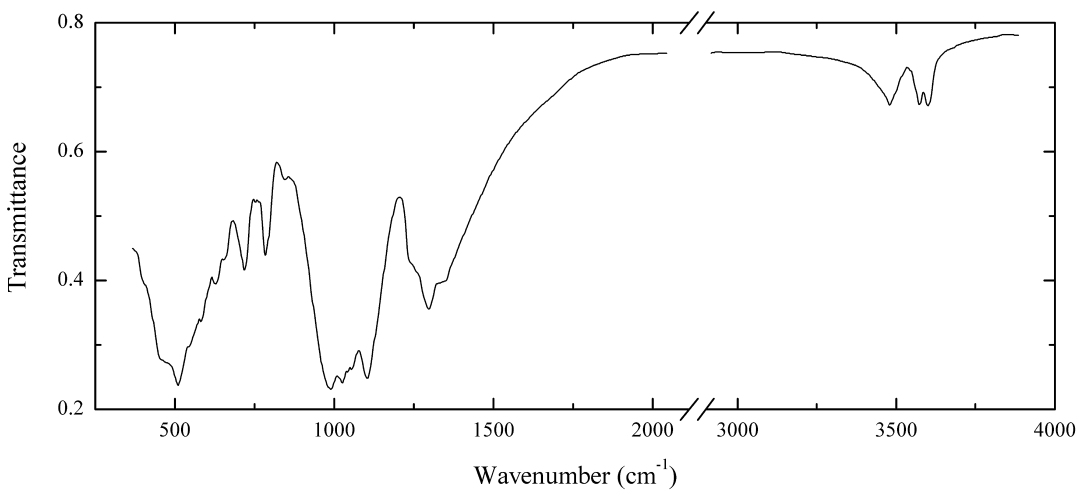
Wavenumbers (cm^{-1}): 3390, 1613w, 1400sh, 1150s, 1079s, 980sh, 915sh, 884s, 742, 664w, 630sh, 595, 506, 459.

BSi54 Serendibite $Ca_2(Mg,Al)_6(Si,Al,B)_6O_{20}$



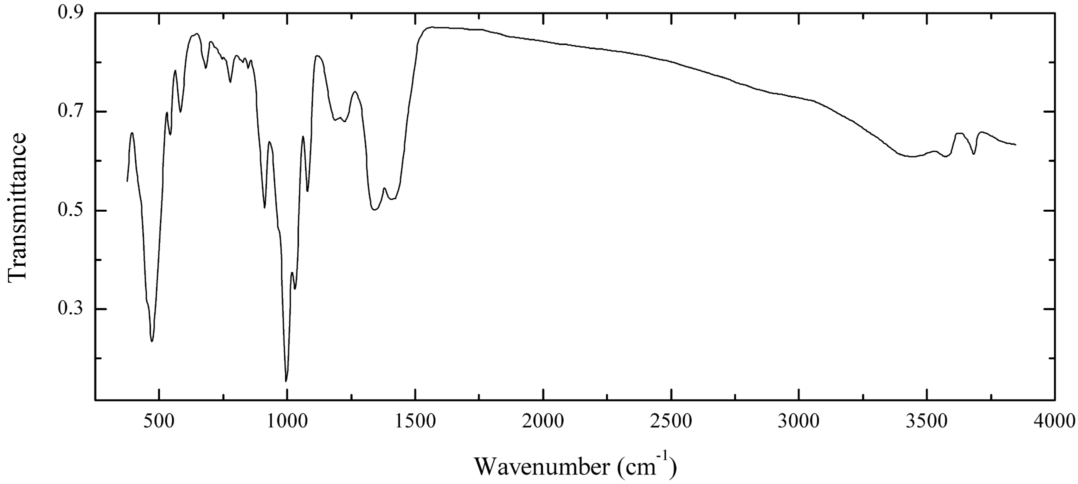
Locality: Johnsburg, New York, USA.
Description: Blue platy crystals in rock.
Wavenumbers (cm^{-1}): 1240sh, 1160sh, 1082s, 975s, 920sh, 848, 796, 750sh, 655sh, 620sh, 602, 535s, 480sh, 466s, 425sh.

BSi55 Elbaite $Na(Li_{1.5}Al_{1.5})Al_6(Si_6O_{18})(BO_3)_3(OH)_4$



Locality: Varuträsk, Skellefteå, Västerbotten, Sweden.
Description: Green crystal from the association with spodumene and pollucite. Fe-bearing variety. The empirical formula is (electron microprobe, Li calculated) $(Na_{0.8}Ca_{0.2})(Li_{1.4}Al_{1.0}Fe_{0.4}Mn_{0.2})Al_{6.0}(Si_6O_{18})(BO_3)_3(OH)_4$.
Wavenumbers (cm^{-1}): 3585, 3560, 3465, 1360sh, 1300, 1250sh, 1103s, 1053s, 1025s, 987s, 847w, 783, 717, 650sh, 627, 580sh, 508s, 470sh.

BSi56 Britvinite $Pb_{15}Mg_9(Si_{10}O_{28})(BO_3)_4(CO_3)_2(OH)_{12}O_2$

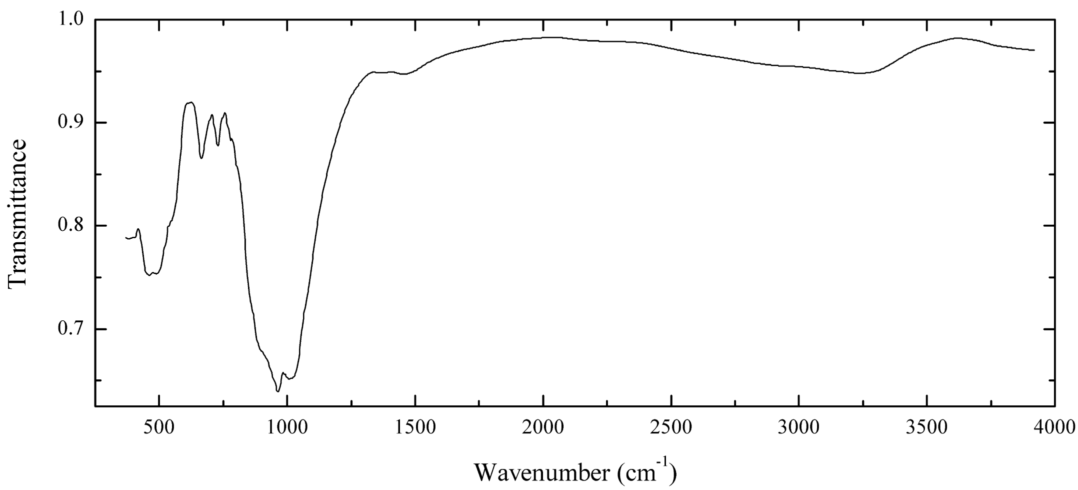


Locality: Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Colourless platelets from the association with calcite, barytocalcite, brucite, cerussite and hausmannite. Holotype sample. The empirical formula is $Pb_{14.75}Mg_{9.03}Si_{9.73}Al_{0.37}O_{30.76}(BO_3)_{3.51}(CO_3)_{2.18}(OH)_{11.17}$. Triclinic, space group $P\bar{1}$; $a = 9.3409(8)$, $b = 9.3597(7)$, $c = 18.8333(14)$ Å, $\alpha = 80.365(6)°$, $\beta = 75.816(6)°$, $\gamma = 59.870(5)°$. Optically biaxial (−), $\alpha = 1.896(2)$, $\beta = 1.903(2)$, $\gamma = 1.903(2)$. $D_{calc} = 5.51$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 18.1 (100), 3.39 (30), 3.02 (90), 2.698 (70), 2.275 (30), 1.867 (30), 1.766 (40), 1.519 (40).

Wavenumbers (cm^{-1}): 3685, 3570, 3440, 1440sh, 1418, 1349, 1230, 1215sh, 1195, 1087, 1033s, 1000s, 966, 912, 847w, 834w, 777, 752w, 682, 600w, 582, 544, 467s, 445s.

BSi57 Hundholmenite-(Y) $(Y,\mathit{REE},Ca,Na)_{15}(Al,Fe^{3+})Ca_xAs^{3+}_{1-x}(Si,As^{5+})Si_6B_3(O,F)_{48}$

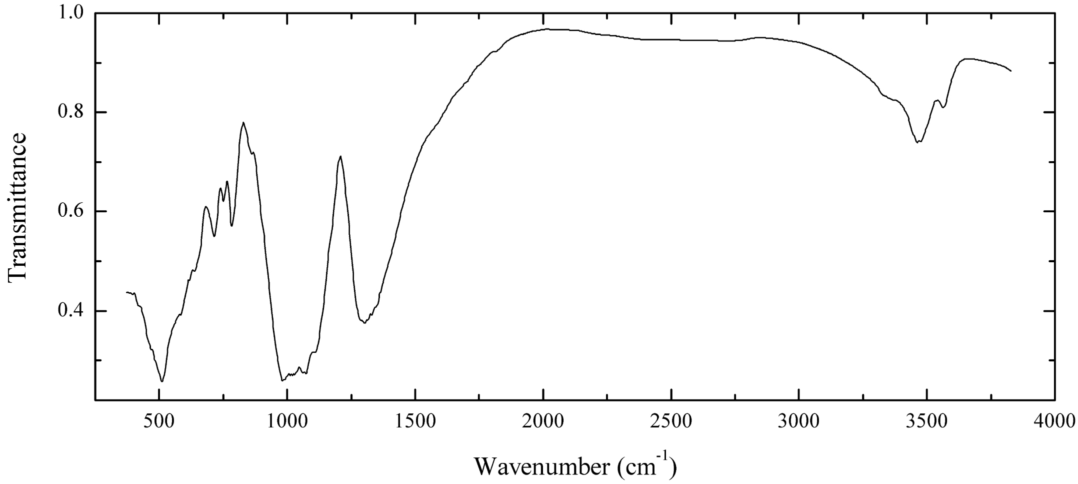


Locality: Hundholmen, Tysfjord, Nordland Co., Norway (type locality).

Description: Brown grains from yttrofluorite.

Wavenumbers (cm^{-1}): 3230w, 1390w, 1013s, 963s, 910sh, 725, 663, 545sh, 490, 458, 380.

BSi58 Olenite (Na,□)$Al_3Al_6(Si_6O_{18})(BO_3)_3(O,OH)_4$

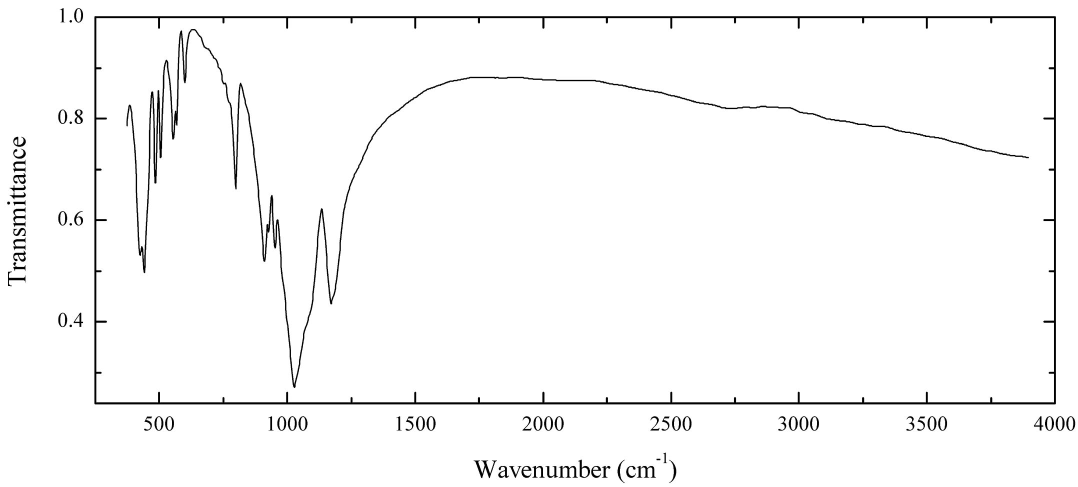


Locality: Uvildy lake, South Urals, Russia.

Description: Blue crystals from the association with dumortierite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3557, 3460, 3360sh, 1312s, 1110sh, 1070s, 1015s, 984s, 862w, 782, 750, 715, 635sh, 580sh, 510s, 470sh.

BSi59 Poudretteite $KNa_2B_3Si_{12}O_{30}$

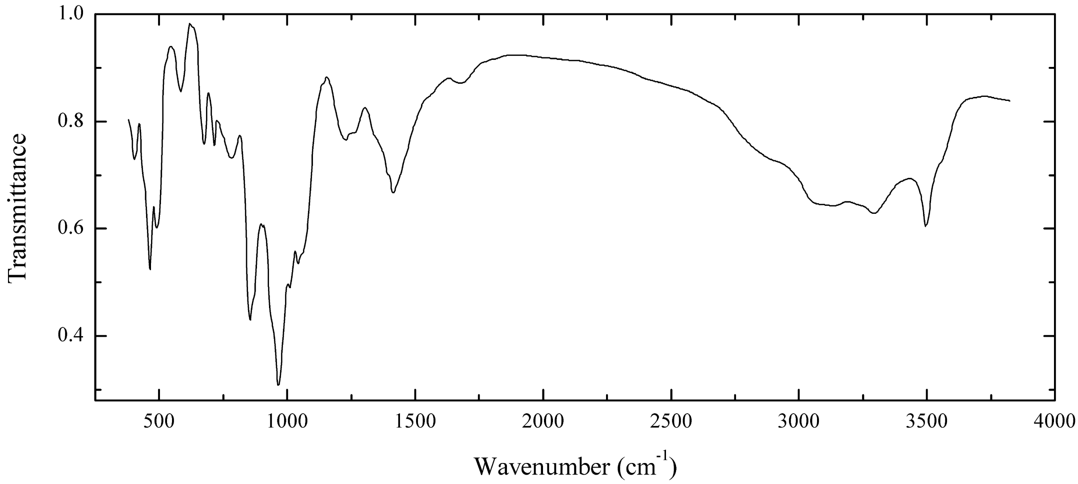


Locality: A placer in the Mogok area, Myanmar.

Description: Colourless. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 2720w, 1169s, 1085sh, 1025s, 952, 926, 911s, 800, 599, 567, 555, 504, 485, 443s, 425.

BSi60 Oyelite $Ca_2BSi_4O_{14}(OH)\cdot6H_2O$

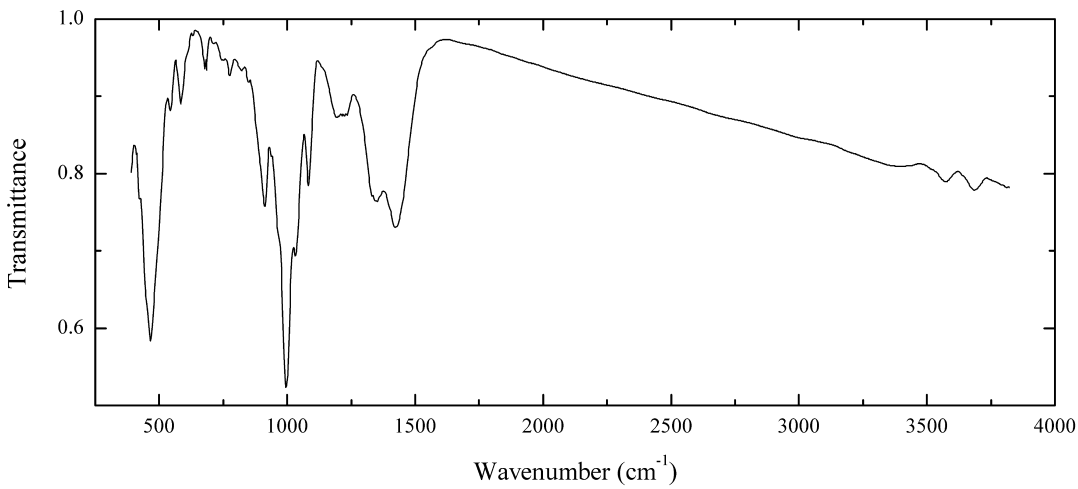


Locality: N'Chwaning II Mine, Kuruman, Kalahari manganese fields, Northern Cape province, South Africa.

Description: White radial aggregates on calcite. Confirmed by IR spectrum. Contains admixture of calcite (the bands at 1,422, 875 and 714 cm^{-1}).

Wavenumbers (cm^{-1}): 3540sh, 3490, 3285, 3120, 2900sh, 1680w, 1422, 1260sh, 1230, 1060sh, 1044s, 1012s, 967s, 945sh, 875sh, 857s, 788, 714, 674, 583, 488, 464s, 404.

BSi61 Britvinite $Pb_{15}Mg_9(Si_{10}O_{28})(BO_3)_4(CO_3)_2(OH)_{12}O_2$

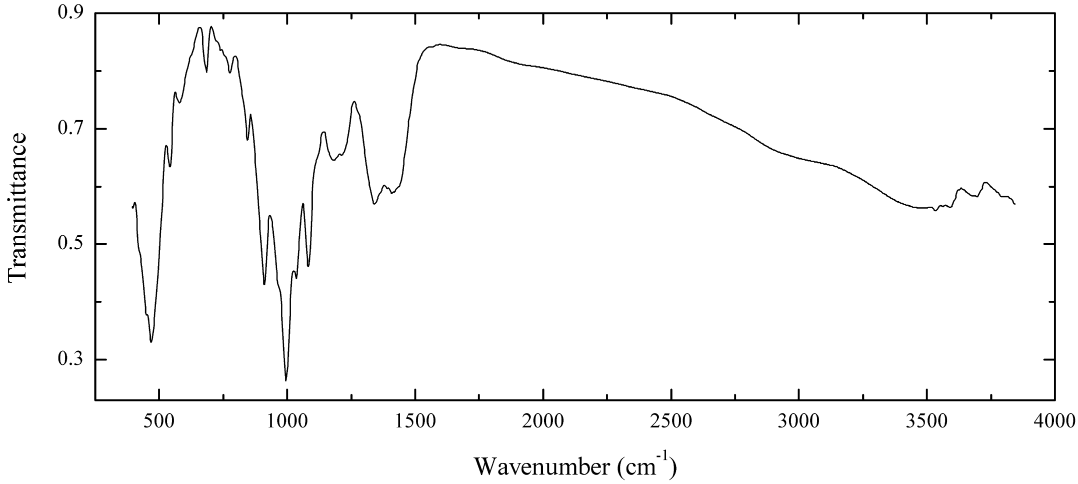


Locality: Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Colourless platelets from the association with calcite, barytocalcite and hausmannite. Confirmed by IR spectrum.

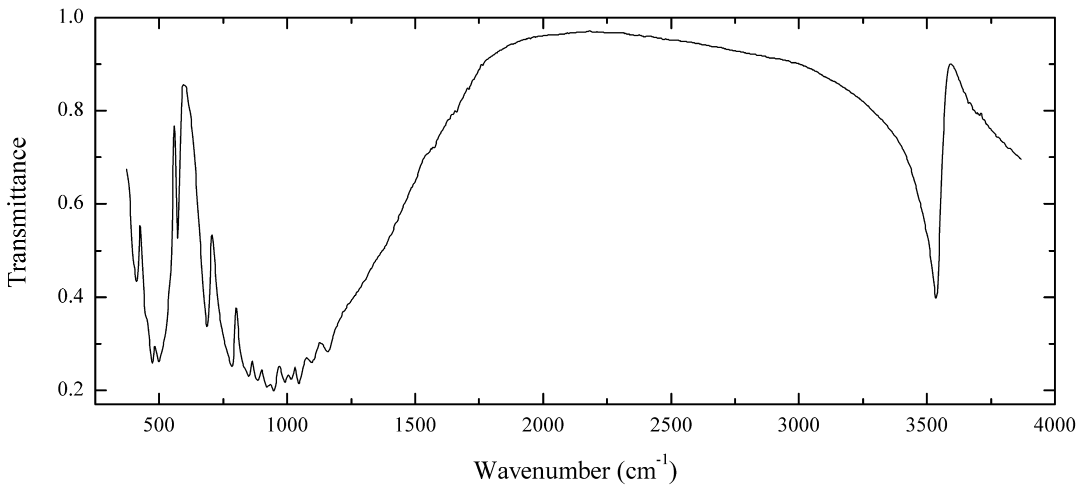
Wavenumbers (cm^{-1}): 3680w, 3570w, 1425s, 1350, 1230, 1195, 1087, 1034s, 1000s, 965sh, 912, 848w, 834w, 776w, 752w, 682, 582, 543, 467s, 445sh.

BSi62 Britvinite $Pb_{15}Mg_9(Si_{10}O_{28})(BO_3)_4(CO_3)_2(OH)_{12}O_2$



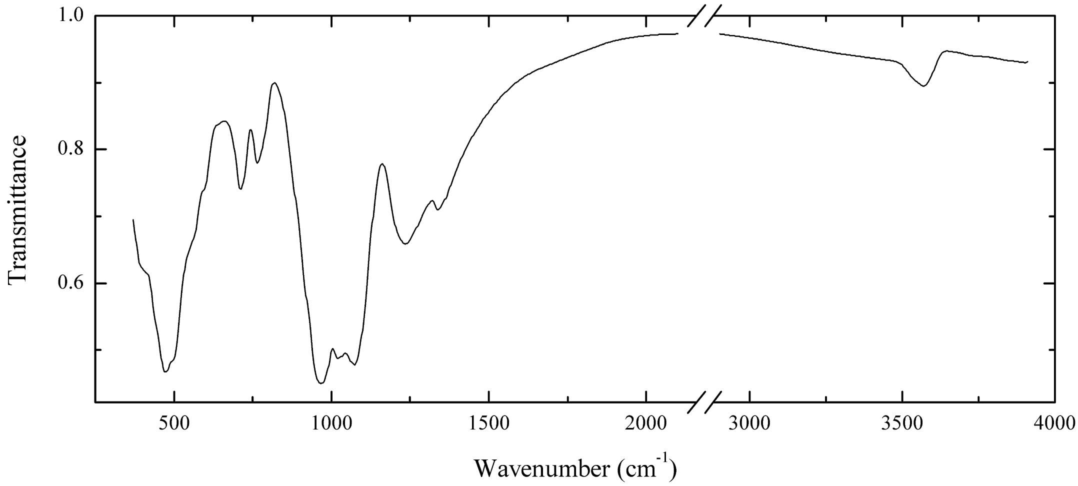
Locality: Kombat mine, Grootfontein district, Otjozondjupa region, Namibia.
Description: Colourless platelets. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3678w, 3570w, 3485w, 1416, 1347, 1228, 1192, 1086s, 1035s, 998s, 970sh, 910s, 846, 776w, 745sh, 720sh, 680w, 580w, 540, 466, 445sh, 420sh.

BSi64 Datolite $CaBSiO_4(OH)$



Locality Borehole at the Korshunovskoe iron deposit, Irkutsk region, Siberia, Russia.
Description: White powdery from the association with halite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3497, 1156, 1091, 1038s, 1009s, 988s, 944s, 916s, 882s, 847s, 830sh, 781, 685, 574, 520sh, 499, 470, 413.

BSi66 Uvite $CaMg_3Al_6(Si_6O_{18})(BO_3)_3[(OH)_3O]$

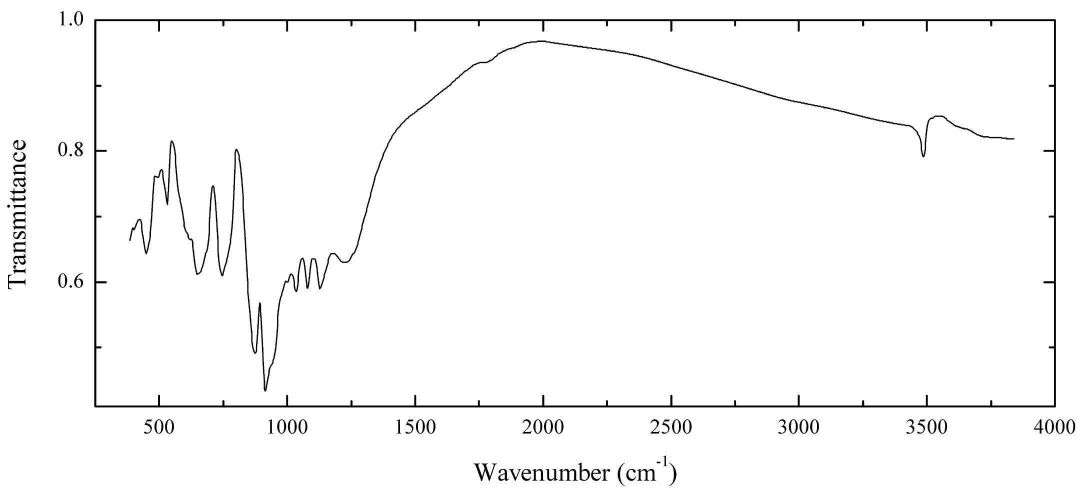


Locality: Arnold mine, Fowler, St. Lawrence Co., New York, USA.

Description: Dark red crystals from the association with tremolite. The empirical formula is (electron microprobe) $(Ca_{0.67}Na_{0.29})Mg_{3.00}(Al_{4.39}Mn^{+}_{0.52}Fe_{0.50}Mg_{0.41}Ti_{0.10}Cr_{0.03})(Si_6O_{18})(BO_3)_3(OH,O,F)_4$.

Wavenumbers (cm^{-1}): 3572, 1345, 1240, 1073s, 1024s, 967s, 764, 712, 595sh, 560sh, 490sh, 470s, 405sh.

BSi67 Okayamalite $Ca_2B_2SiO_7$

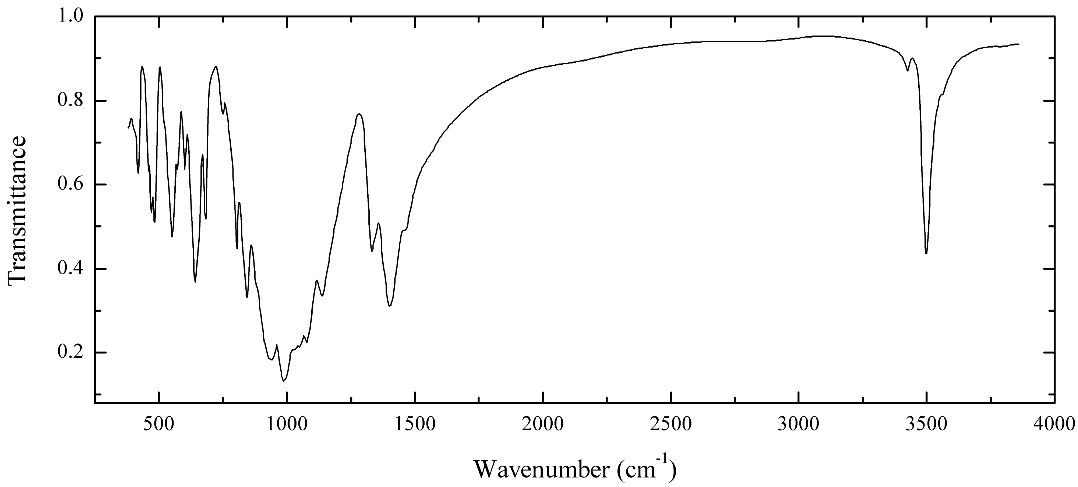


Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan (type locality).

Description: Grey massive. Identified by IR spectrum.

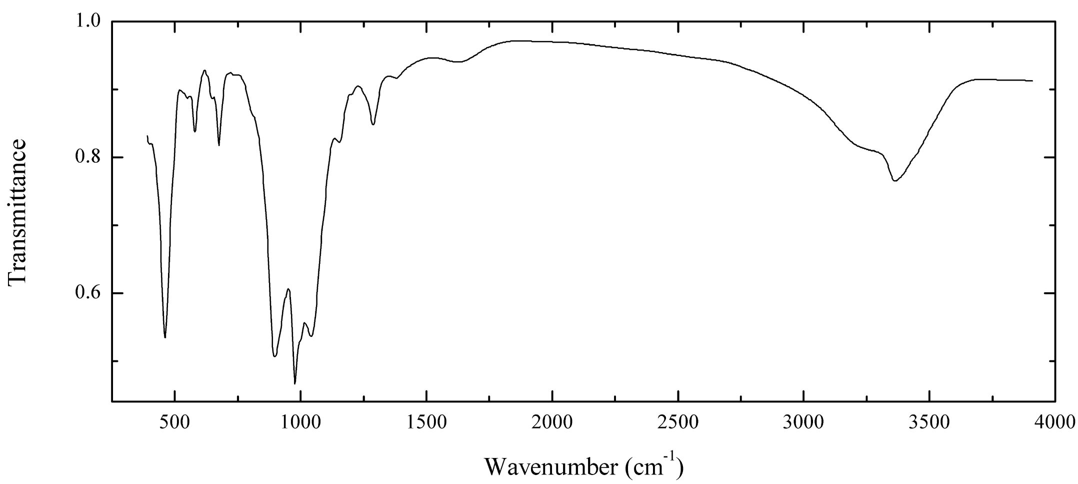
Wavenumbers (cm^{-1}): 3480w, 1234, 1130, 1080, 1036, 1003, 940sh, 915s, 875s, 775sh, 746, 685sh, 650, 623, 580sh, 530w, 497w, 447.

BSi68 Jadarite $LiNaSiB_3O_7(OH)$



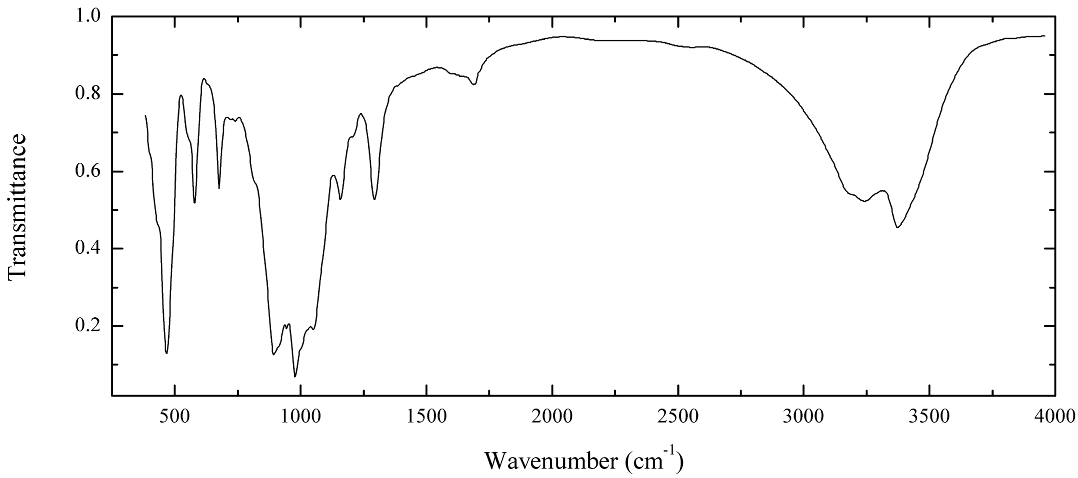
Locality: Jadar valley, Jadar basin, Serbia (type locality).
Description: Light grey, massive. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3485, 3410w, 1460sh, 1405s, 1078s, 1050s, 1030sh, 990s, 941s, 885sh, 845s, 805, 750w, 683, 655sh, 643s, 602, 572, 552, 525sh, 483, 470, 453, 418.

BSi69 Kasatkinite $Ba_2Ca_8B_5Si_8O_{32}(OH)_3{\cdot}6H_2O$



Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia (type locality).
Description: White soft aggregates of acicular to hair-like crystals from the association with prehnite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3330, 3200sh, 1620w, 1380w, 1289, 1200w, 1154, 1041s, 995sh, 977s, 895s, 674, 645w, 577, 544w, 460s.

BSi70 Kasatkinite $Ba_2Ca_8B_5Si_8O_{32}(OH)_3{\cdot}6H_2O$

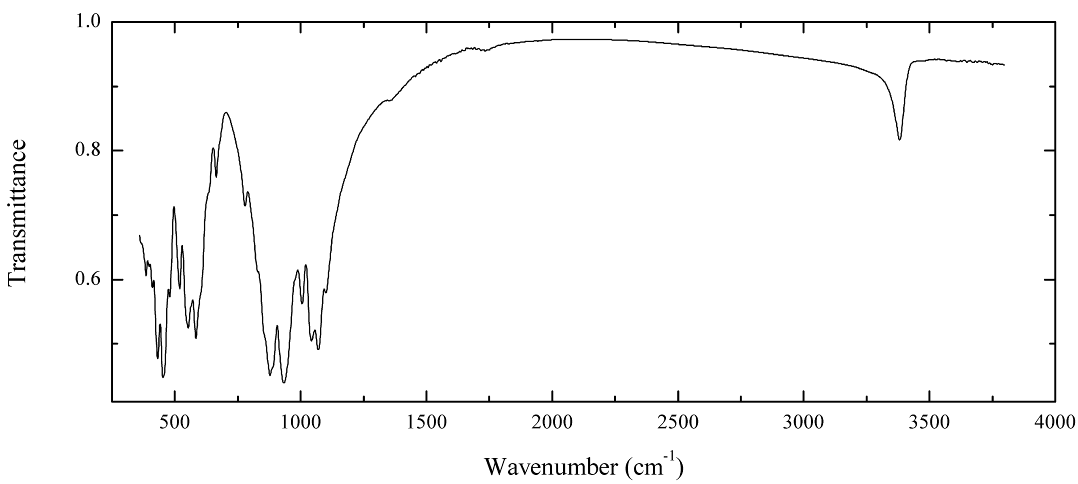


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia (type locality).

Description: White soft aggregates of acicular to hair-like crystals from the association with prehnite, pectolite, calcite and clinochlore. Holotype sample. The empirical formula is $Na_{0.11}K_{0.18}Ba_{1.66}Ca_{7.84}B_{5.05}Al_{0.08}Si_{8.00}O_{31.80}(OH)_{3.06}F_{0.04}{\cdot}6.10H_2O$. Monoclinic, space group $P2_1/c$, $P2/c$ or Pc, $a = 5.745(3)$, $b = 7.238(2)$, $c = 20.79(1)$ Å, $\beta = 90.82(5)°$. Optically biaxial (+), $\alpha = 1.600(5)$, $\beta = 1.603(2)$, $\gamma = 1.626(2)$. $D_{meas} = 2.95(5)$ g/cm^3, $D_{calc} = 2.89$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 5.89 (24), 3.48 (23), 3.36 (24), 3.009 (100), 2.925 (65), 2.633 (33), 2.116 (29).

Wavenumbers (cm^{-1}): 3345s, 3210, 3160sh, 2515w, 1686w, 1630sh, 1293, 1205sh, 1157, 1050s, 1000sh, 978s, 944s, 910sh, 892s, 820sh, 741w, 723w, 676, 578, 550sh, 464s, 430sh, 405sh.

BSi71 Axinite-(Mg) $Ca_2MgAl_2(Si_2O_7)_2BO(OH)$

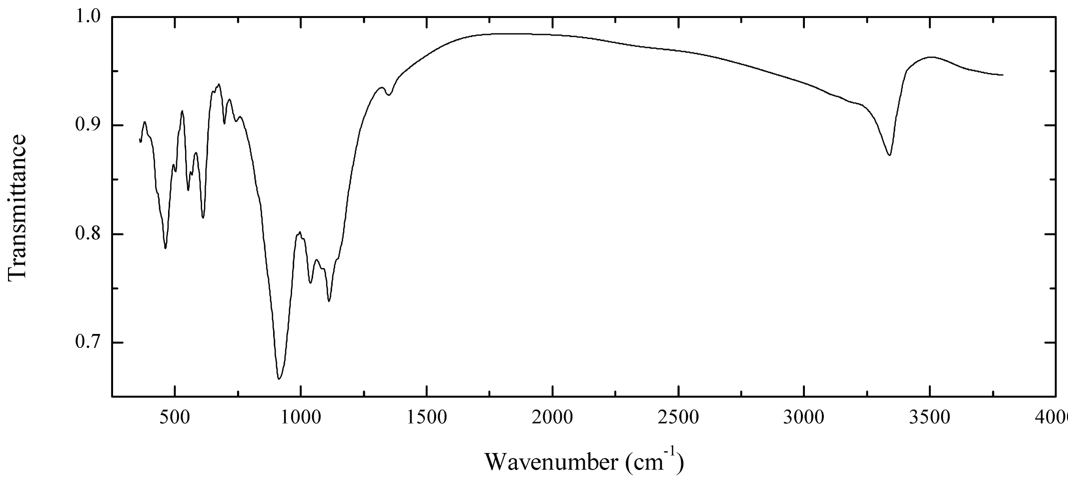


Locality: Petlinskiy quarry, Bakal, South Urals, Russia.

Description: Brownish-grey grains. Investigated by Yu.V. Erokhin. Mg : (Fe + Mn) ≈ 3:2 (in atomic units).

Wavenumbers (cm^{-1}): 3382, 1732w, 1352w, 1101, 1070s, 1043s, 1006, 933s, 890sh, 878s, 860sh, 840sh, 779, 664, 630sh, 600sh, 583, 553, 519, 479, 553s, 431s, 411, 388.

BSi72 Vistepite $Mn^{2+}{}_5SnB_2Si_5O_{20}$

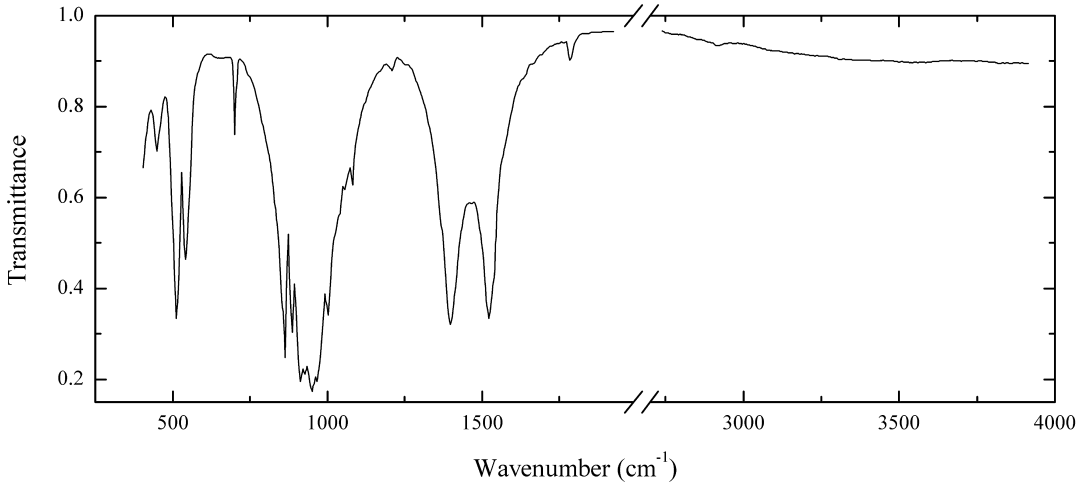


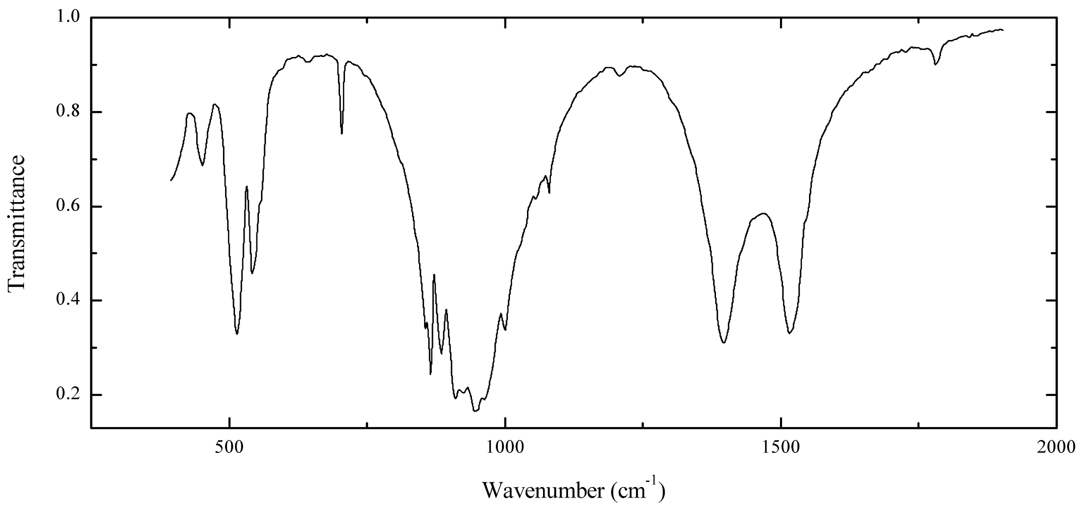
Locality: About 8 km upriver from the settlement Inylchek, near the Trudovoe tin deposit, Inylchek range, Tien Shan Mts., Kyrgyzstan (type locality).

Description: Yellow-orange grains from the association with rhodonite, quartz, tephroite, spessartine, galena, hübnerite, chalcopyrite, sphalerite, stannite, rhodochrosite, cassiterite, celsian, fluorite, helvite, neotocite, schorl, pyrite and pyrophanite. Holotype sample. The empirical formula is $(Mn_{4.84}Ca_{0.10}Fe_{0.05})Sn_{1.02}B_2(Si_{4.90}Al_{0.11})O_{20}$. Monoclinic, space group $P2/m$, $a = 28.77(1)$, $b = 7.01(2)$, $c = 13.72(2)$ Å, $\beta = 96.6(2)°$. Optically biaxial (–), $\alpha = 1.693(3)$, $\beta = 1.711(5)$, $\gamma = 1.715(5)$, $2V = 57(3)°$. $D_{meas} = 3.67(5)$ g/cm^3, $D_{calc} = 3.70$ g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 3.41 (80), 3.22 (80), 2.83 (100), 2.81 (100), 2.24 (70), 1.750 (60), 1.703 (50).

Wavenumbers (cm^{-1}): 3340, 3200sh, 1350w, 1145sh, 1112s, 1090sh, 1039s, 1005sh, 914s, 746w, 697w, 611, 569, 552, 502, 462, 450sh, 430sh.

CSi1 Spurrite $Ca_6(SiO_4)_2(CO_3)$



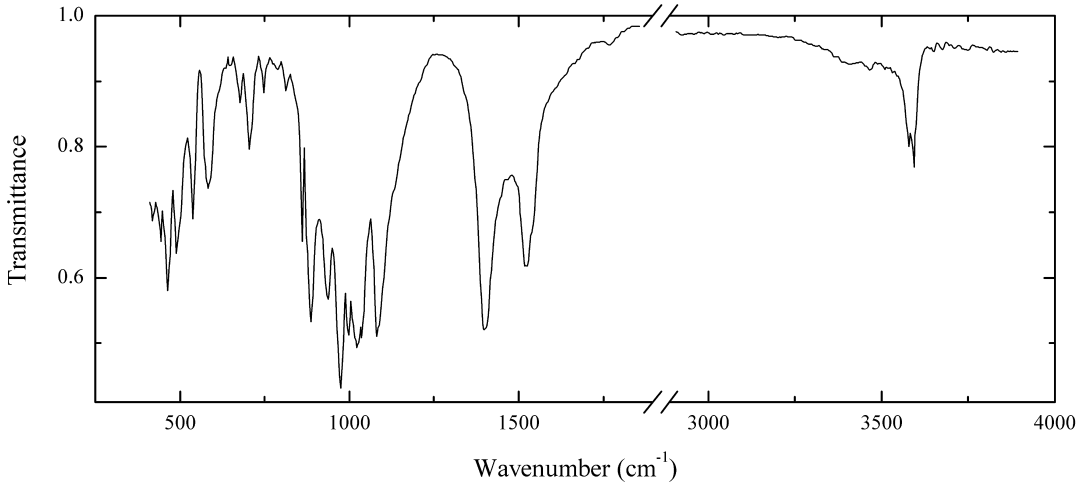


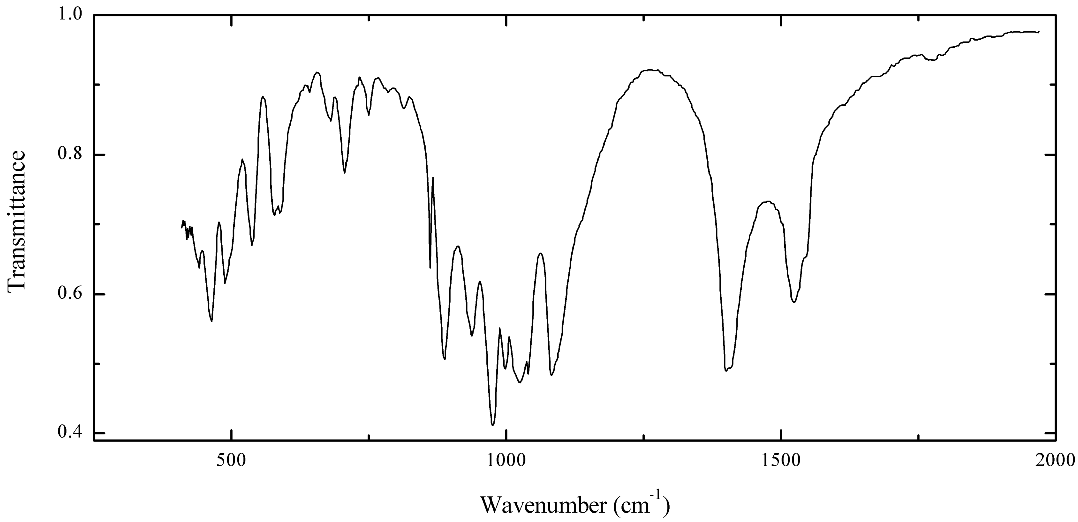
Locality: Darwin, Inyo Co., California, USA.

Description: Grey granular aggregate of polysynthetic twins ("paraspurrite") from the association with vesuvianite and larnite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 1783w, 1520s, 1396s, 1212w, 1080, 1055, 1035sh, 1000, 960sh, 949s, 927s, 921s, 911s, 884s, 862s, 854, 703, 540, 511, 413.

CSi2 Fukalite $Ca_4Si_2O_6(CO_3)(OH)_2$



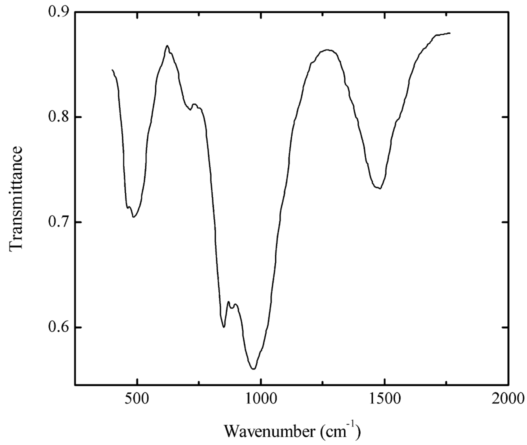


Locality: Gumeshevskiy copper mine, Polevskoy, Middle Urals, Russia.

Description: Colourless lenticular crystals from the association with ellestadite-(OH), foshagite, andradite, chlorite, tobermorite, calcite, anhydrite and gypsum. The crystal structure is solved. Orthorhombic, space group $P2_12_12_1$; $a = 3.786$, $b = 10.916$, $c = 23.379$ Å. Optically biaxial (−), $\alpha = 1.585(1)$, $\beta = 1.626(2)$, $\gamma = 1.645(1)$. $D_{meas} = 2.78(2)$ g/cm^3. The empirical formula is $(Ca_{3.91}Mg_{0.05}Fe_{0.02}Al_{0.01})Si_{1.99}S_{0.01}O_6(CO_3)(OH)_2$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 5.84 (25), 2.921 (69), 2.847 (100), 2.458 (37), 2.338 (36), 1.948 (19).

Wavenumbers (cm^{-1}): 3587, 3572, 3457w, 3405w, 1774w, 1540sh, 1523, 1404s, 1140sh, 1095sh, 1082s, 1037s, 1023s, 998s, 975s, 936, 887s, 880sh, 860, 816w, 786w, 747w, 705, 676w, 596, 580sh, 538, 495sh, 487, 462, 440, 412.

CSi3 Iimoriite-(Y) $Y_2(SiO_4)(CO_3)$

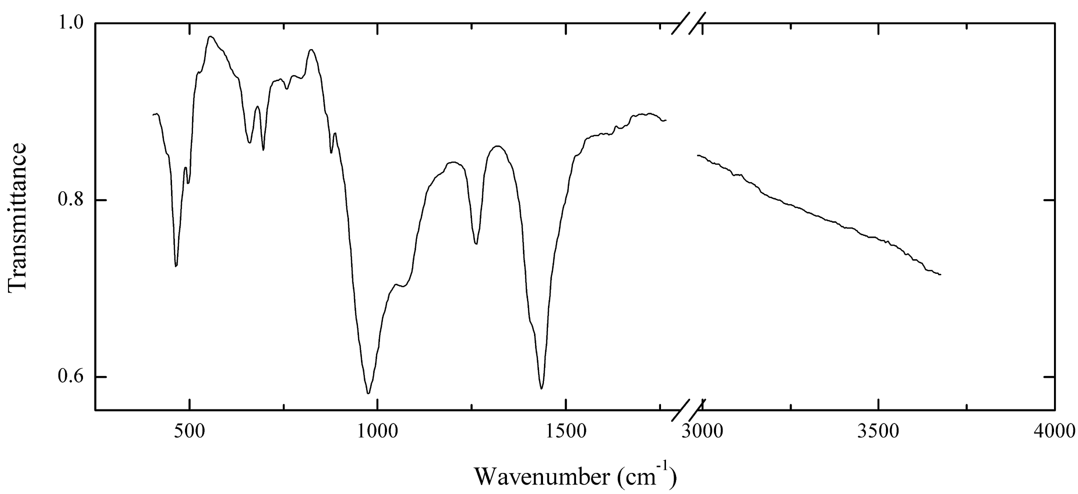


Locality: Åskagen quarry, near the former mining settlement Torskebäcken, 12 km ENE of Filipstad town, Värmlands län, Sweden.

Description: Brown massive from the association with allanite-(Y), allanite-(Nd), thalenite-(Y) and tengerite-(Y). The empirical formula is $(Y_{1.29}Ca_{0.31}Yb_{0.11}Dy_{0.10}Gd_{0.08}Nd_{0.07}Sm_{0.06}Er_{0.05}Ce_{0.01})$ $[(SiO_4)_{0.96}(PO_4)_{0.04}](CO_3)_x$.

Wavenumbers (cm^{-1}): 1550sh, 1460, 1095sh, 1015sh, 969s, 945sh, 877, 954s, 710w, 555sh, 493, 463, 425sh.

CSi4 Kampfite $Ba_{12}(Si_{11}Al_5)O_{31}(CO_3)_8Cl_5$

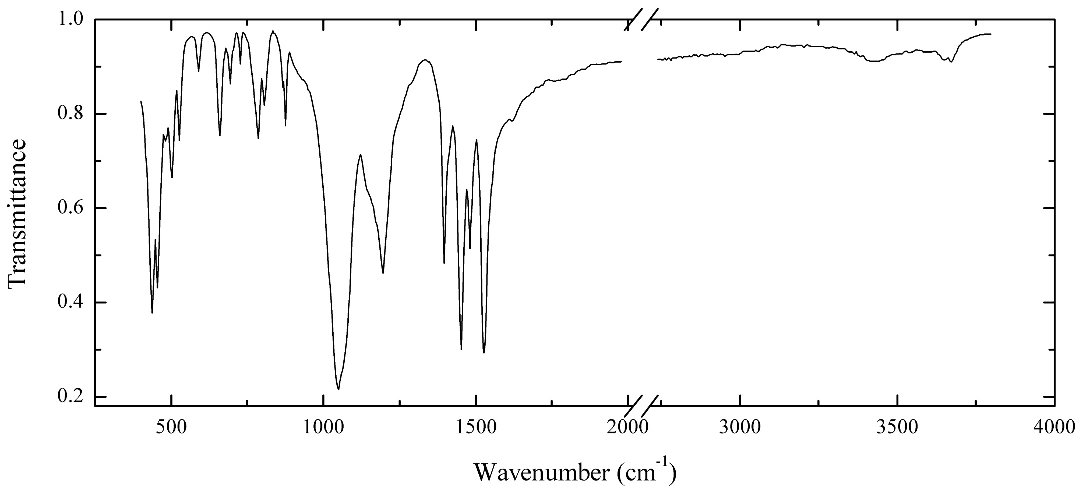


Locality: Esquire #1 claim, Rush Creek, Fresno Co., California, USA (type locality).

Description: Bluish-grey granular aggregate from the association with quartz and sanbornite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1435s, 1410sh, 1262, 1064s, 976s, 874, 860w, 800w, 756w, 692, 655, 525w, 493, 457s.

CSi5 Carletonite $KNa_4Ca_4Si_8O_{18}(CO_3)_4(OH,F)\cdot H_2O$

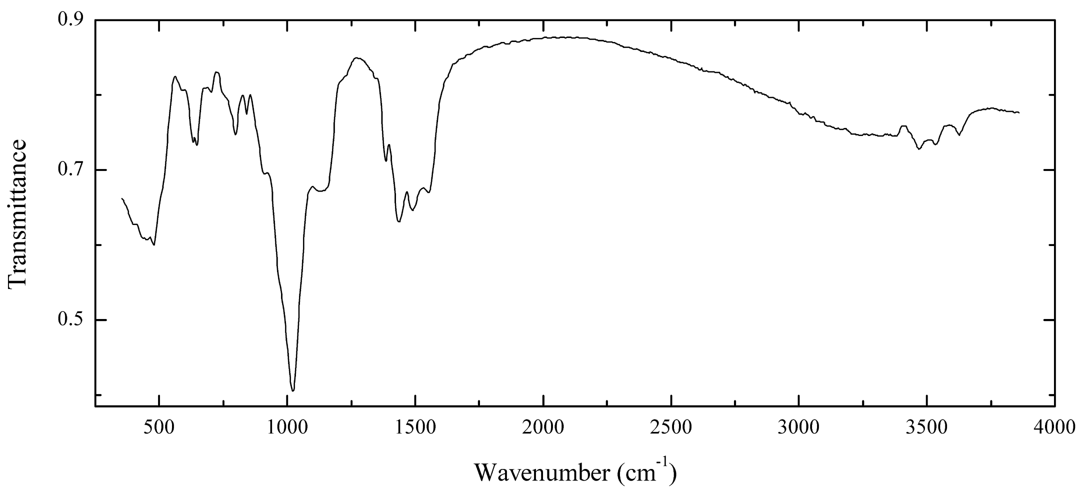


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Light violet crystal from the association with quartz, fluorite, albite and pectolite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3640w, 3410w, 1765w, 1620w, 1526s, 1481, 1451s, 1396, 1193, 1150sh, 1060sh, 1047s, 875, 866w, 804, 784, 728w, 705sh, 693w, 660, 589w, 524, 500, 491, 453, 436s.

CSi7 Caysichite-(Y) $Y_4(Ca_3\mathit{REE})(Si_8O_{20})(CO_3)_6(OH)\cdot 7H_2O$

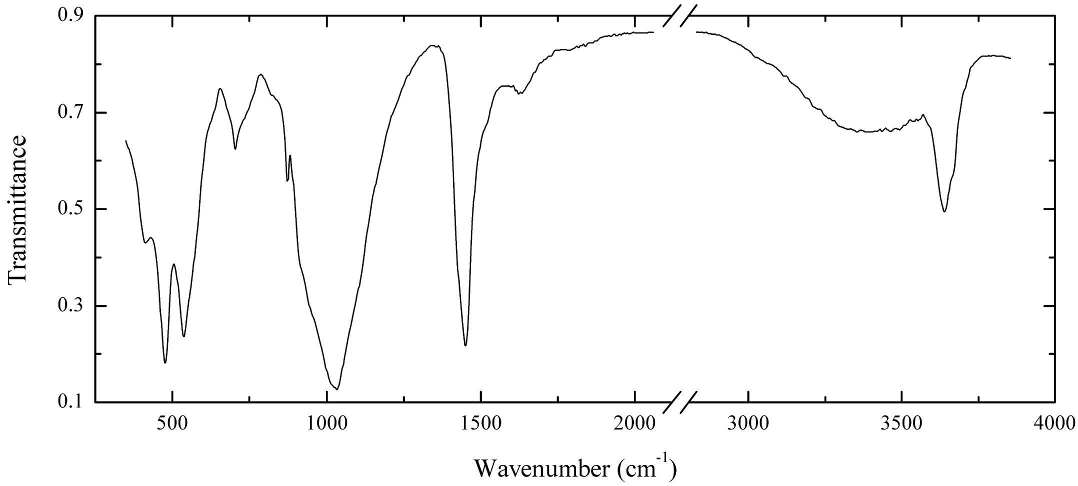


Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: White radial-fibrous aggregates in yttrofluorite. Identified by IR spectrum and semi-quantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3605w, 3500w, 3450w, 3300w, 3240sh, 1565sh, 1528, 1497, 1435, 1385, 1144, 1022s, 980sh, 965sh, 907, 837w, 796, 780sh, 750sh, 702w, 637, 624, 590w, 502sh, 480, 457, 445sh, 430.

CSi8 Niksergievite $[(Ba,Ca)_2Al(CO_3)(OH)_4][Al_2(AlSi_3O_{10})(OH)_2]\cdot nH_2O$

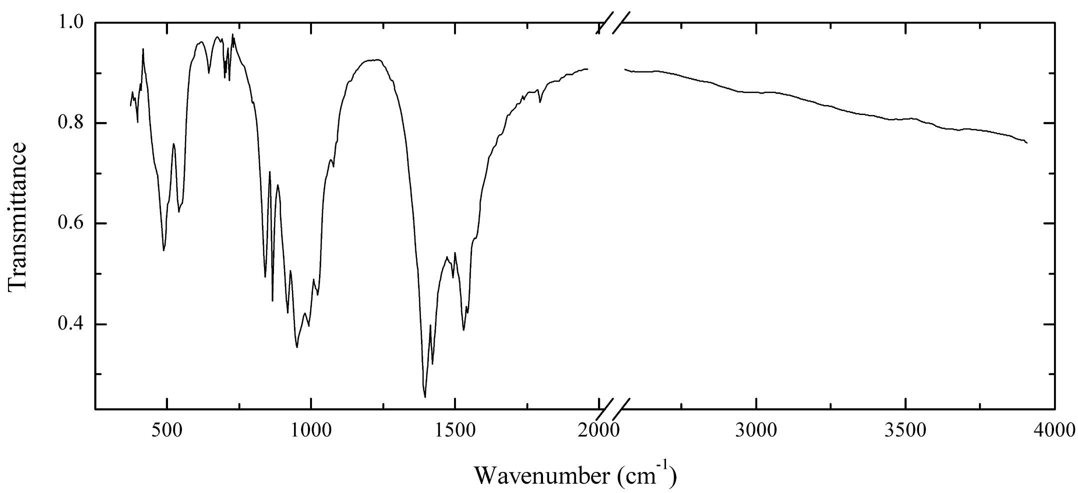


Locality: The −400 m level of the Tekeli Pb–Zn mine, SE Kazakhstan (type locality).

Description: White rosette-like aggregates in the association with calcite, quartz, dolomite, celsian, sphalerite, pyrite, barite and montmorillonite. Holotype sample. Monoclinic, space group $C2/c$, $C2$, *or* Cm; $a = 5.176(3)$, $b = 8.989(3)$, $c = 16.166(5)$ Å, $\beta = 96.44(6)°$. Optically biaxial (−), $\alpha = 1.580(2)$, $\beta = 1.625(2)$, $\gamma = 1.625(2)$. $D_{meas} = 3.16$ g/cm^3 and $D_{calc} = 3.21$ g/cm^3. The empirical formula is $(Ba_{1.27}Ca_{0.65}K_{0.02})_{1.92}(Al_{3.49}Si_{3.42}Mg_{0.07}Fe^{2+}{}_{0.02})_{7.00}O_{10.00}(CO_3)_{0.99}(OH)_{6.20}\cdot 0.20H_2O$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 16.1 (40) (001), 4.49 (90) (020), 3.68 (60) (014, -113), 2.585 (100) (130, -201, -131), 2.230 (90) (-134, 220), 2.069 (80) (043), 1.692 (60) (-311, -151, 240).

Wavenumbers (cm^{-1}): 3665sh, 3640, 3405, 1630, 1454s, 1080sh, 1035s, 1020sh, 980sh, 960sh, 920sh, 876, 835sh, 750sh, 704, 625sh, 560sh, 535s, 474s, 417.

CSi9 Tilleyite $Ca_5Si_2O_7(CO_3)_2$

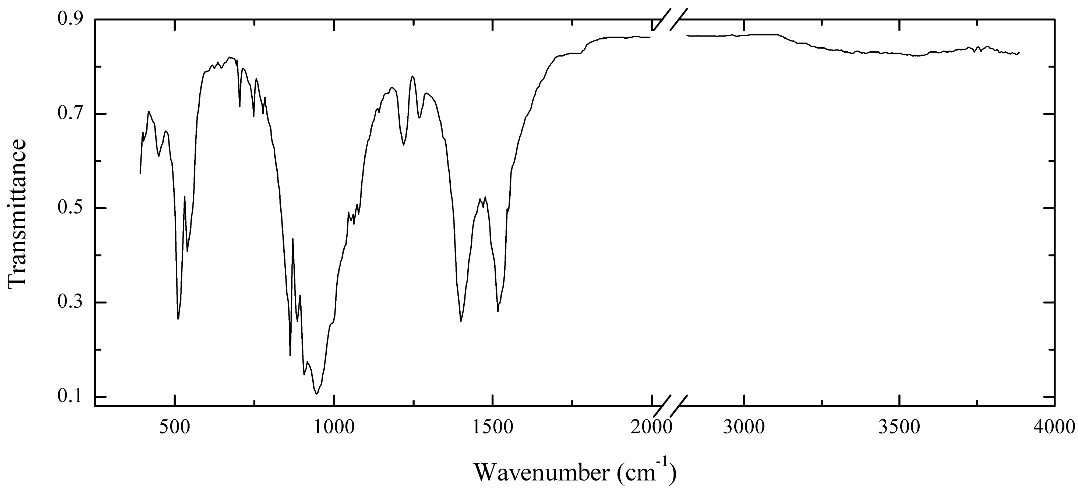


Locality: Outcrop near the Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan.

Description: Light grey single-crystal fragment from the association with bicchulite and gehlenite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1797w, 1570sh, 1550sh, 1535s, 1500, 1424s, 1398s, 1072, 1023, 995s, 970sh, 953s, 923s, 868, 843, 715w, 697w, 645w, 550sh, 541, 505sh, 488, 450sh, 395.

CSi10 Spurrite $Ca_6(SiO_4)_2(CO_3)$

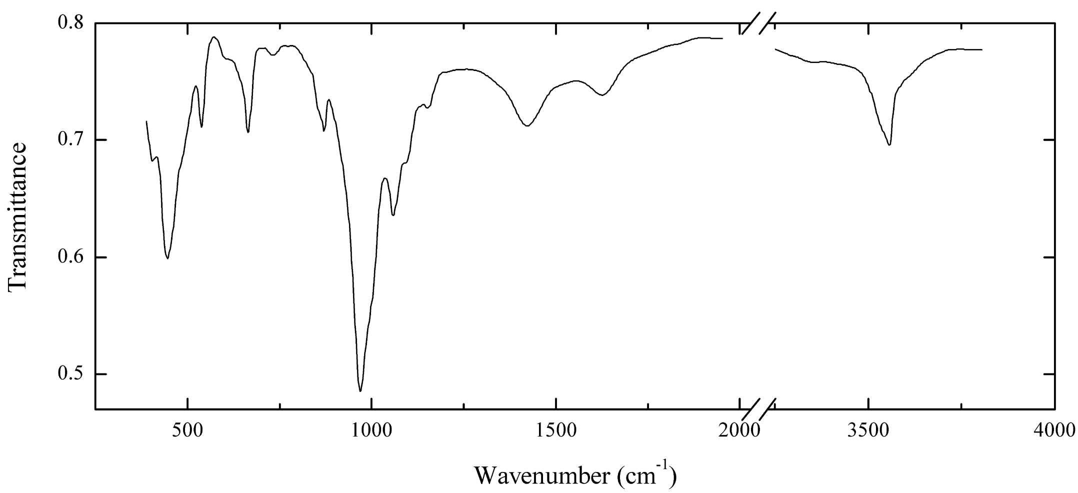


Locality: Outcrop near the Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan.

Description: Lilac granular aggregate from the association with wollastonite, tilleyite and rankinite. Identified by IR spectrum and powder X-ray diffraction pattern. Boron-rich variety (the bands at 745, 777, 1,217 and 1,265 cm^{-1}).

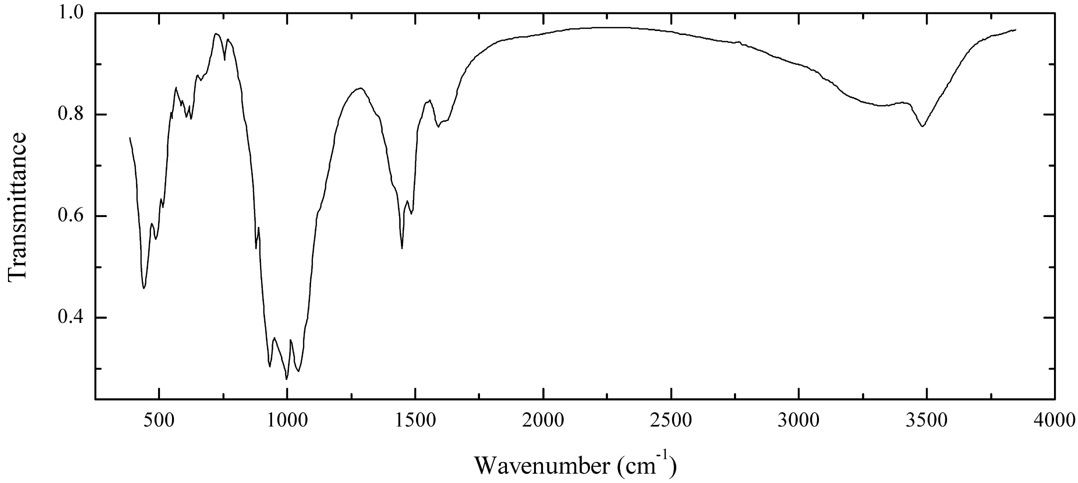
Wavenumbers (cm^{-1}): 1776w, 1520s, 1399s, 1355sh, 1265, 1217, 1080, 1054, 998, 955sh, 947s, 910s, 884s, 863s, 855sh, 777w, 745w, 702w, 540, 512s, 451.

CSi11 Whelanite $Ca_5Cu_2(Si_6O_{17})(CO_3)(OH)_2 \cdot nH_2O$?



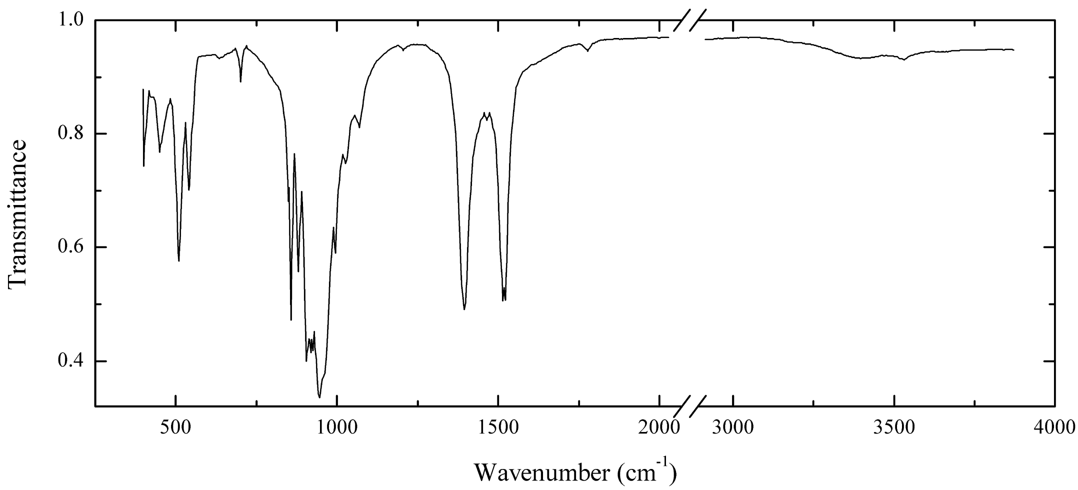
Locality: Christmas mine, Christmas, Banner district, Dripping Spring Mts., Gila Co., Arizona, USA.
Description: Clusters of light blue crystals. Ca : Cu : Si = 5 : 1.8 : 6 (by electron microprobe data). A questionable mineral.
Wavenumbers (cm^{-1}): 3550, 1630w, 1420, 1153w, 1096, 1064, 971s, 876, 860sh, 730, 665, 538, 446s, 404.

CSi12 Scawtite $Ca_7(Si_6O_{18})(CO_3)\cdot 2H_2O$



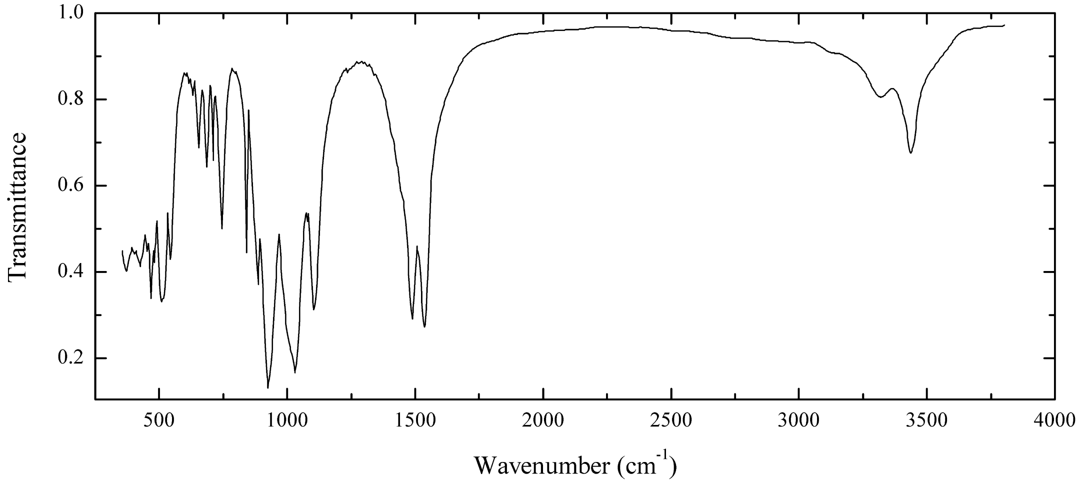
Locality: Borehole at Arimao-Norte, Cienfuegos province, Cuba.
Description: White grains from the association with wollastonite, ellestadite-(OH) and tobermorite. Identified by IR spectrum and optical parameters.
Wavenumbers (cm^{-1}): 3580sh, 3463, 3320, 1625sh, 1594, 1486, 1448, 1425sh, 1120sh, 1070sh, 1042s, 998s, 930s, 877, 753w, 710sh, 680sh, 663w, 624, 605, 576w, 548w, 513, 487, 441s.

CSi13 Spurrite $Ca_6(SiO_4)_2(CO_3)$



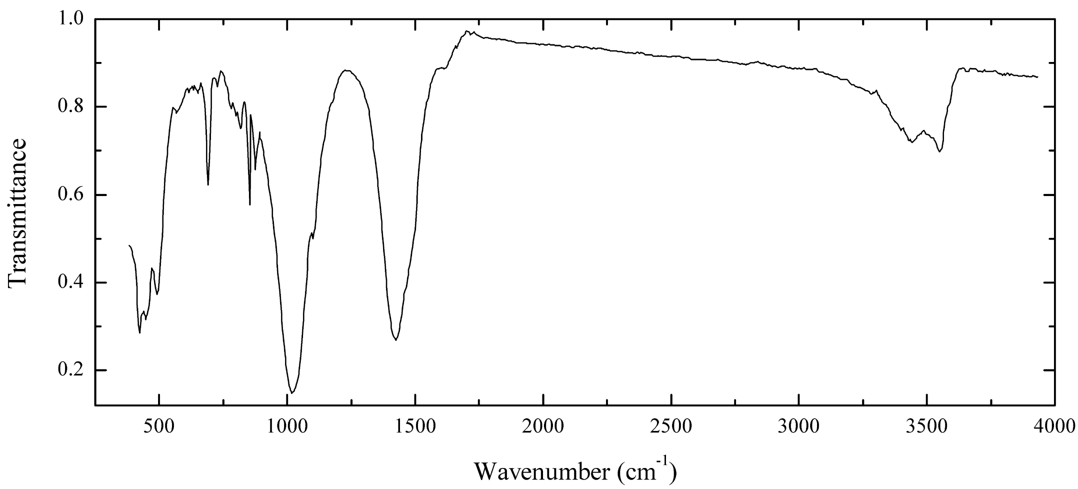
Locality: Darwin, Inyo Co., California, USA.
Description: Grey granular aggregate of polysynthetic twins ("paraspurrite") from the association with vesuvianite and larnite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3560w, 3420w, 1522s, 1397s, 1090, 1033, 1001, 960sh, 949s, 928s, 921s, 912s, 885, 863s, 855, 702, 540, 511, 453.

CSi14 Kainosite-(Y) $Ca_2(Y,\mathit{REE})_2Si_4O_{12}(CO_3)\cdot H_2O$



Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: White prismatic crystals in yttrofluorite. Identified by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3420, 3305w, 1534s, 1484s, 1107s, 1080, 1030s, 1010sh, 925s, 886, 842, 745, 710, 686, 654, 630w, 618w, 541, 515sh, 509s, 479, 466s, 452, 420, 373.

CSi15 Ferrisurite $(Pb,Ca)_{2-3}(Fe^{3+},Al)_2(Si_4O_{10})(CO_3)_{1.5-2}(OH)_2(OH,F)_{0.5-1}\cdot nH_2O$

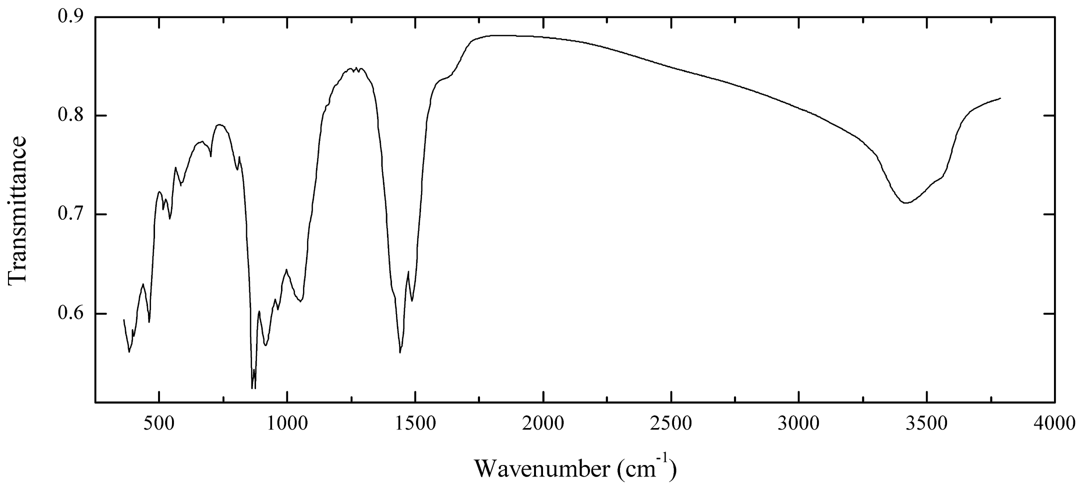


Locality: Shirley Ann mining claim, near Big Dot Spring, Inyo Co., California, USA (type locality).

Description: Greenish-grey radial aggregates from the association with cerussite, quartz, calcite, galena and pyrite. Identified by IR spectrum. Contains little admixture of quartz (weak bands at 778 and 800 cm^{-1} and shoulder at 1,090 cm^{-1}).

Wavenumbers (cm^{-1}): 3535, 3430, 1615w, 1425s, 1090sh, 1019s, 875, 852, 816, 800w, 778w, 727w, 689, 650w, 570w, 491, 450sh, 437s, 421s.

CSi16 Bussenite $Na_2Ba_2Fe^{2+}Ti(Si_2O_7)(CO_3)(OH)_3F$

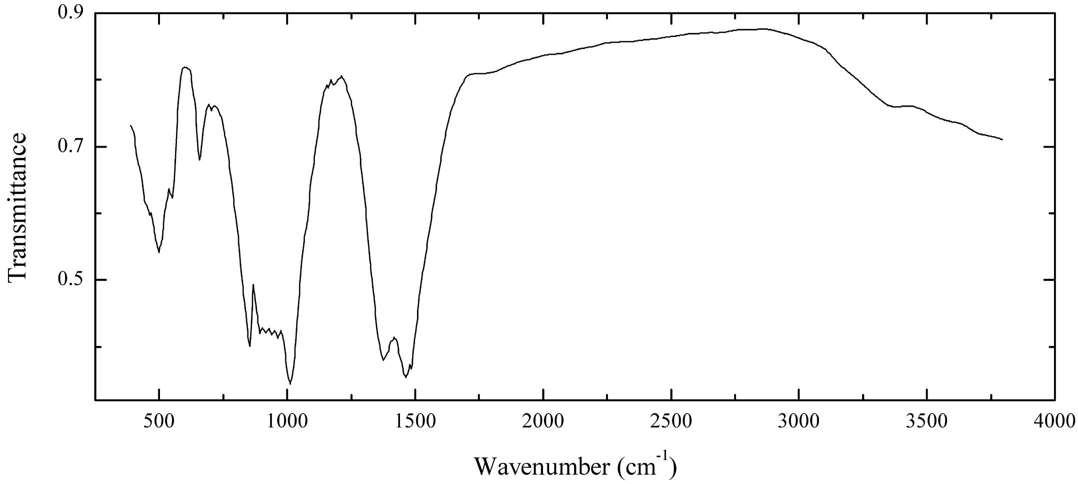


Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Curved platy crystals from the association with natrolite, sodalite, aegirine, biotite, vinogradovite, titanite, eudialyte, calcite, barytocalcite, fluorapatite, fluorite, djerfisherite and molybdenite. Holotype sample. Triclinic, space group $P1$, $a = 5.419$, $b = 7.042$, $c = 16.334$ Å, $\alpha = 102.45°$, $\beta = 93.20°$, $\gamma = 90.00°$. Optically biaxial (+), $\alpha = 1.671$, $\beta = 1.694$, $\gamma = 1.734$, $2V = 71°$. $D_{meas} = 3.63$ g/cm^3 and $D_{calc} = 3.73$ g/cm^3. The empirical formula is $Na_{1.98}K_{0.09}Ba_{1.28}Sr_{0.45}Ca_{0.19}Fe_{0.64}Mn_{0.45}Ti_{0.99}Nb_{0.05}Si_{2.04}O_{7.38}(CO_3)_{0.89}(OH)_{2.95}F_{1.00}$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.910 (44), 3.186 (100), 3.055 (38), 2.797 (29), 2.738 (62), 2.695 (32), 2.677 (29), 2.613 (32), 2.312 (28).

Wavenumbers (cm^{-1}): 3535, 3420, 1642sh, 1484, 1444s, 1410sh, 1100sh, 1058, 965, 915s, 874s, 865s, 816w, 703w, 590, 542, 520, 459, 410sh, 385.

CSi17 Biraite-(Ce) $Ce_2Fe^{2+}(Si_2O_7)(CO_3)$

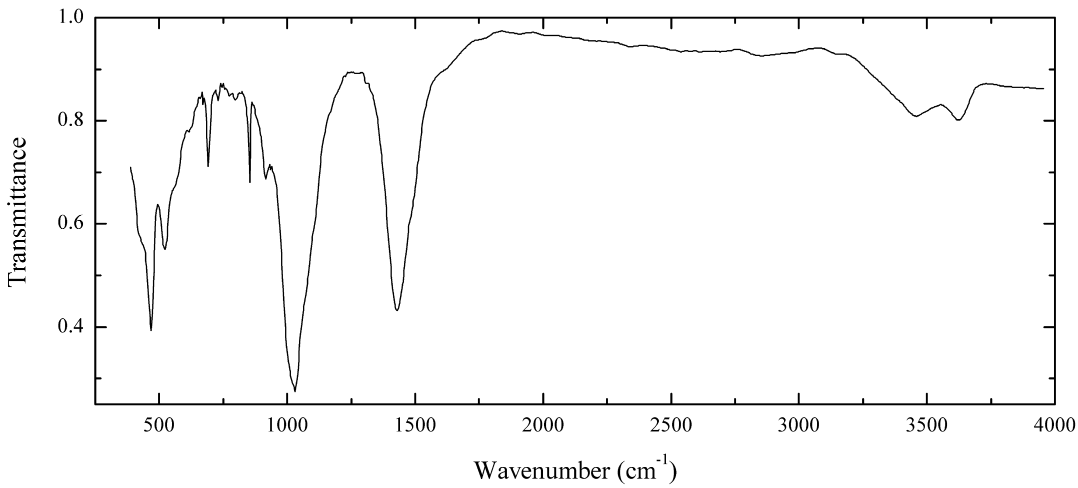


Locality: Biraya carbonatite dyke (at 56°52′ N, 116°45′ E), the basin of the river Biraya, Irkutsk region, Siberia, Russia (type locality).

Description: Brown grains from the association with cordylite-(Ce), cordylite-(La), aragonite, strontianite, Sr-Fe-dolomite, ancylite-(Ce), ancylite-(La), hydroxylbastnasite-(Ce), daqingshanite-(Ce), daqingshanite-(La), tremolite, winchite, ferriallanite-(Ce), törnebohmite-(Ce), cerite, chevkinite-(Ce), belkovite, humite, fergusonite-(Ce), fergusonite -(Nd), pyrochlore, barite and monazite-(Ce). Cotype sample. Monoclinic, space group $P2_1/c$; $a = 6.498(7)$, $b = 6.726(1)$, $c = 18.53(1)$ Å, $\beta = 108.86°$. $\gamma = 90.00°$. The empirical formula of the holotype sample is $[(Ce_{1.01}La_{57}Nd_{0.25}Pr_{0.09}Sm_{0.02})Ca_{0.07}Na_{0.02}Ba_{0.01}](Fe_{0.60}Mg_{0.25}Mn_{0.11}Ti_{0.01})(Si_{1.97}O_{6.87}F_{0.17})(CO_3)_{0.99}$.

Wavenumbers (cm^{-1}): 3350w, 1735w, 1465s, 1373s, 1090sh, 1065sh, 1010s, 966s, 938s, 921s, 893s, 853s, 840sh, 701w, 658, 547, 499, 465sh, 425sh.

CSi18 Surite $Pb(Pb,Ca)(Al,Fe^{3+},Mg)_2[(Si,Al)_4O_{10}](CO_3)_2(OH)_2$

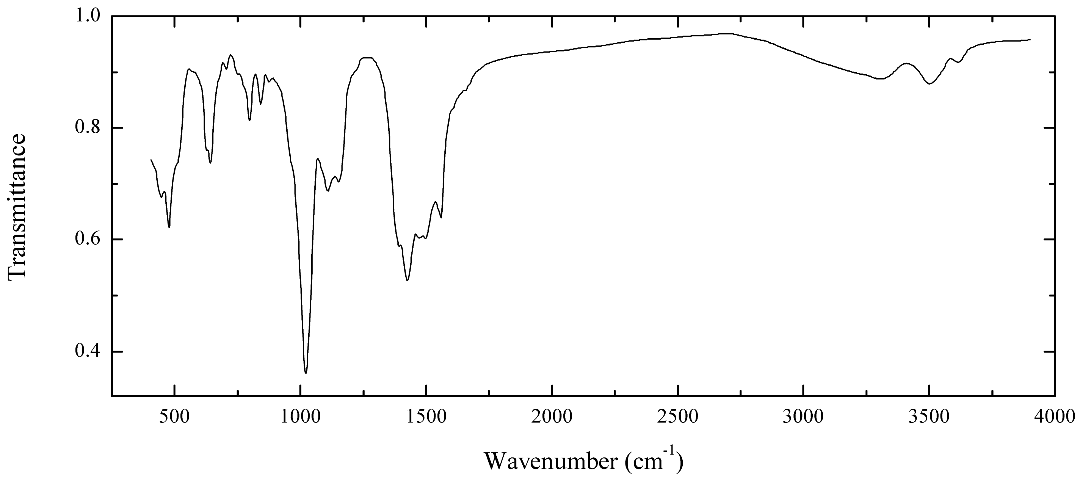


Locality: Mammoth polymetallic, fluorspar and barite mine, St. Anthony deposit, Tiger, Mammoth district, Pinal Co., Arizona, USA.

Description: White scaly aggregate with strong lustre. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3617, 3440, 1433s, 1029s, 916, 854, 796w, 773w, 727w, 692, 610sh, 560sh, 522, 469s, 425sh.

CSi19 Caysichite-(Y) $Y_4(Ca_3\mathit{REE})(Si_8O_{20})(CO_3)_6(OH)\cdot 7H_2O$

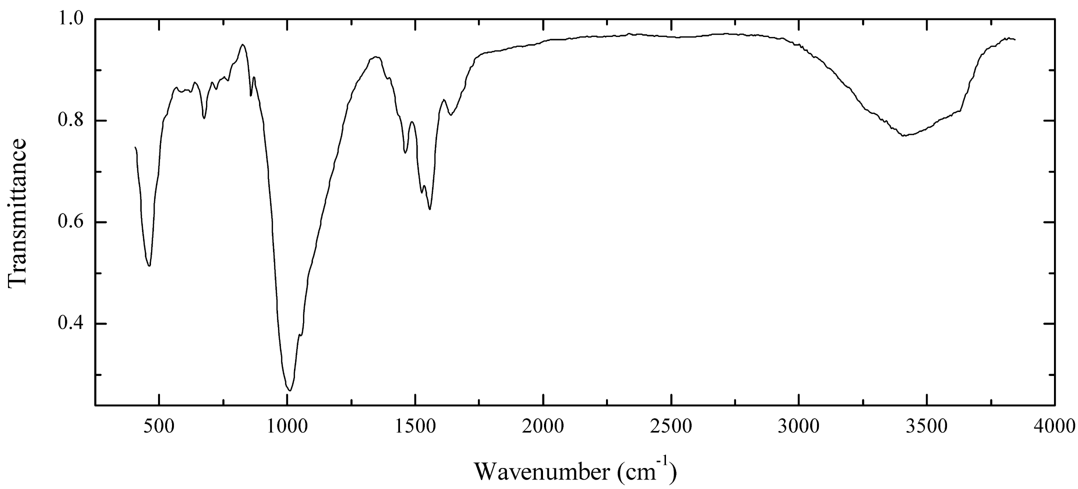


Locality: Row Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: Grey massive with greasy lustre, from the association with yttrofluorite and quartz. Identified by IR spectrum and semiquantitative electron microprobe analysis (Y $\gg$ Yb).

Wavenumbers (cm^{-1}): 3605w, 3495w, 3300w, 1564, 1500, 1480, 1428s, 1392s, 1152, 1116, 1025s, 970sh, 879w, 842, 797, 753w, 705w, 642, 626, 510sh, 477, 447.

CSi20 Ashcroftine-(Y) $K_5Na_5(Y,Ca)_{12}(Si_{28}O_{70})(CO_3)_8(OH)_2\cdot 8H_2O$

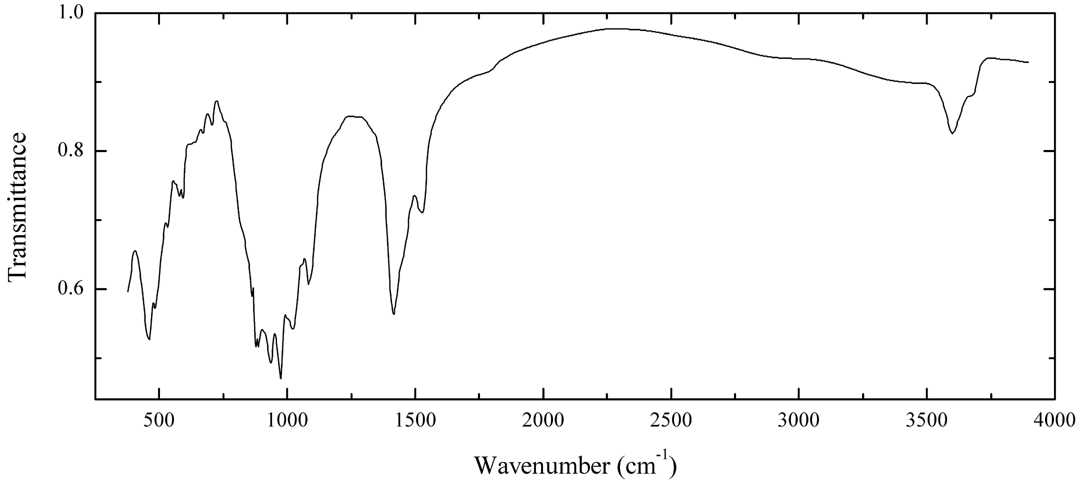


Locality: "Pocket K", 45 km NW of Julianehaab, Narssârssuk, Greenland (type locality).

Description: Pale lilac acicular crystals from the association with feldspar, calcite, elpidite, quartz and aegirine. Identified by IR spectrum and qualitative electron microprobe analysis.

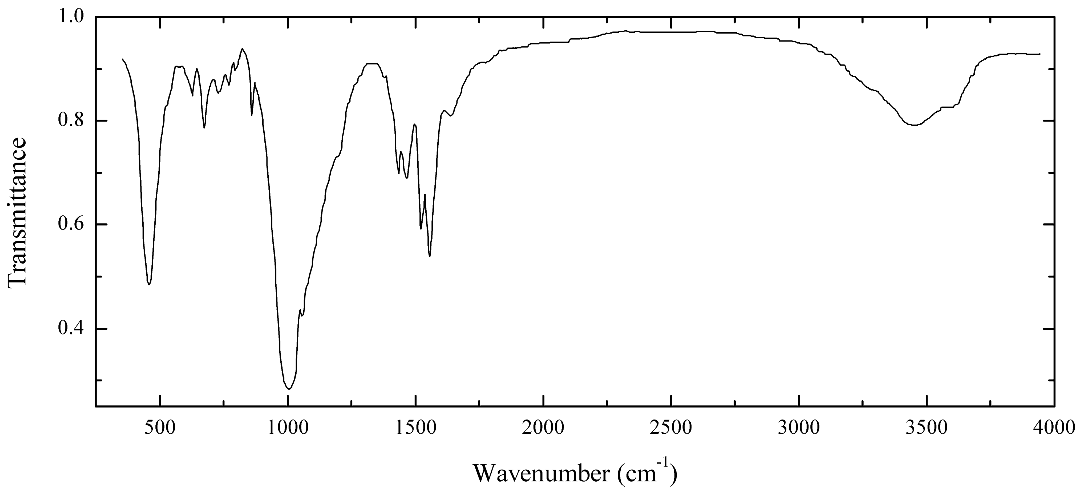
Wavenumbers (cm^{-1}): 3590sh, 3410, 3250sh, 1647, 1555, 1545sh, 1524, 1460, 1430sh, 1386w, 1175sh, 1100sh, 1055s, 1012s, 858, 766w, 722w, 674, 626w, 595w, 520sh, 490sh, 462s.

CSi21 Fukalite $Ca_4Si_2O_6(CO_3)(OH)_2$



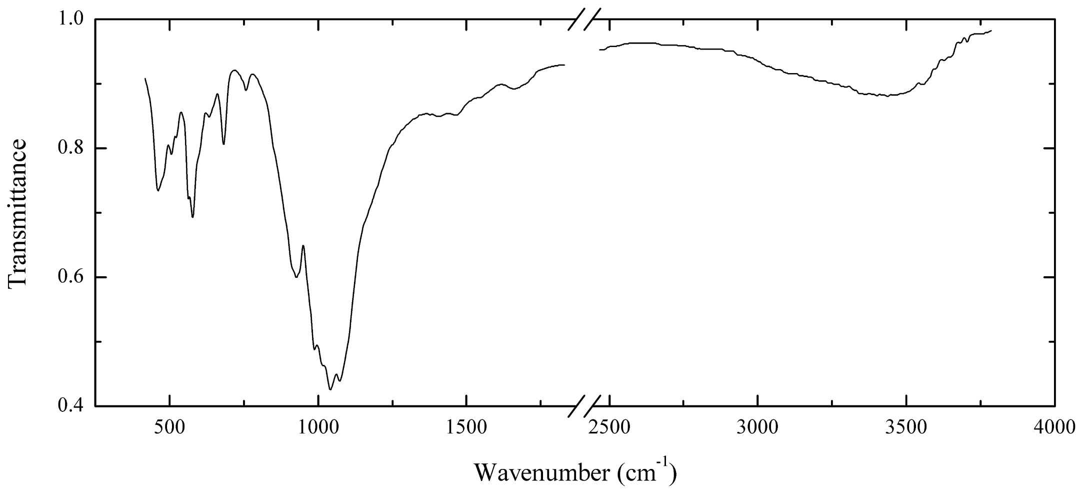
Locality: Kelskoe plateau, South Ossetia, Caucasus.
Description: White granular aggregate from the association with rondorfite, larnite and calcite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3645w, 3567, 1750sh, 1523, 1412s, 1085, 1021s, 998, 976s, 936s, 886s, 877s, 861, 706w, 670w, 640w, 594, 579, 534, 485, 460s.

CSi22 Ashcroftine-(Y) $K_5Na_5(Y,Ca)_{12}(Si_{28}O_{70})(CO_3)_8(OH)_2{\cdot}8H_2O$



Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada.
Description: Lilac acicular crystals from the association with feldspar and aegirine. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3580sh, 3420, 3260sh, 1645, 1556s, 1524, 1467, 1435sh, 1380w, 1195sh, 1080sh, 1058s, 1007s, 860, 796w, 770w, 730w, 674, 627w, 525sh, 456s.

PSi1 Phosinaite-(Ce) $Na_{13}Ca_2Ce(Si_4O_{12})(PO_4)_4$

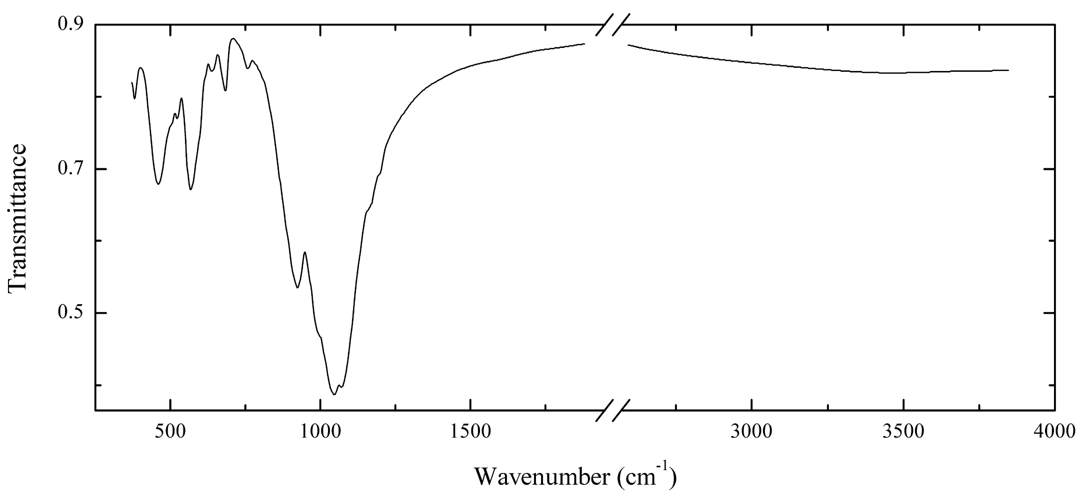


Locality: Kedykverpakhk Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: Lilac single-crystal grains from the association with villiaumite. Confirmed by qualitative electron microprobe analysis. Altered and hydrated sample.

Wavenumbers (cm^{-1}): 3415, 1665w, 1465w, 1415w, 1074s, 1044s, 1014s, 990s, 935sh, 927, 915sh, 761w, 682, 634w, 600sh, 579, 564, 525w, 506, 480sh, 463.

PSi2 Phosinaite-(Ce) $Na_{13}Ca_2Ce(Si_4O_{12})(PO_4)_4$

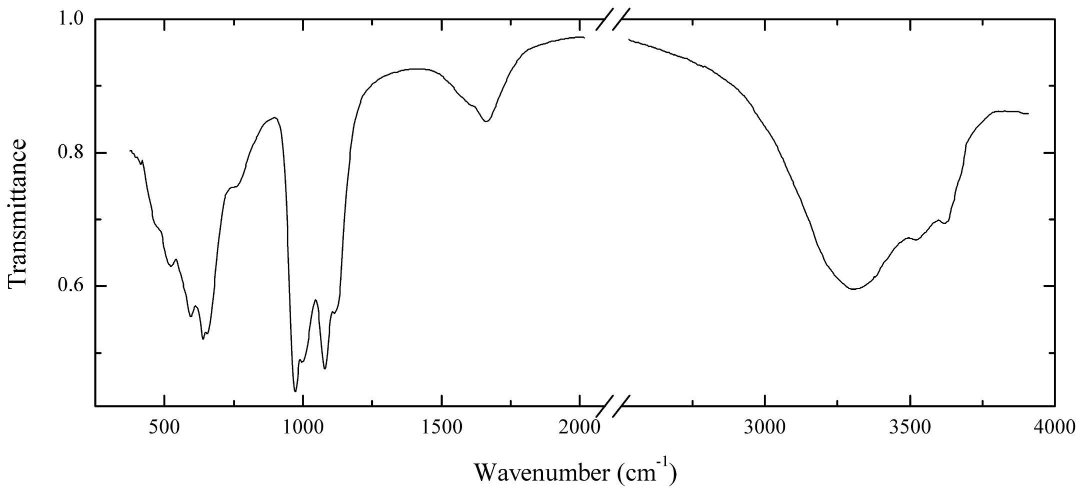


Locality: Palitra pegmatite, Kedykverpakhk Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: Grey transparent crystals with lilac fluorescence under UV radiation from the association with villiaumite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

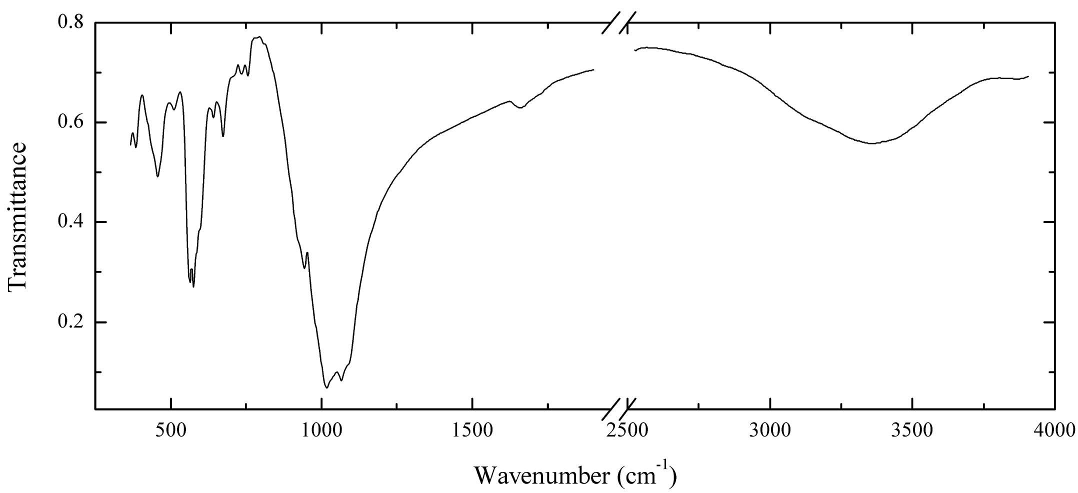
Wavenumbers (cm^{-1}): 1195sh, 1160sh, 1073s, 1044s, 995sh, 926, 764w, 683, 644w, 595sh, 572, 526w, 505sh, 464, 385w.

PSi3 Perhamite $Ca_3Al_7(SiO_3)_3(PO_4)_4(OH)_3 \cdot 16.5H_2O$



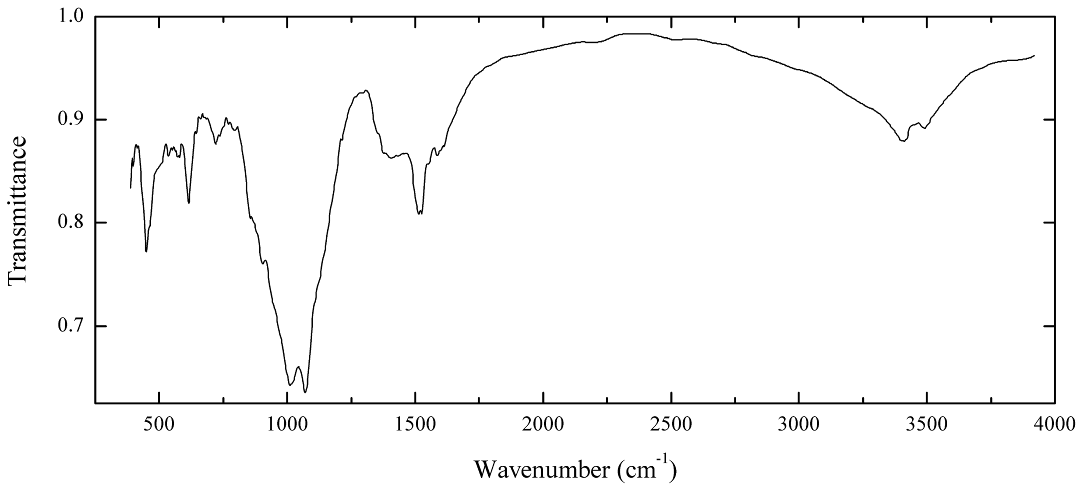
Locality: Penrice quarry, Angaston, South Australia, Australia.
Description: White crusts on limonite.
Wavenumbers (cm^{-1}): 3610, 3505, 3290s, 1660, 1610sh, 1114, 1077s, 999s, 972s, 760sh, 653s, 640s, 598, 515, 470sh.

PSi4 Clinophosinaite $Na_3Ca(PO_4)SiO_3$



Locality: Rasvumchorr Mt., Khibiny alkaline massif, Kola peninsula, Murnansk region, Russia.
Description: Pale lilac grains from the association with villiaumite, nepheline, sodalite, aegirine, lamprophyllite, lomonosovite, eudialyte, lovozerite, nacaphite and rasvumite. Confirmed by electron microprobe analysis and powder X-ray diffraction pattern. The empirical formula is $Na_{3.38}Ca_{0.79}Si_{1.04}P_{0.96}O_{6.96} \cdot nH_2O$. The bands at 3,350, 3,050 and 1,660 cm^{-1} indicate the presence of H_2O molecules.
Wavenumbers (cm^{-1}): 3350, 3150sh, 1660w, 1090sh, 1063s, 1030sh, 1015s, 943, 925sh, 758w, 737w, 710sh, 673, 642, 595sh, 585sh, 606, 565, 510w, 460, 374.

PSi5 Abenakiite-(Ce) $Na_{36}(Ca,REE)_6(SiO_3)_6(PO_4)_6(CO_3)_6(S^{4+}O_2)O$

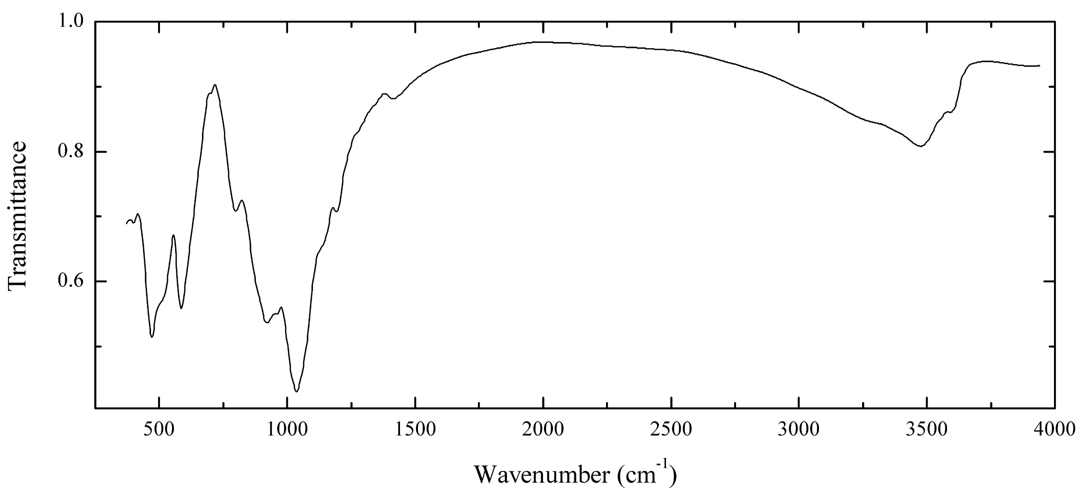


Locality: Sirenevaya pegmatite vein, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow-grey grain from ussingite. S-deficient H_2O-bearing variety (or a related species). The empirical formula is (electron microprobe) $(Na_{5.55}K_{0.17}Ca_{0.04})(Ce_{3.34}La_{1.71}Nd_{1.20}Pr_{0.46})Th_{0.12}(Si_{5.97}P_{6.86}S_{0.17})O_x(CO_3)_y{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3465w, 3390, 1580sh, 1520, 1410w, 1140sh, 1070s, 1013s, 902, 860sh, 718w, 615, 573w, 535w, 500sh, 448.

PSi6 "Ellenbergerite-(PO$_4$)" $(Mg,\square)_2(Mg,Al)_{12}(HSiO_4)_6(HPO_4)(OH)_6$



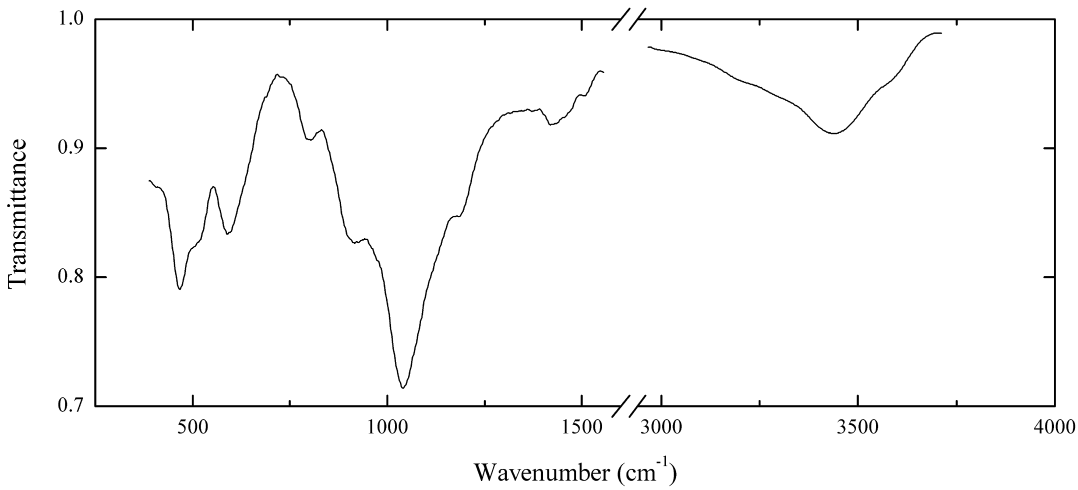
Locality: Dora-Maira massif, Cuneo province, Piedmont, Italy (type locality of ellenbergerite).

Description: Cream-red grains from the association with talc, quartz, pyrope, magnesiostaurolite and rutile. The empirical formula is (electron microprobe) $(Mg_{7.55}Fe_{0.1}Ti_{0.25}Al_{5.1})(Si_{6.6}P_{1.4})(O,OH)_x$. The crystal structure is solved. Hexagonal, space group $P6_3mc$. Phosphorus occupies its own site in the crystal structure. The crystal-chemical formula is $(Mg_{0.61}Ti_{0.08}\square_{0.31})_2(Mg_{0.52}Al_{0.43}\square_{0.05})_{12}[SiO_3(O_{0.29}(OH)_{0.71})]_6[(P_{0.71}Si_{0.20}\square_{0.09})O_3OH]_2(OH)_6$. Optically uniaxial (+), $\omega = 1.640(2)$,

$\varepsilon = 1.644(2)$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 6.24 (60), 4.52 (60), 3.63 (90), 3.157 (100), 2.699 (70), 2.369 (60), 2.306 (60), 2.212 (80), 1.801 (60), 1.552 (70). A mineral species different from PO_4-poor ellenbergerite and phosphoellenbergerite. Not approved by the IMA CNMNC.

Wavenumbers (cm^{-1}): 3575w, 3470, 3300sh, 1415w, 1195, 1135, 1040, 950sh, 925s, 800, 700w, 630sh, 586, 505sh, 472s, 400.

PSi7 "Ellenbergerite-(PO$_4$)" $(Mg,\square)_2(Mg,Al)_{12}(HSiO_4)_6(HPO_4)(OH)_6$

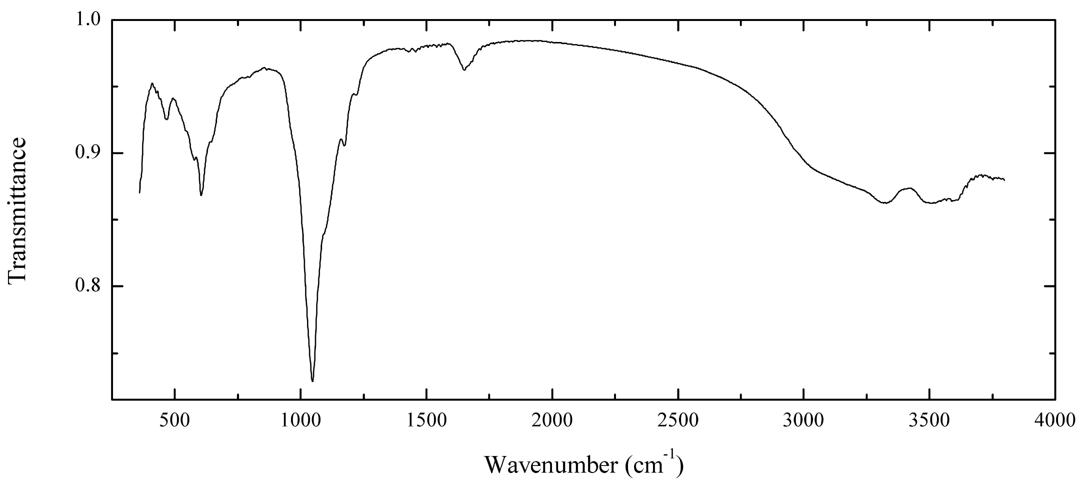


Locality: Dora-Maira massif, Cuneo province, Piedmont, Italy (type locality of ellenbergerite).

Description: Greenish-blue crystals from the association with talc, magnesioaluminoceladonite, pyrope, magnesiostaurolite and rutile. The empirical formula is (electron microprobe) $(Mg_{8.21}Al_{4.36}Fe_{0.32}Ti_{0.05})(Si_{5.85}P_{2.15})(O,OH)_x$. A mineral species different from PO_4-poor ellenbergerite and phosphoellenbergerite. Not approved by the IMA CNMNC.

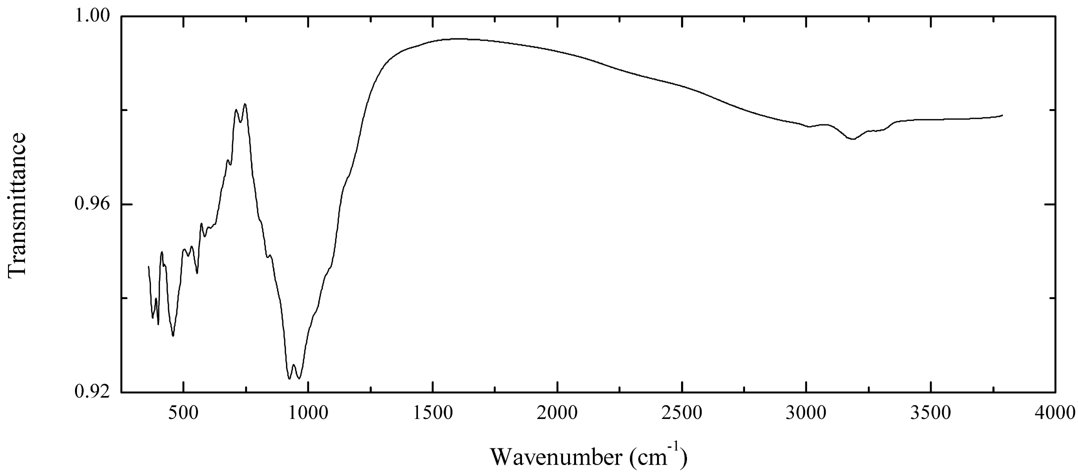
Wavenumbers (cm^{-1}): 3570w, 3420, 1420, 1190sh, 1040s, 917, 768, 590, 510sh, 467s.

PSi8 Krásnoite $Ca_3Al_{7.7}Si_3P_4O_{23.5}(OH)_{12.1}F_2\cdot 8H_2O$



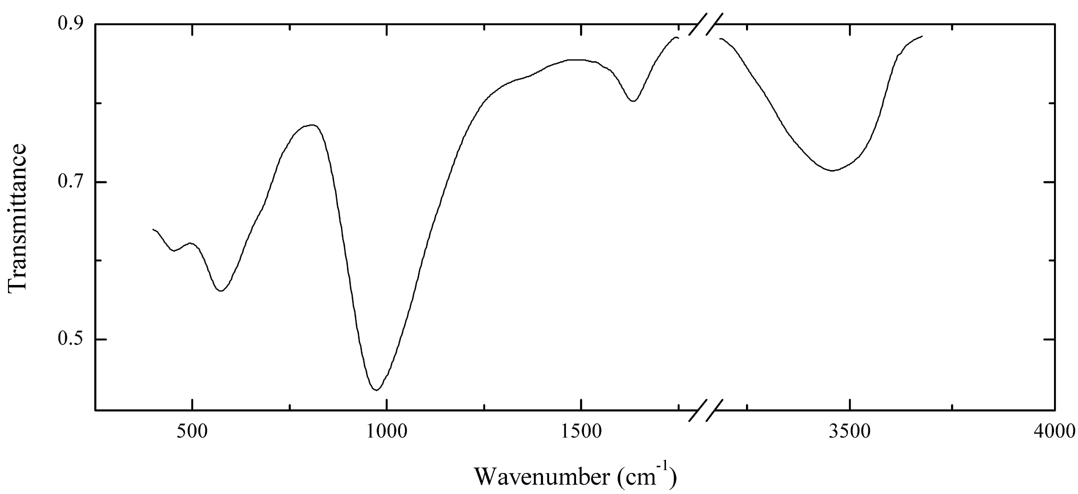
Locality: Huber Stock, Krásno, Horní Slavkov, Czech Republic (type locality).
Description: Colourless tabular crystals from the association with kunatite and chalcosiderite.
Wavenumbers (cm^{-1}): 3600, 3504, 3327, 3120sh, 1652, 1457w, 1429w, 1221, 1174, 1095sh, 1047s, 970sh, 645sh, 605, 580, 545sh, 469.

PSi9 Lavoisierite $Mn^{2+}_8[Al_{10}(Mn^{3+}Mg)](Si_3O_{10})(Si_2O_7)_2(SiO_4)_4(PO_4)(OH)_{12}$



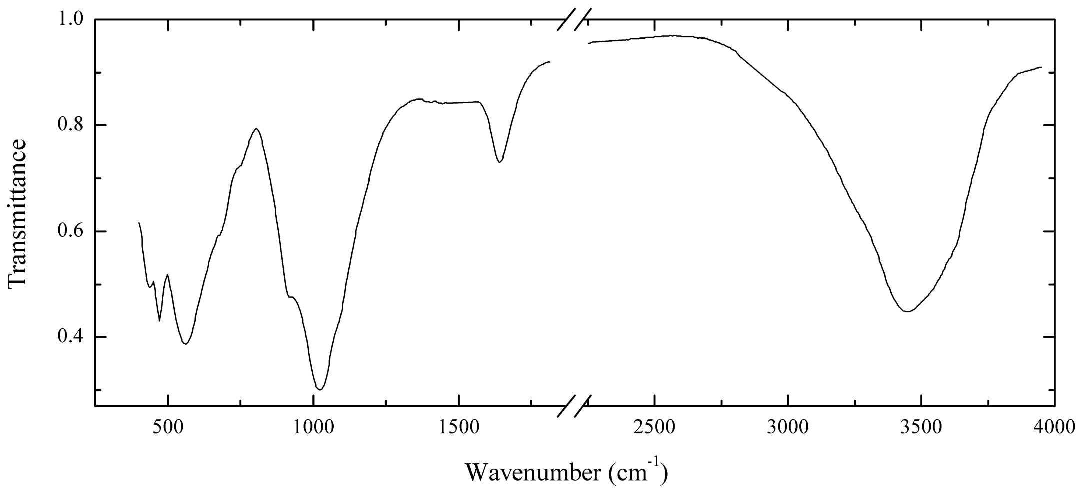
Locality: Punta Genzane, Biolai, Torino province, Piedmont, Italy (type locality).
Description: Aggregate of brown acicular crystals. The empirical formula is (electron microprobe) $(Mn_{6.4}Ca_{1.3}Mg_{0.3})(Al_{9.2}Mg_{1.4}Fe_{0.7}Mn_{0.7})(Si_{11.1}P_{0.4}As_{0.3}V_{0.2})(O,OH)_{56}$.
Wavenumbers (cm^{-1}): 3280sh, 3192, 3010w, 1160sh, 1080sh, 1040sh, 963s, 925s, 840, 810sh, 730w, 687, 610sh, 584, 554, 518, 458s, 400, 376.

Sia1 Imogolite $Al_2SiO_5{\cdot}nH_2O$



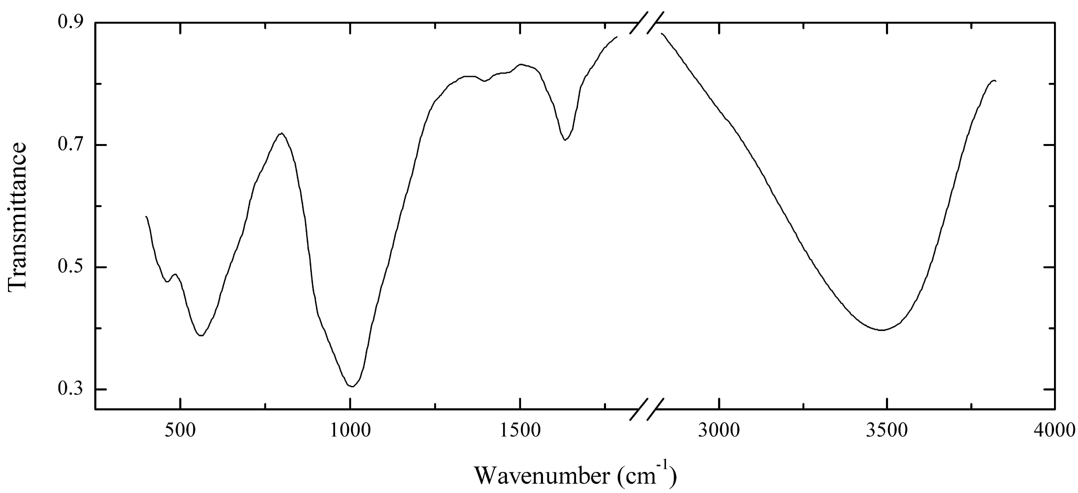
Locality: Fukuiwa, Kanuma city, Tochigi prefecture, Kanto region, Honshu, Japan.
Description: Beige fine-grained aggregate. Decomposed pumice. Related to allophane. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3445, 1635, 970s, 573, 456.

Sia2 Allophane $Al_2SiO_5 \cdot nH_2O$



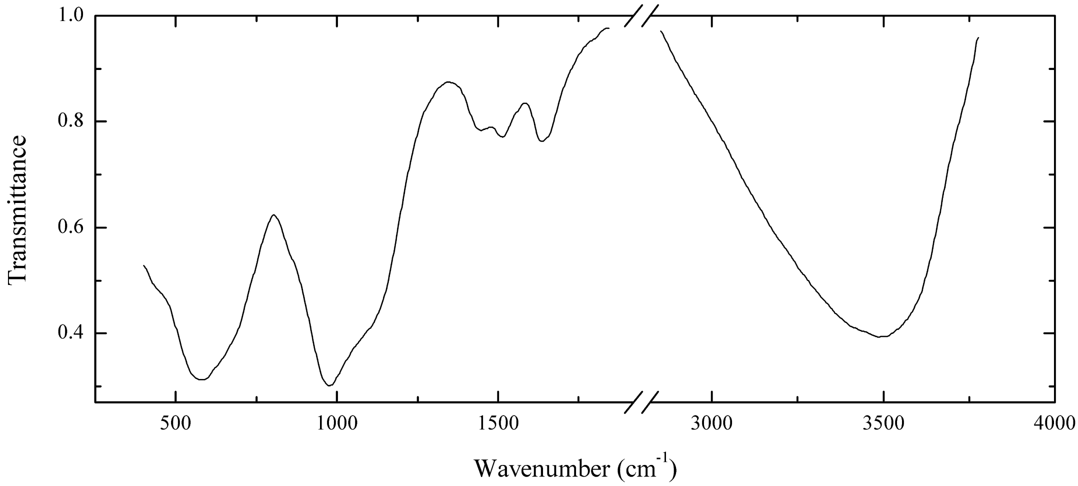
Locality: Hilarion mine, Lavrion mining district, Agios Konstantinos, Attikí (Attika, Attica) prefecture, Greece.
Description: Light blue massive from the association with malachite and gypsum. Amorphous.
Wavenumbers (cm^{-1}): 3447s, 1631, 1020s, 915, 745sh, 710sh, 562s, 470, 436.

Sia3 Allophane $Al_2SiO_5 \cdot nH_2O$



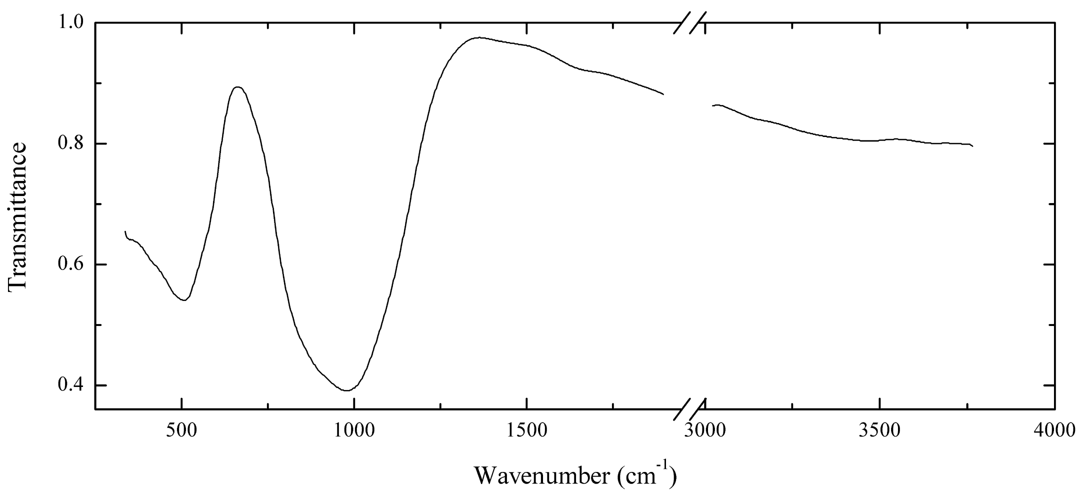
Locality: Crocoite pit, Uspenskaya Mt., near Berezovsk, Middle Urals, Russia.
Description: Grey massive. Amorphous.
Wavenumbers (cm^{-1}): 3460s, 1632, 1396w, 1002s, 915sh, 675sh, 560s, 460, 430sh.

Sia4 **Allophane** $Al_2SiO_5 \cdot nH_2O$



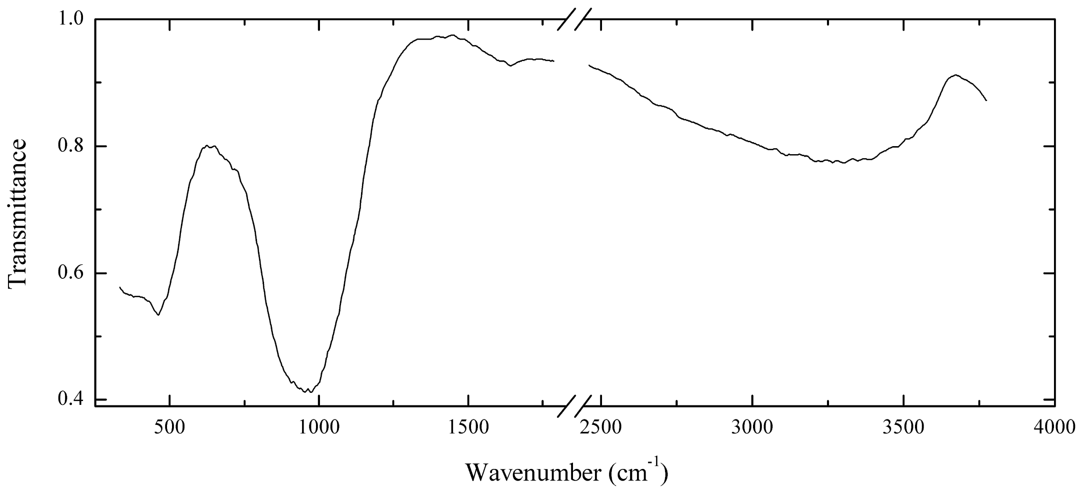
Locality: Olimpiadinsky mine, Krasnoyarsk Krai, Siberia, Russia.
Description: Bluish colloform. Amorphous. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3490s, 1635, 1510, 1440w, 1080sh, 978s, 587s, 440sh.

Sia5 **Britholite-(Ce)** $(Ce,Ca)_5(SiO_4,PO_4)_3(OH,F)$



Locality: Burpala alkaline massif, Republic of Buryatia, Transbaikal area, Siberia, Russia.
Description: Metamict, amorphous. Identified by electron microprobe analysis.
Wavenumbers (cm^{-1}): 3450w, 1660w, 1448w, 1100sh, 997s, 920sh, 725sh, 560sh, 515, 420sh, 360.

Sia6 Thorite $Th(SiO_4)$

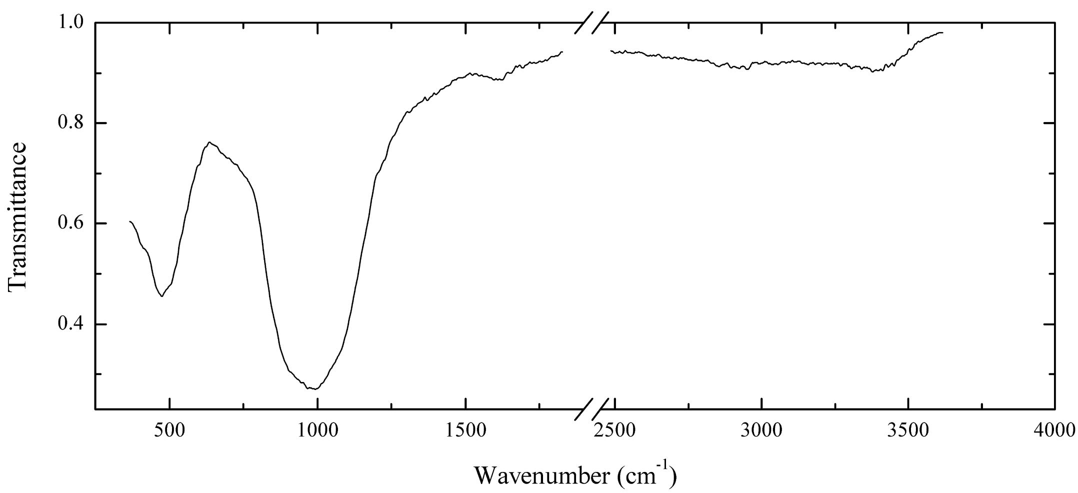


Locality: Brekvikstrand, Langesundsfjorden, Larvik, Vestfold, Norway.

Description: Orange grains from nepheline syenite. Metamict, amorphous and hydrated. Identified by electron microprobe analysis.

Wavenumbers (cm^{-1}): 3270, 1640w, 967s, 460, 400sh.

Sia7 Thorosteenstrupine $Na_{0-5}Ca_{1-3}(Th,REE)_6(Mn,Fe,Al,Ti)_{4-5}(Si_6O_{18})_2[(Si,P)O_4]_6(OH,F,O)_x \cdot nH_2O$

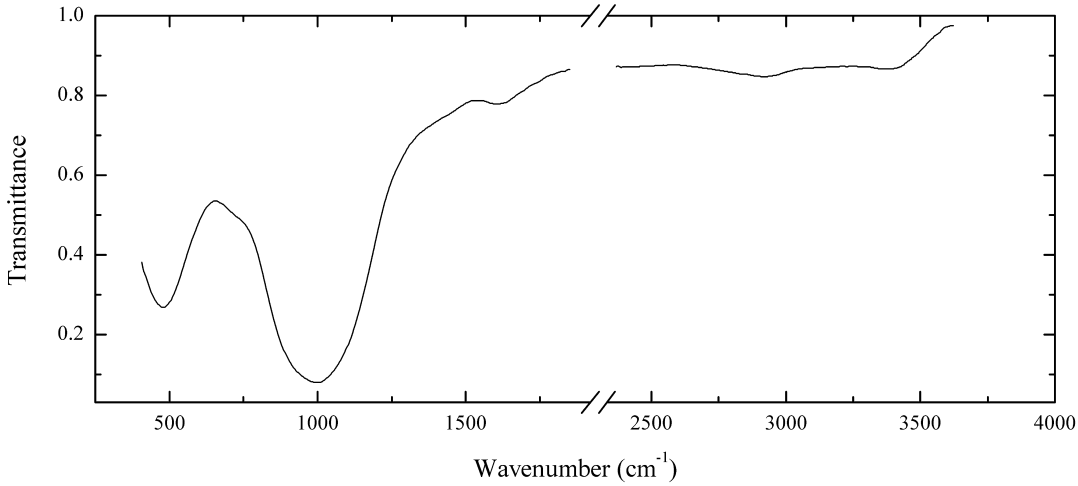


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Dark brown isometric grains from the association with ussingite and aegirine. Metamict, amorphous. Identified by electron microprobe analysis. The content of ThO_2 is about 23 wt. %.

Wavenumbers (cm^{-1}): 3405w, 2960w, 2925w, 2860w, 1620w, 988s, 930sh, 474, 410sh.

Sia8 Steenstrupine-(Ce) $Na_{14}(REE,Th)_6(Mn,Fe,Ti)_4\ (Si_6O_{18})_2[(Si,P)O_4]_6(PO_4)(OH)_2{\cdot}nH_2O$

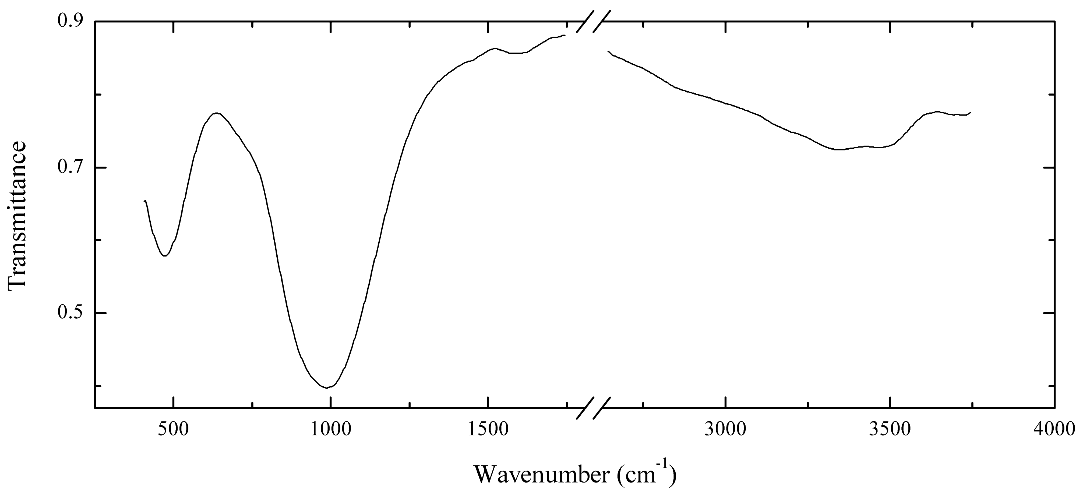


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow-brown central parts of steenstrupine crystals from peralkaline pegmatite. Metamict, amorphous. Identified by electron microprobe analysis. The empirical formula is $Na_{14.21}Ca_{0.7}(Ce_{2.1}La_{1.0}Nd_{0.4}Pr_{0.1})Th_{1.1}(Mn_{3.4}Fe_{0.75})(Si_6O_{18})_{2.0}[(Si_{0.8}P_{0.2})O_4]_{6.0}(PO_4)_{1.0}(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3510sh, 3410sh, 3365w, 2920w, 1610w, 998s, 950sh, 500sh, 470.

Sia9 Steenstrupine-(Ce) $Na_{14}(REE,Th)_6(Mn,Fe,Ti)_4\ (Si_6O_{18})_2[(Si,P)O_4]_6(PO_4)(OH)_2{\cdot}nH_2O$

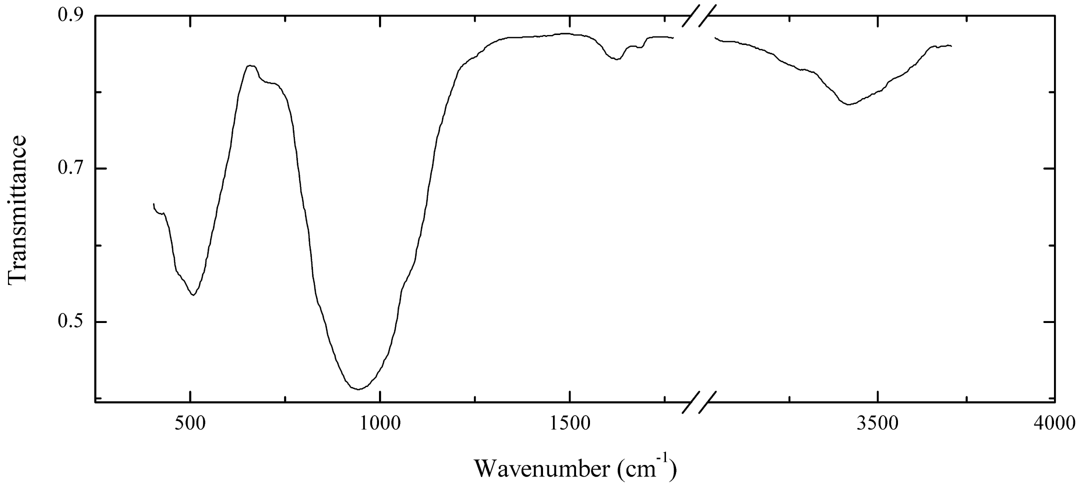


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown grains from massive ussingite, from the association with natisite, ferronordite-(Ce), kazakovite and vuonnemite. Metamict, amorphous. Confirmed by electron microprobe analysis. The empirical formula is $Na_{6.2}Ca_{1.0}K_{0.3}(Ce_{2.1}La_{1.2}Nd_{0.5}Pr_{0.2})Th_{1.3}U_{0.1}(Mn_{3.4}Fe_{0.4}Zr_{0.3}Ti_{0.2})(Si_6O_{18})_{2.0}[(Si_{0.6}P_{0.4})O_4]_{6.0}(PO_4)_{1.0}(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3485w, 3340w, 1650w, 1600w, 995s, 935sh, 490sh, 465.

Sia10 Britholite-(Y) $(Y,Ca)_5(SiO_4,PO_4)_3(OH,F)$

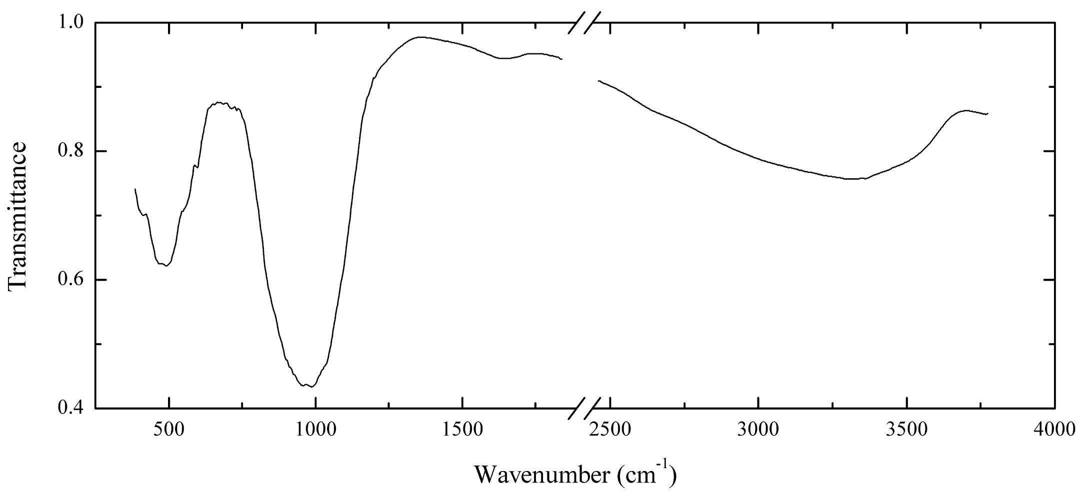


Locality: Vyuntspakhk Mt., Western Keivy Mts., Kola peninsula, Murnansk region, Russia.

Description: Greenish-brown colloform, from pegmatite. Metamict, amorphous. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3530sh, 3395, 3260sh, 1680w, 1620w, 1085sh, 944, 840sh, 700w, 504, 468sh, 420sh.

Sia11 Calciobritholite $(Ca,\mathit{REE})_5(SiO_4,PO_4)_3(OH,F)$

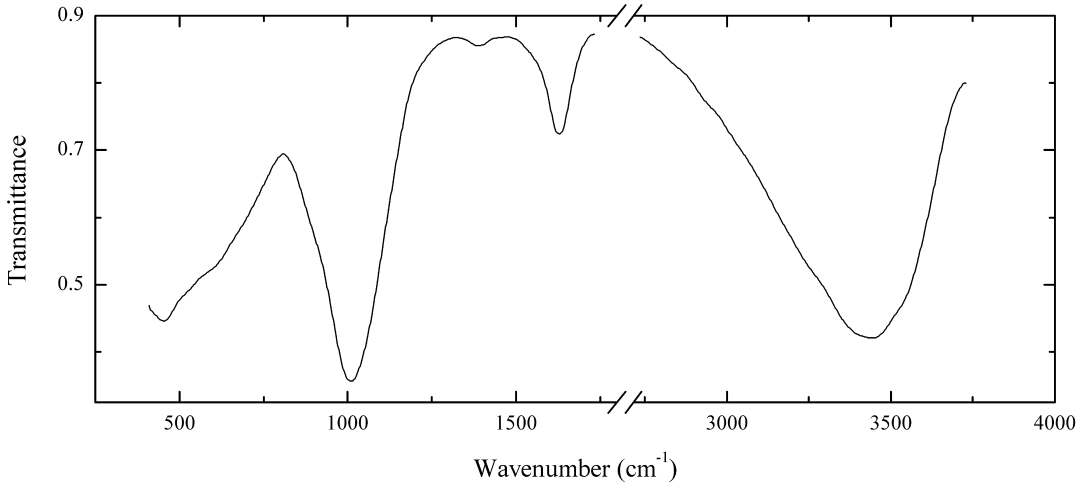


Locality: Sakharyok massif, Western Keivy Mts., Kola peninsula, Murnansk region, Russia.

Description: Brown grain from pegmatite, from the association with rhabdophane-(Ce) and *REE* carbonates. Metamict, amorphous. Confirmed by electron microprobe analysis. The empirical formula is $(Ca_{2.46}Ce_{0.70}Y_{0.50}Nd_{0.38}La_{0.26}Th_{0.12}Pr_{0.11}Sm_{0.08}Gd_{0.07}Dy_{0.04}Yb_{0.02}Mn_{0.02}Pb_{0.01})[(SiO_4)_{2.28}(PO_4)_{0.72}](OH)_xF_{0.35}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3310, 2670sh, 1653w, 1030sh, 988s, 960s, 601w, 565sh, 498, 473, 410sh.

Sia12 Niobosilicate Sia12 $Ca_xThFe(Nb,Ti)_2(Si,P)_2O_{12}\cdot nH_2O$ (?)

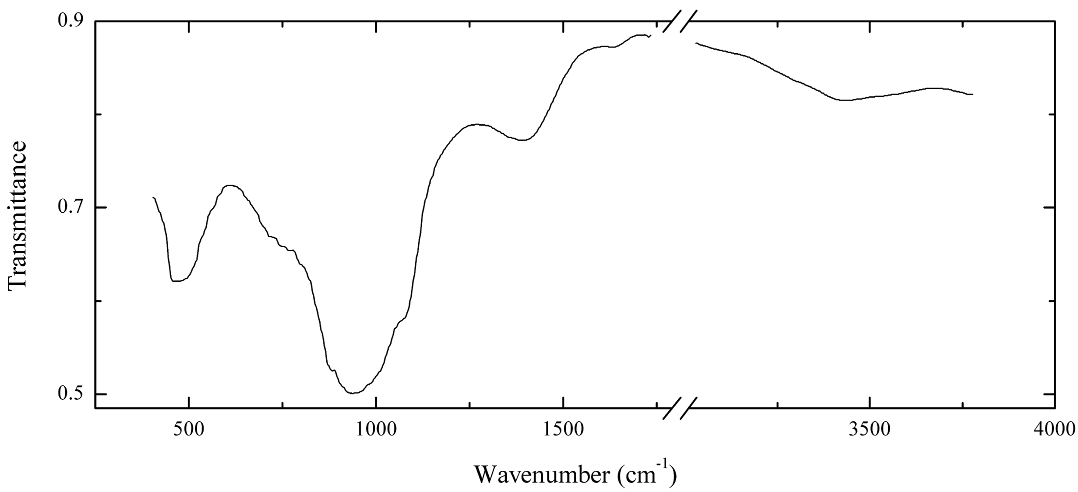


Locality: Pegmatite No. 13, Tyulbnyunuai river, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Amber-yellow pseudomorphs after steenstrupine. Metamict, amorphous. The empirical formula is $Ca_{0.18}(Th_{0.88}Ce_{0.18}La_{0.09})(Fe_{0.37}Al_{0.32}Mg_{0.06})(Nb_{1.00}Ti_{0.89}Zr_{0.06})(Si_{1.68}P_{0.32})(O,OH)_{12}\cdot nH_2O$. Related to karnasurtite? Needs further investigation.

Wavenumbers (cm^{-1}): 3500sh, 3440s, 3300sh, 1635, 1390w, 1008s, 600sh, 520sh, 457s.

Sia13 Gadolinite-(Ce) $Ce_2Fe^{2+}Be_2Si_2O_{10}$

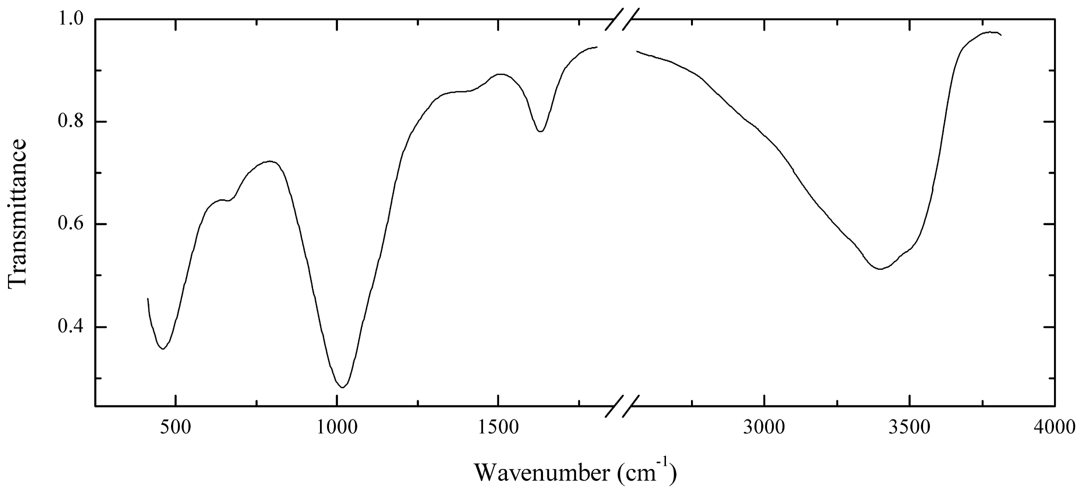


Locality: Vevja quarry, Tvedalen, Larvik, Vestfold, Norway.

Description: Brown grains from the association with potassic feldspar, aegirine, biotite, nepheline and zircon. Metamict, amorphous. Investigated by A.O. Larsen.

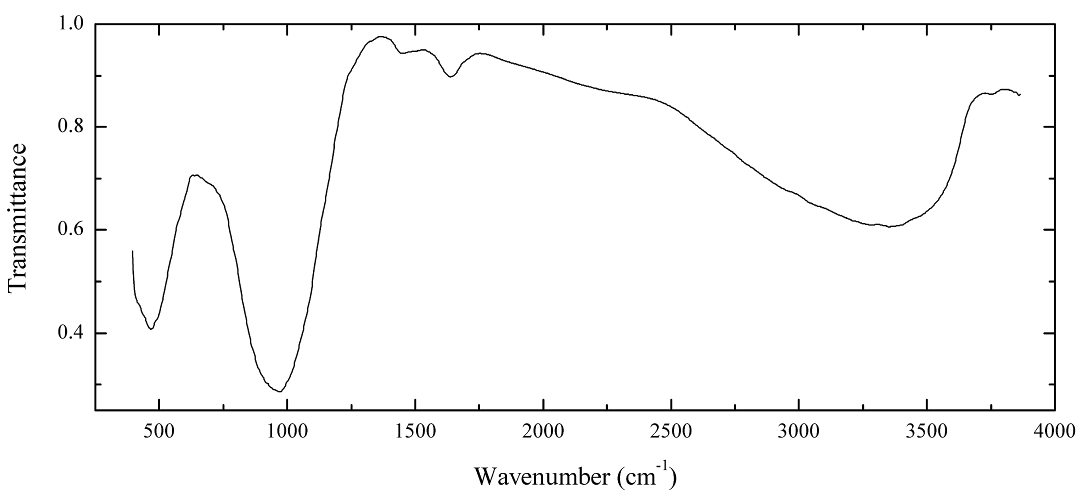
Wavenumbers (cm^{-1}): 3410w, 1640w, 1395, 1070sh, 1010sh, 946s, 878, 730sh, 495sh, 465.

Sia14 Hisingerite $Fe^{3+}{}_2Si_2O_5(OH)_4{\cdot}2H_2O$



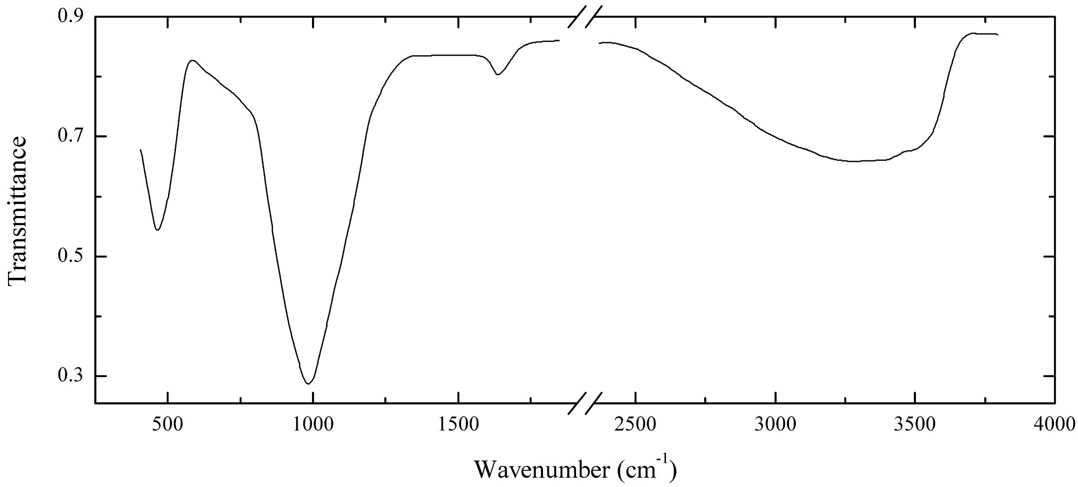
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Brown colloform. Amorphous. Identified by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3560sh, 3500, 1640, 1405w, 1021s, 672w, 456s.

Sia15 Silicate Sia15 $Ca_5Th_8Si_{12}O_{42}(OH)_6{\cdot}nH_2O$ (?)



Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Orange-yellow pseudomorph after thorite from the association with feklichevite, cancrinite, pectolite and aegirine-augite. Metamict, amorphous. The empirical formula is $(Ca_{4.91}Sr_{0.06}Ba_{0.06})(Th_{7.67}Y_{0.17}La_{0.06})(Si_{11.60}Al_{0.40})(O,OH)_{48}{\cdot}nH_2O$. Needs further investigation.
Wavenumbers (cm^{-1}): 3400, 2950sh, 1630w, 1440w, 967s, 915sh, 490sh, 465s, 440sh, 420sh.

Sia16 Silicate Sia16 $Na_3Th_2Si_6O_{17}(OH){\cdot}nH_2O$ (?)

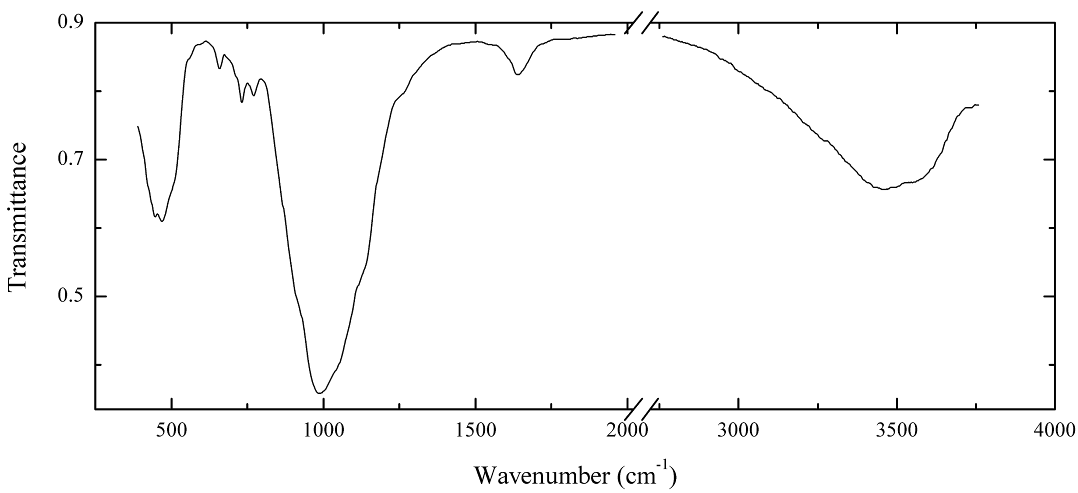


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless grains from the association with ussingite. Metamict, amorphous. Investigated by A.P. Khomyakov.

Wavenumbers (cm^{-1}): 3485sh, 3290, 1645, 1500w, 984s, 780sh, 690w, 625w, 459.

Sia17 Silicate Sia17 $(Na,K)_5Th_9[Si(O,OH)_3]_{24}{\cdot}nH_2O$ (?)

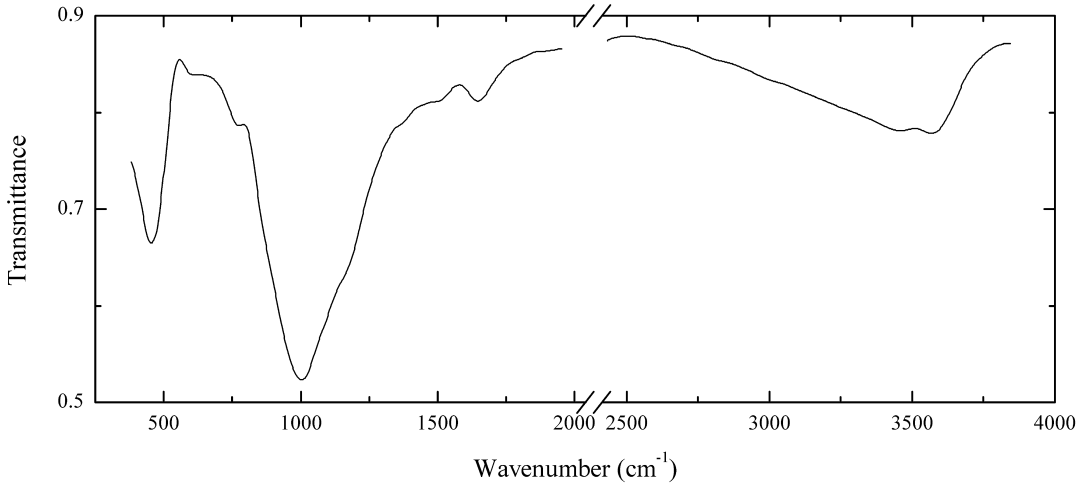


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless grains with green fluorescence under short-wave UV radiation, from the association with ussingite, natisite, ferronordite-(Ce), kazakovite and vuonnemite. Metamict, amorphous. The empirical formula is $(Na_{3.89}K_{1.04}Pb_{0.14}Sr_{0.10})Th_{9.02}[Si(O,OH)_3]_{24}{\cdot}nH_2O$.

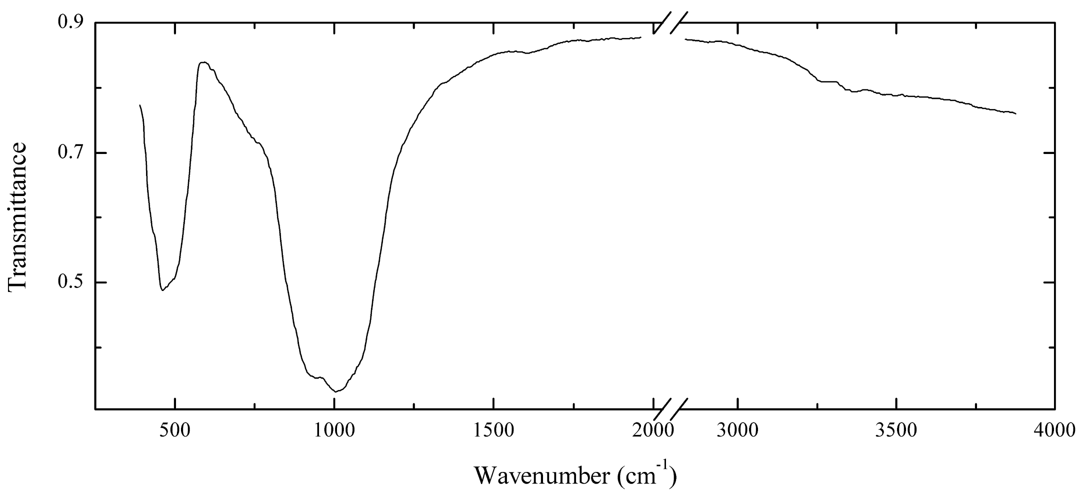
Wavenumbers (cm^{-1}): 3510sh, 3430, 1630, 1270sh, 1130sh, 1030sh, 979s, 915sh, 767w, 732, 705sh, 655w, 550sh, 490sh, 462, 438, 420sh, 405sh.

Sia18 Turkestanite $K_{1-x}Th(Ca,Na)_2(Si_8O_{20}) \cdot nH_2O$



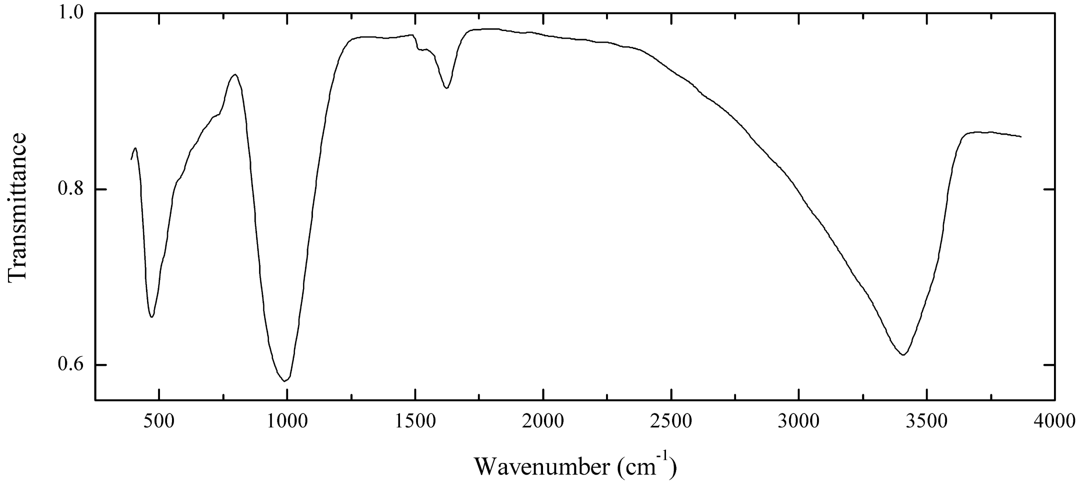
Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alai range, Tien Shan Mts., Tajikistan.
Description: Green isometric crystals ingrown in quartz. Metamict, amorphous. Confirmed by electron microprobe analysis.
Wavenumbers (cm^{-1}): 3560. 3440, 1645, 1150sh, 1065sh, 999s, 774, 600w, 456.

Sia19 Umbozerite $Na_3Sr_4(Mn,Fe)ThSi_8O_{24}(OH)$



Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Green prismatic crystals from the association with ussingite, sphalerite, belovite and manganoan pectolite. Metamict, amorphous. Specimen No. 77840 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Confirmed by electron microprobe analysis.
Wavenumbers (cm^{-1}): 3325w, 3230w, 1075sh, 1011s, 934s, 770sh, 500sh, 470, 435.

Sia20 "Zirfesite"

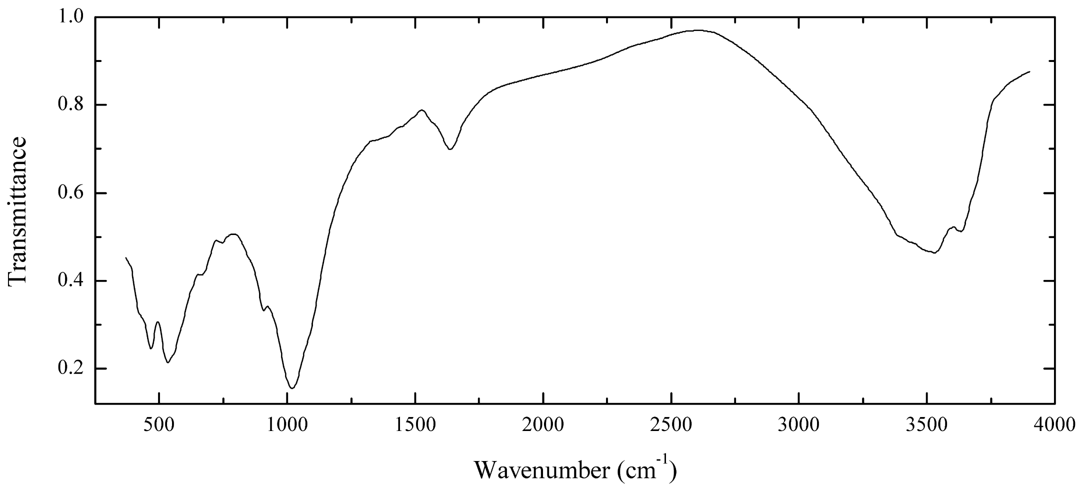


Locality: Pegmatite No. 60, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown soft porous mass. Amorphous product of eudialyte weathering accompanied by leaching of Na.

Wavenumbers (cm^{-1}): 3250sh, 3410s, 1620, 1525w, 990s, 730w, 675sh, 640w, 585, 515sh, 468s.

Sia21 "Allophanoid" $(Al,Zn,Cu)_2(Si,Al)O_5 \cdot nH_2O$

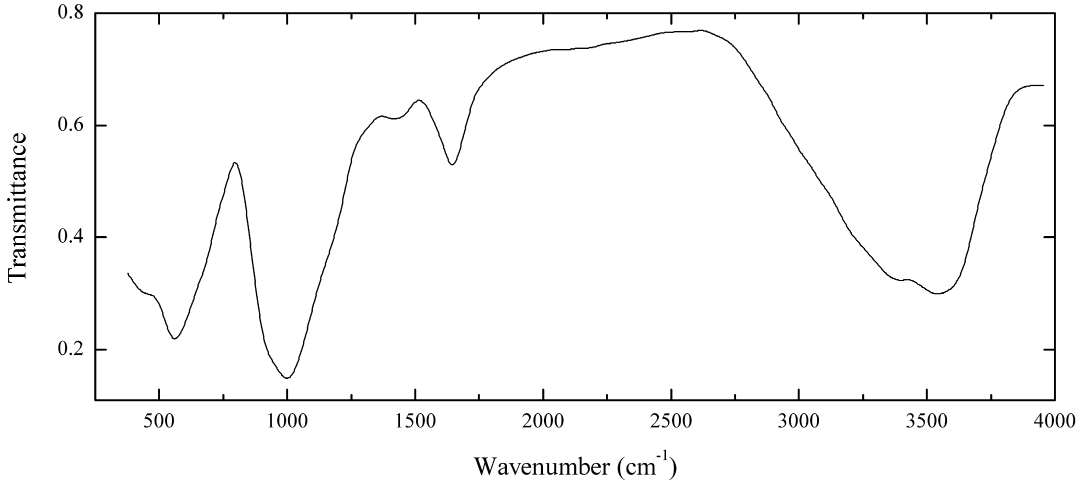


Locality: Kamariza mines, Lavrion mining district, Agios Konstantinos, Attikí (Attika, Attica) prefecture, Greece.

Description: Light blue massive from the association with gibbsite. Amorphous. Related to dioctahedral smectites. The empirical formula is $(Al_{2.63}Zn_{0.19}Cu_{0.16}Fe_{0.03})(Si_{0.84}Al_{0.08}As_{0.06}S_{0.02}) \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3625, 3510, 1640, 1020s, 908, 748w, 660sh, 533s, 467, 420sh.

Sia22 Allophane $Al_2SiO_5 \cdot nH_2O$

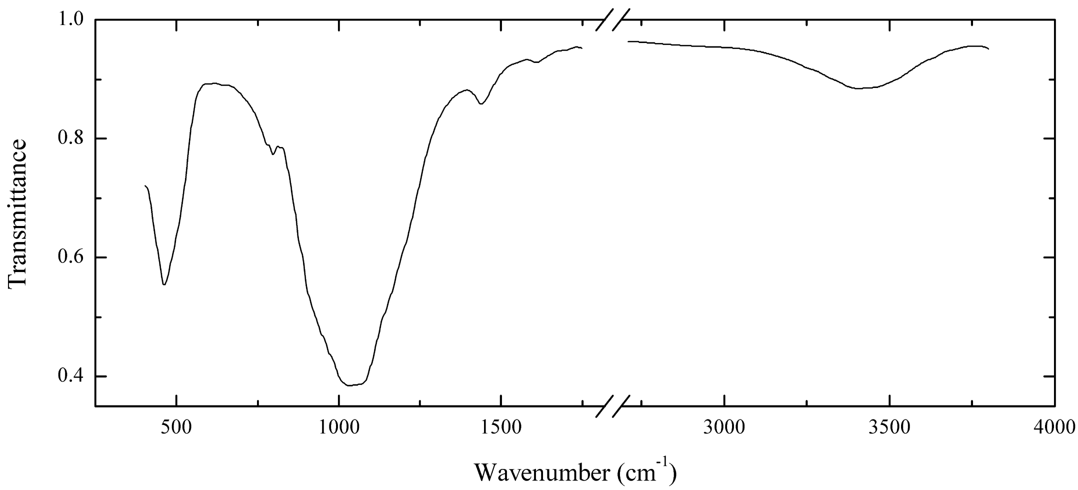


Locality: Rosas mine, Narcao, Carbonia-Iglesias province, Sardinia, Italy.

Description: Greenish-blue semitransparent mass from the association with malachite and calcite. Amorphous.

Wavenumbers (cm^{-1}): 3525s, 3385s, 1648, 1590sh, 1425w, 1200sh, 1160sh, 1003s, 930sh, 660sh, 562s, 460.

Sia23 Ekanite $ThCa_2Si_8O_{20}$

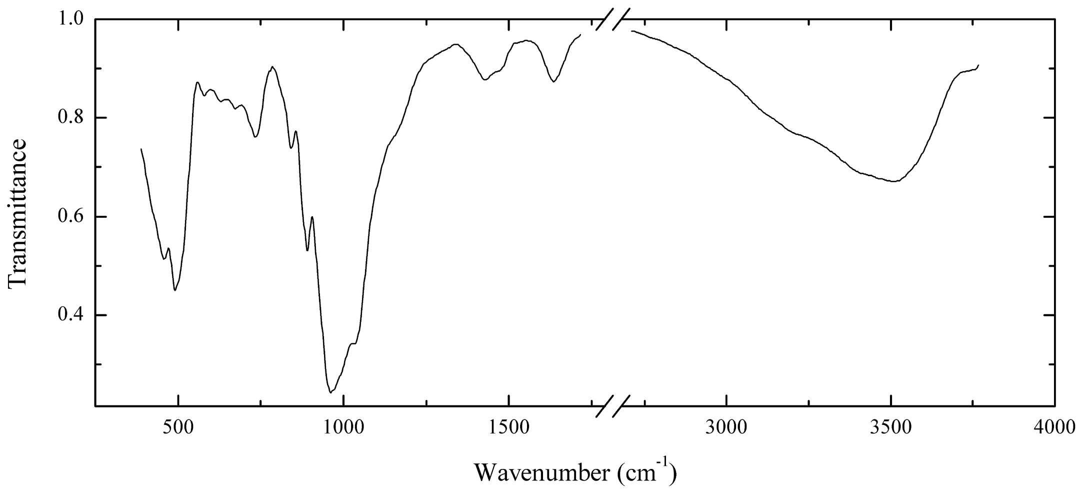


Locality: An unknown placer near Ratnapura, Ehaliyagoda district, Sri Lanka.

Description: Bottle-green transparent pebble. Amorphous, metamict, probably contains submicroscopic inclusions of quartz. The approximate empirical formula is (electron microprobe) $(Th_{0.9}U_{0.05})Ca_{2.1}Si_{8.00}O_{20} \cdot nH_2O$

Wavenumbers (cm^{-1}): 3410, 1607w, 1443, 1175sh, 1070sh, 1040, 950sh, 885sh, 800, 780sh, 500sh, 465s.

Sib1 Tobermorite $Ca_5[(Si,Al)_6(O,OH)_{17}]\cdot 5H_2O$

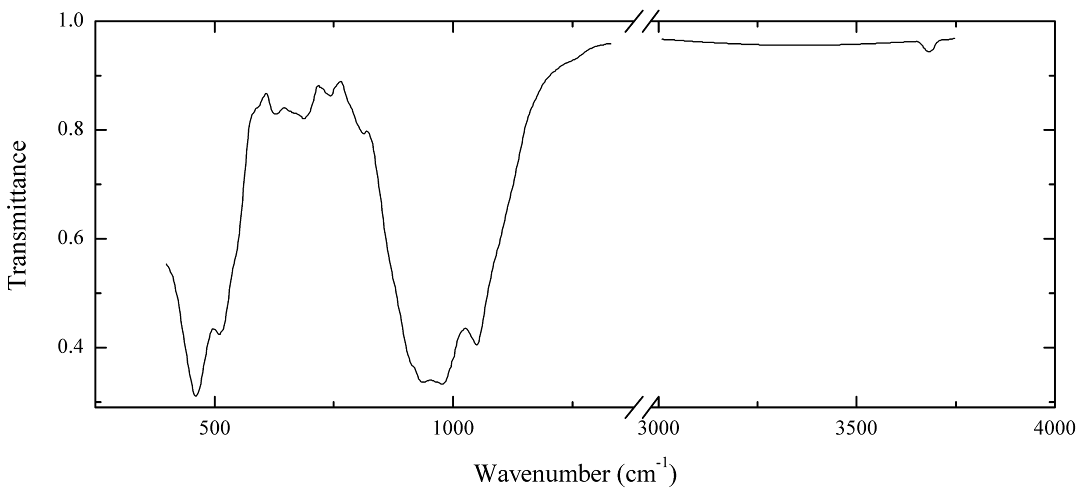


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White fine-grained aggregate from the association with calcite, andradite and vesuvianite. Na- and CO_3-bearing, Al-rich variety. The empirical formula is $Na_{0.5}Ca_{5.0}[(Si_{4.9}Al_{1.1})(O,OH)_{17}](CO_3)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3510, 3425sh, 3250sh, 1638, 1475sh, 1426, 1150sh, 1033s, 985sh, 962s, 888, 840, 730, 676w, 634w, 583w, 484s, 452.

Sib2 Aluminotschermakite $\square Ca_2(Mg_3Al_2)(Si_6Al_2O_{22})(OH)_2$

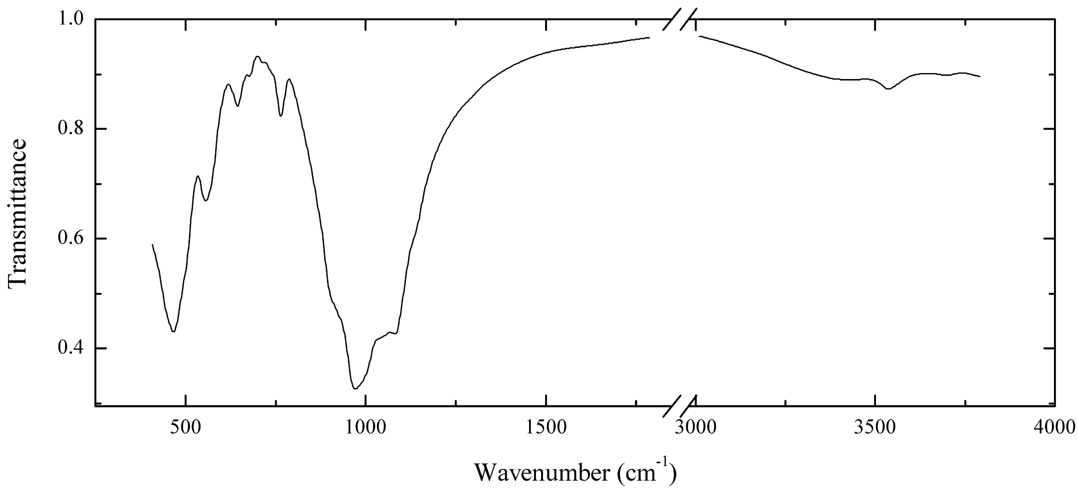


Locality: Mundarara mine, Longido, Kilimanjaro region, Tanzania.

Description: Black grains from the association with corundum. The empirical formula is (electron microprobe) $(Na_{0.4}K_{0.1})(Ca_{1.9}Na_{0.1})(Mg_{2.7}Fe_{1.1}Al_{1.1}Cr_{0.1})(Si_{6.0}Al_{2.0}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3680w, 1051, 978s, 944s, 900sh, 815, 738w, 685, 655sh, 634w, 540sh, 509, 459s.

Sib3 Leakeite $NaNa_2(Mg_2Fe^{3+}{}_2Li)(Si_8O_{22})(OH)_2$

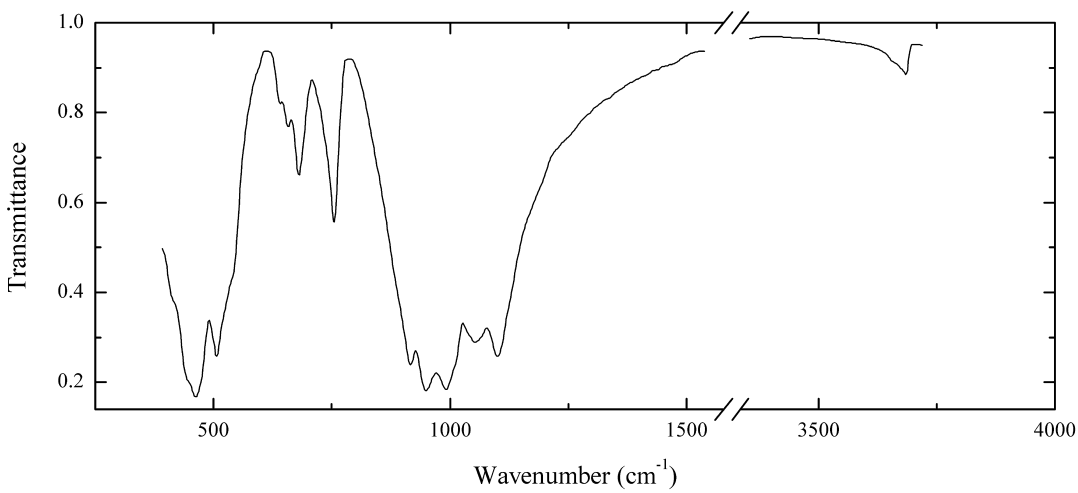


Locality: Norra Kärr, Gränna, Jönköping, Småland, Sweden.

Description: Black long-prismatic crystals from the association with albite and aegirine. Al-rich variety. The empirical formula is (electron microprobe) $(Na_{2.6}K_{0.4})(Mg_{2.1}Fe_{1.0}Al_{1.0}Li_x)(Si_{8.0}O_{22})(OH)_yF_{0.9}$.

Wavenumbers (cm^{-1}): 3543w, 1144, 1089, 1081, 1050sh, 995sh, 976s, 930sh, 910sh, 764, 675w, 644, 560, 464.

Sib4 Actinolite $\square Ca_2(Mg,Fe^{2+})_5(Si_8O_{22})(OH)_2$

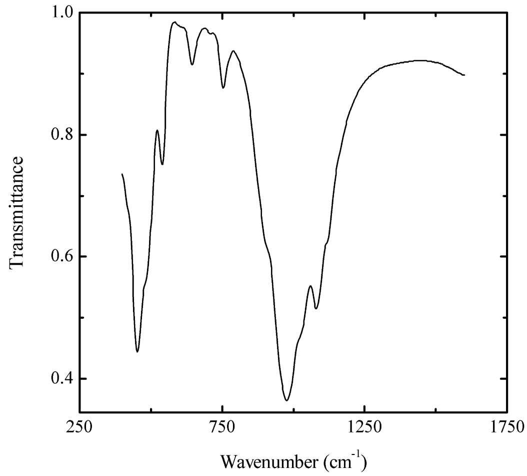


Locality: Malyshevskoe deposit, Emerald Mines, Middle Urals, Russia.

Description: Dark green long-prismatic crystals from the association with phlogopite and dravite. The empirical formula is (electron microprobe) $(Ca_{1.84}Na_{0.18})(Mg_{4.42}Fe_{0.61}Al_{0.08})(Si_{7.83}Al_{0.17}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3685, 3670w, 3650sh, 1102s, 1058, 1010sh, 994s, 951s, 920s, 758, 685, 661, 643w, 535sh, 520sh, 506s, 464s, 445sh, 415sh.

Sib5 Arfvedsonite $NaNa_2(Fe^{2+}{}_4Fe^{3+})(Si_8O_{22})(OH)_2$

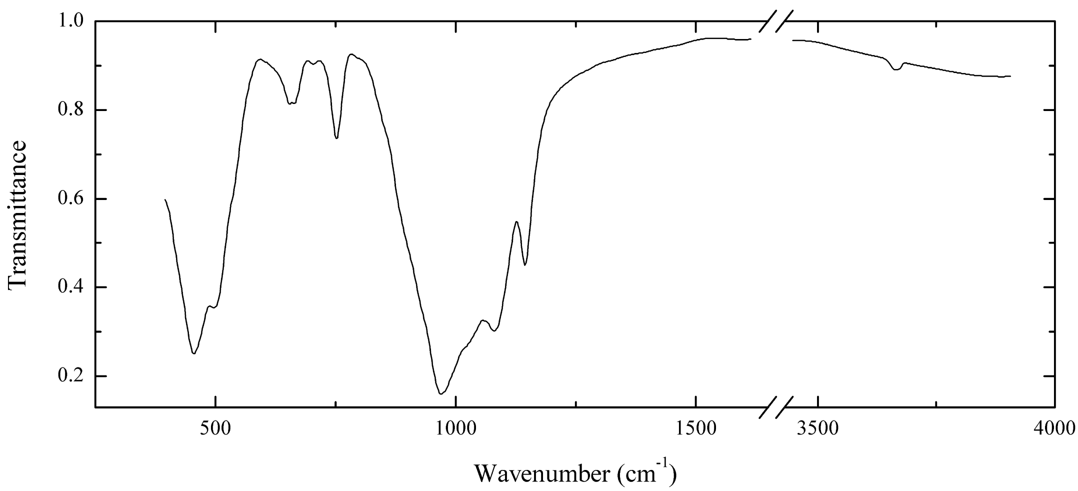


Locality: Kent granite massif, Karagandy region, Kazakhstan.

Description: Black grain with bluish streak from the association with microcline and quartz. The empirical formula is (electron microprobe) $(Na_{2.6}K_{0.25})(Fe_{3.6}Mg_{0.9}Al_{0.3}Zn_{0.1}Ti_{0.1})(Si_{8.0}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 1120, 1080, 1025sh, 976s, 905sh, 775sh, 754, 708w, 644, 538, 480sh, 451s, 400sh.

Sib6 Arfvedsonite $NaNa_2(Fe^{2+}{}_4Fe^{3+})(Si_8O_{22})(OH)_2$

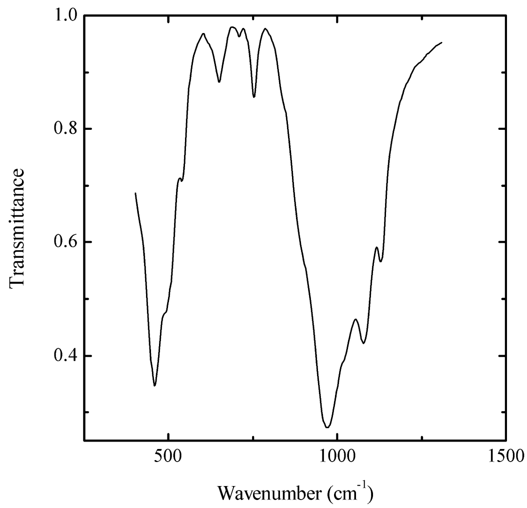


Locality: Northern quarry, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Black prismatic twin from the association with eudialyte, microcline, sodalite, nepheline, ilmenite and aegirine. The empirical formula is (electron microprobe) $(Na_{1.9}K_{0.4}Mn_{0.3}Ca_{0.2})(Fe_{3.4}Mg_{1.3}Ti_{0.2}Al_{0.2})(Si_{7.9}Al_{0.1}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3665w, 1138, 1074s, 1020sh, 966s, 925sh, 748, 700w, 662, 651, 565sh, 535sh, 497, 454s.

Sib7 Fluorarfvedsonite $NaNa_2(Fe^{2+}{}_4Fe^{3+})(Si_8O_{22})(F,OH)_2$

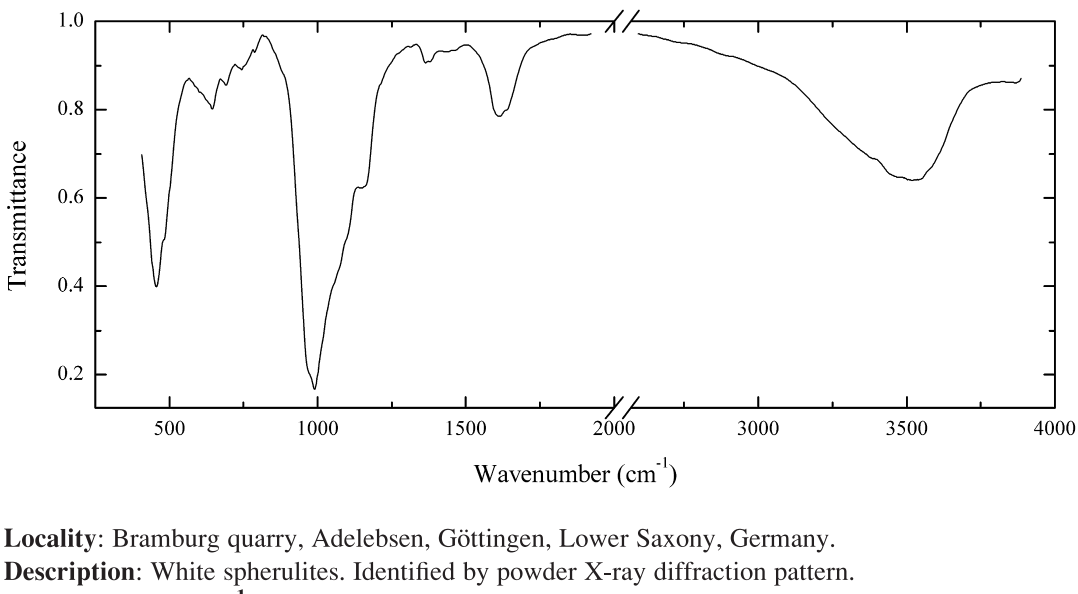


Locality: Katugin Ta–Nb deposit, Chita region, Transbaikal area, Eastern Siberia, Russia.

Description: Black grain from the association with fluorannite and neighborite. The empirical formula is (electron microprobe) $(Na_{2.4}K_{0.3})(Fe_{3.9}Mg_{0.6}Ti_{0.2}Zn_{0.1}Al_{0.1})(Si_{8.0}O_{22})F_{1.1}(OH,O)_{0.9}$.

Wavenumbers (cm^{-1}): 1129, 1078s, 1020sh, 971s, 905sh, 753, 709w, 665sh, 650, 537, 490, 454s, 420sh.

Sib8 Tacharanite $Ca_{12}Al_2Si_{18}O_{51}\cdot18H_2O$

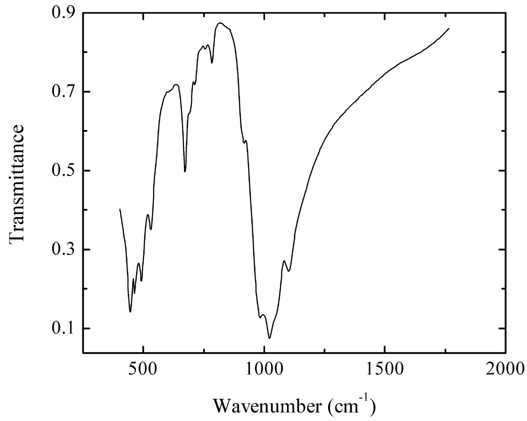


Locality: Bramburg quarry, Adelebsen, Göttingen, Lower Saxony, Germany.

Description: White spherulites. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3515, 3385sh, 1615, 1384w, 1367w, 1153, 1095sh, 1055sh, 1015sh, 991s, 970sh, 791w, 740w, 689w, 643, 620sh, 478, 451s.

Sib9 Anthophyllite $\square Mg_7(Si_8O_{22})(OH)_2$

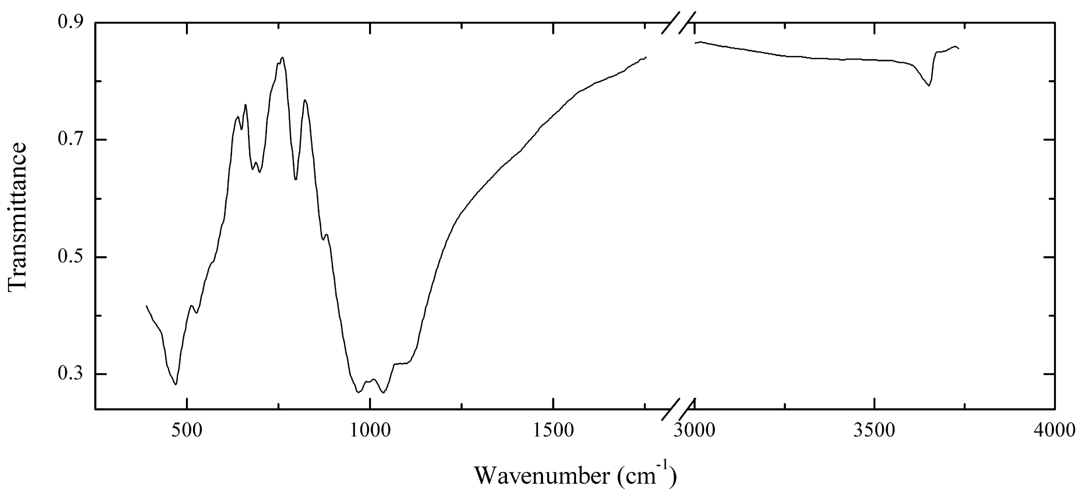


Locality: Paakkila, Kuortane, Finland.

Description: Grey radial fibrous aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1098, 1040sh, 1018s, 975s, 912, 782, 755w, 712, 690, 669, 531, 495s, 465s, 448s, 425sh.

Sib10 Holmquistite $\square Li_2(Mg,Fe^{2+})_3(Al,Fe^{3+})_2(Si_8O_{22})(OH)_2$

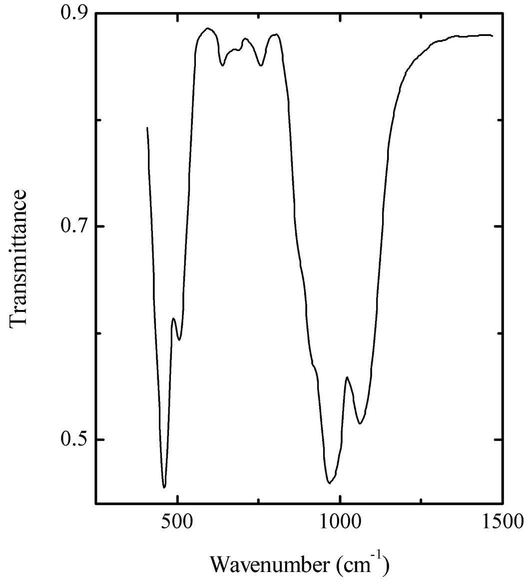


Locality: Utö mines, Utö island, Stockholm, Södermanland, Sweden (type locality).

Description: Black columnar aggregate. The empirical formula is (electron microprobe, Li calculated): $(Li_{1.9}Na_{0.1})(Mg_{2.1}Fe_{0.9}Mn_{0.1}Zn_{0.1})(Al_{1.2}Fe_{0.8})(Si_{8.0}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3653w, 1099s, 1039s, 1001, 973s, 878, 798, 735w, 700, 679, 648w, 600sh, 570sh, 550sh, 525, 467s, 450sh, 405sh.

Sib11 Barroisite □(CaNa)(Mg_3AlFe^{3+})(Si_7AlO_{22})$(OH)_2$

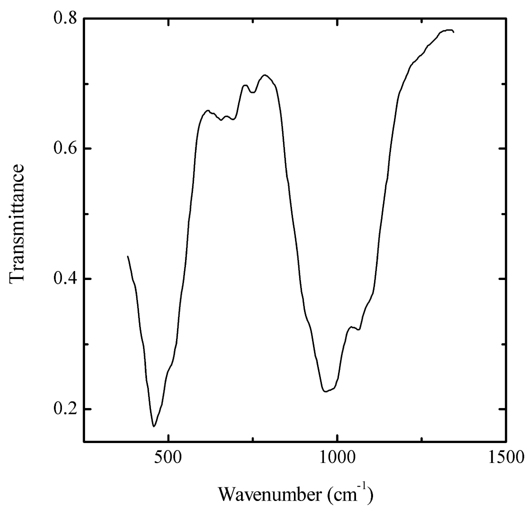


Locality: Ishkul, Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black grains. Investigated by A.G. Bazhenov. The empirical formula is (wet chemical analysis) ($K_{0.2}Na_{0.15}$)($Ca_{1.1}Na_{0.9}$)($Mg_{2.7}Fe^{2+}{}_{1.4}Mn_{0.1}Fe^{3+}{}_{0.8}Ti_{0.1}$)($Si_{7.4}Al_{0.5}Fe^{3+}{}_{0.1}O_{22}$)$(OH)_xF_{0.4}$.

Wavenumbers (cm^{-1}): 1090sh, 1065s, 985sh, 970s, 920sh, 880sh, 754w, 686w, 642w, 507, 461s.

Sib12 Barroisite □(CaNa)(Mg_3AlFe^{3+})(Si_7AlO_{22})$(OH)_2$

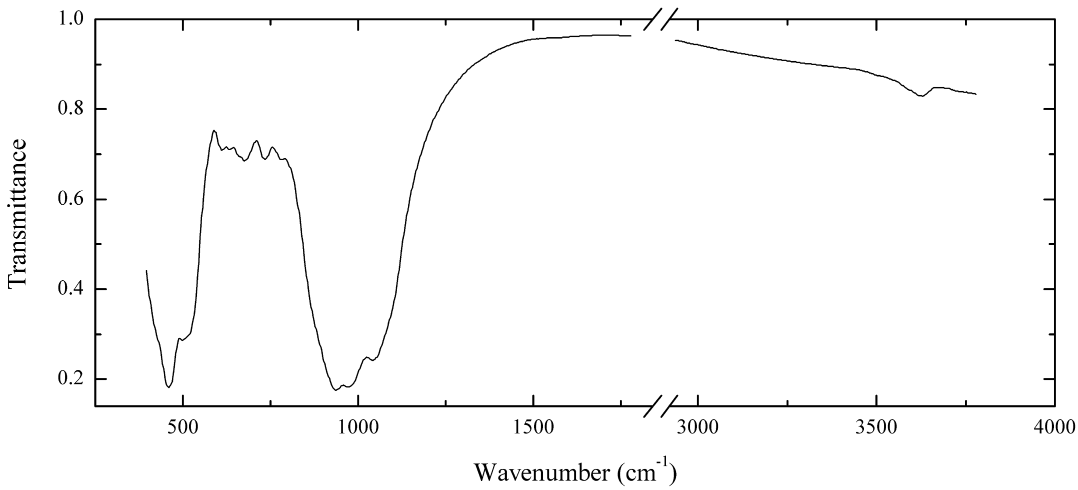


Locality: Marun-Keu eclogite complex, Polar Urals, Russia.

Description: Grey-green grains from the contact zone of eclogite. The empirical formula is ($K_{0.05}Na_{0.9}Ca_{1.05}$)($Mg_{3.7}Fe_{1.0}Al_{0.4}$)($Si_{7.1}Al_{0.9}O_{22}$)$(OH,F)_2$.

Wavenumbers (cm^{-1}): 1095sh, 1058, 990sh, 970s, 915sh, 753w, 689w, 658w, 640sh, 555sh, 540sh, 505sh, 475sh, 459s, 440sh, 420sh.

Sib13 **Hastingsite** $NaCa_2(Fe^{2+}{}_4Fe^{3+})(Si_6Al_2O_{22})(OH)_2$

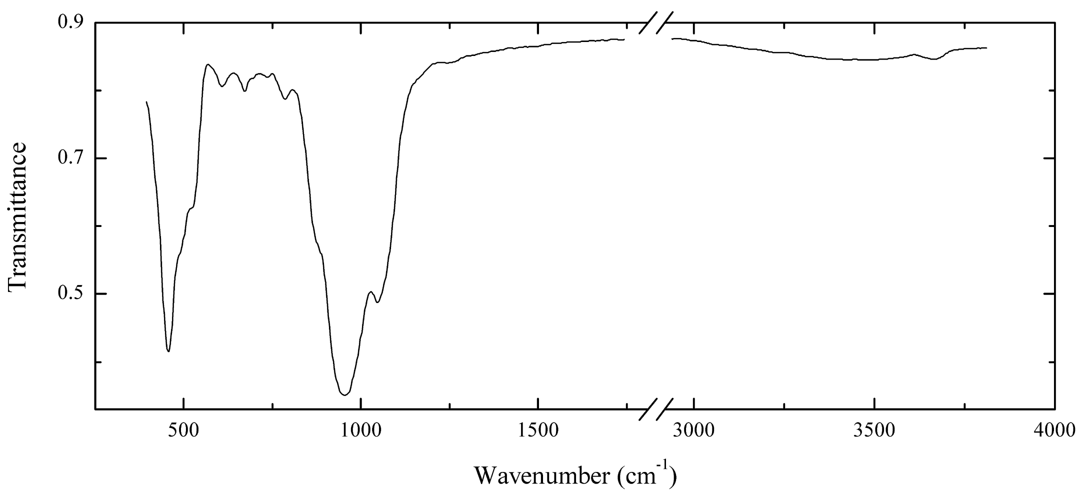


Locality: Dmitrievskiy mine, Transbaikal area, Siberia, Russia.

Description: Black grains. The empirical formula is (electron microprobe) $K_{0.28}Na_{0.65}Ca_{1.76}(Fe_{3.12}Mg_{0.98})(Fe_{0.67}Ti_{0.22}Al_{0.11})(Si_{6.27}Al_{1.73}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3630w, 1085sh, 1050s, 977s, 936s, 870sh, 782w, 732w, 677w, 660sh, 627w, 606w, 510sh, 489, 451s, 415sh.

Sib14 **Hastingsite** $NaCa_2(Fe^{2+}{}_4Fe^{3+})(Si_6Al_2O_{22})(OH)_2$

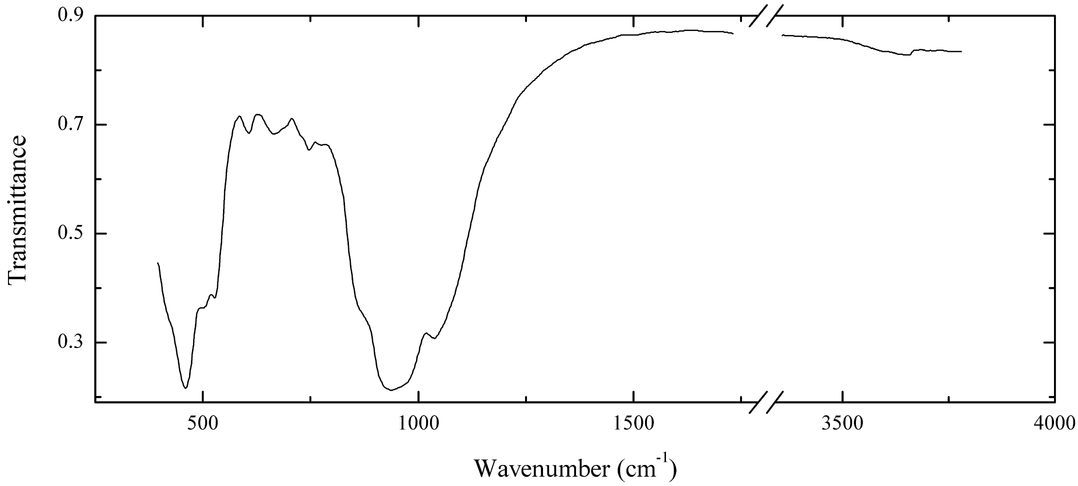


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black grains. Investigated by A.G. Bazhenov. The empirical formula is (wet chemical analysis): $K_{0.41}Na_{1.34}Ca_{1.34}(Fe^{2+}{}_{1.69}Mg_{0.69}Mn_{0.42}Fe^{3+}{}_{1.35}Al_{0.71}Ti_{0.12})(Si_{6.11}Al_{1.89}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3640w, 1049s, 880sh, 787w, 735w, 695sh, 668w, 607w, 525sh, 490sh, 453s.

Sib15 Potassic-hastingsite $(K,Na)Ca_2(Fe^{2+}{}_4Fe^{3+})(Si_6Al_2O_{22})(OH)_2$

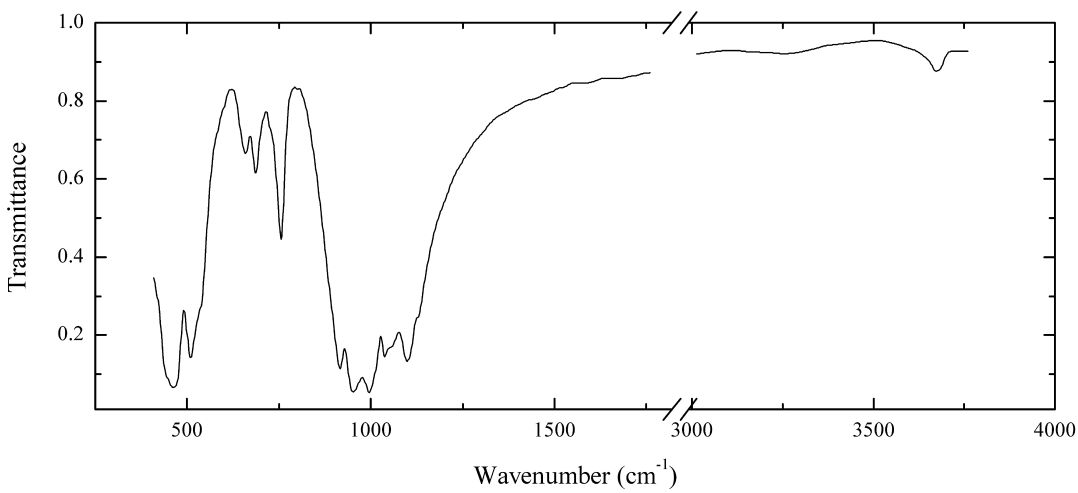


Locality: Odinochnoe deposit, Kuraginskiy district, Eastern Sayan Mts., Siberia, Russia.

Description: Black grains. The empirical formula is (electron microprobe) $K_{0.46}Na_{0.35}Ca_{1.99}(Fe_{4.16}Mg_{0.55}Al_{0.25}Mn_{0.08}Ti_{0.01})(Si_{5.72}Al_{2.28}O_{22})Cl_{0.69}(OH,F)_{1.31}$.

Wavenumbers (cm^{-1}): 3640, 1045s, 975sh, 943, 930sh, 870sh, 780w, 747w, 725sh, 680sh, 662w, 598w, 521, 487, 450s, 415sh.

Sib16 Actinolite $\square Ca_2(Mg,Fe^{2+})_5(Si_8O_{22})(OH)_2$

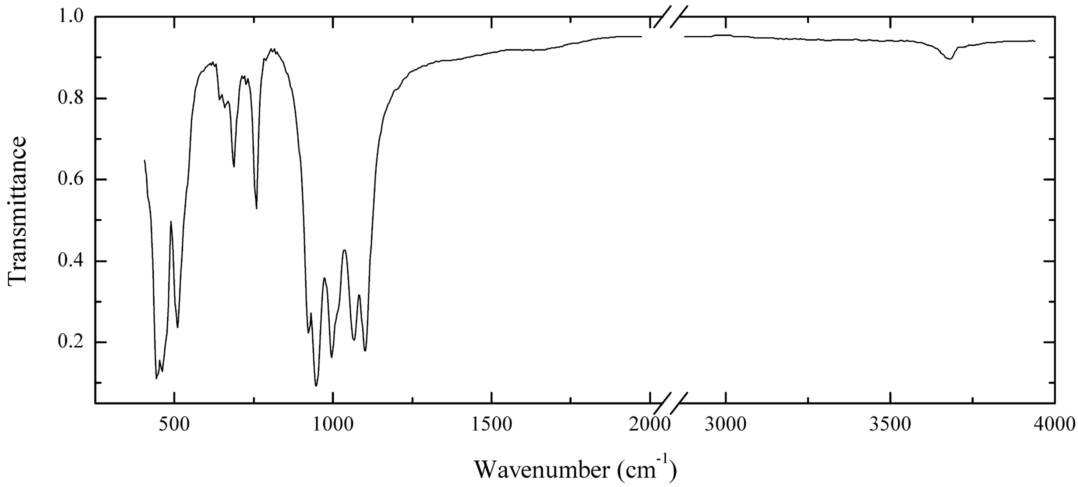


Locality: Bastnäs, Riddarhyttan, Västmanland, Sweden.

Description: Dark green long-prismatic crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3670w, 1124, 1101s, 1055sh, 1036s, 995s, 952s, 917s, 756, 720sh, 685, 654, 540sh, 512s, 462s, 445sh.

Sib17 Actinolite □$Ca_2(Mg,Fe^{2+})_5(Si_8O_{22})(OH)_2$

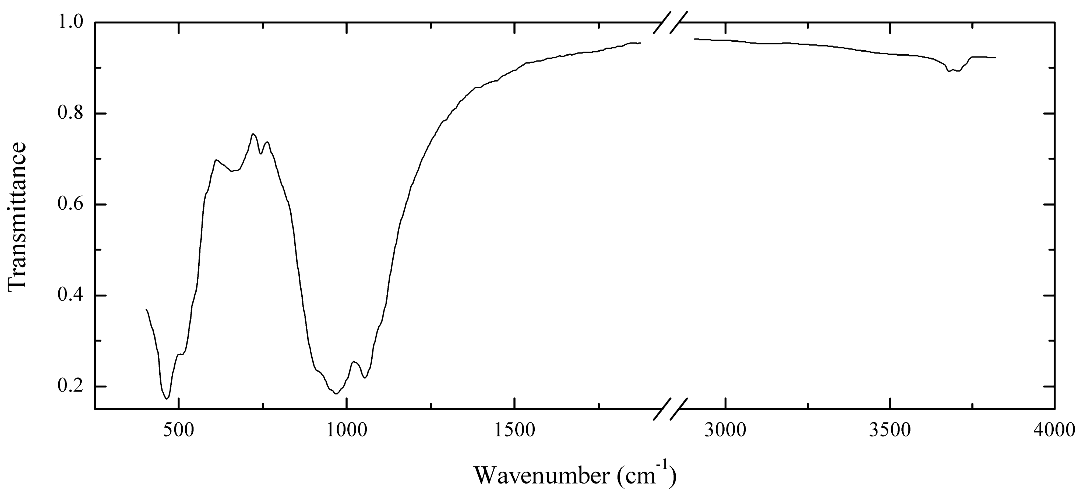


Locality: Alpe Rosso, Orcesco, Druogno, Vigezzo valley, Piedmont, Italy.

Description: White fibrous aggregate in marble, in the association with vigezzite. The empirical formula is (electron microprobe) $Ca_{2.0}(Mg_{4.95}Fe_{0.9}Mn_{0.1}Al_{0.05})(Si_{7.95}Al_{0.05}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3670w, 1102s, 1067s, 1015sh, 996s, 947s, 923s, 757, 723w, 687, 662w, 644w, 540sh, 509, 461s, 445s, 410sh.

Sib18 Magnesiotaramite $Na(CaNa)(Mg_3AlFe^{3+})(Si_6Al_2O_{22})(OH)_2$

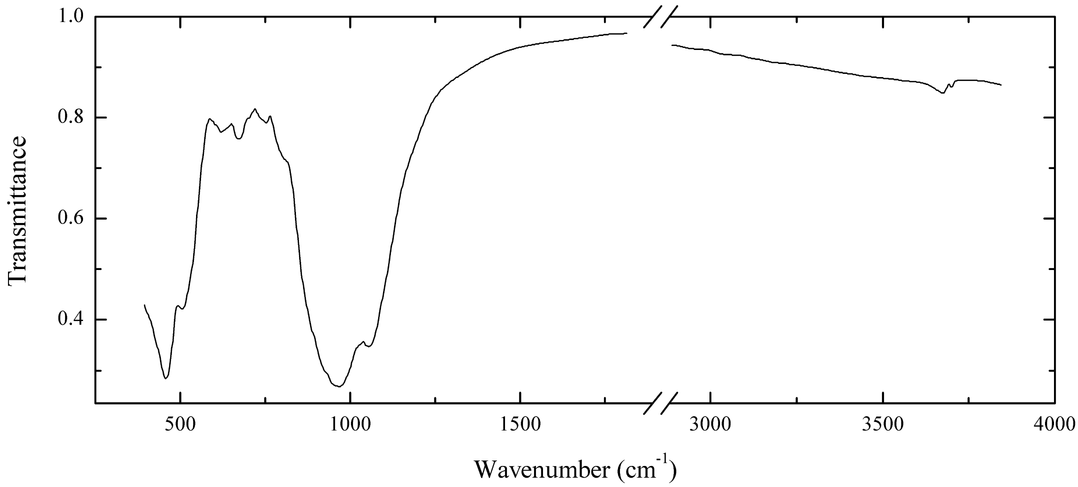


Locality: Malyshevskoe deposit, Emerald Mines, Middle Urals, Russia.

Description: Greenish-grey prismatic crystals from the association with margarite. The empirical formula is (electron microprobe) $(Na_{0.83}K_{0.07})(Ca_{1.40}Na_{0.60})(Mg_{3.27}Mn_{0.01}Al_{1.08}Fe_{0.57}Cr_{0.05}Ti_{0.02})(Si_{6.39}Al_{1.61}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3695w, 3665w, 1105sh, 1054s, 971s, 920sh, 743w, 679, 663, 545sh, 509, 463s, 420sh.

Sib19 Katophorite $Na(CaNa)(Fe^{2+}{}_4Al)(Si_7AlO_{22})(OH)_2$

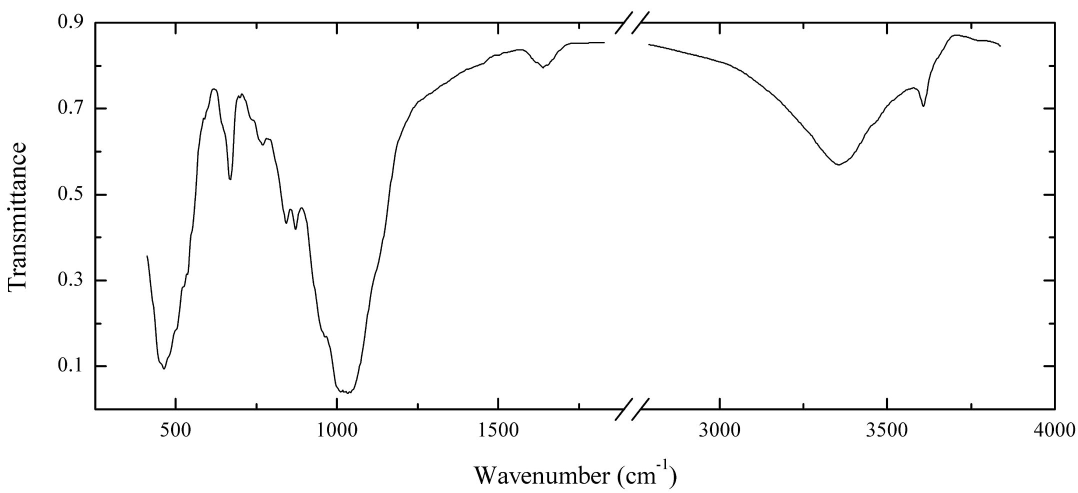


Locality: Sakharyok massif, Western Keivy Mts., Kola peninsula, Murnansk region, Russia.

Description: Black grains with blue streak. The empirical formula is (electron microprobe) $(Na_{0.7}K_{0.2})(Ca_{1.4}Na_{0.6})[(Fe_{2.4}Mg_{1.5}Mn_{0.1})(Al_{0.7}Fe_{0.3})](Si_{6.8}Al_{1.2}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3690w, 3665w, 1055s, 964s, 920sh, 805sh, 747w, 670, 623w, 506, 455s.

Sib20 Plancheite $Cu_8(Si_4O_{11})_2(OH)_4{\cdot}H_2O$

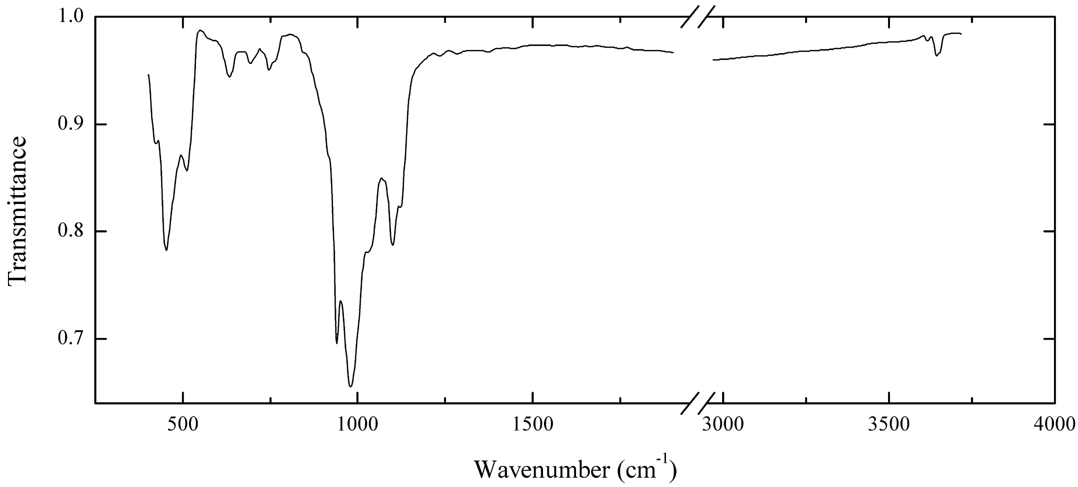


Locality: Musonoi mine, Kolwezi, Katanga Copper Crescent, Democratic Republic of Congo.

Description: Light blue radial fibrous aggregates from the association with malachite. Identified by IR spectrum.

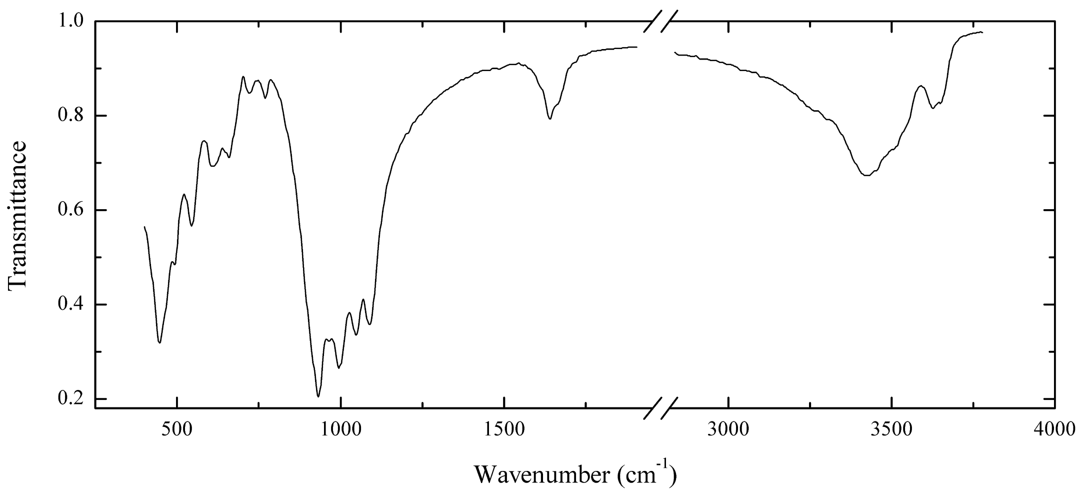
Wavenumbers (cm^{-1}): 3598, 3350, 1640w, 1130sh, 1032s, 1008s, 960sh, 869, 841, 763, 730sh, 665, 530sh, 505sh, 458s.

Sib21 Manganogrunerite $\square Mn_2Fe^{2+}{}_5(Si_8O_{22})(OH)_2$



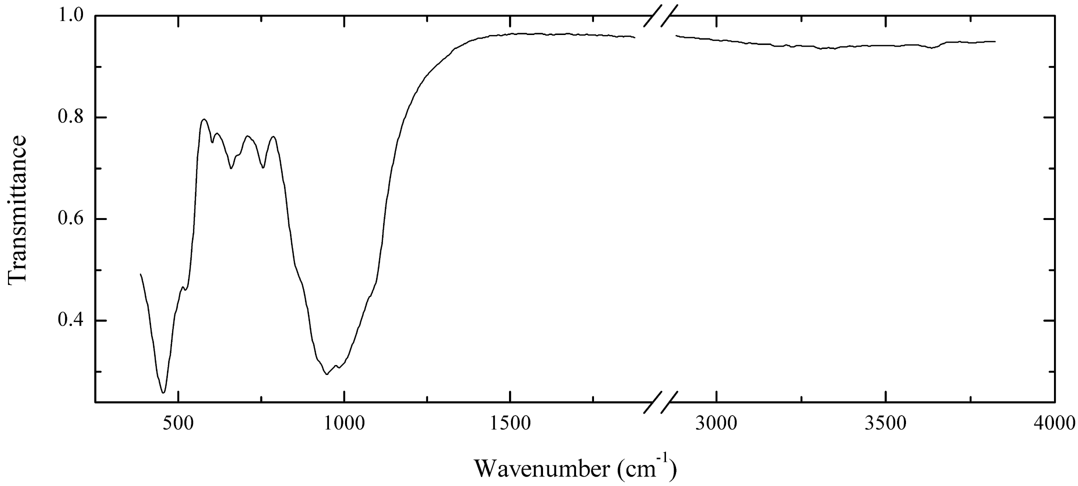
Locality: Nikolaevskiy mine, Dalnegorsk, Kavalerovo mining district, Primorskiy Kray, Russia.
Description: Grey-green random fibrous aggregate from the association with ilvaite and hedenbergite. The empirical formula is (electron microprobe) $K_{0.03}(Mn_{1.20}Ca_{0.80})(Fe_{3.74}Mg_{0.63}Mn_{0.59}Ti_{0.02})(Si_{7.88}Al_{0.09}Fe_{0.03}O_{22})(OH)_2$.
Wavenumbers (cm^{-1}): 3625w, 1140sh, 1123, 1100s, 1034, 982s, 939s, 760sh, 746, 693w, 634, 510, 450s, 406.

Sib22 Inesite $Ca_2Mn^{2+}{}_7(Si_{10}O_{28})(OH)_2·5H_2O$



Locality: N'Chwaning mine, Kuruman, Kalahari manganese fields, Northern Cape province, South Africa.
Description: Pink radial aggregate from the association with orlymanite and xonotlite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3635, 3610, 3490sh, 3410, 1665sh, 1645, 1091s, 1050s, 997s, 970s, 934s, 771w, 722w, 661, 620sh, 610, 547, 493, 447s, 420sh.

Sib23 Chloro-potassichastingsite $KCa_2(Fe^{2+}{}_4Fe^{3+})(Si_6Al_2O_{22})(OH)_2Cl_2$

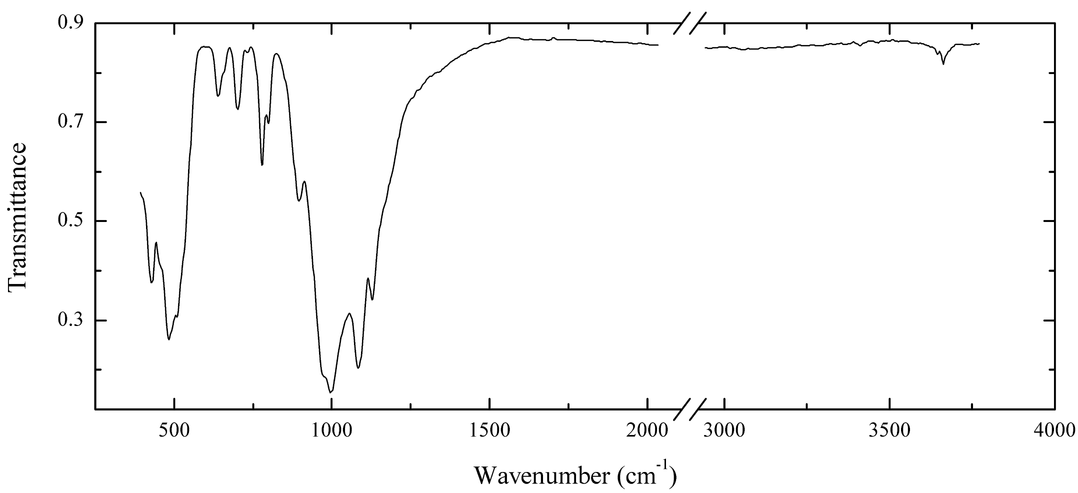


Locality: Dashkesan Co–Fe deposit, Dashkesan, Azerbaijan (type locality).

Description: Very dark green coarse prismatic crystals from the association with quartz, chlorite, actinolite, chlorapatite, epidote, magnetite, hematite and sulfides. Neotype sample. Monoclinic, space group *C*2/*m*. Unit-cell dimensions refined from the powder data are $a = 9.979(4)$, $b = 18.035(8)$, $c = 5.302(3)$ Å, $\beta = 104.71(4)°$. $D_{meas} = 3.52$ g/cm^3, $D_{calc} = 3.53$ g/cm^3. Optically biaxial (−), $\alpha = 1.728$, $\beta = 1.749$, $\gamma = 1.751$, $2V_{meas} = 15°$. The empirical formula is $(K_{0.64}Na_{0.34})Ca_{1.90}(Fe^{2+}{}_{3.25}Fe^{3+}{}_{0.97}Mg_{0.72}Mn_{0.06}Al_{0.06}Ti_{0.05})(Si_{5.89}Al_{2.11}O_{22})[Cl_{1.31}(OH)_{0.60}F_{0.07}O_{0.02}]$. The strongest lines of powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 8.53 (100) (110); 3.32 (11) (240); 3.16 (51) (310); 2.981 (12) (221); 2.839 (18) (330), 2.749 (23) (33-1, 151), 2.191 (6) (261).

Wavenumbers (cm^{-1}): 3620w, 1085sh, 987s, 948s, 925sh, 870sh, 749, 673w, 655, 597w, 515, 490sh, 450s.

Sib24 Cummingtonite $\square Mg_7(Si_8O_{22})(OH)_2$

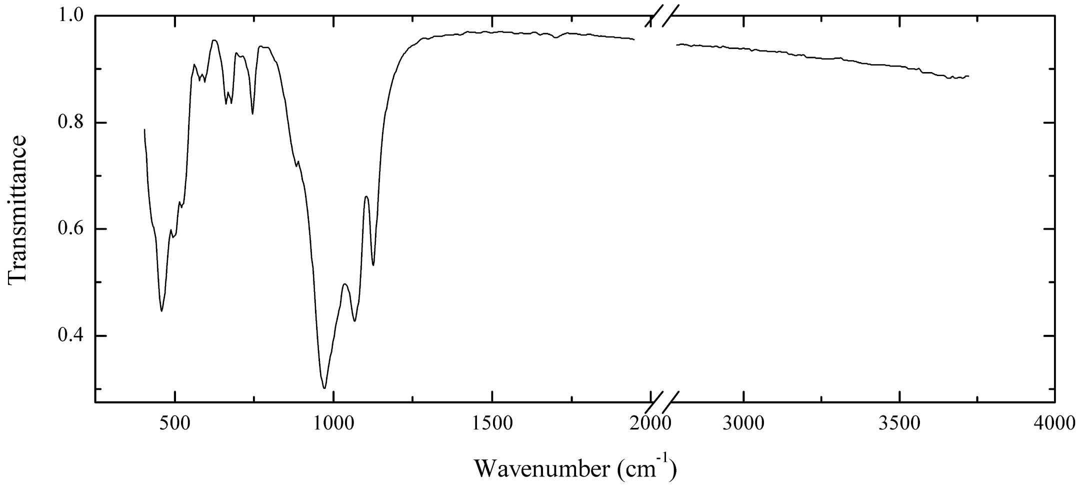


Locality: Lebedinskiy mine, Kursk Magnetic Anomaly, Russia.

Description: Brown columnar aggregate from the association with quartz, calcite and hematite. The empirical formula is (electron microprobe) $Ca_{0.06}(Mg_{4.58}Fe_{2.30}Mn_{0.07})(Si_{7.95}Al_{0.05}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3645w, 3430w, 1170sh, 1128, 1083s, 997s, 970s, 893, 798, 777, 734w, 700sh, 695, 655sh, 638, 530sh, 507, 481s, 455sh, 427.

Sib25 Ungarettiite $NaNa_2(Mn^{2+}{}_2Mn^{3+}{}_3)(Si_8O_{22})O_2$

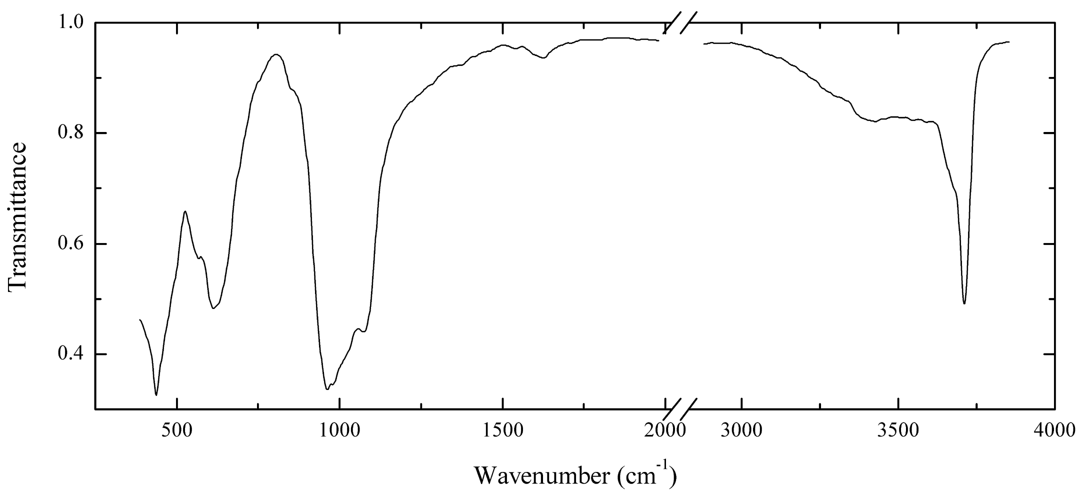


Locality: Tanohata mine, Iwate prefecture, Japan.

Description: Very dark red grains. The empirical formula is (electron microprobe) $(K_{0.19}Na_{2.53}Ca_{0.16})(Mn_{4.19}Mg_{0.81}Fe_{0.32}Al_{0.05}Ti_{0.02})(Si_{8.00}O_{22})O_2$. Bands of OH groups are not observed in the IR spectrum. Thus it is not kôzulite. *Note: Tanahata mine is the type locality of kôzulite*.

Wavenumbers (cm^{-1}): 1126s, 1067s, 969s, 886, 746, 710w, 677, 661, 592w, 577w, 524, 497, 458s, 430sh.

Sib26 Carlosturanite $(Mg,Fe^{2+},Ti)_{21}(Si,Al)_{12}O_{28}(OH)_{34}\cdot H_2O$

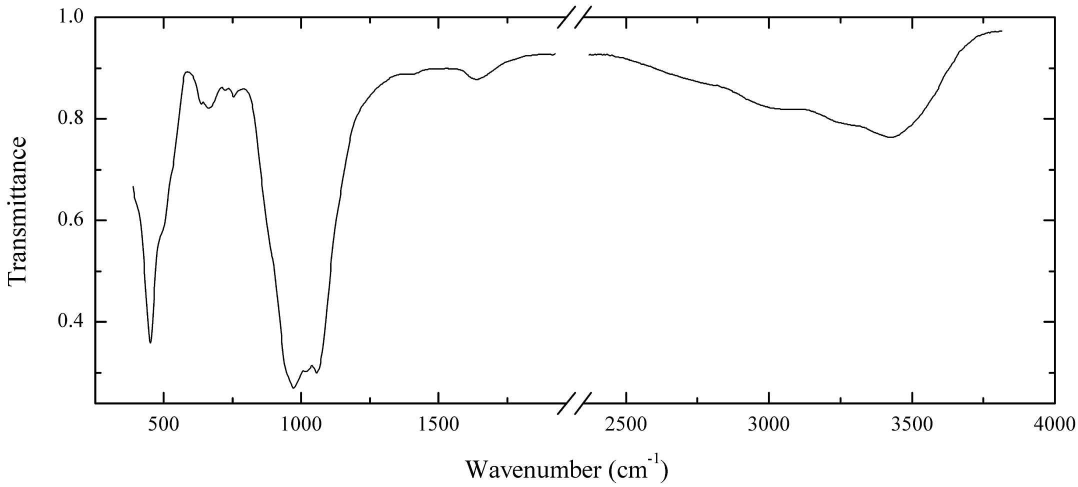


Locality: Val Varaita, near Sempeyre, Piemonte, Italy (type locality).

Description: Light brown fibrous aggregate from the association with diopside, chrysotile, brucite, magnetite and clinohumite.

Wavenumbers (cm^{-1}): 3693, 3665sh, 3405. 1627w, 1069s, 1010sh, 977s, 959s, 850sh, 620sh, 606, 564, 470sh, 432s.

Sib27 Ershovite $Na_4K_3(Fe^{2+},Mn^{2+},Ti)_2[Si_8O_{20}(OH)_2](OH)_2 \cdot 4H_2O$

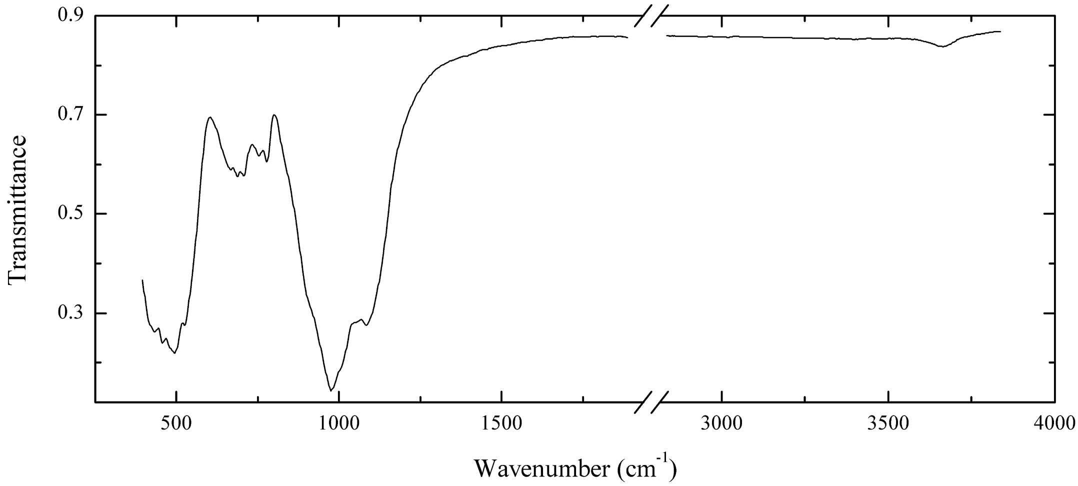


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Olive green grains from the association with orthoclase, nepheline, sodalite, aegirine, alkalic amphibole, villiaumite, natrite, rasvumite, vuonnemite, astrophyllite, shcherbakovite, kazakovite, koashvite, thermonatrite and nacaphite. Holotype sample. Triclinic, space group *P*-1, Unit-cell dimensions refined from the powder data are $a = 10.244(2)$, $b = 11.924(3)$, $c = 5.276(3)$ Å, $\alpha = 103.491(2)°$, $\beta = 96.960(3)°$, $\gamma = 91.945(3)°$, $Z = 1$. $D_{meas} = 2.75(2)$ g/cm^3, $D_{calc} = 2.73$ g/cm^3. Optically biaxial (+), $\alpha = 1.569(2)$, $\beta = 1.574(2)$, $\gamma = 1.590(2)$, $2V_{meas} = 15(2)°$. The empirical formula is $Na_{4.08}K_{2.95}Ca_{0.02}(Fe_{0.87}Mn_{0.68}Ti_{0.38}Mg_{0.13})Si_{8.00}O_{19.98}(OH)_{4.04} \cdot 5.06H_2O$. The strongest lines of powder X-ray diffraction pattern are [*d*, Å (*I*, %)] 11.58 (100), 2.990 (100), 2.709 (80), 2.608 (70), 2.459 (60), 2.160 (60), 1.652 (80).

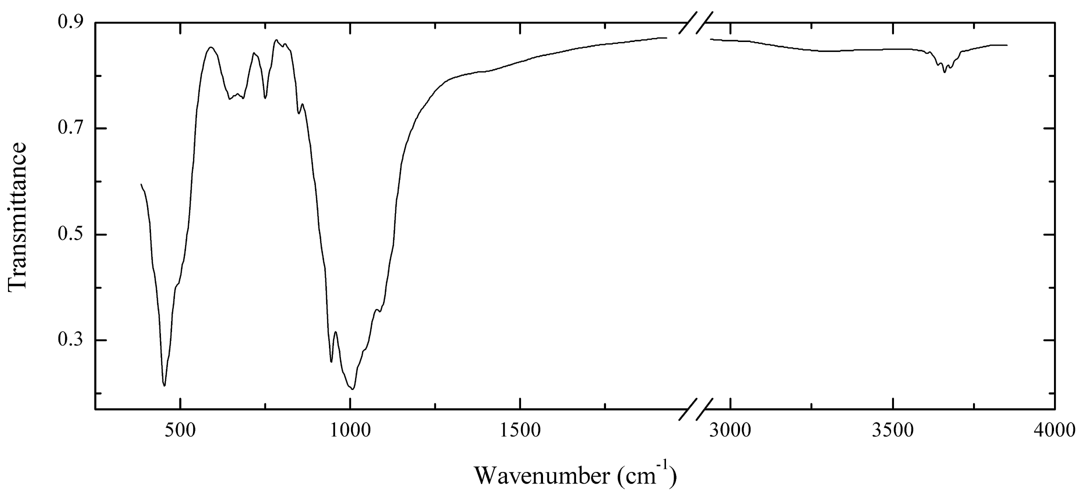
Wavenumbers (cm^{-1}): 3500sh, 3380, 3210sh, 3050sh, 1630w, 1400w, 1120sh, 1056s, 1019s, 970s, 945sh, 890, 750w, 723w, 661, 633w, 525sh, 495sh, 447s, 415sh.

Sib28 Gedrite □$Mg_5Al_2(Si_6Al_2O_{22})(OH)_2$



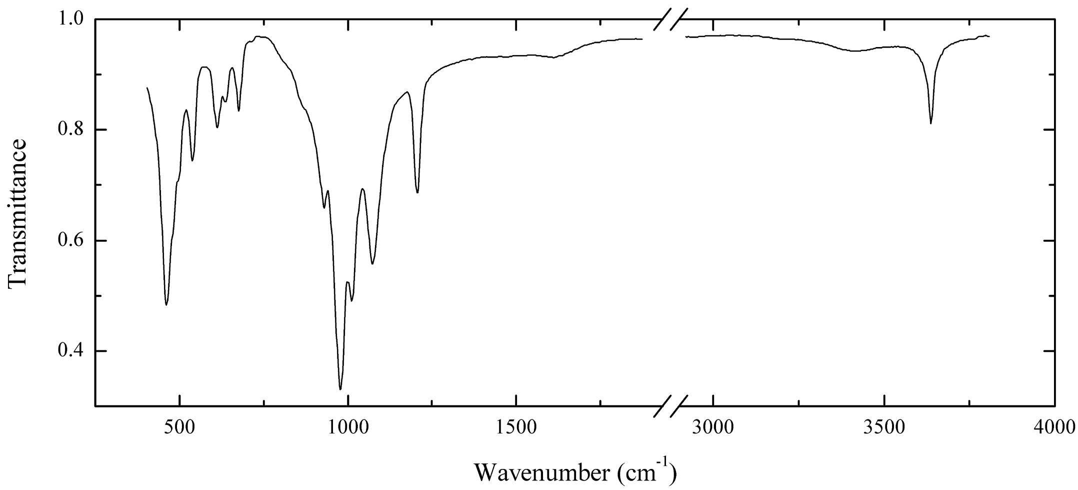
Locality: Terbes-Ostrov, near Shueretskaya railway station, Karelia, Russia.
Description: Dark grey columnar aggregate from the association with almandine, biotite, quartz and kyanite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3630w, 1090, 1058, 1005sh, 979s, 900sh, 840sh, 780, 754w, 707, 686, 658, 524, 493s, 459s, 430

Sib29 Parvo-manganotremolite □$(CaMn)(Mg,Fe^{2+})_5(Si_8O_{22})(OH)_2$



Locality: Droujba (Druzhba) mine, Laki (Lyki), Djurkovo Complex, Rhodope Mts., Plovdiv region, Bulgaria.
Description: Green-grey fibrous aggregate from the association with johannsenite, rhodonite, quartz and calcite. The empirical formula is (electron microprobe) $(Ca_{0.7}Mn_{1.3})(Mg_{3.1}Fe_{1.6}Mn_{0.2}Al_{0.1})(Si_{7.9}Al_{0.1}O_{22})(OH)_2$.
Wavenumbers (cm^{-1}): 3655w, 3635w, 3615w, 1085, 1035sh, 1005s, 943s, 920sh, 849, 752, 677, 646, 495sh, 454s.

Sib30 Xonotlite $Ca_6(Si_6O_{17})(OH)_2$

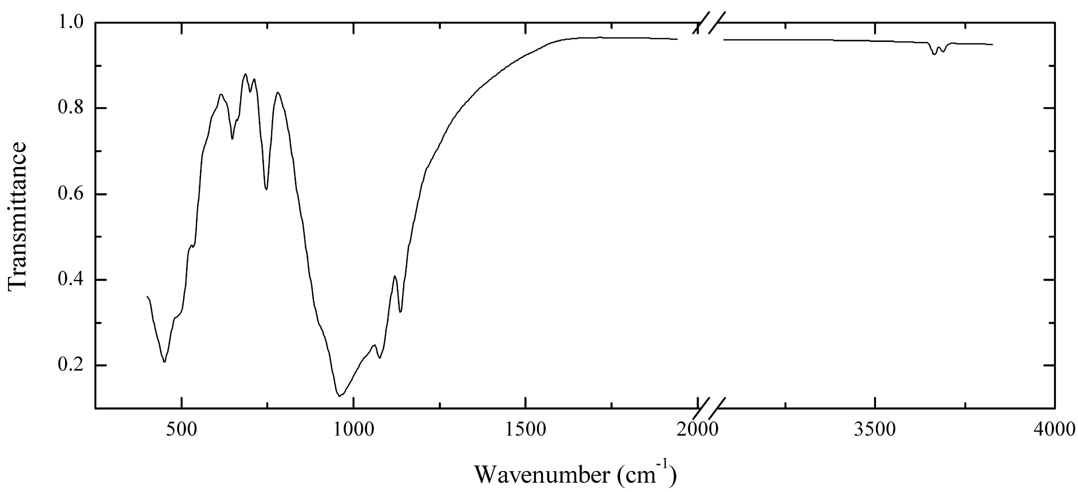


Locality: Arimao-Norte, Cienfuegos province, Cuba.

Description: White parallel-fibrous aggregate from the association with wollastonite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3609, 1203, 1070, 1010s, 974s, 927, 850sh, 810sh, 715w, 671, 632, 606, 533, 490, 475sh, 453.

Sib31 Potassic-arfvedsonite $KNa_2(Fe^{2+}{}_4Fe^{3+})(Si_8O_{22})(OH)_2$

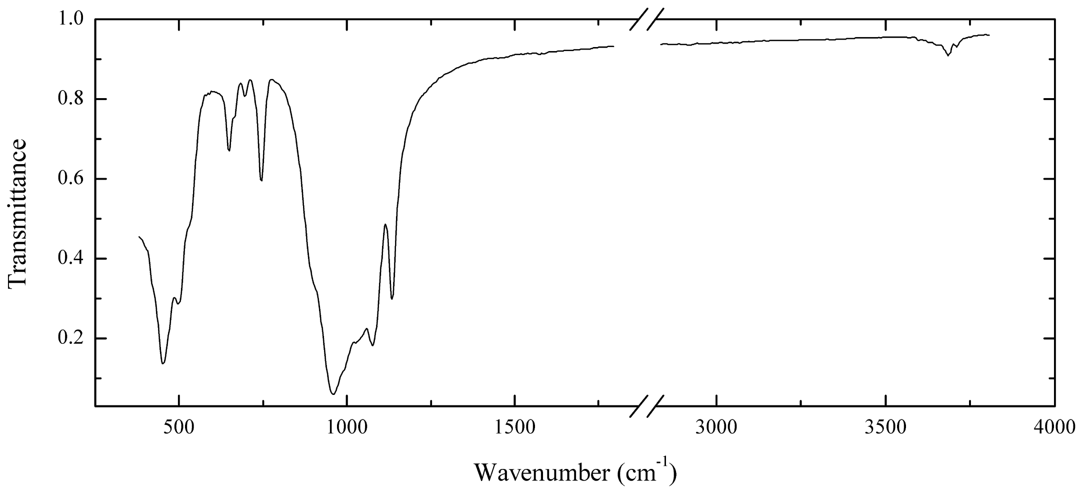


Locality: Palitra pegmatite, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Dark green prismatic crystals. Li-rich variety. The empirical formula is (electron microprobe; Li by wet chemical analysis) $K_{0.8}Na_{2.2}(Fe_{2.7}Mg_{1.2}Mn_{0.5}Ti_{0.1}Al_{0.1}Li_{0.4})(Si_{8.0}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3690w, 3665w, 1139, 1078s, 1045sh, 990sh, 959s, 746, 698w, 665w, 649, 534, 495sh, 449.

Sib32 Potassic-arfvedsonite $KNa_2(Fe^{2+}{}_4Fe^{3+})(Si_8O_{22})(OH)_2$

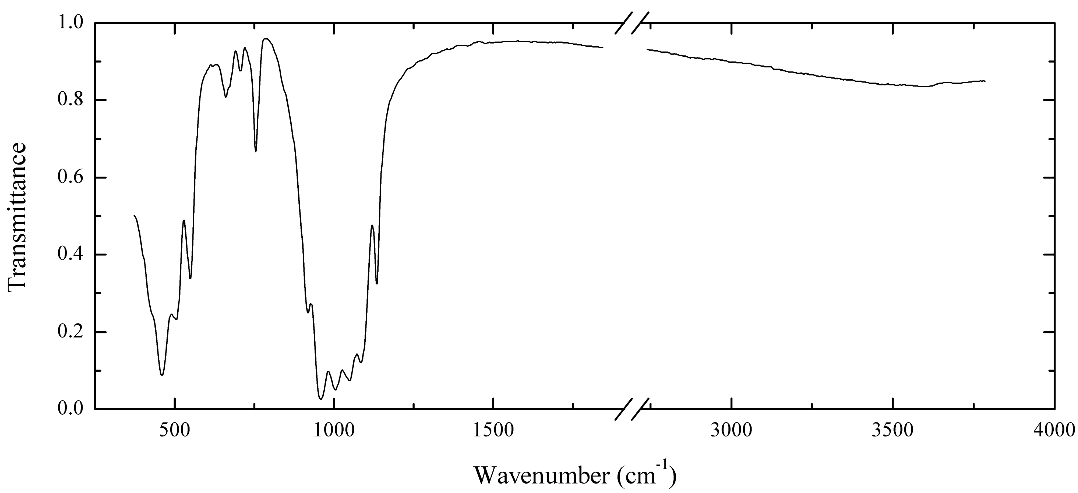


Locality: "Pegmatite Valley", the lowermost tributary to the Lilleelv river, Kangerluarsuk area, Ilímaussaq complex, Greenland (type locality).

Description: Black prismatic crystals from the association with analcime, sodalite, aegirine, steenstrupine-(Ce) and epistolite. Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/m$; $a = 10.002(2)$, $b = 18.054(3)$, $c = 5.319(1)$ Å, $\beta = 103.90(3)°$, $Z = 2$. $D_{meas} = 3.39(2)$ g/cm^3, $D_{calc} = 3.43$ g/cm^3. Optically biaxial (–), $\alpha = 1.683(2)$, $\beta = 1.692(2)$, $\gamma = 1.699(2)$.The empirical formula is $(K_{0.67}Na_{0.22})(Na_{1.95}Ca_{0.05})(Fe^{2+}{}_{3.29}Fe^{3+}{}_{1.26}Li_{0.29}Mn_{0.19}Ti_{0.05}Zn_{0.02}Mg_{0.01})(Si_{7.76}Fe^{3+}{}_{0.13}Al_{0.11})O_{22}[(OH)_{1.81}F_{0.18}]$. The strongest lines of the powder X-ray pattern [d, Å (I, %) (hkl)] are 9.02 (28) (020), 8.53 (100) (110), 3.303 (23) (240); 3.184 (40) (310), 2.847 (17) (330).

Wavenumbers (cm^{-1}): 3690w, 3665w, 1134, 1076s, 1025sh, 990sh, 957s, 900sh, 741, 692w, 661w, 643, 520sh, 491, 445s, 430sh, 400sh.

Sib33 Potassic-leakeite $KNa_2(Mg_2Fe^{3+}{}_2Li)(Si_8O_{22})(OH,F)_2$

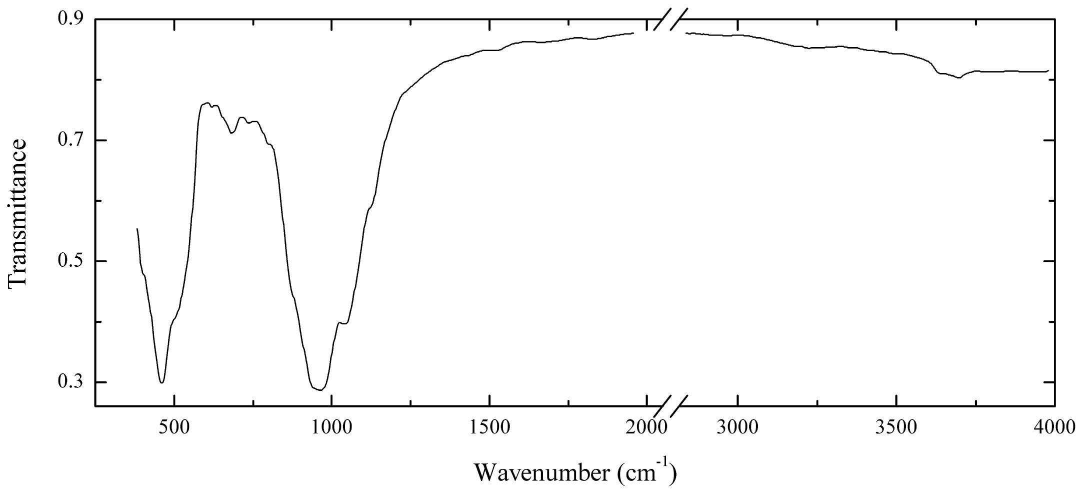


Locality: Shkatulka pegmatite, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Bluish-green random fibrous aggregate from the association with ussingite, serandite, sphalerite, belovite-(Ce) and bykovaite. Investigated by I.V. Pekov. The empirical formula is $K_{0.60}Na_{2.38}Li_{0.86}Mg_{1.49}Mn_{0.59}Fe^{2+}{}_{0.19}Fe^{3+}{}_{1.79}Ti_{0.08}(Si_{7.93}Al_{0.07}O_{22})(OH,O)_{1.26}F_{0.74}$. Confirmed by IR spectrum. Bands of OH groups are not observed in the IR spectrum.

Wavenumbers (cm^{-1}): 1139, 1090s, 1051s, 1005s, 958s, 919, 754, 705w, 671w, 659, 545, 502, 453s, 425sh.

Sib34 Magnesiosadanagaite $NaCa_2[Mg_3(Al,Fe^{3+})_2](Si_5Al_3O_{22})(OH)_2$

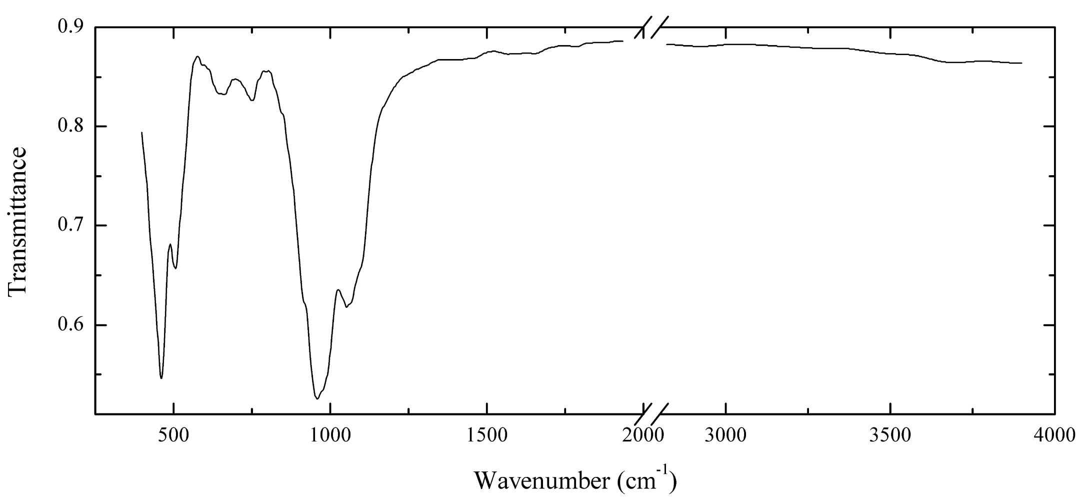


Locality: Kyshtym series, Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black grains from amphibolite, from the association with corundum and spinel. Investigated by A.G. Bazhenov. The empirical formula is $(Na_{0.47}K_{0.23})(Ca_{1.92}Mn_{0.04})(Mg_{2.28}Fe^{2+}{}_{1.11}Al_{1.15}Fe^{3+}{}_{0.43}Ti_{0.12})(Si_{5.38}Al_{2.62}O_{22})(OH,F,O)_2$.

Wavenumbers (cm^{-1}): 3685w, 3660w, 3630w, 1125sh, 1036, 963s, 945sh, 785sh, 804, 745w, 686, 624w, 515sh, 460s, 400sh.

Sib35 Barroisite $\square(CaNa)[Mg_3(Al,Fe^{3+})_2](Si_7AlO_{22})(OH)_2$

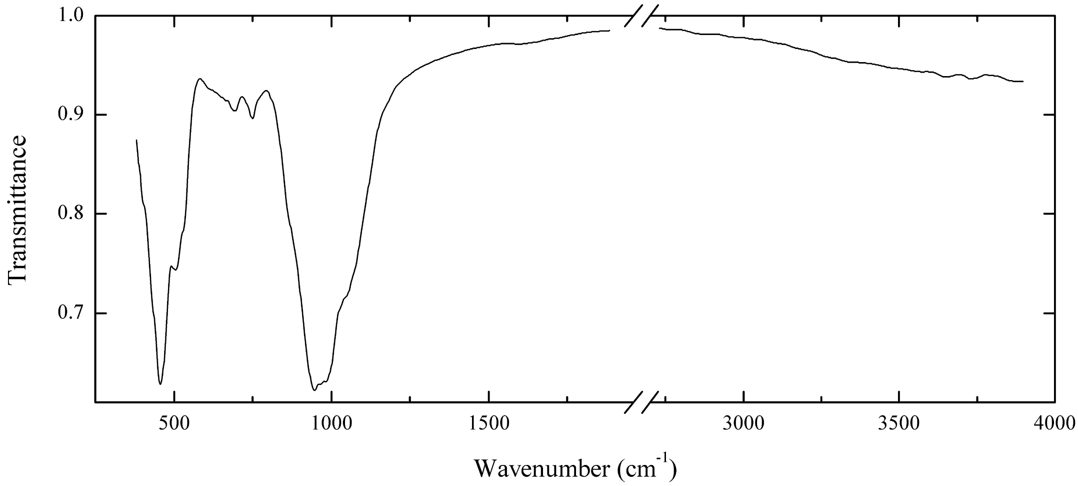


Locality: Ishkul lake, Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black grains from fenite. Investigated by A.G. Bazhenov. Al-deficient variety. The empirical formula is $K_{0.10}Na_{0.95}Ca_{1.12}(Mg_{2.72}Fe^{2+}_{1.41}Mn_{0.05}Fe^{3+}_{0.76}Ti_{0.14})(Si_{7.42}Al_{0.50}Fe_{0.07}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): (3680w), 1100sh, 1058, 975sh, 963s, 920sh, 753, 660, 507, 460s.

Sib36 Ferritschermakite $\square Ca_2[Mg_3(Fe^{3+},Al)_2](Si_6Al_2O_{22})(OH)_2$

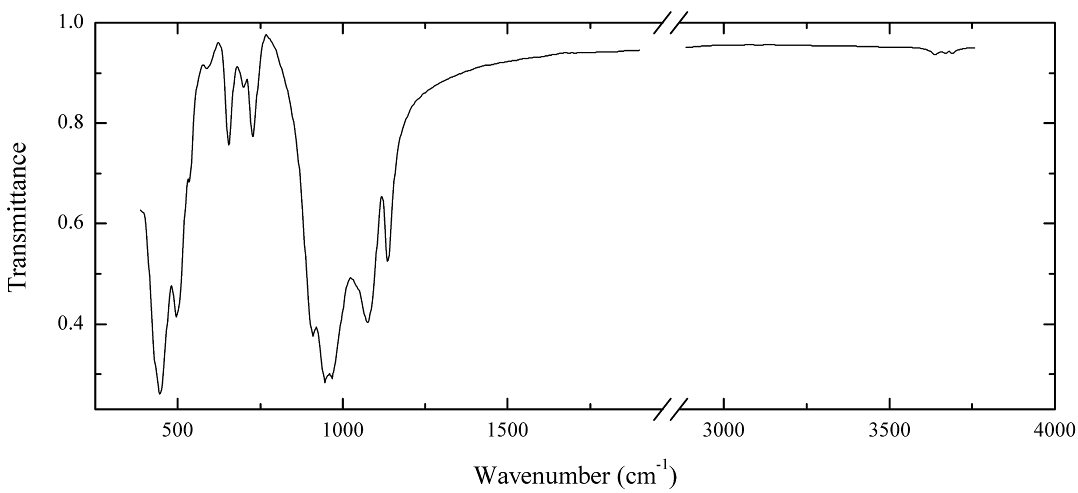


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black grains. Investigated by A.G. Bazhenov. The empirical formula is $(K_{0.2}Na_{0.1})(Ca_{1.7}Na_{0.3})(Mg_{2.3}Fe^{2+}_{1.4}Mn_{0.1}Fe^{3+}_{0.9}Al_{0.2}Ti_{0.1})(Si_{6.3}Al_{1.7}O_{22})(OH,F)_2$.

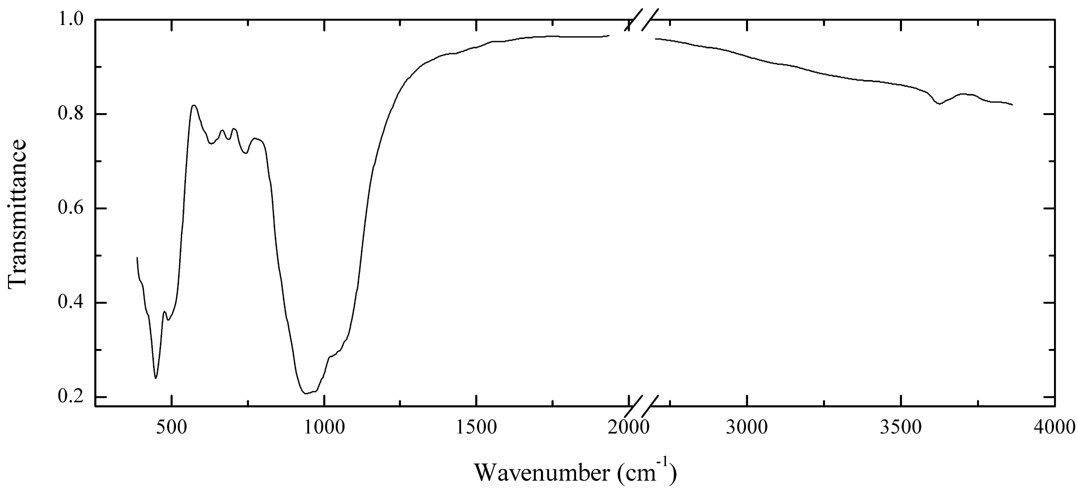
Wavenumbers (cm^{-1}): 3700w, 3605w, 1125sh, 1075sh, 1040sh, 984s, 960sh, 947s, 870sh, 749, 695, 650sh, 530sh, 506, 457s, 410sh.

Sib37 Potassicrichterite $K(CaNa)Mg_5(Si_8O_{22})(OH)_2$



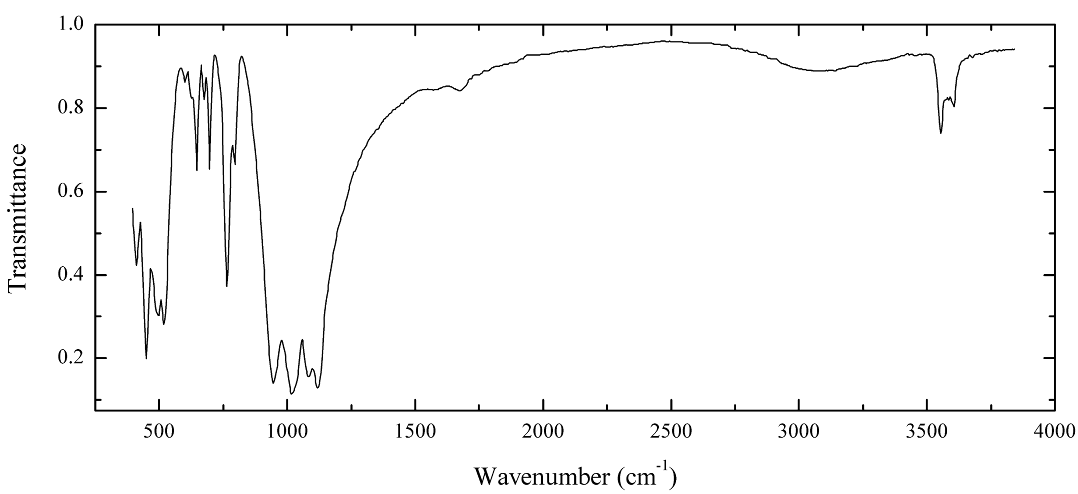
Locality: Itkutskiy district, Malyi Murun (Malomurunskiy) massif, Eastern Siberia, Russia.
Description: Bluish-grey parallel-fibrous aggregate from the association with phlogopite and calcite. The empirical formula is $K_{1.0}Na_{0.8}Ca_{0.3}(Mg_{4.3}Fe_{0.5})(Si_{8.0}O_{22})(OH)_2$.
Wavenumbers (cm^{-1}): 3690w, 3675w, 3650w, 1146, 1082, 1045sh, 978s, 956s, 920s, 738, 707w, 665, 596w, 545, 503, 456s, 445sh.

Sib38 Ferri-ferrohornblende $\square Ca_2(Fe^{2+}{}_4Fe^{3+})(Si_7AlO_{22})(OH)_2$



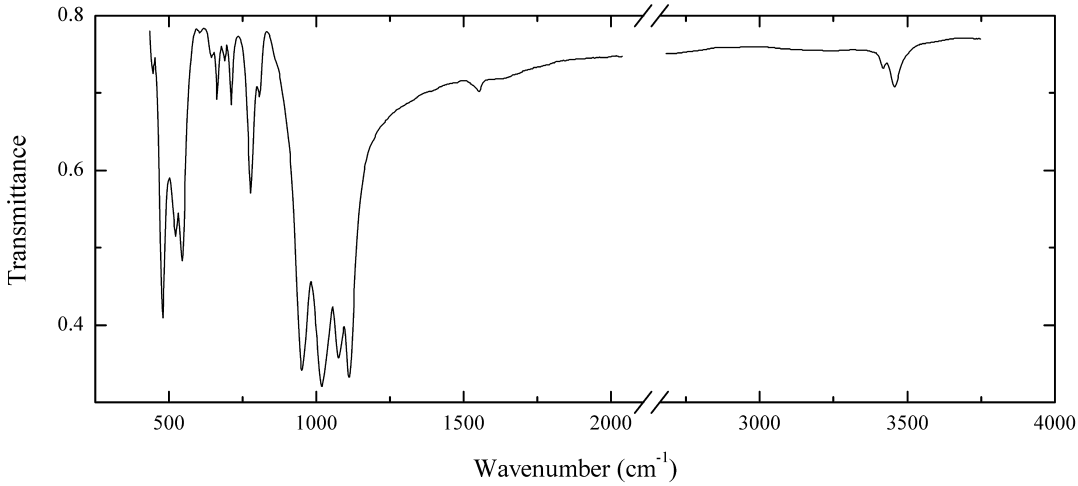
Locality: Saktaevskiy quarry, Ilmeny (Il'menskie) Mts., South Urals, Russia.
Description: Black grains from granite pegmatite, from the association with amazonite. Investigated by A.G. Bazhenov. The empirical formula is $K_{0.24}(Ca_{1.43}Na_{0.58})(Fe^{2+}{}_{3.00}Mg_{0.42}Mn_{0.16}Fe^{3+}{}_{1.25}Ti_{0.18})(Si_{6.68}Al_{1.28}Fe^{3+}{}_{0.04}O_{22})(OH,F)_2$.
Wavenumbers (cm^{-1}): 3600w, 1070sh, 1020sh, 965sh, 944s, 742, 687, 633, 610sh, 510sh, 490s, 447s, 420sh, 395sh.

Sib39 Fluorcanasite $K_3Na_3Ca_5(Si_{12}O_{30})(F,OH)_4 \cdot H_2O$



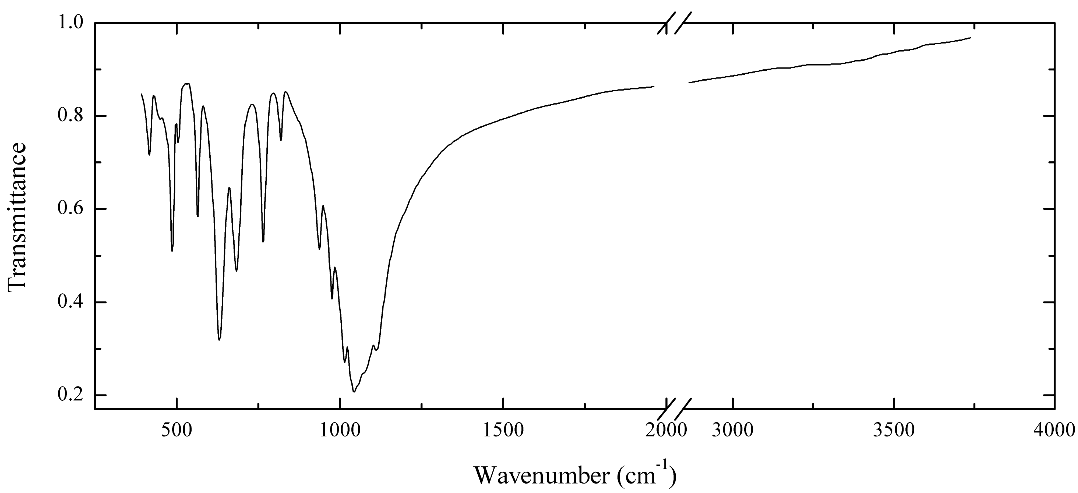
Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: Green granular aggregate from the association with magnesium astrophyllite and aegirine. Confirmed by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3605, 3555, 3080w, 1680w, 1590w, 1122s, 1086s, 1020s, 951s, 798, 765, 697, 671w, 646, 630w, 597w, 517, 495, 446s, 408.

Sib40 Frankamenite $K_3Na_3Ca_5(Si_{12}O_{30})(F,OH)_4 \cdot H_2O$



Locality: Malyi Murun (Malomurunskiy) massif, Eastern Siberia, Russia (type locality).
Description: Dark green granular aggregate from the association with charoite. Confirmed by IR spectrum, electron microprobe analysis and single-crystal X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3600, 3554w, 1595w, 1125s, 1088s, 1025s, 954s, 797, 767, 697, 673w, 645, 622w, 596w, 515, 495, 445s, 407.

Sib41 Moskvinite-(Y) $Na_2K(Y,\mathit{REE})(Si_5O_{15})$

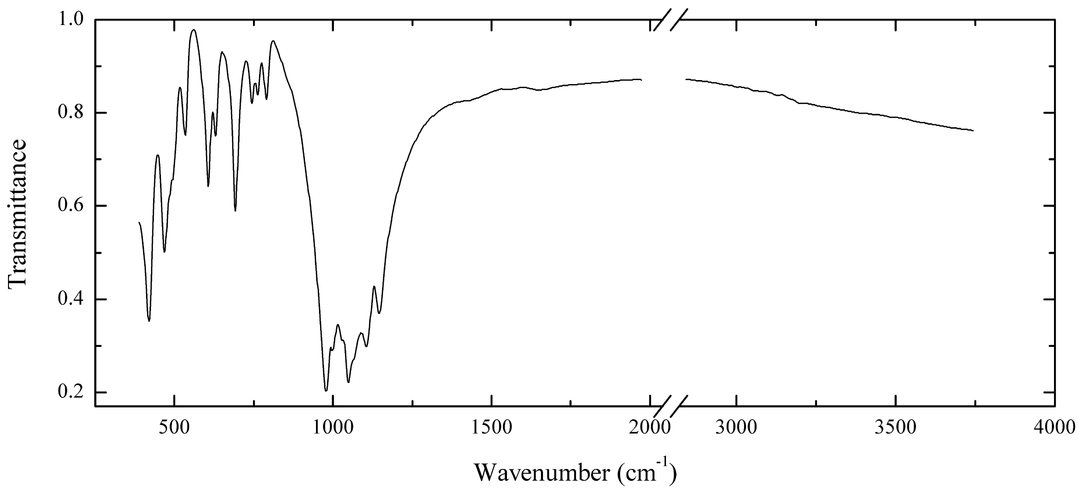


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alai range, Tien-Shan Mts., Tajikistan (type locality).

Description: Colourless equant grains from the association with reedmergnerite, shibkovite, nordite-(Ce), leucophanite, microcline, hyalotekite, telyushenkoite, kentbrooksite, polylithionite and albite. Holotype sample. The crystal structure is solved. Orthorhombic, space group *Ibmm*, $a = 10.623, b = 14.970, c = 8.552$ Å, $Z = 4$. $D_{meas} = 2.91$ g/cm^3, $D_{calc} = 2.92$ g/cm^3. Optically biaxial (+), $\alpha = 1.555$, $\beta = 1.558$, $\gamma = 1.566$, $2V_{meas} = 64°$. The empirical formula is $Na_{2.05}K_{0.95}(Y_{0.77}Dy_{0.09}Gd_{0.04}Er_{0.04}Ho_{0.02}Sm_{0.02}Tb_{0.01}Nd_{0.01})Si_{6.00}O_{15.00}$. The strongest lines of powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 5.32 (35) (200), 4.98 (100) (121), 3.45 (50) (310), 3.26 (85) (141), 3.05 (75) (240, 222), 1.754 (42) (103), 2.490 (45) (251, 060, 242).

Wavenumbers (cm^{-1}): 1109s, 1070sh, 1095sh, 1041s, 1015s, 976, 937, 817, 765, 682, 629s, 563, 504w, 486, 450w, 413.

Sib42 Manaksite $KNaMn^{2+}(Si_4O_{10})$

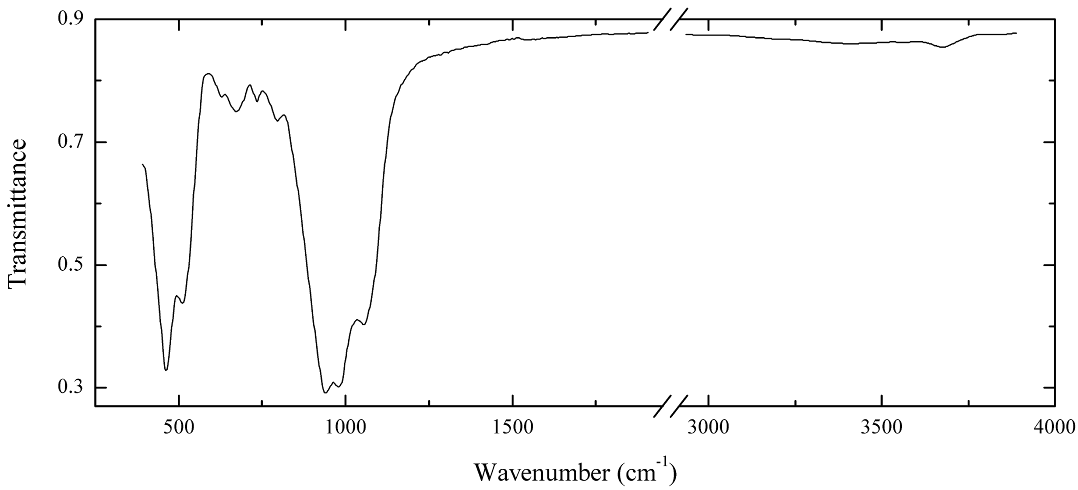


Locality: Palitra pegmatite, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Beige crystal from the association with ussingite, analcime, natrosilite, villiaumite, serandite, aegirine, potassicarfvedsonite, sphalerite, vuonnemite, phosinaite-(Ce), *etc*. Investigated by I.V. Pekov. The chemical composition is (electron microprobe, wt. %) Na_2O 8.14, K_2O 11.90, MgO 0.27, MnO 15.24, FeO 3.10, SiO_2 61.20, total 99.85. The crystal structure is solved. Confirmed by IR spectrum, electron microprobe analysis and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 1444s, 1103s, 1060sh, 1047s, 1027s, 1006s, 977s, 787, 759, 741, 689, 626, 602, 528, 492, 479, 463, 414s.

Sib43 Ferrokaersutite $NaCa_2(Fe^{2+}{}_4Ti)(Si_6Al_2O_{22})(OH)_2$

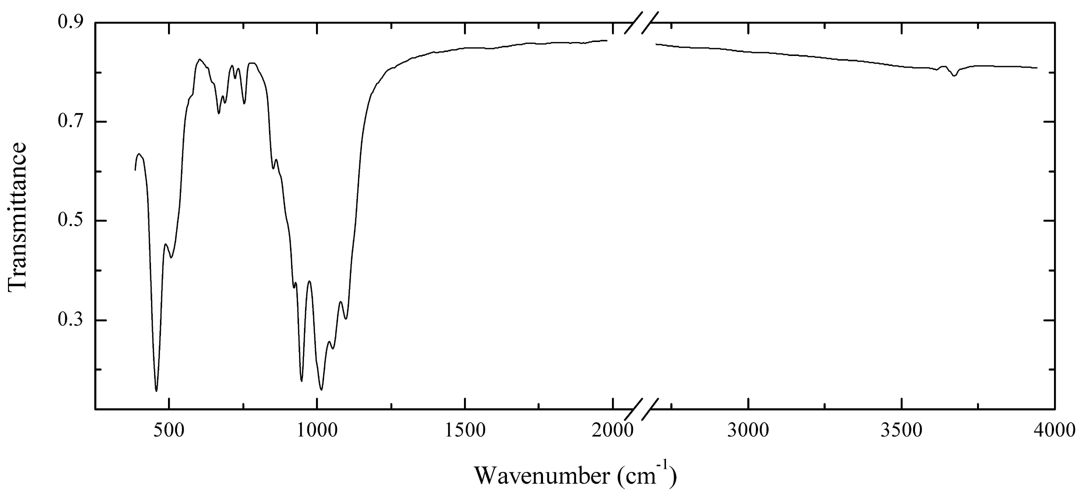


Locality: Khlebodarovka, Chaplinskiy district, Kherson region, Ukraine.

Description: Dark greenish-brown grains from camptonite, from the association with biotite-4M_3. The empirical formula is (electron microprobe) $(Na_{0.7}K_{0.2})Ca_{1.9}(Fe_{2.7}Mg_{1.5}Ti_{0.55}Al_{0.25})(Si_{6.0}Al_{2.0}O_{22})(OH,O)_2$.

Wavenumbers (cm^{-1}): 1675w, 1080sh, 1057, 981s, 941s, 801, 734w, 674, 626w, 506, 459s.

Sib44 Parvo-manganotremolite $\square(Ca,Mn)_2Mg_5(Si_8O_{22})(OH)_2$

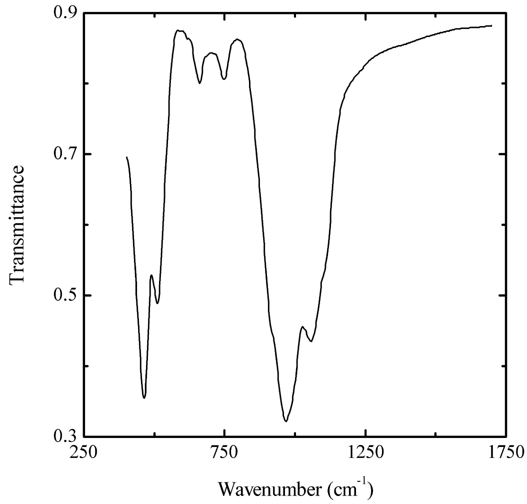


Locality: Chiuruco mine, Dos Mayo province, Huanuco, Peru.

Description: White fibrous aggregate from the association with rhodonite. The empirical formula is (electron microprobe) $(Ca_{1.5}Mn_{0.5})(Mg_{4.0}Mn_{0.7}Fe_{0.3})(Si_{8.0}O_{22})(OH)_2$.

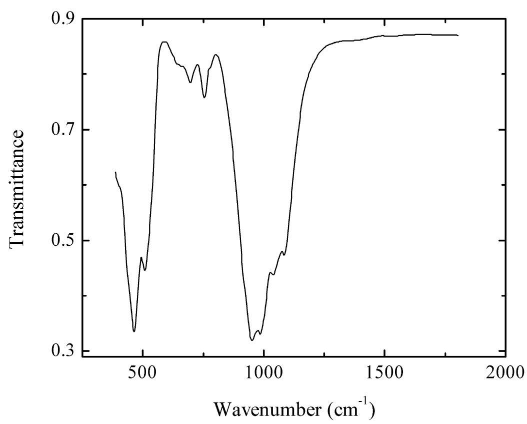
Wavenumbers (cm^{-1}): 3655w, 1100s, 1055s, 1015s, 945s, 921, 900sh, 875sh, 849, 753, 720w, 686, 665, 645sh, 575sh, 505, 455s.

Sib45 Magnesio-ferrikatophorite $Na(CaNa)(Mg_4Fe^{3+})(Si_7AlO_{22})(OH)_2$



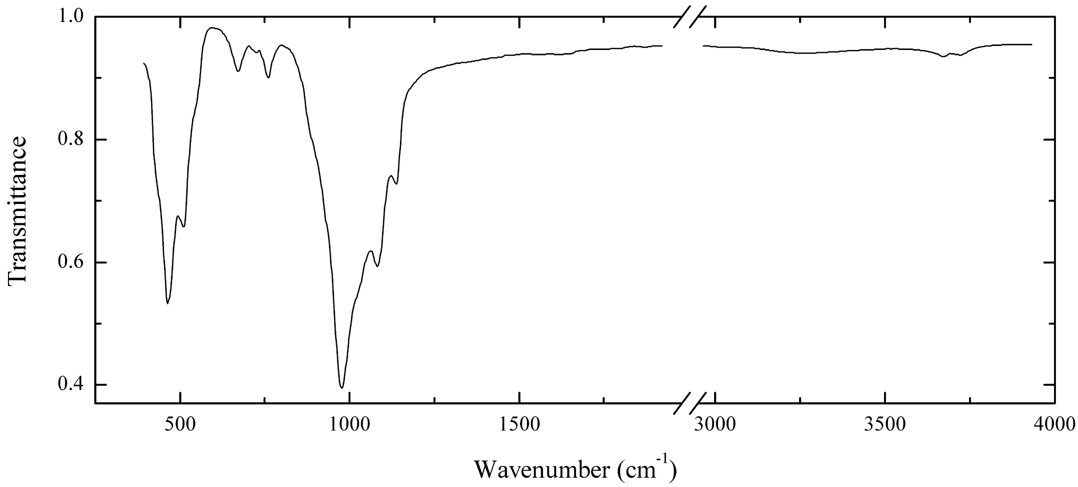
Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.
Description: Black grains. Investigated by A.G. Bazhenov. The empirical formula is $(Na_{0.36}K_{0.33})(Ca_{1.17}Na_{0.75}Mn_{0.08})(Mg_{2.93}Fe^{2+}{}_{1.16}Fe^{3+}{}_{0.78}Ti_{0.09}Al_{0.06})(Si_{7.42}Al_{0.58}O_{22})(OH)_{1.18}F_{0.93}$.
Wavenumbers (cm^{-1}): 1105sh, 1061s, 968s, 915sh, 875sh, 750, 663, 507, 459s, 405sh.

Sib46 Magnesio-hornblende $\square Ca_2[Mg_4(Al,Fe^{3+})](Si_7AlO_{22})(OH)_2$



Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.
Description: Black grains. Investigated by A.G. Bazhenov. The empirical formula is $(Na_{0.33}K_{0.09})(Ca_{1.90}Na_{0.07}Mn_{0.03})(Mg_{2.54}Fe^{2+}{}_{1.61}Al_{0.48}Fe^{3+}{}_{0.24}Ti_{0.13})(Si_{6.70}Al_{1.30}O_{22})(OH,F)_2$.
Wavenumbers (cm^{-1}): 1125sh, 1088, 1044, 987s, 952s, 920sh, 790sh, 754, 693, 655sh, 507, 461s.

Sib47 Magnesio-arfvedsonite $NaNa_2(Mg_4Fe^{3+})(Si_8O_{22})(OH)_2$

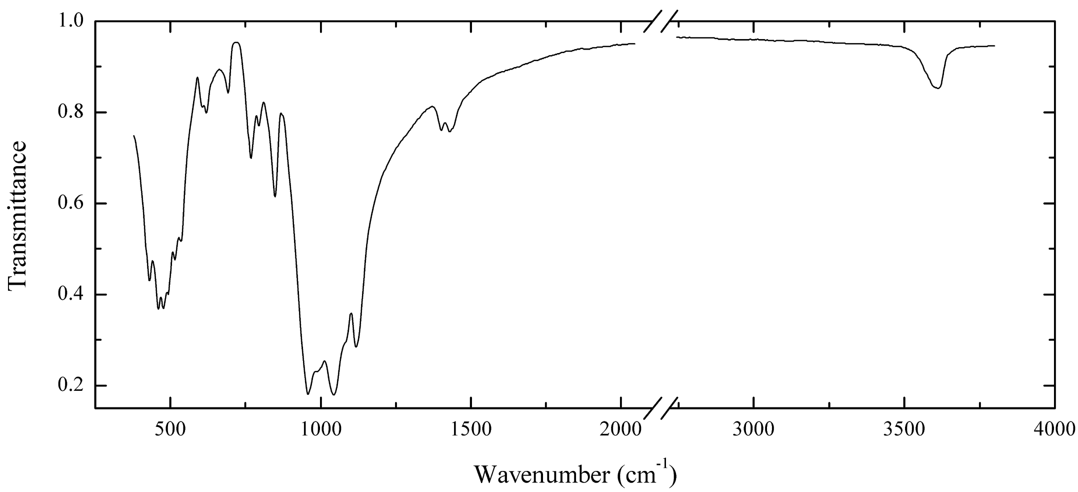


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black prismatic crystals from the association with microclite and pyrochlore. The empirical formula is (electron microprobe) $(Na_{0.57}K_{0.30})(Na_{1.71}Ca_{0.29})(Mg_{2.76}Mn_{0.17}Fe_{1.83}Al_{0.22}Ti_{0.03})(Si_{7.85}Al_{0.15}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3685w, 3633w, 1137, 1079s, 1015sh, 972s, 920sh, 890sh, 754, 714w, 669, 540sh, 509, 462s, 430sh.

Sib48 Miserite $(K,\square)_{1.5}(Ca,Mn)_6[Si_6(O,OH)_{15}](Si_2O_7)(F,OH)_2 \cdot nH_2O$ ($n \ll 1$)

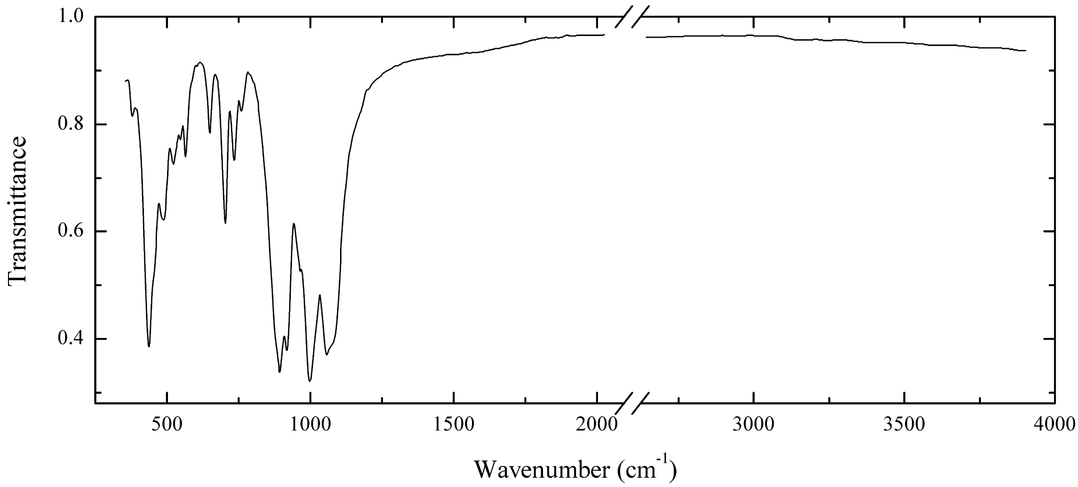


Locality: Dara-i Pioz glacier, Dara-I Pioz alkaline massif, Alai range, Tien-Shan Mts., Tajikistan.

Description: Aggregate of pink acicular crystals from the association with agrellite, pectolite, albite and quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3590, 1432, 1403, 1114s, 1080sh, 1043s, 985sh, 957s, 849, 794, 767, 692, 635sh, 617, 601, 529, 515, 488, 470, 455, 427.

Sib49 Manganonordite-(Ce) $Na_3SrCeMn(Si_6O_{17})$

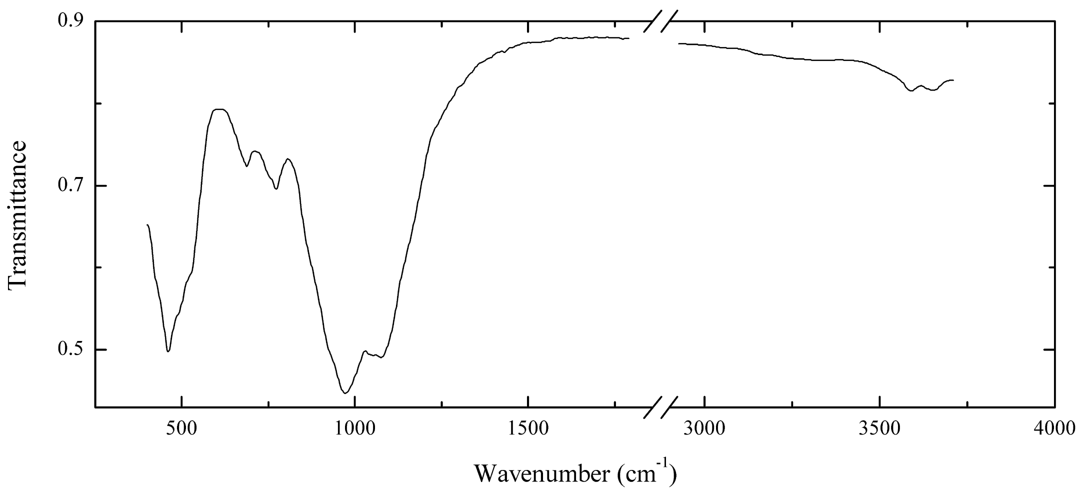


Locality: Pegmatite No. 60, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Pale brown rosette-like aggregate of tabular crystals from peralkaline pegmatite, from the association with ussingite, steenstrupine, umbozerite, sphalerite, chkalovite, epistolite, gerasimovskite, *etc*. Holotype sample. The crystal structure is solved. Orthorhombic, space group *Pcca*; $a = 14.449(4)$, $b = 5.187(2)$, $c = 19.849(5)$ Å, $Z = 4$. $D_{meas} = 3.43$ g/cm^3. Optically biaxial (−), =1.623, =1.636, =1.642. $2V_{meas} = 60(10)$. The empirical formula is $(Na_{2.96}Ca_{0.05})(Sr_{1.02}Ba_{0.02})$ $(Ce_{0.51}La_{0.42}Nd_{0.05}Pr_{0.02})(Mn_{0.42}Zn_{0.24}Fe_{0.23}Mg_{0.10})Si_{5.97}O_{17}$. The strongest lines of the powder X-ray pattern [*d*, Å (*I*, %) (*hkl*)] are 4.215 (100) (210); 3.325 (67) (312); 2.965 (83) (410); 2.875 (55) (314); 2.597 (54) (020).

Wavenumbers (cm^{-1}): 1080sh, 1061s, 1003s, 970, 919s, 895s, 760, 734, 707, 647, 565, 548, 520, 492, 450sh, 435s, 415sh, 370.

Sib50 Gedrite $\square Mg_5Al_2(Si_6Al_2O_{22})(OH)_2$

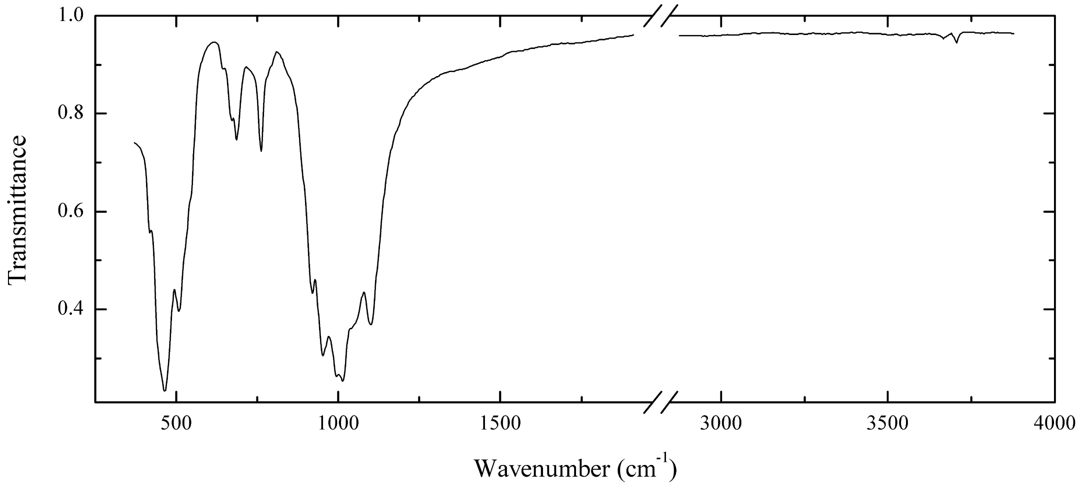


Locality: Hèas valley, near Gédres, Haut Pyrénées, France (type locality).

Description: Black radial aggregate. Confirmed by qualitative electron microprobe analysis.

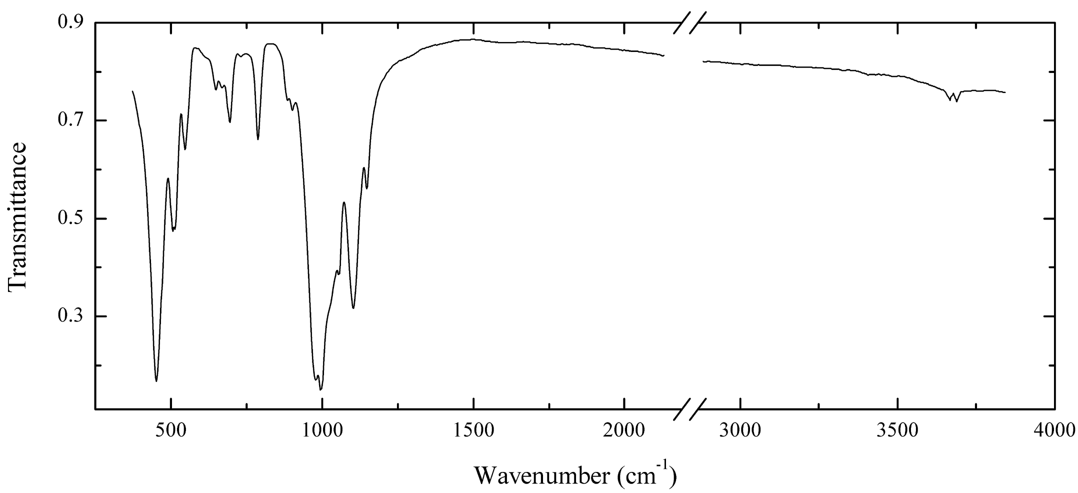
Wavenumbers (cm^{-1}): 3640w, 3570w, 1100sh, 1077s, 977s, 930sh, 870sh, 777, 755sh, 694, 650sh, 520sh, 490sh, 461s, 430sh.

Sib51 Anthophyllite $\square Mg_7(Si_8O_{22})(OH)_2$



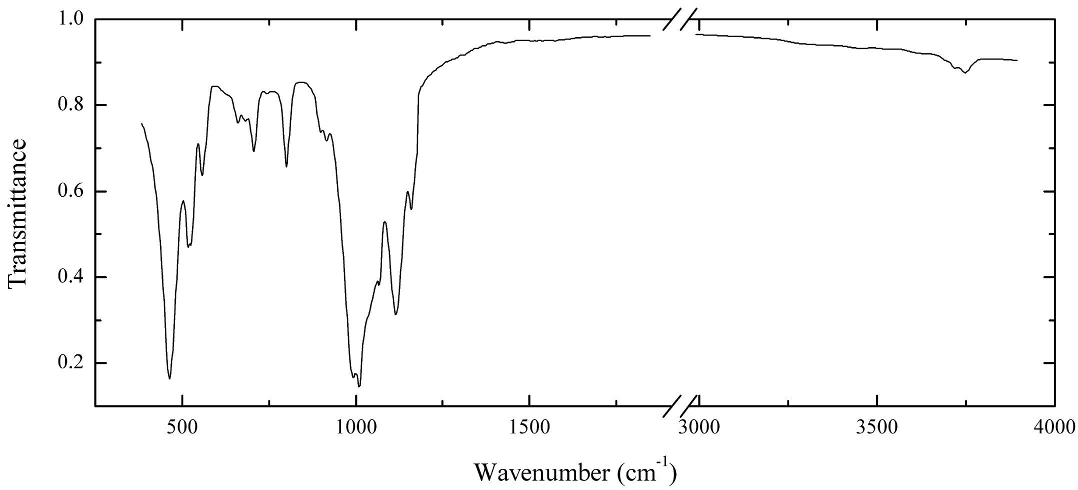
Locality: Large Miassovo lake, Ilmeny (Il'menskie) Mts., South Urals, Russia.
Description: Light green columnar aggregate. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3680w, 3660w, 1100s, 1040sh, 1014s, 998s, 954s, 922, 795sh, 760, 686, 670, 645w, 540sh, 525sh, 508, 466s, 450sh, 425.

Sib52 Magnesio-riebeckite $\square Na_2(Mg_3Fe^{3+}{}_2)(Si_8O_{22})(OH)_2$



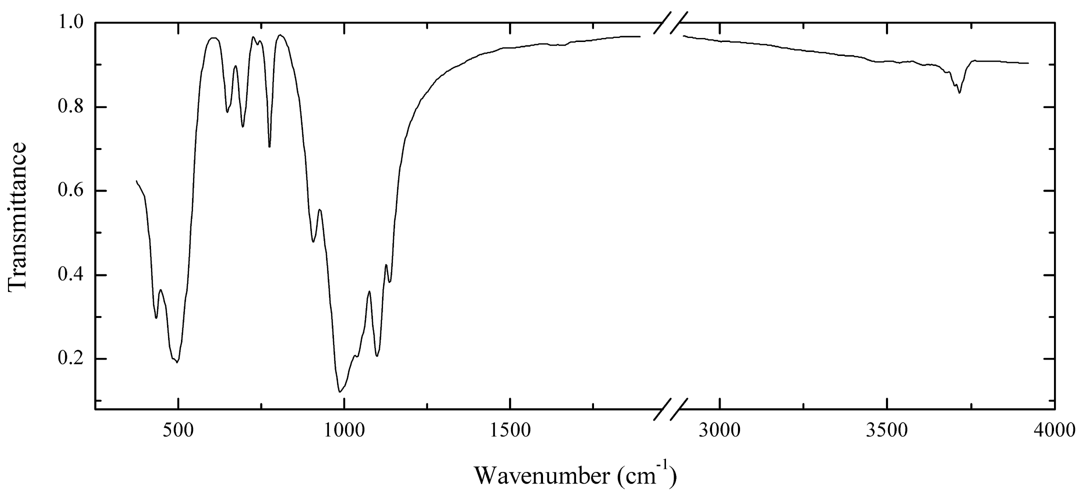
Locality: Srednyaya Padma, Onega Lake, Karelia, Russia.
Description: Blue fibrous aggregate. The empirical formula is (electron microprobe) $(Na_{2.13}Ca_{0.06}K_{0.02})(Mg_{2.32}Fe_{2.70})(Si_{7.85}Al_{0.15}O_{22})(OH)_2$.
Wavenumbers (cm^{-1}): 3655w, 3635w, 1145, 1100, 1053, 1020sh, 993s, 977s, 901, 886w, 784, 732w, 691, 666w, 647w, 544, 513, 503, 451s.

Sib53 Magnesio-hastingsite $NaCa_2(Mg_4Fe^{3+})(Si_6Al_2O_{22})(OH)_2$



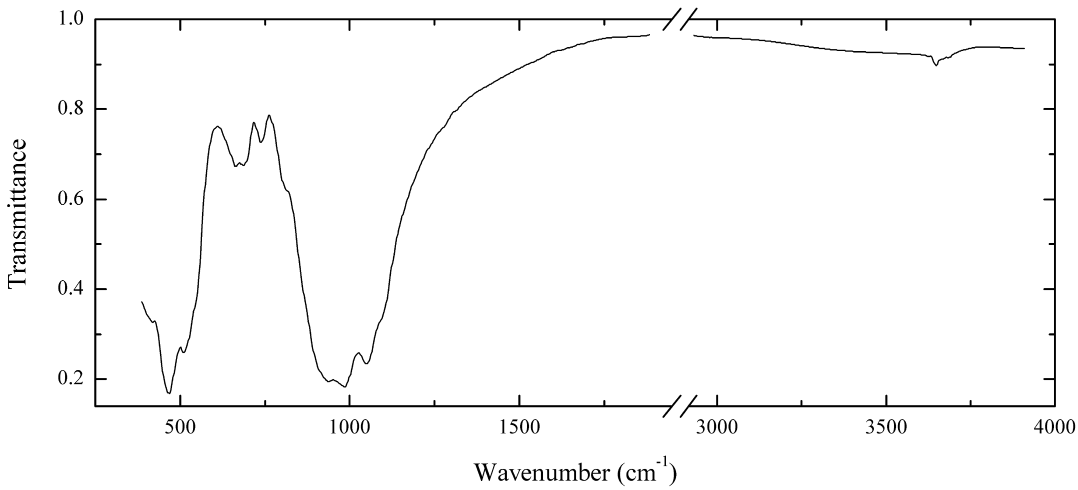
Locality: Afrikanda massif, Afrikanda, Kola peninsula, Murnansk region, Russia.
Description: Dark grey grains from the association with schorlomite and titanite. The empirical formula is (electron microprobe) $Na_{0.8}K_{0.3}Ca_{2.1}(Mg_{2.9}Fe_{1.7}Ti_{0.2}Al_{0.2})(Si_{5.9}Al_{2.1}O_{22})(OH)_2$.
Wavenumbers (cm^{-1}): 3695w, 3670w, 1047s, 974s, 924s, 799, 734, 677, 631, 508, 464s, 440sh.

Sib54 Manganocummingtonite $\square Mn_2Mg_5(Si_8O_{22})(OH)_2$



Locality: Kurganovskoe Mn deposit, Kurganovo, Middle Urals, Russia.
Description: Grey fibrous aggregate from the association with rhodonite, neotocite, spessartite, tephroite and rhodochrosite. The empirical formula is (electron microprobe) $Na_{0.15}Ca_{0.04}Mn_{1.28}Fe_{1.92}Mg_{3.59}(Si_{8.00}O_{22})(OH)_2$.
Wavenumbers (cm^{-1}): 3665sh, 3650w, 3640w, 3622w, 1126, 1090s, 1027s, 1010sh, 990sh, 980s, 901, 773, 736w, 693, 650sh, 647, 497s, 486s, 437s.

Sib55 Pargasite $NaCa_2(Mg_4Al)(Si_6Al_2O_{22})(OH)_2$

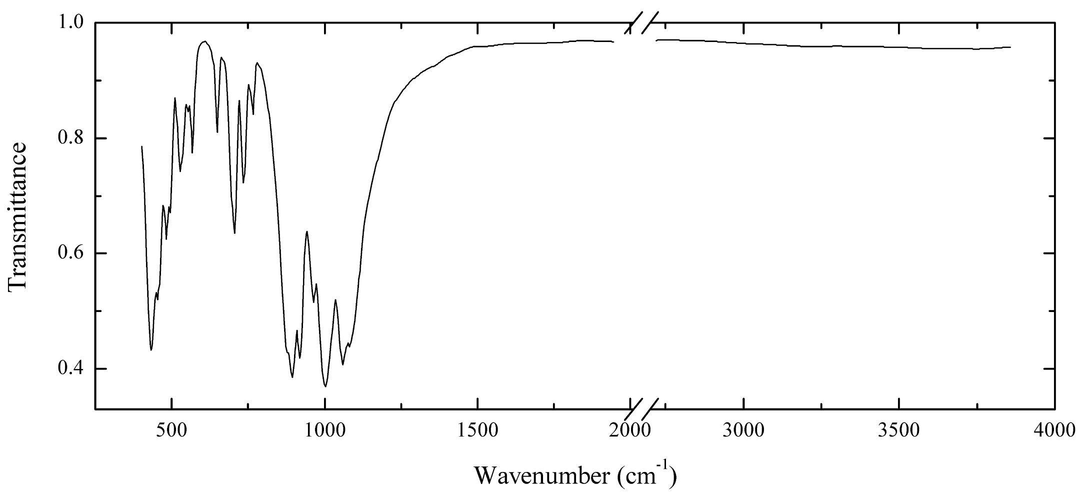


Locality: Yuan-Yang, Yunnan province, China.

Description: Bright green crystal from marble. The empirical formula is (electron microprobe) $(Na_{0.7}K_{0.1}Ca_{0.1})Ca_{2.0}(Mg_{4.2}Al_{0.7}Cr_{0.1})(Si_{6.4}Al_{1.6}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3660w, 1090sh, 1053s, 982s, 944s, 920sh, 815sh, 741w, 689, 668, 545sh, 509s, 466s, 420sh.

Sib56 Nordite-(Ce) $Na_3SrCeZn(Si_6O_{17})$

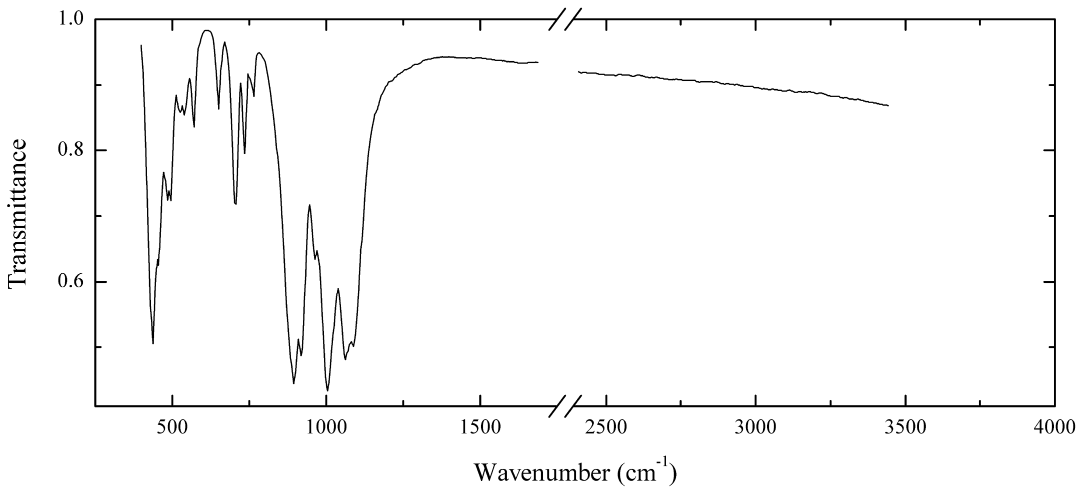


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alai range, Tien-Shan Mts., Tajikistan.

Description: Colourless grains. The empirical formula is $Na_{3.08}(Sr_{0.89}Ca_{0.12})(Ce_{0.50}Nd_{0.26}La_{0.14}Pr_{0.05}Gd_{0.04})Zn_{0.99}Si_{6.02}O_{17}$.

Wavenumbers (cm^{-1}): 1080s, 1057s, 1025sh, 1000s, 980sh, 963, 917s, 892s, 876s, 764w, 735, 704, 695sh, 649, 569, 553w, 537, 526, 495, 482, 453, 433s.

Sib57 Nordite-(La) $Na_3SrLaZn(Si_6O_{17})$

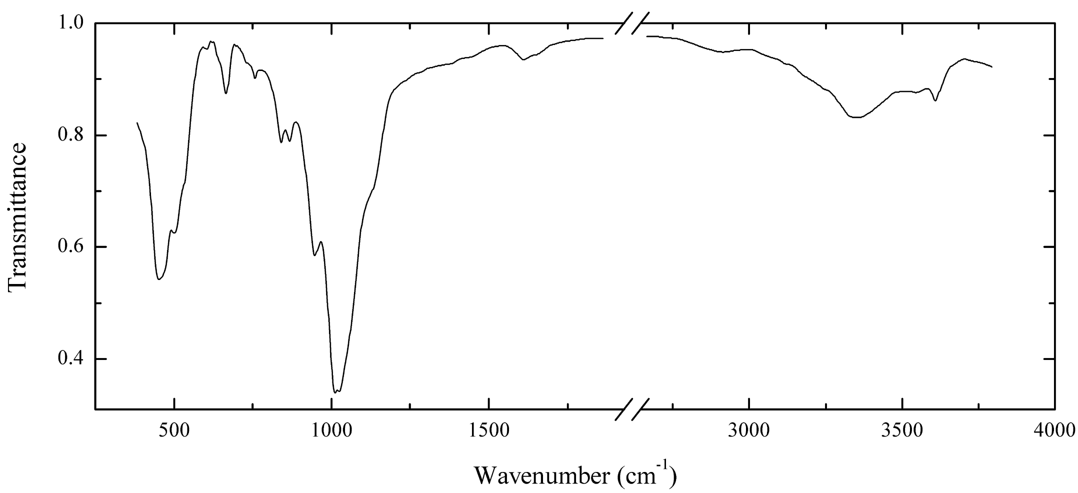


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light brown tabular crystal from the association with natrolite, aegirine, belovite-(Ce), murmanite, sphalerite, strontianite, ancylite-(Ce), *etc*. The empirical formula is $(Na_{2.96}Ca_{0.06})(Sr_{1.02}Ba_{0.01})(La_{0.51}Ce_{0.49}Nd_{0.03})(Zn_{0.55}Fe_{0.17}Mg_{0.17}Mn_{0.14})(Si_{5.92}Al_{0.02})O_{17}$.

Wavenumbers (cm^{-1}): 1081s, 1059s, 1003s, 965, 918s, 894s, 875sh, 762w, 734, 703, 671, 567, 533, 522, 492, 484, 452, 435s.

Sib58 Plancheite $Cu_8(Si_4O_{11})_2(OH)_4{\cdot}H_2O$

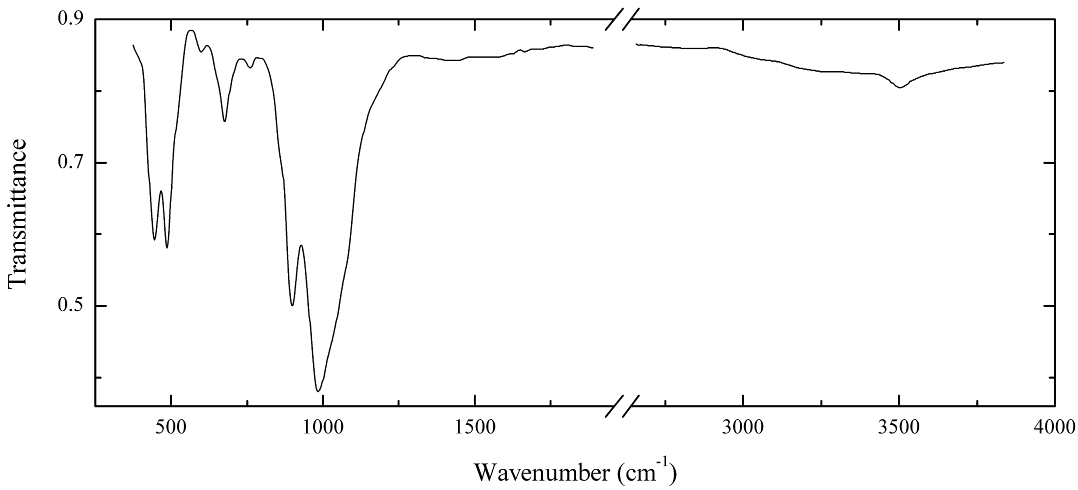


Locality: Musonoi mine, Kolwezi, Katanga Copper Crescent, Democratic Republic of Congo.

Description: Blue spherulites from the association with calcite. Identified by IR spectrum.

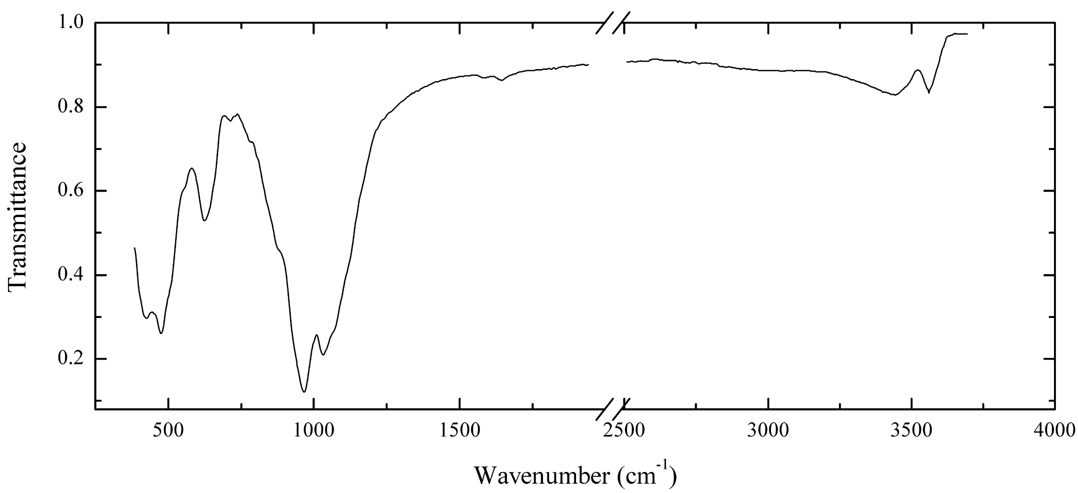
Wavenumbers (cm^{-1}): 3600, 3555w, 3355, 1630s, 1125sh, 1050sh, 1026s, 1013s, 949, 870, 843, 761w, 710sh, 665, 603w, 530sh, 504, 475sh, 453s.

Sib59 Riversideite $Ca_{4+2x}Si_6O_{16}(OH)_{2x}$ (?)



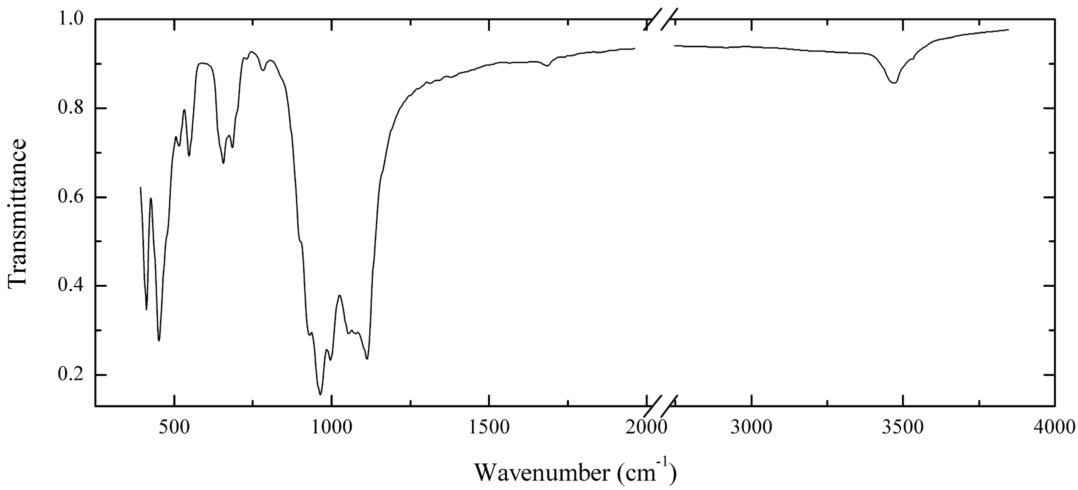
Locality: Product of heating (up to 300 °C) of tobermorite from Zeilberg, Bavaria, Germany.
Description: White powdery.
Wavenumbers (cm^{-1}): 3495w, 1180sh, 1070sh, 1030sh, 987s, 901s, 762w, 678, 600w, 485, 444.

Sib60 Taneyamalite $Na(Mn^{2+},Mg,Fe^{3+},Al)_{12}(Si_6O_{17})_2(O,OH)_{10}$



Locality: Taneyama mine, Toyo village, Kumamoto prefecture, Japan (type locality).
Description: Dark brown massive. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3530, 3410, 1635w, 1580w, 1065sh, 1034s, 970s, 935sh, 875sh, 710w, 640sh, 622, 505sh, 478s, 435, 420sh.

Sib61 Tokkoite $K_2Ca_4(Si_7O_{17})(O,OH,F)_4$

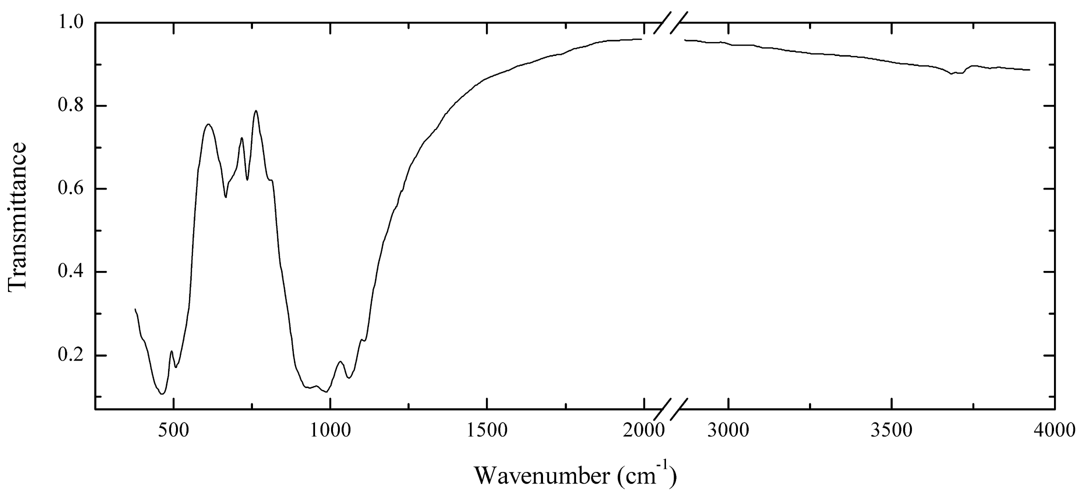


Locality: Magistral'nyi district, Malyi Murun (Malomurunskiy) massif, Eastern Siberia, Russia (type locality).

Description: Yellowish prismatic crystal from the association with charoite, tinaksite, aegirine and microcline. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3530sh, 3470, 1645w, 1107s, 1074s, 1047s, 991s, 959s, 924s, 894, 777w, 726w, 693, 679, 651, 640sh, 543, 513, 470sh, 447s, 410s.

Sib62 Fluoro-edenite $NaCa_2Mg_5(Si_7AlO_{22})F_2$

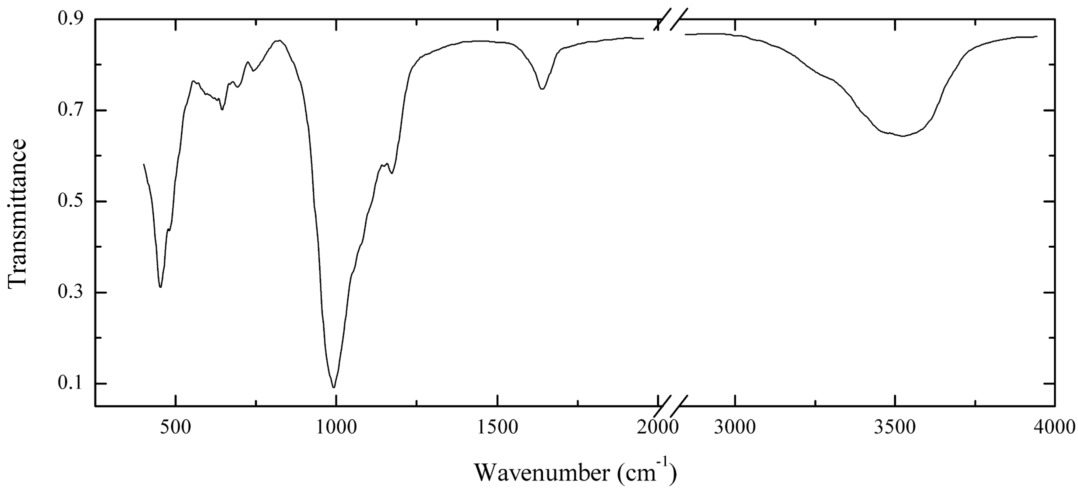


Locality: Parainen (Pargas), Southwestern Finland region, Finland.

Description: Greenish-grey isometric crystal from the association with calcite, chondrodite and fluorphlogopite. The empirical formula is (electron microprobe) $(Na_{0.64}K_{0.10})Ca_{2.01}(Mg_{4.59}Fe_{0.23}Al_{0.16}Ti_{0.01})(Si_{6.85}Al_{1.15}O_{22})[F_{1.7}(OH)_{0.3}]$.

Wavenumbers (cm^{-1}): 3685w, 3656w, 1107, 1057s, 986s, 937s, 910sh, 805sh, 735, 685sh, 667, 540sh, 507, 465s.

Sib63 Tacharanite $Ca_{12}Al_2Si_{18}O_{51}\cdot 18H_2O$

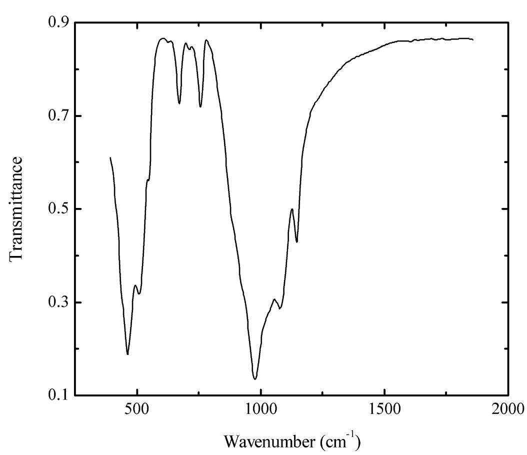


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White porcelain-like fine-grained aggregate from the association with pectolite, natrolite, thomsonite-Ca, lueshite, aegirine-augite, orthoclase, cancrinite, nepheline, nabalamprophyllite and cafetite. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis. K-bearing variety.

Wavenumbers (cm^{-1}): 3500, 3270sh, 1634, 1175, 1110sh, 1075sh, 1050sh, 1015sh, 992s, 970sh, 765sh, 742w, 691, 644, 620sh, 500sh, 479, 450s.

Sib65 Richterite $Na(CaNa)Mg_5(Si_8O_{22})(OH)_2$

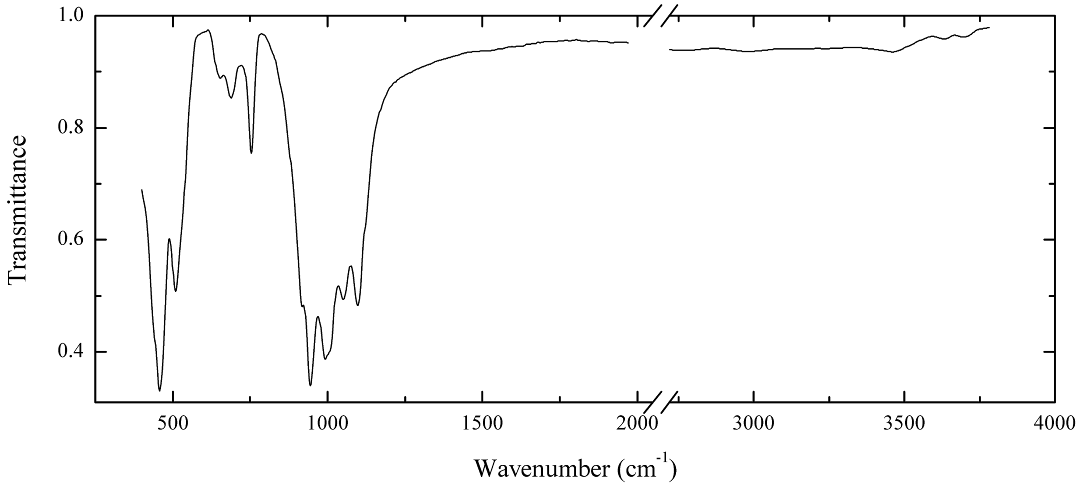


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Yellow prismatic crystal from massive calcite. The empirical formula is (electron microprobe) $Na_{2.0}K_{0.1}Ca_{0.9}(Mg_{4.2}Fe_{0.4}Mn_{0.3}Al_{0.1})(Si_{8.0}O_{22})[Cl_{0.1}(OH,F,O)_{1.9}]$.

Wavenumbers (cm^{-1}): 1145, 1076s, 1025sh, 972s, 925sh, 885sh, 754, 711w, 671, 627w, 549, 511s, 467s, 445sh, 420sh.

Sib66 Actinolite □$Ca_2(Mg,Fe^{2+})_5(Si_8O_{22})(OH)_2$

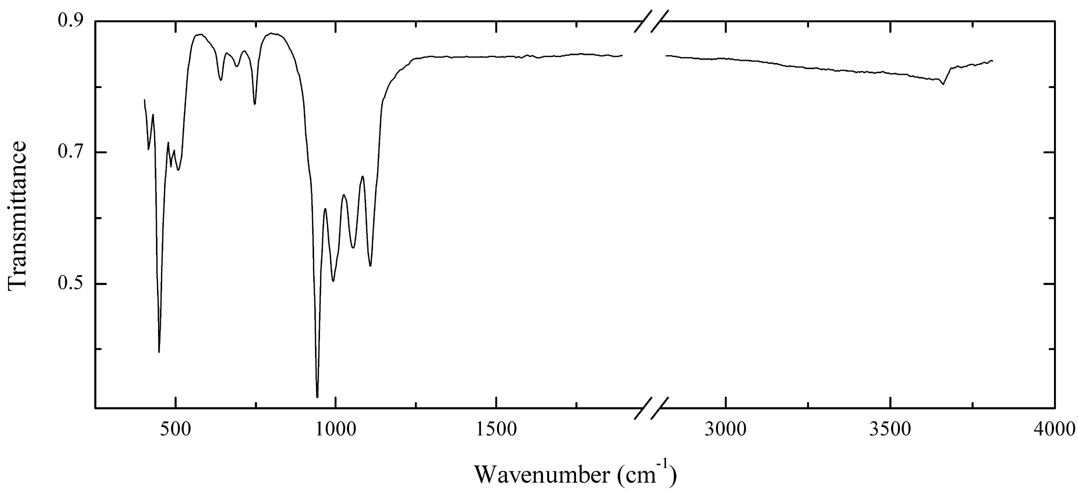


Locality: Dashkesan Co-Fe deposit, Dashkesan, Azerbaijan.

Description: Dark green pseudomorph after clinopyroxene crystal, from the association with calcite and hematite. Fe-rich variety. The empirical formula is (electron microprobe) $(Na_{0.1}Ca_{1.8}Mn_{0.1})(Mg_{2.5}Fe_{2.4}Al_{0.1})(Si_{8.0}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 1125sh, 1098, 1053, 1010sh, 993s, 945s, 919, 751, 687, 654w, 640sh, 505, 452s, 345sh.

Sib67 Ferro-actinolite □$Ca_2(Fe^{2+},Mn,Mg)_5(Si_8O_{22})(OH)_2$

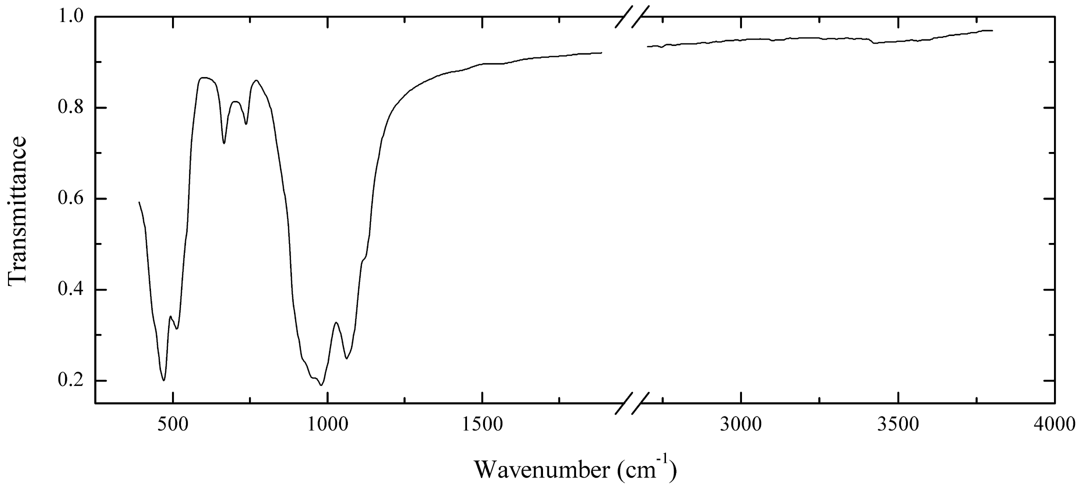


Locality: Nikolaevskiy mine, Dalnegorsk, Kavalerovo mining district, Primorskiy Kray, Russia.

Description: White random fibrous aggregate from the association with ilvaite. The empirical formula is (electron microprobe) $(Ca_{1.7}Mn_{0.3})(Fe_{3.6}Mn_{1.0}Mg_{0.4})(Si_{8.0}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3630w, 1105, 1053, 990, 939s, 915sh, 744, 689w, 639, 508, 483, 447s, 417.

Sib68 Fluoro-edenite $NaCa_2Mg_5(Si_7AlO_{22})F_2$

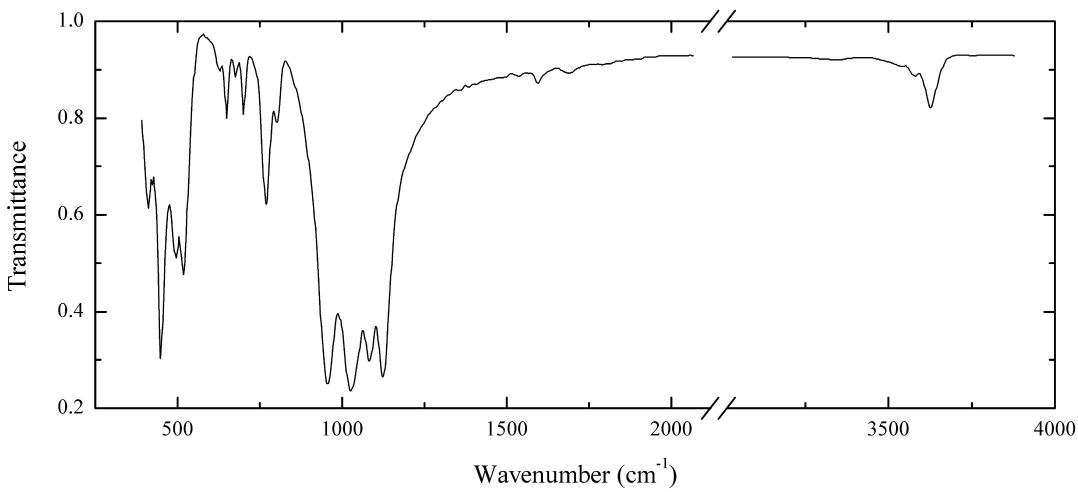


Locality: Yum'echorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Dark grey crystals from pegmatite hosted by effusive rocks. Investigated by B.E. Borutskiy. The empirical formula is $(Na_{0.67}K_{0.33})(Ca_{1.68}Na_{0.32})(Na_{0.20}Mg_{3.77}Fe^{2+}_{0.53}Mn_{0.04}Fe^{3+}_{0.26}Ti_{0.17}Al_{0.03})(Si_{6.89}Al_{1.05}Fe^{3+}_{0.06}O_{22})[F_{1.23}(OH)_{0.73}O_{0.04}]$.

Wavenumbers (cm^{-1}): 1120sh, 1064s, 980s, 955s, 925sh, 895sh, 735w, 664, 540sh, 511s, 500sh, 468s, 435sh, 405sh.

Sib69 Frankamenite $K_3Na_3Ca_5(Si_{12}O_{30})(F,OH)_4{\cdot}H_2O$

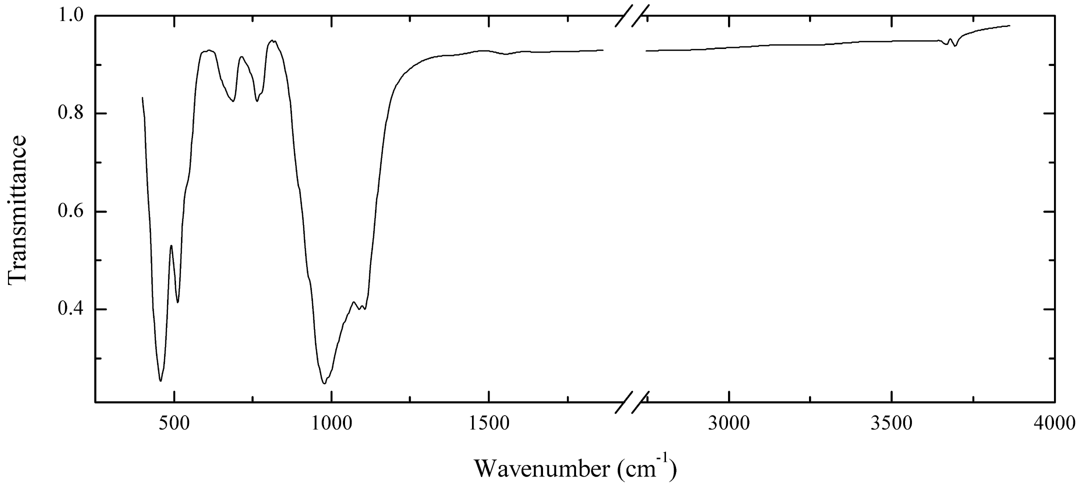


Locality: Magistral'nyi district, Malyi Murun (Malomurunskiy) massif, Aldan shield, Eastern Siberia, Russia (type locality).

Description: Lilac granular aggregate from the association with charoite and aegirine. Confirmed by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3599, 3552w, 1685w, 1593w, 1124s, 1084s, 1027s, 956s, 800, 769, 698, 676w, 646, 627w, 620sh, 517, 495, 447s, 406.

Sib70 Ferri-winchite $\square(CaNa)(Mg_4Fe^{3+})(Si_8O_{22})(OH)_2$

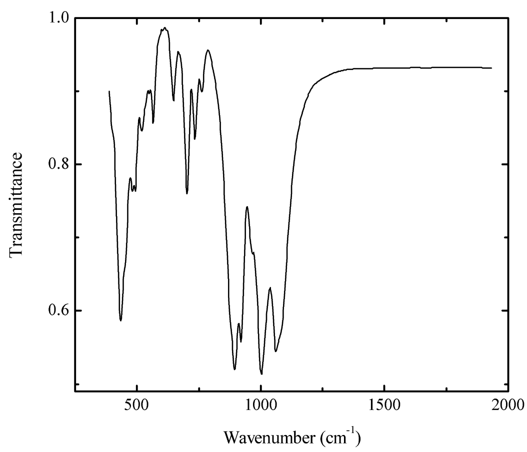


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Dark brownish-green random fibrous aggregate. Investigated by A.G. Bazhenov. The empirical formula is $(K_{0.15}Na_{0.27}\square_{0.58})(Na_{1.38}Ca_{0.62})(Mg_{3.20}Fe^{2+}_{0.53}Mn_{0.07}Fe^{3+}_{1.12}Al_{0.04}Ti_{0.02})(Si_{7.77}Al_{0.23}O_{22})[(OH)_{1.77}F_{0.23}]$.

Wavenumbers (cm^{-1}): 3655w, 3625w, 1103s, 1084s, 1035sh, 985sh, 972s, 925sh, 777, 764, 683, 670sh, 655sh, 535sh, 509s, 458s, 420sh.

Sib71 Ferronordite-(La) $Na_3SrLaFe^{2+}(Si_6O_{17})$



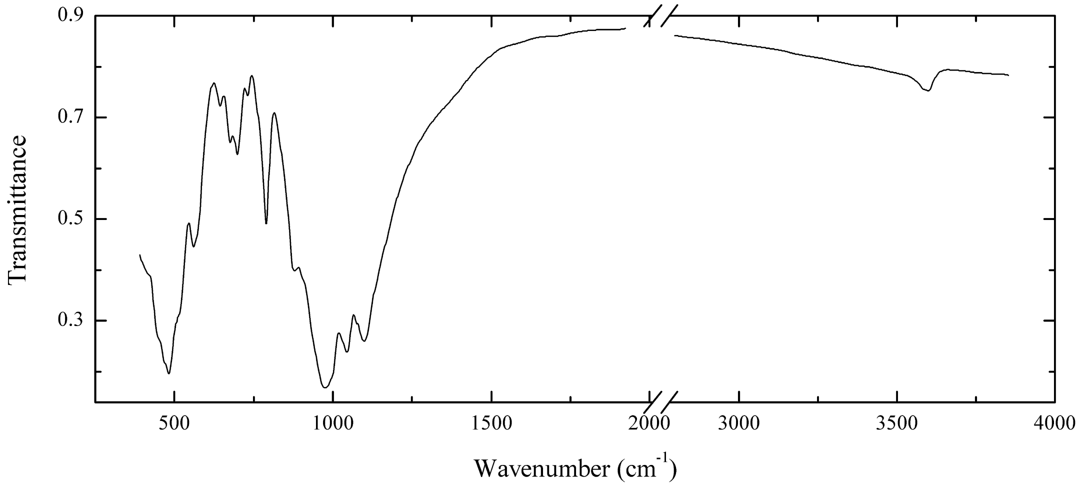
Locality: Bol'shoi Punkaruaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless tabular crystal from the association with ussingite, aegirine, epistolite, sphalerite, steenstrupine-(Ce) and altered serandite. Holotype sample. Orthorhombic, space group *Pcca*, $a = 14.440(5)$, $b = 5.191(2)$, $c = 19.86(1)$ Å. $D_{meas} = 3.54$ g/cm^3, $D_{calc} = 3.62$ g/cm^3. Optically biaxial (−), $\alpha = 1.624(1)$, $\beta = 1.637(1)$, $\gamma = 1.644(1)$, $2V_{meas} = 60(15)°$. The empirical formula is $(Na_{2.92}Ca_{0.08})(Sr_{0.99}Ba_{0.02})(La_{0.57}Ce_{0.41}Pr_{0.05}Nd_{0.04})(Fe_{0.43}Mn_{0.29}Zn_{0.23}Mg_{0.06})(Si_{5.92}Al_{0.02})O_{17}$. The strongest reflexes of the powder X-ray pattern are [*d*, Å (*I*, %) (*hkl*)] 7.20 (40) (200), 4.21 (100)

(210), 3.481 (38) (114), 3.323 (82) (312), 2.964 (88) (410), 2.873 (99) (314), 2.595 (58) (020), 2.442 (44) (406).

Wavenumbers (cm^{-1}): 1080sh, 1062s, 1003s, 967, 921s, 895s, 880sh, 762w, 734, 703, 648, 566, 549w, 535sh, 521, 494, 483, 450sh, 434s, 430sh, 420sh, 395sh.

Sib72 Ferroglaucophane $\square Na_2(Fe^{2+}{}_3Al_2)(Si_8O_{22})(OH)_2$

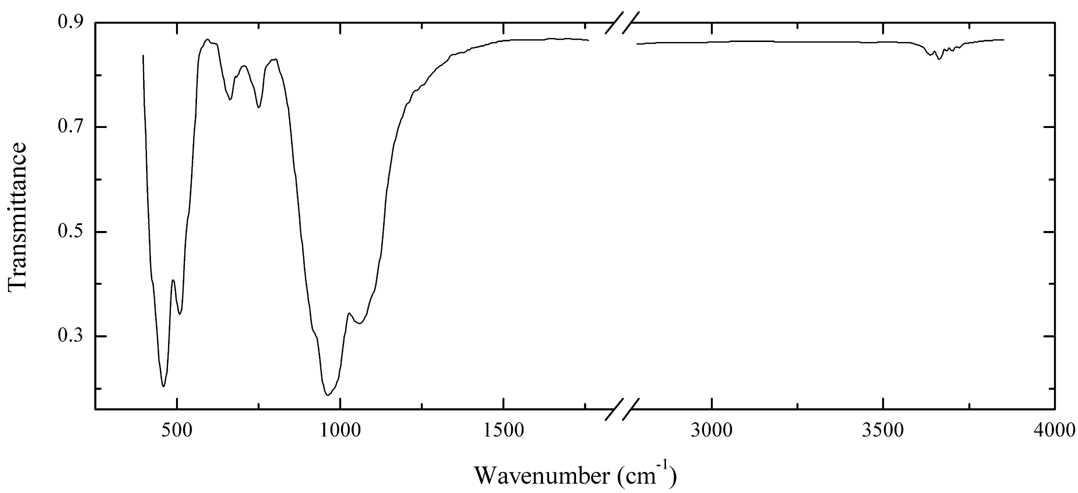


Locality: Junilla mine, Clear Creek district, San Benito, California, USA.

Description: Dark bluish grey granular aggregate. The empirical formula is (electron microprobe) $K_{0.02}(Na_{1.90}Ca_{0.05}Mn_{0.05})(Fe_{2.57}Mg_{1.29}Al_{1.27})(Si_{8.00}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3610w, 1095s, 1044s, 974s, 877, 790, 735w, 695, 672, 648w, 557, 505sh, 473s, 465sh, 445sh, 400sh.

Sib73 Ferri-winchite $\square(CaNa)(Mg_4Fe^{3+})(Si_8O_{22})(OH)_2$

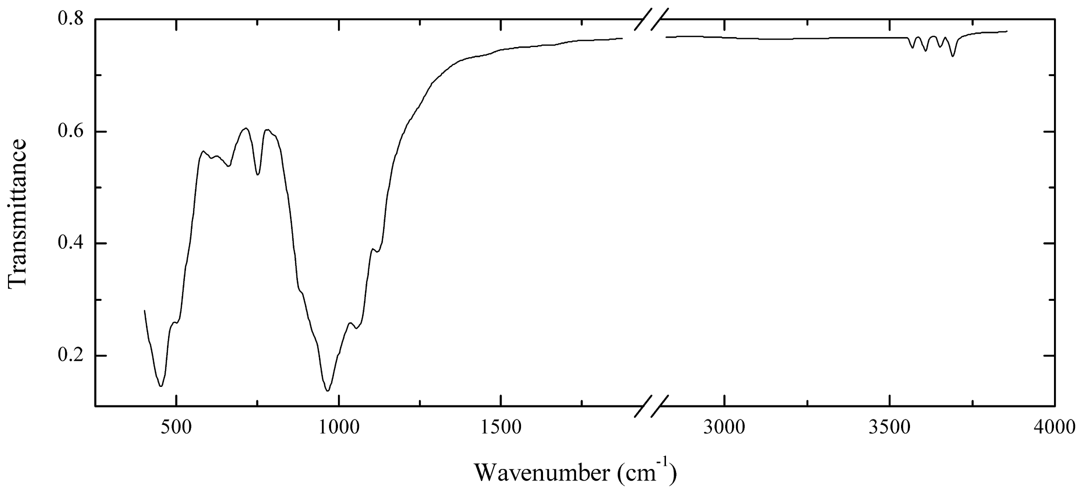


Locality: Vishnevye Mts., South Urals, Russia.

Description: Dark green parallel-fibrous aggregate. The empirical formula is (electron microprobe) $(K_{0.18}Na_{0.07}\square_{0.75})(Ca_{1.06}Na_{0.84})(Mg_{3.11}Fe_{1.72}Mn_{0.22})(Si_{7.71}Al_{0.24}Fe_{0.05}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3655w, 3625w, 1100sh, 1063s, 980sh, 967s, 920sh, 762, 685sh, 664, 600w, 535sh, 507s, 459s, 435sh.

Sib74 Ferrinybøite $NaNa_2(Mg_3Fe^{3+}{}_2)(Si_7AlO_{22})(OH)_2$

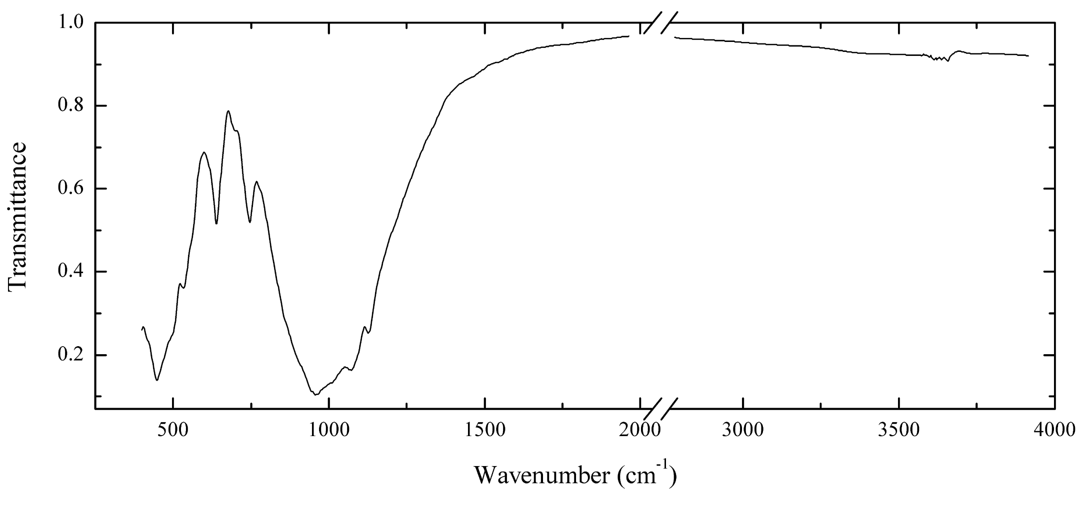


Locality: Turiy massif, Kola peninsula, Murnansk region, Russia.

Description: Black prismatic crystals from massive calcite. The empirical formula is (electron microprobe) $(Na_{0.9}K_{0.1})(Na_{1.6}Ca_{0.4})(Mg_{2.6}Fe_{2.2}Al_{0.1}Ti_{0.1})(Si_{7.2}Al_{0.8}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3685w, 3655w, 3615w, 3565w, 1126, 1062s, 967s, 925sh, 880sh, 753, 663, 607w, 540sh, 502, 456s, 410sh.

Sib75 Ferroleakeite $NaNa_2(Fe^{2+}{}_2Fe^{3+}{}_2Li)(Si_8O_{22})(OH)_2$

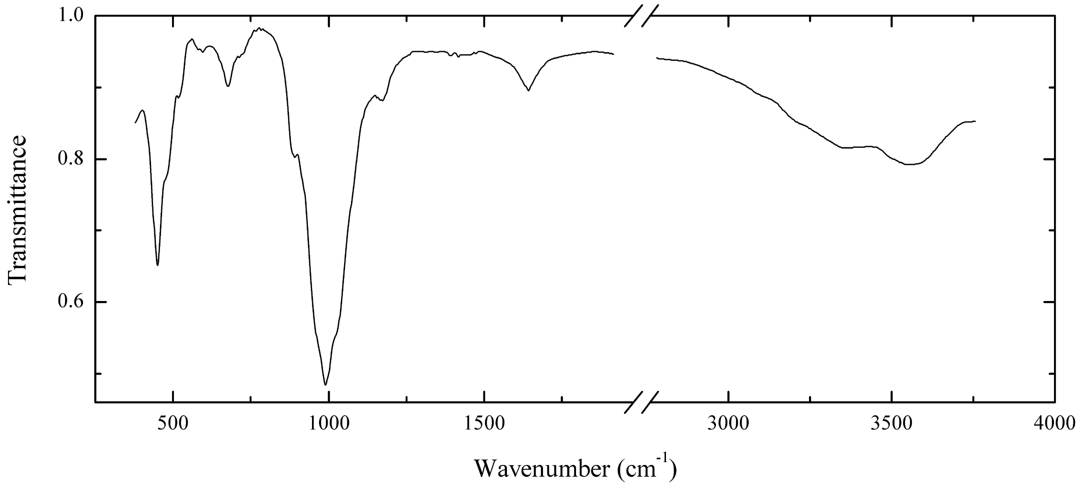


Locality: Khaldzan-Buragtag massif, Altai Mts., Howd Aimag, Mongolia.

Description: Black grains. Confirmed by semiquantitative electron microprobe analysis.

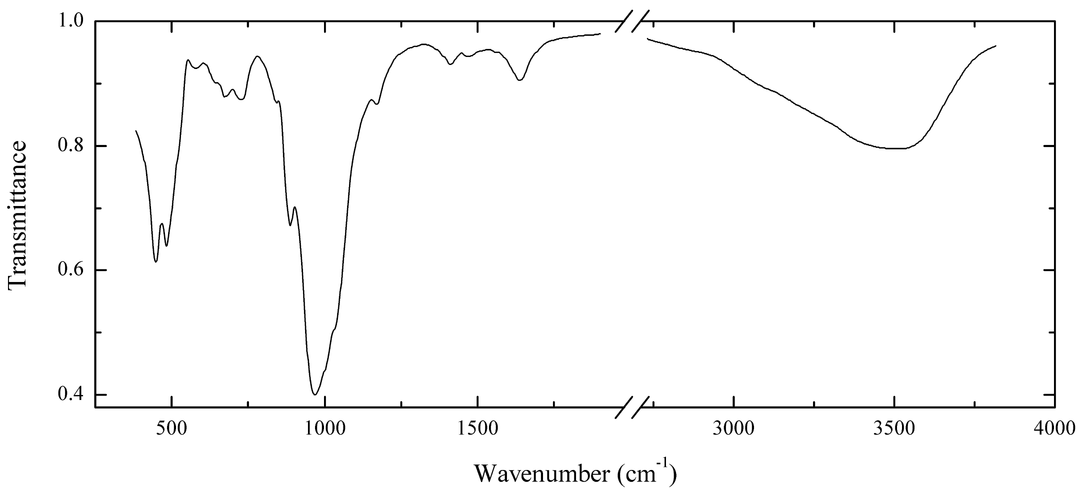
Wavenumbers (cm^{-1}): 3645w, 3605w, 1128s, 1070s, 1005sh, 961s, 900sh, 860sh, 747, 700w, 640, 536, 495sh, 448s, 420sh.

Sib76 Tobermorite $Ca_5[(Si,Al)_6(O,OH)_{17}]\cdot5H_2O$



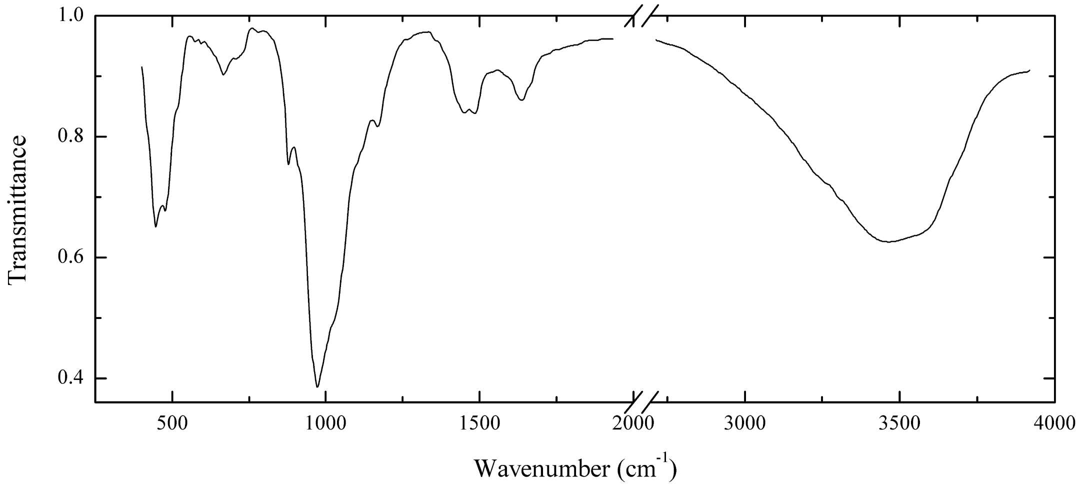
Locality: Mokraya Synya river, Voikaro-Syn'inskiy ultrabasite massif, Polar Urals, Russia.
Description: White fine-grained aggregate from the association with stilbite and natrolite. K-bearing variety. The empirical formula is (electron microprobe) $K_{0.17}(Ca_{4.62}Mn_{0.02}Fe_{0.02})[(Si_{5.36}Al_{0.64})(O,OH)_{17}]\cdot nH_2O$. The strongest reflexes of the powder X-ray pattern are [*d*, Å (*I*, %)] 11.22 (70), 5.423 (40), 3.641 (20), 3.527 (40), 3.317 (30), 3.083 (100), 2.972 (100), 2.805 (80), 2.435 (40).
Wavenumbers (cm^{-1}): 3540, 3340, 3230sh, 1635, 1170, 1025sh, 991s, 963sh, 915sh, 891, 720sh, 678, 594w, 521, 475sh, 449s.

Sib77 Tobermorite $Ca_5[(Si,Al)_6(O,OH)_{17}]\cdot5H_2O$



Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: White crust from the association with calcite. Na- and CO_3-bearing, Al-rich variety. The empirical formula is $Na_{0.3}Ca_{4.9}[(Si_{4.95}Al_{1.05})(O,OH)_{17}](CO_3)_x\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3490, 3430sh, 1634, 1474w, 1411w, 1162, 1030sh, 990sh, 965s, 910sh, 885, 840, 726, 677, 640sh, 587w, 515sh, 481, 446s.

Sib78 Tobermorite $Ca_5[(Si,Al)_6(O,OH)_{17}]\cdot 5H_2O$

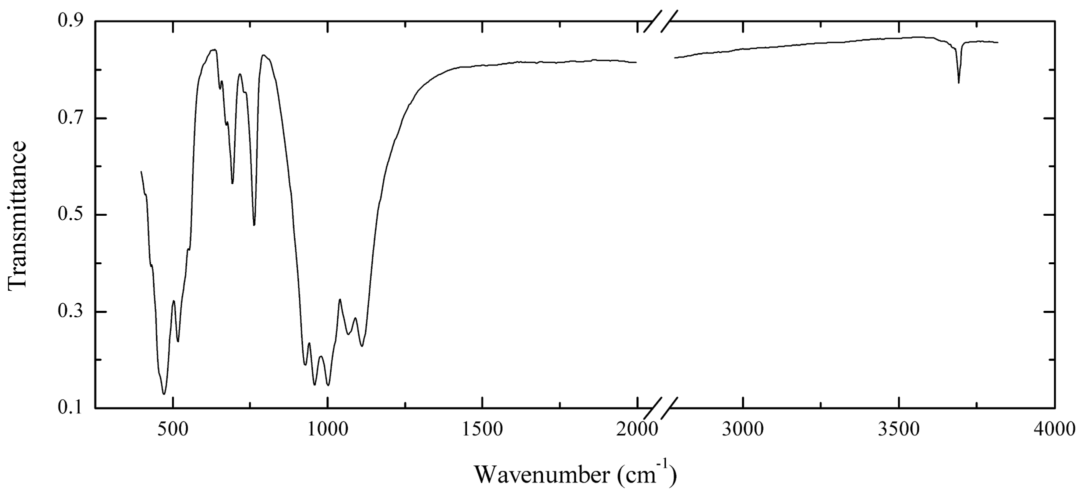


Locality: Campomorto quarry, Pietra Massa locality, Montalto di Castro, Viterbo province, Latium, Italy.

Description: White microfibrous aggregate from the association with ettringite and apophyllite. CO_3-rich variety. The empirical formula is $Na_{0.1}Ca_{5.0}[(Si_{5.35}Al_{0.65})(O,OH)_{17}](CO_3)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3540sh, 3440, 3240sh, 1660sh, 1640, 1475, 1455, 1168, 1025sh, 975s, 915sh, 877, 797w, 715w, 673, 600sh, 520sh, 480, 451s, 420sh.

Sib79 Tremolite $\square Ca_2Mg_5(Si_8O_{22})(OH)_2$

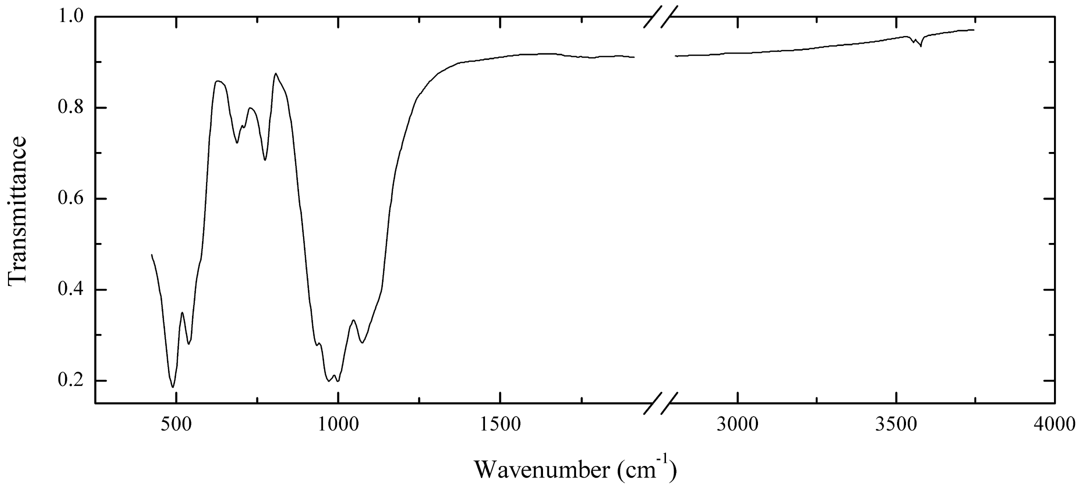


Locality: Pamir Mts., Tajikistan.

Description: Colourless crystal. The empirical formula is $Na_{0.03}(Ca_{1.94}Fe_{0.04}Mn_{0.02})Mg_{5.00}(Si_{7.97}Al_{0.03}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3680w, 1106s, 1064, 1040sh, 1020sh, 995s, 951s, 921s, 757, 725w, 685, 664, 644w, 545, 524, 506s, 462s, 445sh, 417, 400.

Sib81 Edenite $NaCa_2Mg_5(Si_7AlO_{22})(OH)_2$

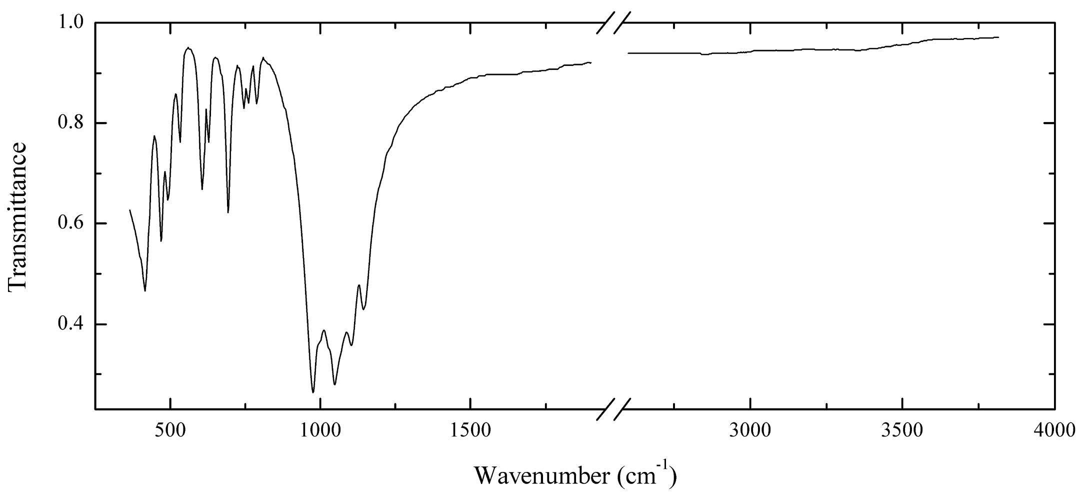


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Dark grey columnar aggregate from the association with phlogopite. The empirical formula is $(Na_{0.8}K_{0.2})Ca_{2.0}(Mg_{3.4}Fe_{1.2}Al_{0.3}Ca_{0.05}Ti_{0.05})(Si_{7.4}Al_{0.6}O_{22})(OH)_{1.6}F_{0.4}$.

Wavenumbers (cm^{-1}): 3640w, 1100sh, 1069s, 989s, 961s, 921s, 751, 683w, 666, 540sh, 509s, 464s.

Sib82 Fenaksite $KNaFe^{2+}(Si_4O_{10})$

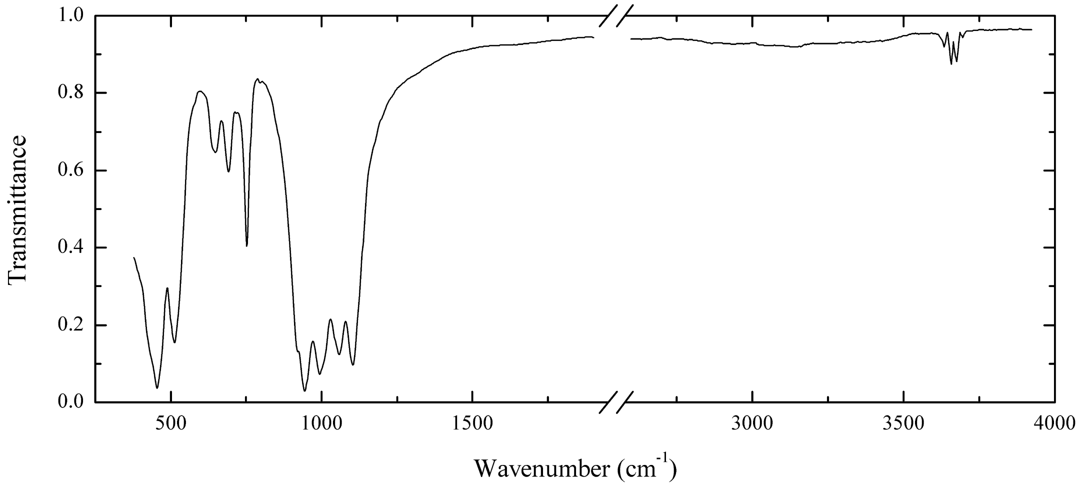


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brownish-rose grains from peralkaline pegmatite, from the association with nepheline, aegirine, delhayelite and eudialyte. Confirmed by semiquantitative electron microprobe analysis (Fe:Mn $\approx$ 4:1).

Wavenumbers (cm^{-1}): 1147, 1104s, 1047s, 1030sh, 995sh, 975s, 786, 757, 743, 689, 623, 603, 528, 490, 464, 412.

Sib83 Actinolite $\square Ca_2(Mg,Fe^{2+})_5(Si_8O_{22})(OH)_2$

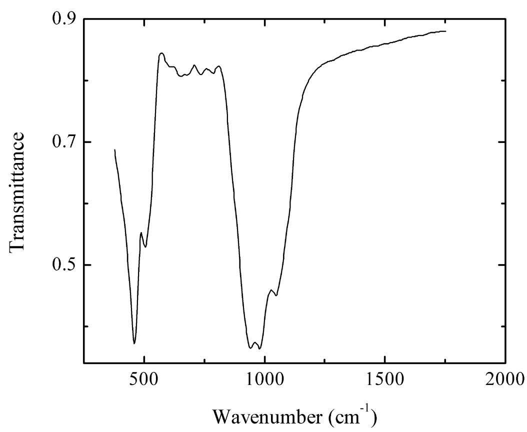


Locality: An unknown locality in Sweden.

Description: Brownish-yellow fibrous aggregate. The empirical formula is (electron microprobe) $(Na_{0.05}Ca_{1.9}Mn_{0.1})(Mg_{3.0}Fe_{1.8}Mn_{0.2})(Si_{7.95}Al_{0.05}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3676w, 3664w, 3648w, 3633w, 1107s, 1057s, 993s, 944s, 920sh, 755, 685, 648, 635sh, 512s, 455s, 440sh.

Sib84 Ferroedenite $NaCa_2(Fe^{2+},Mg)_5(Si_7AlO_{22})(OH)_2$

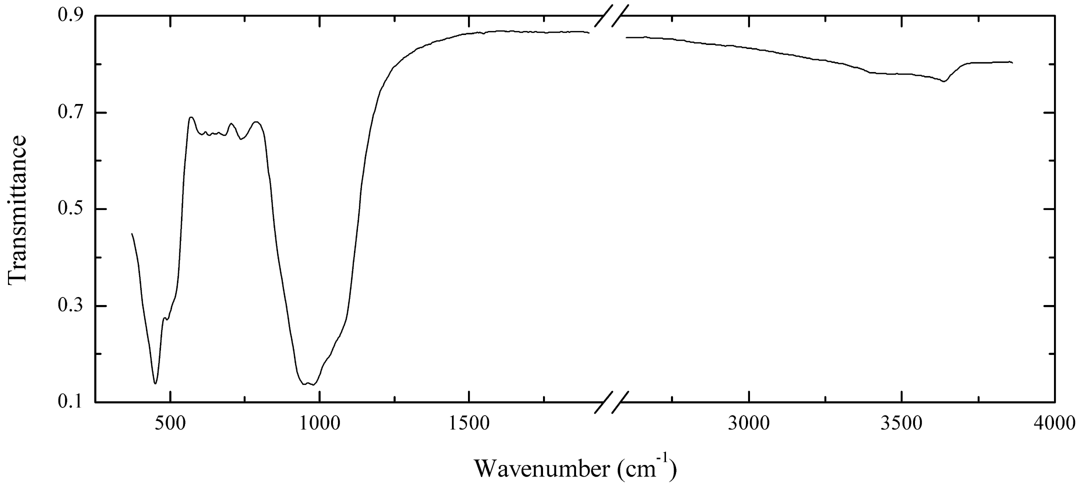


Locality: New Rock Debris quarry, Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black crystal from fenite. The empirical formula is (electron microprobe) $(Na_{0.41}K_{0.24})(Ca_{1.73}Mn_{0.24}Na_{0.03})(Fe_{2.74}Mg_{1.92}Al_{0.21}Ti_{0.05})(Si_{7.13}Al_{0.87}O_{22})(OH,F)_2$.

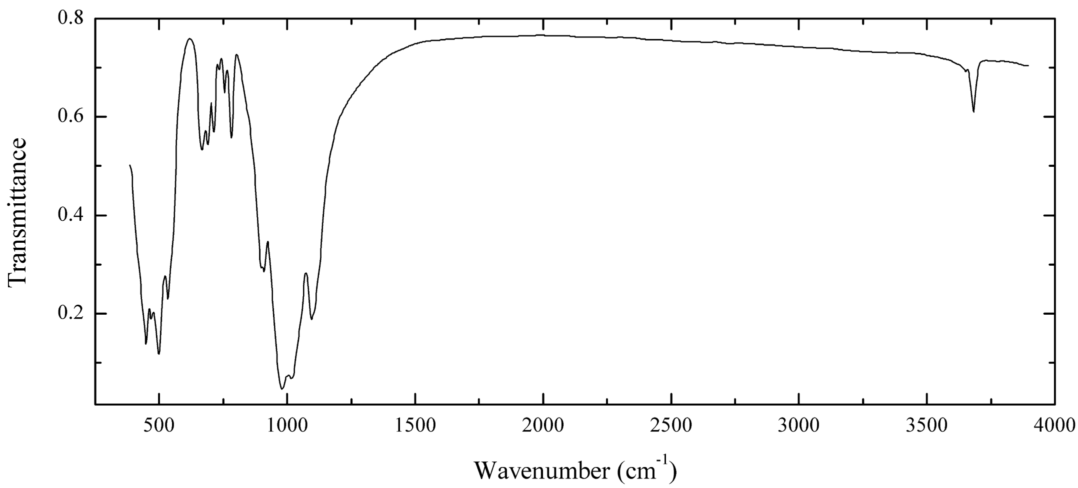
Wavenumbers (cm^{-1}): 1100sh, 1051, 982s, 943s, 885sh, 865sh, 782w, 733w, 685w, 665w, 610sh, 500, 456s.

Sib85 Ferri-ferrotschermakite $\square Ca_2[Fe^{2+}{}_3(Fe^{3+},Al)_2](Si_6Al_2O_{22})(OH)_2$



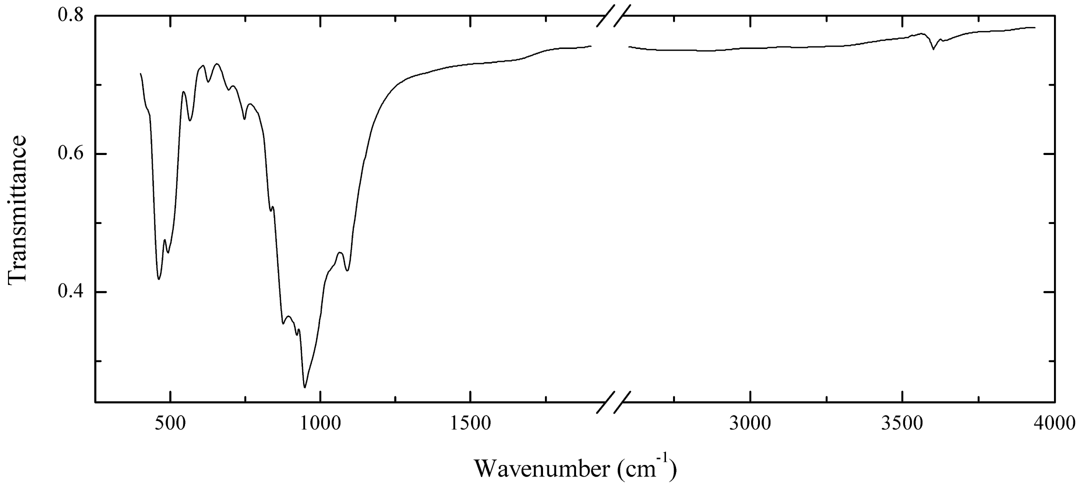
Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.
Description: Black grains. Investigated by A.G. Bazhenov. The empirical formula is $(K_{0.32}Na_{0.02})(Ca_{1.35}Na_{0.54}Mn_{0.11})[(Fe^{2+}{}_{2.45}Mg_{0.55})(Fe^{3+}{}_{1.16}Fe^{2+}{}_{0.41}Ti_{0.28}Al_{0.18})](Si_{6.26}Al_{1.74}O_{22})(OH,F)_2$.
Wavenumbers (cm^{-1}): 3605w, 1075sh, 1050sh, 979s, 953s, 740w, 686w, 644w, 628w, 604w, 515sh, 486, 450s.

Sib86 Anthophyllite $\square Mg_7(Si_8O_{22})(OH)_2$



Locality: Coeur d'Alene district, Shoshone Co., Idaho, USA.
Description: Grey radial aggregate. Fe-rich variety.
Wavenumbers (cm^{-1}): 3667, 3635w, 1105sh, 1093, 1018s, 980s, 911, 901, 781, 755, 734w, 713, 690, 667, 550sh, 532, 497s, 467, 448s, 435sh, 420sh.

Sib87 Ferrogedrite $\square(Fe^{2+},Mg)_5Al_2(Si_6Al_2O_{22})(OH)_2$

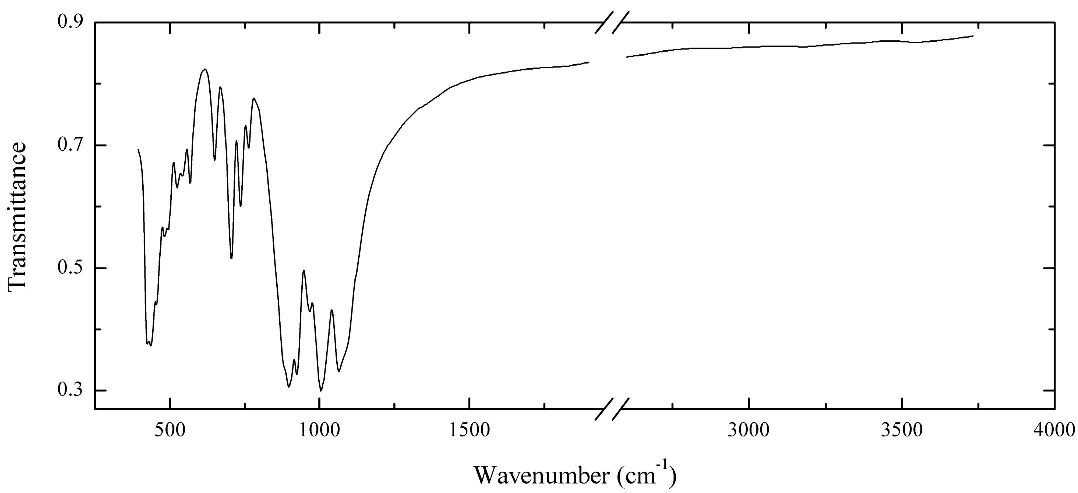


Locality: Spitzenberg, Altenau, Harz, Germany.

Description: Black prismatic crystals the association with magnetite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers ($\mathbf{cm^{-1}}$): 3615w, 1120sh, 1089, 1040sh, 975sh, 945s, 919s, 877s, 829, 747, 698, 633w, 565, 500sh, 488, 457s, 420sh.

Sib88 Ferronordite-(Ce) $Na_3SrCeFe^{2+}(Si_6O_{17})$

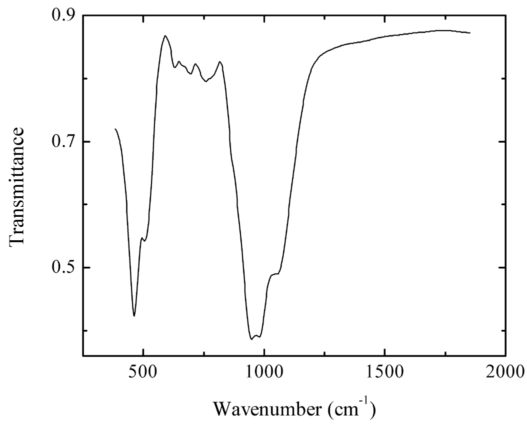


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless tabular crystal from the association with ussingite, vuonnemite, serandite, natisite, kazakovite, *etc*. Cotype sample. The empirical formula is $(Na_{2.97}Ca_{0.11})(Sr_{0.99}Ba_{0.02})(Ce_{0.52}La_{0.42}Nd_{0.05}Sm_{0.01})(Fe_{0.39}Mn_{0.28}Zn_{0.28}Mg_{0.10})(Si_{5.92}Al_{0.01})O_{17}$.

Wavenumbers ($\mathbf{cm^{-1}}$): 1085sh, 1059s, 998s, 965, 919s, 895s, 875sh, 762, 734, 703, 647, 566, 535, 522, 493, 482, 447, 436s, 429s.

Sib89 Ferrohornblende $\square Ca_2[Fe^{2+}_4(Al,Fe^{3+})](Si_7AlO_{22})(OH)_2$

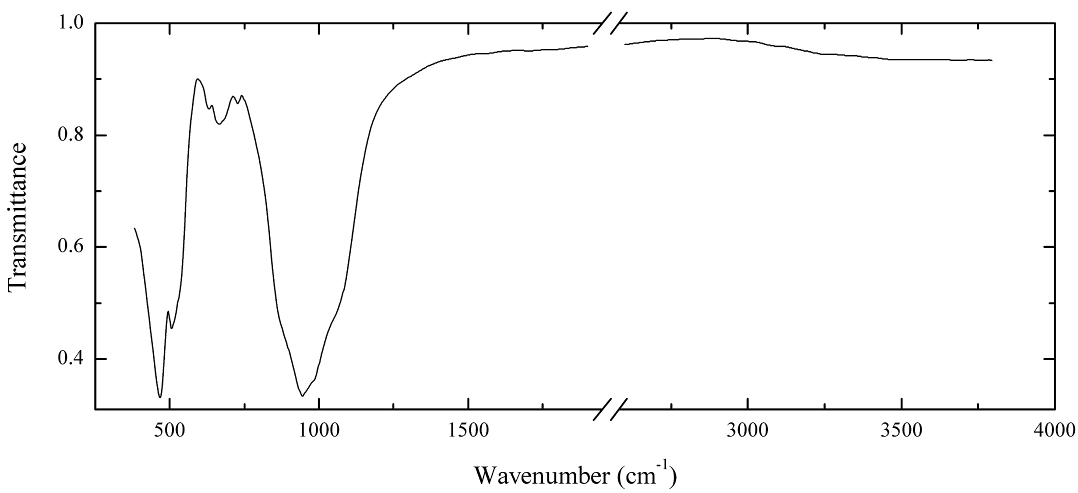


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Dark green grains. Investigated by A.G. Bazhenov. The empirical formula is $(Na_{0.28}K_{0.19})(Ca_{1.75}Na_{0.22}Mn_{0.03})(Fe^{2+}_{1.82}Mg_{1.79}Al_{0.72}Fe^{3+}_{0.50}Ti_{0.20})(Si_{6.53}Al_{1.47}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 1050sh, 981s, 950s, 870sh, 780sh, 756w, 693w, 658w, 629w, 504, 459s.

Sib90 Potassic-fluoro-magnesiohastingsite $KCa_2(Mg_4Fe^{3+})(Si_6Al_2O_{22})F_2$

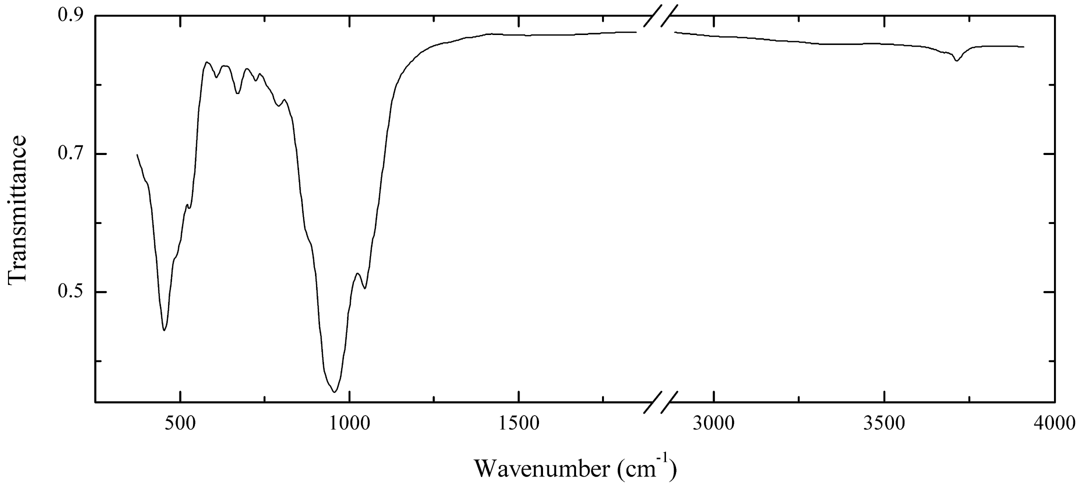


Locality: Burned dump of the shaft No. 204, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Yellow crystals from the association with anorthite, esseneite, fluorphlogopite and hematite. Investigated by B.V. Chesnokov. Monoclinic, $a = 9.900(1)$, $b = 17.986(3)$, $c = 5.306(1)$ Å, $\beta = 105.53°$, $Z = 2$. $D_{meas} = 3.18$ g/cm^3, $D_{calc} = 3.17$ g/cm^3. Optically biaxial (+), $\alpha = 1.648(2)$, $\beta = 1.651(2)$, $\gamma = 1.665(2)$. The empirical formula is (electron microprobe) $(K_{0.32}Ca_{0.29}Na_{0.24})Ca_{2.00}(Mg_{4.10}Fe_{0.76}Al_{0.08}Ti_{0.04}Mn_{0.02})(Si_{5.91}Al_{2.09}O_{22})F_{2.05}$. The strongest lines of powder X-ray diffraction pattern are [d, Å (I, %) (hkl)] 8.41 (40) (110), 3.376 (34) (041), 3.276 (51) (240), 3.130 (100) (310), 2.931 (30) (221), 2.808 (40) (330), 2.705 (42) (151).

Wavenumbers (cm^{-1}): 1070sh, 1040sh, 985sh, 948s, 895sh, 730w, 671, 633w, 520sh, 505, 466s.

Sib91 Potassic-ferrisadanagaite $(K,Na)Ca_2[(Fe^{2+},Mg)_3(Fe^{3+},Al)_2](Si_5Al_3O_{22})(OH)_2$

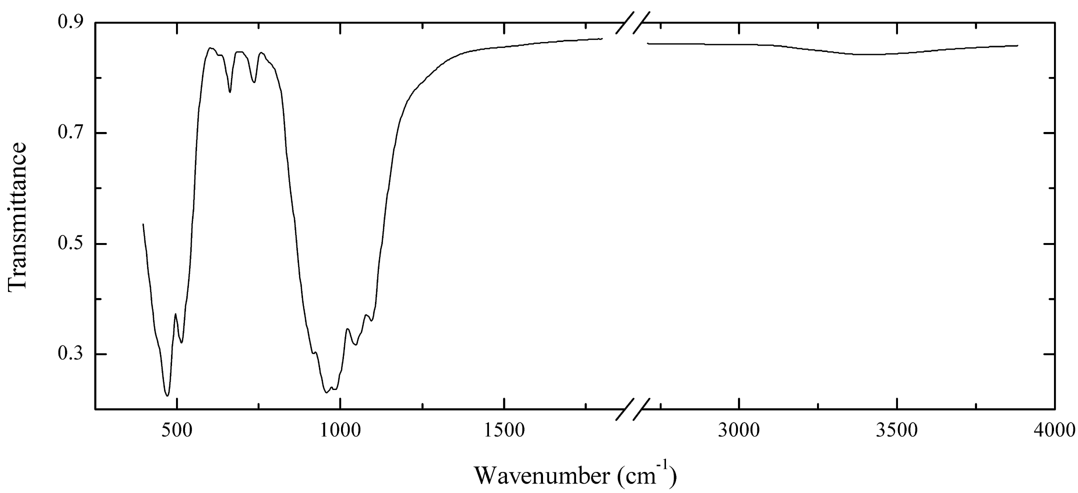


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Black grains. Investigated by A.G. Bazhenov. The empirical formula is $(K_{0.65}K_{0.27})(Ca_{1.72}Na_{0.28})(Fe^{2+}{}_{2.15}Mg_{0.55}Mn_{0.25}Fe^{3+}{}_{1.11}Al_{0.75}Ti_{0.19})(Si_{5.31}Al_{2.69}O_{22})[(OH)_{1.39}F_{0.40}O_{0.21}]$.

Wavenumbers (cm^{-1}): 3660w, 3630sh, 1085sh, 1042, 957, 935sh, 880sh, 794, 755sh, 740w, 673, 611w, 534, 490sh, 460s, 410sh.

Sib92 Amphibole Sib92 $(\square,Na,K)Ca_2[Mg_4(Mg,Ti)](Si_7AlO_{22})F_2$

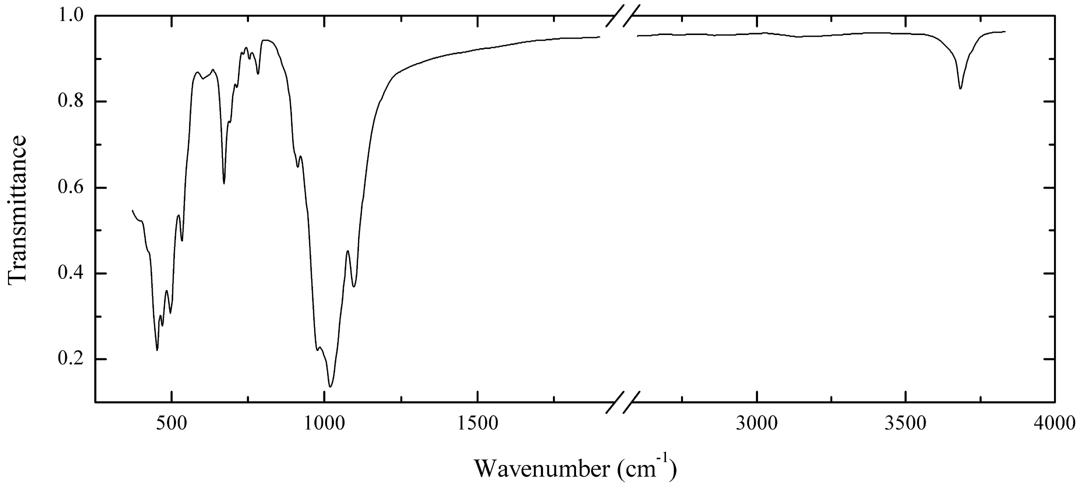


Locality: Burned dump of the shaft No. 45, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Pale brown crystals from the association with anorthite, fluorphlogopite and pyrrhotite. Investigated by B.V. Chesnokov. Monoclinic, $a = 9.854(1)$, $b = 17.938(2)$, $c = 5.278(1)$ Å, $\beta = 104.95°$, $Z = 2$. $D_{meas} = 3.02$ g/cm^3, $D_{calc} = 3.094$ g/cm^3. Optically biaxial (+), $\alpha = 1.607(2)$, $\beta = 1.614(2)$, $\gamma = 1.628(2)$. The empirical formula is (electron microprobe) $Na_{0.30}K_{0.16}Ca_{2.12}(Mg_{4.79}Ti_{0.15}Fe_{0.04}Mn_{0.01})(Si_{6.97}Al_{1.04}O_{22})F_{2.01}$. The strongest lines of powder X-ray diffraction pattern are [d, Å (I, %) (hkl)] 8.41 (53) (110), 3.373 (28) (041), 3.271 (65) (240), 3.118 (100) (310), 2.931 (36) (221), 2.801 (27) (330), 2.702 (47) (151).

Wavenumbers (cm^{-1}): 1140sh, 1098, 1060sh, 1046s, 986s, 957s, 921s, 788w, 737, 664, 635w, 514s, 471s, 440sh, 420sh.

Sib93 Anthophyllite $\square Mg_7(Si_8O_{22})(OH)_2$

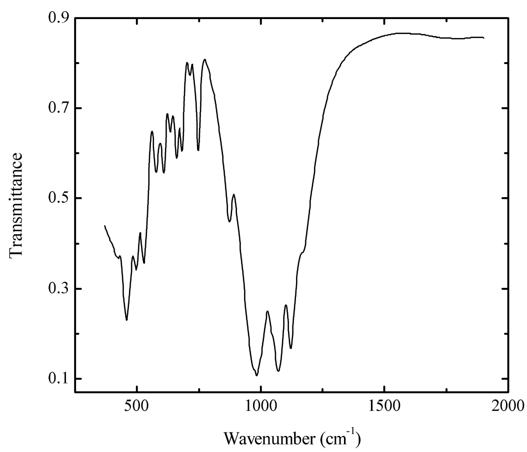


Locality: Paakkila, Tuusniemi, Eastern Finland region, Finland.

Description: White fibrous aggregate from the association with talc. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3677, 1094, 1018s, 974s, 912, 900sh, 781, 754w, 734w, 711, 690, 669, 601w, 550sh, 530, 495s, 466s, 449s, 425sh, 395sh.

Sib94 Ungarettiite $NaNa_2(Mn^{2+}{}_2Mn^{3+}{}_3)(Si_8O_{22})O_2$

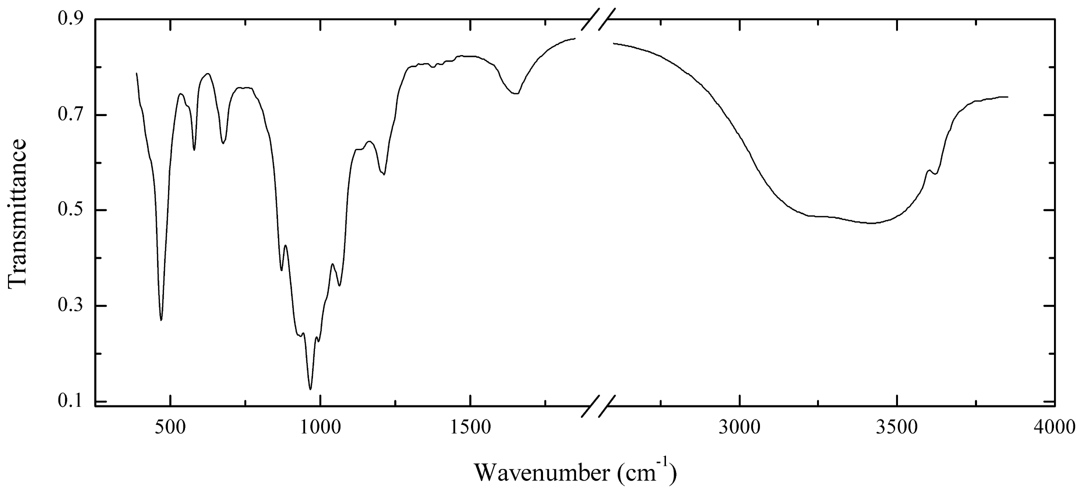


Locality: Woods Mine, Tamworth, Darling Co., New South Wales, Australia.

Description: Very dark red granular aggregate. Na-deficient variety. The empirical formula is (electron microprobe) $(Na_{2.48}Mn_{0.46}Ca_{0.10})Mn_{5.00}(Si_{7.70}Fe^{3+}{}_{0.30}O_{22})O_2$. Bands of OH groups are not observed in the IR spectrum.

Wavenumbers (cm^{-1}): 1170sh, 1121s, 1072s, 1045sh, 984s, 970sh, 873, 747, 713w, 682, 662, 635, 609, 576, 529, 497, 457s, 425.

Sib95 Silicate Sib95 $Ca_{4-x}[Si_6(O,OH)_{17}]\cdot nH_2O$

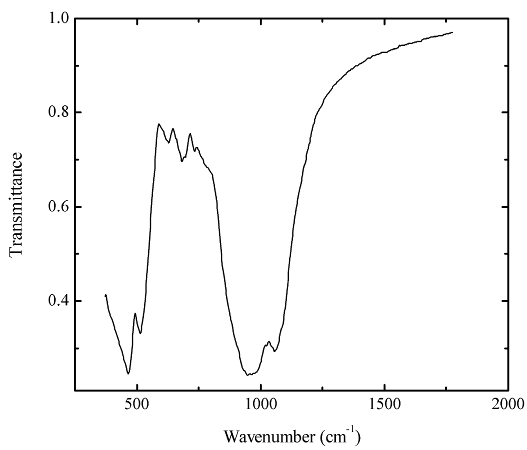


Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan.

Description: White fine-grained aggregate from the association with calcite, pentahydroborite and henmilite. Related to tacharanite. The empirical formula is (electron microprobe) $Ca_{3.75}[Si_{6.00}(O,OH)_{17}]\cdot nH_2O$. The lines of powder X-ray diffraction pattern are [*d*, Å (*I*, %)] 12.24 (30), 7.55 (5), 5.07 (5), 3.027 (100), 2.810 (10).

Wavenumbers (cm^{-1}): 3615, 3380, 3200sh, 1650, 1210, 1135, 1064s, 996s, 965s, 930s, 872s, 675, 579, 470s.

Sib96 Kaersutite $NaCa_2(Mg_4Ti)(Si_6Al_2O_{22})[O(OH)]$

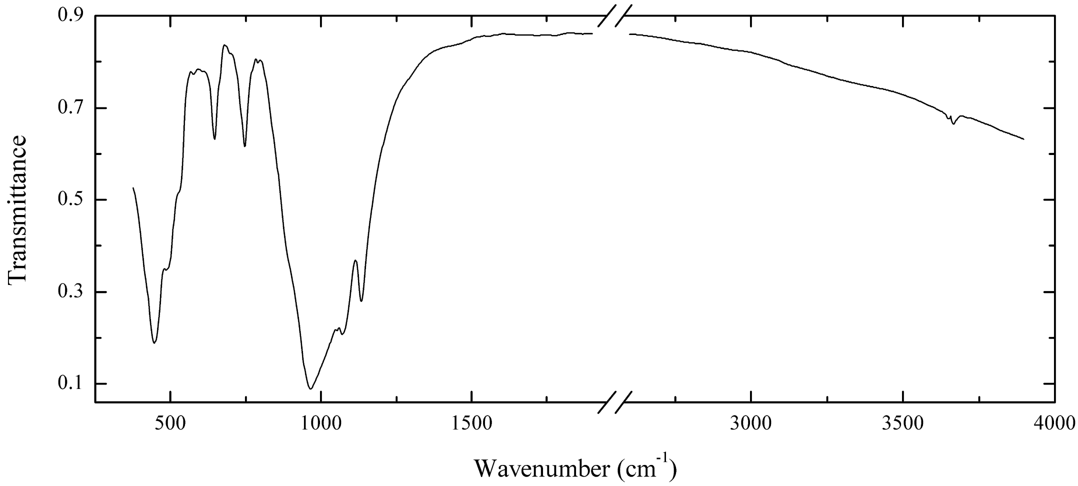


Locality: Nickenicher Sattelberg, Nickenich, near Andernach, Eifel, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Orange-brown acicular crystals. The empirical formula is (electron microprobe) $K_{0.2}Na_{0.8}Ca_{1.95}(Mg_{3.15}Fe_{1.1}Ti_{0.7}Al_{0.1})(Si_{6.0}Al_{2.0}O_{22})(O,OH,F)_2$.

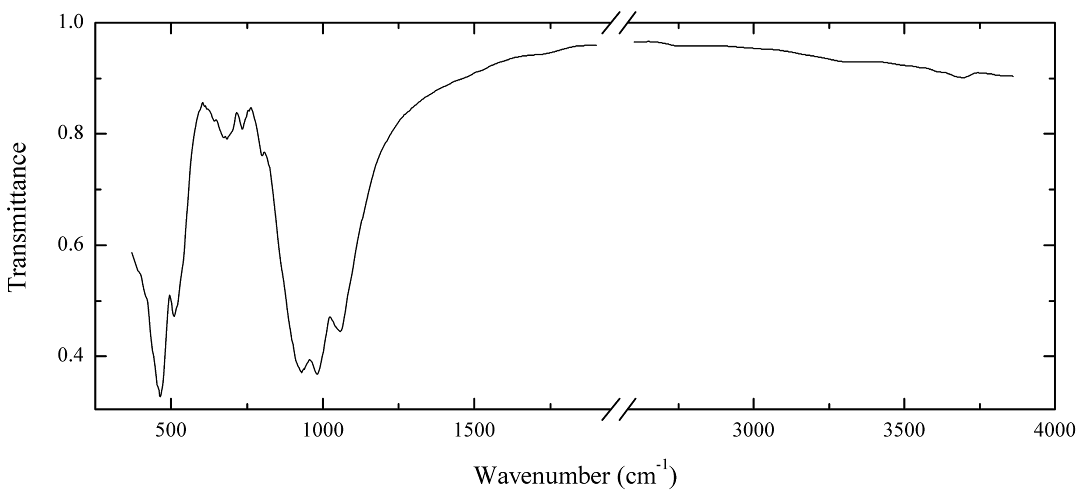
Wavenumbers (cm^{-1}): 1056s, 980sh, 955s, 875sh, 785sh, 732w, 696w, 683, 630w, 513s, 465s, 400sh.

Sib97 Ferroleakeite $NaNa_2(Fe^{2+}{}_2Fe^{3+}{}_2Li)(Si_8O_{22})(OH)_2$



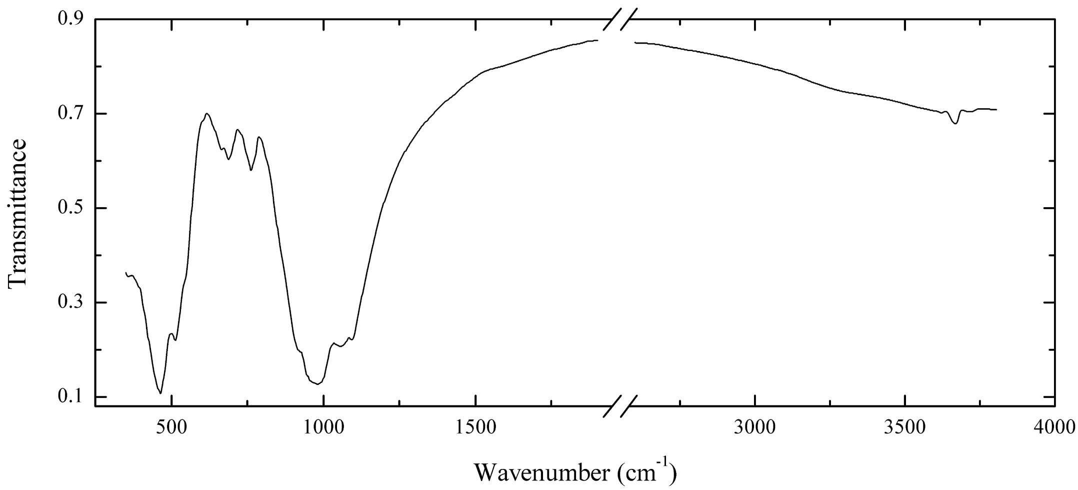
Locality: Khaldzan-Buragtag massif, Altai Mts., Howd Aimag, Mongolia.
Description: Black crystal. The empirical formula is (electron microprobe, Li calculated) $Na_{2.7}K_{0.2}Ca_{0.1}(Fe_{3.9}Mn_{0.1}Al_{0.1}Ti_{0.1}Li_{0.8})(Si_{8.0}O_{22})[(OH)_{1.1}F_{0.9}]$.
Wavenumbers (cm^{-1}): 3638w, 1132s, 1069s, 1000sh, 964s, 747, 665sh, 647, 525sh, 487s, 446s.

Sib98 Fluoro-magnesiohastingsite $NaCa_2(Mg_4Fe^{3+})(Si_6Al_2O_{22})F_2$



Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.
Description: Black grains. The empirical formula is (electron microprobe) $Na_{0.6}K_{0.2}Ca_{2.0}(Mg_{3.9}Fe_{0.7}Al_{0.4})(Si_{6.3}Al_{1.7}O_{22})[F_{1.2}(OH)_{0.8}]$.
Wavenumbers (cm^{-1}): 3670, 1100sh, 1057s, 982s, 933s, 799, 735, 680, 642w, 513s, 464s, 415sh.

Sib99 Magnesiokatophorite $Na(CaNa)(Mg_4Al)(Si_7AlO_{22})(OH)_2$

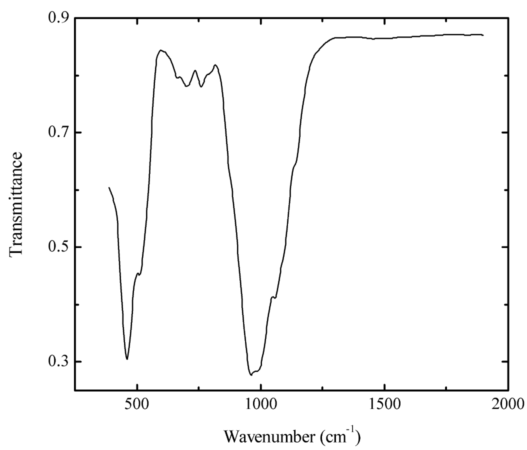


Locality: Marun-Keu ridge, Polar Urals, Russia.

Description: Grey prismatic crystals from eclogite, from the association with Cr-bearing diopside and phlogopite. Na-deficient variety ("carinthine"). The empirical formula is (electron microprobe) $(Na_{0.5}K_{0.1})(Ca_{1.77}Na_{0.3})(Mg_{3.5}Fe_{0.7}Al_{0.8})(Si_{7.0}Al_{1.0}O_{22})(OH,O)_2$.

Wavenumbers (cm^{-1}): 3657, 1096s, 1057s, 976s, 925sh, 763, 791, 664, 545sh, 512s, 462s.

Sib100 Magnesio-hornblende $\square Ca_2[Mg_4(Al,Fe^{3+})](Si_7AlO_{22})(OH)_2$

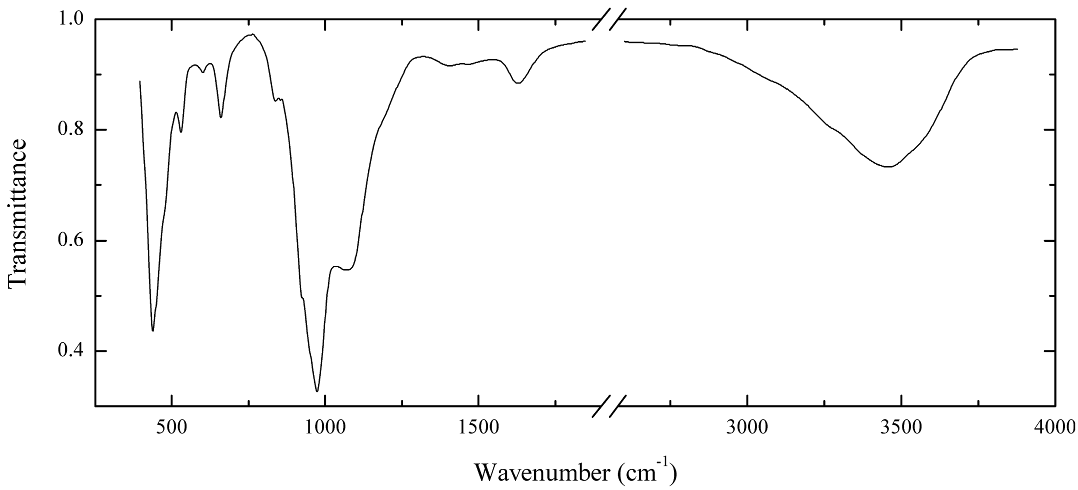


Locality: Magnitka, Chelyabinsk region, South Urals, Russia.

Description: Black columnar aggregate from the association with plagioclase and magnetite. The empirical formula is $Na_{0.43}(Ca_{1.84}Na_{0.16})(Mg_{2.15}Fe_{1.95}Al_{0.90})(Si_{6.65}Al_{1.35}O_{22})(OH,O,F)_2$.

Wavenumbers (cm^{-1}): 1130sh, 1085sh, 1045, 984s, 963s, 790sh, 754, 695, 658w, 535sh, 504, 458s.

Sib101 Plombièrite $Ca_5Si_6O_{16}(OH)_2{\cdot}7H_2O$

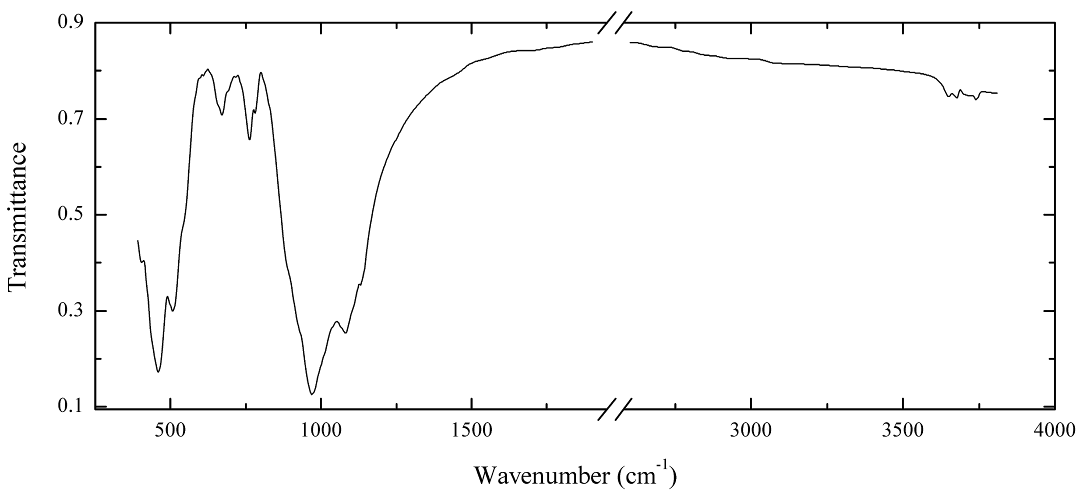


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.

Description: White radial-fibrous aggregate from the association with tobermorite, calcite and prehnite. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500sh, 3430, 3300sh, 1625, 1470w, 1420w, 1190sh, 1080, 978s, 932, 857, 844, 662, 598w, 530, 470sh, 437s, 405sh.

Sib102 Magnesio-riebeckite $\square Na_2(Mg_3Fe^{3+}{}_2)(Si_8O_{22})(OH)_2$

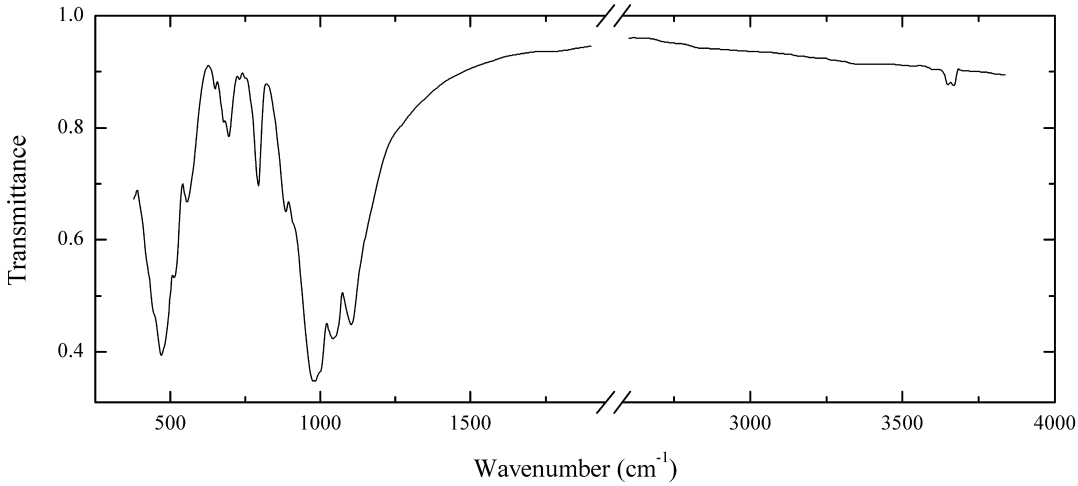


Locality: Alintsi (Alinci), near Prilep, Pelagonia, Macedonia.

Description: Black long-prismatic crystals from a quartz vein crossing syenite. Ca-rich variety. The empirical formula is (electron microprobe) $(Na_{0.3}K_{0.1})(Na_{1.6}Ca_{0.4})(Mg_{2.4}Fe_{2.4}Al_{0.15}Mn_{0.05})(Si_{7.95}Al_{0.05}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3710w, 3680sh, 3640w, 3615w, 1135sh, 1082s, 968s, 900sh, 782, 767, 690sh, 670, 655sh, 545sh, 509s, 458s, 404.

Sib103 Magnesio-riebeckite □$Na_2(Mg_3Fe^{3+}{}_2)(Si_8O_{22})(OH)_2$

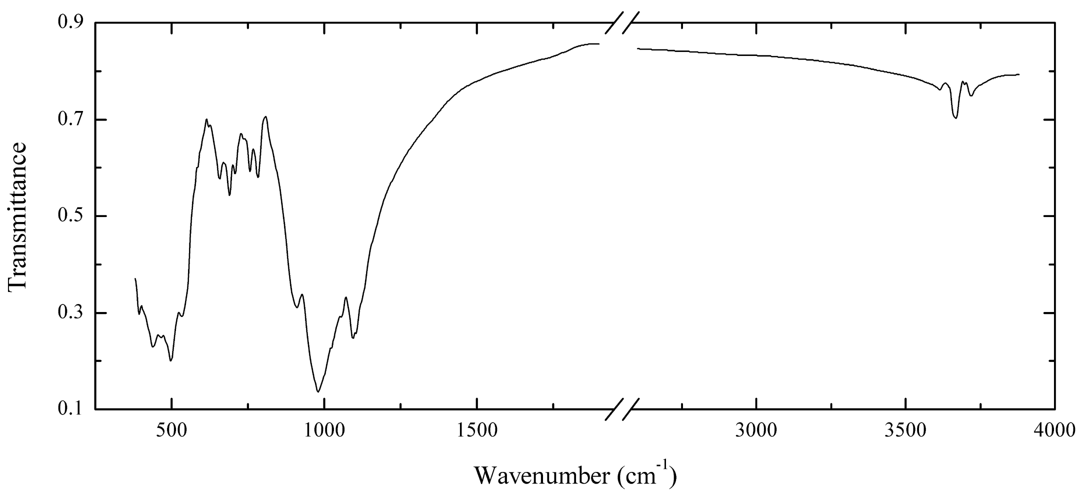


Locality: Skopje, Macedonia.

Description: Very dark green prismatic crystals from amphibole schist. The empirical formula is (electron microprobe) $Na_{1.9}Ca_{0.2}(Mg_{2.4}Fe_{1.9}Al_{0.7})(Si_{8.0}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3655w, 3635w, 1150sh, 1103s, 1043s, 1000sh, 980s, 910sh, 887, 794, 730w, 695, 672, 649w, 556, 514, 468s, 445sh.

Sib104 Cummingtonite □$Mg_7(Si_8O_{22})(OH)_2$

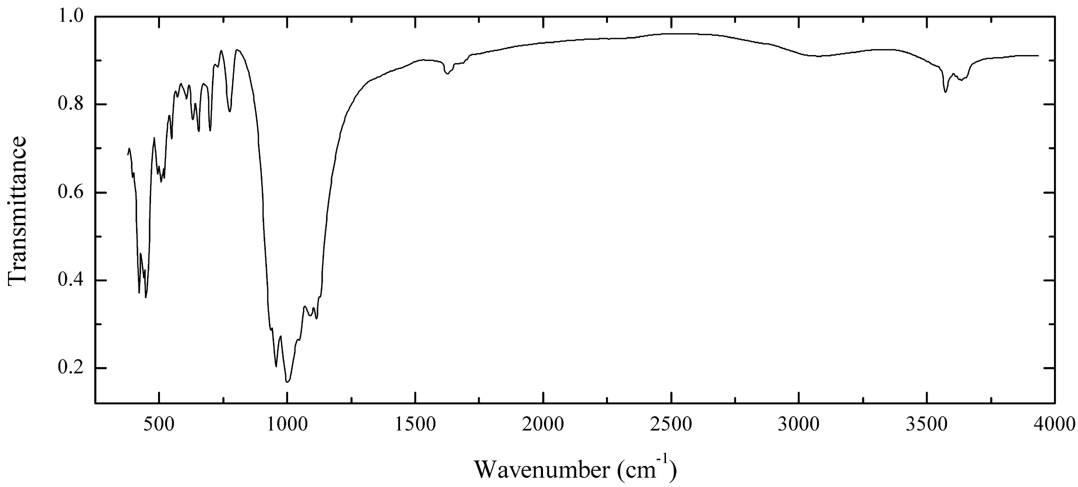


Locality: Kuruvaara (Chalmozero) mine, Yona (Juonni) pegmatite field, Kola peninsula, Murnansk region, Russia.

Description: Grey-green columnar aggregate from the association with biotite. The empirical formula is (electron microprobe) $Ca_{0.05}(Mg_{6.0}Fe_{0.95}Mn_{0.05})(Si_{7.8}Al_{0.1}Fe^{3+}{}_{0.1}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3700w, 3645, 3590w, 1099s, 978s, 909s, 783, 755, 708, 687, 655, 533, 498s, 465, 440s, 394.

Sib105 Charoite $(K,Sr)_8(Ca,Na)_{16}[Si_6O_{11}(O,OH)_6][Si_{12}O_{18}(O,OH)_{12}][Si_{17}O_{25}(O,OH)_{18}](OH,F)_2\cdot1.5H_2O$

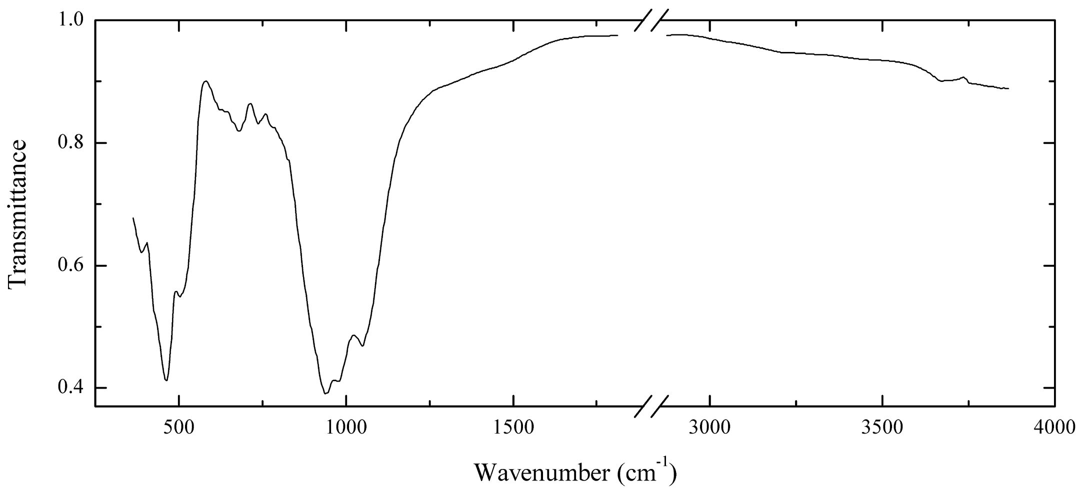


Locality: Malyi Murun (Malomurunskiy) massif, Aldan shield, Eastern Siberia, Russia (type locality).

Description: Lilac fibrous aggregate from the association with aegirine, tinaksite, microcline and quartz.

Wavenumbers (cm^{-1}): 3610w, 3550w, 1680sh, 1627w, 1130, 1115s, 1090s, 1045sh, 1006s, 957s, 937s, 775, 728w, 698, 654, 630, 606w, 568w, 548, 517, 505, 493, 448, 438, 420.

Sib106 Kaersutite $NaCa_2(Mg_4Ti)(Si_6Al_2O_{22})[O(OH)]$

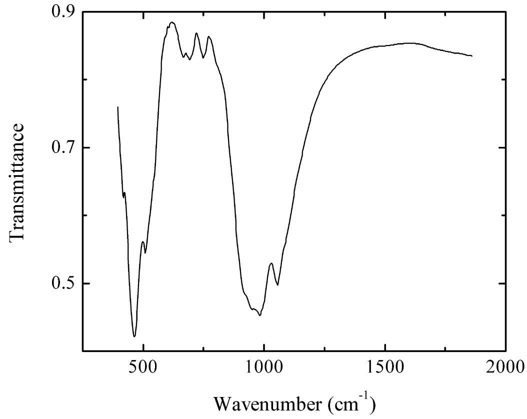


Locality: Suletice, Nymburk district, Bohemia, Czech Republic.

Description: Black short-prismatic crystal from the association with augite. The empirical formula is (electron microprobe) $Na_{0.60}K_{0.37}Ca_{1.91}(Mg_{3.17}Fe_{1.15}Ti_{0.53}Al_{0.14})(Si_{5.88}Al_{2.12}O_{22})(OH,O)_2$.

Wavenumbers (cm^{-1}): (3665w), 1048s, 977s, 941s, 736w, 682, 635sh, 503, 463s, 420sh, 388.

Sib108 Pargasite $NaCa_2(Mg_4Al)(Si_6Al_2O_{22})(OH)_2$

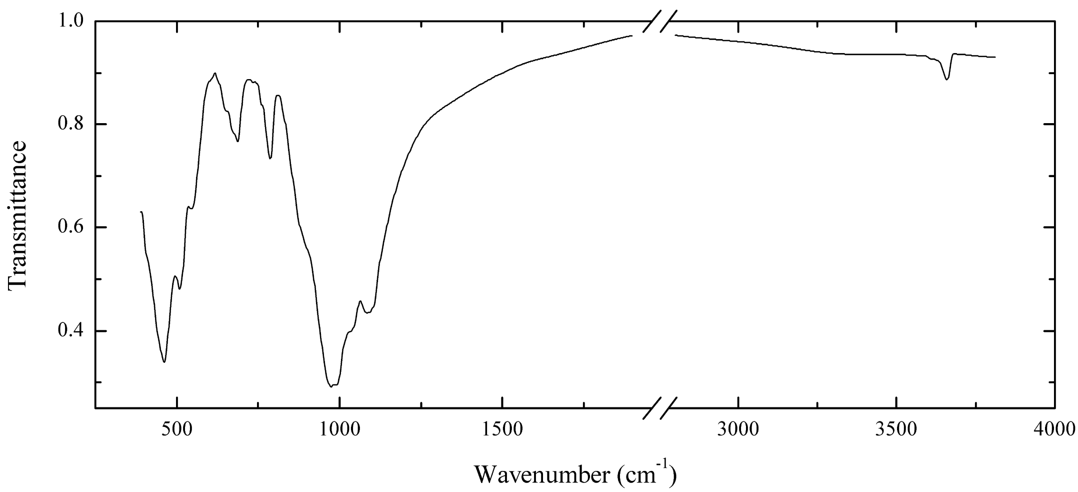


Locality: Luc Yen, Yen Bai Province, Vietnam.

Description: Light green crystals from the association with calcite. Li-bearing variety. The empirical formula is (electron microprobe) $Li_xNa_{0.6}Ca_{1.9}Mg_{4.5}Al_{0.5}Ti_{0.1}(Si_{6.4}Al_{1.6}O_{22})[(OH)_{1.5}F_{0.5}]$.

Wavenumbers (cm^{-1}): 1093, 1066s, 982s, 948s, 920sh, 810sh, 755sh, 745, 691, 664, 540sh, 509, 464s, 420sh.

Sib109 Ferri-parvowinchite $\square(NaMn)[Mg_4Fe^{3+}](Si_8O_{22})(OH)_2$

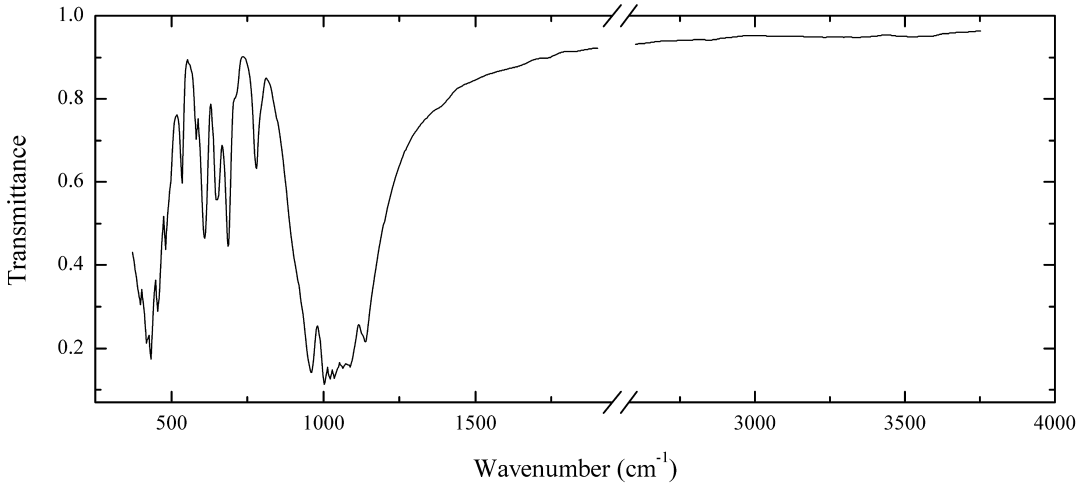


Locality: Varenche mine, St Barthelemy, Aosta valley, Italy.

Description: Yellow columnar aggregate. The empirical formula is (electron microprobe) $(Na_{1.06}Mn_{0.58}Fe_{0.29}Ca_{0.26})(Mg_{4.24}Fe_{0.52}Al_{0.24})(Si_{7.70}Al_{0.30}O_{22})(OH)_{1.7}F_{0.2}Cl_{0.1}$.

Wavenumbers (cm^{-1}): 3655, 1090s, 1030sh, 990s, 973s, 910sh, 785, 687, 650sh, 545, 510, 459s.

Sib110 Agrellite $NaCa_2(Si_4O_{10})F$

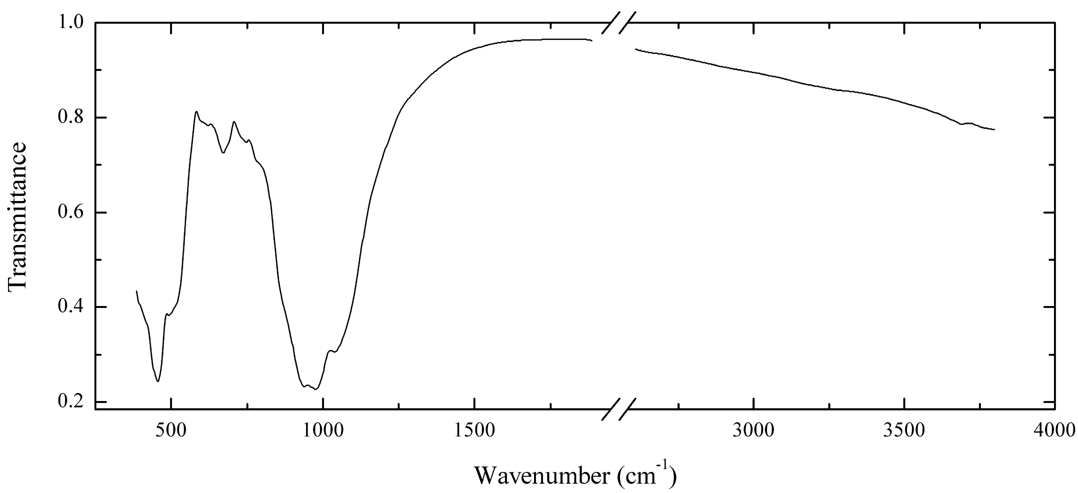


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alai (Alaiskii) range, Tien-Shan Mts., Tajikistan.

Description: White coarse-grained aggregate from the association with miserite, pectolite, albite and quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1390sh, 1140s, 1095sh, 1083s, 1063s, 1045sh, 1037s, 1024s, 1004s, 963s, 780, 686, 652, 646, 608, 584w, 533, 490sh, 478, 453, 427s, 417, 398.

Sib111 Fluoro-potassic-hastingsite $KCa_2(Fe^{2+}{}_4Fe^{3+})(Si_6Al_2O_{22})(OH)_2F_2$

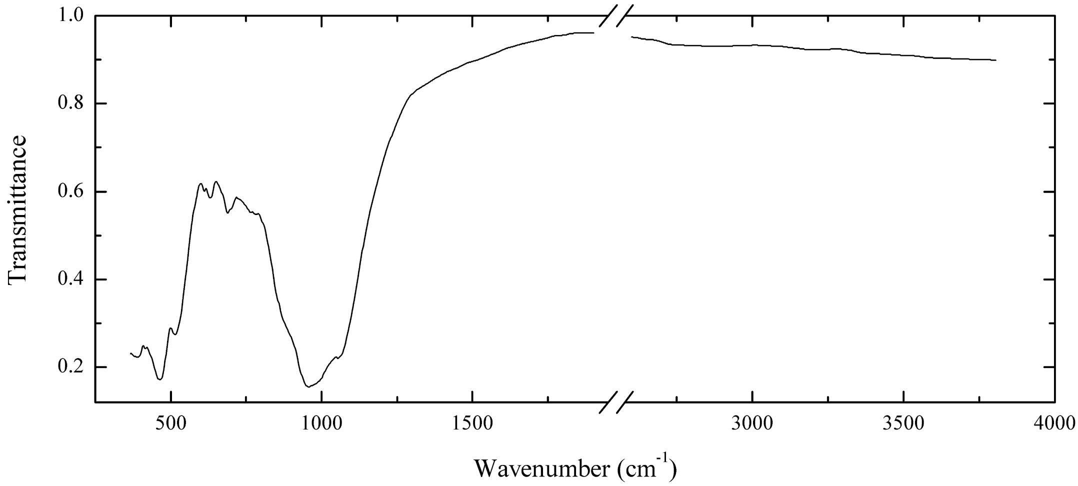


Locality: Greenwood mine, Orange Co., New York, USA (type locality).

Description: Black granular aggregate from the association with magnetite. The empirical formula is (electron microprobe) $(K_{0.52}Na_{0.47}Ca_{2.05})(Fe_{3.40}Mg_{1.45}Ti_{0.11}Cr_{0.03})(Si_{5.96}Al_{1.99}Fe_{0.05}O_{22})$ $[F_{0.97}(OH,O)_{0.93}Cl_{0.10}]$.

Wavenumbers (cm^{-1}): 3670w, 1042s, 978s, 939s, 865sh, 785sh, 748w, 670, 630w, 510sh, 495, 455s, 420sh.

Sib112 Fluoro-kaersutite $NaCa_2(Mg_4Ti)(Si_6Al_2O_{22})OF$

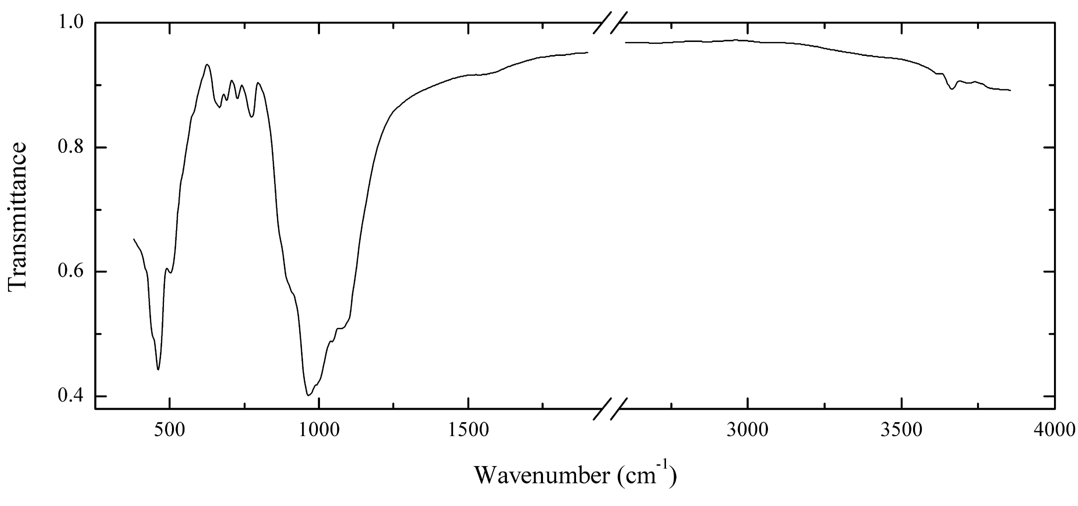


Locality: Rothenberg quarry, Eifel, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Red-brown crystal from the association with augite and phlogopite. The empirical formula is (electron microprobe) $Na_{0.76}K_{0.28}Ca_{1.97}(Mg_{3.40}Fe_{1.00}Ti_{0.56}Mn_{0.02}Al_{0.01})(Si_{5.95}Al_{2.05}O_{22})$ $[F_{0.1}(OH,O)_{0.9}]$.

Wavenumbers (cm^{-1}): 1053s, 980sh, 957s, 780, 700sh, 688, 630, 612w, 514, 463s, 388s.

Sib113 Parvo-ferriwinchite $\square(NaMn)[Mg_4Fe^{3+}](Si_8O_{22})(OH)_2$

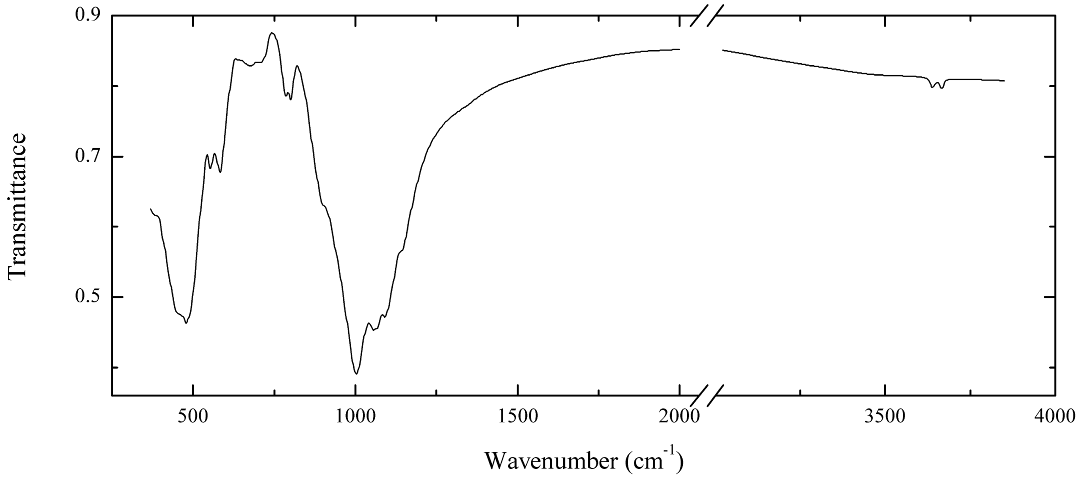


Locality: Tolovanu mine, Bistriţa Mts., Romania.

Description: Brownish-yellow grains from the association with rhodonite, nambulite an spessartite. The empirical formula is (electron microprobe) $(Na_{0.28}K_{0.10})(Na_{1.14}Mn_{0.45}Ca_{0.41})$ $(Mg_{3.51}Mn_{0.50}Fe_{0.85}Al_{0.14})(Si_{8.00}O_{22})(OH)_2$.

Wavenumbers (cm^{-1}): 3660w, 1078, 1047, 995sh, 964s, 910sh, 772, 724w, 690w, 667w, 650sh, 500, 460s, 440sh, 415sh.

Sib114 Fluoro-sodic-ferropedrizite $NaLi_2(Fe^{2+}{}_2Al_2Li)(Si_8O_{22})F_2$

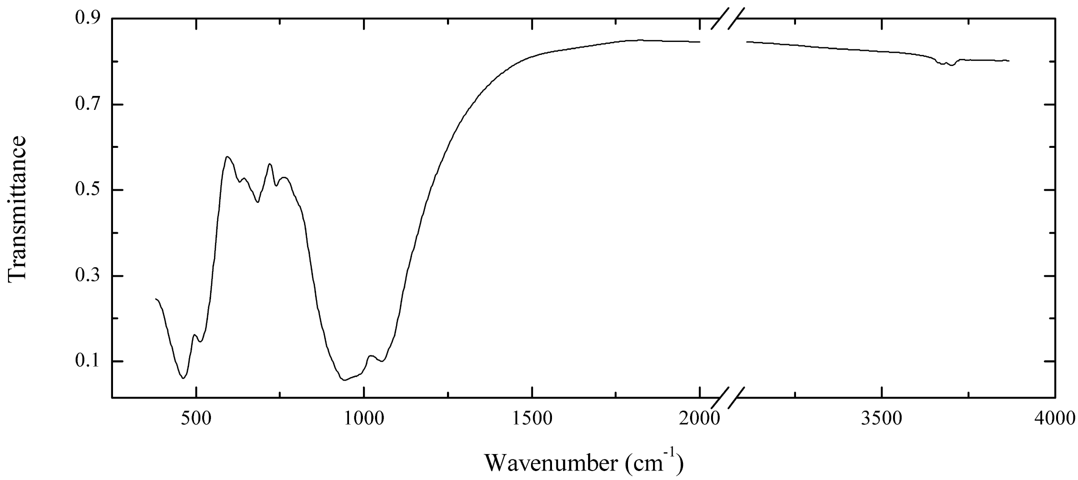


Locality: Tastyg, Sutlug River, Tuva Republic, Russia (type locality).

Description: Black crystals from the association with calcite. The empirical formula is (electron microprobe, Li calculated) $Na_{0.6}Li_{2.0}(Fe_{1.4}Mg_{1.15}Mn_{0.1}Al_{1.7}Li_{0.65})(Si_{7.7}Al_{0.3}O_{22})(F,OH)_2$.

Wavenumbers (cm^{-1}): 3631w, 3613w, 1145sh, 1094s, 1059s, 1002s, 905sh, 799, 787, 709w, 680w, 655sh, 581, 554, 482s, 465sh, 390sh.

Sib115 Oxo-magnesiohastingsite $NaCa_2(Mg_3Fe^{3+}Ti)(Si_6Al_2O_{22})O_2$

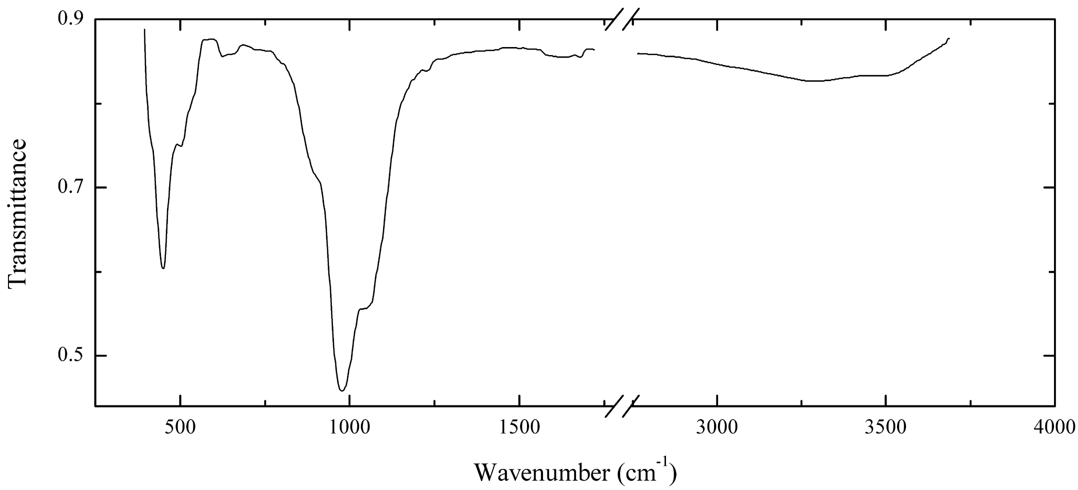


Locality: Deeti volcanic cone, Gregory rift, Tanzania (type locality).

Description: Brown megacryst from the association with diopside, phlogopite and magnetite. Holotype sample. Monoclinic, space group: *C*2/*m*, $a = 9.8837$, $b = 18.0662$, $c = 5.3107$ Å, $\beta = 105.278°$, $Z = 2$. $D_{meas} = 3.19$ g/cm^3, $D_{calc} = 3.219$ g/cm^3. Optically biaxial (−), $\alpha = 1.706$, $\beta = 1.715$, $\gamma = 1.720$. The empirical formula is $(Na_{0.67}K_{0.33})(Ca_{1.87}Na_{0.14}Mn_{0.01})(Mg_{3.27}Fe^{3+}{}_{1.25}Ti_{0.44}Al_{0.08})(Si_{6.20}Al_{1.80}O_{22})[O_{1.40}(OH)_{0.60}]$. The strongest lines of powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 3.383 (62) (131), 3.281 (30) (240), 2.708 (97) (151), 2.596 (75) (061), 2.555 (100) (-202), 2.162 (36) (261), 1.585 (39) (-153), 1.521 (48) (-263).

Wavenumbers (cm^{-1}): 3683w, 3655w, 1055s, 975sh, 940s, 740, 681, 670sh, 634, 508, 460s.

Sib116 Ershovite $Na_4K_3(Fe^{2+},Mn^{2+},Ti)_2[Si_8O_{20}(OH)_2](OH)_2 \cdot 4H_2O$

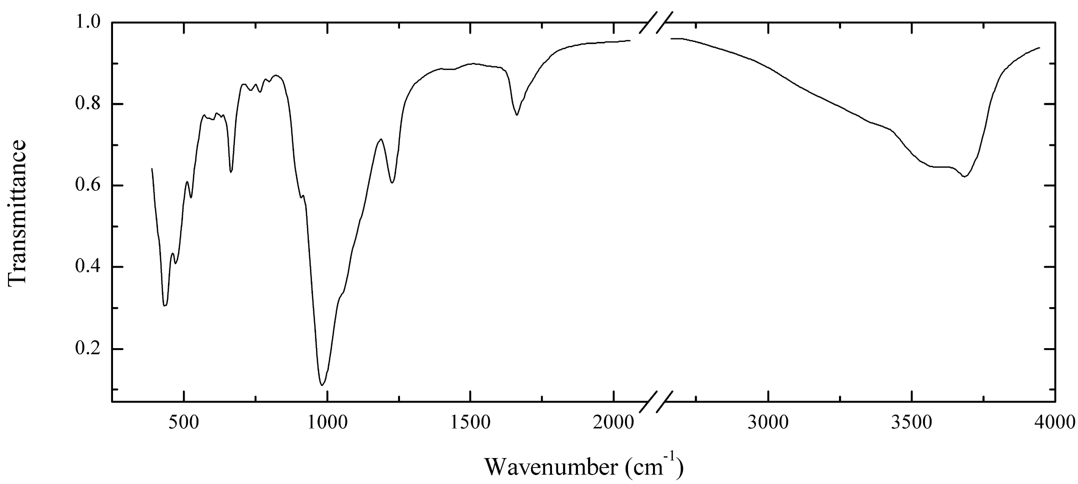


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown crystals from peralkaline pegmatite. Na- and K-deficient, partly oxidized variety. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3515w, 3300w, 1630w, 1053s, 981s, 905sh, 670sh, 628w, 530sh, 501, 446s, 400sh.

Sib117 Tobermorite $Ca_5[(Si,Al)_6(O,OH)_{17}] \cdot 5H_2O$

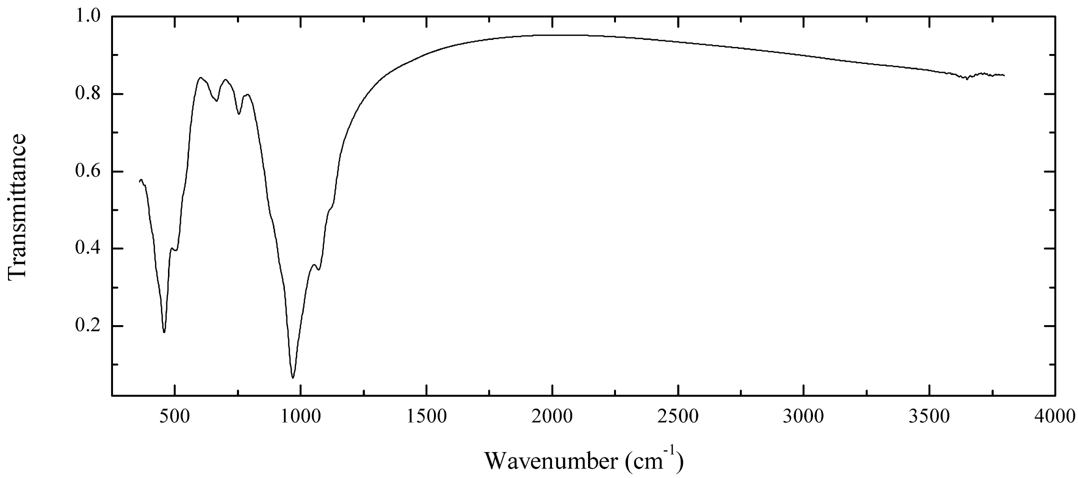


Locality: Okur-Tau, Kansai mining district, Uzbekistan.

Description: White fibrous aggregate from the association with apophyllite and calcite. Investigated by A.E. Zadov. Orthorhombic, a = 11.175, b = 7.377, c = 22.70 Å. Optically biaxial (+), α = 1.549, γ = 1.556. The chemical composition is (electron microprobe) K_2O 0.30, CaO 34.17, FeO 0.70, Al_2O_3 1.30, SiO_2 48.06 wt.%. The strongest lines of powder X-ray diffraction pattern are [d, Å (I, %)] 11.25 (40), 5.46 (40), 3.636 (50), 3.510 (50), 3.306 (90), 3.078 (100), 3.021 (80), 2.974 (100), 2.811 (90), 2.786 (80), 2.428 (60), 2.142 (70), 2.004 (80), 1.846 (100), 1.819 (90), 1.669 (60).

Wavenumbers (cm^{-1}): 3561, 3480, 3280sh, 3050sh, 1630, 1410w, 1210, 1050sh, 984s, 906, 798w, 762w, 730w, 665, 602w, 590sh, 524, 474, 439s, 405sh.

Sib118 Ferrinybøite $NaNa_2(Mg_3Fe^{3+}{}_2)(Si_7AlO_{22})(OH)_2$

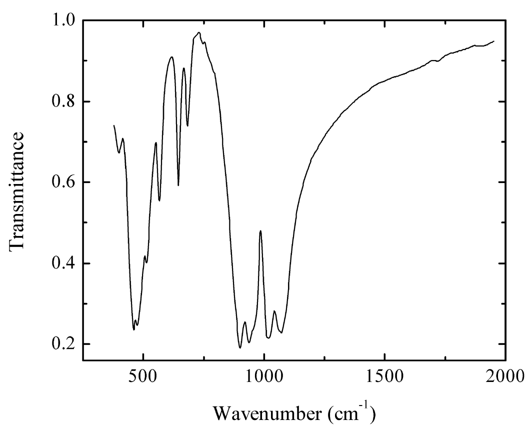


Locality: Vein No. 136, Vishnevye Mts., South Urals, Russia.

Description: Black prismatic crystals from the association with calcite. The empirical formula is $(Na_{0.74}K_{0.28})(Na_{1.53}Ca_{0.47})[(Mg_{2.60}Fe^{2+}{}_{0.71}Mn_{0.10})(Fe^{3+}{}_{1.49}Ti_{0.10})](Si_{6.88}Al_{1.12}O_{22})(OH,F)_2$.

Wavenumbers (cm^{-1}): 3650w, 1120sh, 1073s, 969s, 925sh, 885sh, 755, 667, 655sh, 540sh, 502, 457s.

Sic1 Wollastonite-1M ("parawollastonite") $CaSiO_3$

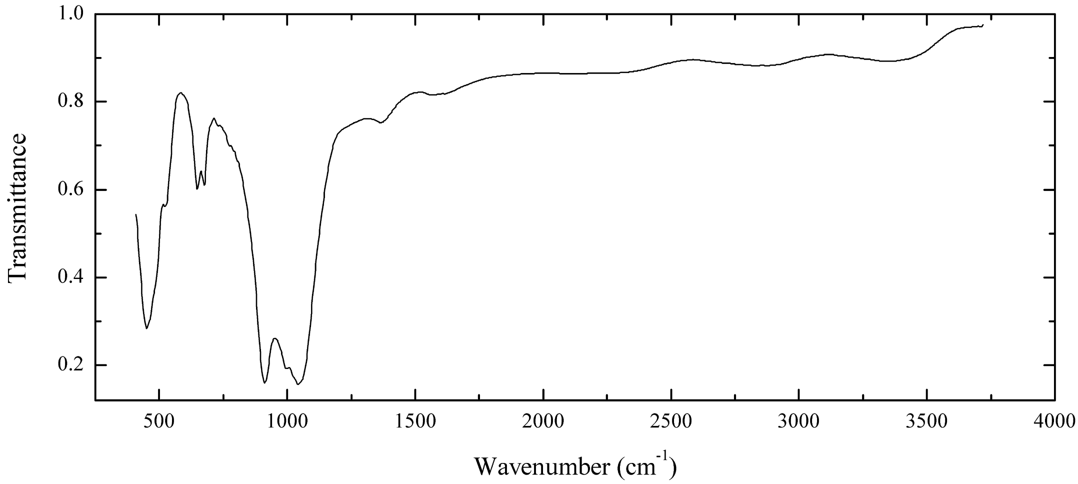


Locality: Product of heating (up to 800 °C) of suolunite from Ioko-Dovyren-layered massif, Siberia, Russia.

Description: White, massive. Investigated by A.E. Zadov.

Wavenumbers (cm^{-1}): 1075s, 1025s, 955sh, 938s, 902s, 681, 643, 564, 510, 471s, 455s, 401.

Sic2 Sérandite $HNaMn_2(Si_3O_9)$

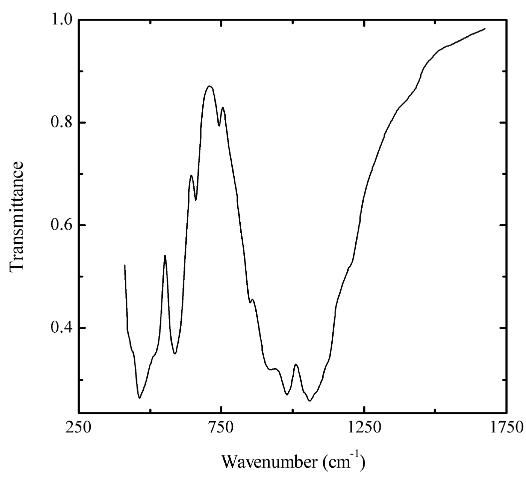


Locality: Palitra pegmatite, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown spherulites from the association with ussingite. The empirical formula is (electron microprobe) $HNa_{1.0}(Mn_{1.05}Ca_{0.9}Fe_{0.05})(Si_{3.0}O_9)$.

Wavenumbers (cm^{-1}): 3350, 2850w, 2300w, 1620w, 1560w, 1373, 1053s, 1003s, 915s, 676, 648, 521, 480sh, 448.

Sic3 Jadeite $NaAl(Si_2O_6)$

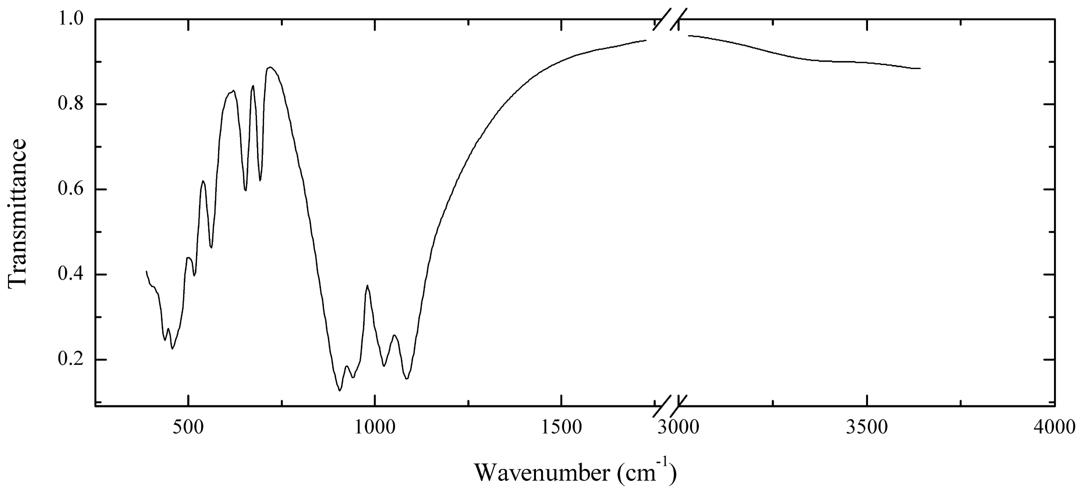


Locality: Andrelândia, Minas Gerais, Brazil.

Description: Grey massive. Identified by IR spectrum and qualitative electron microprobe analysis.

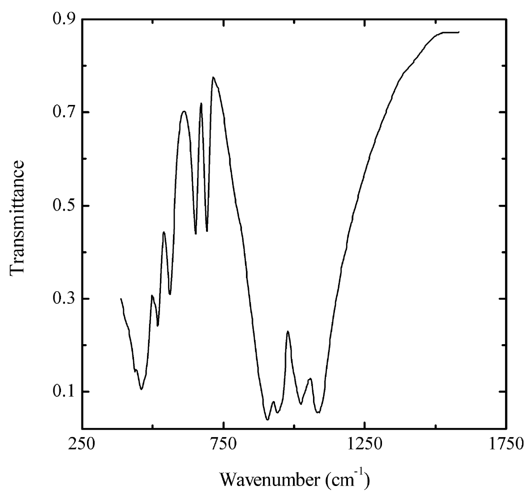
Wavenumbers (cm^{-1}): 1200sh, 1130sh, 1100sh, 1060s, 1055sh, 990s, 929s, 855, 747w, 663, 589, 520sh, 475sh, 460s, 435sh.

Sic4 Bustamite $Ca(Mn,Ca)(Si_2O_6)$



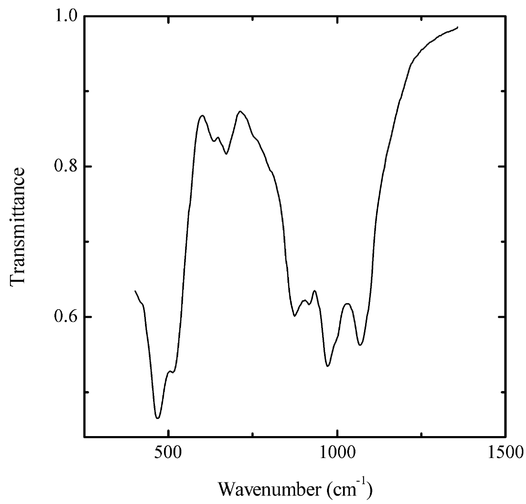
Locality: Trotters dump, Franklin, Franklin mining district, Sussex Co., New Jersey, USA.
Description: Pink fragment of single-crystal grain. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1087s, 1026s, 955sh, 946s, 909s, 696, 656, 563, 519, 475sh, 461s, 438, 420sh.

Sic5 Bustamite $Ca(Mn,Ca)(Si_2O_6)$



Locality: Broken Hill, New South Wales, Australia.
Description: Orange-brown crystal. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1088s, 1028s, 955sh, 947s, 910s, 697, 656, 563, 518, 461s, 441, 415sh.

Sic7 Augite $(Ca,Na)(Mg,Fe,Al,Ti)[(Si,Al)_2O_6]$

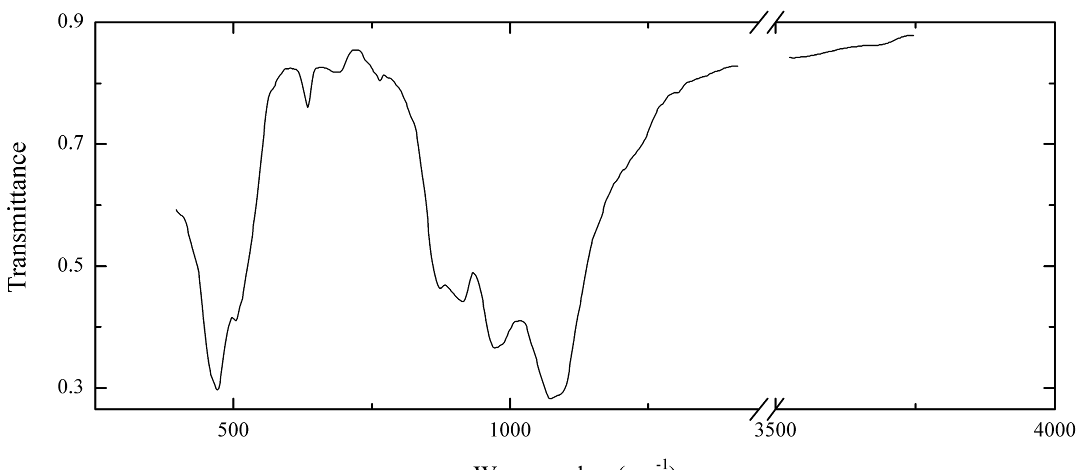


Locality: Nyiragongo volcano, Democratic Republic of Congo.

Description: Dark green crystal. Confirmed by IR spectrum. The charge-balanced empirical formula is (electron mictoprobe) $(Ca_{0.92}Mg_{0.79}Al_{0.13}Fe^{2+}{}_{0.08}Fe^{3+}{}_{0.04}Ti_{0.03}Ni_{0.01})(Si_{1.77}Al_{0.23}O_6)$.

Wavenumbers (cm^{-1}): 1069s, 995sh, 971s, 911, 875s, 670, 638, 504s, 465s, 410sh.

Sic8 Augite $(Ca,Na)(Mg,Fe,Al,Ti)[(Si,Al)_2O_6]$

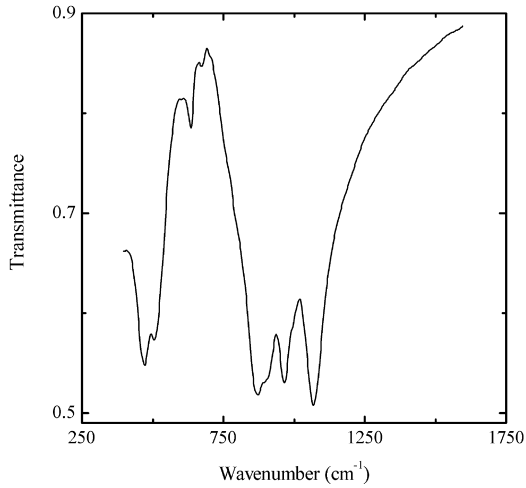


Locality: Bakhtinskoe-2 deposit, South Urals, Russia.

Description: Brown grains. Mn-rich variety. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1090sh, 1069s, 971s, 913, 877, 763w, 682w, 636, 501, 470s, 415sh.

Sic9 Augite (Ca,Na)(Mg,Fe,Al,Ti)[(Si,Al)$_2$O$_6$]

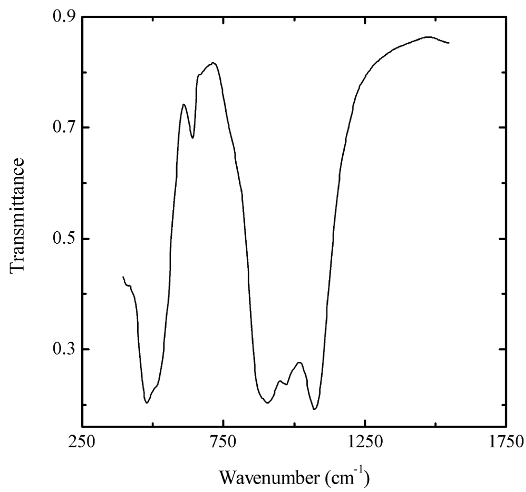


Locality: Tolbachik volcano, Kamchatka peninsula, Russia.

Description: Black crystal. Confirmed by IR spectrum. The empirical formula is (electron mictoprobe) $Ca_{0.71}Mg_{0.96}Fe_{0.27}Al_{0.05}Ti_{0.01})(Si_{1.93}Al_{0.07}O_6)$.

Wavenumbers (cm^{-1}): 1069s, 995sh, 971s, 911, 875s, 670, 638, 504s, 465s, 410sh.

Sic10 Augite (Ca,Na)(Mg,Fe,Al,Ti)[(Si,Al)$_2$O$_6$]

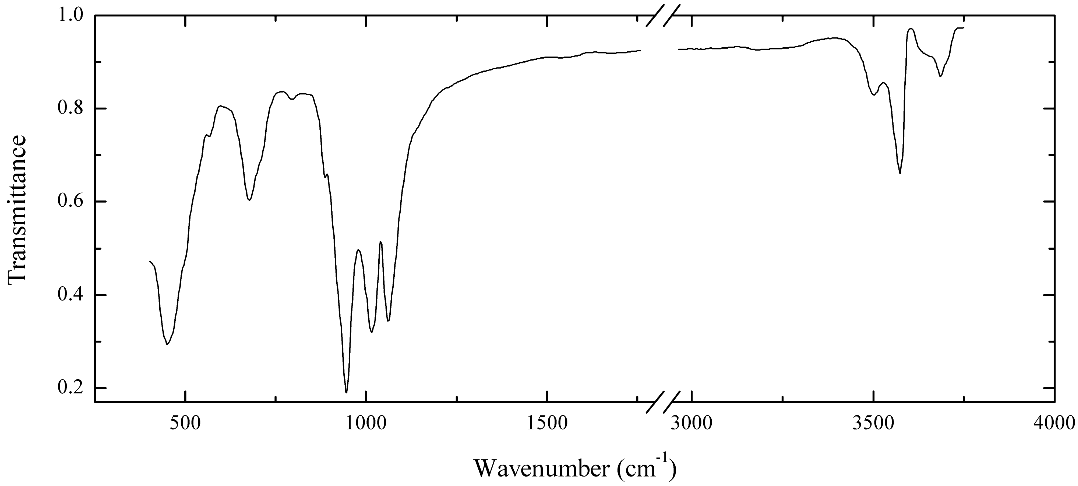


Locality: Central Mongolia.

Description: Black crystal from basalt. Confirmed by IR spectrum. The empirical formula is $(Ca_{0.68}Na_{0.14})(Mg_{0.68}Fe^{2+}{}_{0.21}Fe^{3+}{}_{0.06}Ti_{0.04}Al_{0.19})(Si_{1.80}Al_{0.20}O_6)$.

Wavenumbers (cm^{-1}): 1071s, 972s, 909s, 890sh, 638, 500sh, 477s, 410sh.

Sic11 Balangeroite $(Mg,Fe^{3+},Fe^{2+},Mn^{2+})_{21}Si_8O_{27}(OH)_{20}$

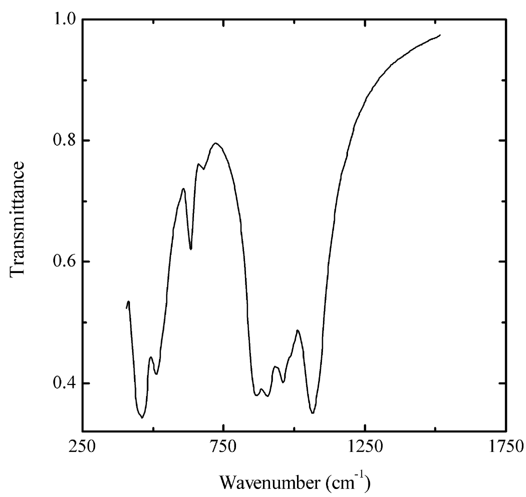


Locality: Poggio San Vittore asbestos mine, Balangero, Lanzo valley, Lanzo massif, Torino province, Piedmont, Italy (type locality).

Description: Brown fibrous aggregate from the association with chrysotile. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3685, 3650sh, 3572, 3500, 1064s, 1018s, 948s, 898, 797w, 710sh, 678, 567w, 495sh, 447s.

Sic12 Hedenbergite $CaFe^{2+}(Si_2O_6)$

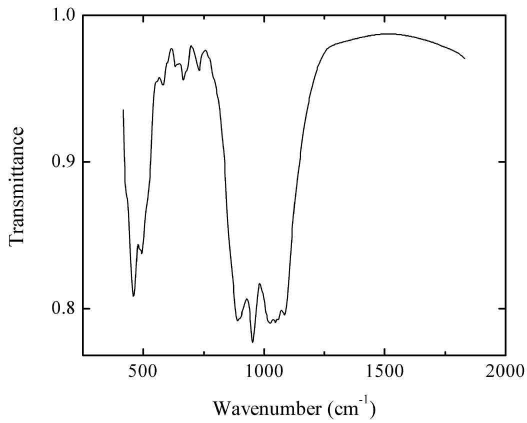


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Black crystal. Confirmed by IR spectrum. Na-bearing variety. The empirical formula is (electron microprobe) $(Na_{0.09}Ca_{0.88}Fe_{0.57}Mg_{0.44}Al_{0.02})(Si_{1.98}Al_{0.02}O_6)$.

Wavenumbers (cm^{-1}): 1066s, 995sh, 966s, 908s, 873s, 679w, 633, 511s, 464s.

Sic13 Pyroxferroite $Ca(Fe^{2+},Mn)_6(Si_7O_{21})$

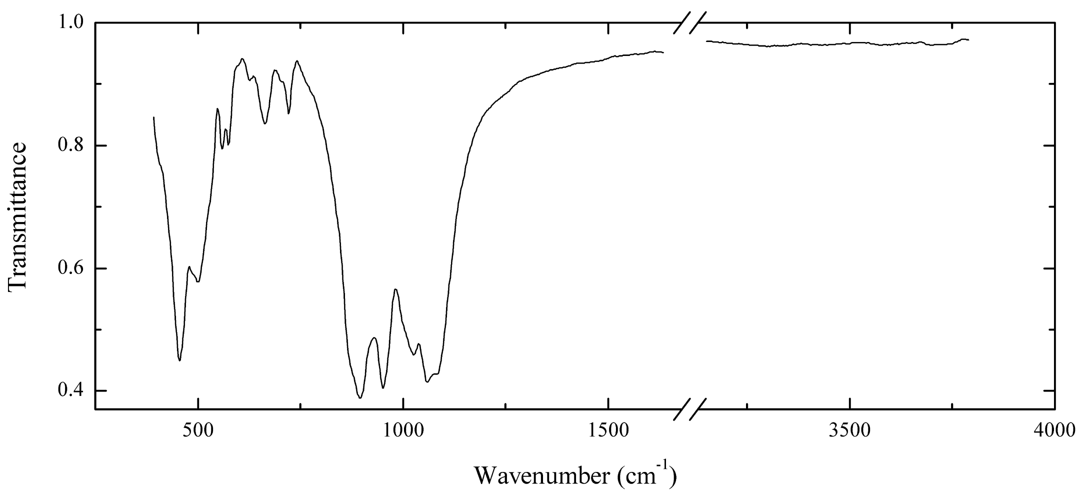


Locality: Bellerberg, near Ettringen, Eifel, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Dark brown prismatic crystal. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1072s, 1052s, 1024s, 954s, 900s, 734, 683w, 667, 640w, 573, 525sh, 497, 463s, 420sh.

Sic14 Rhodonite $CaMn_4(Si_5O_{15})$

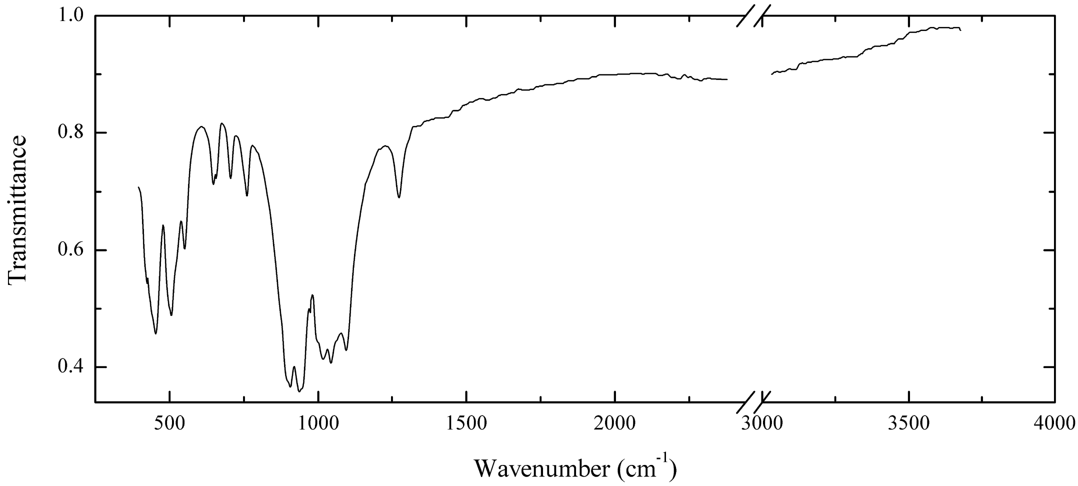


Locality: Enyuvche (Enyovche), Nedelino ore field, Rhodope Mts., Plovdiv region, Bulgaria.

Description: Rose granular aggregate from the association with johannsenite and rhodochrosite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1080s, 1058s, 1026s, 1000sh, 949s, 897s, 875sh, 785sh, 721, 705shw, 663, 629w, 574, 557, 520sh, 498, 490sh, 451s, 403sh.

Sic15 Babingtonite $HCa_2Fe^{2+}Fe^{3+}(Si_5O_{15})$

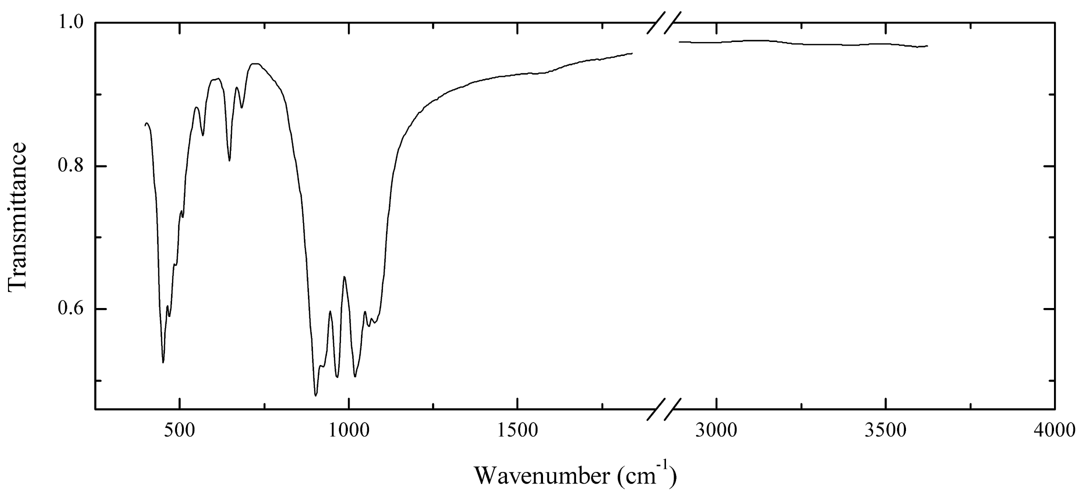


Locality: Grönsjöberget, Borlänge, Dalarna, Sweden.

Description: Black crystals with grey-green streak. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $HCa_{2.02}(Fe_{1.54}Mg_{0.28}Mn_{0.14})(Si_{4.98}Al_{0.02}O_{15})$.

Wavenumbers (cm^{-1}): 1271, 1096s, 1043s, 1018s, 994, 976, 950s, 937s, 909s, 896s, 875sh, 762, 706, 657w, 645, 551, 520sh, 507, 454s, 440sh, 424.

Sic16 Wollastonite $CaSiO_3$

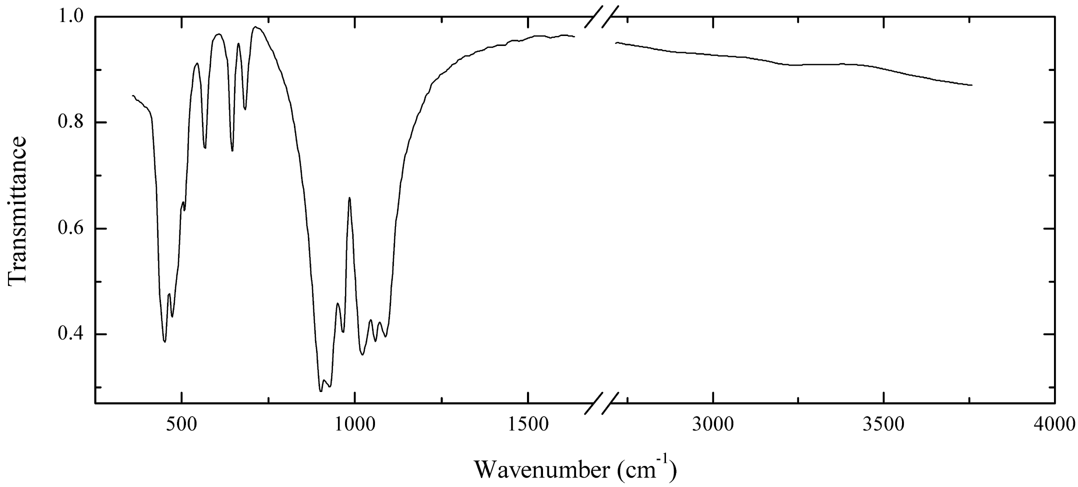


Locality: Kala-i Asad Zn–Pb–Cd deposit, Khakrez district, Kandagar (Kandahar) province, Afghanistan.

Description: White single-crystal grain with perfect cleavage from the association with rustumite, tilleyite, spurrite, hillebrandite, plombierite and calcite. Identified by IR spectrum.

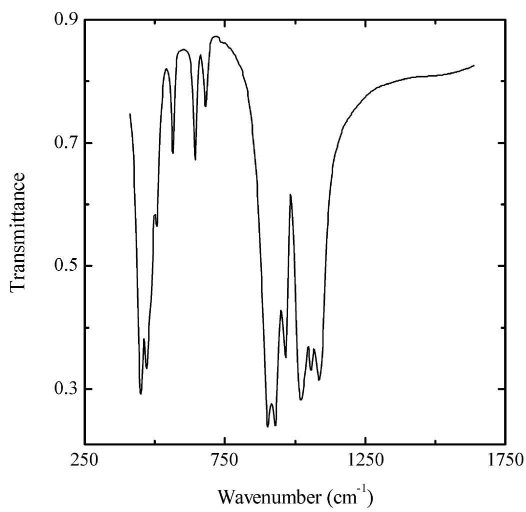
Wavenumbers (cm^{-1}): 1078s, 1058s, 1030sh, 1017s, 966s, 928s, 903s, 681w, 644, 567, 507, 487, 469s, 451s.

Sic17 Wollastonite $CaSiO_3$



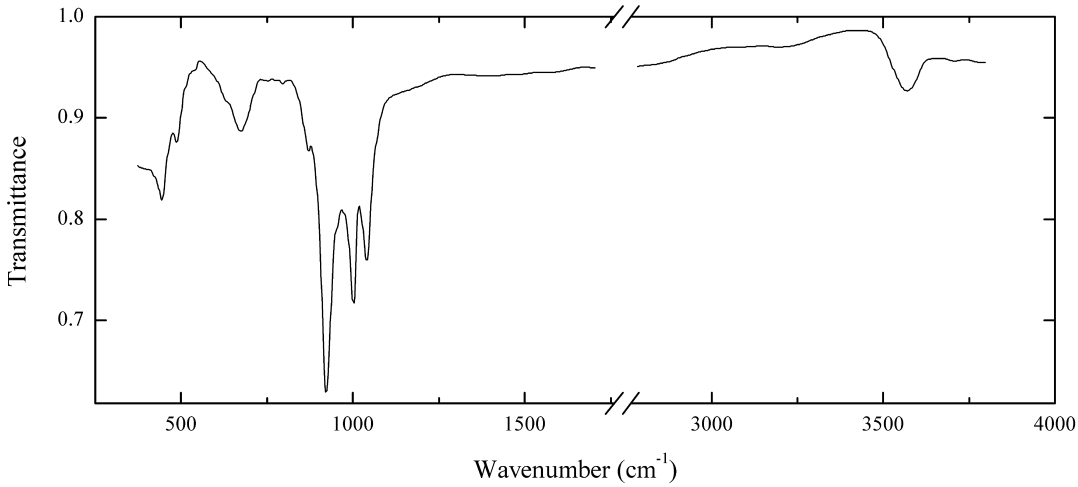
Locality: Near Akchatau, Karagandy region, Kazakhstan.
Description: White columnar aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1092s, 1060s, 1040sh, 1021s. 967s, 928, 920sh, 902s, 679, 642, 564, 505, 480sh, 468s, 449s.

Sic18 Wollastonite $CaSiO_3$



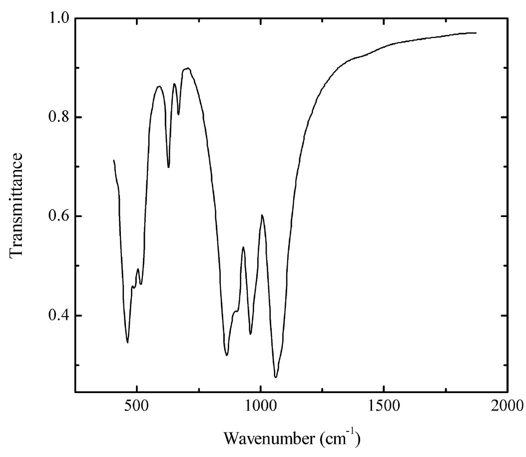
Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.
Description: White fibrous aggregate from rodingite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1088s, 1060s, 1035sh, 1027s, 1020sh, 968s, 931s, 917s, 904s, 681, 645, 565, 506, 485sh, 471s, 453s.

Sic20 Gageite $(Mn^{2+},Mg,Fe^{2+},Zn)_{21}Si_8O_{27}(OH)_{20}$



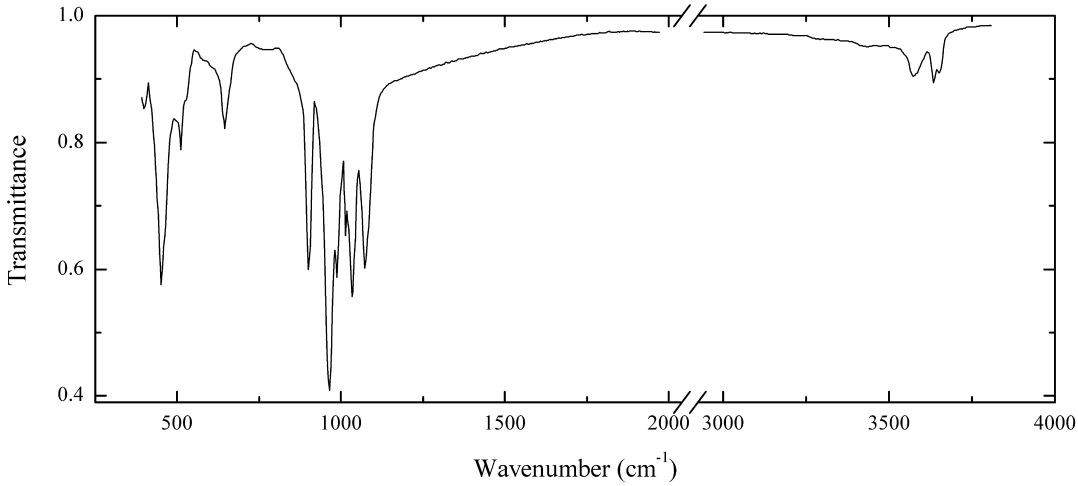
Locality: N'Chwaning mine, Kalahari manganese fields, South Africa.
Description: Brown fibrous aggregate from the association with bementite and andradite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3540, 1034, 997s, 916s, 868, 670, 484, 440.

Sic21 Hedenbergite $CaFe^{2+}(Si_2O_6)$



Locality: Horado mine, Seki city, Gifu prefecture, Chubu region, Honshu island, Japan.
Description: Black crystal. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.99}Fe_{0.90}Mn_{0.06}Mg_{0.04}Zn_{0.01})(Si_{2.00}O_6)$.
Wavenumbers (cm^{-1}): 1080sh, 1064s, 961s, 909, 863s, 670, 629, 515, 490, 461s, 415sh.

Sic22 Hillebrandite $Ca_2(SiO_3)(OH)_2$

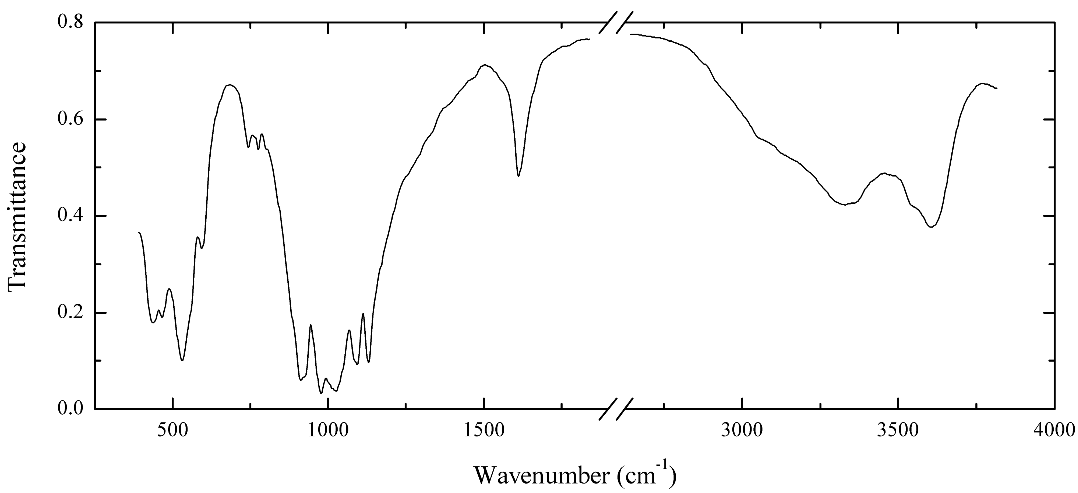


Locality: Kala-i Asad Zn–Pb–Cd deposit, Khakrez district, Kandagar (Kandahar) province, Afghanistan.

Description: Greenish veinlet from the association with rustumite, tilleyite, spurrite, wollastonite, plombierite and calcite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3630, 3615, 3550, 1073s, 1036s, 1016, 987s, 964s, 902s, 642, 525sh, 510, 453s, 405w.

Sic23 Stokesite $CaSn(Si_3O_9){\cdot}2H_2O$

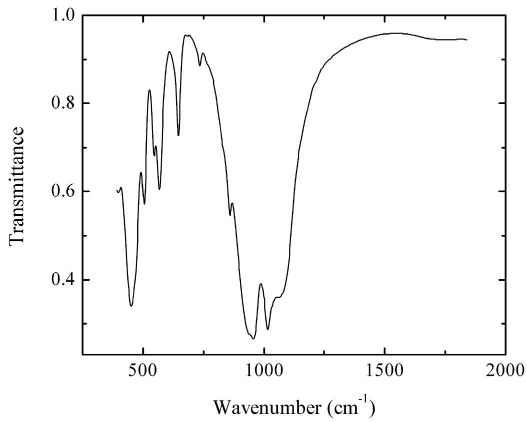


Locality: Urucum mine, Galiléia, Doce valley, Minas Gerais, Brazil.

Description: Spherical aggregate of rose lenticular crystals from the association with a Sn-bearing microlite-group mineral. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3595, 3540sh, 3320, 3100sh, 1615, 1128s, 1089s, 1024s, 974s, 925sh, 910s, 772, 739, 593, 550sh, 528s, 464, 435.

Sic24 Aegirine $NaFe^{3+}(Si_2O_6)$

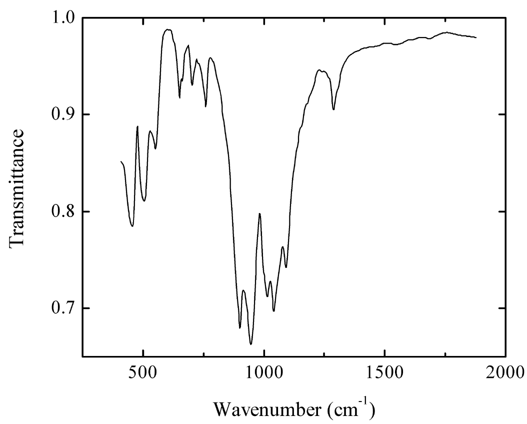


Locality: Malyi Murun (Malomurunskiy) massif, Aldan shield, Eastern Siberia, Russia.

Description: Radial aggregate of black long-prismatic crystals from the association with charoite, microcline and tinaksite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1073s, 1018s, 959s, 935sh, 860, 735w, 645, 565, 544, 504, 453s, 393.

Sic25 Scandiobabingtonite $HCa_2Fe^{2+}Sc(Si_5O_{15})$

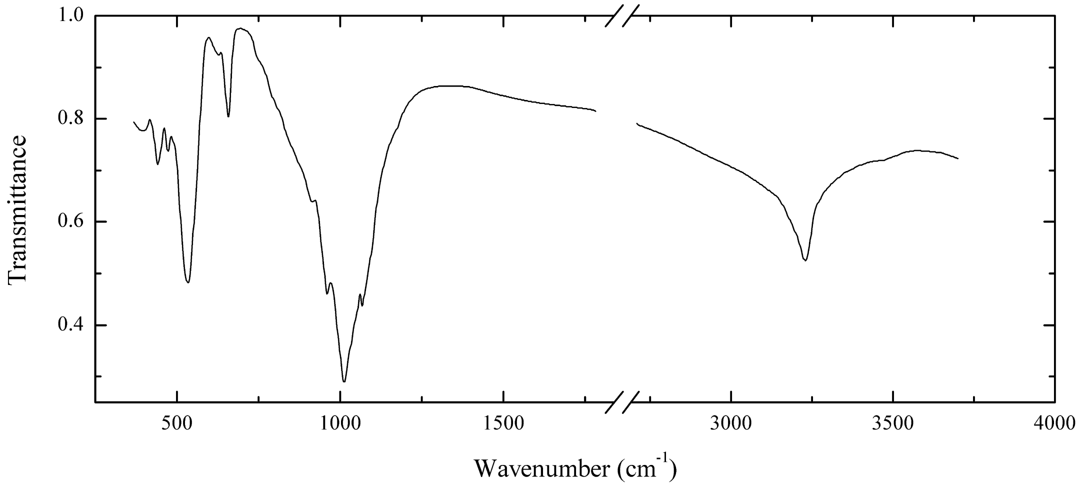


Locality: Heftet Jern, Tørdal, Telemark, Norway.

Description: Brownish-yellow crystals from the association with cascandite, microcline, quartz, biotite and fluorite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1292, 1094, 1040s, 1015s, 1000sh, 947s, 901s, 756, 701, 658w, 648, 550, 505, 455.

Sic26 Shattuckite $Cu_5(Si_2O_6)_2(OH)_2$

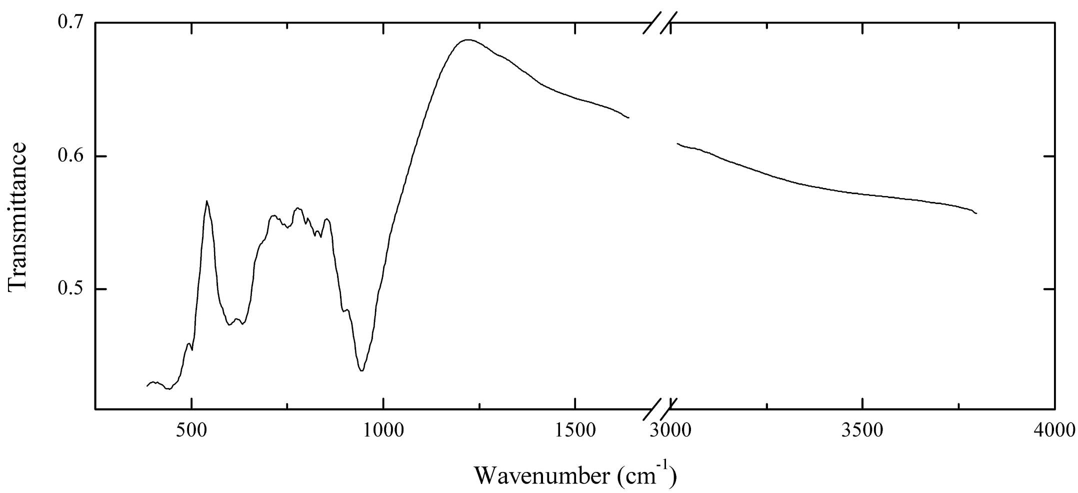


Locality: Mesopotamia Copper Valley, Khorixas district, Kunene region, Namibia.

Description: Blue radial fibrous aggregates from the association with cuprite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3209, 1610w, 1095sh, 1074s, 1040sh, 1015s, 960s, 921, 760sh, 658, 628w, 535s, 475, 441, 403.

Sic27 "Malakhovite" $Ca(Fe^{3+},Mg)_3(Fe^{3+},Si,Al)_3O_{10}$

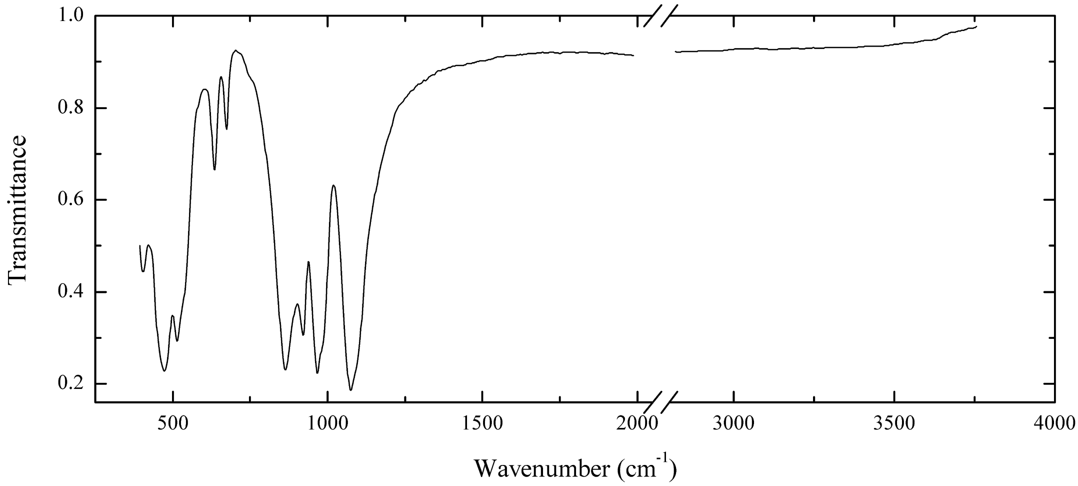


Locality: Burned dump of the Korkinskiy quarry, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Black tabular crystals from the association with melilite, pyroxene, amphibole, wollastonite, anorthite and calcium ferrites. Technogenetic. Investigated by B.V. Chesnokov. Not approved by the IMA CNMNC. Related to aenigmatite-group minerals. Triclinic, $a = 10.58(3)$, $b = 10.90(3)$, $c = 9.10(4)$ Å, $\alpha = 107.08(2)°$, $\beta = 95.02(2)°$, $\gamma = 124.45(2)°$. The empirical formula is $Ca_{1.16}Fe^{3+}_{4.16}Mg_{0.32}Ti_{0.02}Al_{0.64}Si_{0.65}O_{10}$. $D_{calc} = 4.09$ g/cm^3. Strong lines of powder

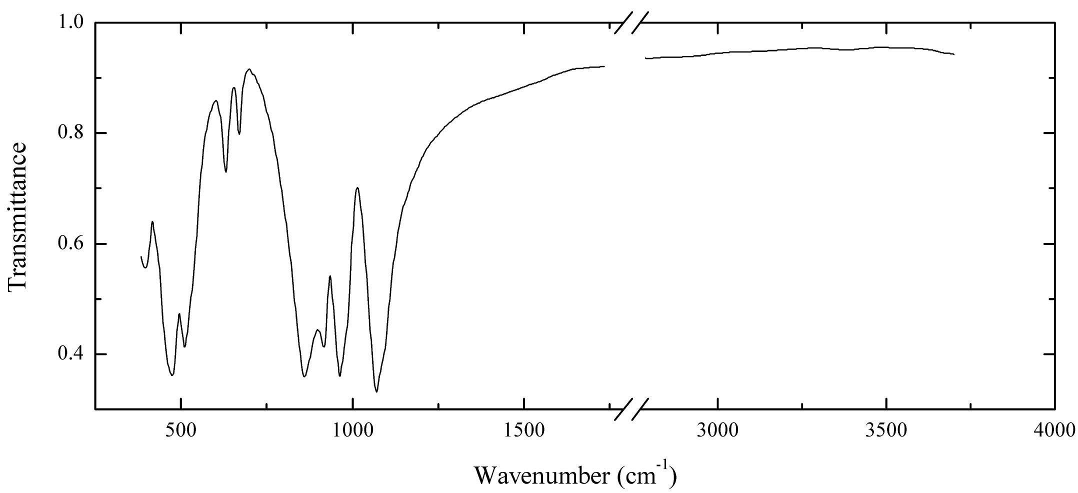
X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.993 (70), 2.721 (80), 2.587 (100), 2.526 (90), 2.473 (40), 2.132 (55), 1.626 (52), 1.517 (70), 1.506 (50).
Wavenumbers (cm^{-1}): 953s, 902s, 838, 824, 801, 750, 690sh, 640s, 596s, 500s, 463s.

Sic28 Diopside $CaMg(Si_2O_6)$



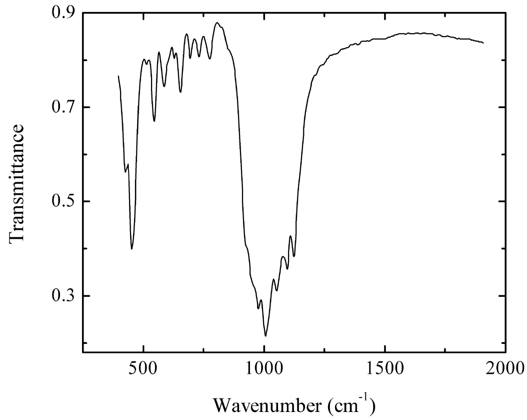
Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Yellow-green prismatic crystals from the association with phlogopite and calcite. The empirical formula is (electron microprobe) $Ca_{1.02}Mg_{0.92}Fe_{0.05}(Si_{2.00}O_6)$.
Wavenumbers (cm^{-1}): 1090sh, 1073s, 980sh, 966s, 921, 864s, 672, 635, 535sh, 512, 470s, 390.

Sic29 Diopside $CaMg(Si_2O_6)$



Locality: Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia.
Description: Light green veinlet in sakhaite-kurchatovite boron ore. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1090sh, 1072s, 975sh, 965s, 919, 864s, 671, 631, 535sh, 511, 471s, 395.

Sic30 Denisovite $(Ca,Na)Ca_2Si_3O_8(F,OH)$ (?)

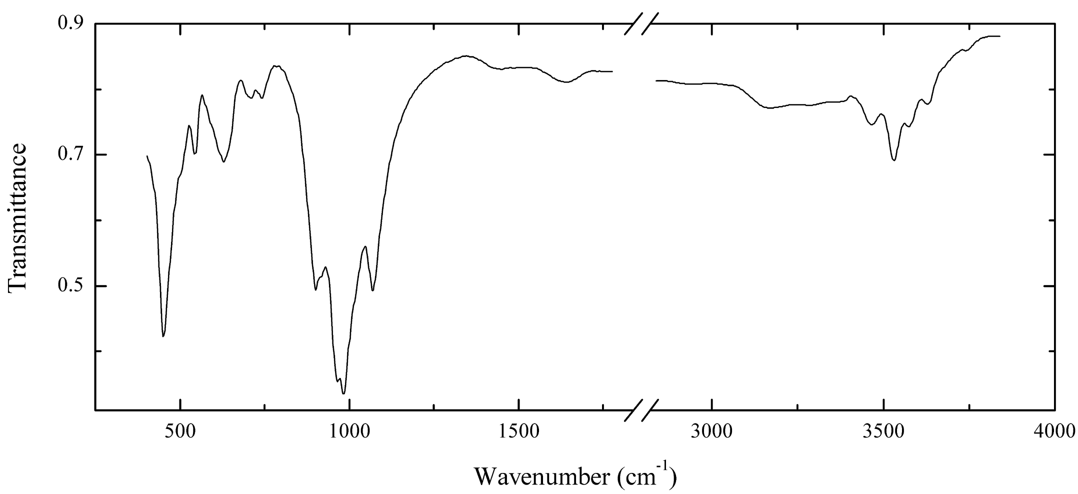


Locality: Eveslogchorr Mt., the valley of the Third tributary of the Vuonnemiok River, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Grey fibrous aggregate from the association with nepheline, potassic feldspar, aegirine, fluorite, apatite, biotite and yuksporite. Holotype sample. Monoclinic, $a = 30.92(7)$, $b = 7.20(3)$, $c = 18.27(5)$ Å, $\beta \approx 95°$. $D_{meas} = 2.76$ g/cm^3, $D_{calc} = 2.81$ g/cm^3. Optically biaxial (+), $\alpha = 1.567(2)$, $\beta = 1.568(2)$, $\gamma = 1.576(2)$. The empirical formula is $(K_{0.68}Na_{0.32})(Ca_{1.95}Mn_{0.04}Sr_{0.01})Si_{3.00}O_8[F_{0.54}(OH)_x]$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 3.65 (80), 3.32 (100), 3.24 (90), 3.03 (90), 3.08 (80), 2.79 (80), 2.75 (100).

Wavenumbers (cm^{-1}): 1123s, 1095s, 1053s, 1003s, 975s, 960sh, 945sh, 923, 850sh, 790sh, 771, 729, 692, 650, 624w, 605sh, 582, 542, 511w, 449s, 422.

Sic31 Jennite $Ca_9(Si_6O_{18})(OH)_6{\cdot}8H_2O$

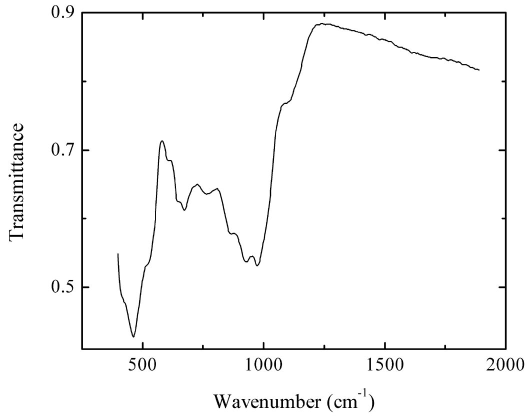


Locality: Ioko-Dovyren-layered massif, Siberia, Russia.

Description: White microfibrous aggregate from the association with calcite. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3635, 3585, 3535, 3473, 3180, 1640, 1440w, 1074s, 985s, 966s, 902s, 741w, 717w, 630, 543, 500sh, 448s.

Sic32 Dorrite $Ca_2Mg_2Fe^{3+}{}_4Al_4Si_2O_{20}$

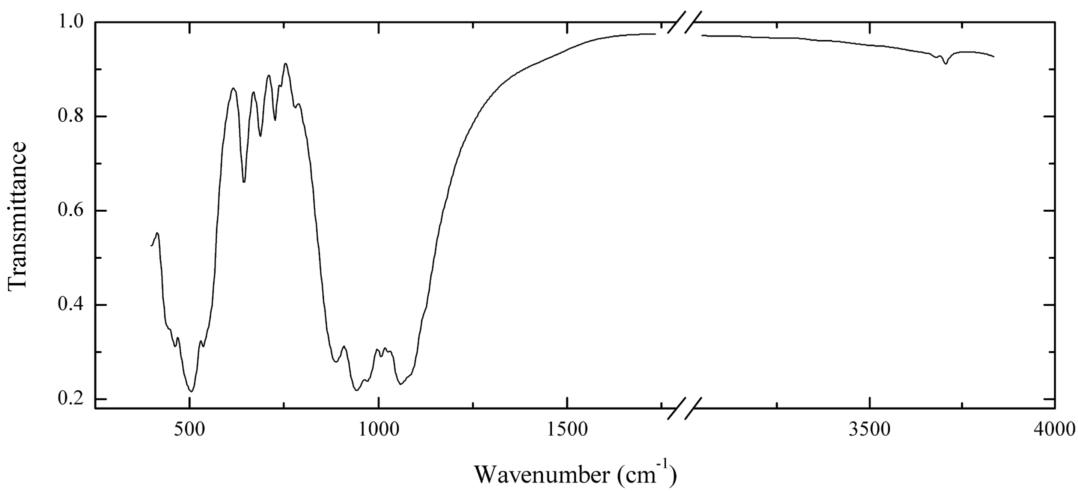


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Dark brownish-red tabular crystals from the association with melilite, pyroxene, amphiboles and fluorphlogopite. Investigated by B.V. Chesnokov. Triclinic, $a = 10.487(3)$, $b = 10.784(9)$, $c = 8.962(5)$ Å, $\alpha = 106.05°$, $\beta = 94.49°$, $\gamma = 124.59°$. The empirical formula is $Ca_{2.09}Fe_{3.31}Mg_{2.52}Ti_{0.08}Mn_{0.05}(Al_{3.26}Si_{2.44}Fe_{0.30})O_{20}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.137 (32), 2.940 (65), 2.690 (64), 2.550 (100), 2.103 (60), 1.940 (56), 1.494 (63).

Wavenumbers (cm^{-1}): 1090sh, 975s, 926s, 866, 760, 671, 640sh, 550w, 515sh, 460s, 420sh.

Sic33 Donpeacorite $(Mn^{2+},Mg)Mg(Si_2O_6)$

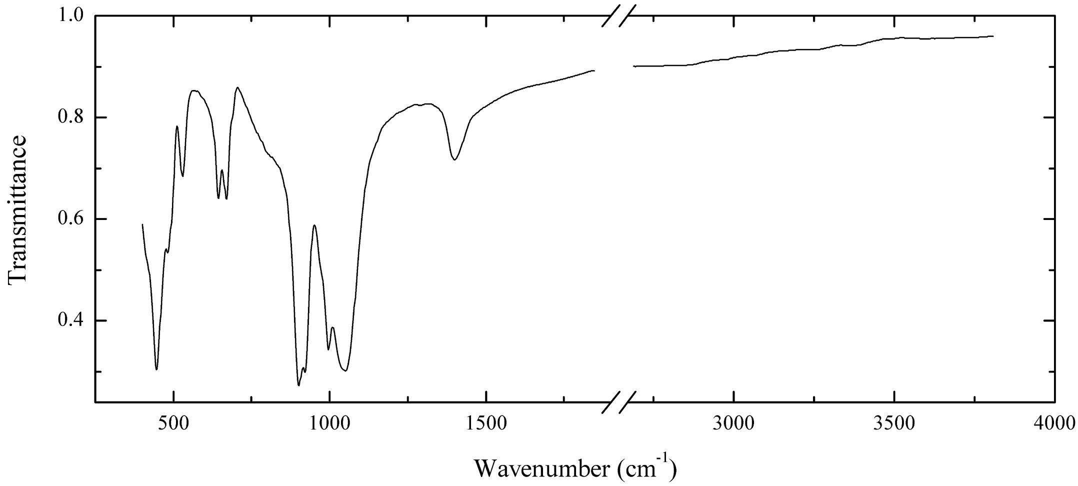


Locality: Balmat No. 4 mine, Balmat, St. Lawrence Co., New York, USA.

Description: Orange-yellow coarse-grained aggregate from the association with manganocummingtonite. Confirmed by IR spectrum. Very weak bands at 3,665 and 3,645 cm^{-1} correspond to O–H stretching vibrations of hydroxyl groups present as structural defects or inclusions of manganocummingtonite.

Wavenumbers (cm^{-1}): 3665w, 3645w, 1075sh, 1052s, 1023, 1002, 967s, 938s, 885, 773w, 737w, 721, 682, 638, 550sh, 540sh, 528, 497s, 455, 435sh.

Sic35 Pectolite $HNaCa_2(Si_3O_9)$

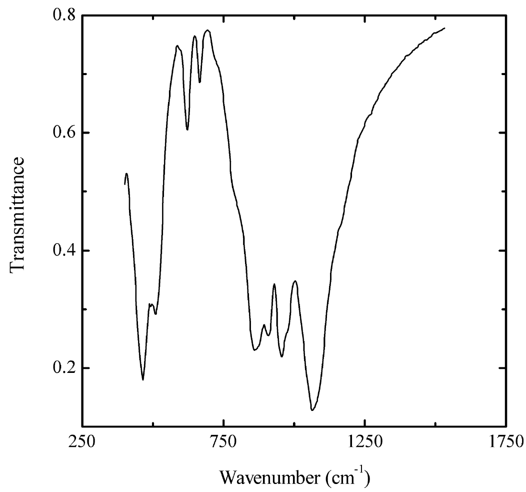


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White radial fibrous aggregates from the association with natrolite and cancrinite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1397, 1049s, 996s, 975sh, 926s, 904s, 820sh, 687w, 669, 642, 527, 500sh, 485, 444s, 410sh.

Sic36 Johannsenite $CaMn(Si_2O_6)$

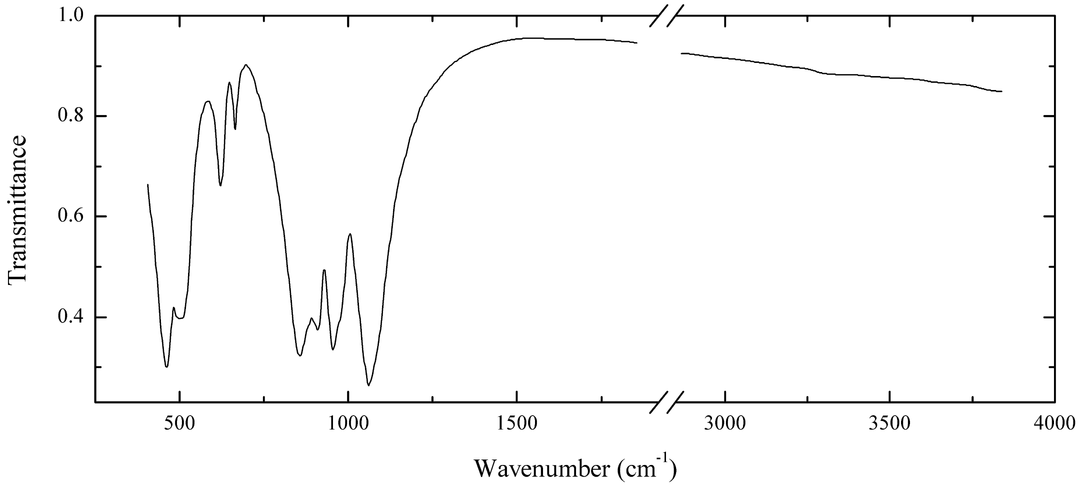


Locality: Konski Dol mine, Madan ore field, Bulgaria.

Description: Brown columnar aggregate from the association with rhodonite, pyrite and calcite. The empirical formula is (electron microprobe) $Ca_{0.9}Mn_{0.8}Fe_{0.2}Mg_{0.1}(Si_{2.00}O_6)$.

Wavenumbers (cm^{-1}): 1066s, 975sh, 954s, 910, 875sh, 860s, 790sh, 665, 618, 506, 461s.

Sic37 Johannsenite $CaMn(Si_2O_6)$

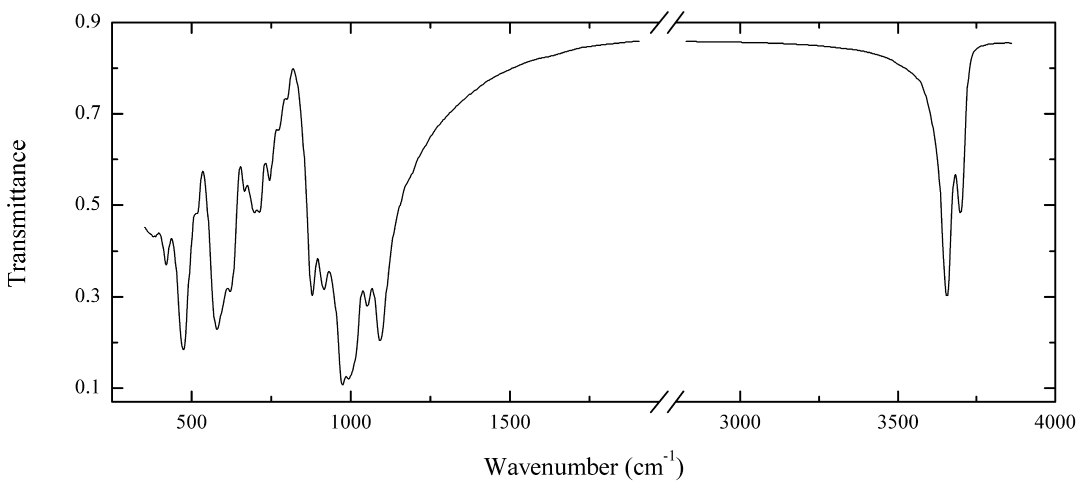


Locality: Dalnegorsk, Primorskiy Kray, Russia.

Description: Dark green split crystal from the association with manganogrunerite and calcite. The empirical formula is (electron microprobe) $Ca_{1.00}(Mn_{0.64}Fe_{0.36})(Si_{2.00}O_6)$.

Wavenumbers (cm^{-1}): 1063s, 975sh, 955s, 912, 857s, 665, 621, 507, 489, 458s.

Sic38 Carpholite $Mn^{2+}Al_2(Si_2O_6)(OH)_4$

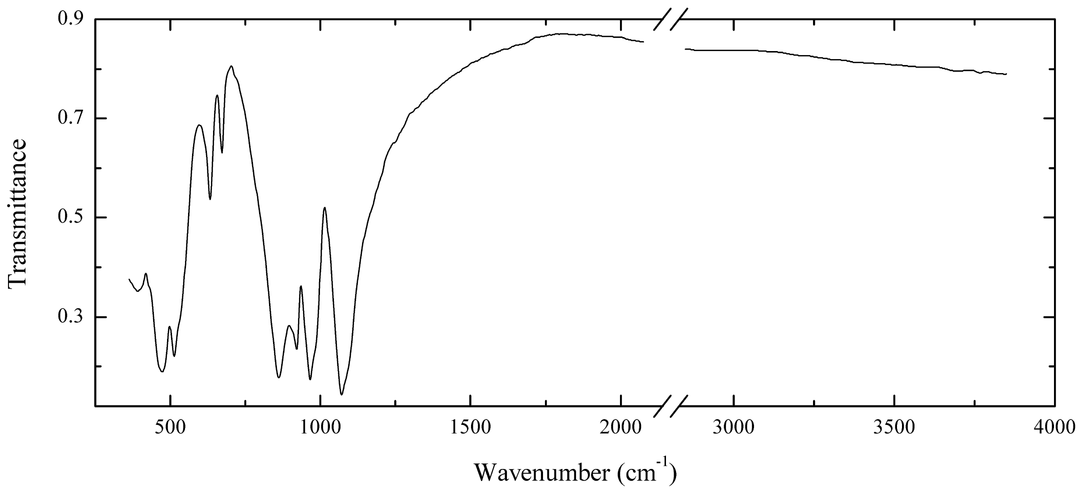


Locality: Biesenrode, Wippra metamorphic zone, Harz, Saxony-Anhalt, Germany.

Description: Grey-green fibrous aggregate. Fe- and Mg-rich variety. The empirical formula is (electron microprobe) $(Mn_{0.67}Fe_{0.18}Mg_{0.15})(Al_{1.83}Fe_{0.14})(Si_{2.00}O_6)(OH)_4$.

Wavenumbers (cm^{-1}): 3630, 3590, 1084s, 1045, 995sh, 987s, 967s, 910, 872, 795w, 766w, 741, 706, 693, 662w, 615, 575s, 513, 471s, 418, 385.

Sic39 Diopside $CaMg(Si_2O_6)$

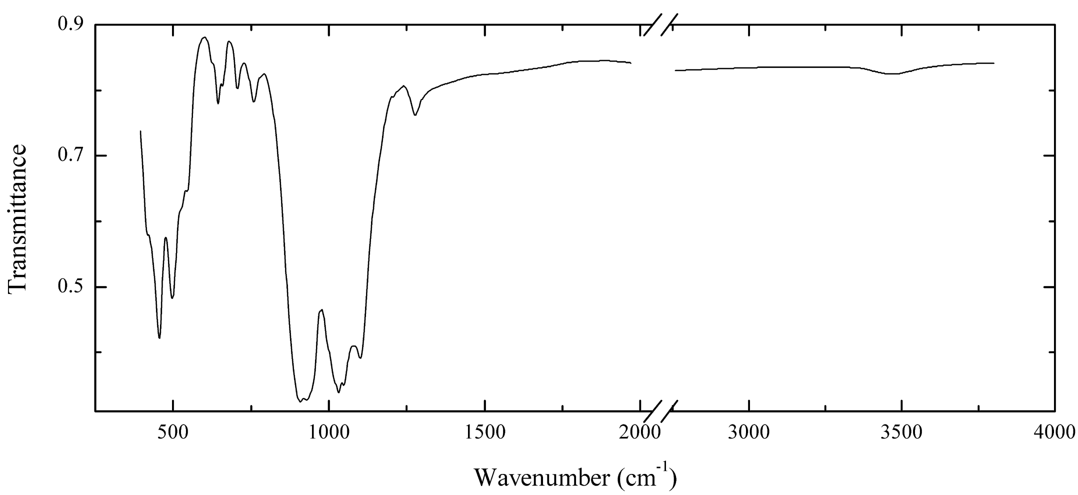


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White prismatic crystals from the association with richterite. The empirical formula is (electron microprobe) $Ca_{1.01}Mg_{0.96}Fe_{0.02}(Si_{2.00}O_6)$.

Wavenumbers (cm^{-1}): 1090sh, 1074s, 980sh, 967s, 922, 864s, 672, 634, 535sh, 512, 472s, 390.

Sic40 Manganbabingtonite $HCa_2Mn^{2+}Fe^{3+}(Si_5O_{15})$

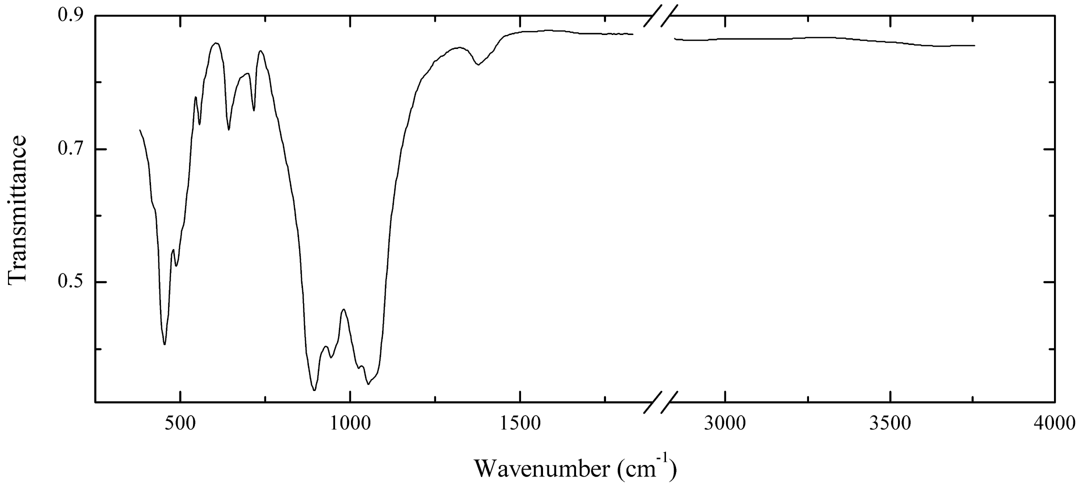


Locality: Kyzyl-Tash Mn deposit, South Urals, Russia.

Description: Pleochroic (dark red-brown to green) crystals with green streak from the association with rhodonite, andradite and hematite. Investigated by E.V. Starikova and A.I. Brusnitsyn. Triclinic, $a = 7.527(5)$, $b = 12.163(7)$, $c = 6.706(5)$ Å, $\alpha = 86.06(1)°$, $\beta = 94.08(1)°$, $\gamma = 111.67(2)°$.The empirical formula is (electron microprobe) $H(Ca_{1.58}Mn_{0.42})Mn_{1.00}(Fe^{3+}{}_{0.87}Mn^{3+}{}_{0.13})(Si_{5.00}O_{15})$. Optically biaxial (+), $\alpha = 1.720(2)$, $\beta = 1.730(2)$, $\gamma = 1.742(2)$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 6.99 (50), 6.68 (57), 3.492 (65), 3.132 (75), 3.035 (93), 2.966 (100).

Wavenumbers (cm^{-1}): 3470w, 1275, 1101s, 1074s, 1047s, 1030s, 929s, 910s, 762, 705, 658w, 642, 624w, 545, 525sh, 497, 455s, 418.

Sic41 Marsturite $HNaCaMn^{2+}{}_3(Si_5O_{15})$

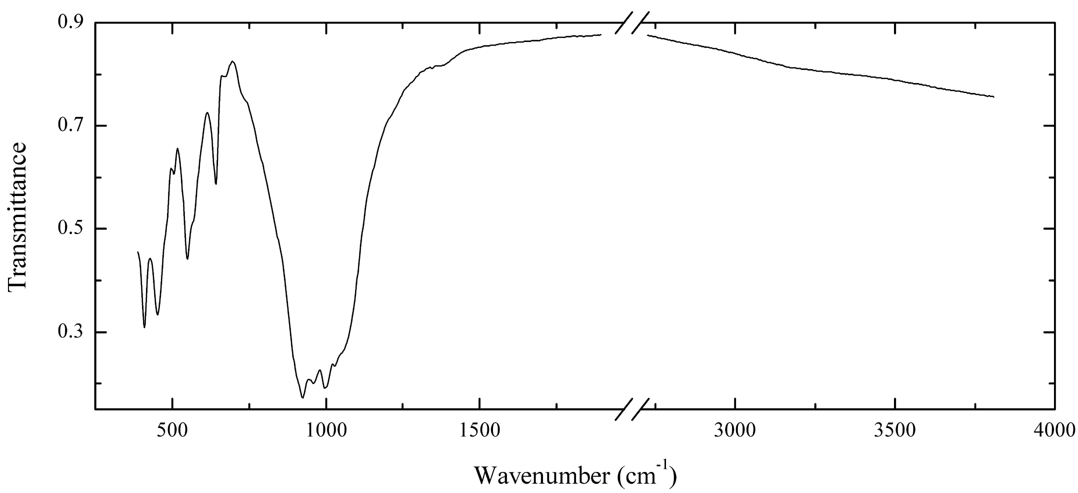


Locality: Molinello mine, Val Graveglia, Genova province, Liguria, Italy.

Description: Orange grains in metamorphic rock. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1395sh, 1365w, 1075sh, 1056s, 1027s, 960sh, 949s, 896s, 880sh, 718, 640, 575sh, 556, 505sh, 487, 452s, 420sh.

Sic42 Namansilite $NaMn^{3+}(Si_2O_6)$

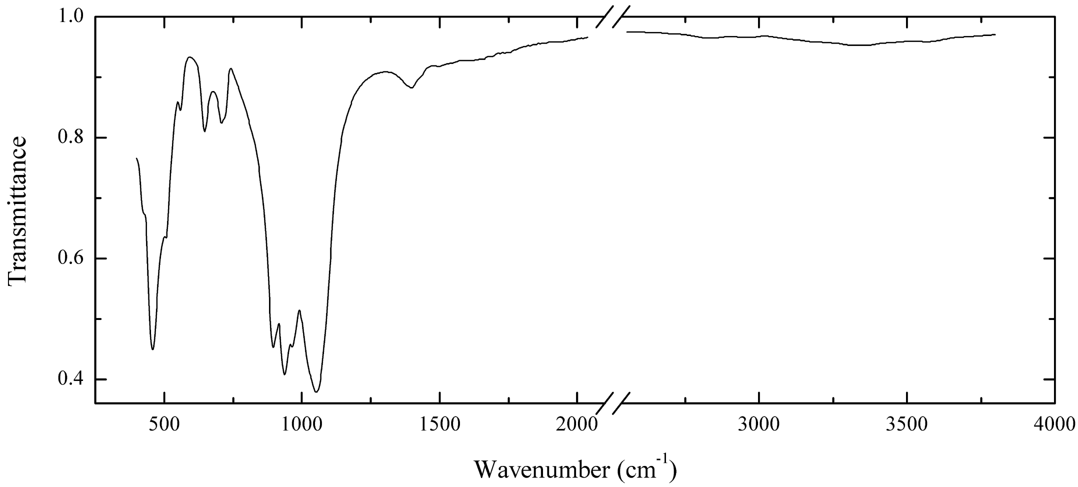


Locality: Cerchiara mine, Borghetto Vara, Vara valley, La Spezia province, Liguria, Italy.

Description: Violet-red columnar aggregate from the association with pectolite. Confirmed by IR spectrum and qualitative electron microprobe analysis. Weak bands at 1,390 and 671 cm^{-1} correspond to the admixture of pectolite.

Wavenumbers (cm^{-1}): 1390w, 1050sh, 1032s, 999s, 960s, 926s, 910sh, 735sh, 688w, 671w, 641, 570sh, 549, 508, 480sh, 452, 405.

Sic43 Natronambulite $H(Na,Li)Mn^{2+}_4(Si_5O_{15})$

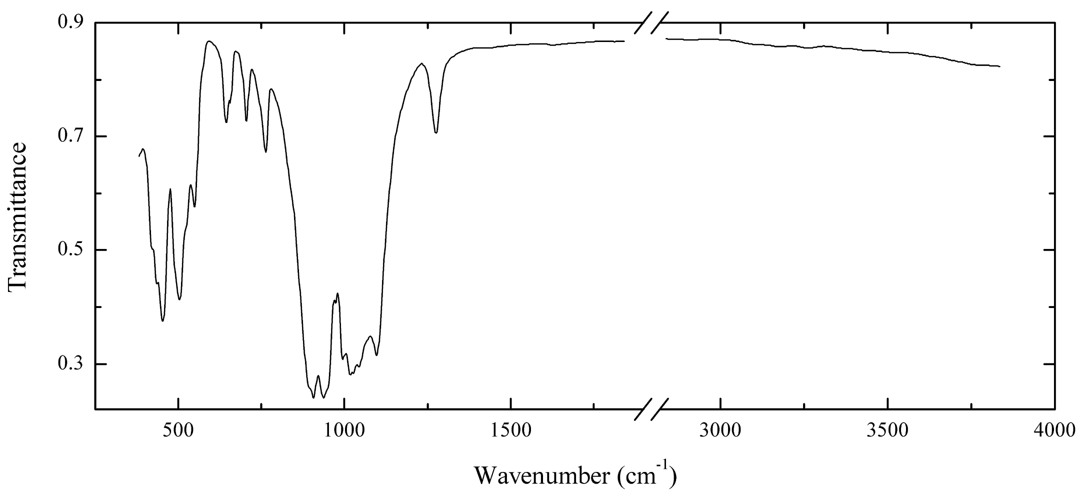


Locality: Tanohata mine, Iwate prefecture, Japan (type locality).

Description: Orange crystals in metamorphic rock. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1395w, 1053s, 1020sh, 967s, 938s, 899s, 720sh, 710, 648, 557w, 510, 459s, 425sh.

Sic44 Manganbabingtonite $HCa_2Mn^{2+}Fe^{3+}(Si_5O_{15})$

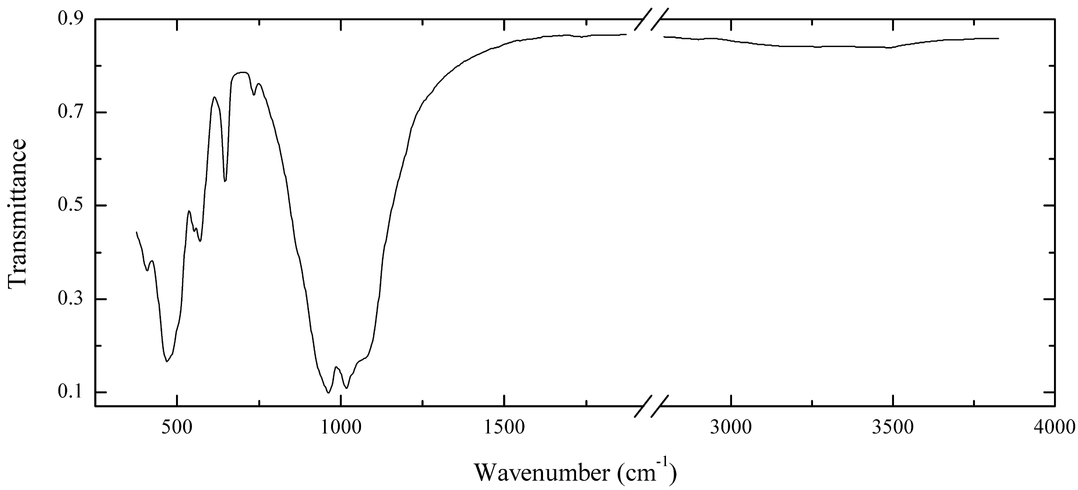


Locality: Rudnyi Kaskad deposit, Krasnokamensk ore field, Kuragan district, Krasnoyarsk region, Eastern Sayan Mts., Siberia, Russia (type locality).

Description: Black crystals from skarn, from the association with magnetite. The empirical formula is (electron microprobe) $H(Ca_{1.93}Mn_{0.01}Na_{0.06})(Mn_{0.78}Fe_{0.22})(Fe_{0.98}Ti_{0.02})(Si_{5.00}O_{15})$.

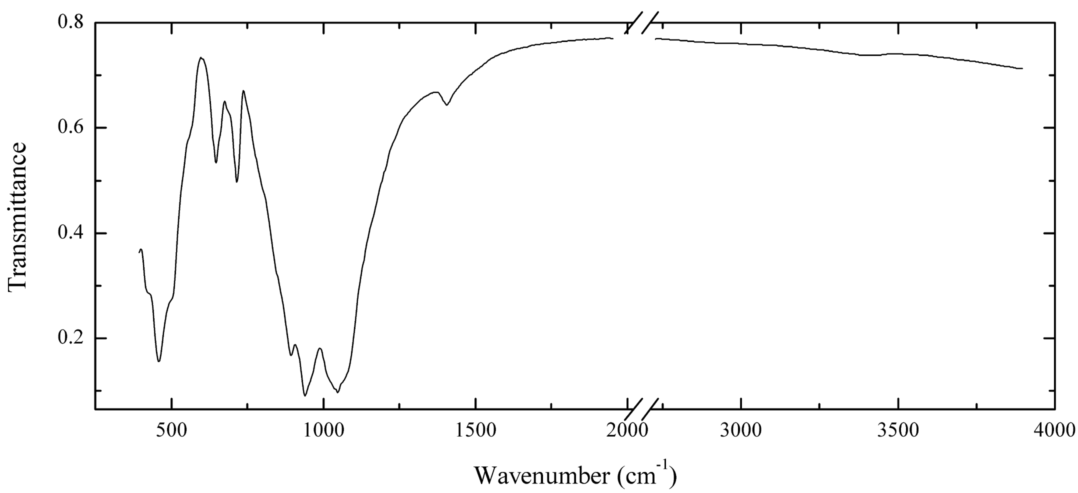
Wavenumbers (cm^{-1}): 1271, 1096s, 1043s, 1027s, 1017s, 993s, 975, 950sh, 935s, 908s, 895sh, 764, 706, 658w, 644, 550, 520sh, 507, 490sh, 455, 440, 421.

Sic45 Natalyite $NaV^{3+}(Si_2O_6)$



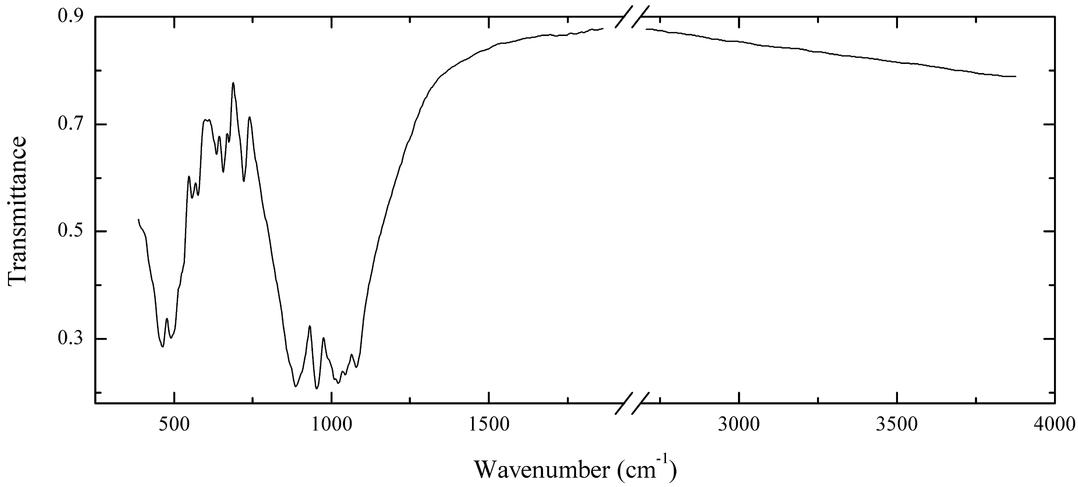
Locality: Borehole at the Kosmozero deposit, Medvezh'egorskiy district, Karelia, Russia.
Description: Brown columnar aggregate from the association with roscoelite. The empirical formula is (electron microprobe) $(Na_{1.00}Ca_{0.02})(V_{0.60}Fe_{0.35}Al_{0.05})(Si_{2.00}O_6)$.
Wavenumbers (cm^{-1}): 1070sh, 1045sh, 1019s, 961s, 930sh, 870sh, 733w, 645, 568, 547, 500sh, 475sh, 462s, 397.

Sic46 Nambulite $H(Li,Na)Mn^{2+}_4(Si_5O_{15})$



Locality: Gozaisho mine, Iwaki city, Fukushima prefecture, Tohoku region, Honshu island, Japan.
Description: Orange crystals in metamorphic rock, in the association with rhodonite. Confirmed by IR spectrum. Na-free variety. The empirical formula is (electron microprobe) $H(Li_xCa_{0.1})(Mn_{3.7}Mg_{0.2}Fe_{0.1})(Si_{5.00}O_{15})$.
Wavenumbers (cm^{-1}): 1398w, 1075sh, 1051s, 1020sh, 960sh, 944s, 898s, 785sh, 719, 665sh, 649, 560sh, 500sh, 461s, 435sh.

Sic47 Pyroxmangite $(Mn,Ca)(Mn,Fe^{2+},Mg)_6(Si_7O_{21})$

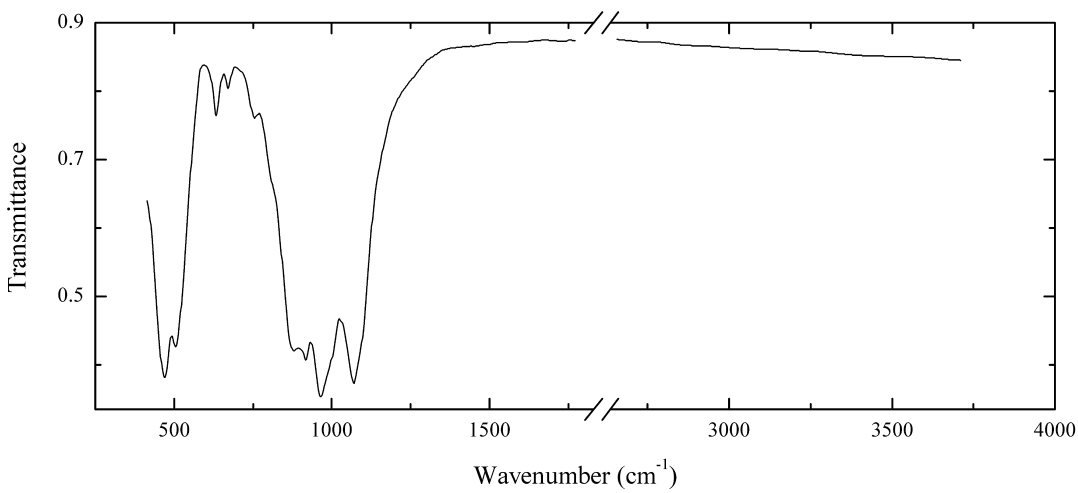


Locality: Southern Faizulinskoe Mn deposit, South Urals, Russia.

Description: Pink fine-grained aggregate. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Mn_{0.9}Ca_{0.1})(Mn_{5.85}Mg_{0.15})(Si_{7.00}O_{21})$.

Wavenumbers (cm^{-1}): 1081s, 1045s, 1022s, 990sh, 953s, 905sh, 886s, 870sh, 723, 674w, 655, 631w, 574, 555, 525sh, 515sh, 488s, 456s.

Sic48 Pigeonite $(Mg,Fe^{2+},Ca)(Mg,Fe^{2+})(Si_2O_6)$

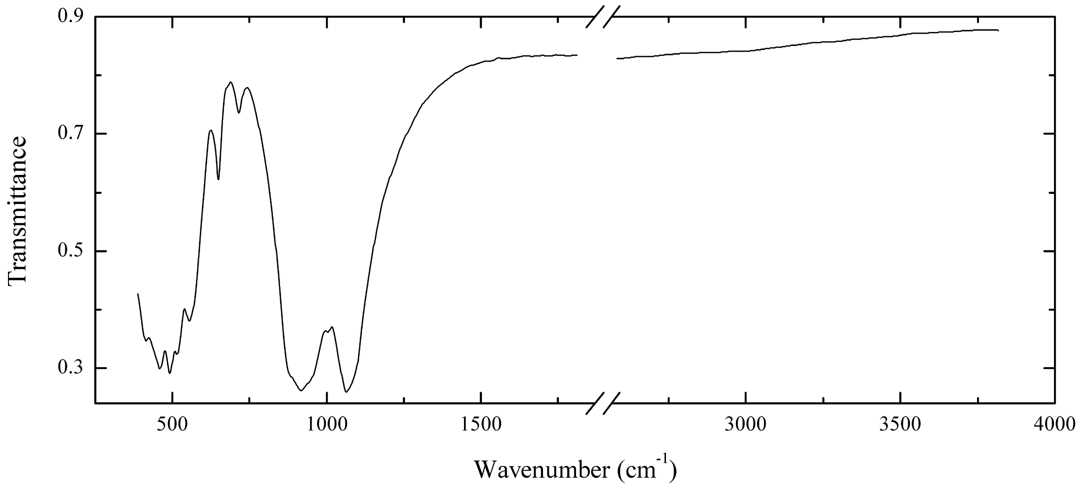


Locality: Loundoun Co., Virginia, USA.

Description: Greenish-grey grains in rock. Confirmed by IR spectrum.

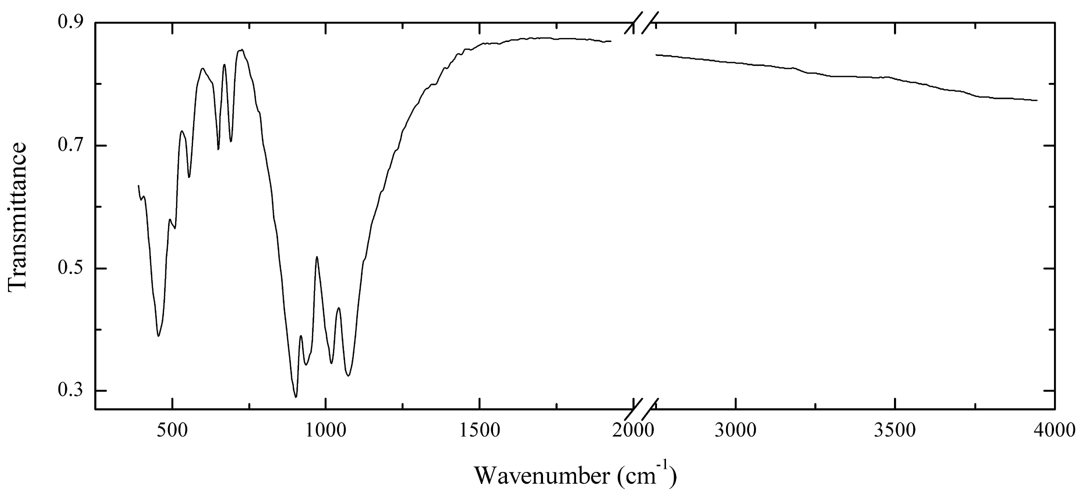
Wavenumbers (cm^{-1}): 1067s, 985sh, 964s, 916s, 885, 755, 670w, 632, 503s, 469s.

Sic49 Omphacite $(Ca,Na)(Mg,Fe,Al)(Si_2O_6)$



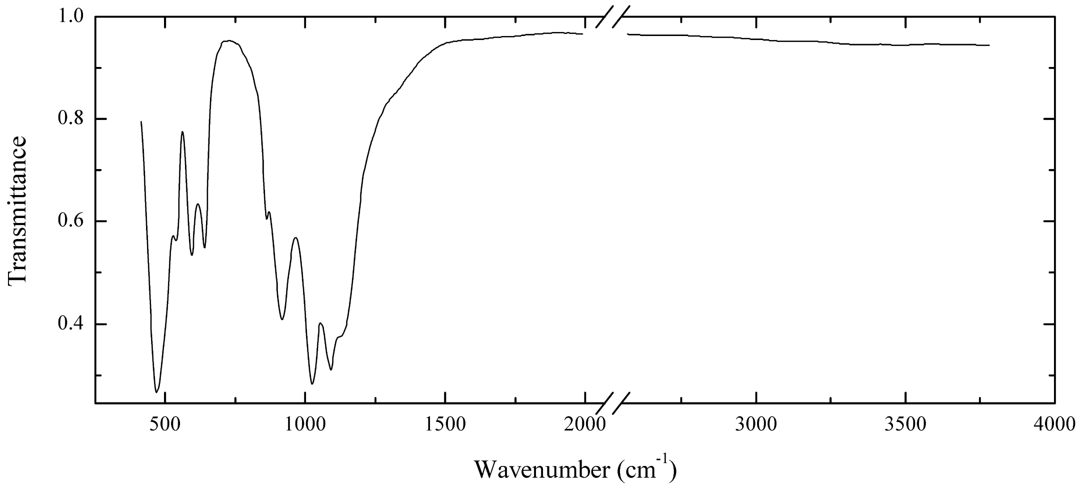
Locality: Weissenstein, near Munich, Germany.
Description: Greenish-grey grains from eclogite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1068s, 1007, 940sh, 923s, 885sh, 710w, 644, 551, 510s, 488s, 453s, 406.

Sic50 Wollastonite-1M ("parawollastonite") $CaSiO_3$



Locality: Synthetic.
Description: White massive. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1080s, 1022s, 950sh, 939s, 903s, 693, 653, 563, 513, 502, 465sh, 457s, 403.

Sic51 Spodumene $LiAl(Si_2O_6)$

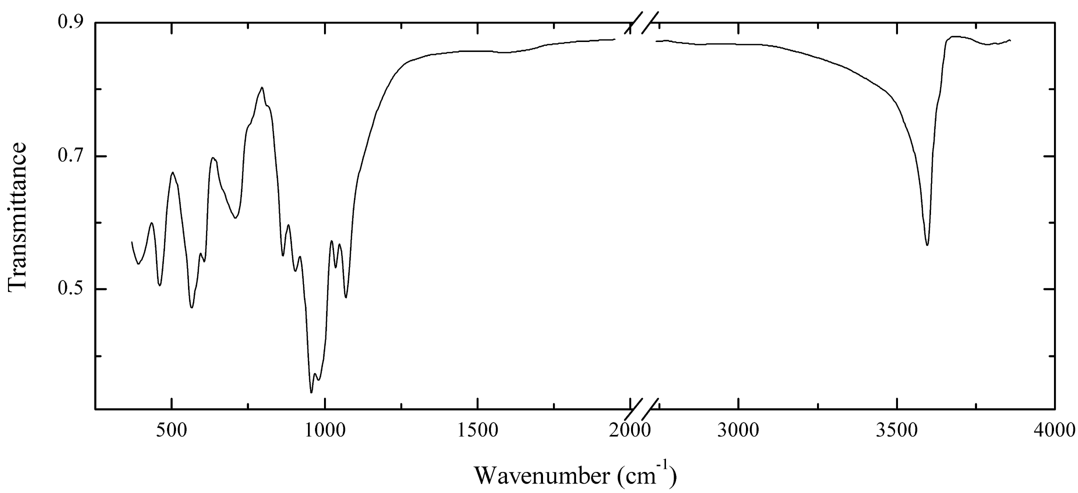


Locality: Okh-Myl'k Mt, Voron'i Tundras Mts., Kola peninsula, Murnansk region, Russia.

Description: Pink coarse-grained aggregate from the association with pollucite and muscovite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1135sh, 1087s, 1020s, 918s, 862, 642, 593, 535, 505sh, 469s.

Sic52 Vanadiocarpholite $Mn^{2+}V^{3+}Al(Si_2O_6)(OH)_4$

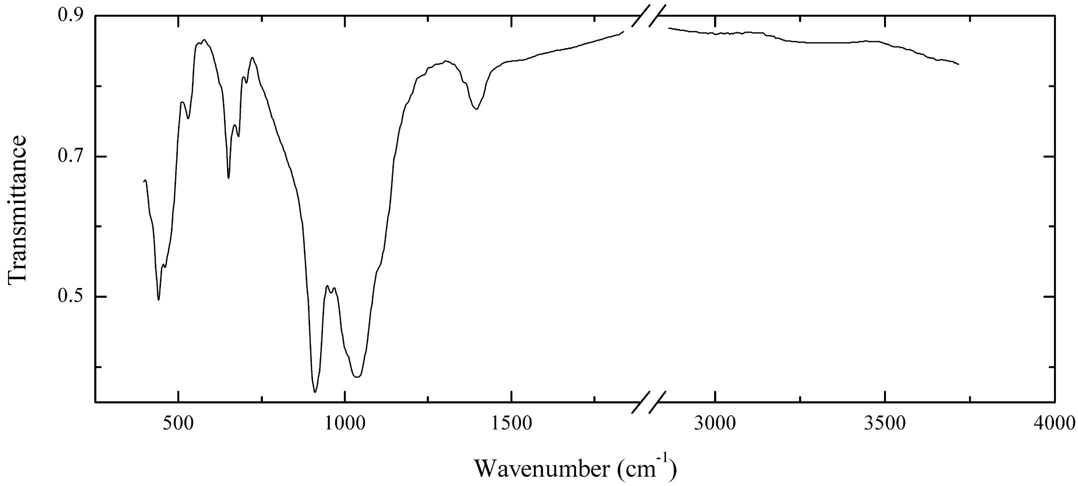


Locality: Molinello mine, Val Graveglia, Genova province, Liguria, Italy.

Description: Brownish-yellow fibrous aggregate in quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3575, 3420sh, 1073, 1038, 987s, 960s, 907, 868, 710, 665sh, 608, 570, 467, 395.

Sic53 Sérandite $HNaMn^{2+}{}_2(Si_3O_9)$

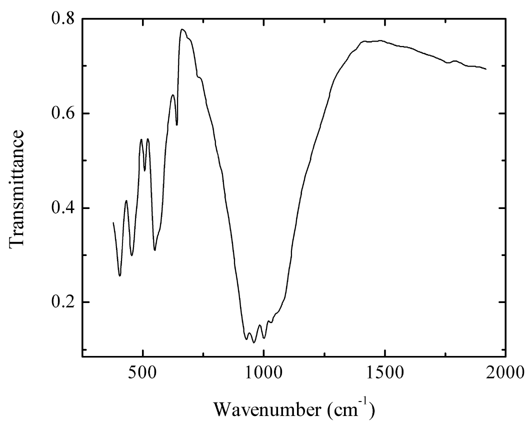


Locality: Shkatulka pegmatite, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow crystals in ussingite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1397, 1110sh, 1042s, 1010sh, 961, 914s, 708w, 684, 655, 531, 480sh, 463, 443s, 415sh.

Sic54 Namansilite $NaMn^{3+}(Si_2O_6)$

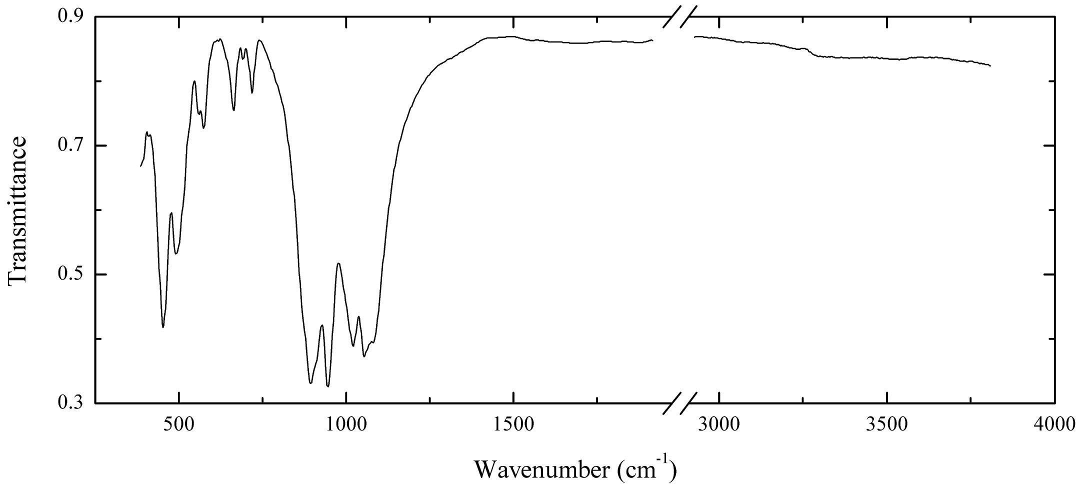


Locality: Cerchiara mine, Borghetto Vara, Vara valley, La Spezia province, Liguria, Italy.

Description: Violet-red columnar aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.

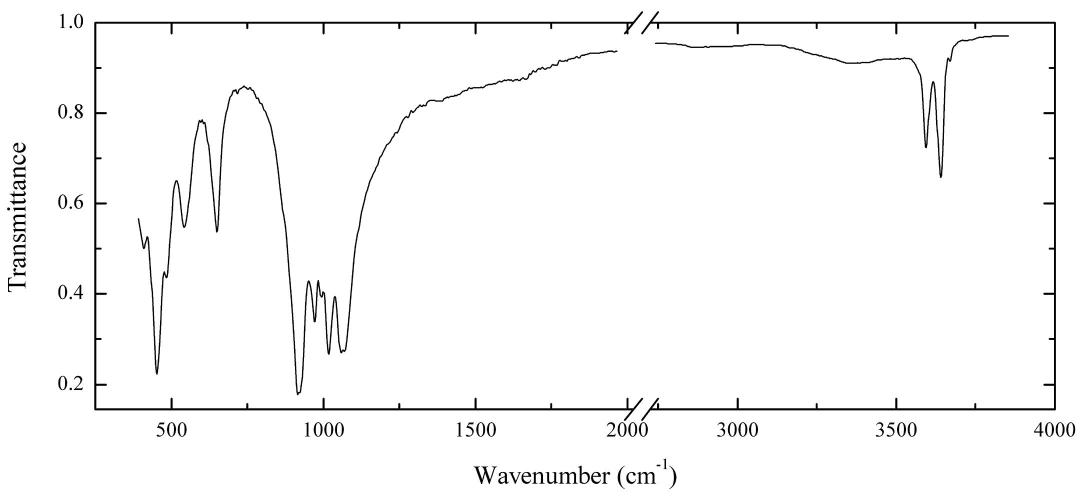
Wavenumbers (cm^{-1}): 1075sh, 1050sh, 1028s, 1005s, 961s, 932s, 733w, 642, 570sh, 552, 510, 480sh, 458, 410.

Sic55 **Rhodonite** $CaMn_4(Si_5O_{15})$



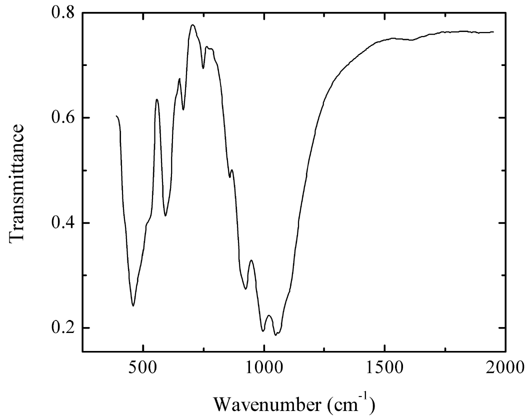
Locality: San Martín mine, Chiurucu, Huallanca, Bolognesi province, Ancash department, Peru.
Description: Rose crystals. Ca-deficient variety. The empirical formula is (electron microprobe) $Ca_{0.51}Mn_{4.04}Fe_{0.22}Mg_{0.19}Zn_{0.04}(Si_{5.00}O_{15})$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1080sh, 1060s, 1025s, 950s, 910sh, 898s, 875sh, 721, 694w, 665, 579, 563, 495, 456s.

Sic56 **Foshagite** $Ca_4(Si_3O_9)(OH)_2$



Locality: Dovyren Bald Mountain (Ioko-Dovyren layered massif), Siberia, Russia.
Description: Pink granular aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3630, 3573, 1076s, 1062s, 1022s, 1000, 978s, 927s, 920s, 655, 548, 487, 452s, 414.

Sic57 Jadeite $NaAl(Si_2O_6)$

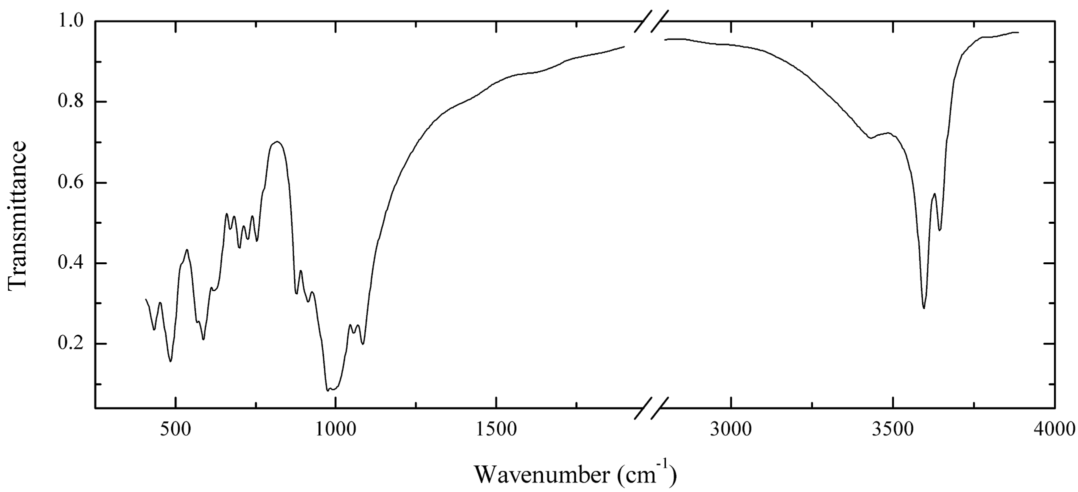


Locality: Ohsa Mt., Ohsa-Osakobe, Niimi, Okayama prefecture, Japan.

Description: Grey granular aggregate from the association with vesuvianite and gehlenite. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $Na_{0.94}Ca_{0.03}Al_{0.98}Mg_{0.03}Fe_{0.01}(Si_{2.00}O_6)$.

Wavenumbers (cm^{-1}): 1090sh, 1060sh, 1049s, 996s, 925s, 910sh, 858, 748w, 665, 605sh, 591, 520sh, 485sh, 461s, 440sh.

Sic58 Ferrocarpholite $(Fe^{2+},Mg)Al_2(Si_2O_6)(OH)_4$

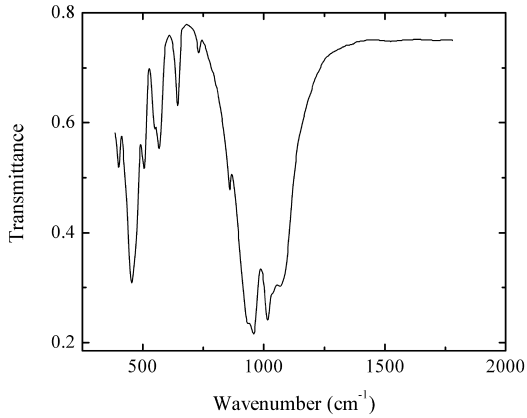


Locality: Bormida valley, Savona province, Liguria, Italy.

Description: Greenish-grey fibrous aggregate. The empirical formula is (electron microprobe) $(Fe_{0.62}Mg_{0.37})Al_{1.97}Si_{2.03}O_6(OH)_4$.

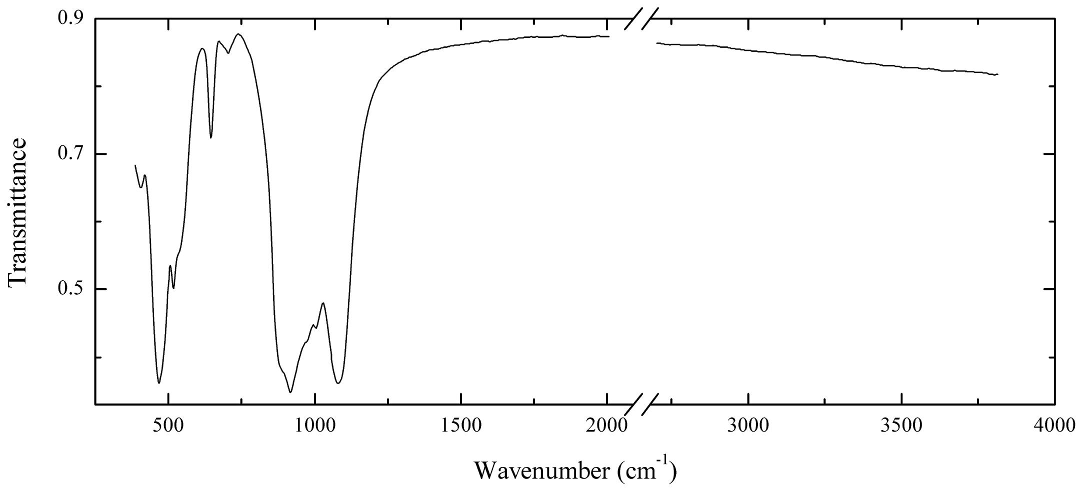
Wavenumbers (cm^{-1}): 3625, 3580, 3425w, 1083, 1052, 1010sh, 992s, 970s, 910, 871, 770sh, 747, 719, 691, 665, 625sh, 611, 580, 560, 477s, 425.

Sic59 Aegirine $NaFe^{3+}(Si_2O_6)$



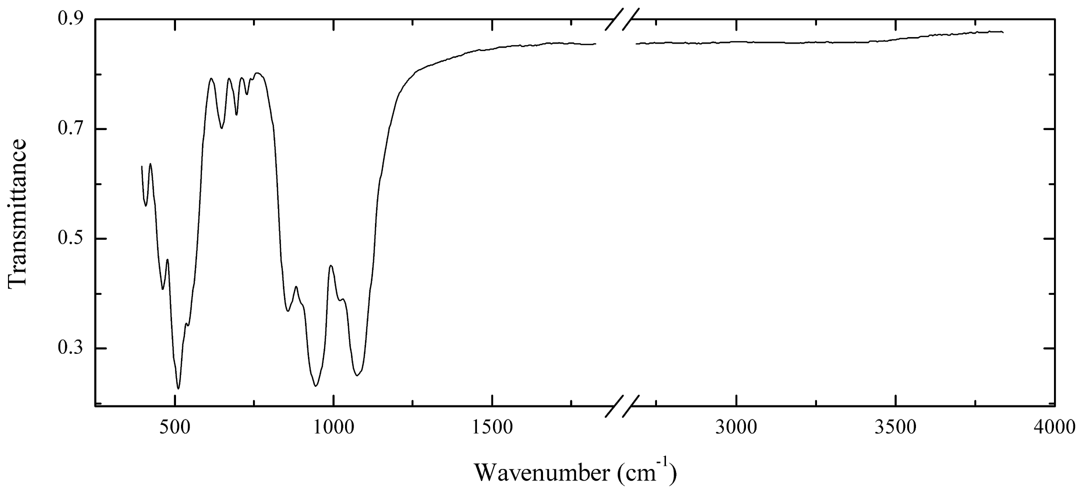
Locality: Malyi Murun (Malomurunskiy) massif, Aldan shield, Eastern Siberia, Russia.
Description: Radial aggregate of black long-prismatic crystals from the association with galena. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1074, 1040sh, 1017s, 958s, 937s. 860, 735w, 644, 566, 544, 505, 454s, 393.

Sic60 Aegirine-augite $(Ca,Na)(Mg,Fe^{2+},Fe^{3+})(Si_2O_6)$



Locality: Inagli alkaline-ulthabasic massif, Sakha (Yakutia) Republic, Siberia, Russia.
Description: Black crystal from the association with Cr-bearing diopside. The empirical formula is (electron microprobe) $Ca_{0.56}Na_{0.47}Mg_{0.48}Fe_{0.47}Al_{0.01}Mn_{0.01}(Si_{2.00}O_6)$.
Wavenumbers (cm^{-1}): 1078s, 1000, 970sh, 910s, 880sh, 697w, 637, 530sh, 510, 462s, 396.

Sic61 **Enstatite** $Mg_2(Si_2O_6)$

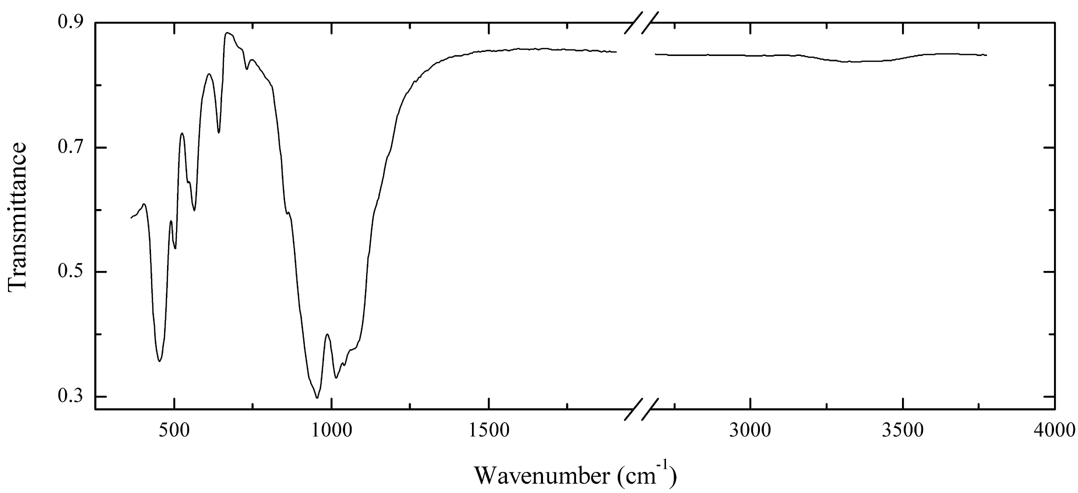


Locality: An unknown locality in Mongolia.

Description: Brown grains. The empirical formula is (electron microprobe) $(Mg_{1.68}Fe_{0.18}Al_{0.09}Ca_{0.03}Cr_{0.01}Na_{0.01})(Si_{1.90}Al_{0.10}O_6)$.

Wavenumbers (cm^{-1}): 1077s, 1020, 944s, 900sh, 859, 747w, 723w, 691, 646, 635sh, 536, 505s, 457, 399.

Sic62 **Aegirine** $NaFe^{3+}(Si_2O_6)$

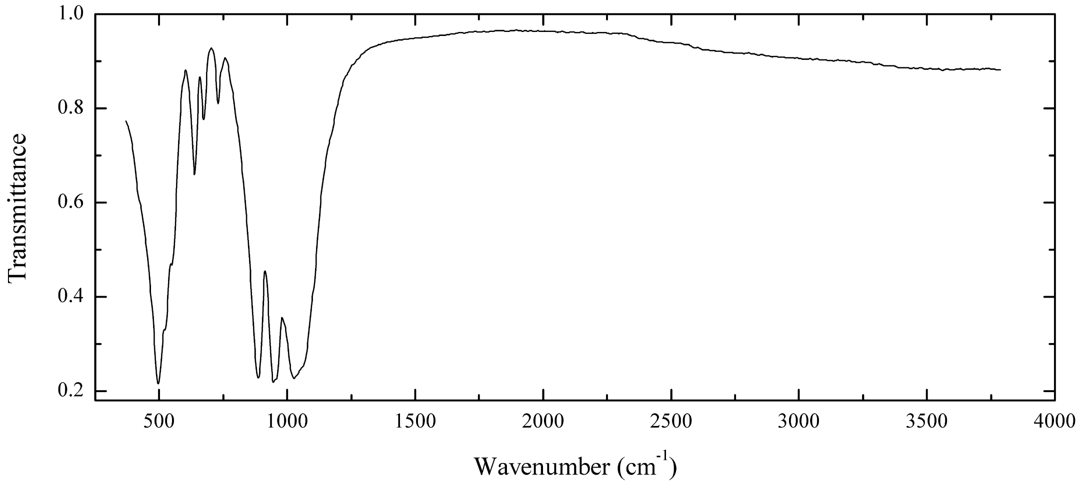


Locality: Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alai (Alaiskii) ridge, Garm district, Tajikistan.

Description: Black prismatic crystal from the association with quartz, polylithionite and pyrochlore. Confirmed by IR spectrum.

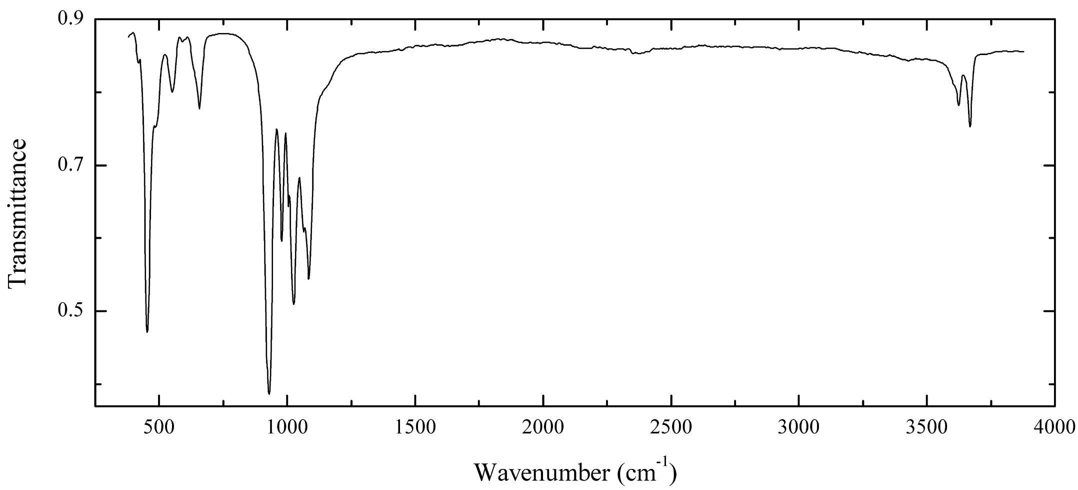
Wavenumbers (cm^{-1}): 1070sh, 1038, 1015s, 958s, 935sh, 859, 734w, 645, 566, 543, 504, 456s.

Sic63 Ferrosilite $Fe^{2+}{}_2(Si_2O_6)$



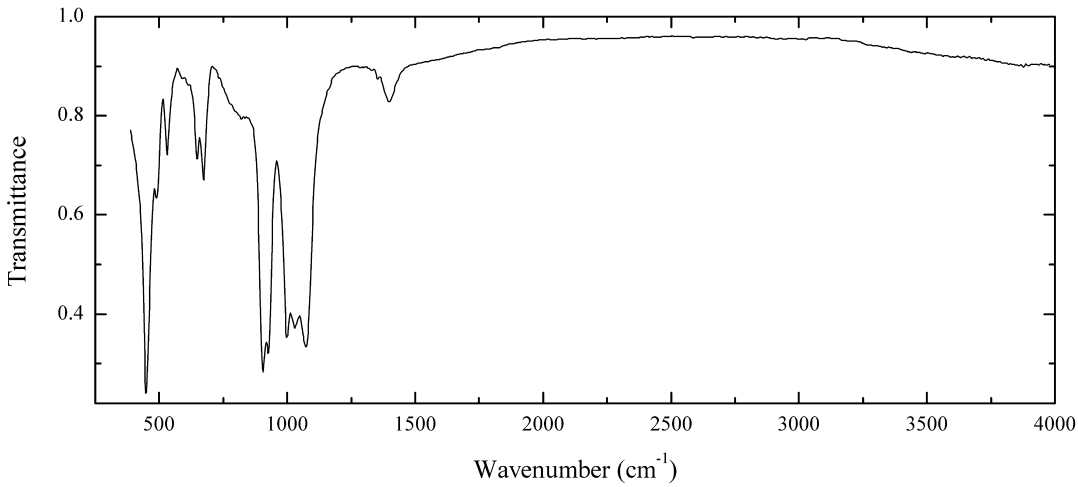
Locality: Tunkinskaya valley, near Malobystrinskoe lazurite deposit, Eastern Siberia, Russia.
Description: Black grains from the association with quartz and almandine. The empirical formula is (electron microprobe) $(Fe_{1.57}Mg_{0.36}Mn_{0.04}Na_{0.02}Ti_{0.01})(Si_{1.97}Al_{0.03}O_6)$.
Wavenumbers (cm^{-1}): 1100sh, 1060sh, 1027s, 957s, 945s, 885s, 740sh, 727w, 670, 634, 545, 520, 491s, 430sh.

Sic64 Foshagite $Ca_4(Si_3O_9)(OH)_2$



Locality: Crestmore, Riverside Co., California, USA.
Description: White fibrous aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3635, 3590, 1083, 1063, 1023s, 1004, 978, 929s, 920sh, 656, 640sh, 605w, 552, 487, 451s, 414w.

Sic65 Pectolite-*M2abc* $HNaCa_2(Si_3O_9)$

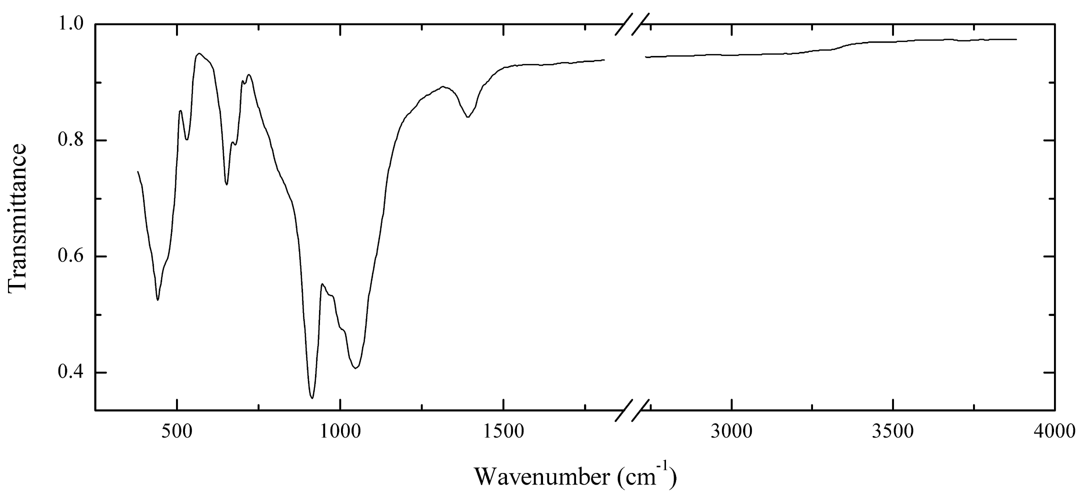


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest town, Middle Urals, Russia.

Description: White radial fibrous aggregates from rodingite, from the association with apophyllite-(KOH), natrolite, vesuvianite and prehnite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1398, 1070s, 1029s, 999s, 927s, 905s, 823w, 670, 643, 610w, 590w, 526, 495sh, 482, 443s, 425sh, 410sh.

Sic66 Sérandite $HNaMn^{2+}{}_2(Si_3O_9)$

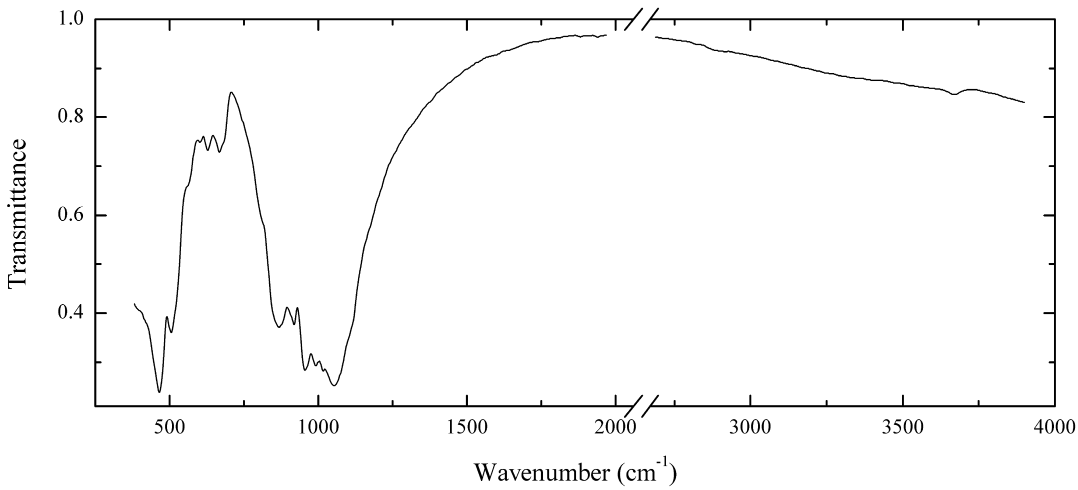


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Orange-rose grains from the association with parakeldyshite. The empirical formula is (electron microprobe) $H_xNa_{1.1}Mn_{1.1}Ca_{0.8}(Si_{3.0}O_9)$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1393, 1100sh, 1044s, 1000sh, 966, 912s, 810sh, 770sh, 706w, 678, 651, 529, 460sh, 438s, 415sh.

Sic67 Petedunnite $Ca(Zn,Mn^{2+},Fe^{2+},Mg)(Si_2O_6)$

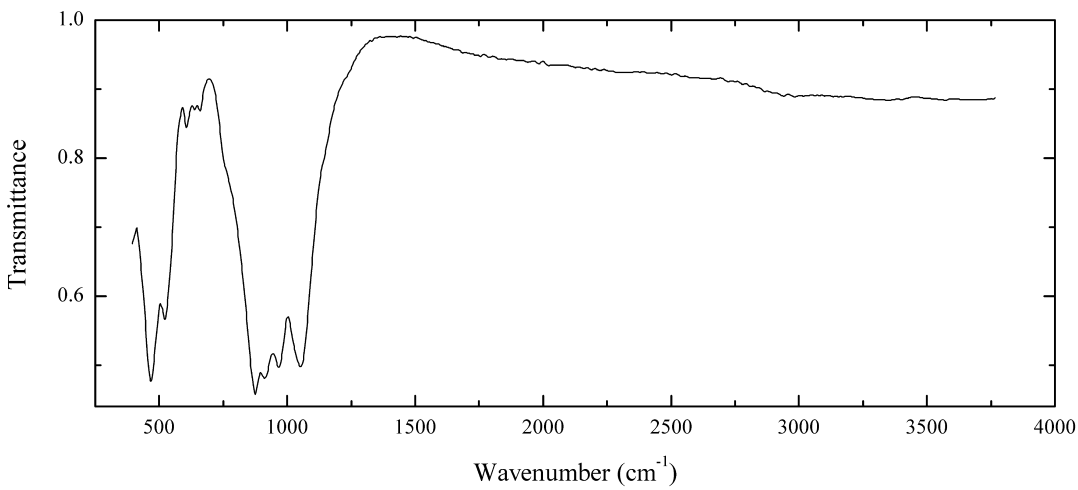


Locality: Franklin, Sussex Co., New Jersey, USA (type locality).

Description: Brown grains with perfect cleavage from the association with willemite and quartz. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3645w, 1100sh, 1053s, 1018s, 991s, 954s, 916, 862, 680sh, 669w, 627w, 601w, 565sh, 505, 462s.

Sic69 Esseneite $CaFe^{3+}(AlSiO_6)$

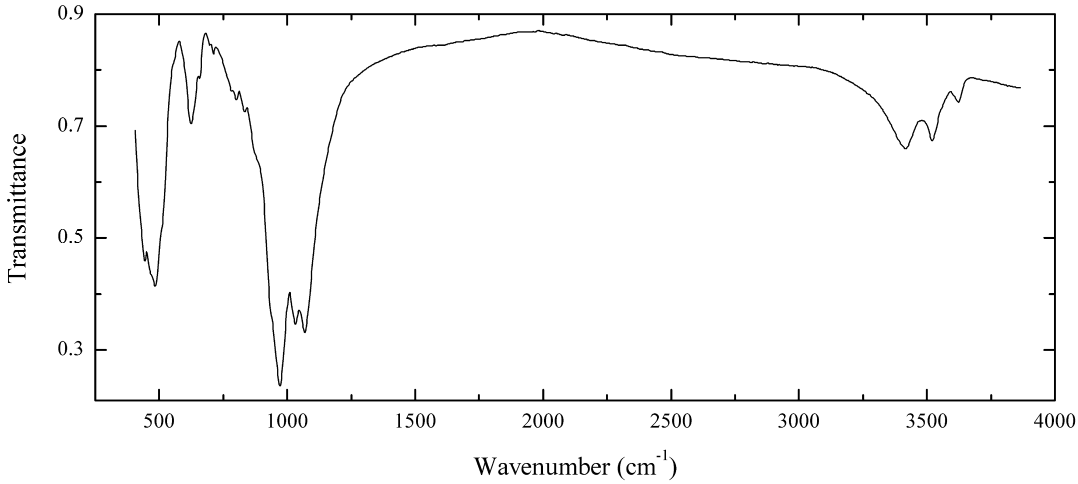


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Yellow crust. Investigated by B.V. Chesnokov. The empirical formula is (electron microprobe) $Ca_{1.01}(Fe^{3+}{}_{0.51}Mg_{0.44}Ti_{0.02})(Si_{1.43}Al_{0.60})O_6$. Confirmed by IR spectrum. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 3.214 (100) (200), 2.981 (60) (-221), 2.950 (55) (310), 2.894 (15) (-311), 2.519 (35) (221), 2.145 (45) (330).

Wavenumbers (cm^{-1}): 1050s, 967s, 912s, 875s, 760sh, 661w, 636w, 606, 517, 464s.

Sic70 Howieite $Na(Fe,Mn,Mg,Al)_{12}(Si_6O_{17})_2(O,OH)_{10}$

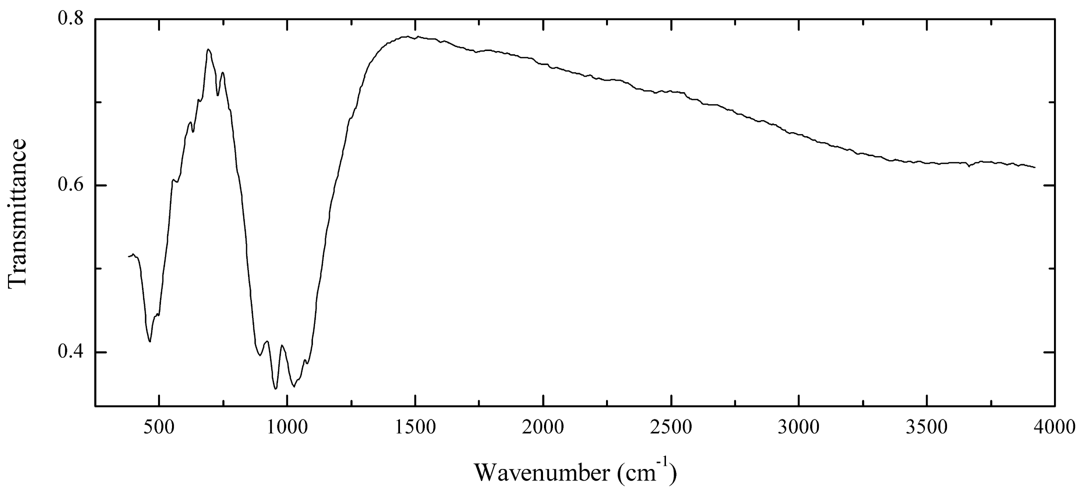


Locality: Laytonville quarry, Laytonville, Mendocino Co., California, USA (type locality).

Description: Aggregate of black acicular crystals from the association with deerite and quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3635w, 3535, 3415, 1071s, 1032s, 972s, 940sh, 880sh, 836, 800w, 779w, 710w, 652w, 620, 500sh, 479, 460sh, 437.

Sic72 Pyroxferroite $Ca(Fe^{2+},Mn)_6(Si_7O_{21})$

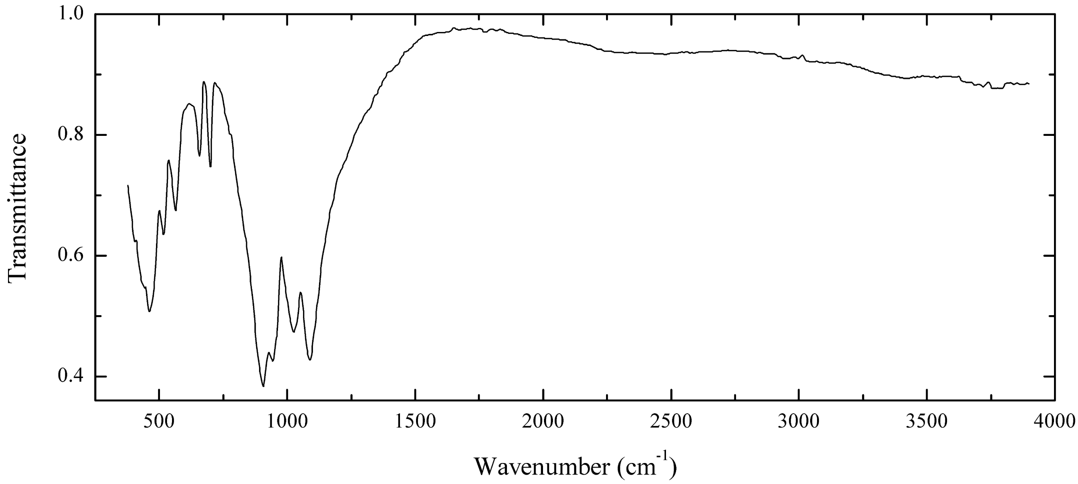


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Black prismatic crystals from the association with fayalite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

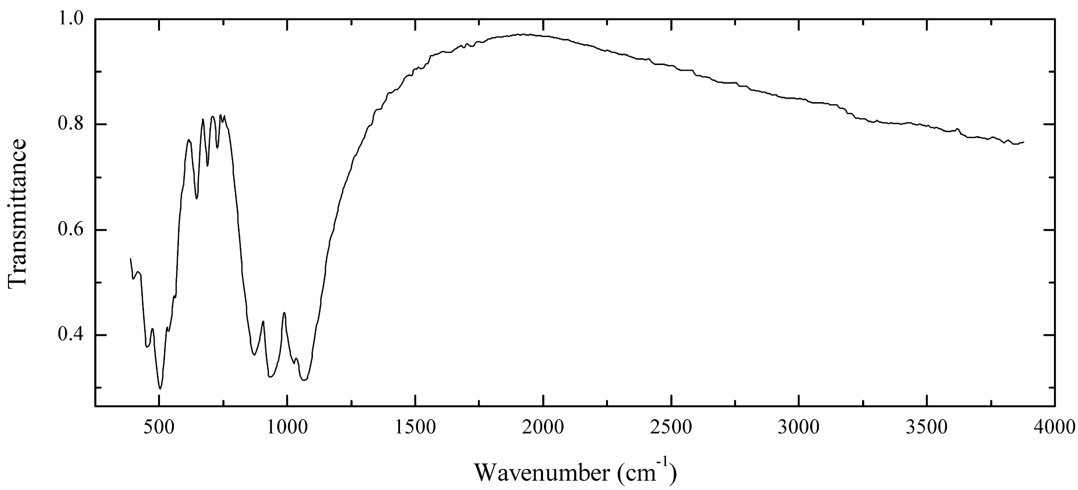
Wavenumbers (cm^{-1}): 1075s, 1050sh, 1027s, 955s, 897s, 728w, 662w, 635, 570, 498, 460s.

Sic73 Bustamite $Ca(Mn,Ca)(Si_2O_6)$



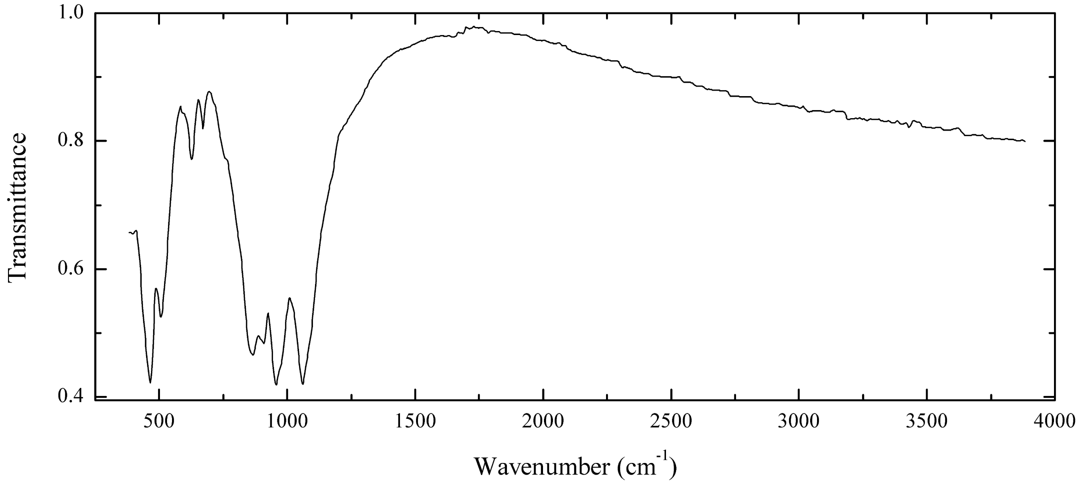
Locality: Zinc Corporation mine, Broken Hill, New South Wales, Australia.
Description: Orange-brown crystal. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1088s, 1027s, 955sh, 947s, 907s, 697, 656, 562, 517, 461s, 442, 410sh.

Sic74 Enstatite $Mg_2(Si_2O_6)$



Locality: Merensky Reef at Rustenburg Platinum Mine, Transvaal, South Africa.
Description: Brown grains. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1067s, 1027s, 960sh, 933s, 871s, 745w, 726w, 690, 645, 555sh, 536s, 503s, 452s, 400.

Sic75 Petedunnite $Ca(Zn,Mn^{2+},Fe^{2+},Mg)(Si_2O_6)$

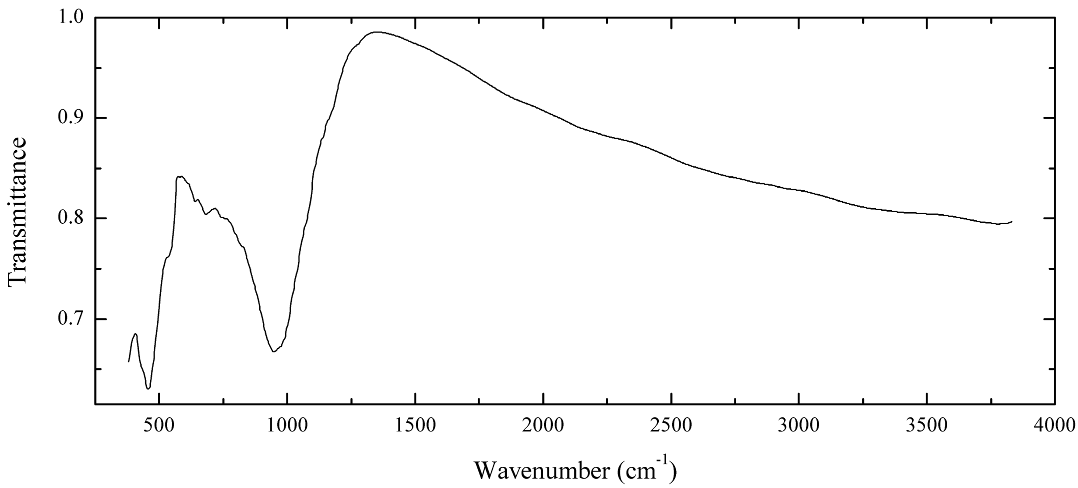


Locality: Franklin, Sussex Co., New Jersey, USA (type locality).

Description: Brown-green grains with perfect cleavage. The empirical formula is (electron microprobe) $(Ca_{0.83}Na_{0.17})(Zn_{0.36}Mg_{0.26}Fe_{0.26}Mn_{0.17})(Si_{1.90}Al_{0.10}O_6)$.

Wavenumbers (cm^{-1}): 1058s, 975sh, 954s, 908s, 861s, 760sh, 670w, 626, 504, 465s.

Sic76 Rhönite $Ca_2(Mg,Fe^{2+},Fe^{3+},Ti)_6[(Si,Al)_6O_{20}]$

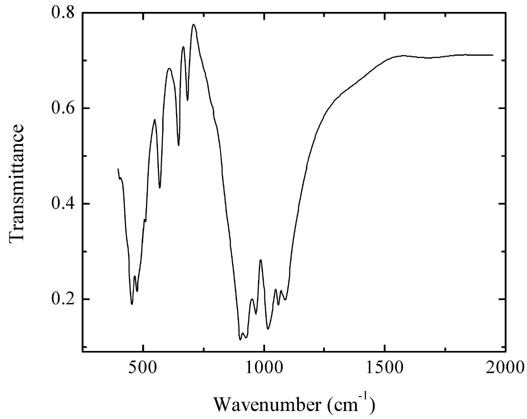


Locality: Nickenicher Sattel (Eicher Sattel), Eich, Andernach, Eifel, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Dark red twinned crystals. The empirical formula is (electron microprobe) $(Ca_{1.59}Na_{0.41})(Mg_{3.08}Fe_{2.32}Ti_{0.53}Mn_{0.08})(Si_{3.10}Al_{2.46}Fe_{0.44}O_{20})$.

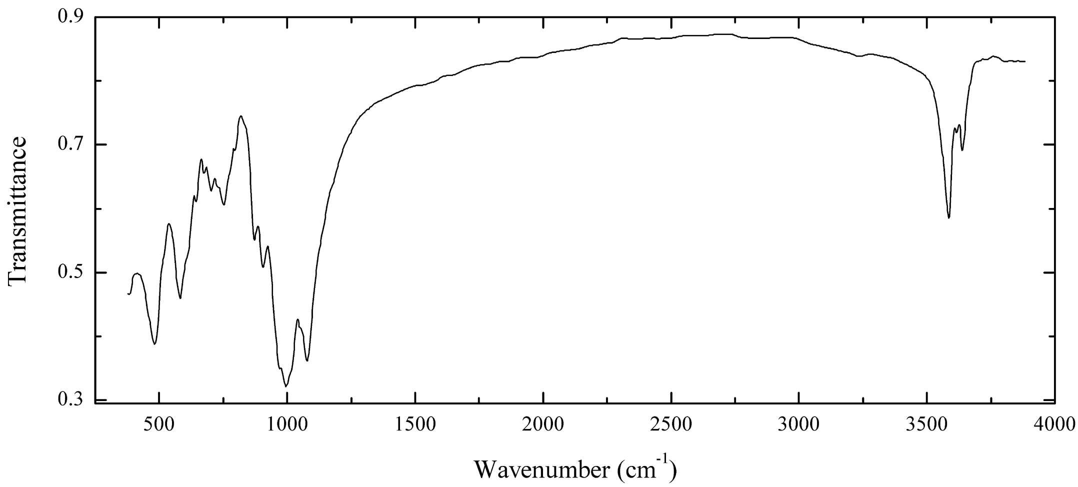
Wavenumbers (cm^{-1}): 949s, 682w, 639w, 530sh, 454s, 430sh.

Sic77 Wollastonite $CaSiO_3$



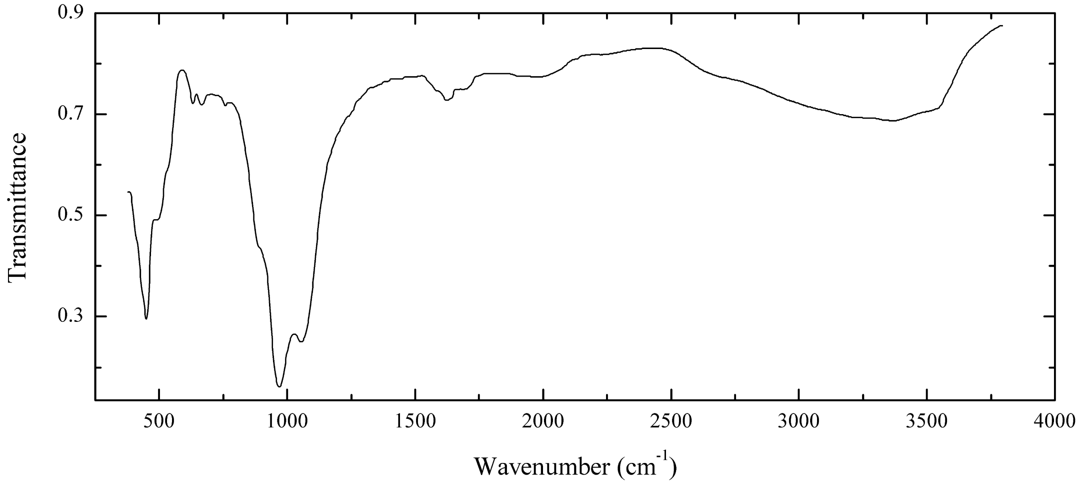
Locality: Charcas, San Luis Potosí, Mexico.
Description: White crystals from the association with nifontovite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1088s, 1060s, 1016s, 966s, 924s, 903s, 681, 647, 567, 509, 473s, 455s.

Sic78 Magnesiocarpholite $MgAl_2(Si_2O_6)(OH)_4$



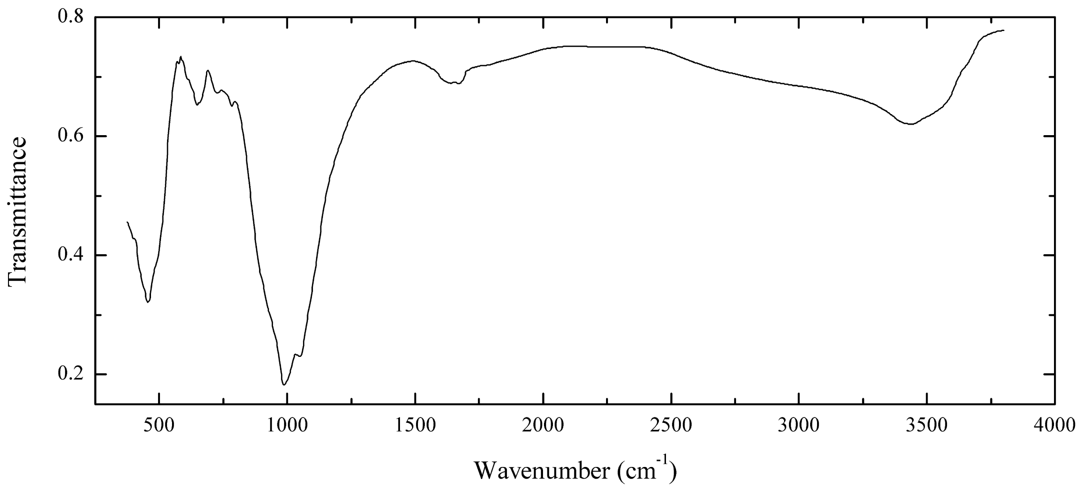
Locality: Zaphorokipos, Crete island, Greece.
Description: Clusters of white acicular crystals in marble. Identified by electron microprobe analysis and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3625, 3600w, 3575, 1178s, 1015sh, 996s, 970s, 906, 872, 795sh, 754, 704, 675w, 645, 600sh, 581, 482s.

Sic79 Ershovite $Na_4K_3(Fe^{2+},Mn^{2+},Ti)_2[Si_8O_{20}(OH)_2](OH)_2{\cdot}4H_2O$



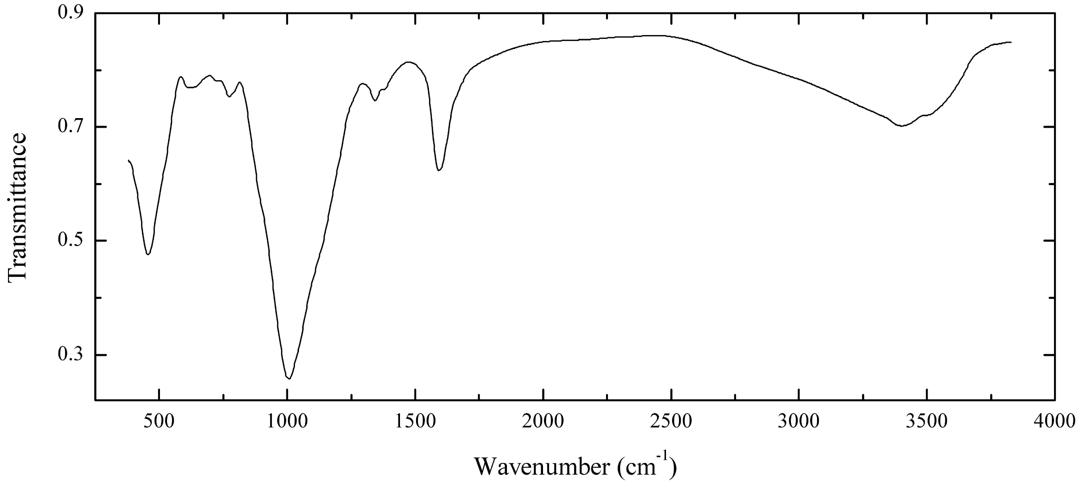
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Brown crystals from peralkaline pegmatite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3500sh, 3320, 3180sh, 2700sh, 1950, 1675, 1625, 1052s, 970s, 884, 767w, 667, 631, 530sh, 493, 450s, 440sh.

Sic80 Paraershovite $Na_3K_3Fe^{3+}{}_2[Si_8O_{20}(OH)_2](OH)_2{\cdot}4H_2O$



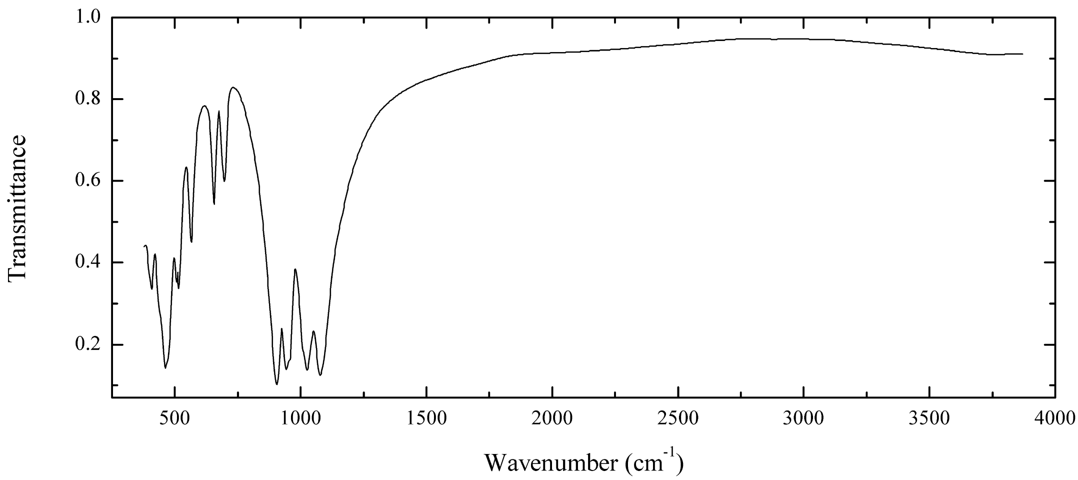
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Brown crystals from peralkaline pegmatite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3430, 3000sh, 1840w, 1650, 1050s, 986s, 925sh, 900sh, 783w, 727w, 650, 495sh, 455s, 400sh.

Sic81 Paraershovite $Na_3K_3Fe^{3+}{}_2[Si_8O_{20}(OH)_2](OH)_2{\cdot}4H_2O$



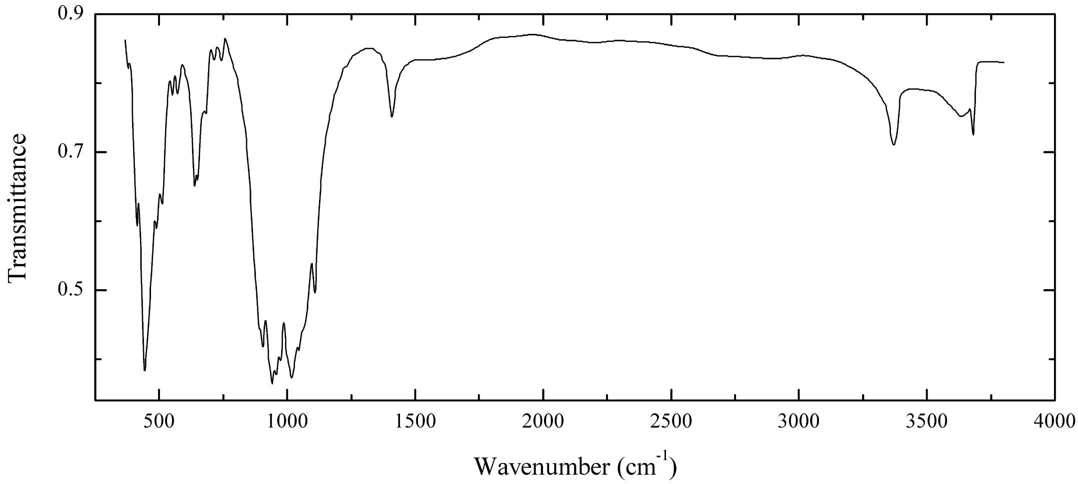
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Brown grains from peralkaline pegmatite. Confirmed by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3420, 2950sh, 1602, 1380w, 1350, 1120sh, 1008s, 775w, 625w, 525sh, 454.

Sic82 Ferrobustamite $Ca_{1.67}Fe^{2+}{}_{0.33}(Si_2O_6)$



Locality: Horado mine, Seki city, Gifu prefecture, Chubu region, Honshu island, Japan.
Description: Beige fibrous aggregate. The empirical formula is (electron microprobe) $(Ca_{1.63}Fe_{0.33}Mn_{0.07})Si_{1.97}O_6$. Confirmed by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 1077s, 1025s, 1010sh, 955sh, 941s, 905s, 696, 654, 563, 515, 508, 460s, 409.

Sic83 Santaclaraite $CaMn^{2+}_4[Si_5O_{14}(OH)](OH)\cdot H_2O$

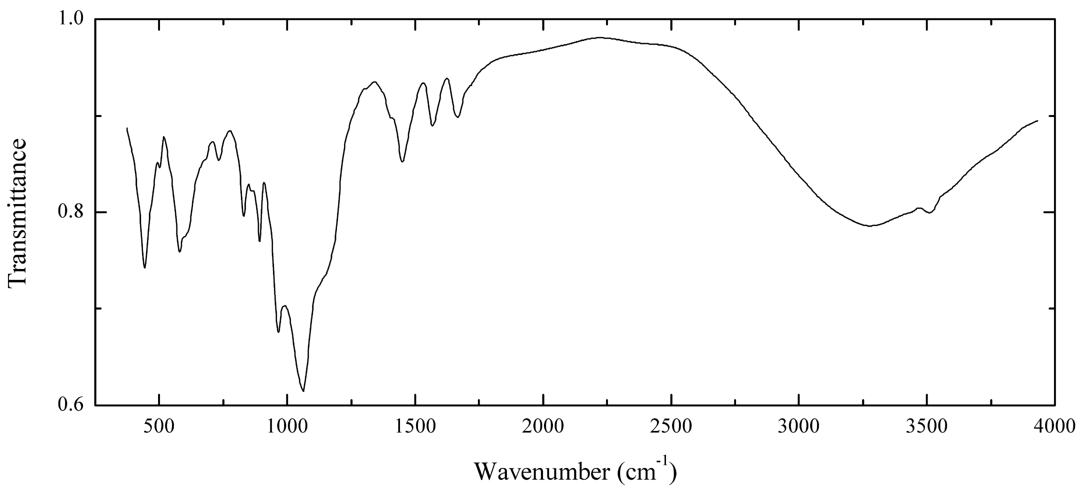


Locality: Mangan Prospect, near Mt. Hamilton, Santa Clara Co., California, USA.

Description: Pink radiated aggregates of elongated platy crystals. Compare with IR spectra of rhodonite, natronambulite and marsturite.

Wavenumbers (cm^{-1}): 3660, 3615, 3350, 1640w, 1530w, 1407, 1108, 1065sh, 1048s, 1020s, 1000sh, 974s, 958s, 941s, 930sh, 905s, 890, 743w, 714w, 684, 650, 637, 572w, 550w, 512, 488, 443s, 413, 380.

Sic84 Yegorovite $Na_4[Si_4O_8(OH)_4]\cdot 7H_2O$



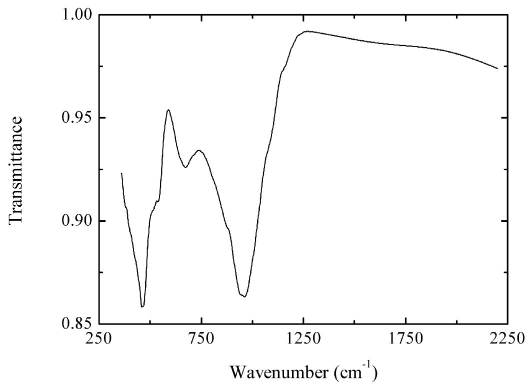
Locality: The pegmatite Palitra, Kedykverpakhk Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Colourless coarse lamellar crystals from the association with revdite, megacyclite and earlier natrosilite, microcline, villiaumite, *etc*. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/c$, $a = 9.874$, $b = 12.398$, $c = 14.897$ Å, $\beta = 104.68°$, $Z = 4$. Optically biaxial (−), $\alpha = 1.474(2)$, $\beta = 1.479(2)$, $\gamma = 1.482(2)$. $D_{meas} = 1.90(2)$ g/cm^3,

D_{calc} = 1.92 g/cm^3. The empirical formula is $Na_{3.98}Si_{4.01}O_{8.02}(OH)_{3.98}·7.205H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 7.21 (70) (002), 6.21 (72) (012, 020), 4.696 (44) (022), 4.003 (49) (211), 3.734 (46) (-213), 3.116 (100) (024, 040), 2.463 (38) (-402, -243).

Wavenumbers (cm^{-1}): 3485, 3270, 1668, 1568, 1453, 1410sh, 1140sh, 1063s, 967s, 893, 860w, 830, 730w, 675sh, 600sh, 580, 503w, 445.

Sic85 Rhönite $Ca_2(Mg,Fe^{2+},Fe^{3+},Ti)_6[(Si,Al)_6O_{20}]$

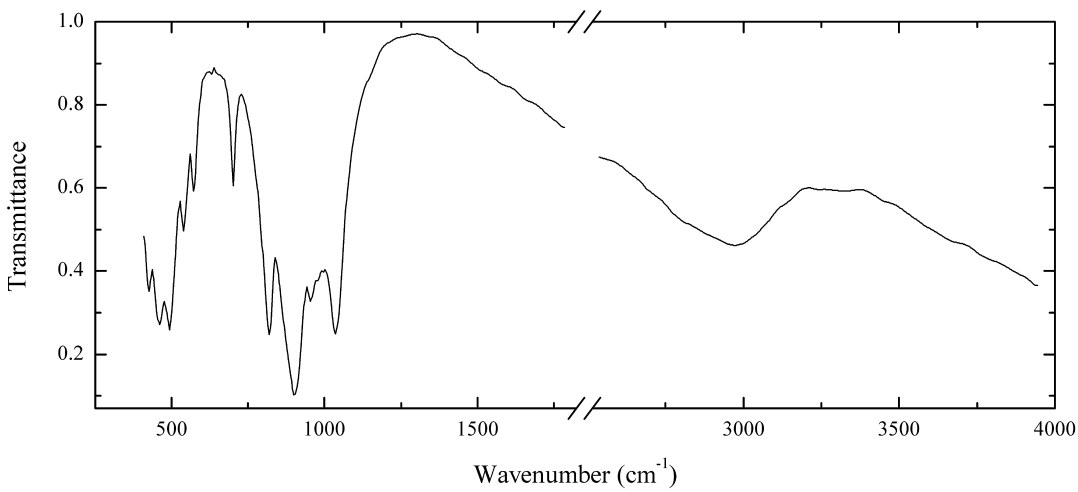


Locality: Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Dark brown grains. Fe-rich variety. The empirical formula is (electron microprobe) $(Ca_{2.0}Na_{0.15})(Mg_{2.2}Fe_{2.5}Ti_{1.1}Mn_{0.05})(Si_{3.0}Al_{2.6}Fe_{0.4}O_{20})$.

Wavenumbers (cm^{-1}): 963s, 945sh, 870sh, 669, 530sh, 460s.

Sid1 Manganilvaite $CaMn^{2+}Fe^{2+}Fe^{3+}(Si_2O_7)O(OH)$

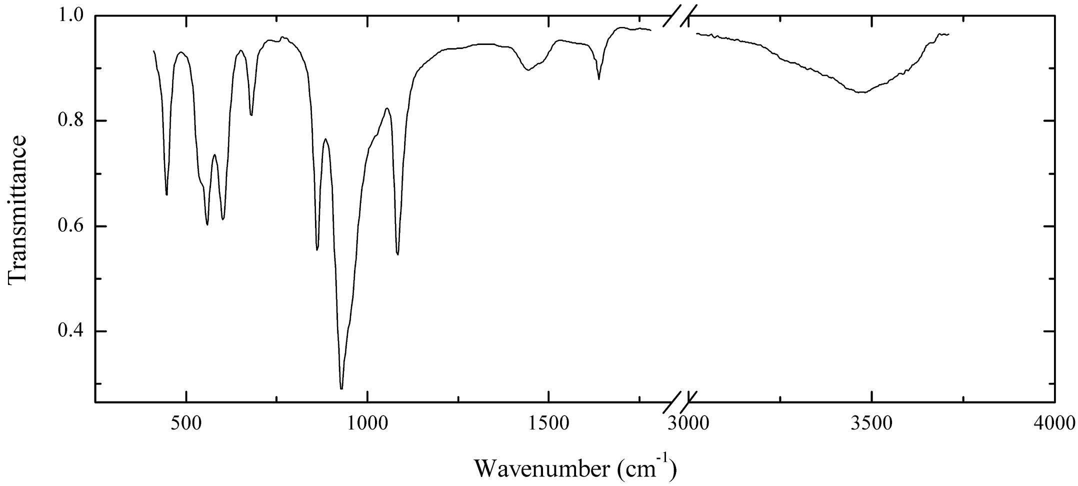


Locality: Dalnegorsk, Primorskiy Kray, Russia.

Description: Black short-prismatic crystal from the association with manganogrunerite and quartz. The empirical formula is (electron microprobe) $(Ca_{0.94}Mn_{0.06})(Mn_{0.69}Fe_{0.31})Fe_{1.02}(Si_{2.00}O_7)O(OH)$.

Wavenumbers (cm^{-1}): 2990, 1041s, 980, 957, 903s, 819s, 700, 569, 534, 488s, 448s, 419.

Sid2 Hemimorphite $Zn_4(Si_2O_7)(OH)_2 \cdot H_2O$

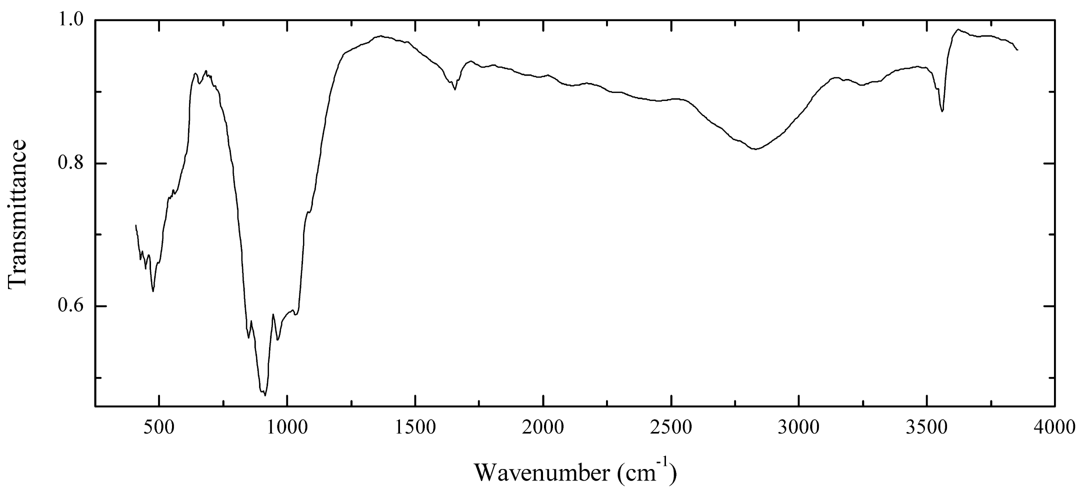


Locality: San Felix mine, El Antimoneo, Sonora, Mexico.

Description: Colourless split crystal from the association with quartz. The empirical formula is (electron microprobe) $(Zn_{3.88}Mn_{0.03}Fe_{0.02})(Si_{2.00}O_7)(OH,H_2O)_3$. Weak band at 1,440 cm^{-1} corresponds to the admixture of a carbonate mineral.

Wavenumbers (cm^{-1}): 3445, 1635w, 1440w, 1085s, 955sh, 934s, 865s, 678, 605, 561, 541, 449.

Sid3 Hennomartinite $SrMn^{3+}{}_2(Si_2O_7)(OH)_2 \cdot H_2O$

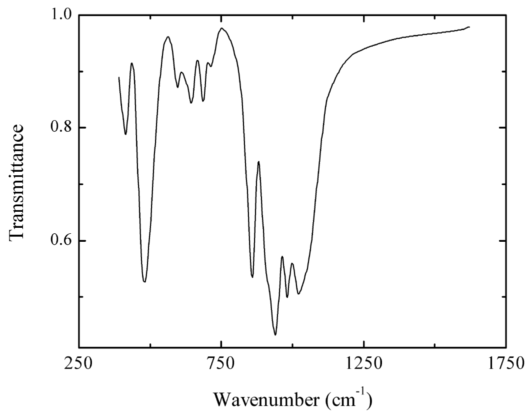


Locality: Wessels mine, Kalahari manganese fields, Northern Cape province, South Africa (type locality).

Description: Reddish-brown aggregate from the association with braunite.

Wavenumbers (cm^{-1}): 3540, 3340w, 2820, 2655w, …, 1087, 1035, 990sh, 966s, 918s, 902s, 851s, 661w, 605sh, 560sh, 537, 500, 477, 447, 414.

Sid5 Åkermanite $Ca_2Mg(Si_2O_7)$

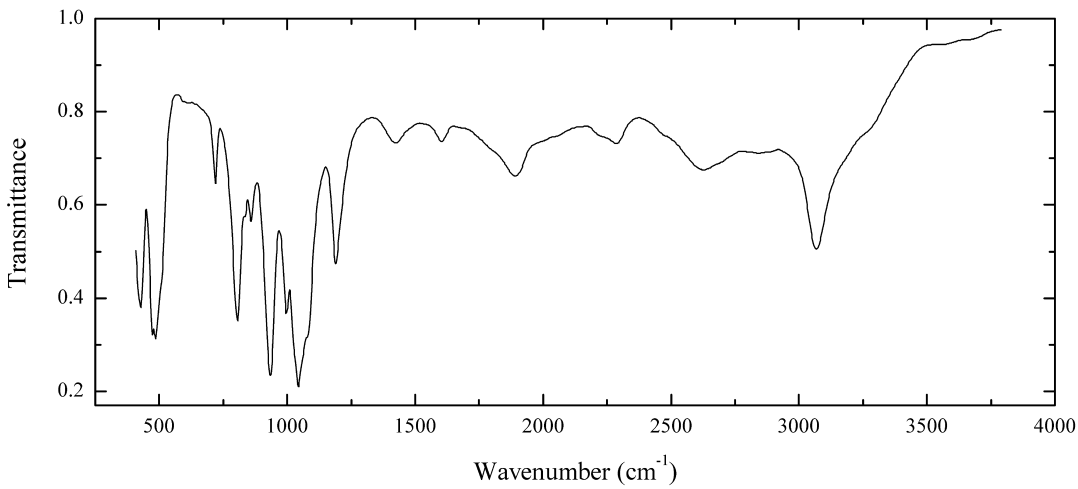


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Dark grey coarse-grained aggregate. The empirical formula is (electron microprobe) $(Ca_{1.73}Na_{0.24})(Mg_{0.64}Fe_{0.15}Al_{0.21})(Si_{1.98}Al_{0.02}O_7)$.

Wavenumbers (cm^{-1}): 1040sh, 1019s, 976s, 934s, 905sh, 853s, 706w, 680, 638, 620sh, 587, 472s, 403.

Sid6 Suolunite $Ca_2[Si_2O_5(OH)_2]\cdot H_2O$

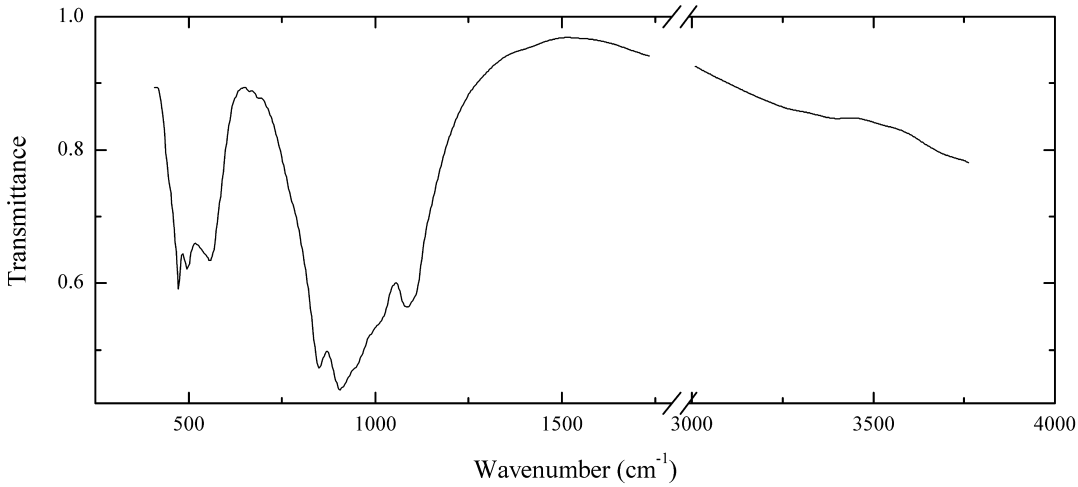


Locality: Yoko-Dovyrenskiy massif, the Republic of Buryatia, Transbaikal Territory, Eastern Siberia, Russia.

Description: White grains from calcic xenolith. Identified by IR spectrum and electron microprobe analysis. Investigated by A.E. Zadov.

Wavenumbers (cm^{-1}): 3250sh, 3058, 2850w, 2630, 2290w, 2220sh, 1900, 1610w, 1420w, 1380sh, 1191, 1075sh, 1042s, 998, 932s, 858, 833, 803s, 716, 500sh, 480s, 471s, 417.

Sid8 Keiviite-(Y) $(Y,Yb)_2(Si_2O_7)$

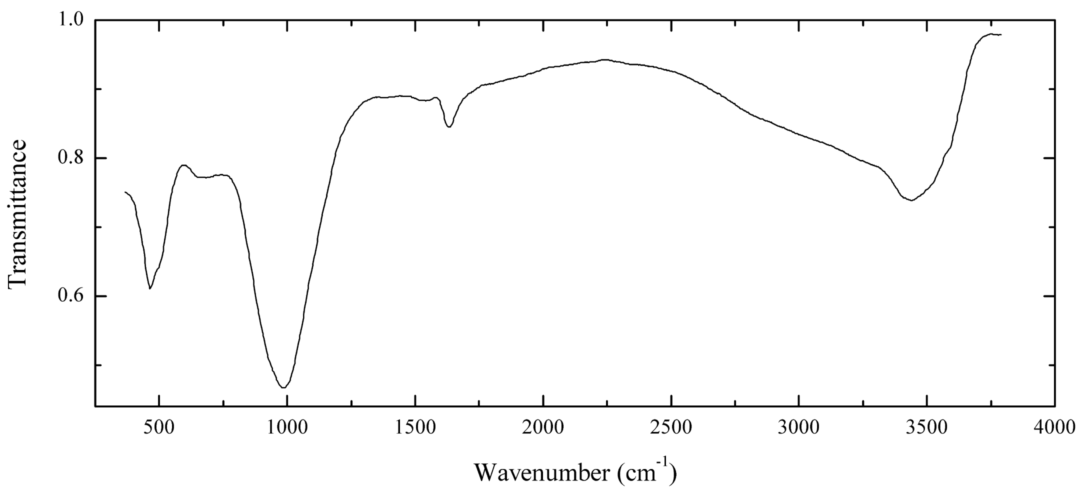


Locality: Ploskaya Mt., Western Keivy Mts., Kola peninsula, Murnansk region, Russia (type locality).

Description: Pink spherulite from massive yttrofluorite. The empirical formula is (electron microprobe) $(Y_{0.76}Yb_{0.73}Er_{0.17}Lu_{0.17}Tm_{0.10}Dy_{0.03}Ca_{0.03}Ho_{0.01}Sm_{0.01})(Si_{2.00}O_7)$.

Wavenumbers (cm^{-1}): 1110sh, 1091s, 1015sh, 955sh, 912s, 853s, 559, 540sh, 499, 476.

Sid9 Yttrialite-(Y) $Y_2(Si_2O_7)$

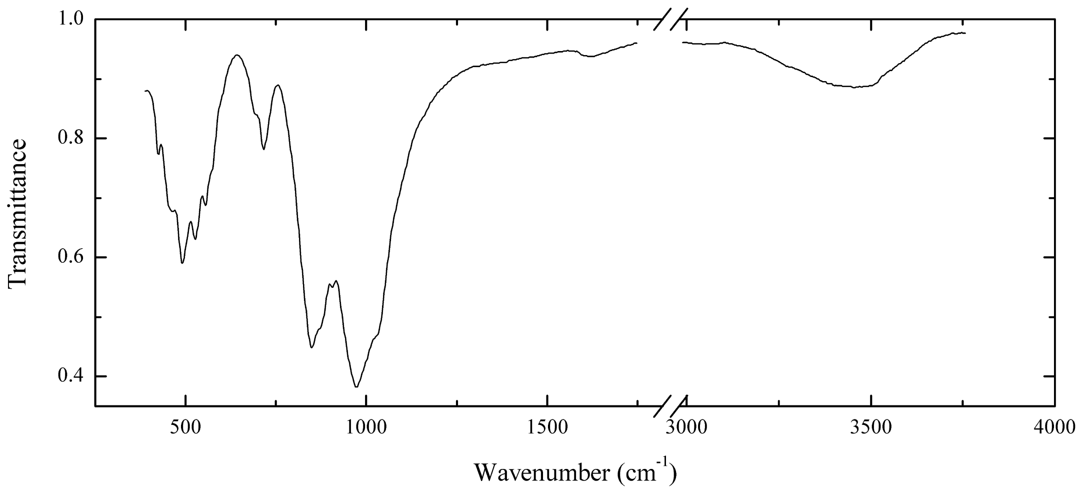


Locality: Idkerberget, Borlänge, Dalarna, Sweden.

Description: Brown massive from the association with tengerite-(Y). Amorphous, metamict and hydrated sample. The empirical formula is (electron microprobe) $(Y_{1.30}Yb_{0.16}Dy_{0.10}Er_{0.07}Sm_{0.03}Ca_{0.12}Th_{0.10}Fe_{0.07}Pb_{0.04}U_{0.03})(Si_{1.85}Al_{0.10}P_{0.06}O_7)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3540sh, 3410, 2900sh, 1625, 1530w, 986s, 670w, 500sh, 462.

Sid10 Yttrialite-(Y) $Y_2(Si_2O_7)$

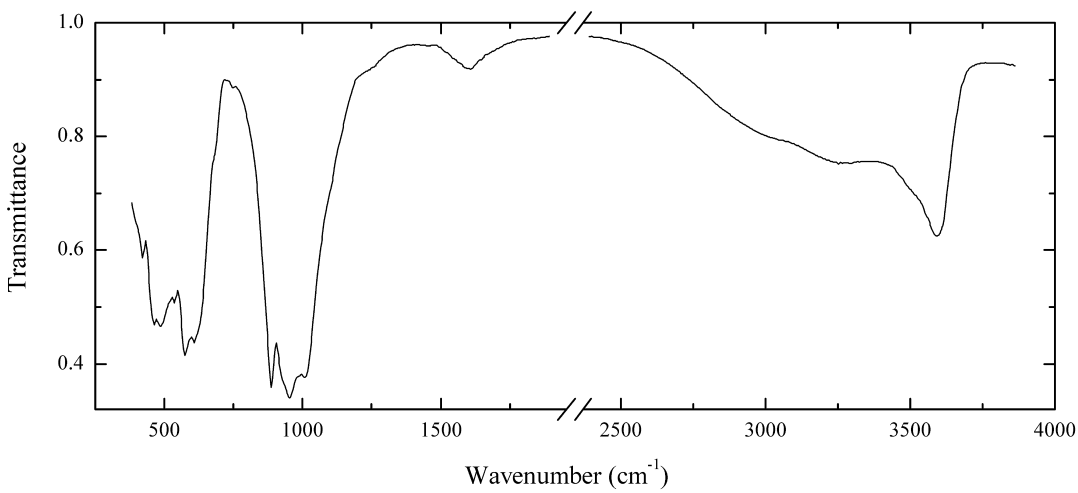


Locality: Idkerberget, Borlänge, Dalarna, Sweden.

Description: Brown massive from the association with tengerite-(Y). Amorphous, metamict and hydrated sample after annealing at 950 °C during 1.5 h. The empirical formula is (electron microprobe) $(Y_{1.30}Yb_{0.16}Dy_{0.10}Er_{0.07}Sm_{0.03}Ca_{0.12}Th_{0.10}Fe_{0.07}Pb_{0.04}U_{0.03})(Si_{1.85}Al_{0.10}P_{0.06}O_7){\cdot}nH_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 4.343 (43), 3.314 (28), 2.998 (100), 2.903 (54), 2.858 (35), 2.793 (45), 2.706 (29).

Wavenumbers (cm^{-1}): 3415, 3260sh, 1625w, 1030sh, 975s, 908, 870sh, 849s, 718, 693w, 570w, 555, 528, 491, 465, 455sh, 423.

Sid11 Lawsonite $CaAl_2(Si_2O_7)(OH)_2{\cdot}H_2O$

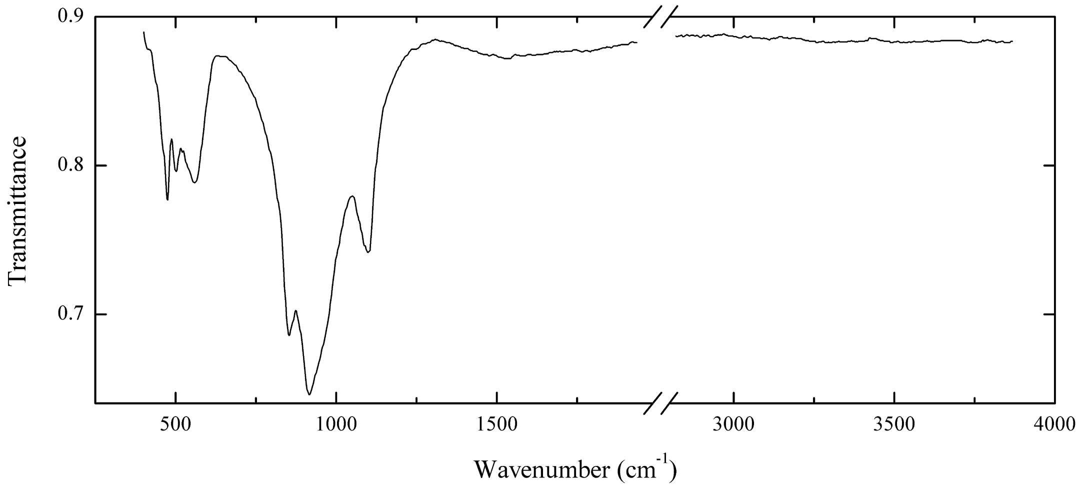


Locality: Tiburon peninsula, Marin Co., California, USA (type locality).

Description: White semitransparent grains. Specimen No. 1/9869 from the Mineralogical Museum of the St. Petersburg State University. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3565, 3250, 3020sh, 1605w, 1007s, 951s, 920sh, 884s, 751w, 675sh, 607s, 573s, 533, 510sh, 485, 465, 419, 405sh.

Sid12 Keiviite-(Yb) $(Yb,Y)_2(Si_2O_7)$

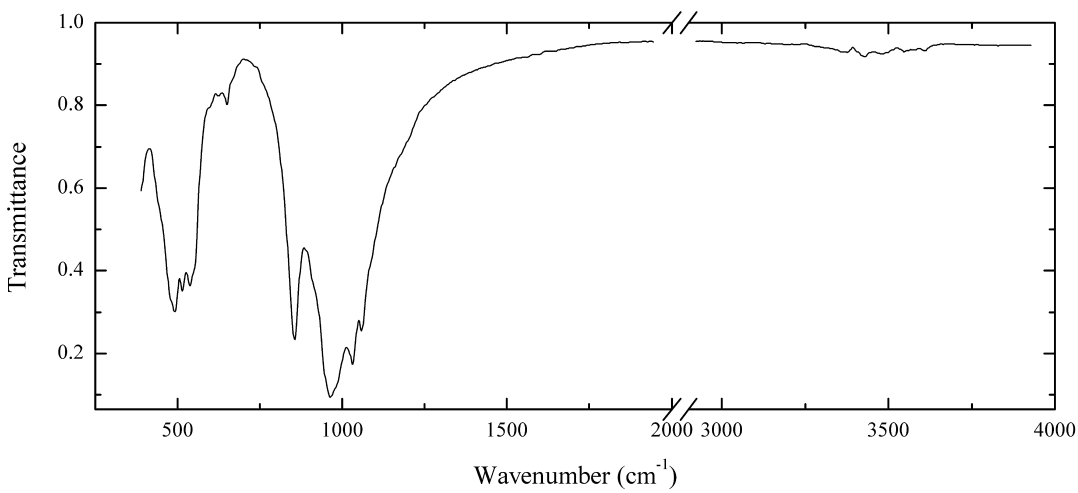


Locality: Ploskaya Mt., Western Keivy Mts., Kola peninsula, Murnansk region, Russia (type locality).

Description: White cluster of prismatic crystals from massive yttrofluorite. The empirical formula is (electron microprobe) $(Yb_{0.79}Y_{0.69}Er_{0.18}Lu_{0.12}Tm_{0.12}Dy_{0.04}Ca_{0.04}Sm_{0.03})(Si_{2.00}O_7)$.

Wavenumbers (cm^{-1}): 1097, 1080sh, 950sh, 917s, 852s, 570sh, 558, 540sh, 501, 475.

Sid13 Cuspidine $Ca_8(Si_2O_7)_2F_4$

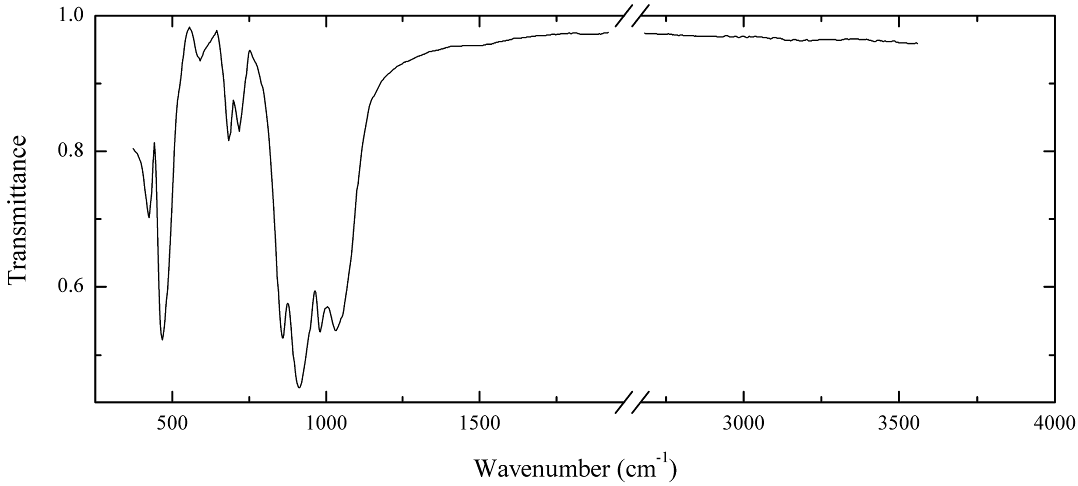


Locality: Tyrnyauz Mo-W deposit, Baksan valley, Republic of Kabardino-Balkaria, Northern Caucasus, Russia.

Description: Light grey coarse-grained aggregate. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3595w, 3335w, 3465w, 3410w, 3355w, 1170sh, 1057s, 1031s, 980sh, 965s, 915sh, 854s, 649w, 624w, 595sh, 545sh, 536, 512, 488s, 476, 440sh.

Sid14 Alumoåkermanite $(Ca,Na)_2(Al,Mg,Fe)(Si_2O_7)$

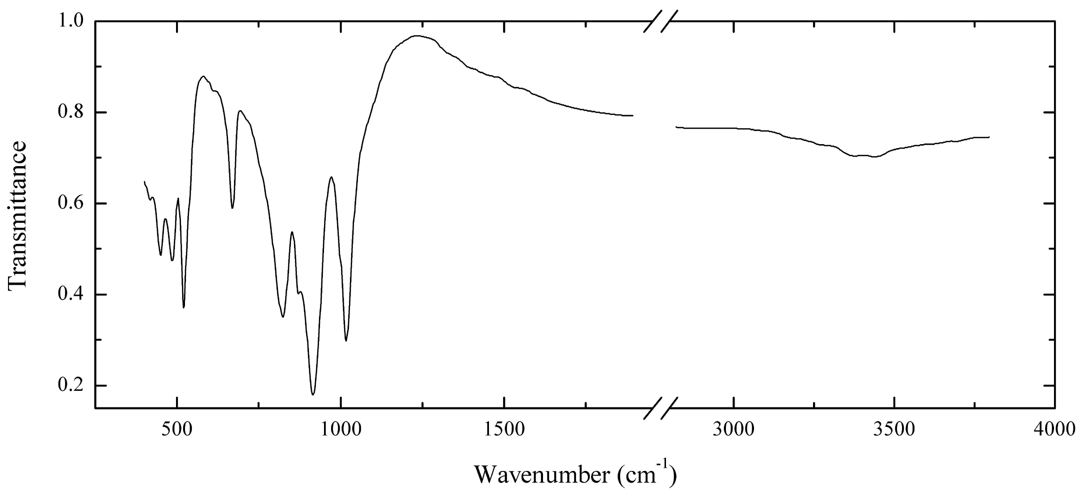


Locality: Namuaiv Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Grey transparent grains from cuspidine-bearing metasomatic rock, from the association with pectolite. Investigated by A.K. Shpachenko and A.P. Khomyakov. Optically uniaxial (−), $\varepsilon = 1.619$, $\omega = 1.630$. The empirical formula is (electron microprobe) $(Ca_{1.23}Na_{0.73}Sr_{0.13})(Al_{0.64}Mg_{0.13}Fe_{0.10}Mn_{0.04})Si_{2.02}O_7$.

Wavenumbers (cm^{-1}): 1033s, 981s, 913s, 857s, 713, 681, 610sh, 587w, 465s, 422.

Sid15 Nasonite $Pb_6Ca_4(Si_2O_7)_3Cl_2$

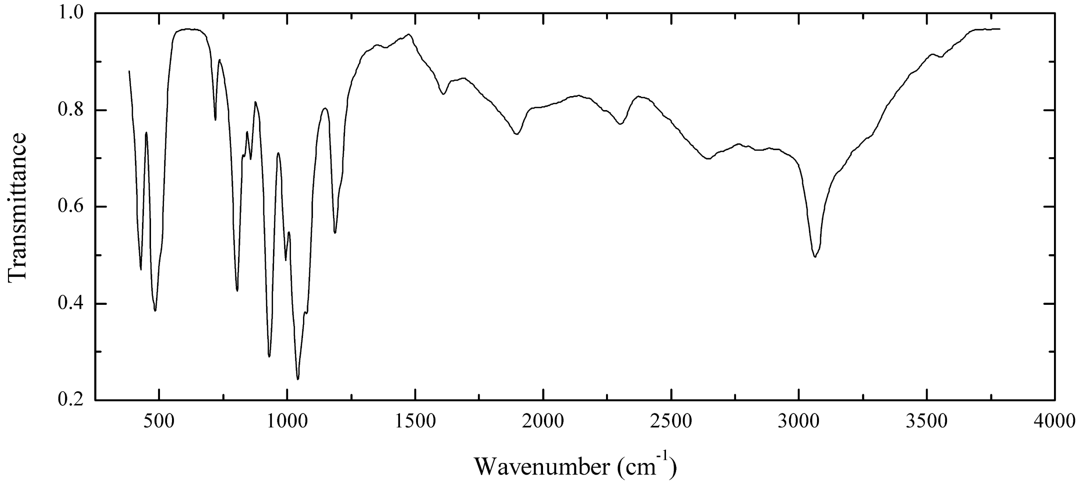


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: Yellow grains from the association with barysilite. Confirmed by electron microprobe analysis.

Wavenumbers (cm^{-1}): 1015s, 912s, 867, 821s, 665, 534, 514s, 479, 442, 409.

Sid16 Suolunite $Ca_2[Si_2O_5(OH)_2]\cdot H_2O$

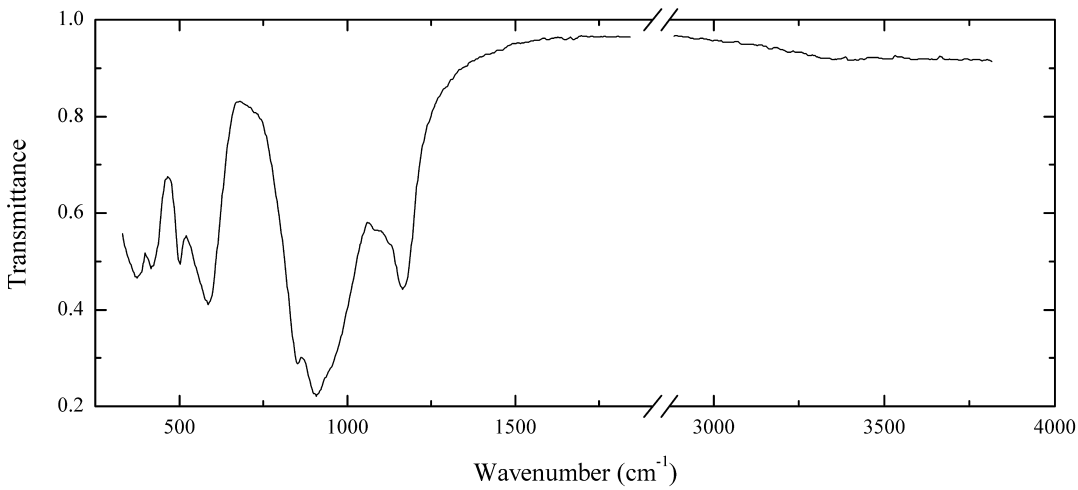


Locality: Mine Lac d'Amiante (Lake Asbestos mine), Saint-Joseph-de-Coleraine, Chaudière-Allalaches, Québec, Canada.

Description: Yellowish coarse-grained aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3550w, 3250sh, 3060, 2860w, 2650, 2300, 1900, 1610w, 1385w, 1210sh, 1192, 1079s, 1043s, 997, 857, 832, 804s, 717, 500sh, 481, 470sh, 420.

Sid17 Thortveitite $(Sc,Y)_2(Si_2O_7)$

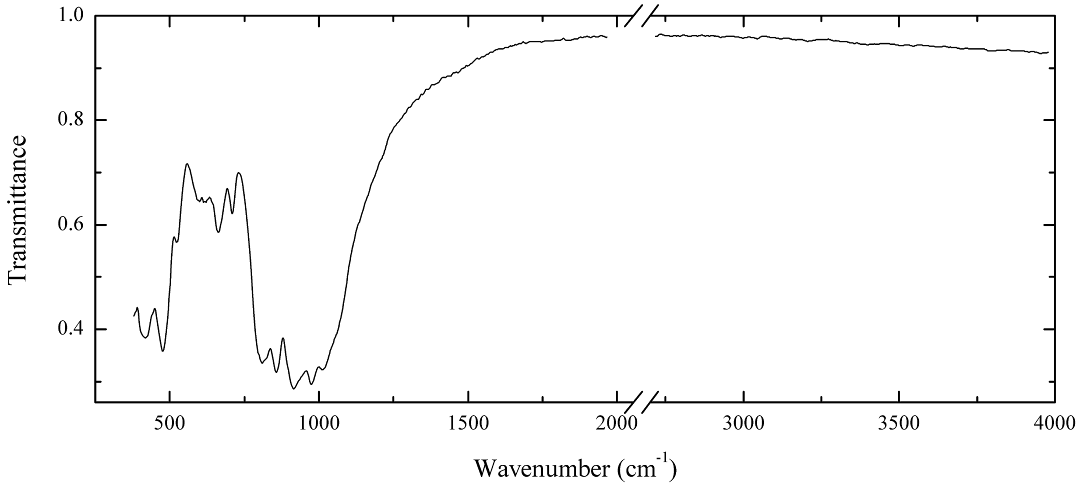


Locality: Undeland (Unneland), Evje og Horness, Aust-Agder, Norway.

Description: Grey-green long-prismatic crystals from the association with beryl, feldspar and quartz. The empirical formula is (electron microprobe) $(Sc_{1.58}Y_{0.33}Fe_{0.06}La_{0.02})(Si_{1.94}Al_{0.06}O_7)$.

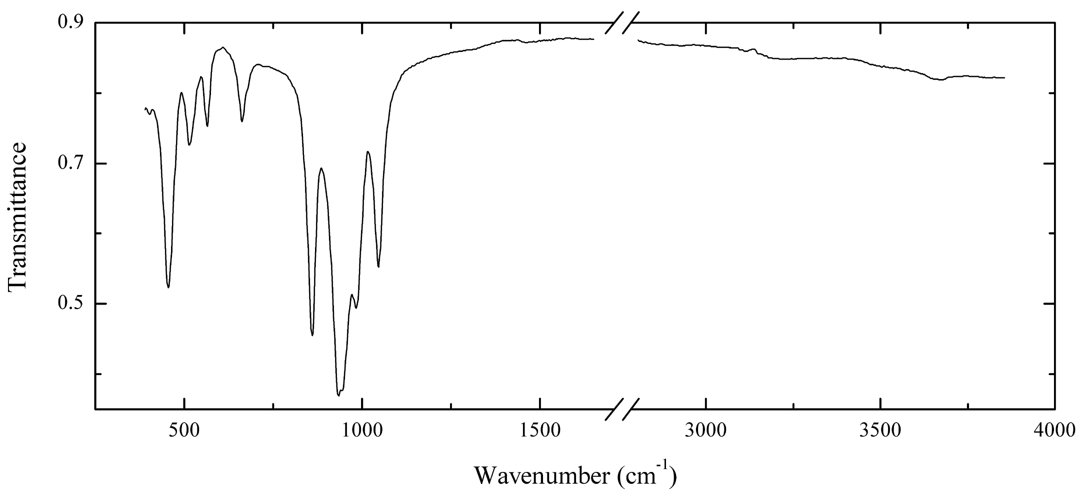
Wavenumbers (cm^{-1}): 1167, 1130sh, 950sh, 909s, 854s, 586, 500, 420, 375.

Sid18 Gehlenite $Ca_2Al(AlSiO_7)$



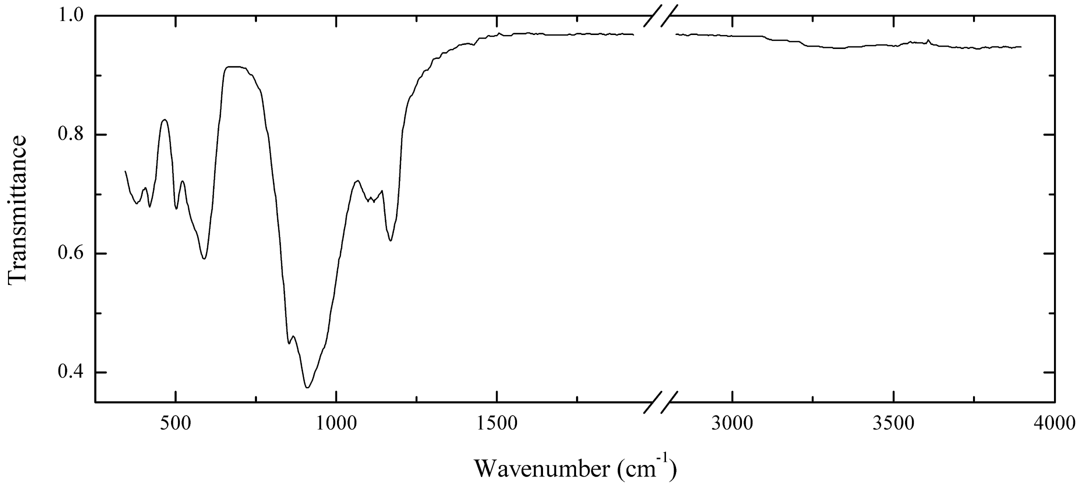
Locality: Hirata outcrop, near Toyo station, Kushiro area, Hiroshima prefecture, Japan.
Description: Grey granular aggregate from the association with clinopyroxene, andradite and feldspar. The empirical formula is (electron microprobe) $(Ca_{1.8}Na_{0.1})(Al_{0.7}Mg_{0.2}Fe_{0.1})(Al_{0.75}Si_{1.25}O_7)$.
Wavenumbers (cm^{-1}): 1050sh, 1011s, 974s, 915s, 856s, 807s, 710, 667, 621w, 604w, 523, 477s, 410.

Sid19 Ericssonite $BaMn^{2+}{}_2Fe^{3+}(Si_2O_7)O(OH)$



Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).
Description: Dark red grains with perfect cleavage from the association with bustamite.
Wavenumbers (cm^{-1}): 3630w, 1043, 982, 944s, 931s, 859s, 675sh, 662, 564, 516, 455, 396w.

Sid20 Thortveitite $(Sc,Y)_2(Si_2O_7)$

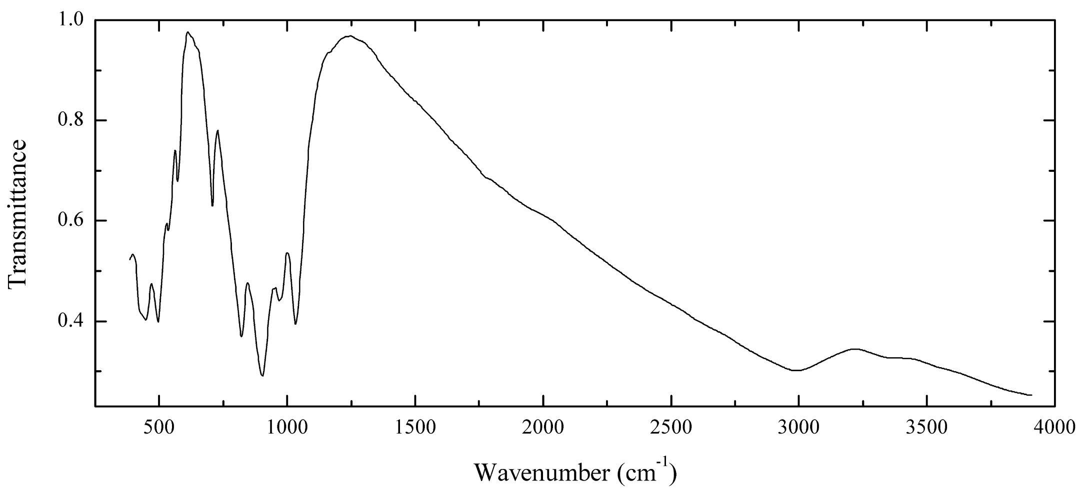


Locality: Överlida, Svenljunga, Västergötland, Sweden.

Description: Grey-green prismatic crystal from the association with microcline and Sc-rich euxenite-(Y). The empirical formula is (electron microprobe) $(Sc_{1.85}Y_{0.10}Fe_{0.03}Mn_{0.02})(Si_{1.93}Fe_{0.04}P_{0.03}O_7)$.

Wavenumbers (cm^{-1}): 1166, 1119, 1095, 950sh, 909s, 853s, 584, 560sh, 500, 412, 371.

Sid21 Ilvaite $CaFe^{2+}{}_2Fe^{3+}(Si_2O_7)O(OH)$

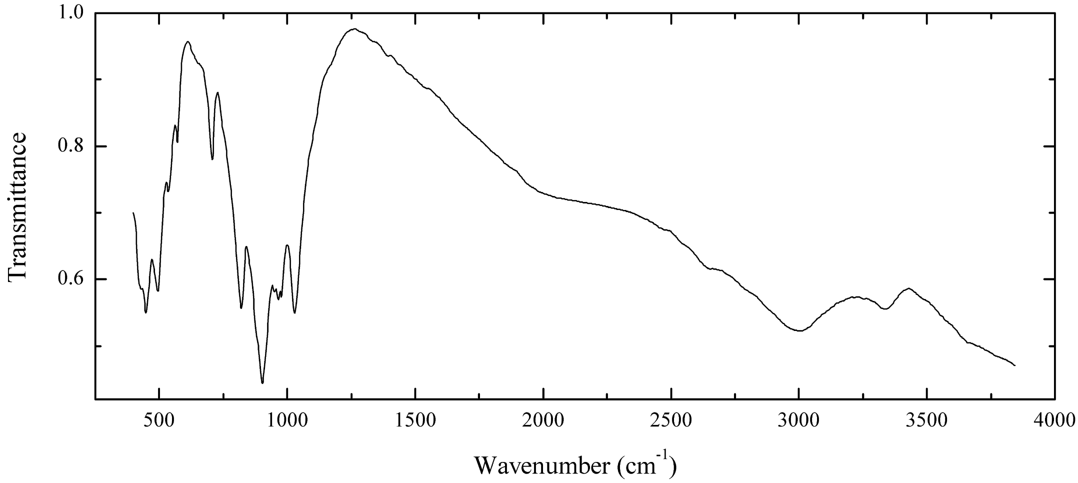


Locality: Dalnegorsk, Primorskiy Kray, Far East, Russia.

Description: Black flattened short-prismatic crystal from the association with hedenbergite and quartz. The empirical formula is (electron microprobe) $Ca_{0.97}Fe_{2.67}Mn_{0.33}Al_{0.02}(Si_{2.00}O_7)O(OH)$.

Wavenumbers (cm^{-1}): 3300w, 2990, 1030s, 980, 965, 902s, 819s, 707, 570, 537, 495s, 445s, 425sh.

Sid22 Ilvaite $CaFe^{2+}{}_2Fe^{3+}(Si_2O_7)O(OH)$

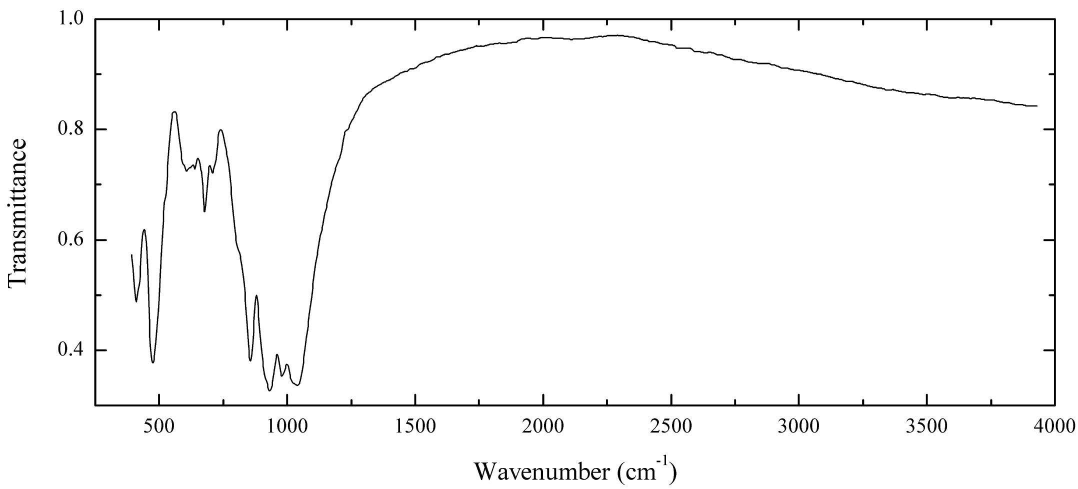


Locality: Ilímaussaq complex, Narsaq, Kitaa (West Greenland) province, Greenland.

Description: Black grains from the association with epidote. Identified by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3300w, 2985, 1027s, 979, 967, 951, 902s, 820s, 706, 571, 535, 495, 447s, 425sh.

Sid23 Gehlenite $Ca_2Al(AlSiO_7)$

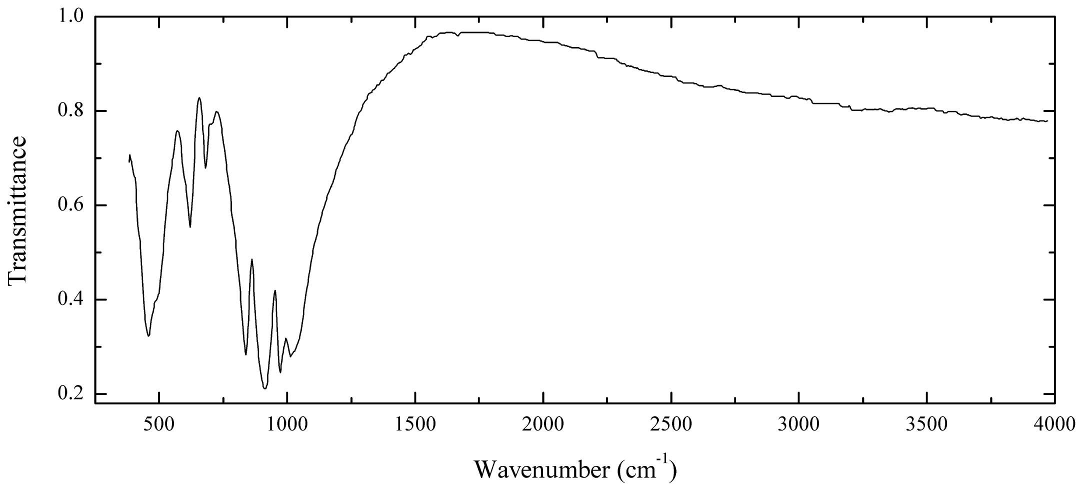


Locality: Cavalluccio Mt. (Monte Cavalluccio), Campagnano municipality, Roma province, Latium region, Italy.

Description: Grey crystals from the association with sanidine. Confirmed by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 1037s, 1025sh, 976s, 930s, 855s, 805sh, 706w, 674, 635w, 603w, 475s, 410.

Sid24 Hardystonite $Ca_2Zn(Si_2O_7)$

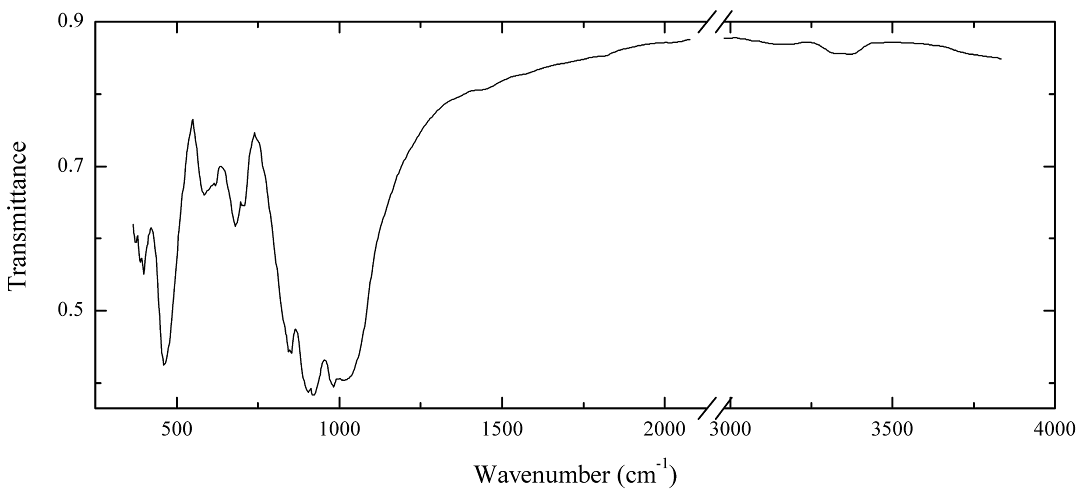


Locality: Franklin, Sussex Co., New Jersey, USA (type locality).

Description: Light grey grains with pale violet fluorescence under short-wave UV radiation, from the association with andradite and Mn-bearing calcite. Confirmed by IR spectrum and qualitative electron microprobe analysis..

Wavenumbers (cm^{-1}): 1040sh, 1016s, 972s, 912s, 839s, 700w, 679, 619, 600sh, 550sh, 490sh, 457.

Sid25 "Åkermanite-Fe^{2+}" $Ca_2Fe^{2+}(Si_2O_7)$

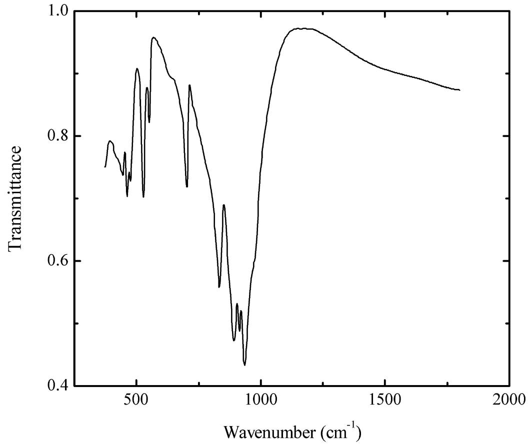


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Brown grains from the association with nepheline and leucite. Not approved by the IMA CNMNC. The empirical formula is (electron microprobe) $(Ca_{1.61}Na_{0.39})(Fe_{0.48}Al_{0.32}Mg_{0.19}Ti_{0.01})(Si_{1.97}Al_{0.03}O_7)$.

Wavenumbers (cm^{-1}): 3360w, 3305w, 1020s, 980s, 920s, 859s, 705, 681, 610sh, 584, 462s, 395.

Sid26 Barysilite $Pb_8Mn(Si_2O_7)$

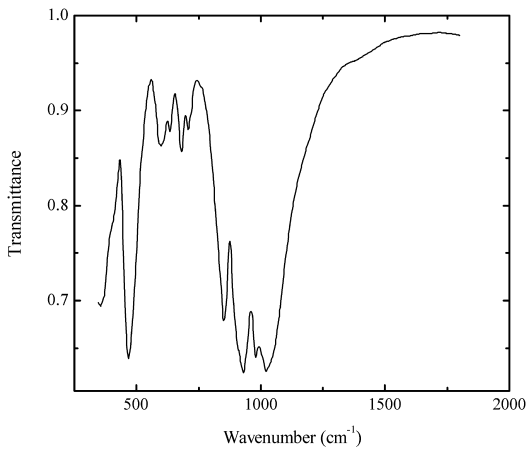


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: Yellowish platy grains from skarn. Specimen No. 1/9492 from the Mineralogical Museum of St. Petersburg State University. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 970sh, 934s, 913s, 892s, 833, 701, 550w, 525, 476, 461, 441, 420sh.

Sid27 Åkermanite $Ca_2Mg(Si_2O_7)$

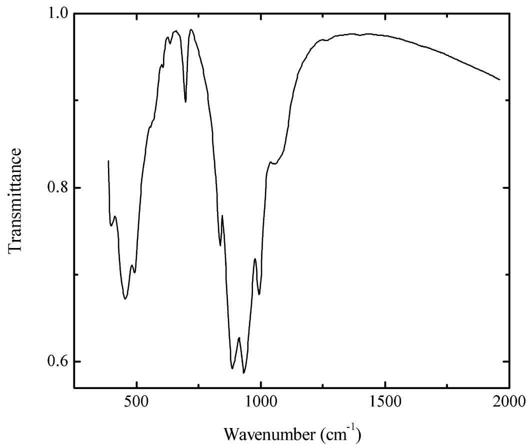


Locality: Graulay (other versions of spelling: Graulai, Graulei), near Hillesheim, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Light yellow crystals from the association with nepheline, leucite, augite, magnetite, fluotapatite and perovskite. The empirical formula is (electron microprobe) $(Ca_{1.7}Na_{0.3})(Mg_{0.6}Al_{0.3}Fe_{0.1})(Si_{2.0}O_7)$.

Wavenumbers (cm^{-1}): 1021s, 977s, 928s, 850s, 705w, 680, 633w, 593, 466s, 400.

Sid28 Melanotekite $Pb_2Fe^{3+}{}_2(Si_2O_7)_2O_2$

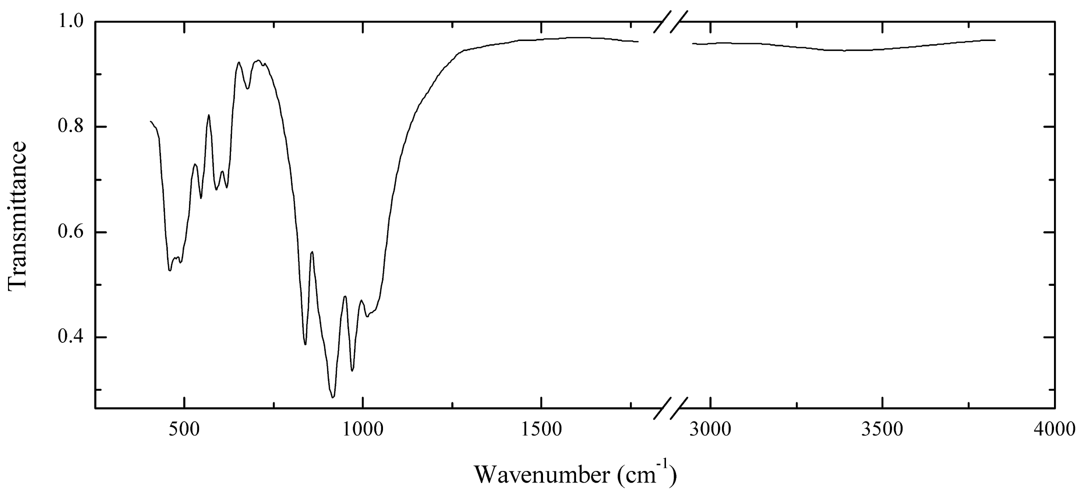


Locality: Jakobsberg mine, Nordmarksberg, Filipstad, Värmland, Sweden.

Description: Dark brown grains. The empirical formula is (electron microprobe) $Pb_{2.03}(Fe_{1.90}Mn_{0.04}Ti_{0.02}Al_{0.02})(Si_4O_7)_{2.00}O_2$.

Wavenumbers (cm^{-1}): 1060, 992, 936s, 888s, 836, 697, 641w, 607w, 565sh, 493, 458, 396.

Sid29 Hardystonite $Ca_2Zn(Si_2O_7)$

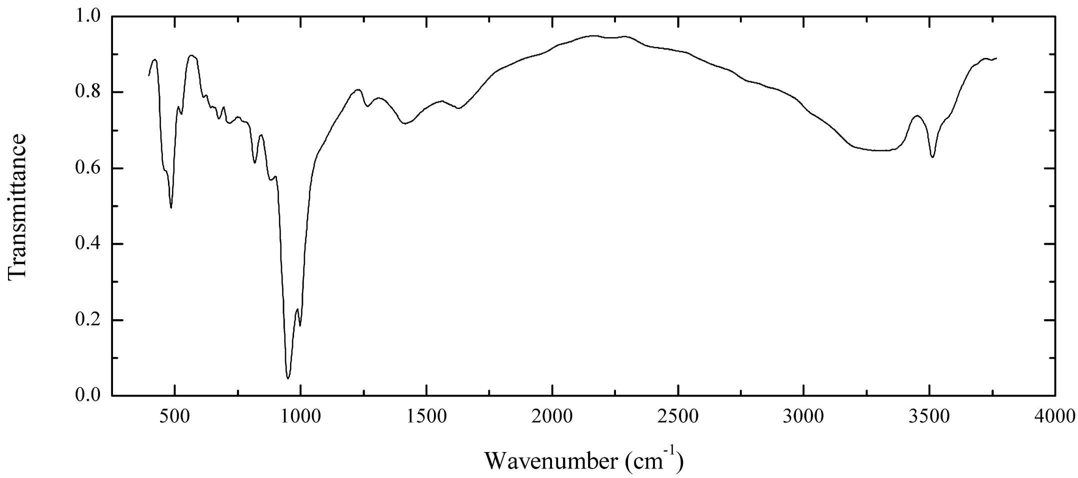


Locality: North Hill mine, Hardyston township, Franklin mining district, Sussex Co., New Jersey, USA (type locality).

Description: Light brown granular aggregate from the association with franklinite, willemite, vesuvianite and calcite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1030sh, 1012, 970s, 916s, 890sh, 840s, 681w, 618, 591, 547, 500sh, 489, 459.

Sid30 Aklimaite $Ca_4[Si_2O_5(OH_2)](OH)_4{\cdot}5H_2O$

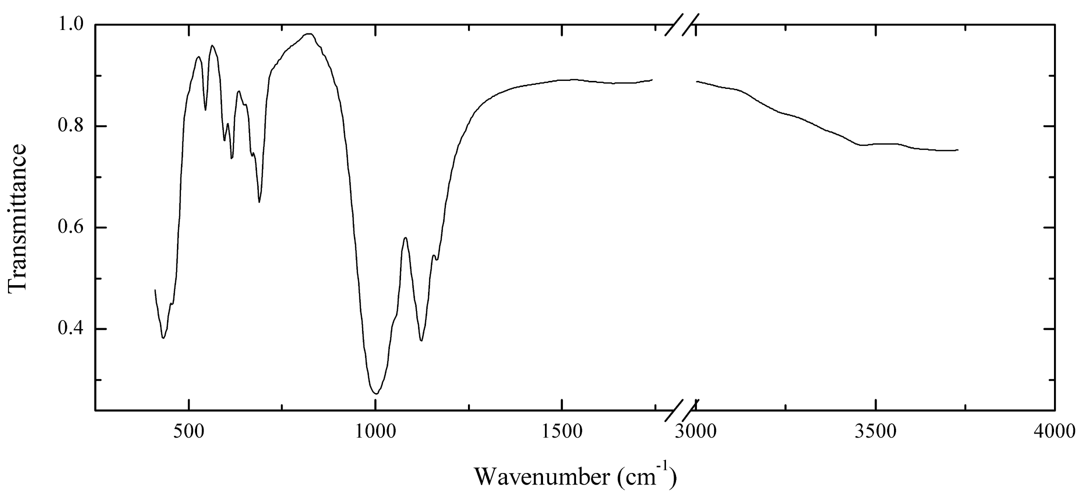


Locality: Lakargi Mt., Upper Chegem caldera, Kabardino-Balkaria, Northern Caucasus, Russia (type locality).

Description: Columnar lath-shaped crystals from the association with larnite, calcium humite-group members, hydrogarnets, bultfonteinite, afwillite and ettringite. Holotype sample. Monoclinic, space group *C*2/*m*, $a = 16.907(5)$, $b = 3.6528(8)$, $c = 13.068(4)$ Å, $\beta = 117.25(4)°$, $V = 717.5(4)$ Å^3, $Z = 2$. Optically biaxial (–), $\alpha = 1.548(2)$, $\beta = 1.551(3)$, $\gamma = 1.553(2)$. $D_{calc} = 2.274$ g/cm^3. The empirical formula is $(Ca_{4.02}Na_{0.01})[Si_{2.00}O_{5.07}(OH)_{1.93}][(OH)_{3.16}F_{0.84}]{\cdot}5H_2O$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 11.64 (100) (001), 2.948 (32) (310, 203), 3.073 (20) (404, 311), 2.320 (12) (005, 510), 2.901 (11) (004), 8.30 (10) (201).

Wavenumbers (cm^{-1}): 3575sh, 3510, 3300, 1650, 1410, 1280, 1015s, 965s, 900, 833, 728, 685, 650, 621, 569, 492, 463.

Sif1 Afghanite $(Na,K)_{5.5}Ca_{2.5}(Si_6Al_6O_{24})(SO_4)_{1.5}Cl_{1.5}$

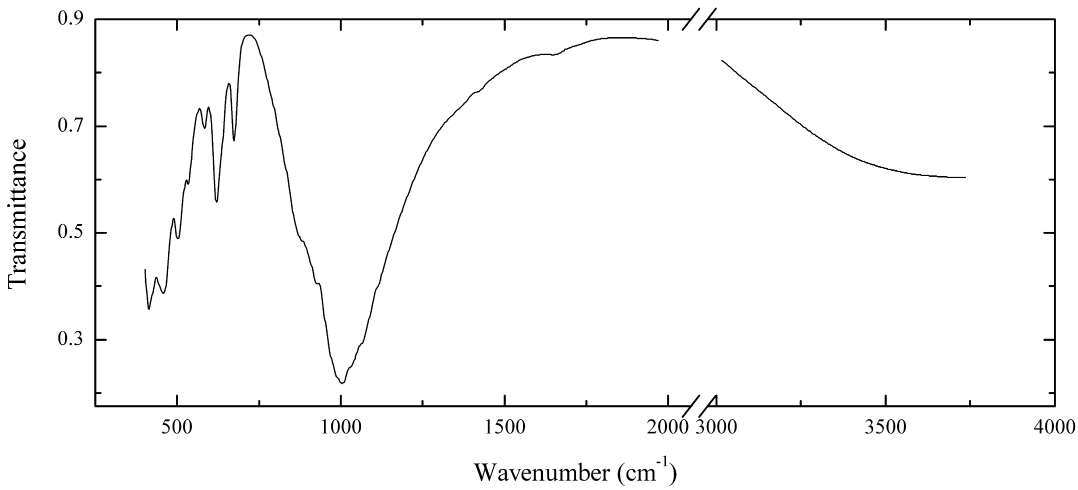


Locality: Malobystrinskoe lazurite deposit, near Slyudyanka, Irkutsk region, Eastern Siberia, Russia.

Description: Colourless grains from the association with lazurite, fluorapatite and diopside. Identified by IR spectrum and powder X-ray diffraction pattern.

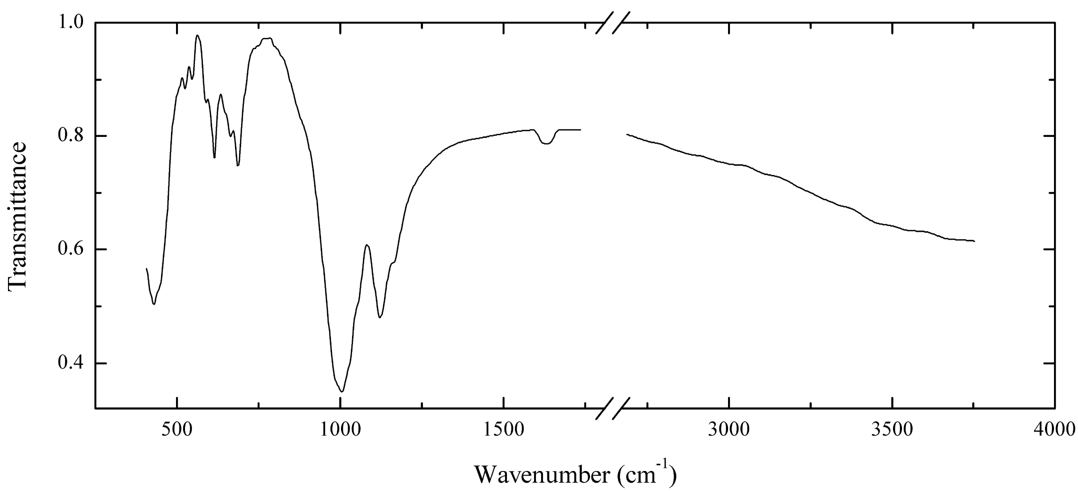
Wavenumbers (cm^{-1}): 3465w, 1166, 1123s, 1054, 1002s, 685, 663, 643w, 611, 590, 540, 449, 426s.

Sif2 Bystrite $(Na,K)_7Ca(Si_6Al_6O_{24})S^{2-}{}_{1.5}{\cdot}H_2O$



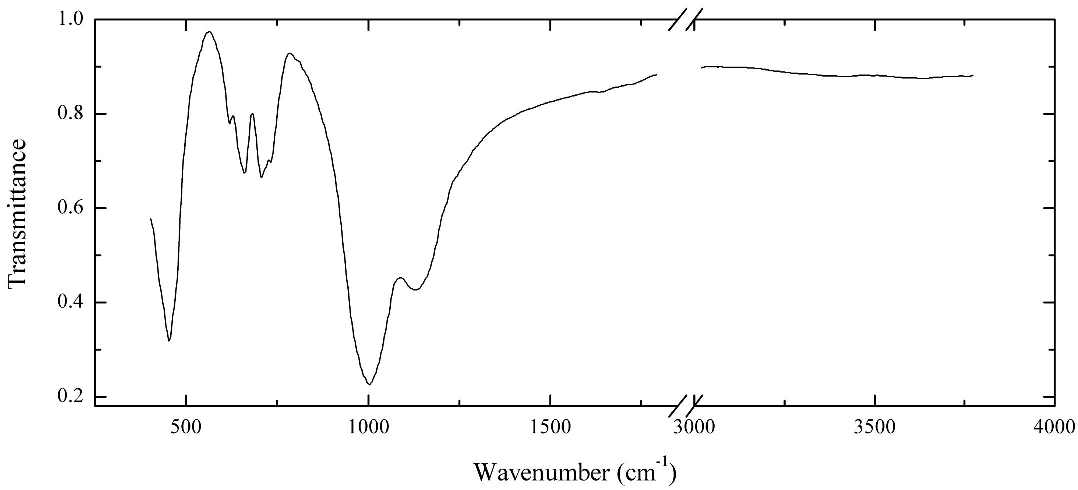
Locality: Malobystrinskoe lazurite deposit, near Slyudyanka, Irkutsk region, Eastern Siberia, Russia.
Description: Orange-yellow grains from the association with lazurite, diopside and calcite. Identified by IR spectrum and powder X-ray diffraction pattern. Evolves H_2S during grinding.
Wavenumbers (cm^{-1}): 3450w, 1648w, 1415sh, 1115sh, 1060sh, 1025sh, 1003s, 975sh, 929, 880sh, 670, 630sh, 615, 580, 530, 497, 455s, 407s.

Sif3 Tounkite $(Na,Ca,K)_8(Si_6Al_6O_{24})(SO_4)_2Cl{\cdot}nH_2O$



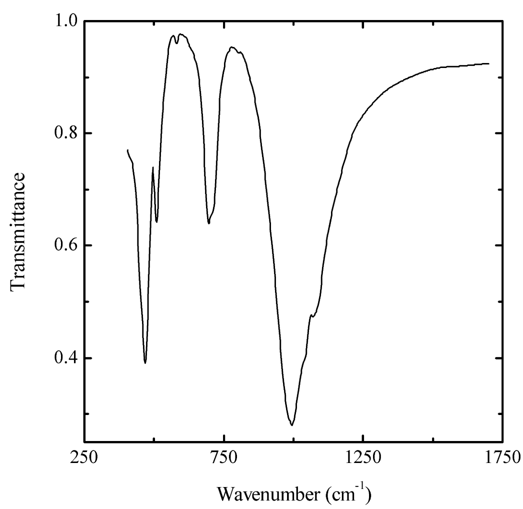
Locality: Tultuiskoe lazurite deposit, near Slyudyanka, Irkutsk region, Eastern Siberia, Russia.
Description: Light blue grains from the association with lazurite and afghanite. Identified by IR spectrum and powder X-ray diffraction pattern. The crystal structure is investigated on a single crystal (space group *P*3; unit-cell parameters are a = 12.757, c = 32.211 Å).
Wavenumbers (cm^{-1}): 3450w, 1628w, 1415w, 1165, 1122s, 1055sh, 1005s, 685, 661, 611, 584w, 543w, 521w, 445sh, 425s.

Sif4 Haüyne $Na_6Ca_2(Si_6Al_6O_{24})(SO_4)_2$



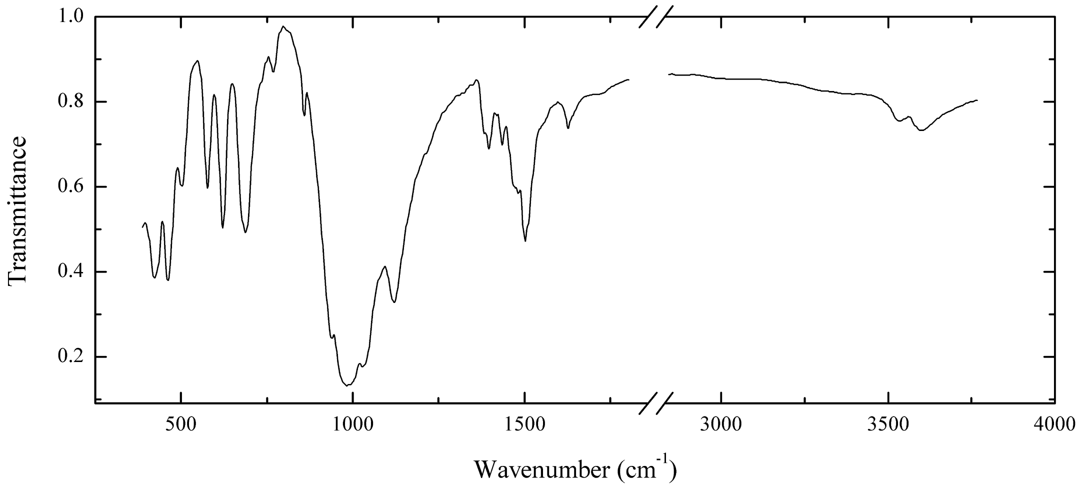
Locality: Ladjvardara lazurite deposit, Pamir Mts., Tajikistan.
Description: Light green grains from the association with diopside and calcite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1135s, 1003s, 728, 710sh, 701, 655, 645sh, 613, 447s.

Sif5 Nepheline $(Na,K)(AlSiO_4)$



Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Greenish crystals from the association with tisinalite and Fe-deficient eudialyte. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{0.79}K_{0.18}(Al_{0.97}Si_{1.03}O_4)$.
Wavenumbers (cm^{-1}): 1090sh, 1072, 1040sh, 994s, 985sh, 705sh, 693, 578w, 507, 466s, 455sh.

Sif6 Cancrinite $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}\cdot 2H_2O$

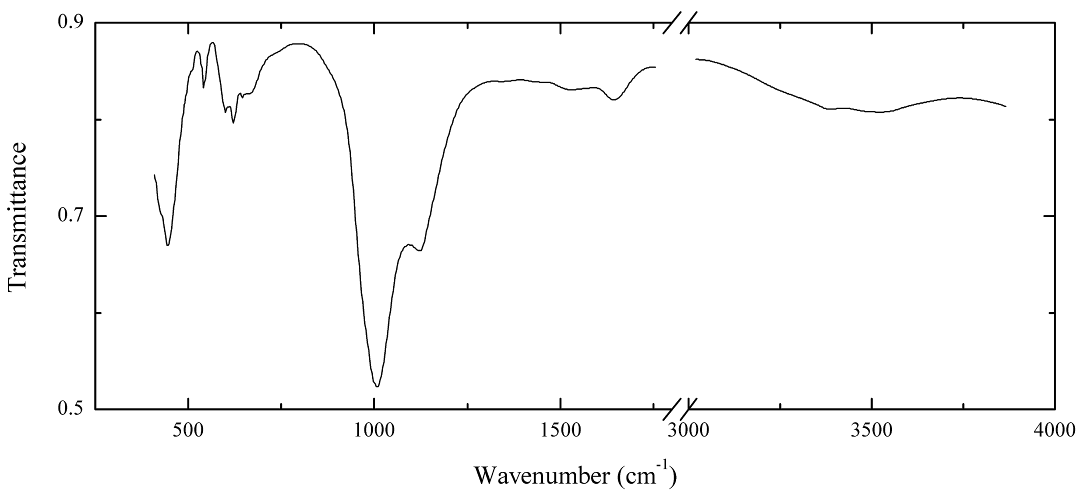


Locality: Oktyabr'skiy alkaline massif, southern Ukraine.

Description: Yellowish-grey grains from the association with sodalite and feldspar. Identified by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Na_{6.78}Ca_{1.13}K_{0.05}(Al_{5.96}Si_{6.04}O_{24})(CO_3)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3465w, 1166, 1123s, 1054, 1002s, 685, 663, 643w, 611, 590, 540, 449, 426s.

Sif7 Alloriite $(Na,K)_{6.5}Ca(Si_6Al_6O_{24})(SO_4)(OH)_{0.5}\cdot H_2O$

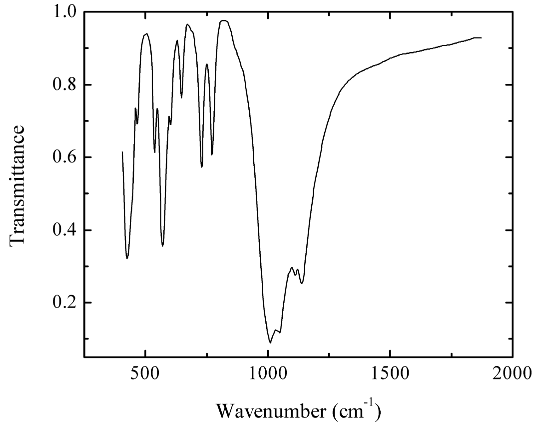


Locality: Monte Cavalluccio (Cavalluccio Mt.), Campagnano municipality, Roma province, Latium region, Italy (type locality).

Description: Colourless short-prismatic crystals from the association with sanidine. Identified by IR spectrum. Ca- and SO_4-rich variety. The empirical formula is (electron microprobe) $Na_{3.4}K_{2.6}Ca_{1.9}(Al_{6.0}Si_{6.0}O_{24})(SO_4)_{1.5}Cl_{0.25}(OH)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3510w, 1645w, 1122s, 1005s, 970sh, 728w, 673, 657, 641, 619, 597, 540, 445s, 415sh.

Sif8 Microcline $K(AlSi_3O_8)$

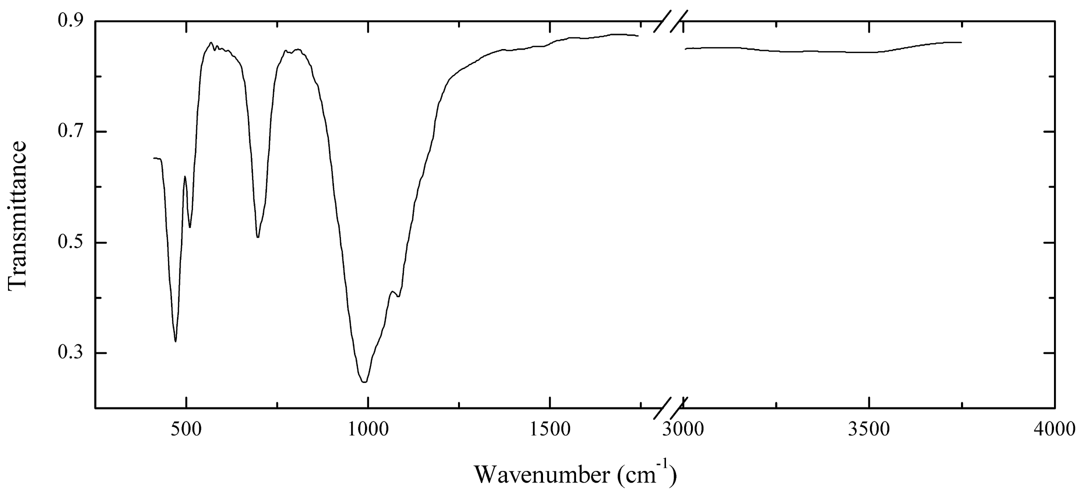


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White powdery from peralkaline pegmatite. High-ordered variety. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1143s, 1115s, 1051s, 1011s, 770, 727, 648, 604, 570s, 535, 465, 428s, 421s.

Sif9 Nepheline $(Na,K)(AlSiO_4)$

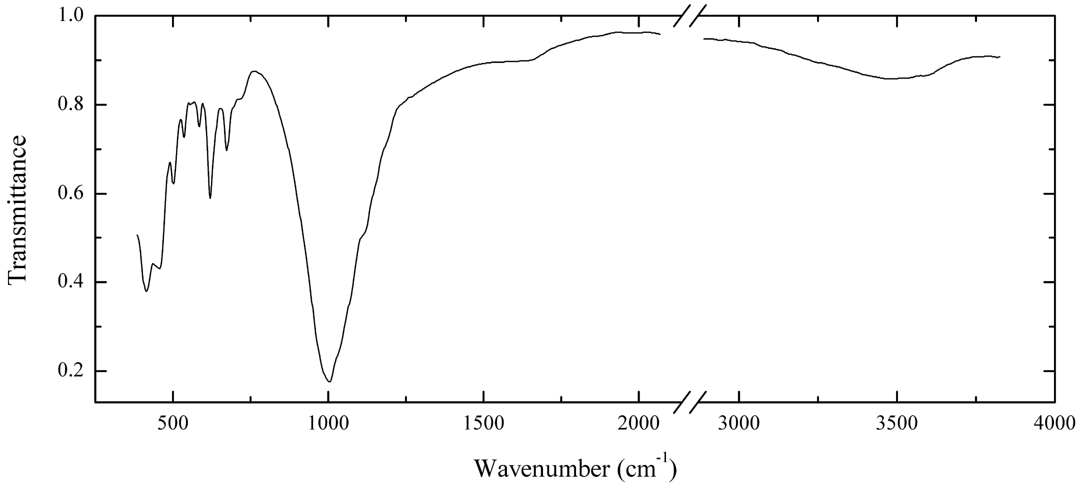


Locality: Monte Cavalluccio (Cavalluccio Mt.), Campagnano municipality, Roma province, Latium region, Italy.

Description: Colourless prismatic crystals from the association with sanidine and biotite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1085, 1070sh, 1025sh, 991s, 710sh, 696, 507, 468s.

Sif10 Bystrite $(Na,K)_7Ca(Si_6Al_6O_{24})S^{2-}{}_{1.5}\cdot H_2O$

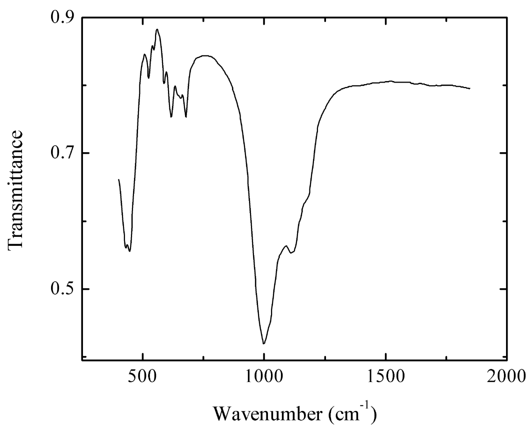


Locality: Malobystrinskoe lazurite deposit, near Slyudyanka, Irkutsk region, Eastern Siberia, Russia.

Description: Orange-yellow grains from the association with lazurite, diopside and calcite. Confirmed by IR spectrum. Evolves H_2S during grinding.

Wavenumbers (cm^{-1}): 3565sh, 3460w, 1645w, 1120sh, 1065sh, 1030sh, 1004s, 970sh, 925sh, 710w, 673, 617, 584, 533, 498, 454s, 413s.

Sif11 Liottite $(Na,K)_5Ca_3(Si_6Al_6O_{24})(SO_4)_2Cl$

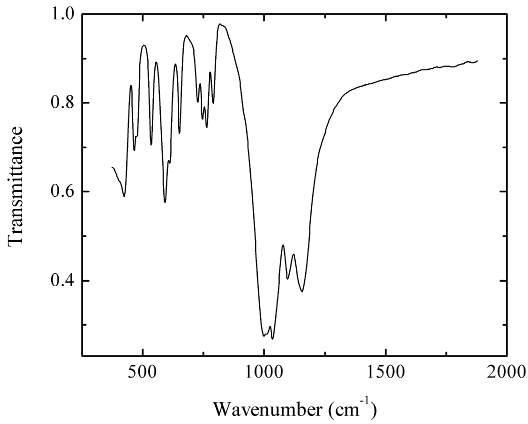


Locality: Montenero quarry, Onano, near Viterbo, Latium region, Italy.

Description: Colourless short-prismatic crystals from cavities in alkaline basalt. Confirmed by IR spectrum and single-crystal X-ray diffraction pattern.

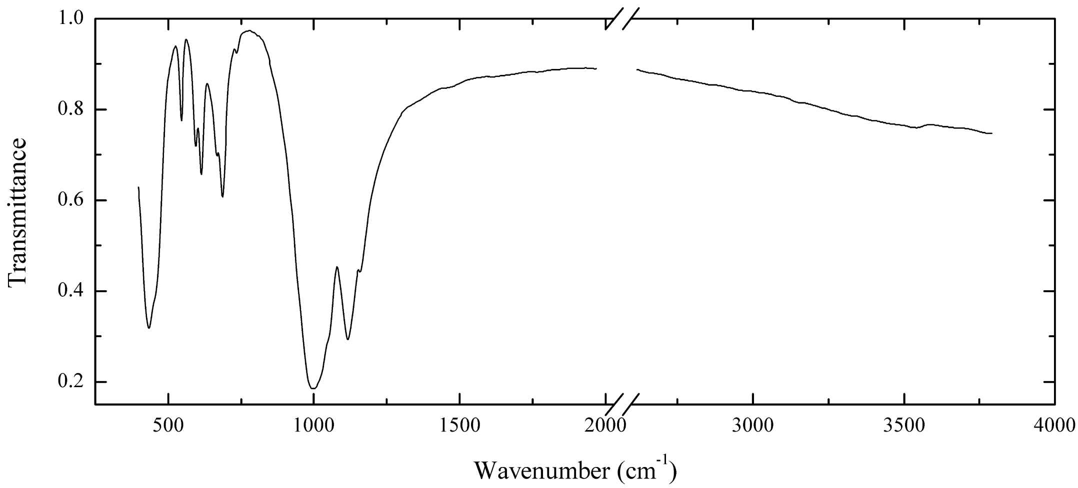
Wavenumbers (cm^{-1}): 1180sh, 1118s, 1075sh, 1030sh, 1004s, 679, 653, 645sh, 617, 587, 545w, 524, 441s, 427s.

Sif12 Albite $Na(AlSi_3O_8)$



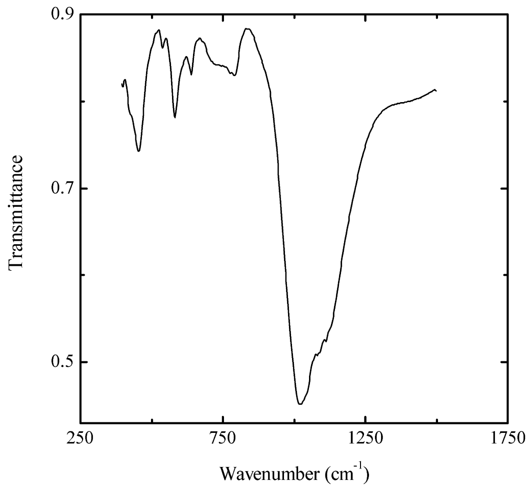
Locality: Monte Avanza mine, Forni Avoltri, Udine province, Friuli–Venezia Giulia, Italy.
Description: White grains. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1159s, 1145sh, 1097s, 1036s, 1014s, 996s, 789, 764, 746, 726, 652, 613, 593s, 535, 480, 467, 431s, 420sh.

Sif13 Afghanite $(Na,K)_{5.5}Ca_{2.5}(Si_6Al_6O_{24})(SO_4)_{1.5}Cl_{1.5}$



Locality: Ladjvardara lazurite deposit, Pamir Mts., Tajikistan.
Description: Light blue massive from the association with lazurite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{5.70}Ca_{2.42}K_{0.28}(Al_{5.95}Si_{6.05}O_{24})(SO_4)_{1.58}Cl_{1.39}(OH,CO_3)_x$ ($x \ll 1$).
Wavenumbers (cm^{-1}): 3550w, 1470w, 1164, 1121s, 1050sh, 1020sh, 1004s, 736w, 685, 667, 650sh, 613, 593, 542, 450sh, 430s.

Sif16 Anorthoclase (Na,K)($AlSi_3O_8$)

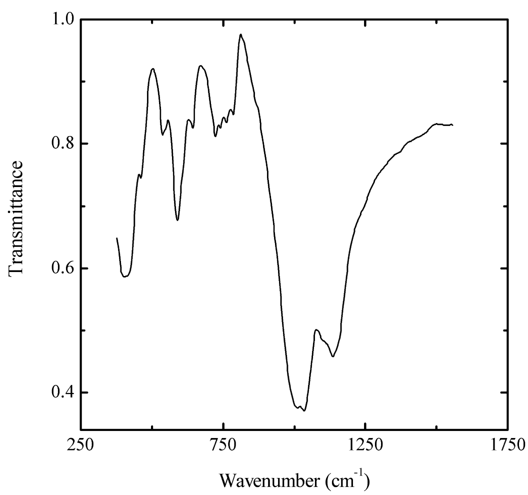


Locality: Synthetic.

Description: White powdery. K-free variety. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 1100sh, 1029s, 798, 730sh, 747, 589, 546w, 460, 435sh.

Sif17 Anorthoclase (Na,K)($AlSi_3O_8$)

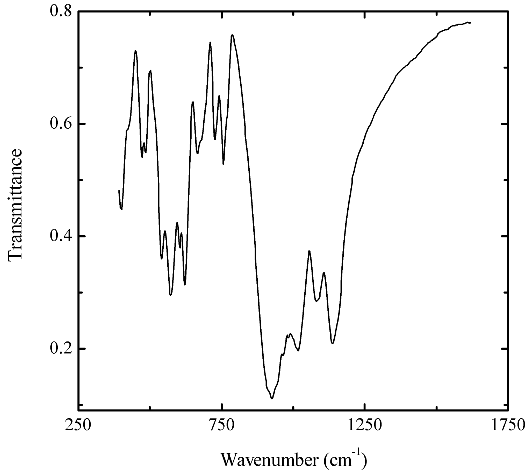


Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Split platy crystals from the association with natrolite, analcime and chabazite.

Wavenumbers (cm^{-1}): 1138s, 1110sh, 1100sh, 1036s, 1012s, 778, 763, 742, 724, 705sh, 646, 610sh, 589, 536, 462, 422s.

Sif18 Anorthite $Ca(Al_2Si_2O_8)$

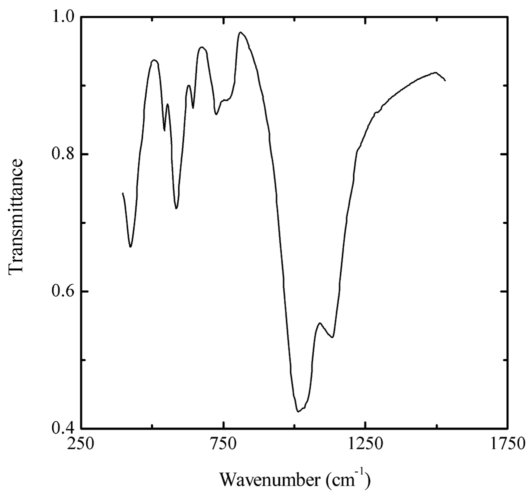


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: White twins from the association with chondrodite, wollastonite, forsterite and troilite. Investigated by B.V. Chesnokov. The empirical formula is (electron microprobe) $Ca_{0.95}Na_{0.02}Mg_{0.01}Ti_{0.02}Fe_{0.09}Al_{1.83}Si_{2.08}O_{8.00}$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 4.05 (50), 3.21 (100), 2.52 (50), 1.930 (60).

Wavenumbers (cm^{-1}): 1155sh, 1140s, 1078, 1020s, 985s, 968s, 945sh, 929s, 913s, 770sh, 757, 726, 700sh, 680, 663, 620, 602, 572, 539, 510sh, 483, 469, 420, 400.

Sif19 Sanidine $K(AlSi_3O_8)$

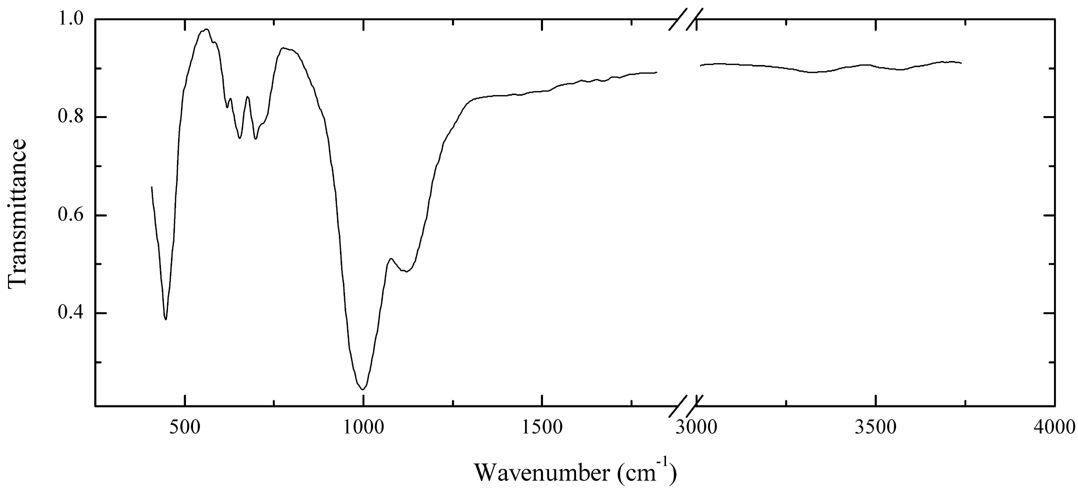


Locality: Kaskasnyunachorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White granular aggregate from the association with freudenbergite, titanite and rutile. The empirical formula is (electron microprobe) $K_{0.81}Na_{0.14}Ba_{0.02}(Al_{0.96}Fe_{0.02}Si_{3.02}O_8)$.

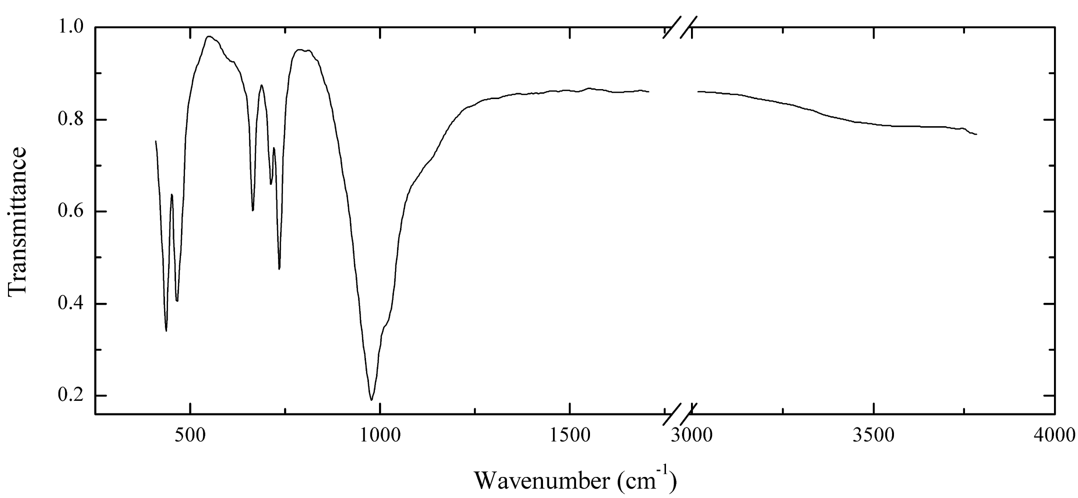
Wavenumbers (cm^{-1}): 1138s, 1110sh, 1100sh, 1036s, 1012s, 778, 763, 742, 724, 705sh, 646, 610sh, 589, 536, 462, 422s.

Sif20 **Lazurite** $(Ca,Na)_8(Si_6Al_6O_{24})[(SO_4),S,Cl,(OH)]_2$



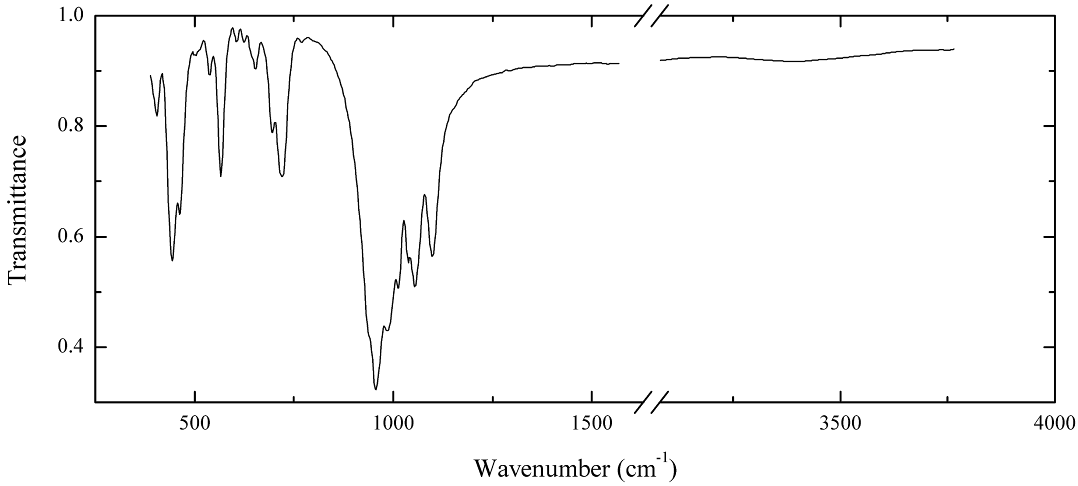
Locality: Malobystrinskoe lazurite deposit, near Slyudyanka, Irkutsk region, Eastern Siberia, Russia.
Description: Blue massive. Cubic variety. Investigated by A.N. Sapozhnikov.
Wavenumbers ($\mathbf{cm^{-1}}$): 3530w, 3330w, 1123s, 999s, 724, 698, 651, 615, 585w, 447s, 420sh.

Sif21 **Sodalite** $Na_6(Si_6Al_6O_{24})Cl_2$



Locality: Near Kukavaara Mt., Northern Karelia, Russia.
Description: Blue coarse-grained aggregate from nepheline syenite. Confirmed by IR spectrum.
Wavenumbers ($\mathbf{cm^{-1}}$): 1015sh, 985sh, 979s, 737, 714, 668, 465s, 435s.

Sif23 Banalsite $BaNa_2(Al_4Si_4O_{16})$

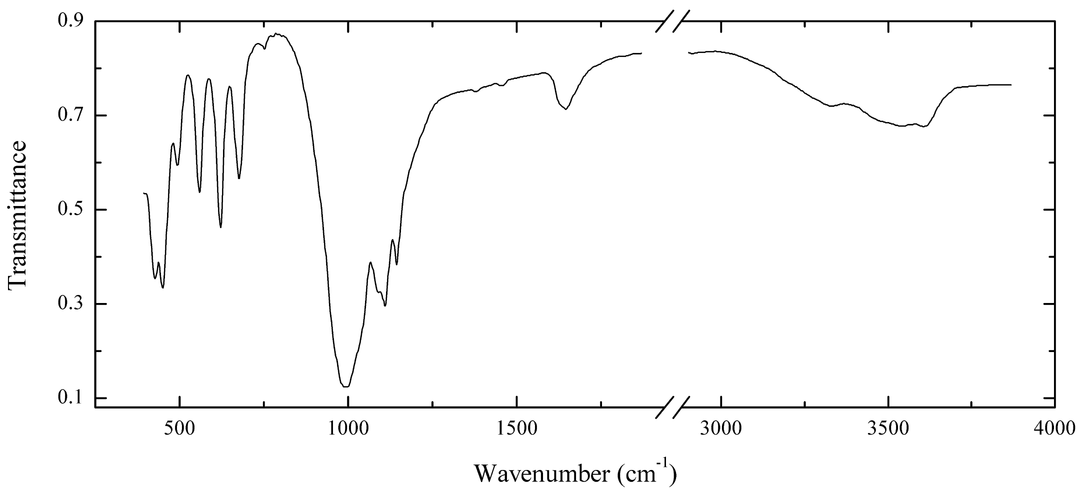


Locality: Trädgårdsvarpen, Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: White granular aggregate from the association with andradite, Mn-rich phlogopite, melanotekite and carbonates. The empirical formula is (electron microprobe) $Na_{1.90}Ba_{1.05}K_{0.01}(Al_{3.97}Fe_{0.04}Si_{3.99}O_{16})$.

Wavenumbers (cm^{-1}): 1098, 1052s, 1036s, 1012s, 984s, 954s, 938s, 769w, 721, 713, 691, 652, 641w, 621w, 603w, 563, 535, 508w, 463, 444s, 406.

Sif24 Vishnevite $(Na,K)_8(Si_6Al_6O_{24})(SO_4)\cdot 2H_2O$

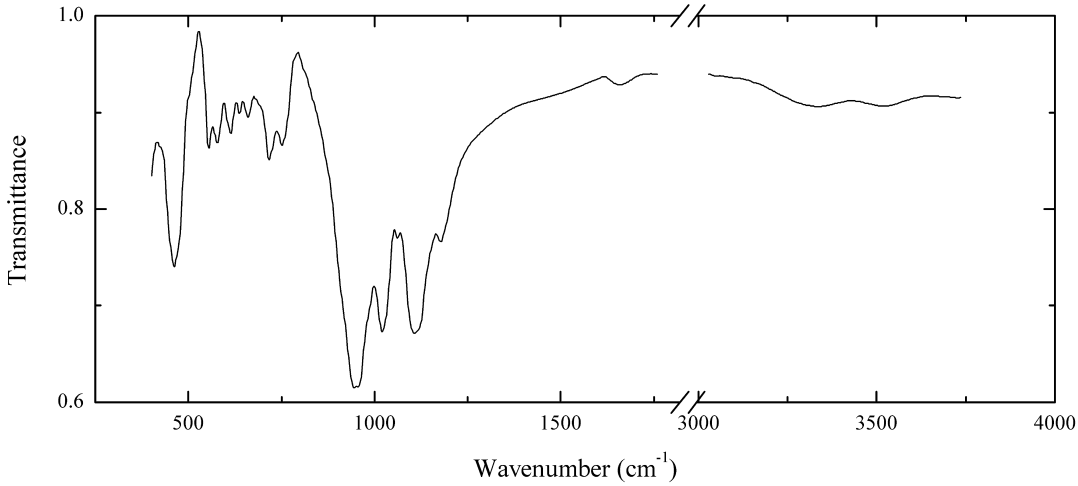


Locality: Kurochkin Log, Vishnevye Mts., South Urals, Russia.

Description: Light blue massive. The empirical formula is (electron microprobe) $Na_{6.6}K_{1.2}Ca_{0.1}(Al_{5.8}Si_{6.2}O_{24})(SO_4)_{1.0}(OH,CO_3)_x\cdot nH_2O$ (x << 1).

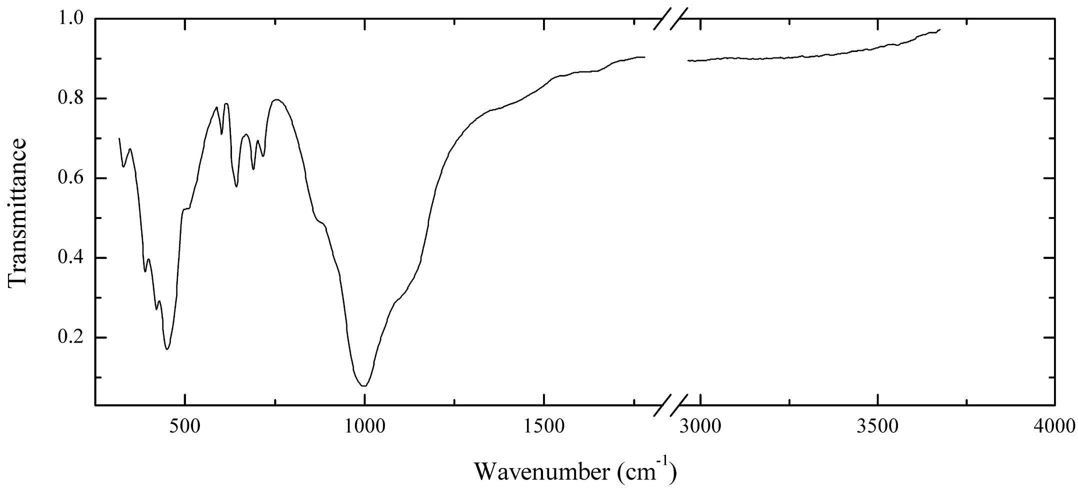
Wavenumbers (cm^{-1}): 3610, 3540, 3340, 1645, 1630sh, 1457w, 1380w, 1149, 1116s, 1099s, 1040sh, 1001s, 756w, 679, 623, 562, 496, 449s, 428s.

Sif25 Wenkite $(Ba,K)_4(Ca,Na)_6(Si,Al)_{20}O_{41}(OH)_2(SO_4)_3 \cdot H_2O$



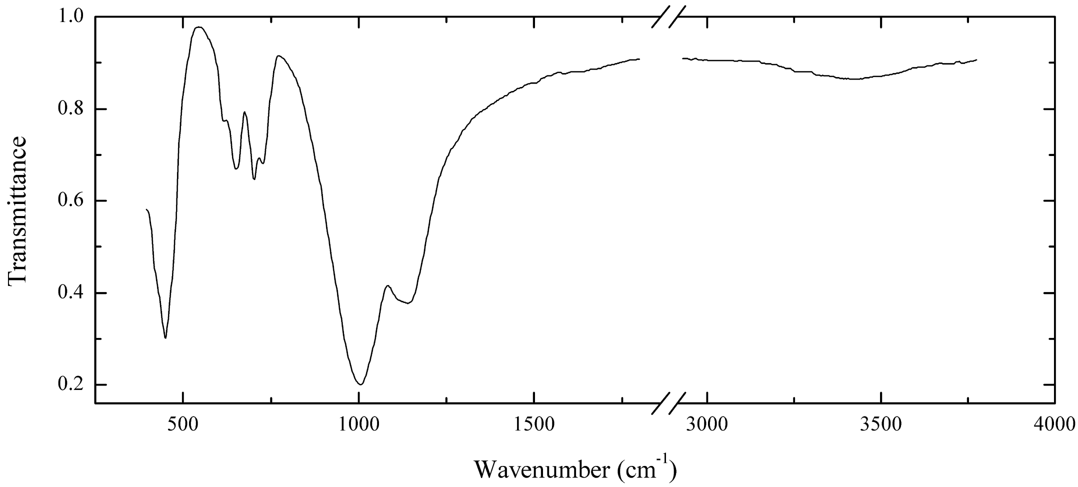
Locality: Garpenberg Norra mine, Garpenberg, Hedemora, Dalarna, Sweden.
Description: Light rose grains in quartz.
Wavenumbers (cm^{-1}): 3500, 3315, 1653w, 1181, 1111s, 1063, 1022s, 960s, 948s, 753, 719, 660, 637, 613, 577, 554, 500sh, 462s.

Sif26 Lazurite $(Ca,Na)_8(Si_6Al_6O_{24})[(SO_4),S,Cl,(OH)]_2$



Locality: An unknown locality in Italy.
Description: Dark blue massive. S^{2-}-dominant variety ($S^{2-} > SO_4^{2-}$ in formula units).
Wavenumbers (cm^{-1}): 1100sh, 1000s, 985sh, 875sh, 725, 697, 645, 608, 505, 450s, 420s, 390, 325.

Sif27 Haüyne $Na_6Ca_2(Si_6Al_6O_{24})(SO_4)_2$

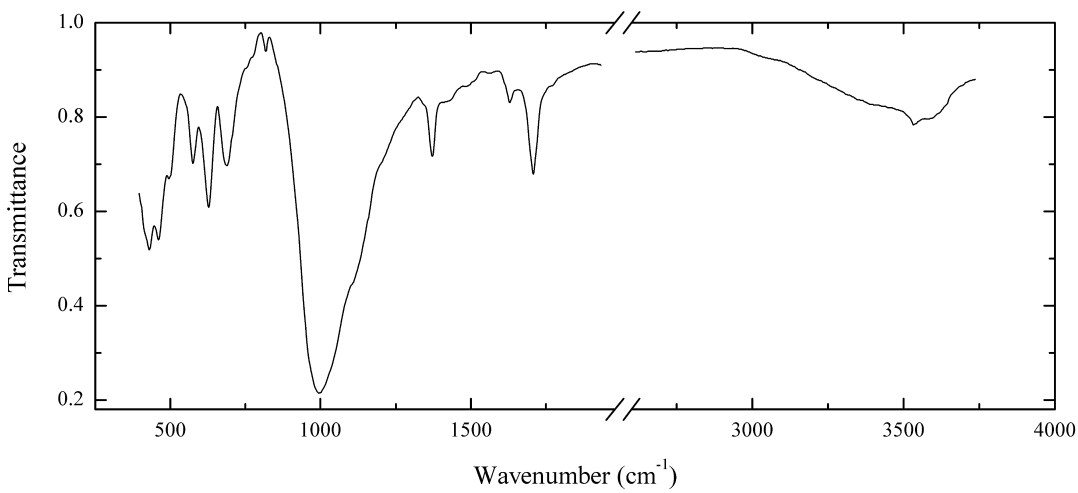


Locality: Mendig, Laacher See area, Eifel Mountains, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Light blue crystal from the association with sanidine. The empirical formula is (electron microprobe, OH calculated) $Na_{5.1}K_{0.7}Ca_{2.1}(Al_{5.9}Si_{6.1}O_{24})(SO_4)_{1.8}Cl_{0.3}(OH)_{0.2}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3400w, 1139s, 1120sh, 1004s, 726, 700, 650, 612, 447s, 425sh.

Sif28 Kyanoxalite $Na_7(Al_{6-5}Si_{6-7}O_{24})(C_2O_4)_{0.5-1}\cdot 5H_2O$

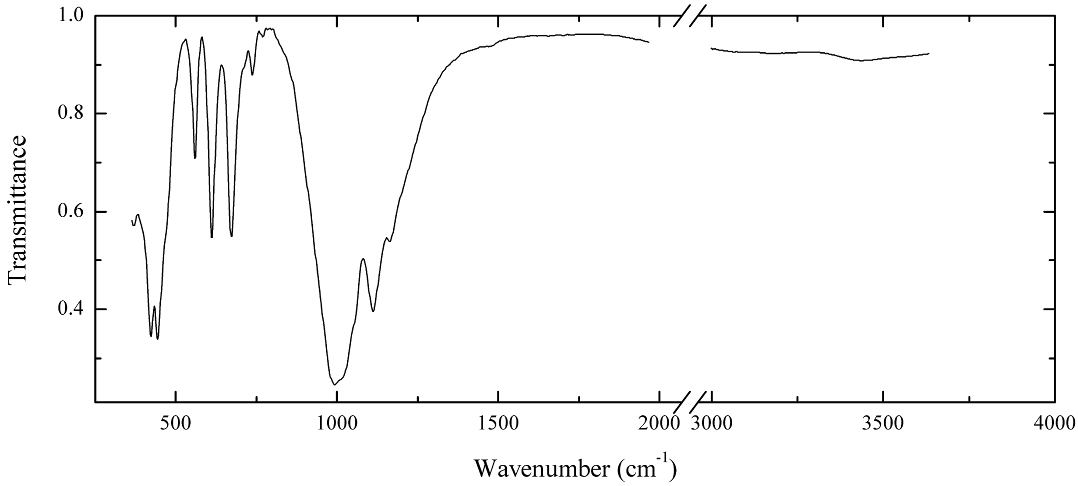


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (cotype locality).

Description: Light blue prismatic crystals from the association with sodalite, murmanite and loparite. Cotype sample. The crystal structure is solved. Hexagonal, space group $P6_3$, $a = 12.738(2)$, $c = 5.335(1)$ Å, $Z = 1$. The empirical formula is $Na_{5.97}K_{0.07}Ca_{0.01}(Al_{5.29}Si_{6.71}O_{24})(C_2O_4)_{0.56}(SO_4)_{0.05}F_{0.05}Cl_{0.01}\cdot 4.8H_2O$. Optically uniaxial (−), $\omega = 1.494(2)$, $\varepsilon = 1.486(2)$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 6.28 (48), 4.66 (32), 3.636 (77), 3.216 (100), 2.727 (47), 2.413 (24).

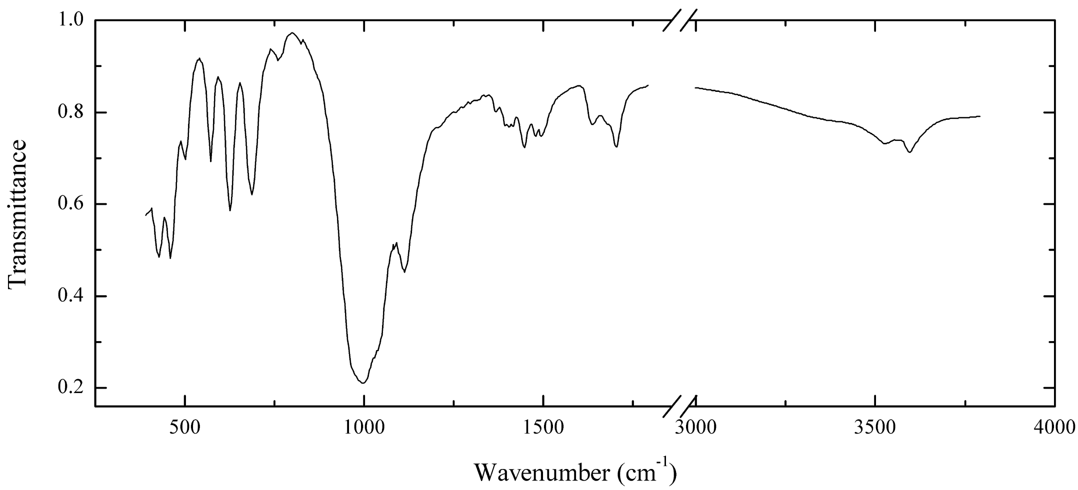
Wavenumbers (cm^{-1}): 3580, 3530, 3400sh, 1713, 1635, 1373, 1115sh, 997s, 817w, 770sh, 687, 625, 573, 495, 457, 426s, 415sh.

Sif29 Davyne $(Na,K)_6Ca_2(Al_6Si_6O_{24})[(SO_4)_{0.5-1}Cl_{1-0}]Cl_2$



Locality: Sar-e Sang, Badakhshan, Afghanistan.
Description: Bright blue grains from the association with lazurite. The crystal structure is solved. Hexagonal, space group $P6_3$, $a = 12.773(2)$, $c = 5.333(1)$ Å, $Z = 1$. SO_4^{2-}-rich variety. The empirical formula is $Na_{5.39}Ca_{2.01}K_{0.81}(Si_{6.10}Al_{5.90}O_{24})Cl_{1.96}(SO_4)_{1.13}(OH,H_2O)_x$ ($x \approx 0.1$).
Wavenumbers (cm^{-1}): 3440w, 1167, 1114s, 1015sh, 999s, 770w, 735, 711w, 669, 608, 556, 465sh, 439s, 417s.

Sif30 Cancrinite $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}\cdot 2H_2O$

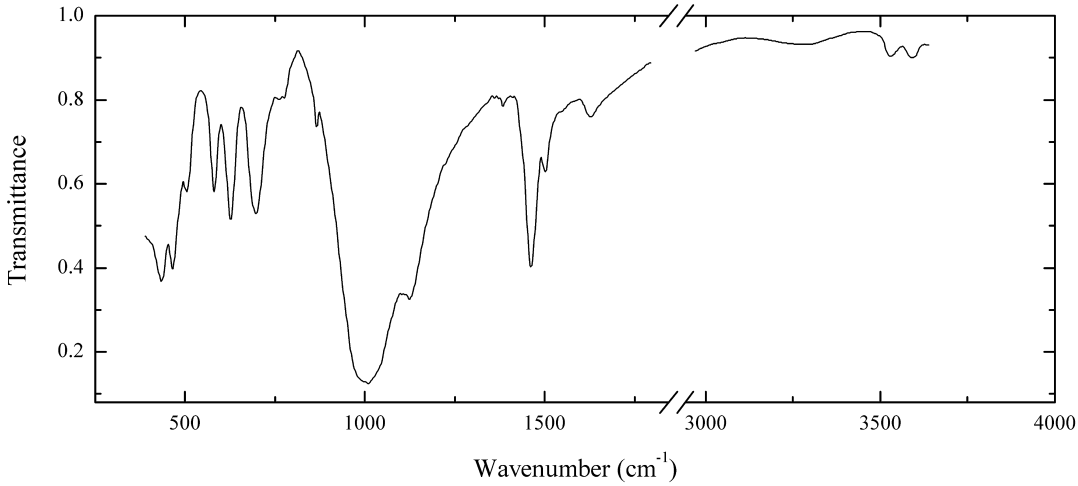


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Blue grains from the association with natrolite, eudialyte and feldspar. The crystal structure is solved. Hexagonal, space group $P6_3$, $a = 12.688(4)$, $c = 5.189(1)$ Å, $Z = 1$. Optically

uniaxial (−), $\omega = 1.500(2)$, $\varepsilon = 1.490(2)$. $D_{meas} = 2.370(15)$ g/cm^3. Oxalate-bearing variety. The empirical formula is $Na_{7.14}K_{0.36}Ca_{0.07}(Si_{6.50}Al_{5.50}O_{24})(CO_3,C_2O_4)_xCl_{0.03}(SO_4)_{0.03}{\cdot}nH_2O$ ($x \approx 1$, $n \approx 1$). The crystal-chemical formula is $[Na_{1.41}Ca_{0.07}H_2O_{1.48}][Na_{5.65}K_{0.35}(CO_3)_{1-y}(C_2O_4)_y][Si_{6.5}Al_{5.5}O_{24}]$ ($y \approx 0.25$).

Wavenumbers (cm^{-1}): 3590, 3525, 3400sh, 1696, 1675sh, 1627, 1490, 1475, 1440, 1400, 1360w, 1110s, 1035sh, 998s, 817w, 760w, 685, 624, 572, 501, 460s, 426s.

Sif31 Cancrisilite $Na_7(Al_5Si_7O_{24})(CO_3){\cdot}3H_2O$

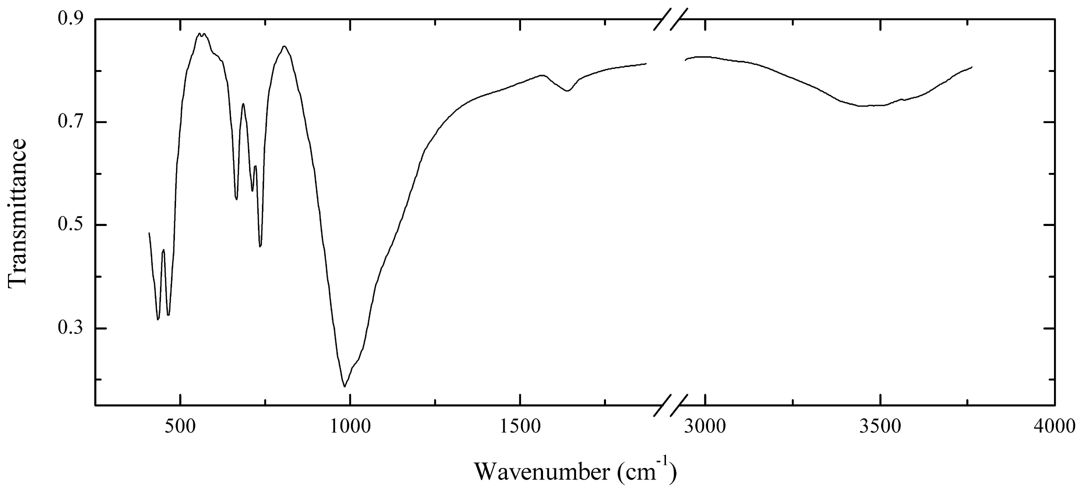


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless crystals from the association with potassic feldspar, aegirine, merlinoite, kalborsite, villiaumite and thermonatrite. Investigated by L.V. Olysych and I.V. Pekov. The empirical formula is (electron microprobe) $Na_{7.48}Ca_{0.14}Sr_{0.02}(Al_{5.04}Si_{6.96}O_{24})(CO_3)_x{\cdot}nH_2O$.

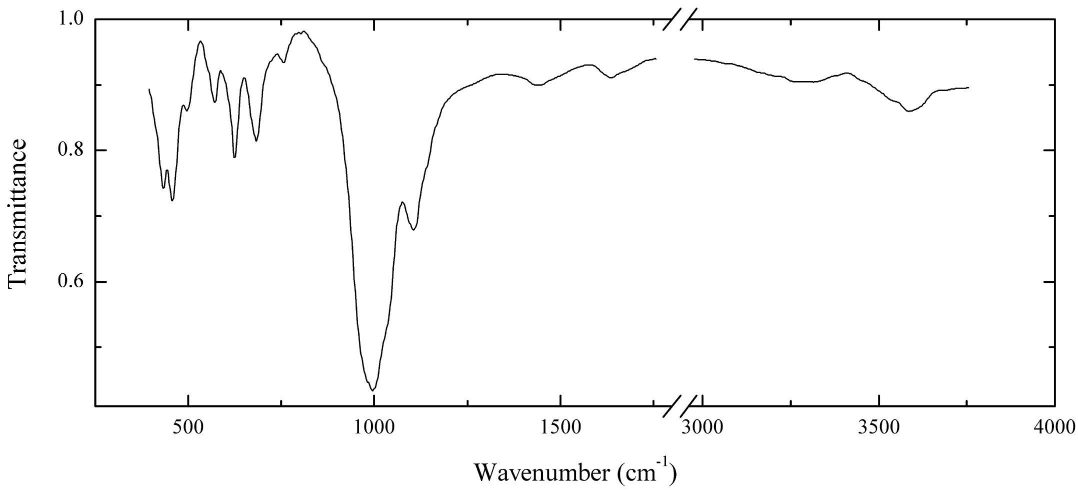
Wavenumbers (cm^{-1}): 3592w, 3526w, 3290w, 1630, 1505, 1465s, 1382w, 1127s, 1008s, 864, 774w, 693, 623, 575, 500, 457s, 429s.

Sif32 Sodalite $Na_6(Si_6Al_6O_{24})Cl_2$



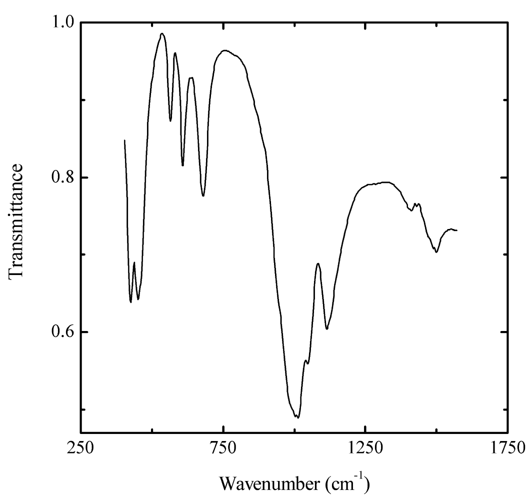
Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Blue grains from peralkaline pegmatite. S-rich variety. The crystal-chemical formula is (electron microprobe) $Na_{8.2}(Al_{5.9}Si_{6.1}O_{24})Cl_{1.0}[S,(SO_4)]_{0.7}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3450, 1640, 1445w, 1100sh, 1020sh, 983s, 970sh, 733, 711, 665, 460s, 429s.

Sif33 Pitiglianoite $K_2Na_6(Si_6Al_6O_{24})(SO_4)\cdot 2H_2O$



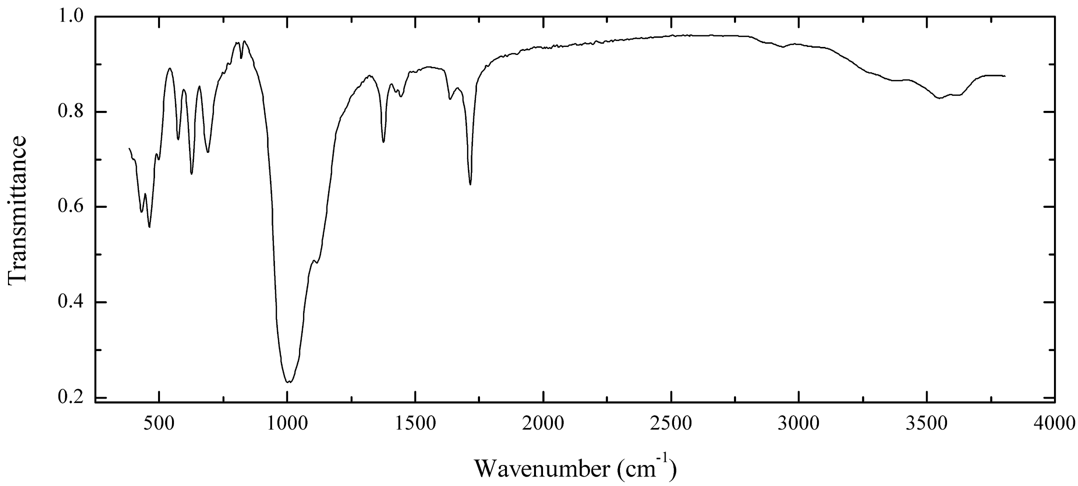
Locality: Malyi Murun (Malomurunskiy) massif, Aldan shield, Eastern Siberia, Russia.
Description: Blue grains from the association with perlialite. The empirical formula is $K_{2.9}Na_{4.4}Ca_{0.4}(Al_{5.7}Si_{6.3}O_{24})(SO_4)_{1.1}Cl_{0.1}(CO_3)_{0.05}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3595, 3300, 1700w, 1633w, 1500w, 1440w, 1115, 1035sh, 1000s, 990sh, 760w, 681, 622, 569, 549w, 493, 451, 423.

Sif34 Davyne $(Na,K)_6Ca_2(Al_6Si_6O_{24})[(SO_4)_{0.5-1}Cl_{1-0}]Cl_2$



Locality: Monte Somma, Somma-Vesuvius complex, Naples province, Campania, Italy (type locality).
Description: Colourless prismatic crystals. The empirical formula is $Na_{5.1}K_{0.8}Ca_{2.1}(Si_{6.1}Al_{5.9}O_{24})Cl_{2.5}(SO_4)_{0.55}(CO_3)_x(OH,H_2O)_y$ ($x << 1$).
Wavenumbers (cm^{-1}): 1505, 1410w, 1127s, 1052s, 682, 608, 562, 447s, 420s.

Sif35 Kyanoxalite $Na_7(Al_{6-5}Si_{6-7}O_{24})(C_2O_4)_{0.5-1}\cdot5H_2O$

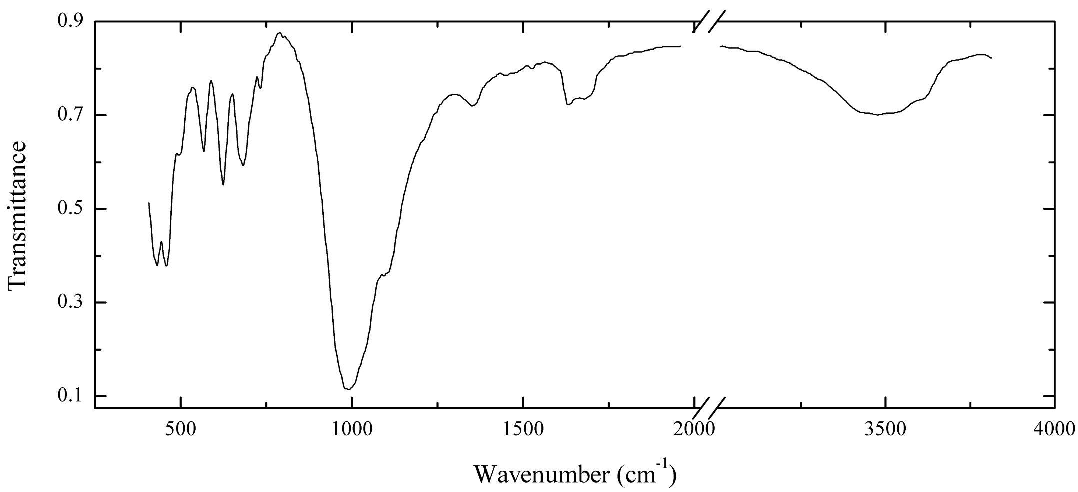


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (cotype locality).

Description: Light blue grain from the association with sodalite, murmanite and belovite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3610, 3530, 3375, 2925w, 2870w, 1712, 1640sh, 1630, 1440, 1422w, 1371, 1118s, 1009s, 818w, 772w, 740sh, 688, 626, 572, 496, 459s, 428, 405sh.

Sif36 Kyanoxalite $Na_7(Al_{6-5}Si_{6-7}O_{24})(C_2O_4)_{0.5-1}\cdot5H_2O$

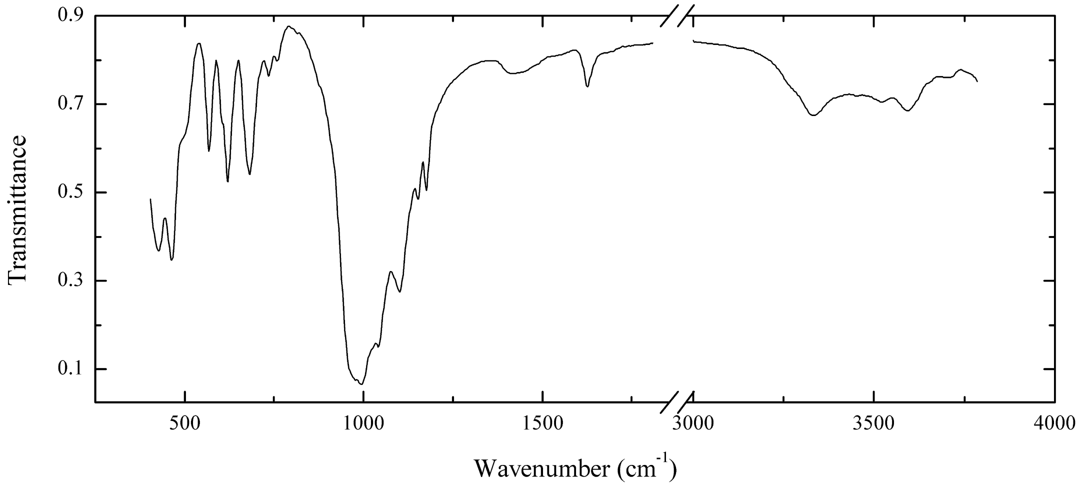


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light blue grains from peralkaline pegmatite. Disordered variety. Identified by IR spectrum. The empirical formula is $Na_xK_{0.36}(Si_{6.65}Al_{5.35}O_{24})(C_2O_4,CO_3)_y(SO_4)_{0.21}(PO_4)_{0.16}\cdot nH_2O$ ($x \approx 6.7$, $y \approx 0.5$).

Wavenumbers (cm^{-1}): 3600sh, 3470, 1682, 1635, 1360, 1100sh, 990s, 732w, 685, 625, 570, 495, 459s, 428s.

Sif37 Vishnevite $(Na,K)_8(Si_6Al_6O_{24})(SO_4){\cdot}2H_2O$

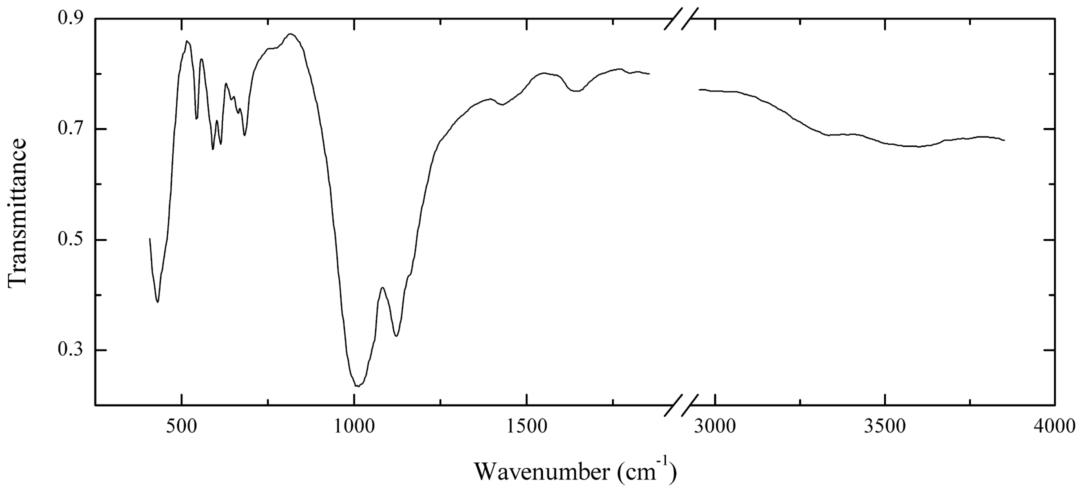


Locality: Borehole at the Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Dark grey grain from altered nosean syenite, pseudomorph after nosean. K-free variety. The empirical formula is $Na_{7.70}(Al_{5.66}Si_{6.34}O_{24})(SO_4)_{0.87}(CO_3)_{0.13}Cl_{0.03}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3590, 3520w, 3330, 1623, 1445sh, 1422, 1184, 1160, 1109s, 1048s, 998s, 980sh, 759w, 737, 681, 670sh, 620, 605, 568, 495sh, 461s, 428s.

Sif38 Afghanite $(Na,K)_{5.5}Ca_{2.5}(Si_6Al_6O_{24})(SO_4)_{1.5}Cl_{1.5}$

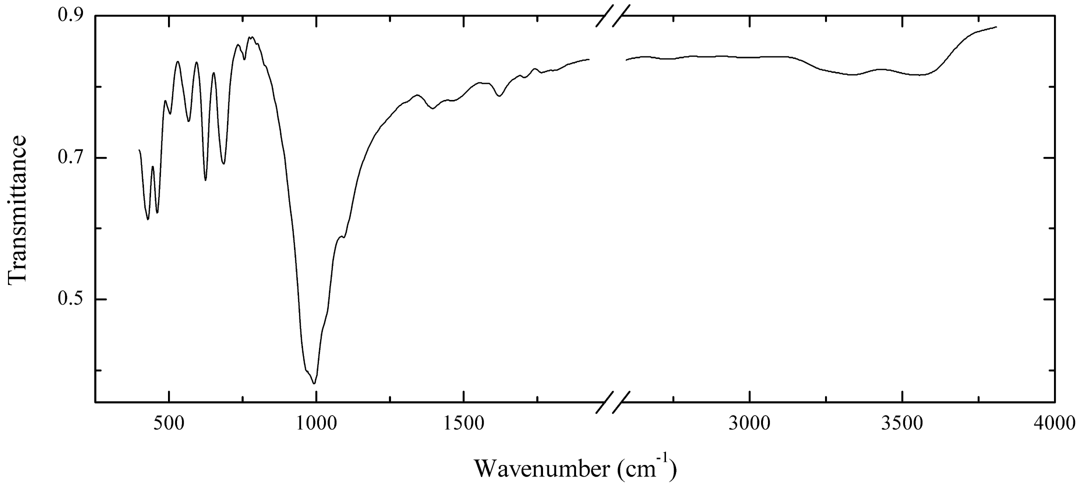


Locality: Tre Croci, Vetralla, near Vico lake, Viterbo province, Latium, Italy.

Description: White semitransparent grains from the association with sanidine and piergorite. Identified by IR spectrum. Hydrated variety. The empirical formula is $Na_{5.19}K_{0.42}Ca_{2.37}(Al_{5.88}Si_{6.12}O_{24})(SO_4)_{1.37}(CO_3)_{0.16}Cl_{1.40}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3550, 3320, 1640, 1430, 1160sh, 1121s, 1055s, 1010s, 770w, 684, 663, 643, 613, 592, 543, 450sh, 430s.

Sif39 Hydroxycancrinite $Na_8(Si_6Al_6O_{24})(OH)_2{\cdot}2H_2O$

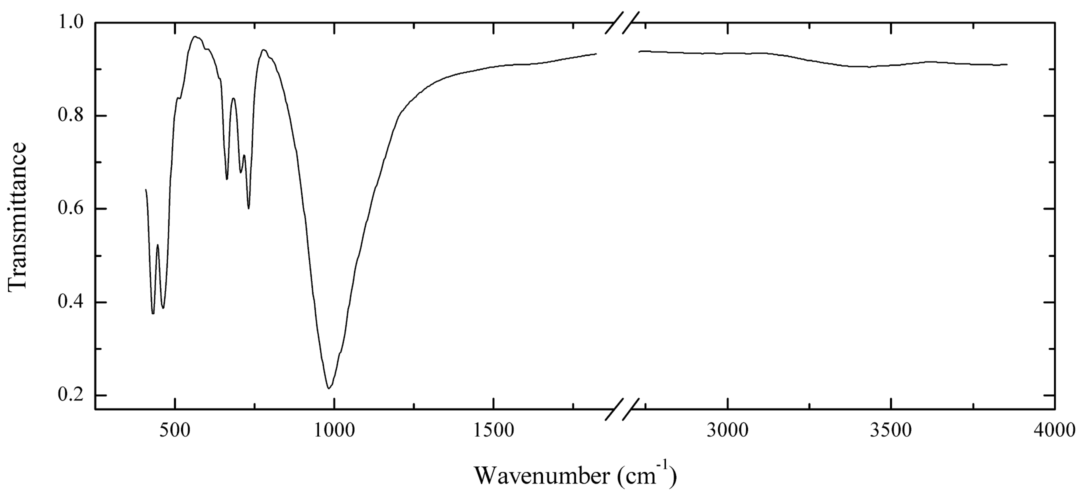


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Light bluish-grey coarse-grained aggregate from the association with natrolite, steenstrupine, vuonnemite, epistolite, mountainite, ilmajokite and nastrophite. Holotype sample. Hexagonal, space group $P6_3$, $a = 12.740(3)$, $c = 5.182(2)$ Å, $Z = 1$. Optically uniaxial (+), $\omega = 1.494(2)$, $\varepsilon = 1.501(2)$. $D_{meas} = 2.32(2)$ g/cm^3, $D_{calc} = 2.26$ g/cm^3. The empirical formula is $Na_{6.03}K_{0.10}Ca_{0.16}Mg_{0.03}Fe_{0.02}(Al_{6.03}Si_{5.97}O_{24})(OH)_{1.23}(CO_3)_{0.36}{\cdot}2.35H_2O$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 6.43 (25), 4.70 (60), 4.17 (20), 3.68 (70), 3.26 (100), 2.756 (50), 2.433 (30).

Wavenumbers (cm^{-1}): 3585, 3520, 3340, 3260, 1775w, 1725w, 1625, 1475w, 1395, 1370sh, 1100s, 1030sh, 995s, 970sh, 758w, 683, 623, 565, 500, 458s, 427s.

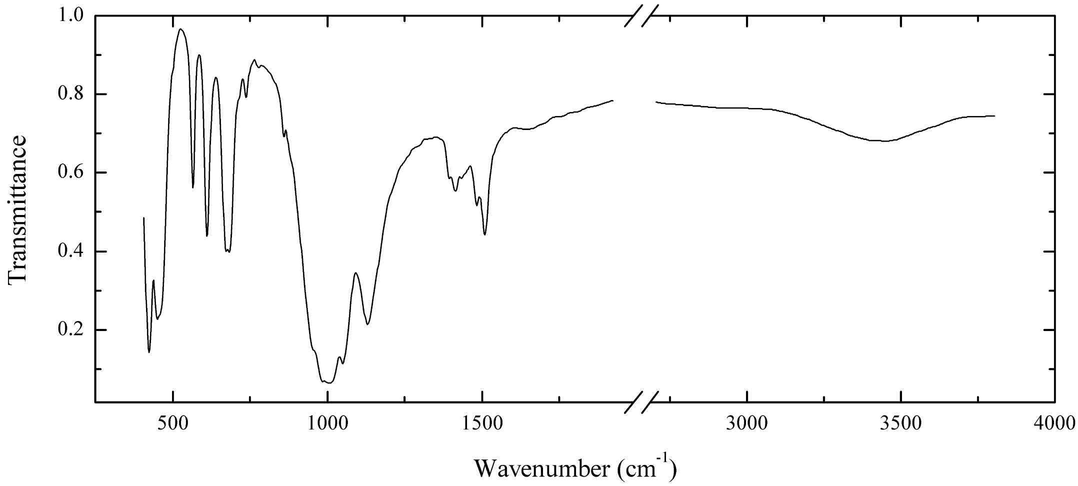
Sif40 Lazurite $(Ca,Na)_8(Si_6Al_6O_{24})[(SO_4),S,Cl,(OH)]_2$



Locality: Product of heating of lazurite from Malobystrinskoe deposit, Eastern Siberia, Russia, at 600° in the presence of Fe + FeS buffer during 72 h.

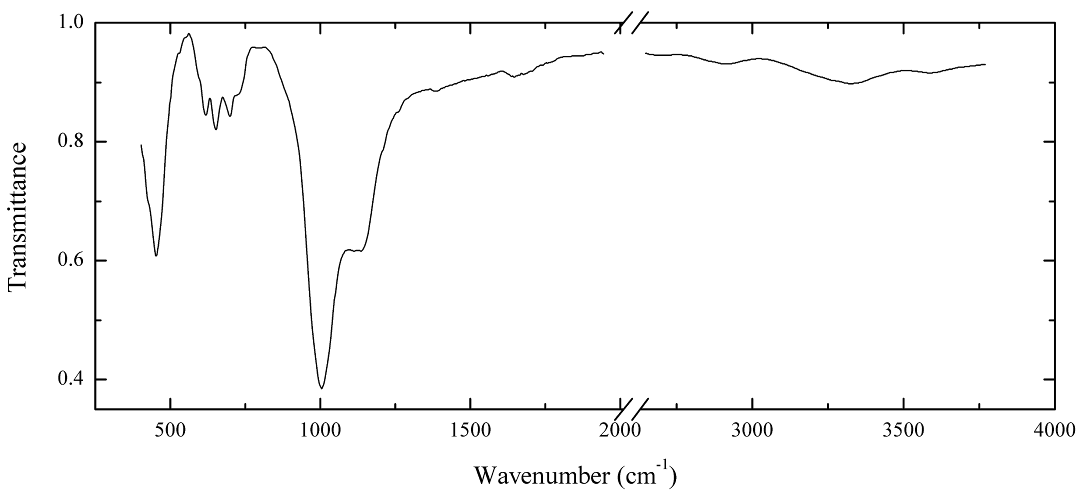
Description: Very dark blue massive. Investigated by A.N. Sapozhnikov. Cubic, $a = 8.94$ Å. S^{2-}-dominant variety ($S^{2-} \gg SO_4^{2-}$ in formula units), sulfite analogue of sodalite. The empirical formula is $Na_{6.34}Ca_{1.60}K_{0.01}(Al_{5.90}Si_{6.10}O_{24})S_{1.73}(SO_4)_{0.06}Cl_{0.05}$.
Wavenumbers (cm^{-1}): 1140sh, 985s, 732, 708, 662, 640sh, 515w, 461s, 430s.

Sif41 Balliranoite $(Na,K)_6Ca_2(Si_6Al_6O_{24})Cl_2(CO_3)$



Locality: Tulyuiskoe lazurite deposit, near Slyudyanka, Irkutsk region, Eastern Siberia, Russia.
Description: Yellow-green grains from the association with calcite, sodalite, diopside and pyrrhotite. Investigated by A.N. Sapozhnikov and N.V. Chukanov. S^{2-}-bearing variety. The crystal-chemical formula is $[Na_{5.5}Ca_{0.5}(CO_3)_{0.66}(SO_4)_{0.34}(S_2)_{0.28}(H_2O)_{0.38}][Ca_{2.0}Cl_{2.0}][Si_6Al_6O_{24}]$.
Wavenumbers (cm^{-1}): 3410, 1645, 1504, 1478, 1432w, 1410, 1391w, 1125s, 1045s, 1015sh, 1001s, 985sh, 955sh, 880sh, 859w, 779w, 736w, 712w, 683, 671, 610, 565, 453s, 425s.

Sif42 Giuseppettite $Na_5K_2Ca(Si_6Al_6O_{24})[(SO_4),Cl]_{2-x}\cdot H_2O$

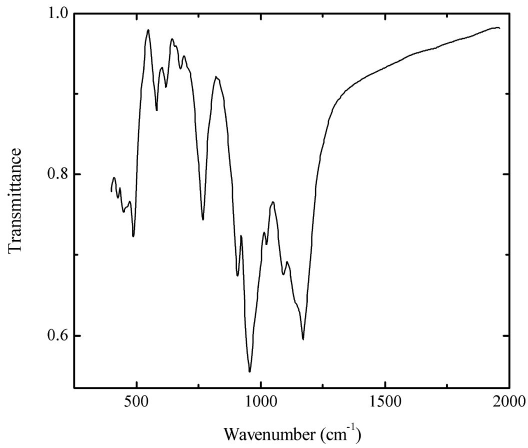


Locality: Monte Cavalluccio (Cavalluccio Mt.), Campagnano municipality, Roma province, Latium region, Italy.

Description: Pale lilac bipyramidal crystals from the association with sanidine. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3590w, 3340, 2935w, 1650w, 1390w, 1142s, 1120sh, 1007s, 725sh, 698, 649, 614, 590sh, 444s, 415sh.

Sif43 Indialite $Mg_2(Al_4Si_5O_{18})$

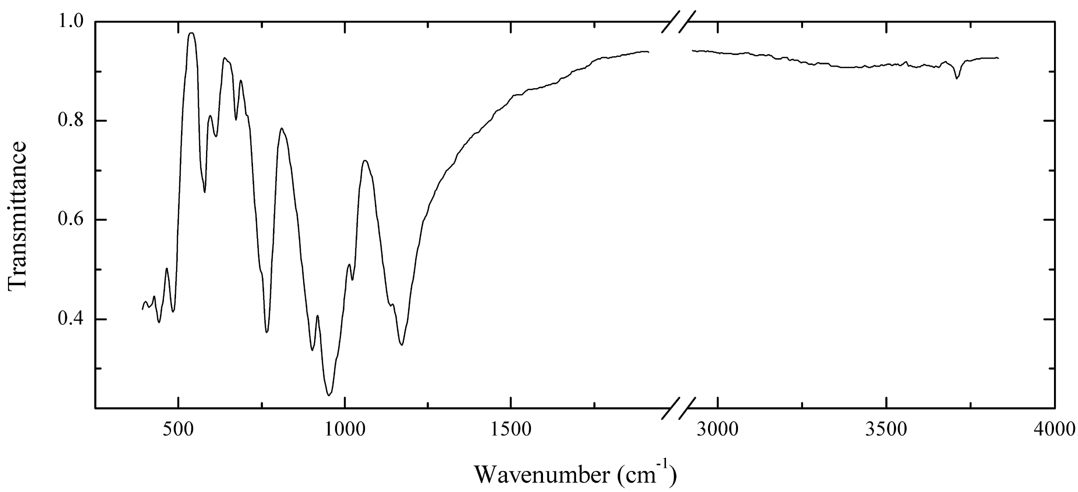


Locality: Kladno (Schöller) mine, Libušin, Kladno, Bohemia, Czech Republic.

Description: Blue imperfect crystals from burned rock.

Wavenumbers (cm^{-1}): 1175s, 1150sh, 1027, 958s, 908, 767, 673w, 616, 578, 565sh, 520sh, 483, 443, 409.

Sif44 Cordierite $Mg_2(Al_4Si_5O_{18})$

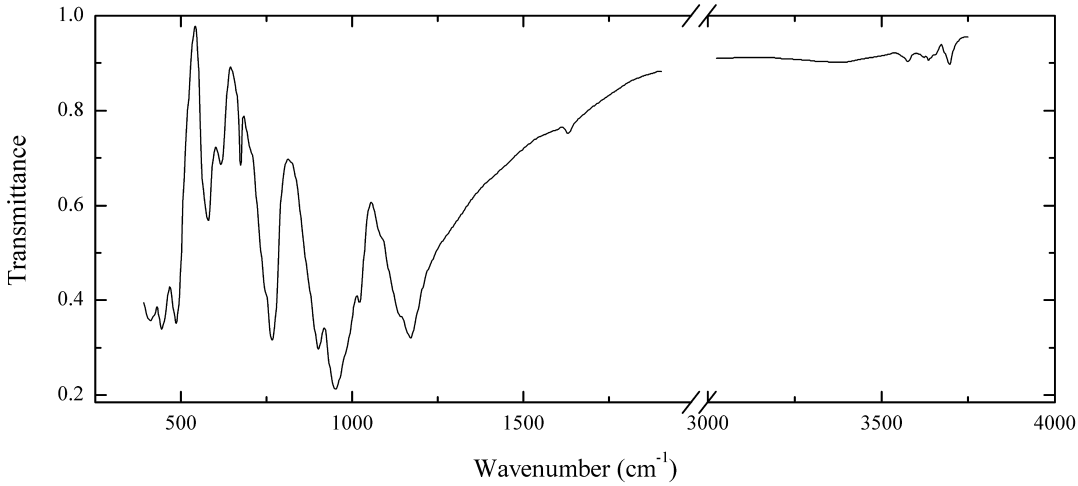


Locality: Tsihombe, Madagascar.

Description: Blue massive. Identified by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3694w, 3630w, 3570w, 1173s, 1140s, 1090sh, 1026, 956s, 906s, 769s, 750sh, 704w, 676, 618, 581, 570sh, 486, 442s, 418.

Sif45 Cordierite $Mg_2(Al_4Si_5O_{18})$

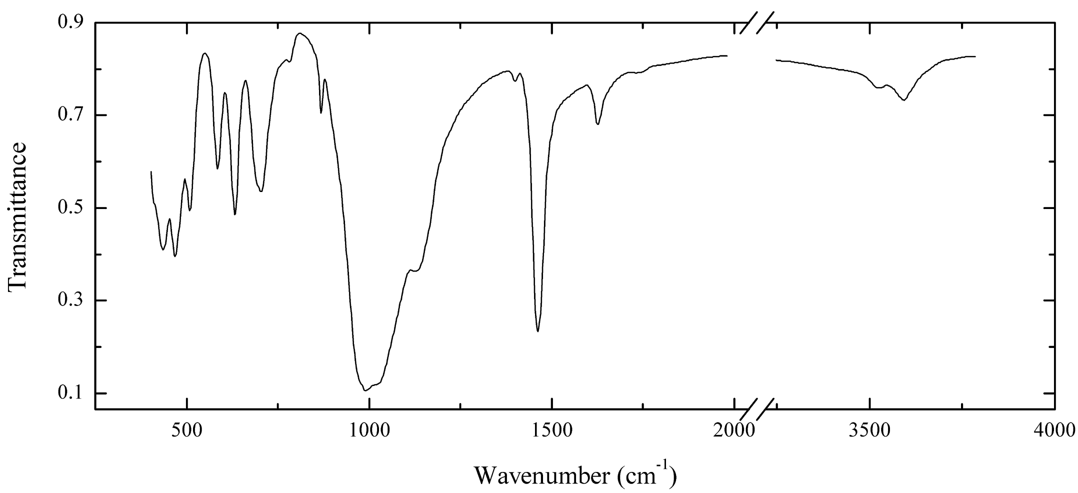


Locality: Pamir Mts., Tajikistan.

Description: Blue massive. Identified by IR spectrum and electron microprobe analysis. Investigated by A.I. Brusnitsyn.

Wavenumbers (cm^{-1}): 3692w, 3630w, 3570w, 1635w, 1173s, 1140s, 1088, 1025, 955s, 906s, 768s, 750sh, 705sh, 676, 617, 582, 570sh, 485, 442s, 418.

Sif46 Cancrisilite $Na_7(Al_5Si_7O_{24})(CO_3)\cdot 3H_2O$

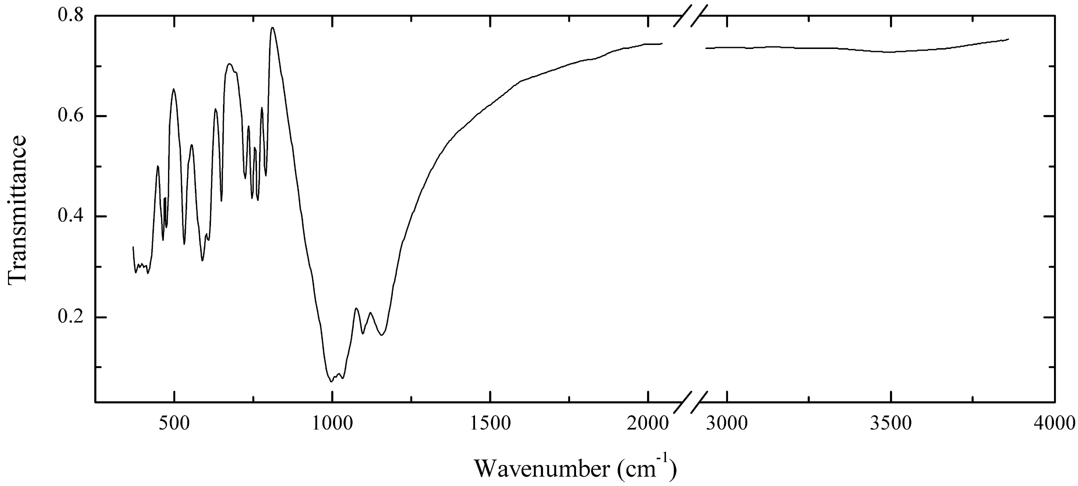


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light lilac coarse-grained aggregate. Identified by IR spectrum. The empirical formula is $Na_{6.83}Ca_{0.08}K_{0.04}(Al_{4.96}Si_{7.04}O_{24})(CO_3)_{1.02}Cl_{0.03}\cdot nH_2O$.

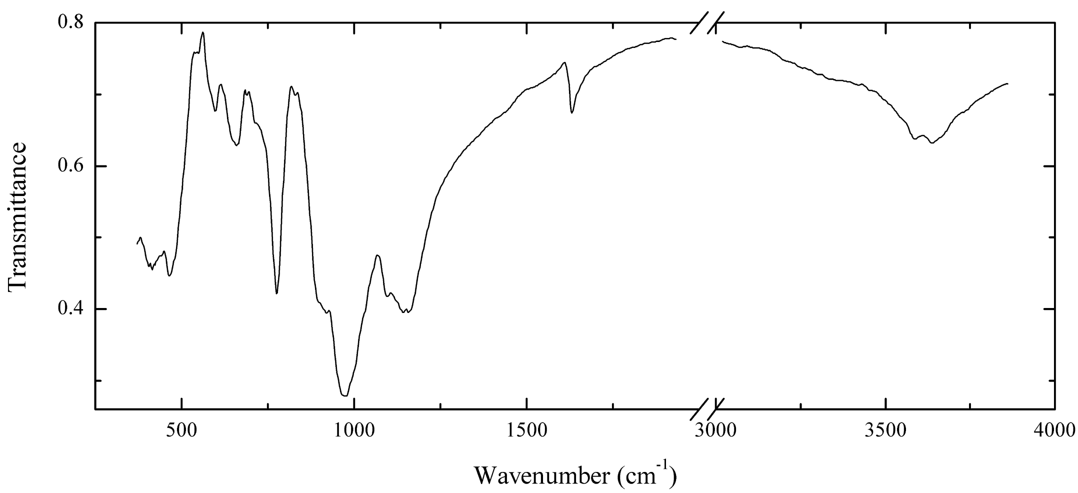
Wavenumbers (cm^{-1}): 3590, 3525, 1730w, 1645sh, 1631, 1462s, 1400w, 1132s, 1020sh, 992s, 975sh, 865, 705sh, 695, 685sh, 625, 577, 500, 459s, 431s, 405sh.

Sif49 Albite $Na(AlSi_3O_8)$



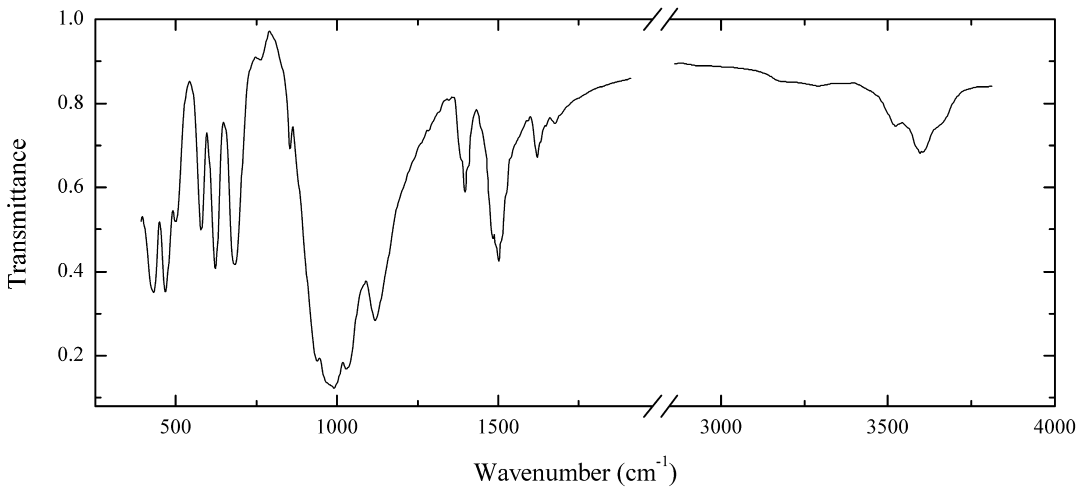
Locality: Urucum mine, (Córrego do Urucum pegmatite), Galiléia, Doce valley, Minas Gerais, Brazil.
Description: White platy crystals from the association with coutinhoite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1158s, 1097s, 1035s, 1014s, 996s, 789, 763, 745, 726, 651, 611, 592s, 534, 479, 467, 430s, 400s.

Sif50 Cordierite $Mg_2(Al_4Si_5O_{18})$



Locality: Lipovka (Lipovskaya) mine, Lipovka pegmatite field, Rezh district, Middle Urals, Russia.
Description: Bright orange grains from the contact zone of granite pegmatite, from the association with tourmaline, amphibole, plagioclase and calcite. An unusual variety high content of Be, Na, Ca and H_2O. The empirical formula is $Na_{0.27}Ca_{0.19}(Mg_{1.79}Fe^{2+}_{0.19})(Al_{3.31}Be_{0.60}Si_{5.065}O_{18})\cdot 0.92H_2O$. The crystal structure is solved. Orthorhombic, space group *Cccm*, $a = 16.850(3)$, $b = 9.729(2)$, $c = 9.298(2)$ Å, $Z = 8$.
Wavenumbers (cm^{-1}): 3630, 3575, 1628, 1161s, 1138s, 1098s, 971s, 918s, 895sh, 773s, 657, 596, 543w, 475sh, 463s, 407s.

Sif51 Cancrinite $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}\cdot 2H_2O$

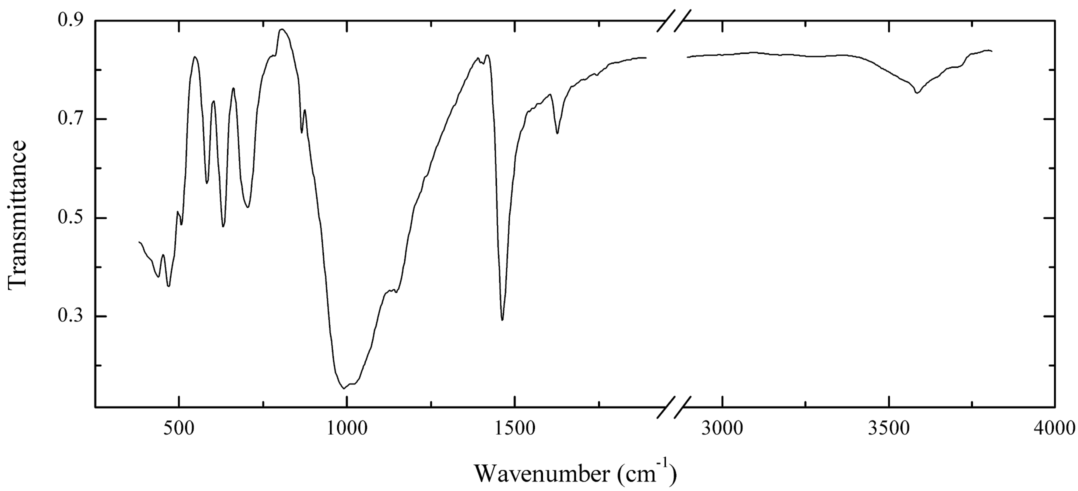


Locality: Vishnevye Mts., South Urals, Russia.

Description: Grey coarse-grained aggregate. Identified by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe, CO_3 calculated) $Na_{6.4}Ca_{1.2}K_{0.1}(Si_{6.2}Al_{5.8}O_{24})(CO_3)_{1.6}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3675sh, 3620, 3540, 3315w, 3220sh, 1685w, 1630, 1525sh, 1510sh, 1502, 1490sh, 1484, 1405sh, 1398, 1385sh, 1124s, 1035s, 1000sh, 993s, 975sh, 941s, 858, 762w, 682, 621, 577, 496, 463s, 415s.

Sif52 Cancrisilite $Na_7(Al_5Si_7O_{24})(CO_3)\cdot 3H_2O$

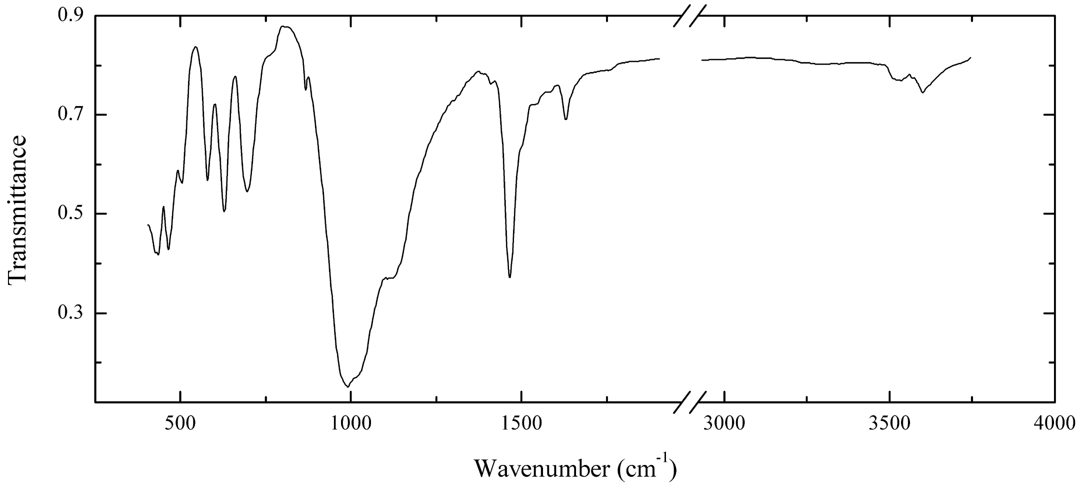


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brown granular aggregate from peralkaline pegmatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{7.38}(Si_{7.25}Al_{4.70}Fe_{0.05})(CO_3)_x(PO_4)_{0.09}(SO_4)_{0.03}$.

Wavenumbers (cm^{-1}): 3600, 1633, 1464s, 1402w, 1150, 1065sh, 1027s, 994s, 865, 698, 626, 578, 500, 461s, 429s.

Sif53 Cancrisilite $Na_7(Al_5Si_7O_{24})(CO_3)\cdot 3H_2O$

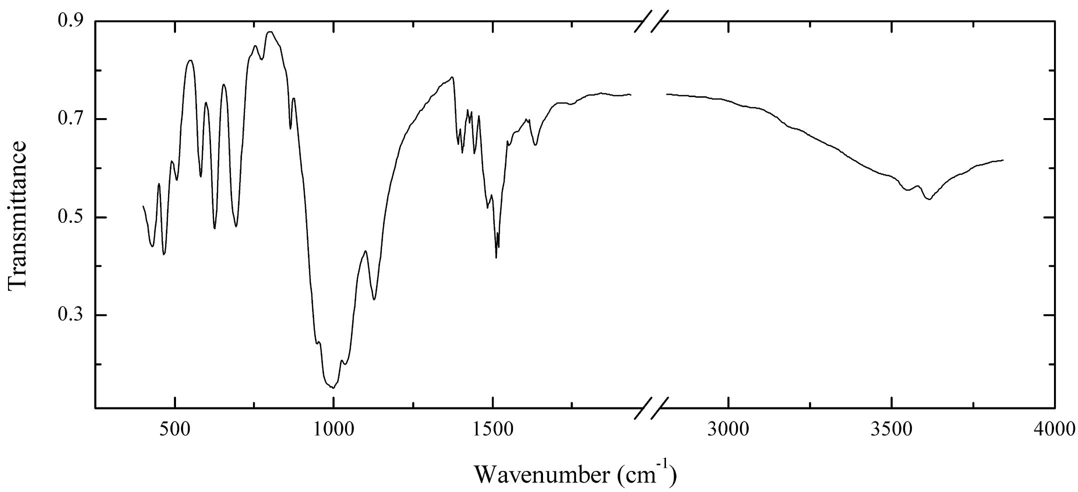


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow grain from peralkaline pegmatite, from the association with villiaumite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3600, 3525, 1634, 1500sh, 1464s, 1410w, 1120s, 1015sh, 992s, 865, 775sh, 750sh, 693, 624, 576, 498, 460s, 427s.

Sif54 Cancrinite $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}\cdot 2H_2O$

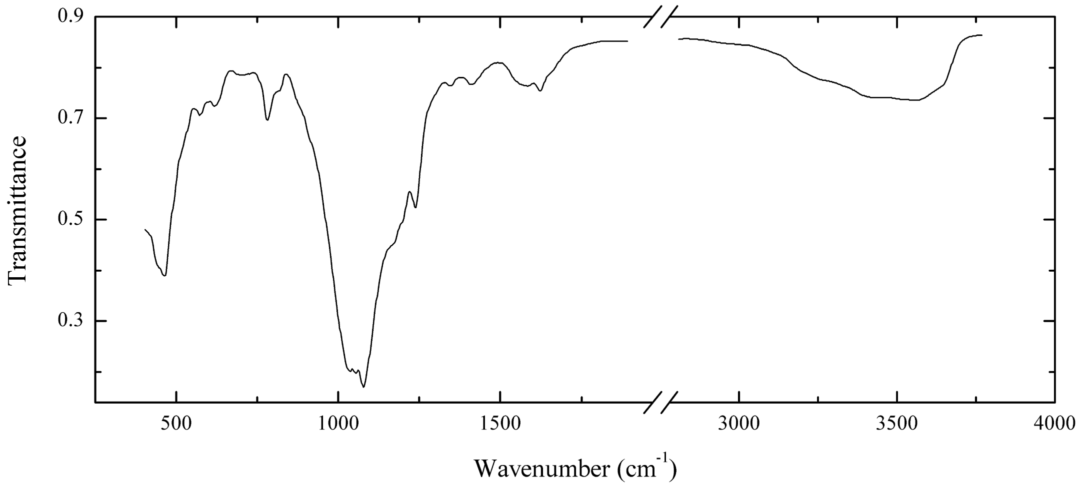


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Grey prismatic crystal from alkaline pegmatite, from the association with orthoclase, aegirine-augite, feklichevite and pectolite. Identified by IR spectrum. The empirical formula is (electron microprobe, CO_3 calculated) $Na_{5.85}Ca_{1.4}K_{0.05}(Si_{6.1}Al_{5.9}O_{24})(CO_3)_{1.4}\cdot nH_2O$.

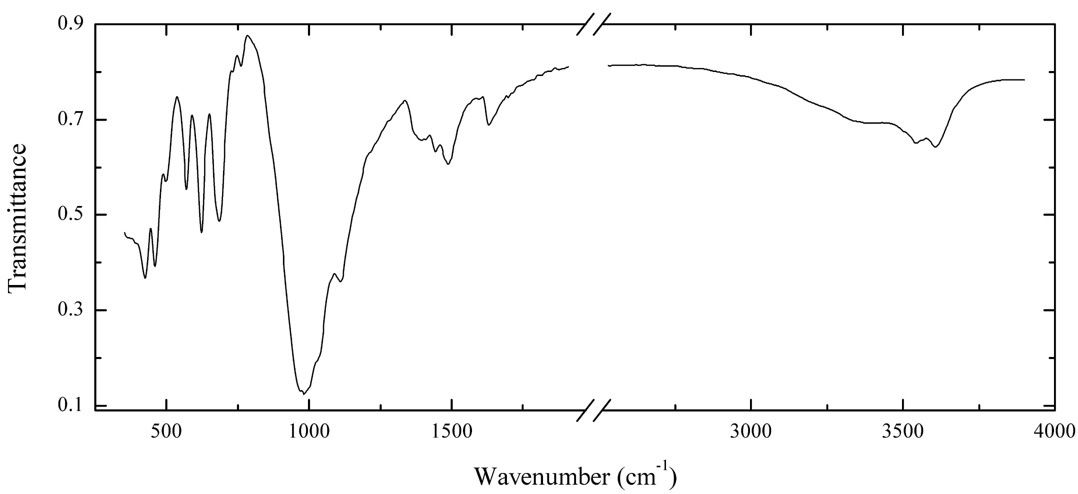
Wavenumbers (cm^{-1}): 3597, 3532, 3460sh, 1745w, 1633, 1565sh, 1545sh, 1525sh, 1510, 1502, 1480, 1460sh, 1434, 1419w, 1398, 1382, 1124s, 1035s, 1000sh, 992s, 970sh, 942s, 859, 766w, 685, 620, 576, 499, 459s, 422s.

Sif55 Kenyaite $Na_2Si_{22}O_{41}(OH)_8{\cdot}6H_2O$ (?)



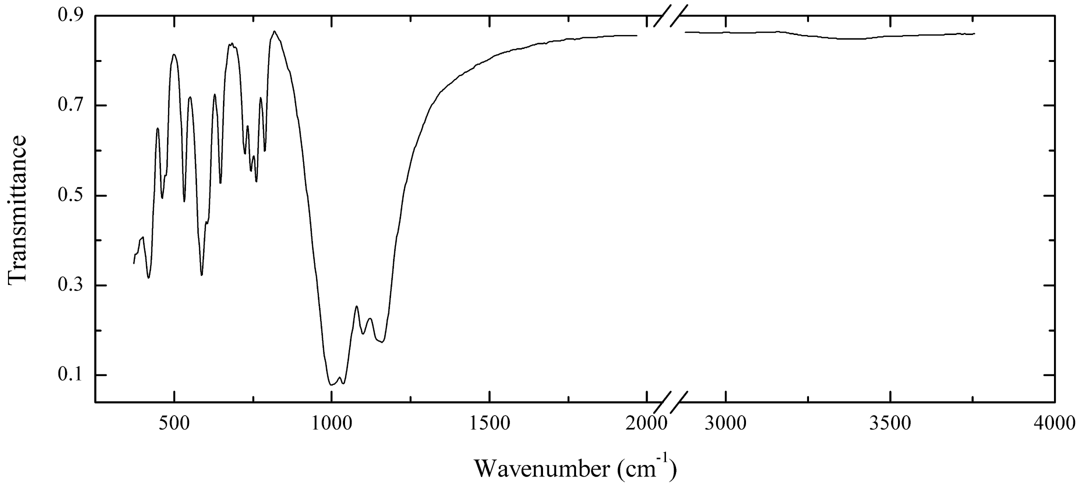
Locality: Magadi lake, Kenya (type locality).
Description: Light grey microconcretions.
Wavenumbers (cm^{-1}): 3640sh, 3550, 3460sh, 3270sh, 1625, 1580, 1480w, 1347w, 1236, 1195sh, 1160sh, 1110sh, 1081s, 1057s, 1046s, 815sh, 780, 700w, 617, 583, 464, 450sh.

Sif56 Cancrinite $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}{\cdot}2H_2O$



Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Ca- and CO_3-deficient variety. Brownish outer zones in grey crystals of normal cancrinite, from the association with potassic feldspar, pectolite, magnesio-arfvedsonite and clinopyroxene. The empirical formula is $Na_{7.65}K_{0.05}Ca_{0.04}(Al_{5.71}Si_{6.28}Fe_{0.01}O_{24})(CO_3)_{0.95}(SO_4)_{0.07}Cl_{0.02}{\cdot}2.6H_2O$. The crystal structure is solved. Trigonal, space group $P3$, a = 12.727(4), c = 5.186(2), Z = 1.
Wavenumbers (cm^{-1}): 3596, 3533, 3375, 1637, 1489, 1444, 1396, 1114s, 1030sh, 995sh, 982s, 970sh, 860sh, 760w, 735w, 683, 675sh, 622, 570, 497, 458s, 425s, 380sh.

Sif57 Albite $Na(AlSi_3O_8)$

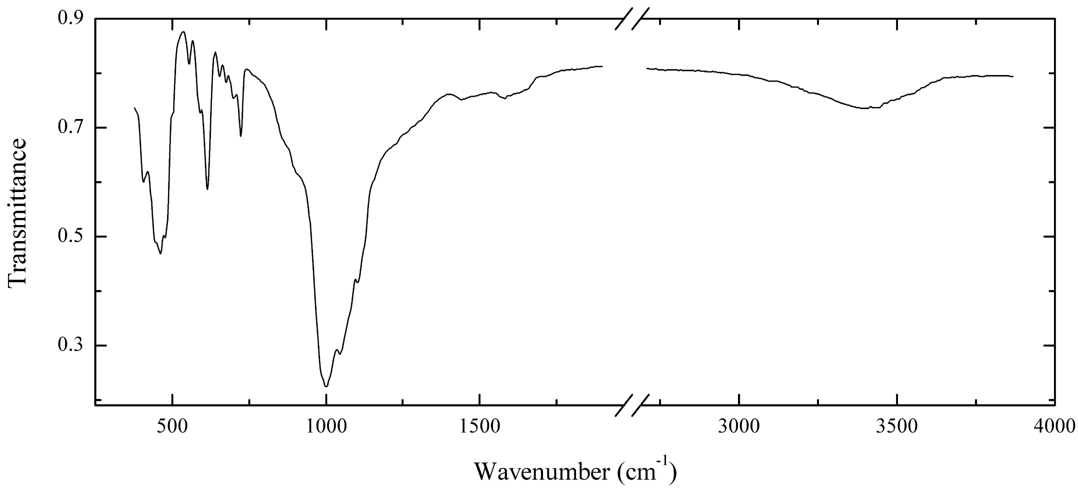


Locality: Malinovaya Varaka, Loukhi district, northern Karelia, Russia.

Description: Red granular aggregate from the association with quartz, biotite and fluorapatite. Ca-bearing variety. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Na_{0.86}Ca_{0.12}Ka_{0.01}(Al_{1.07}Fe_{0.03}Si_{2.90}O_{24})$.

Wavenumbers (cm^{-1}): 1158s, 1145sh, 1098s, 1036s, 1003s, 788, 761, 743, 724, 650, 611, 591s, 536, 478, 465, 427s.

Sif58 Lithosite $K_3(Al_2Si_4O_{12})(OH){\cdot}nH_2O$

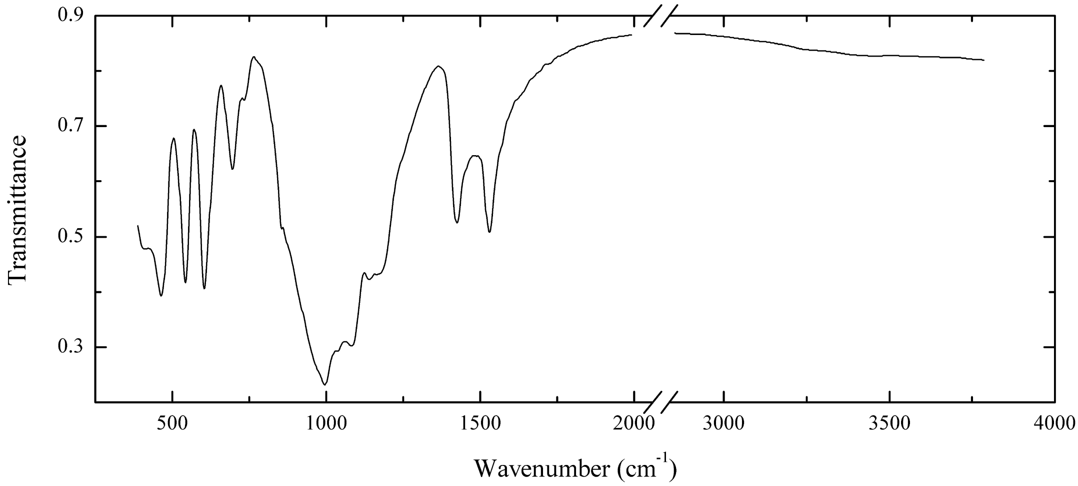


Locality: Borehole in the Vuonnemiok River valley, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless grains from peralkaline pegmatite, from the association with shafranovskite, lomonosovite, lamprophyllite, catapleiite, koashvite, zirsinalite, sodalite, aegirine, pectolite and molybdenite. Holotype sample. Monoclinic, $a = 15.197$, $b = 10.233$, $c = 8.435$ Å, $\beta = 90.21°$, $Z = 2$. The empirical formula is $K_{2.92}(Al_{1.97}Si_{4.04}O_{12})(OH)_x{\cdot}nH_2O$. Optically biaxial (+), $\alpha = 1.510(2)$, $\beta = 1.513(2)$, $\gamma = 1.527(2)$, $2V_{meas} = 47°$. $D_{calc} = 2.54$ g/cm^3, $D_{meas} = 2.51$ (1) g/cm^3. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 3.46 (84), 3.26 (84), 3.16 (84), 3.07 (100), 2.82 (73), 2.10 (83), 2.05 (50).

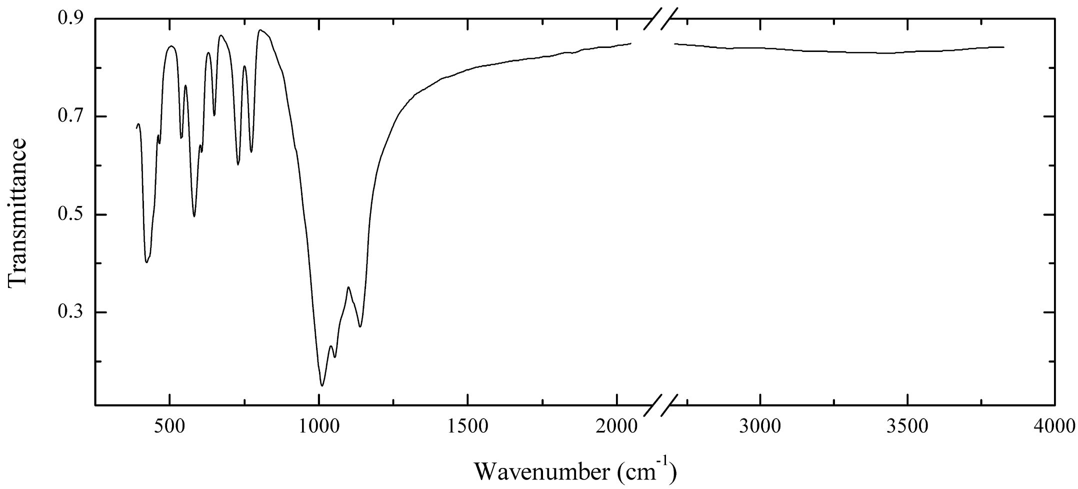
Wavenumbers (cm^{-1}): 3390, 1625sh, 1580w, 1445w, 1260sh, 1120sh, 1103s, 1080sh, 1050sh, 1037s, 1010sh, 1000s, 985sh, 910sh, 860sh, 726, 701w, 676w, 653w, 612, 586, 550w, 499, 477, 461s, 441, 410.

Sif59 Meionite $Ca_4(Al_6Si_6O_{24})(CO_3)$



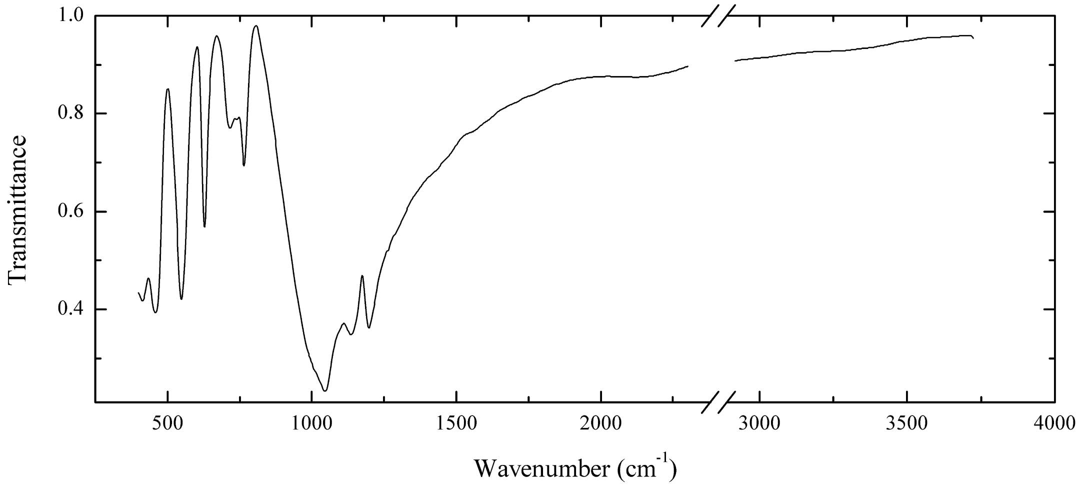
Locality: San Vito quarry, Monte Somma, Vesuvius volcanic complex, Campania, Italy.
Description: Grey crystals from the association with kalsilite. Identified by IR spectrum. The empirical formula is (electron microprobe, CO_3 calculated) $(Ca_{3.8}Na_{0.2})(Al_{5.8}Si_{6.2}O_{24})(CO_3)_{0.95}(SO_4)_{0.04}Cl_{0.02}$.
Wavenumbers (cm^{-1}): 1527, 1421, 1155, 1134, 1075s, 1032s, 990s, 880sh, 850, 727w, 691, 600, 538, 461, 400.

Sif61 Microcline $K(AlSi_3O_8)$



Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White platelets growing on natrolite crystals. High-ordered low-temperature variety. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1136s, 1070sh, 1051s, 1009s, 770, 728, 647, 606, 579, 537, 465, 442, 428, 420s.

Sif62 Marialite $Na_4(Al_3Si_9O_{24})Cl$

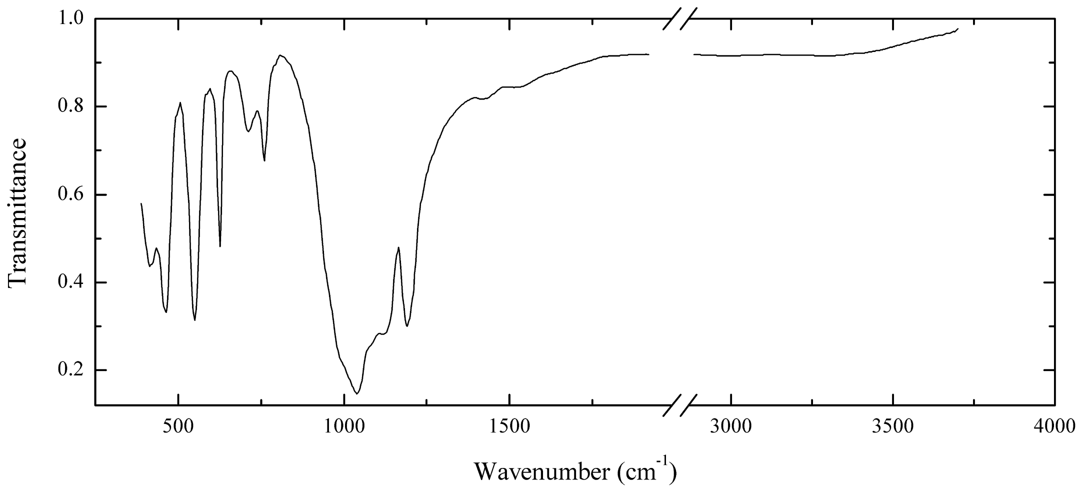


Locality: Gurumdy river, Eastern Pamir Mts., Tajikistan.

Description: Lilac prismatic crystal. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Na_{3.6}Ca_{0.4})(Al_{3.4}Si_{8.6}O_{24})(SO_4)_{0.05}Cl_{0.9}$.

Wavenumbers (cm^{-1}): 1195s, 1134s, 1045s, 995sh, 766, 740w, 714, 626, 547s, 457s, 413s.

Sif63 Marialite $Na_4(Al_3Si_9O_{24})Cl$

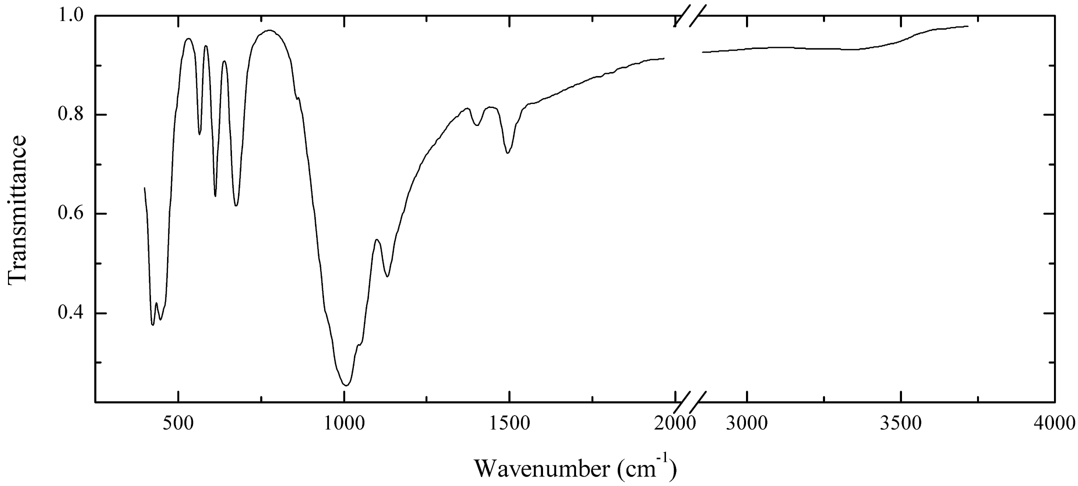


Locality: Gurumdy river, Eastern Pamir Mts., Tajikistan.

Description: Yellow prismatic crystal. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Na_{3.3}Ca_{0.7})(Al_{3.6}Si_{8.4}O_{24})(SO_4)_{0.05}Cl_{0.9}(CO_3,OH)_x$.

Wavenumbers (cm^{-1}): 3300w, 1525w, 1422w, 1193s, 1123s, 1042s, 995sh, 763, 714, 625, 548s, 462s, 419.

Sif64 Balliranoite $(Na,K)_6Ca_2(Si_6Al_6O_{24})Cl_2(CO_3)$

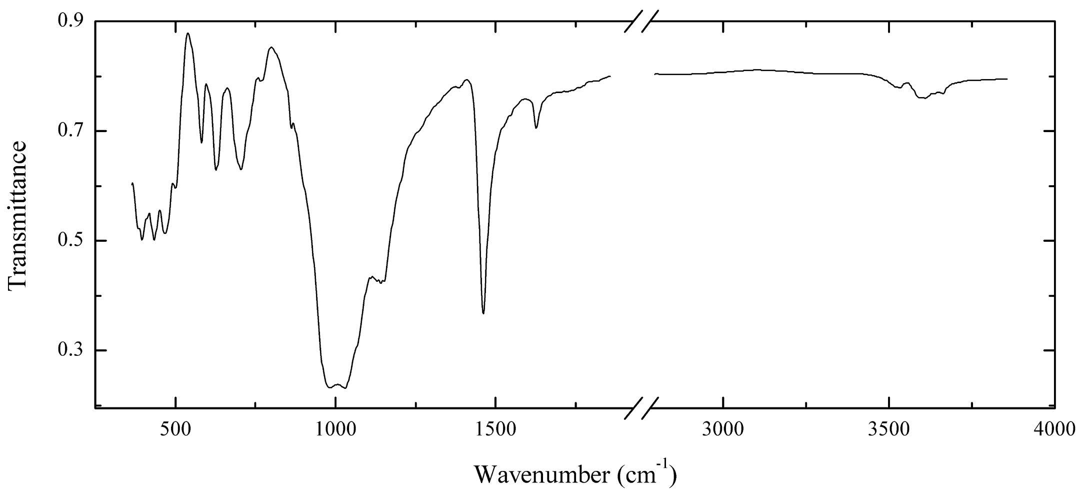


Locality: Monte Somma, Vesuvius volcanic complex, Campania, Italy (type locality).

Description: Colourless prismatic crystals from the association with orthoclase, phlogopite, humite, calcite, diopside, pargasite, haüyne and apatite. The empirical formula is $(Na_{4.84}Ca_{2.48}K_{0.74})(Si_{6.00}Al_{6.00}O_{24})[(CO_3)_{0.82}(SO_4)_{0.28}]Cl_{2.34}[Si_6Al_6O_{24}]\cdot nH_2O$ ($n \approx 0.1$).

Wavenumbers (cm^{-1}): 3370w, 1510. 1407w, 1130s, 1050s, 1007s, 950sh, 857w, 678, 609, 563, 445s, 420s.

Sif65 Cancrisilite $Na_7(Al_5Si_7O_{24})(CO_3)\cdot 3H_2O$

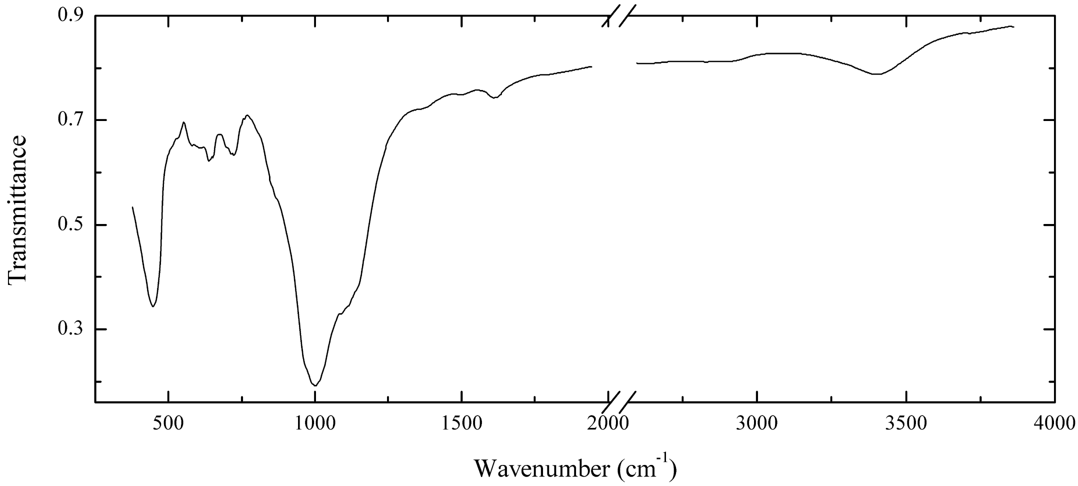


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada.

Description: Lilac grains from peralkaline pegmatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{6.93}(Al_{4.34}Si_{7.66}O_{24})(CO_3)_x\cdot nH_2O$

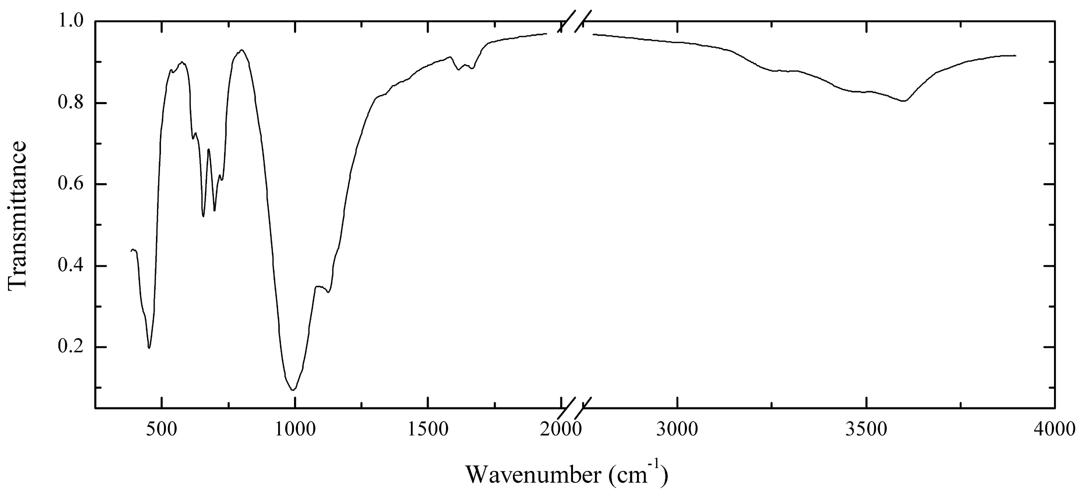
Wavenumbers (cm^{-1}): 3660w, 3600, 3525w, 1635, 1466s, 1145s, 1033s, 983s, 864, 760w, 720sh, 700, 625, 577, 493, 465s, 430s, 390s.

Sif66 Lazurite $(Ca,Na)_8(Si_6Al_6O_{24})[(SO_4),S,Cl,(OH)]_2$



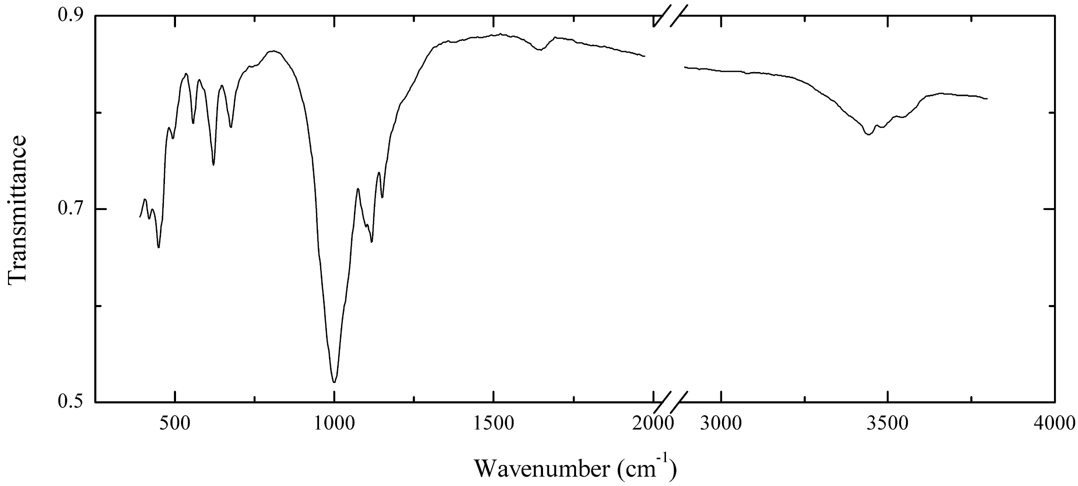
Locality: Granite Mt., Little Rock, Pulaski Co., Arkansas, USA.
Description: Dark blue massive. High-hydrous S^{2-}-dominant variety ($S^{2-} > SO_4^{2-}$ in formula units). Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3395, 1617w, 1205sh, 1100sh, 1000s, 718, 640, 605w, 580sh, 445s.

Sif67 Nosean $Na_8(Si_6Al_6O_{24})(SO_4)\cdot H_2O$



Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Grey grains from nosean syenite. Identified by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3615, 3500sh, 3310w, 1675w, 1625w, 1170sh, 1137s, 998s, 729, 702, 660, 640sh, 621, 550w, 452s, 430sh.

Sif68 Pitiglianoite $K_2Na_6(Si_6Al_6O_{24})(SO_4)\cdot 2H_2O$

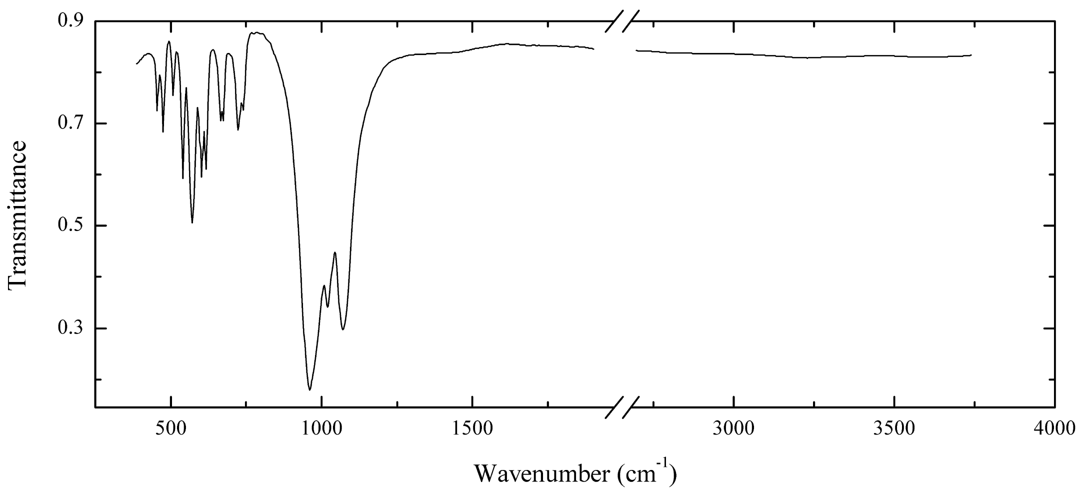


Locality: Monte Cavalluccio, Sacrofano caldera, Campagnano municipality, Roma province, Latium region, Italy.

Description: Light grey prismatic crystals from the association with nosean and peprossiite. Identified by IR spectrum and single-crystal X-ray diffraction pattern. The empirical formula is (electron microprobe; OH calculated) $K_{2.2}Na_{5.7}(Al_{5.9}Si_{6.1}O_{24})(SO_4)_{0.9}(OH)_{0.2}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3530w, 3460, 3430, 1640w, 1153, 1117, 1099, 1035sh, 1000s, 755w, 678, 622, 559. 495, 447s, 426.

Sif69 Paracelsian $Ba(Al_2Si_2O_8)$

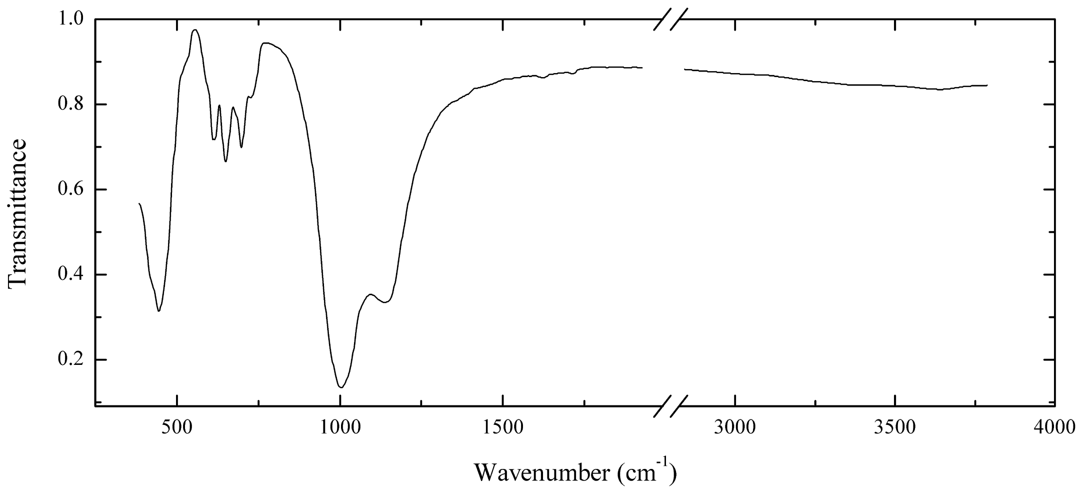


Locality: Benallt mine, Rhiw, Lleyn peninsula, Gwynedd, Wales, UK.

Description: White imperfect crystals.

Wavenumbers (cm^{-1}): 1072s, 1025s, 990sh, 962s, 739, 723, 670, 663, 614, 600, 570s, 537, 504, 472, 452.

Sif70 Franzinite $(Na,K)_6Ca_2(Si_6Al_6O_{24})(SO_4)_2{\cdot}nH_2O$ ($n \approx 0.4$)

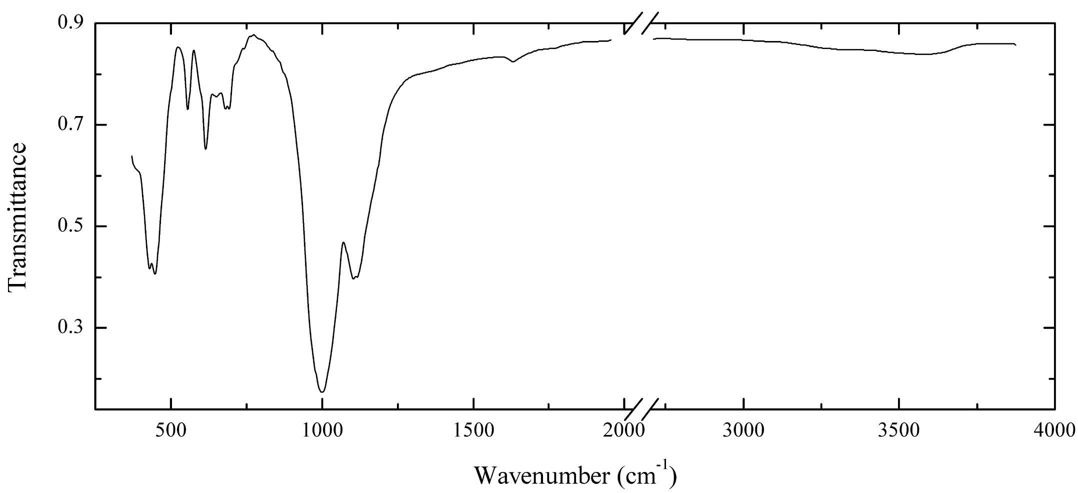


Locality: Pitigliano, Grosseto province, Tuscany, Italy.

Description: Colourless grain with perfect cleavage from the association with sanidine and grossular. Identified by IR spectrum and single-crystal X-ray diffraction pattern. Unit-cell parameters are $a = 12.88$, $c = 26.46$ Å. The empirical formula is (electron microprobe) $Na_{4.6}K_{1.4}Ca_{2.0}(Al_{5.9}Si_{6.1}O_{24})(SO_4)_{2.0}Cl_{0.1}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3620w, 1715w, 1625w, 1138s, 1008s, 727w, 698, 647, 617, 609, 590sh, 525sh, 446s, 420sh.

Sif71 Giuseppettite $Na_5K_2Ca(Si_6Al_6O_{24})[(SO_4),Cl]_{2-x}{\cdot}H_2O$

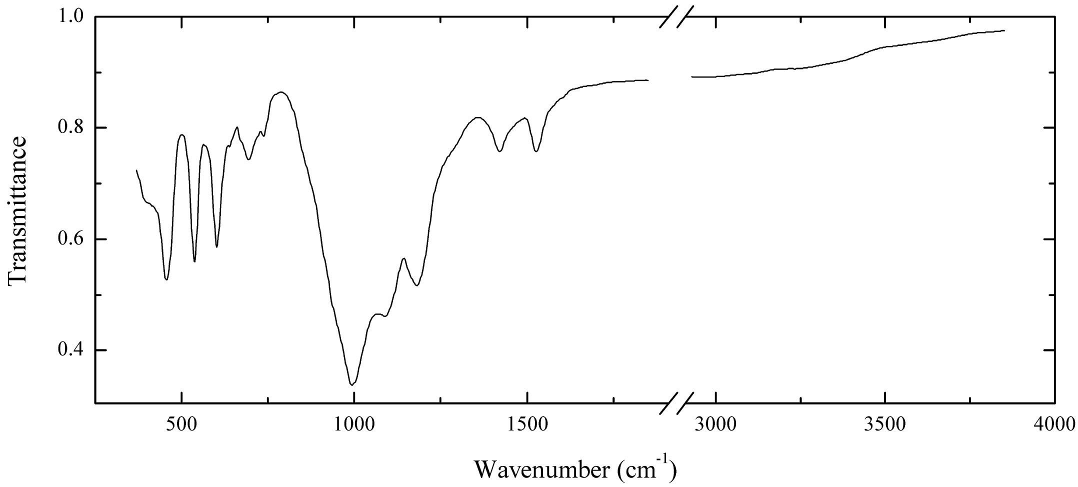


Locality: Cavalluccio Mt. (Monte Cavalluccio), Sacrofano caldera, Campagnano municipality, Roma province, Latium region, Italy.

Description: Blue-violet transparent grains from sanidinite. Identified by IR spectrum and single-crystal X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3600w, 3320sh, 1638w, 1385w, 1115s, 1105s, 690, 678, 649w, 616, 595sh, 555, 470sh, 447s, 429s, 385sh.

Sif72 Silvialite $Ca_4(Al_6Si_6O_{24})(SO_4)$

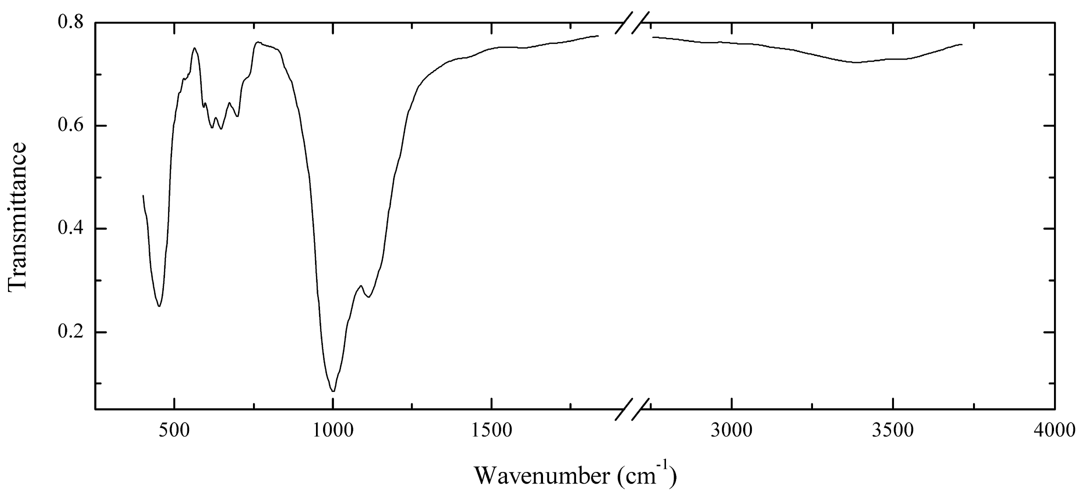


Locality: Loitsch quarry, Weida, Gera, Thuringia, Germany.

Description: Light grey semitransparent grains from basalt. Confirmed by IR spectrum. CO_3^{2-}-bearing variety.

Wavenumbers (cm^{-1}): 1527, 1420, 1177s, 1090s, 999s, 740w, 697, 675sh, 645sh, 607, 543, 463, 425sh.

Sif73 Franzinite $(Na,K)_6Ca_2(Si_6Al_6O_{24})(SO_4)_2 \cdot nH_2O$ ($n \approx 0.4$)

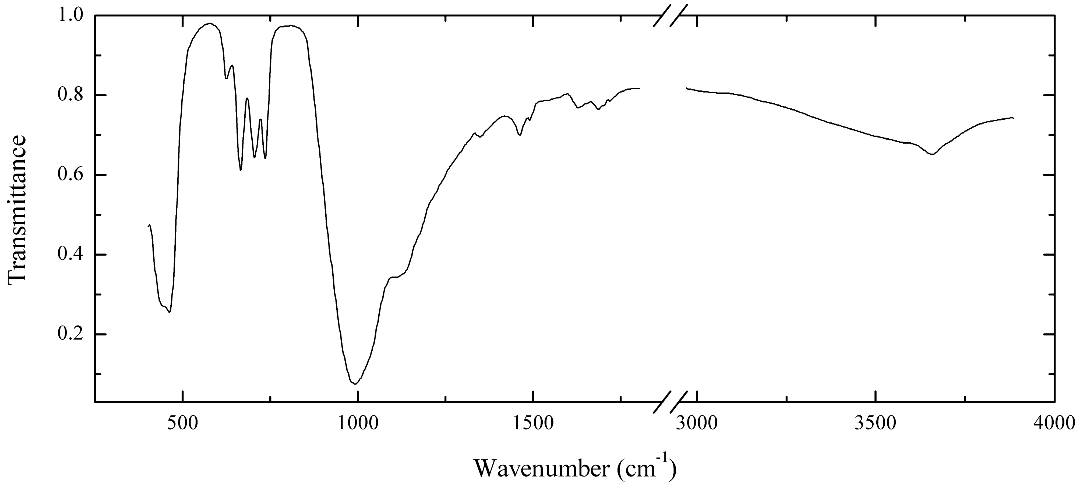


Locality: Biachella valley, Sacrofano caldera, Campagnano municipality, Roma province, Latium region, Italy.

Description: White short-prismatic crystals from sanidinite, from the association with phlogopite. Identified by IR spectrum.

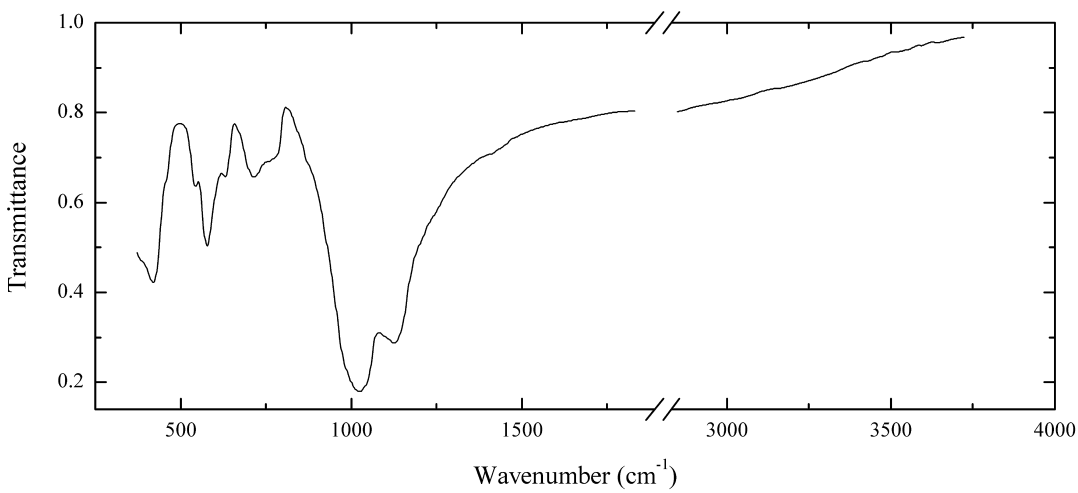
Wavenumbers (cm^{-1}): 3520w, 3400w, 1630w, 1440w, 1145sh, 1120s, 1004s, 730sh, 700, 649, 620, 591, 545sh, 520sh, 450, 444s.

Sif74 Sodalite $Na_6(Si_6Al_6O_{24})Cl_2$



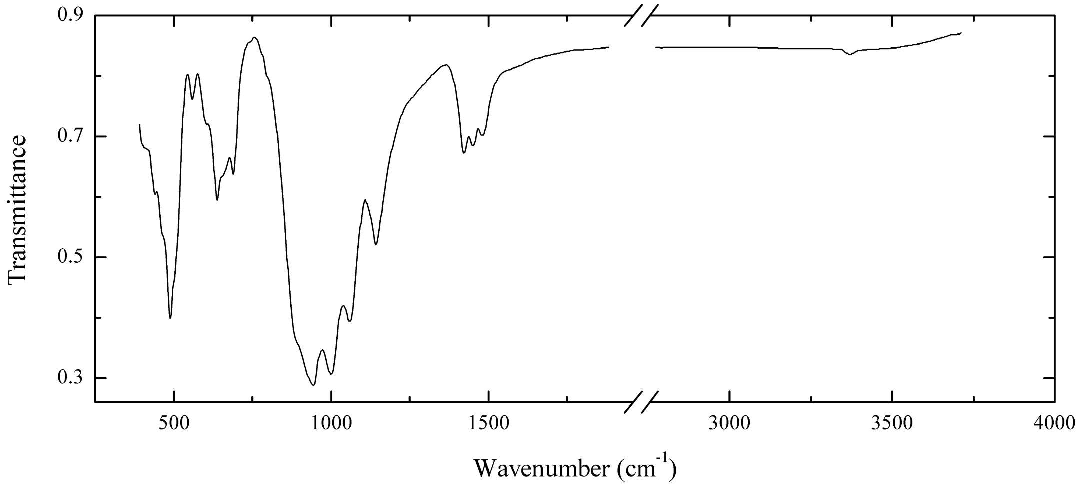
Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Brownish grains from peralkaline pegmatite. H_2O- and CO_3^{2-} and SO_4^{2-}-bearing variety. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3655, 3500sh, 1690w, 1641w, 1495w, 1461, 1348w, 1135sh, 1115sh, 1025sh, 993s, 733, 701, 663, 621w, 460s, 435sh.

Sif75 Sanidine $K(AlSi_3O_8)$



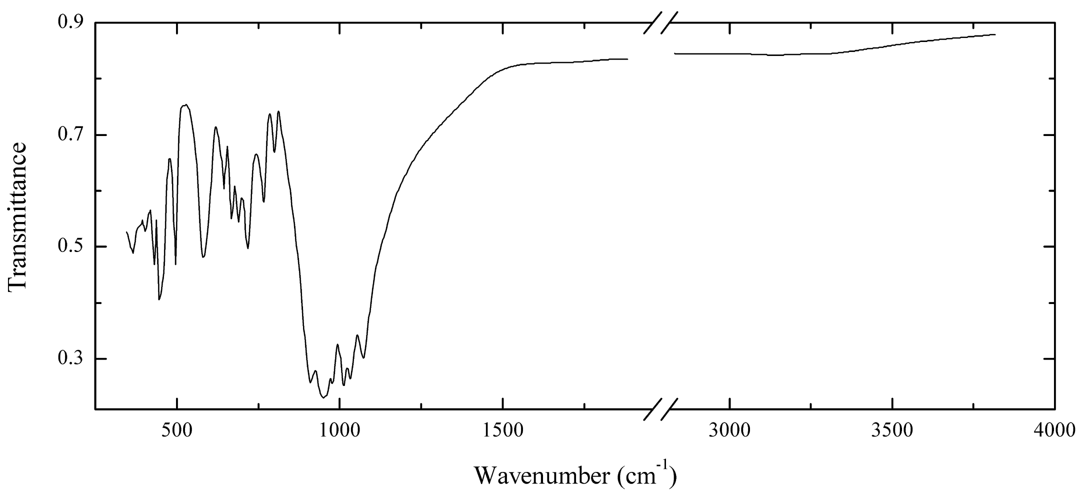
Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless crystals growing on natrolite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1133s, 1035s, 1020sh, 760sh, 722, 631, 582s, 421s, 400sh.

Sif76 Sarcolite $(Na_4Ca_{12}Al_8Si_{12}O_{46})(SiO_4,PO_4)(OH,H_2O)_4(CO_3,Cl)$



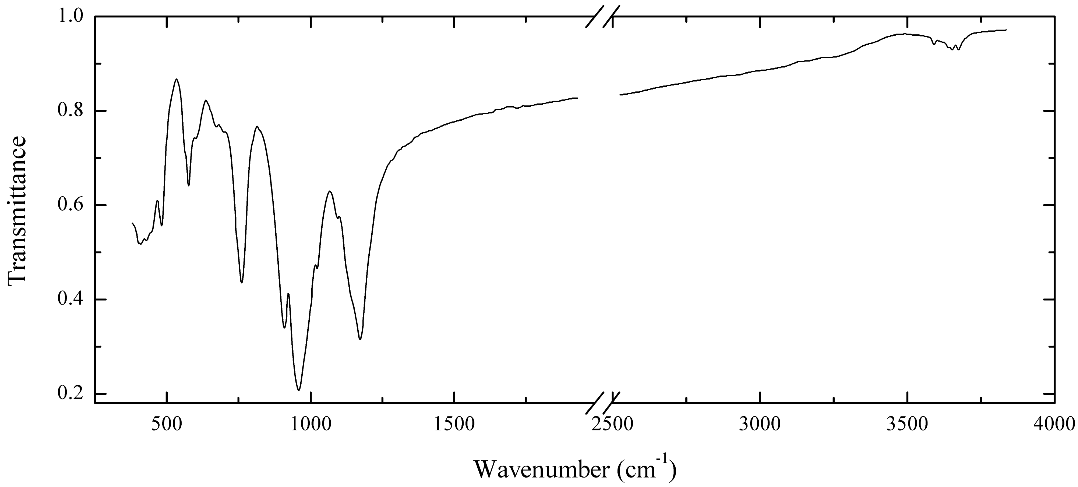
Locality: Monte Somma, Somma-Vesuvius complex, Campania, Italy (type locality).
Description: Pale pink transparent crystals from the association with wollastonite, garnet and forsterite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3400w, 1485, 1455, 1423, 1147, 1065s, 1003s, 946s, 900sh, 694, 655sh, 643, 606w, 562w, 510sh, 490s, 470sh, 442, 390sh.

Sif77 Slawsonite $Sr(Al_2Si_2O_8)$



Locality: Kochi city, Kochi prefecture, Shikoku island, Japan.
Description: White grains in rock. The empirical formula is (electron microprobe) $(Sr_{0.90}Ba_{0.02}Ca_{0.03})(Si_{2.08}Al_{1.90}Fe_{0.01}Mn_{0.01}O_8)$.
Wavenumbers (cm^{-1}): 1073s, 1033s, 1013s, 980s, 952s, 913s, 803, 768, 718, 691, 668, 647, 635sh, 583, 496, 460sh, 450s, 432, 407.

Sif78 **Sekaninaite** $(Fe^{2+},Mg)_2(Al_4Si_5O_{18})$

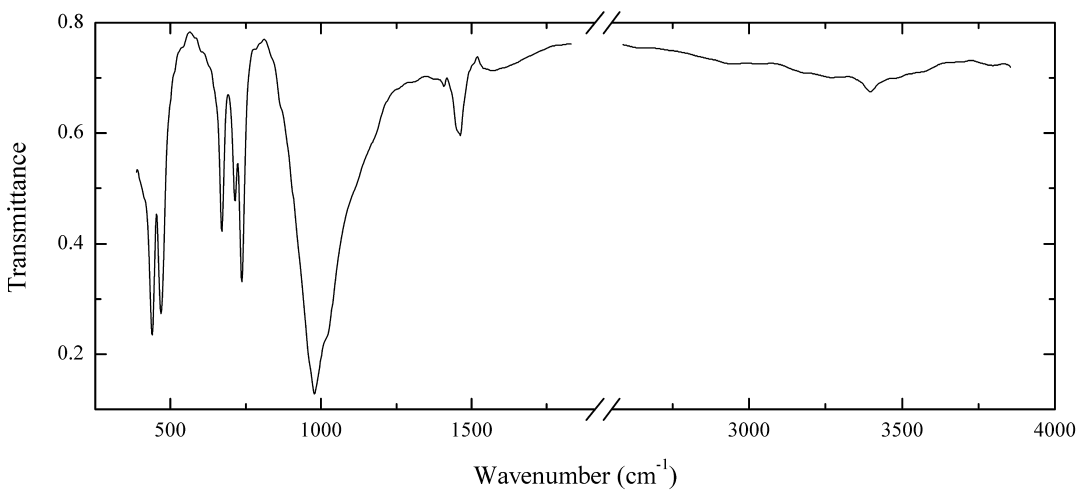


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Light violet grains from hornfels. Investigated by Yu. P. Menshikov. Identified by IR spectrum, electron microprobe analysis and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3655w, 3630w, 3572w, 1171s, 1140sh, 1092, 1024, 959s, 910s, 763s, 740sh, 695sh, 670w, 599, 577, 561, 483, 445sh, 430, 410.

Sif80 **Sodalite** $Na_6(Si_6Al_6O_{24})Cl_2$

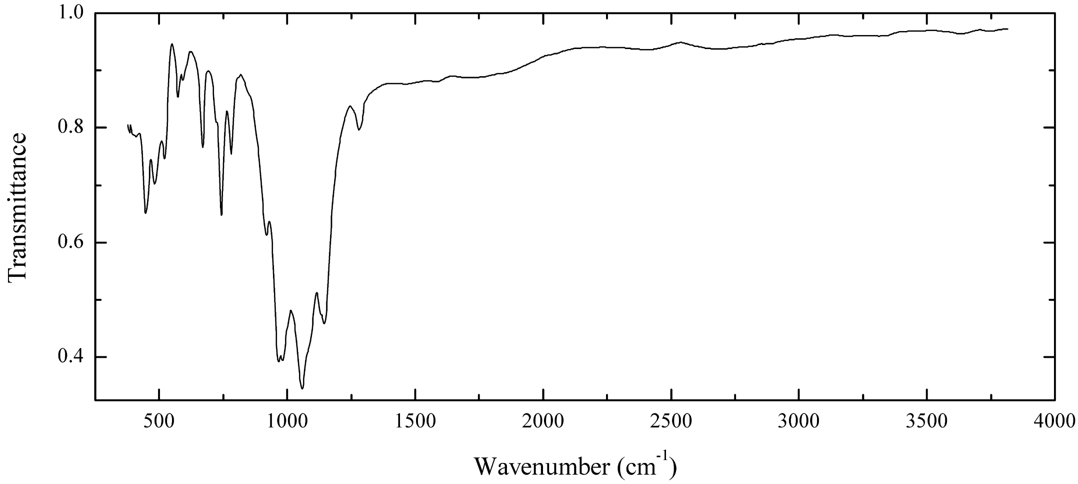


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pinkish-white with bright yellow fluorescence under UW radiation from peralkaline pegmatite, from the association with villiaumite. CO_3^{2-}-bearing variety.

Wavenumbers (cm^{-1}): 3390w, 1585w, 1475, 1020sh, 978s, 860sh, 736, 712, 668, 466s, 437s, 405.

Sif81 Ussingite $HNa_2AlSi_3O_9$

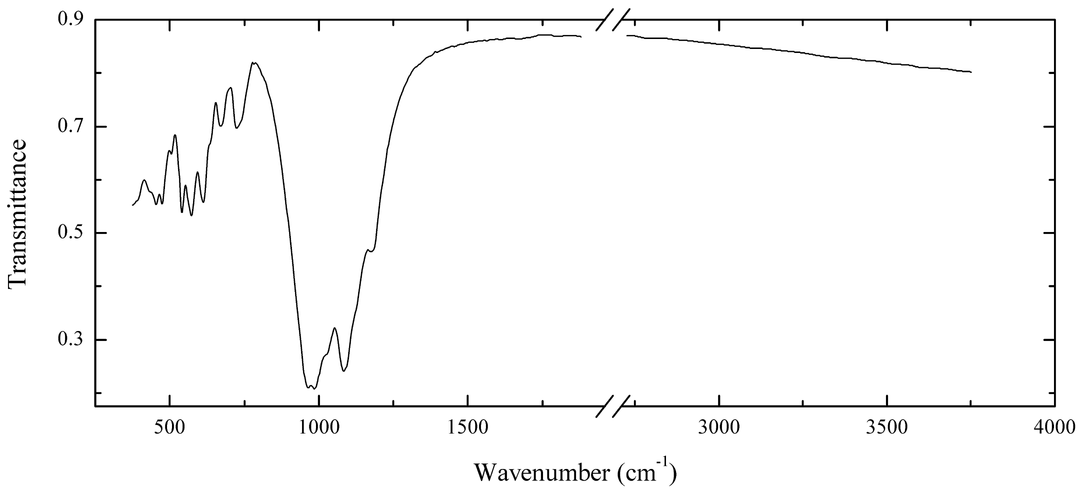


Locality: Shkatulka pegmatite, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Lilac granular aggregate. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 2670w, 2370w, 1720w, 1577w, 1267, 1133s, 1119s, 1075sh, 1047s, 972s, 954s, 907, 769, 732, 710w, 658, 593w, 581w, 563w, 510, 473, 436, 400.

Sif82 Celsian $Ba(Al_2Si_2O_8)$

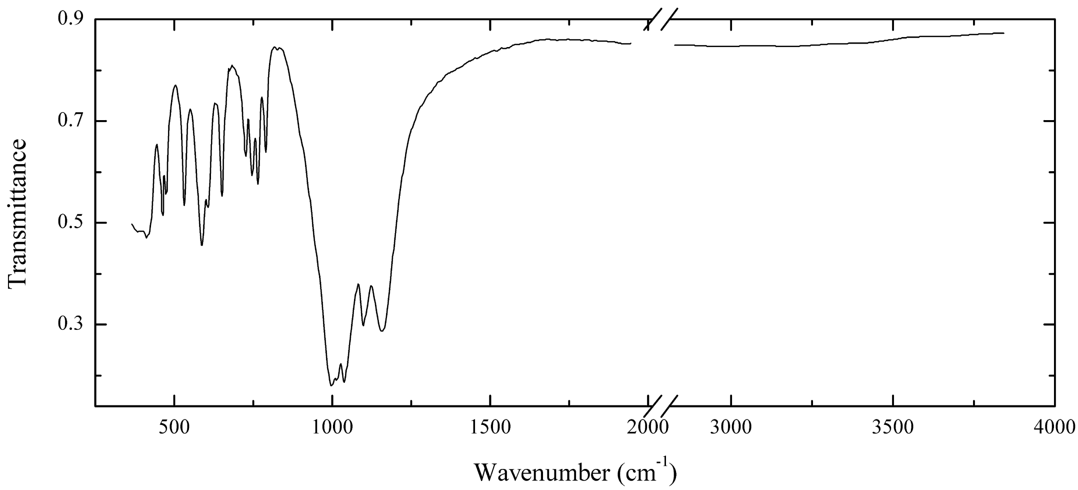


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: Yellowish grains from skarn, from the association with jacobsite, barite and manganoan phlogopite. The empirical formula is (electron microprobe) $(Ba_{0.90}Ca_{0.04}Ka_{0.04})(Si_{2.06}Al_{1.96})O_8$.

Wavenumbers (cm^{-1}): 1172, 1081s, 1020sh, 983s, 964s, 740sh, 725w, 665w, 630sh, 610, 572, 538, 504w, 473, 452.

Sif84 Albite $Na(AlSi_3O_8)$

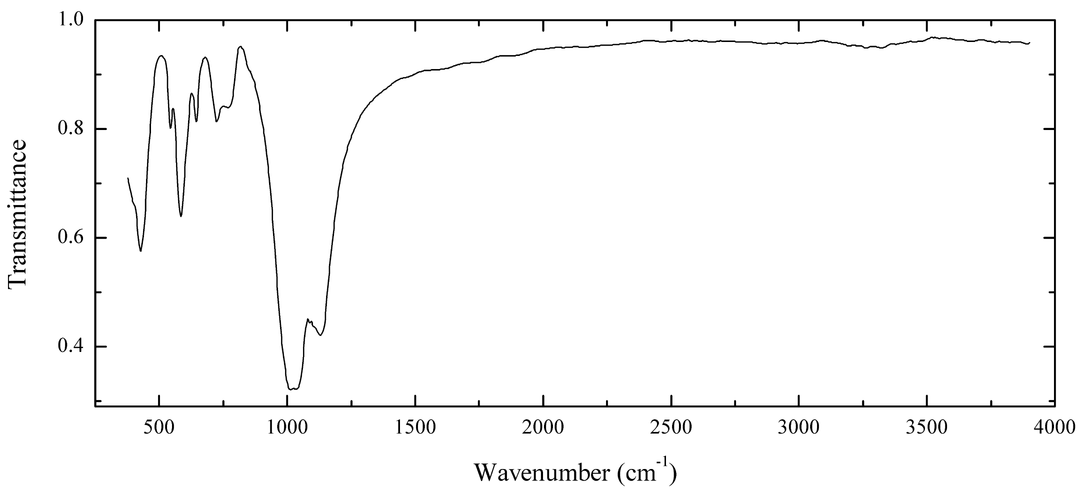


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless grains with perfect cleavage from the association with lorenzenite. The empirical formula is $Na_{1.02}Ca_{0.01}(Al_{1.00}Si_{2.99})O_8$.

Wavenumbers (cm^{-1}): 1158s, 1097s, 1037s, 1013s, 995s, 905sh, 789, 763, 745, 725, 651, 608, 589, 534, 478, 466, 415, 390sh.

Sif85 Orthoclase $K(AlSi_3O_8)$

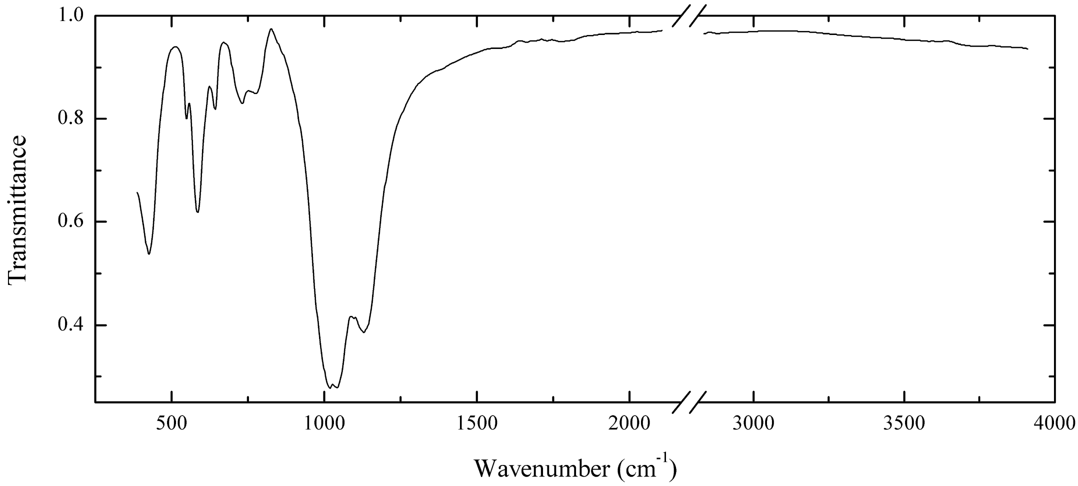


Locality: Udacha, Khabarovskiy Kray, Russia.

Description: Baveno twin. Confirmed by IR spectrum.

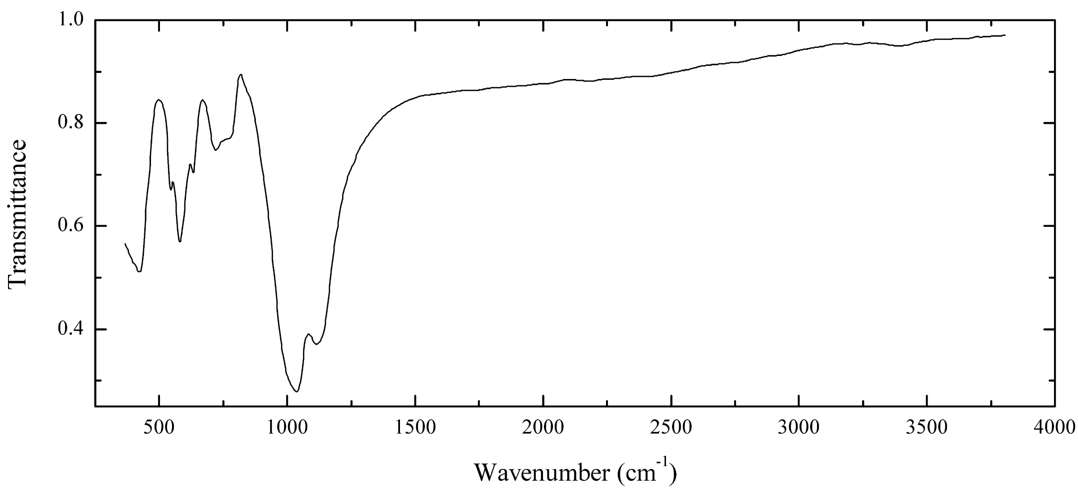
Wavenumbers (cm^{-1}): 1133s, 1038s, 1012s, 771, 726, 641, 583, 541, 425s, 400sh.

Sif86 Orthoclase $K(AlSi_3O_8)$



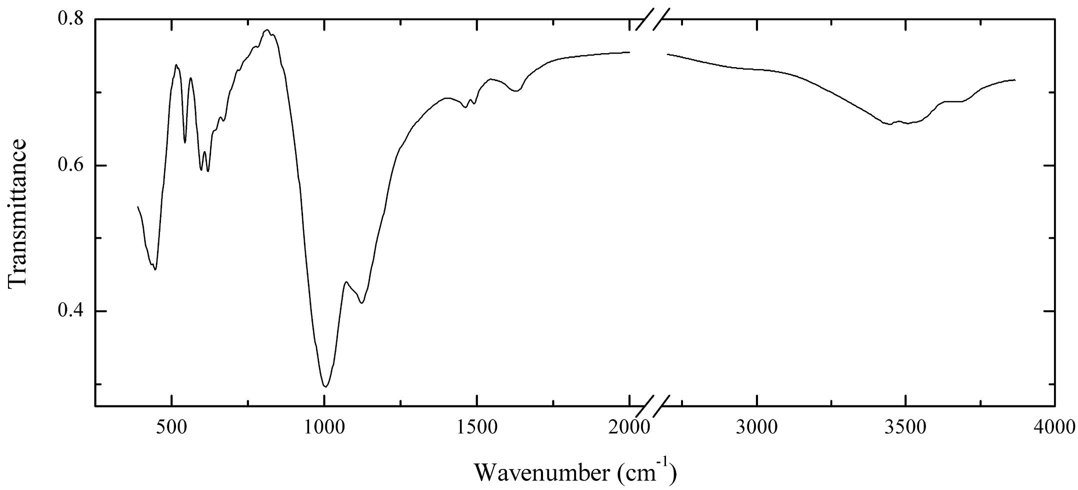
Locality: Monte Cavalluccio (Cavalluccio Mt.), Sacrofano caldera, Campagnano municipality, Roma province, Latium region, Italy.
Description: White granular aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1128s, 1041s, 1017s, 775, 728, 637, 582, 546, 422s.

Sif87 Sanidine $K(AlSi_3O_8)$



Locality: Biachella valley, Sacrofano caldera, Campagnano municipality, Roma province, Latium region, Italy.
Description: Colourless tabular crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1118s, 1035s, 765sh, 721, 633, 581, 544, 423s, 400sh.

Sif88 Alloriite $Na_5K_{1.5}Ca(Si_6Al_6O_{24})(SO_4)(OH)_{0.5}·H_2O$

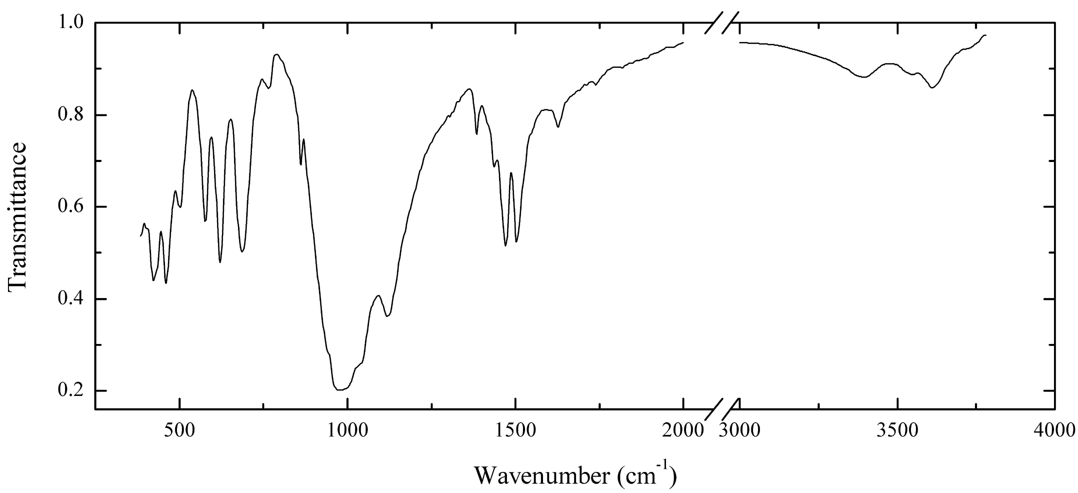


Locality: Monte Cavalluccio (Cavalluccio Mt.), Sacrofano caldera, Campagnano municipality, Roma province, Latium region, Italy (type locality).

Description: Colourless short-prismatic crystal from the association with sanidine, biotite, andradite and apatite. Holotype sample. Trigonal, space group *P*31*c*, $a = 12.892(3)$, $c = 21.340(5)$ Å, $Z = 4$. The empirical formula is ($Z = 1$) $Na_{19.16}K_{6.21}Ca_{4.87}(Si_{25.26}Al_{22.74}O_{96})(SO_4)_{4.88}(CO_3)_{0.70}Cl_{0.46}(OH)_{0.76}·4.73H_2O$. Optically uniaxial (+), $\omega = 1.497(2)$, $\varepsilon = 1.499(2)$. $D_{calc} = 2.358$ g/cm³, $D_{meas} = 2.35$ g/cm³. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.3 (70) (100), 4.85 (90) (104), 3.76 (80) (300), 3.68 (70) (301), 3.33 (100) (214), 2.694 (70) (314, 008).

Wavenumbers (cm^{-1}): 3660w, 3500, 3430, 1630w, 1490w, 1463w, 1185sh, 1123s, 1105sh, 1006s, 780sh, 750sh, 670, 646, 619, 596, 543, 445s, 425sh.

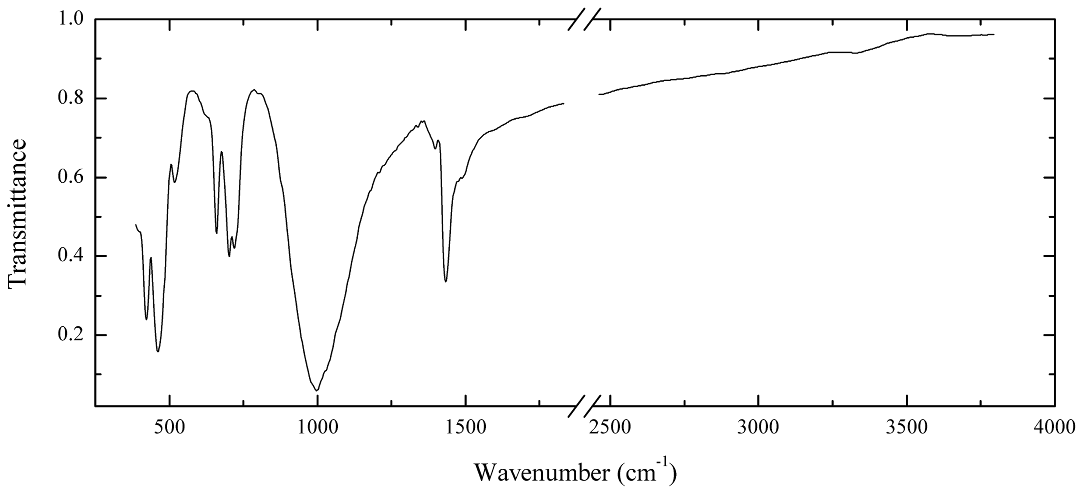
Sif89 Cancrinite $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}·2H_2O$



Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

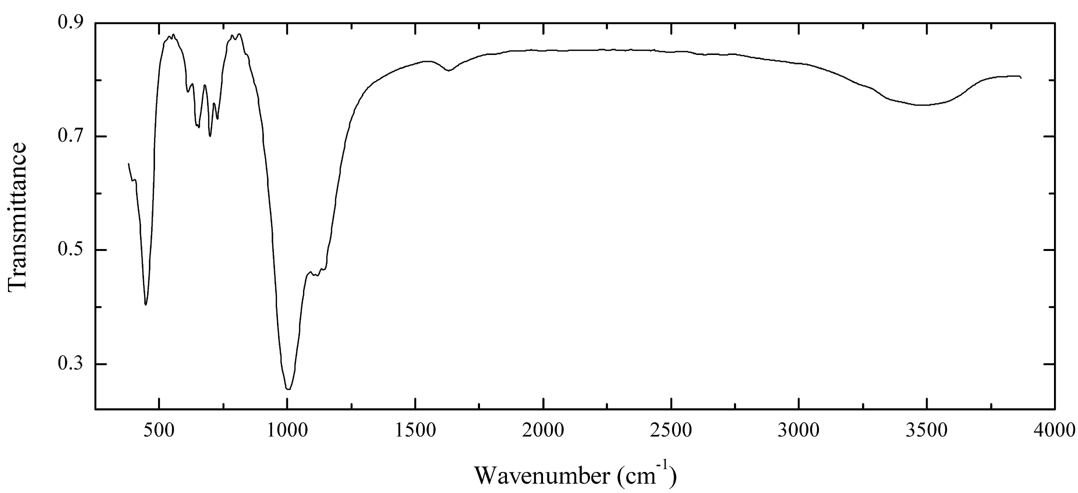
Description: Brown prismatic crystals from the association with potassic feldspar, sodalite, nepheline, aegirine, biotite, natrolite and lorenzenite. Intermediate member of the series cancrinite-cancrisilite. The crystal structure is solved. Trigonal, space group *P*3, $a = 12.607(2)$, $c = 5.111(1)$ Å. The empirical formula is $(Na_{7.12}Ca_{0.43}K_{0.05})(Si_{6.60}Al_{5.37}Fe_{0.03}O_{24})(CO_3)_{1.16}(OH)_{0.31}\cdot 3.01H_2O$.
Wavenumbers (cm^{-1}): 3607, 3590, 3323w, 3385w, 2340w, 1745w, 1630w, 1525sh, 1510sh, 1503, 1474, 1442, 1425sh, 1388, 1120s, 1030sh, 982s, 942s, 860, 764w, 687, 620s, 577, 500, 458s, 424s.

Sif90 "Carbonate sodalite" $Na_8[Al_6Si_6O_{24}](CO_3)$



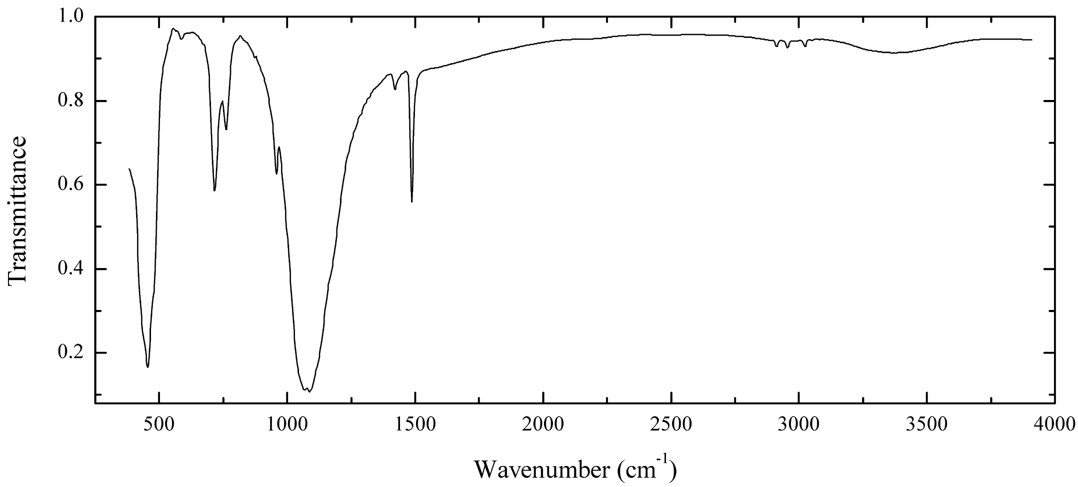
Locality: Artificial.
Description: Product of heating of cancrinite in oxygen at 1,000 °C during 30 min.
Wavenumbers (cm^{-1}): 1490sh, 1436s, 1403w, 997s, 730sh, 718, 700, 658, 515, 463s, 424s.

Sif91 Nosean $Na_8(Si_6Al_6O_{24})(SO_4)\cdot H_2O$



Locality: Cianini quarry, Capranica, Viterbo, Italy.
Description: Bluish grains from sanidinite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3460, 1635w, 1140s, 1110s, 1002s, 727, 698, 650, 612, 448s, 400.

Sif92 Tsaregorodtsevite $[N(CH_3)_4][Si_{2.5}Al_{0.5}O_6]_2$

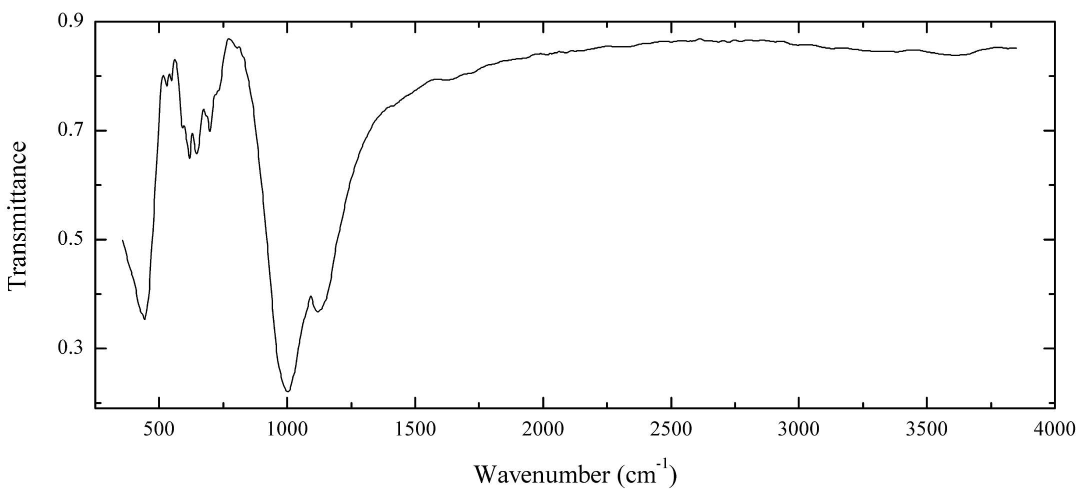


Locality: Yaruta Mt., Mun'-Hambo ridge, Subpolar Urals, Hanty-Mansi autonomous district, Russia (type locality).

Description: White isometric crystals from the association with anatase and chlorite. Identified by IR spectrum and single-crystal X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3360w, 3025w, 2955w, 2912w, 1492, 1425w, 1120sh, 1091s, 1069s, 955, 760, 715, 495sh, 452s, 435sh, 405sh.

Sif93 Biachellaite $(Na,Ca,K)_8(Si_6Al_6O_{24})(SO_4)_2(OH)_{0.5}\cdot H_2O$

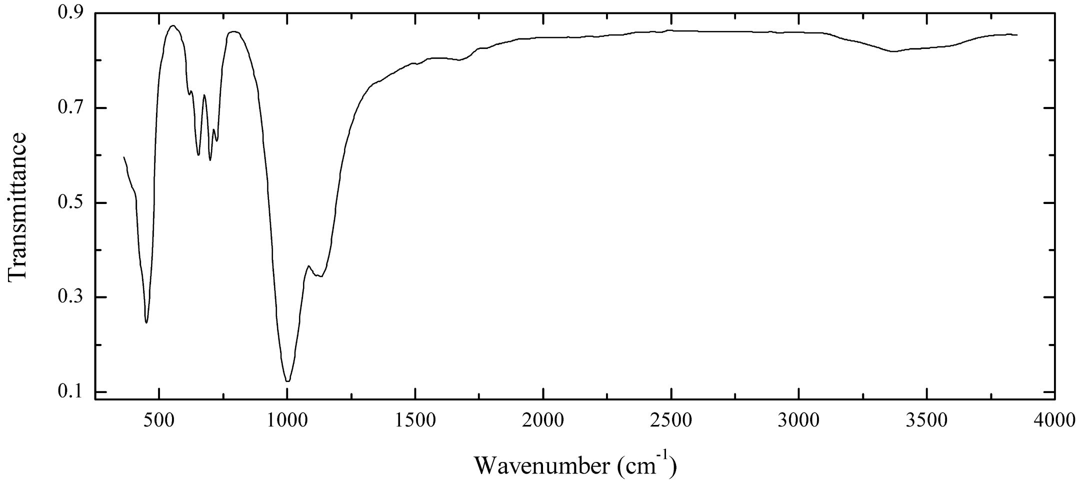


Locality: Biachella Valley, Sacrofano Caldera, Sacrofano municipality, Rome province, Latium region, Italy (type locality).

Description: Colourless equant dipyramidal-pinacoidal crystals from the association with sanidine, diopside, andradite, leucite and haüyne. Holotype sample. Trigonal, space group *P*3, $a = 12.913(1)$, $c = 79.605(5)$ Å, $Z = 15$. The empirical formula is $(Na_{3.76}Ca_{2.50}K_{1.44})_{\Sigma7.70}(Si_{6.06}Al_{5.94}O_{24})(SO_4)_{1.84}Cl_{0.15}(OH)_{0.43}\cdot 0.81H_2O$. Optically uniaxial (+), $\omega = 1.512(1)$, $\varepsilon = 1.514(1)$. $D_{calc} = 2.515$ g/cm^3, $D_{meas} = 2.51(1)$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern

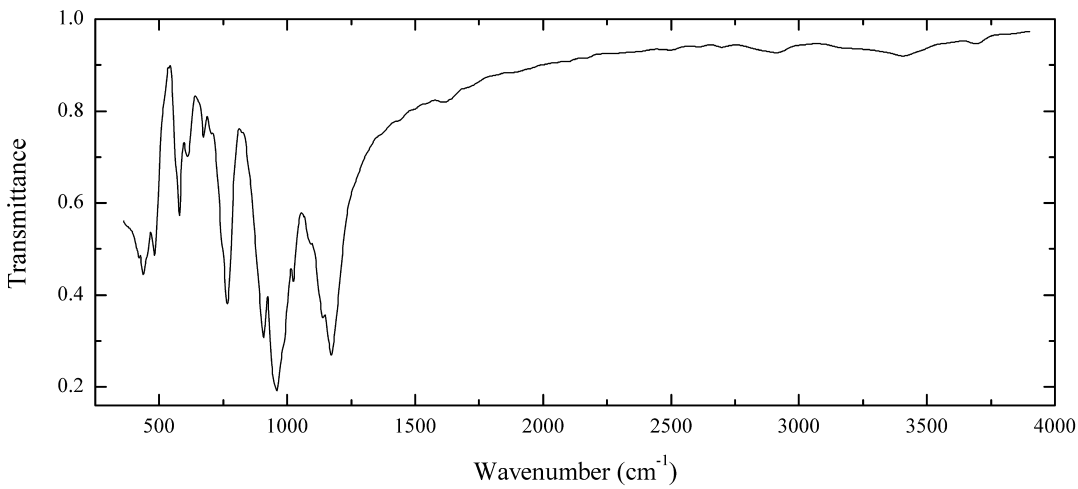
[*d*, Å (*I*, %) (*hkl*)] are 11.07 (19) (100, 101), 6.45 (18) (110, 111), 3.720 (100) (2.1.10, 300, 301, 2.0.16, 302), 3.576 (18) (1.0.21, 2.0.17, 306), 3.300 (47) (1.0.23, 2.1.15), 3.220 (16) (2.1.16, 222).
Wavenumbers (cm^{-1}): 3600w. 1635w, 1122s, 1001s, 730sh, 700, 646, 620, 592, 547w, 530w, 445s.

Sif94 Haüyne $Na_6Ca_2(Si_6Al_6O_{24})(SO_4)_2$



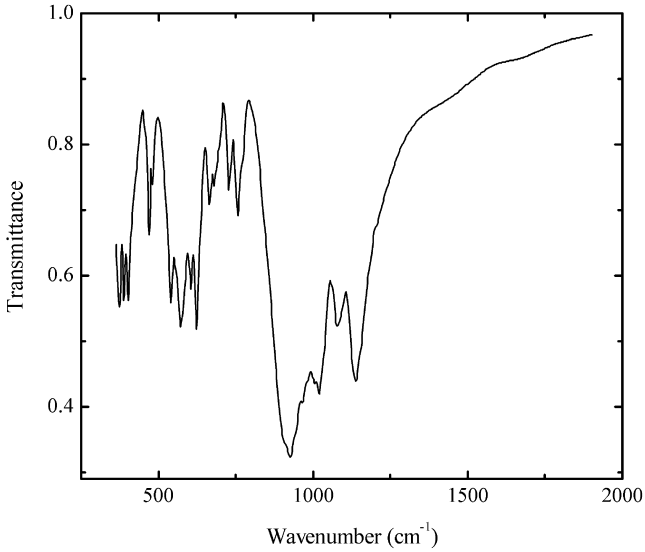
Locality: Monte Cavalluccio (Cavalluccio Mt.), Campagnano municipality, Roma province, Latium region, Italy.
Description: Violet crystals from the association with sanidine and clinopyroxene. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3350w, 1677w, 1128s, 1001s, 725, 699, 651, 616, 452s, 425sh, 400sh.

Sif95 Cordierite $Mg_2(Al_4Si_5O_{18})$



Locality: Nampona quarry, Fort Dauphin, Anosy region, Tuléar Province, Madagascar.
Description: Light grey transparent grains. Identified by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3682w, 3395w, 2915w, 2345w, 2325w, 1650sh, 1620w, 1173s, 1139s, 1025, 957s, 906s, 767s, 750sh, 705w, 673w, 615, 580, 570sh, 484, 440, 420sh.

Sif96 Anorthite $Ca(Al_2Si_2O_8)$

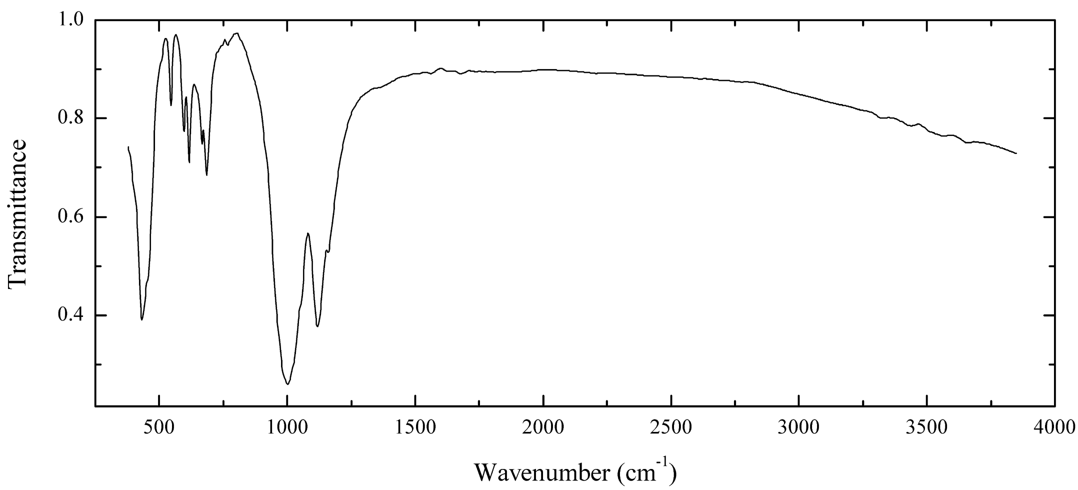


Locality: An unknown locality in Viterbo province, Latium, Italy.

Description: Colourless crystals. The empirical formula is (electron microprobe) $Ca_{0.97}Na_{0.04}Al_{1.98}Si_{2.02}O_8$.

Wavenumbers (cm^{-1}): 1138s, 1077s, 1019s, 967s, 940sh, 926s, 910sh, 770sh, 757, 726, 680w, 664, 622s, 603, 572s, 540, 510sh, 481w, 469, 402, 387, 374.

Sif97 Afghanite $(Na,K)_{5.5}Ca_{2.5}(Si_6Al_6O_{24})(SO_4)_{1.5}Cl_{1.5}$

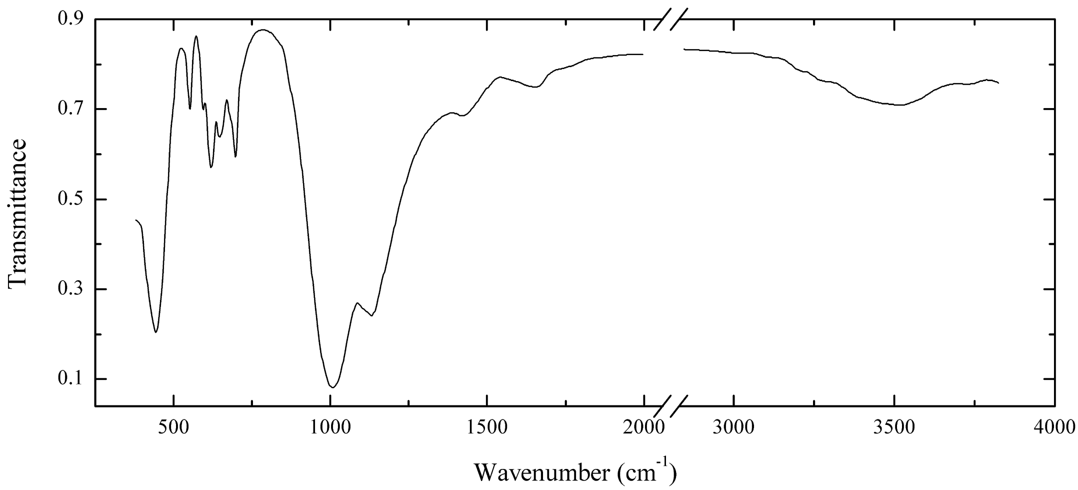


Locality: Sar-e Sang, Badakhshan, Afghanistan (type locality).

Description: Blue crystal from the association with lazurite, calcite, phlogopite and pyrite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{5.1}K_{0.5}Ca_{2.5}(Si_{6.1}Al_{5.9}O_{24})(SO_4)_{1.6}Cl_{1.5}$.

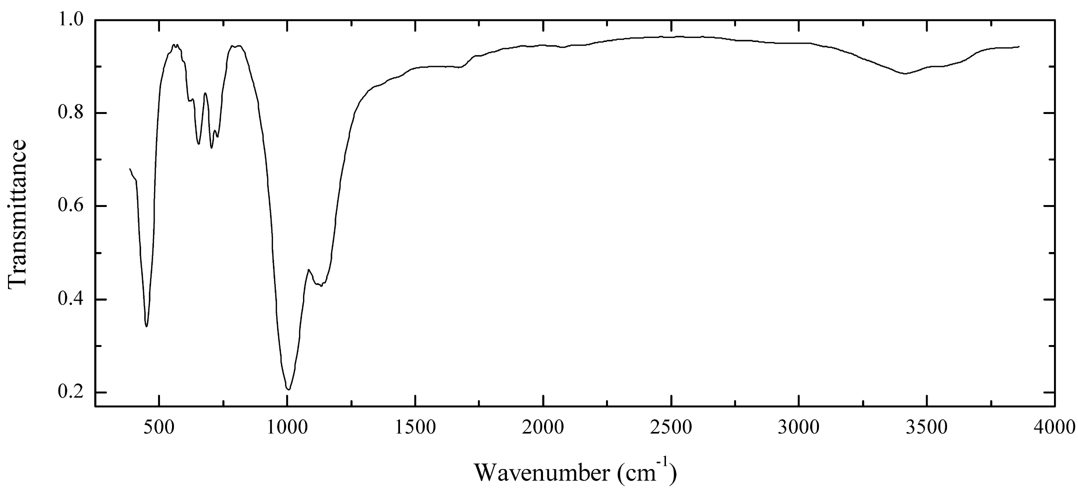
Wavenumbers (cm^{-1}): 1164s, 1121s, 1050sh, 1003s, 765w, 685, 665, 650sh, 614, 594, 542, 520sh, 450sh, 429s.

Sif98 Marinellite $(Na,K)_7Ca(Si_6Al_6O_{24})(SO_4)_{1.3}Cl_{0.4}$



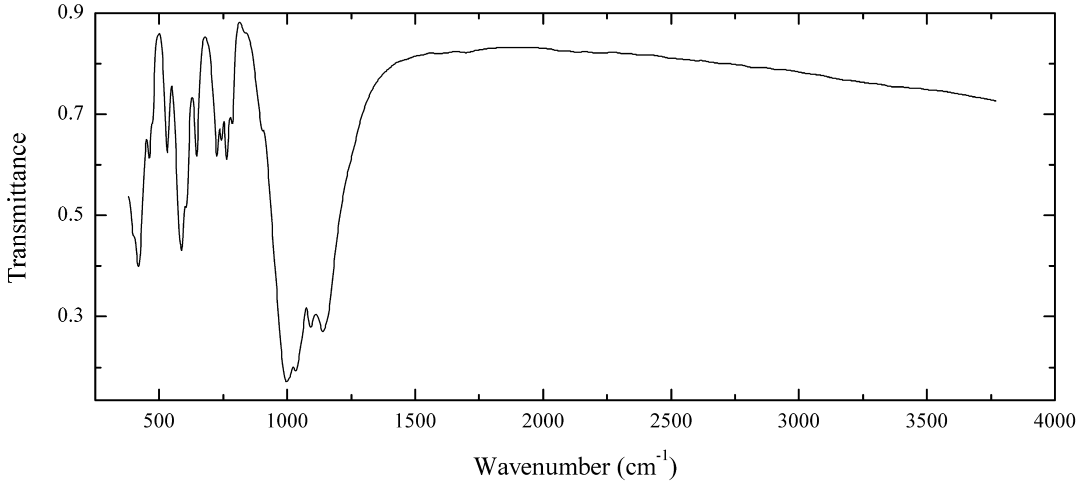
Locality: Lapilli quarry near Magliano Romano, Rome province, Latium, Italy.
Description: Pale violet crystal. Identified by IR spectrum and single-crystal X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3475, 3440sh, 3265sh, 1660w, 1630w, 1425w, 1143s, 1110sh, 1004s, 715sh, 695, 647, 618, 590, 549, 438s.

Sif99 Nosean $Na_8(Si_6Al_6O_{24})(SO_4)\cdot H_2O$



Locality: Pitigliano, Tuscany, Italy.
Description: Colourless rhombic dodecahedron. Identified by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3525w, 3390, 1660w, 1127s, 1003s, 725, 702, 652, 617, 590w, 451s, 400sh.

Sif100 Antiperthite $Na(AlSi_3O_8) + K(AlSi_3O_8)$

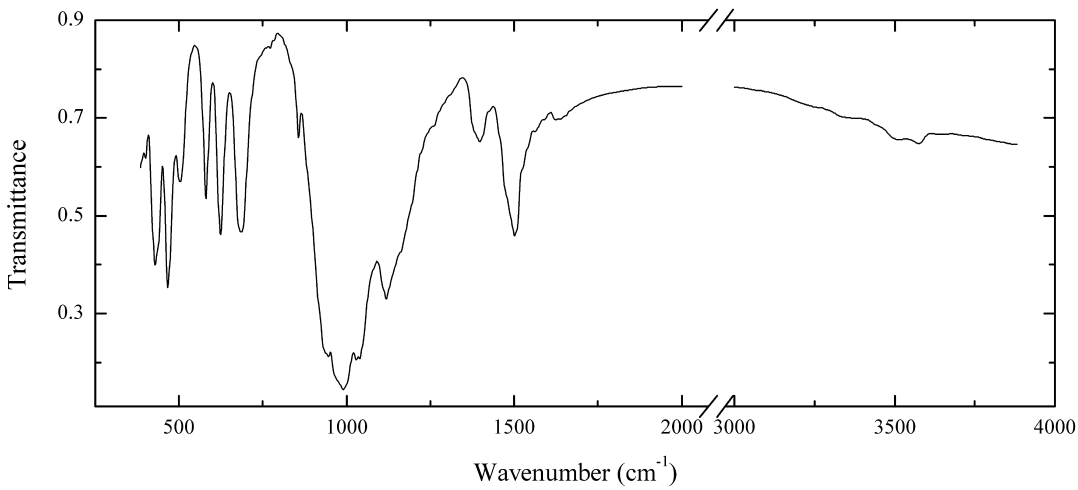


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Microscopic intergrowth of prevailing albite and subordinate potassic feldspar. A product of disintegration of initially homogeneous anorthoclase. Porphyroblast (metacryst) in aegirine-eudialyte lujavrite. Investigated by electron microscopy and electron microprobe analysis.

Wavenumbers (cm^{-1}): 1140s, 1092s, 1033s, 998, 904w, 788w, 765, 745, 728, 648, 608, 590s, 580sh, 532, 477w, 463, 420s, 405sh.

Sif101 "High cancrinite" $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}{\cdot}nH_2O$

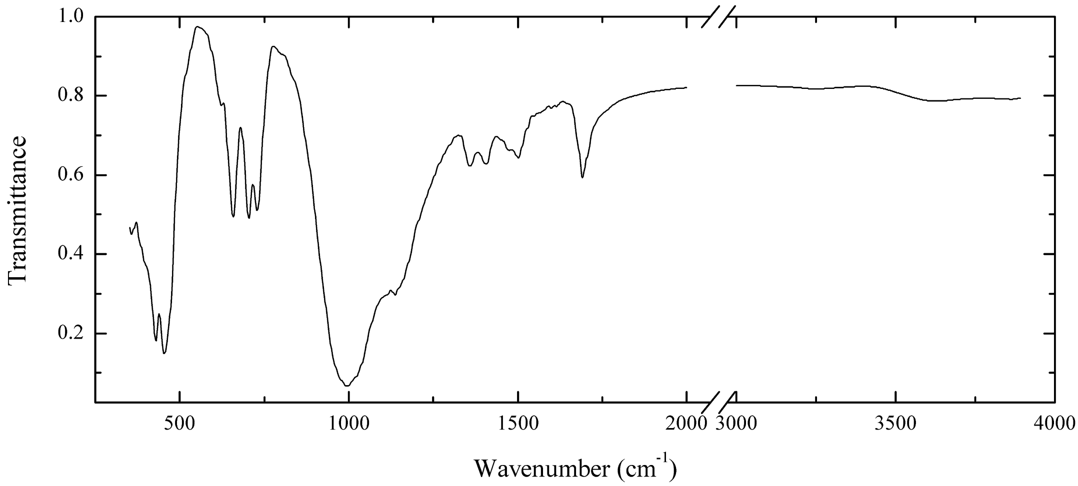


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: White semitransparent accordion-like crystals. High-temperature low-hydrous Cl-bearing variety initially formed as anhydrous analogue of cancrinite. Water molecules are present only in wide channels as a result of postcrystallization low-temperature hydration. The empirical formula is $(Na_{6.5}Ca_{1.4}K_{0.1})(Si_{6.1}Al_{5.9}O_{24})(CO_3)_{1.6}Cl_{0.3}{\cdot}nH_2O$ ($n \approx 1$).

Wavenumbers (cm^{-1}): 3570w, 3520w, 1627w, 1505, 1400, 1120s, 1033s, 995s, 943s, 857, 687, 675sh, 624, 580, 502, 465s, 429s.

Sif102 **Haüyne** $Na_6Ca_2(Si_6Al_6O_{24})(SO_4)_2$

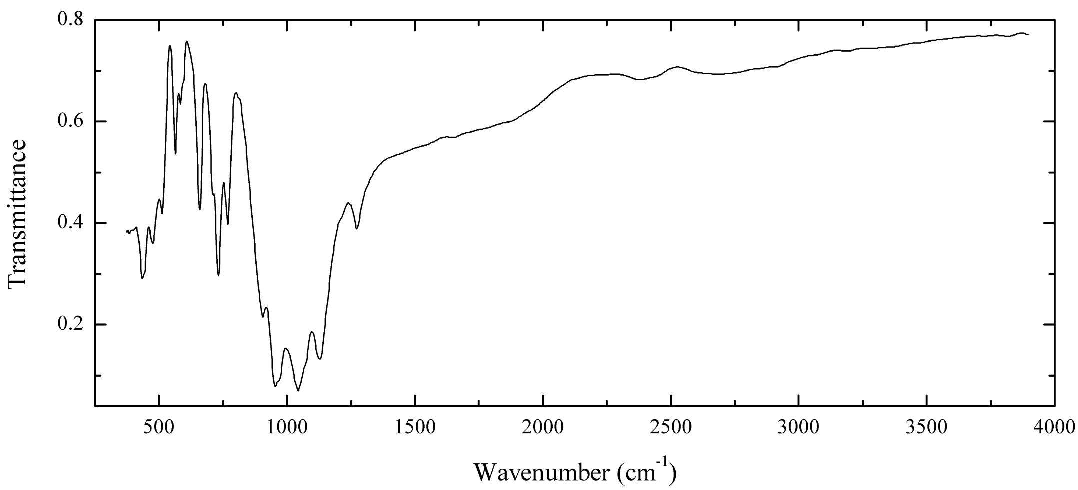


Locality: Oldoinyo Lengai carbonatitic volcano, Gregory rift, northern Tanzania.

Description: Greenish yellow transparent grains from coarse-grained ijolite, from the association with diopside, nepheline and accessory perovskite, magnetite and apatite. Gem-quality carbon-bearing variety. Investigated by A.N. Zaitsev. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3615w, 1695, 1501, 1480w, 1409, 1370, 1135s, 997s, 727, 702, 655, 617w, 452s, 426s.

Sif103 **Ussingite** $HNa_2AlSi_3O_9$

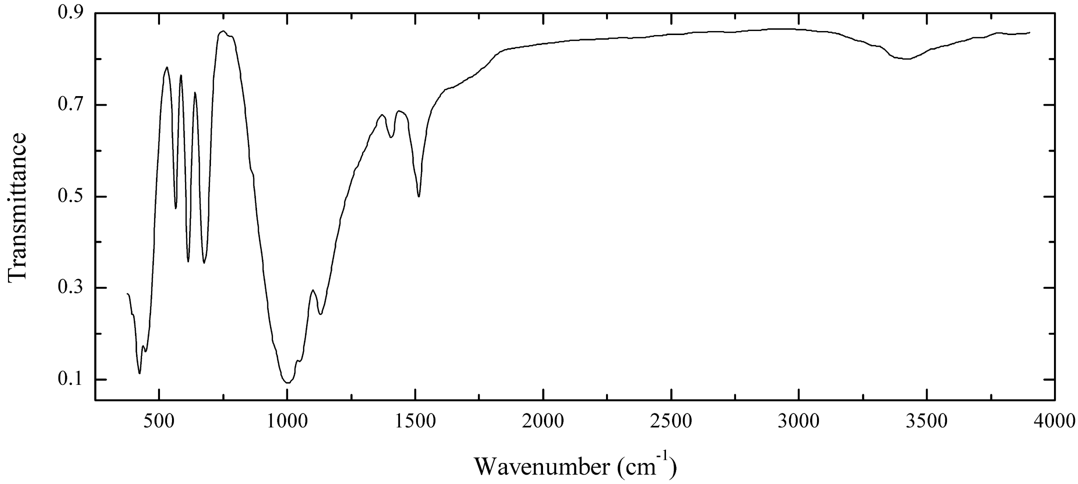


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pale rose coarse-grained aggregate. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 2660w, 2375w, 1740sh, 1275, 1131s, 1075sh, 1045s, 970sh, 955s, 906, 769, 732s, 710, 658, 595w, 582w, 563, 512, 475, 436s, 400.

Sif104 Balliranoite $(Na,K)_6Ca_2(Si_6Al_6O_{24})Cl_2(CO_3)$

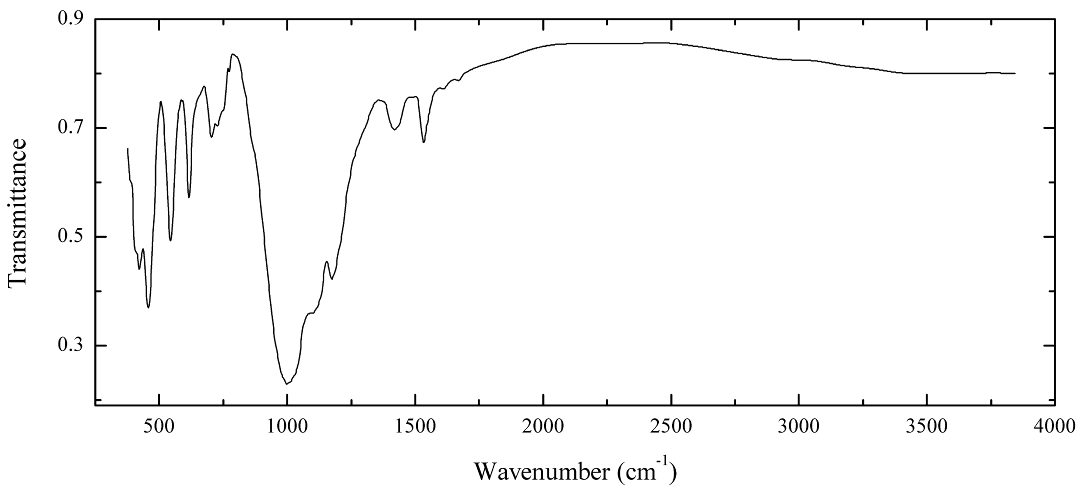


Locality: Monte Somma, Vesuvius volcanic complex, Campania, Italy (type locality).

Description: Colourless coarse prismatic crystals from the association with orthoclase, phlogopite, humite, calcite, diopside, pargasite, haüyne and apatite. Holotype sample. The crystal structure is solved. Hexagonal, $P6_3$; $a = 12.695(2)$, $c = 5.325(1)$ Å, $Z = 1$. Optically uniaxial (+), $\omega = 1.523(2)$, $\varepsilon = 1.525(2)$. $D_{meas} = 2.48(1)$ g/cm^3, $D_{calc} = 2.486(12)$ g/cm^3. The empirical formula is $Na_{4.70}Ca_{2.53}K_{0.73}(Si_{6.02}Al_{5.98}O_{23.995})Cl_{2.34}(CO_3)_{0.82}(SO_4)_{0.27}\cdot 0.12H_2O$. The strongest lines of the powder diffraction pattern [d, Å (I, %) (hkl)] are 4.797 (100) (101), 3.669 (57) (300), 3.281 (73) (211), 2.754 (16) (400), 2.662 (58) (002), 2.446 (31) (401), 2.120 (18) (330).

Wavenumbers (cm^{-1}): 3385w, 1650sh, 1511, 1407w, 1130s, 1048s, 1005s, 950sh, 857w, 685sh, 677, 610, 563, 446s, 422s, 405sh.

Sif105 Meionite $Ca_4(Al_6Si_6O_{24})(CO_3)$

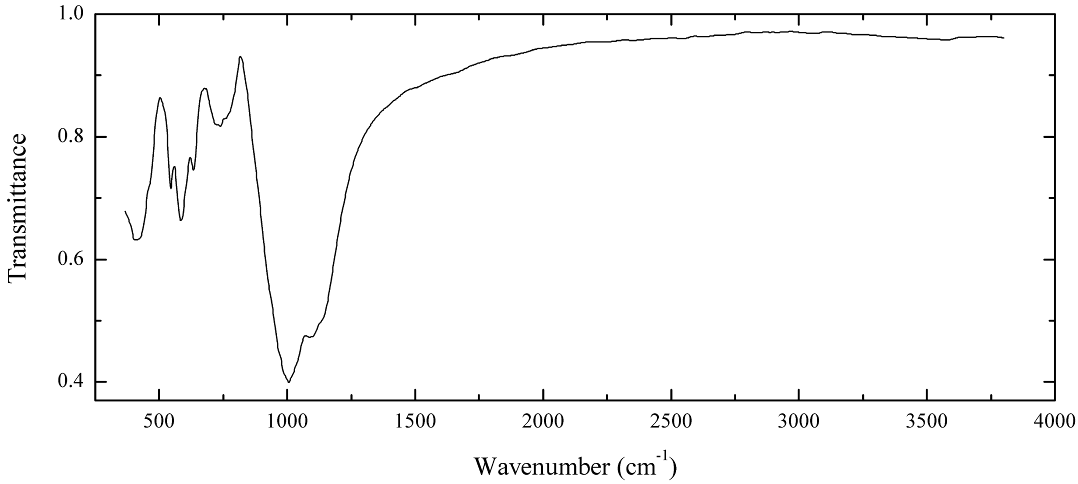


Locality: San Vito quarry, Monte Somma, Vesuvius volcanic complex, Campania, Italy.

Description: Light grey prismatic crystals. Identified by IR spectrum and single-crystal X-ray diffraction data. Tetragonal, $a = 12.123(2)$, $c = 7.574(2)$ Å.

Wavenumbers (cm^{-1}): 1533, 1420w, 1172s, 1095sh, 999s, 865sh, 795w, 722w, 700, 615, 544, 458s, 425s, 410sh.

Sif106 Plagioclase (Na,Ca)[(Si,Al)$_4$O$_8$]

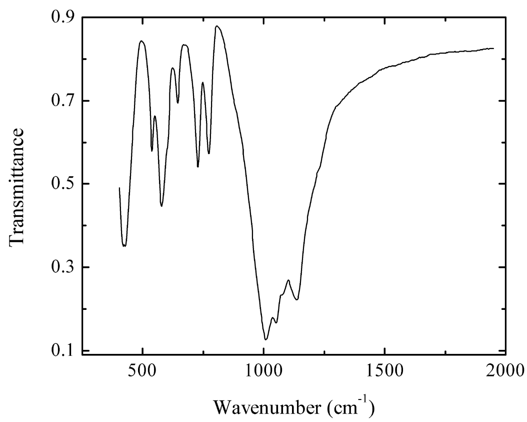


Locality: Rothenberg basalt quarry, Rothenberg Mt., near Mendig, Eifel, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Colourless crystals from the association with oxyphlogopite, nepheline, sanidine, augite, diopside and magnetite. Disordered variety. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $(Na_{0.57}Ca_{0.34}K_{0.06}Ba_{0.02})(Si_{2.59}Al_{1.42}O_8)$.

Wavenumbers (cm^{-1}): 1135sh, 1097s, 1005s, 760sh, 735, 620, 583s, 543, 420sh, 410s.

Sif107 Microcline K(AlSi$_3$O$_8$)

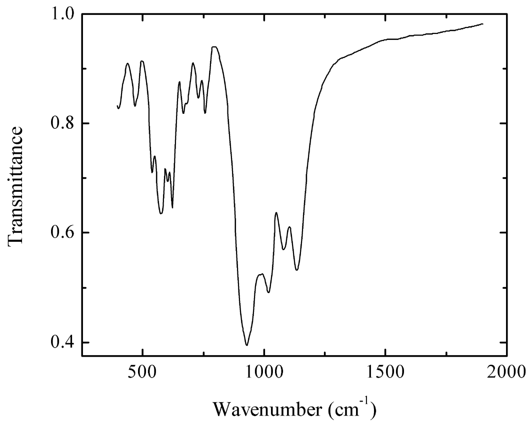


Locality: Putelichorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White granular aggregate from the association with sodalite, aegirine and normandite. Identified by IR spectrum.

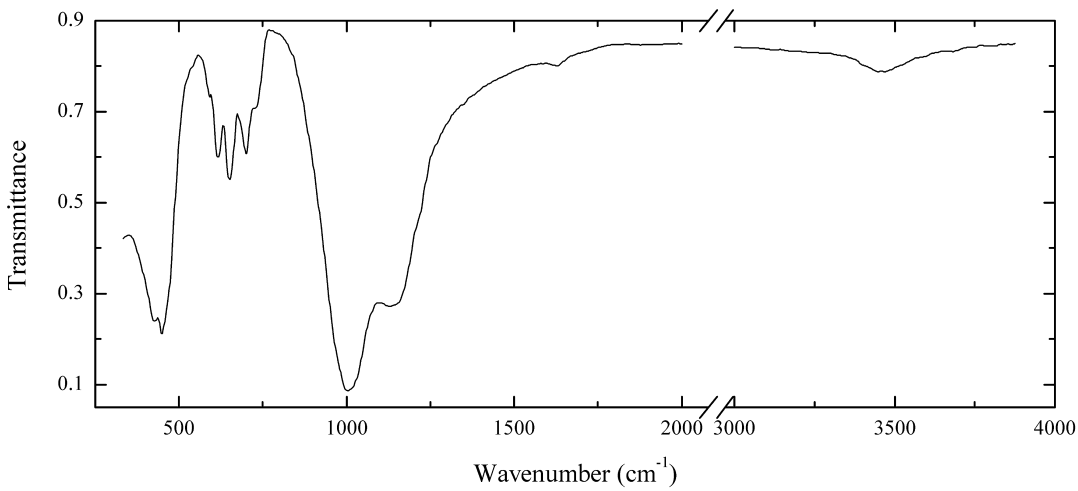
Wavenumbers (cm^{-1}): 1137s, 1025sh, 1053s, 1011s, 772, 728, 645, 605, 578, 536, 428s, 418s.

Sif108 Anorthite $Ca(Al_2Si_2O_8)$



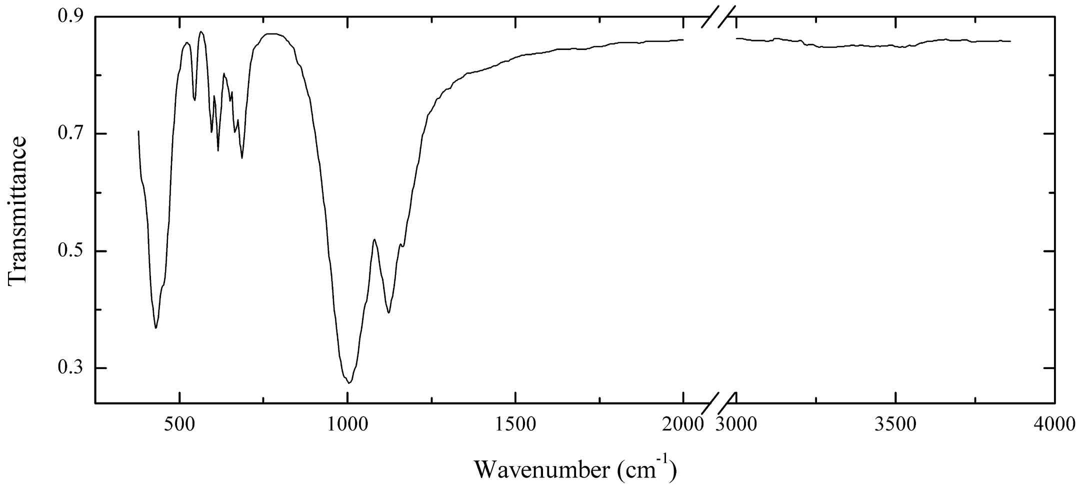
Locality: San Vito quarry, Vesuvius volcanic complex, Campania, Italy.
Description: White crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1136s, 1092s, 1020s, 940sh, 930s, 920sh, 765sh, 757, 728, 682, 668, 630s, 604, 576s, 538, 475sh, 467, 401.

Sif109 Haüyne $Na_6Ca_2(Si_6Al_6O_{24})(SO_4)_2$



Locality: Monte Cavalluccio (Cavalluccio Mt.), Campagnano municipality, Roma province, Latium region, Italy.
Description: Light blue crystals from the association with sanidine and phlogopite. Confirmed by IR spectrum. The empirical formula is (electron microprobe, OH calculated) $(Na_{4.62}Ca_{2.15}K_{1.18})(Si_{6.01}Al_{5.99}O_{24})(SO_4)_{1.73}Cl_{0.13}(OH)_{0.52}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3415, 1625w, 1130s, 1005s, 723, 700, 649, 590w, 448s, 425s.

Sif110 Afghanite $(Na,K)_{5.5}Ca_{2.5}(Si_6Al_6O_{24})(SO_4)_{1.5}Cl_{1.5}$

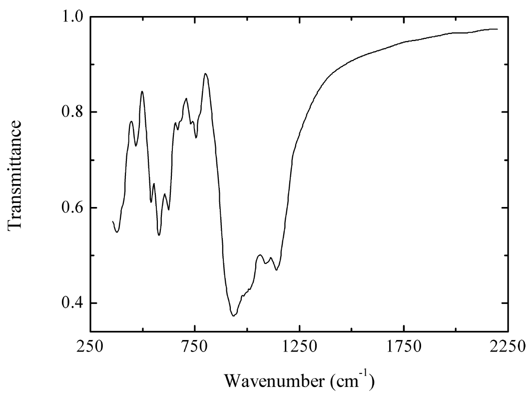


Locality: Tre Croci, Vetralla, Vico lake, Viterbo province, Latium, Italy.

Description: Colourless short-prismatic crystals. Identified by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Na_{5.3}Ca_{2.4}K_{0.3}(Al_{6.0}Si_{6.0}O_{24})(SO_4)_{1.5}Cl_{1.4}$.

Wavenumbers (cm^{-1}): 1164, 1124s, 1005s, 685, 665, 616, 595, 545, 450sh, 431s, 410sh.

Sif111 Anorthite $Ca(Al_2Si_2O_8)$

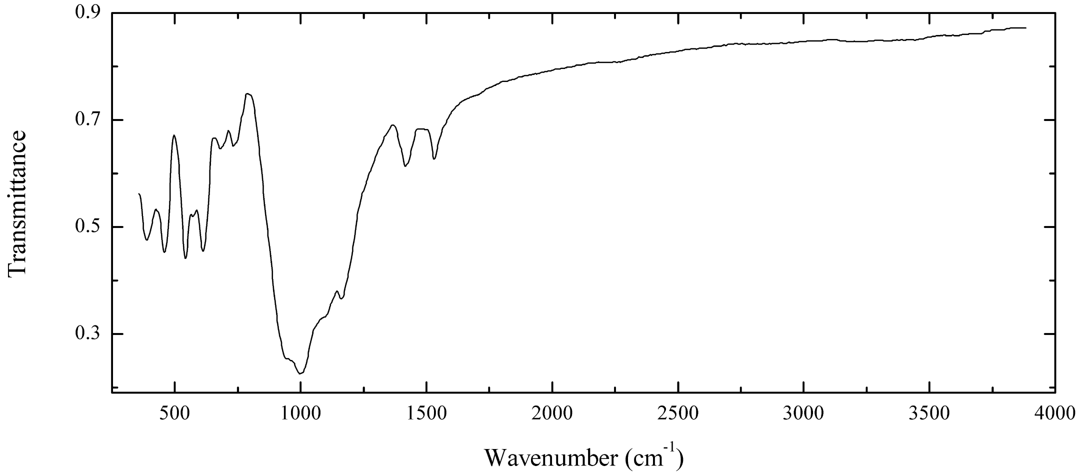


Locality: Birkhin (Ozernovskii) gabbro massif, Naryn-Kunta, Irkutsk region, Eastern Siberia, Russia.

Description: White veinlet in metasomatic rock. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.89}Na_{0.11}K_{0.01})(Si_{2.07}Al_{1.92}Fe_{0.02})O_8$.

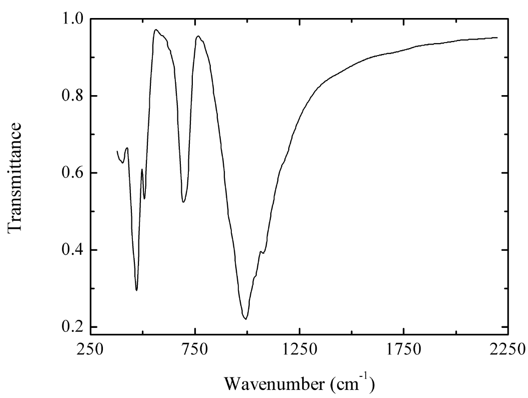
Wavenumbers (cm^{-1}): 1144s, 1096s, 1000sh, 939s, 775sh, 754, 729, 680sh, 667, 623, 577s, 540, 467, 400sh, 383s.

Sif112 Meionite $Ca_4(Al_6Si_6O_{24})(CO_3)$



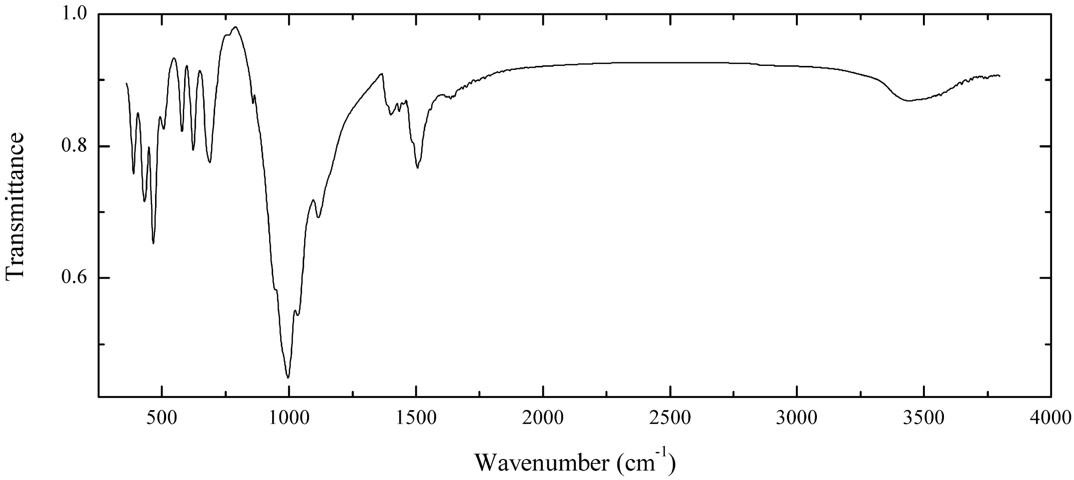
Locality: Birkhin (Ozernovskii) gabbro massif, Naryn-Kunta, Irkutsk region, Eastern Siberia, Russia.
Description: Colourless grains from calcic xenolith. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1529, 1420, 1162s, 1090sh, 997s, 945sh, 860sh, 740sh, 732w, 686w, 611, 560, 541, 462, 406.

Sif113 Nepheline $(Na,K)(AlSiO_4)$



Locality: Graulay (Graulai, Grauley), near Hillesheim, Eifel Mountains, Rhineland-Palatinate (Rheinland-Pfalz), Germany.
Description: Pale rose transparent short-prismatic crystals from alkaline basalt, the association with leucite, aufite, fluorapatite and perovskite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{2.8}K_{1.2}Si_{4.0}Al_{3.9}Fe_{0.1}O_{16}$. The crystal structure is solved. Hexagonal, space group $P6_3$, $a = 10.0438(1)$, $c = 8.4145(1)$ Å. Si and Al are disordered that results in the absence of the band at 578–579 cm^{-1} in the IR spectrum.
Wavenumbers (cm^{-1}): 1180sh, 1077s, 1040sh, 997s, 915sh, 694, 505, 469s, 460sh, 400.

Sif114 "High cancrinite" $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}\cdot nH_2O$

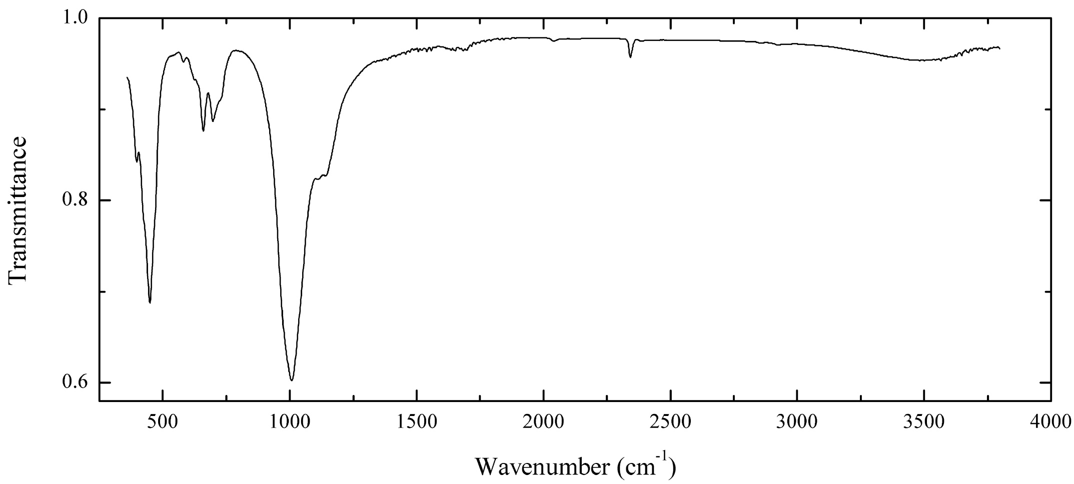


Locality: In den Dellen pumice quarry, near Mendig, Laacher See area, Eifel Mountains, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: White prismatic crystals in cancrinite–sanidine effusive rock. High-temperature low-hydrous Cl-bearing variety initially formed as anhydrous analogue of cancrinite. Water molecules are present only in wide channels as a result of postcrystallization low-temperature hydration.

Wavenumbers (cm^{-1}): 3560sh, 3447, 1637w, 1506, 1485sh, 1450w, 1434w, 1400w, 1385sh, 1160sh, 1116, 1036s, 996s, 945sh, 857w, 761w, 688, 623, 579, 506, 466, 431, 392.

Sif115 Lazurite CO_2-bearing $(Ca,Na)_8(Si_6Al_6O_{24})(SO_4,S,Cl,CO_2,H_2O)_2$

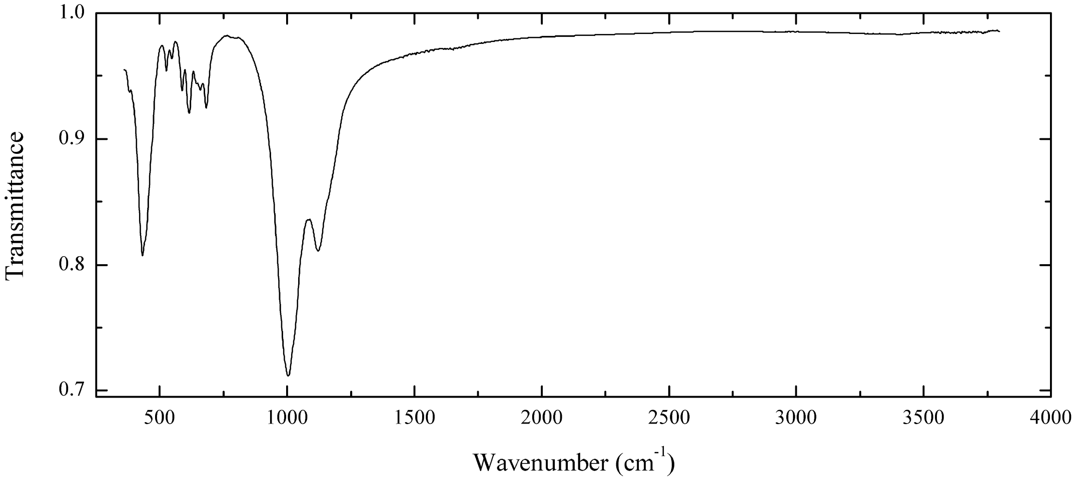


Locality: Sar-e Sang, Badakhshan, Afghanistan.

Description: Blue twin from the association with diopside and carbonates. The band at 2,342 cm^{-1} indicates the presence of CO_2 molecules.

Wavenumbers (cm^{-1}): 3495, 2342, 2044w, 1685w, 1645w, 1142, 1112, 1007s, 725sh, 698, 660, 625sh, 585w, 449s, 498.

Sif116 **Liottite** $(Na,K)_5Ca_3(Si_6Al_6O_{24})(SO_4)_2Cl$

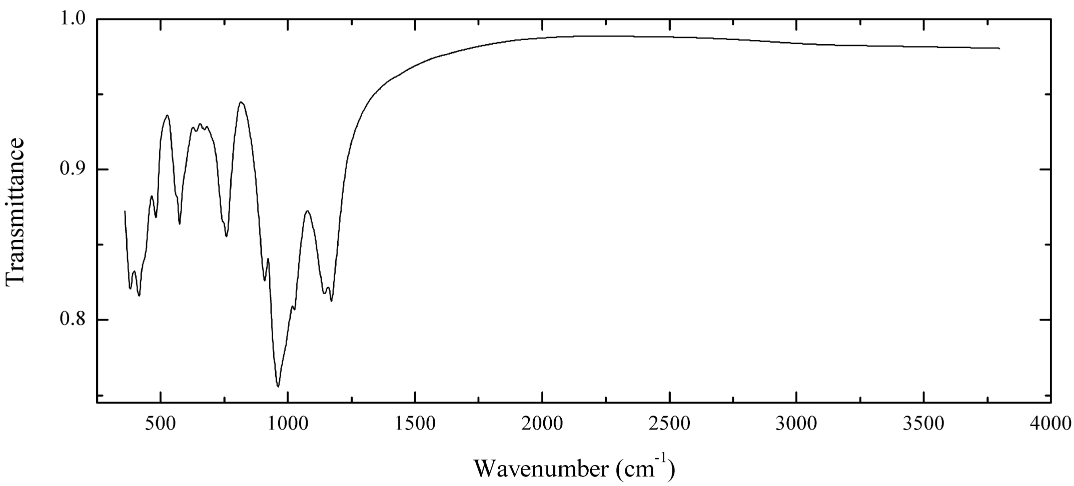


Locality: Poggio Bottinello, Farnese, near Viterbo, Latium region, Italy.

Description: Colourless tabular crystals from the association with sanidine, franzinite and zeolites. Confirmed by IR spectrum and single-crystal X-ray diffraction pattern. Hexagonal, $a = 12.811(3)$, $c = 16.092(7)$ Å.

Wavenumbers (cm^{-1}): 3405w, 1645w, 1155sh, 1121s, 1004s, 682, 658, 645sh, 616, 588, 547, 526, 432s, 384.

Sif117 **Ferroindialite** $(Fe^{2+},Mg)_2Al_4Si_5O_{18}$



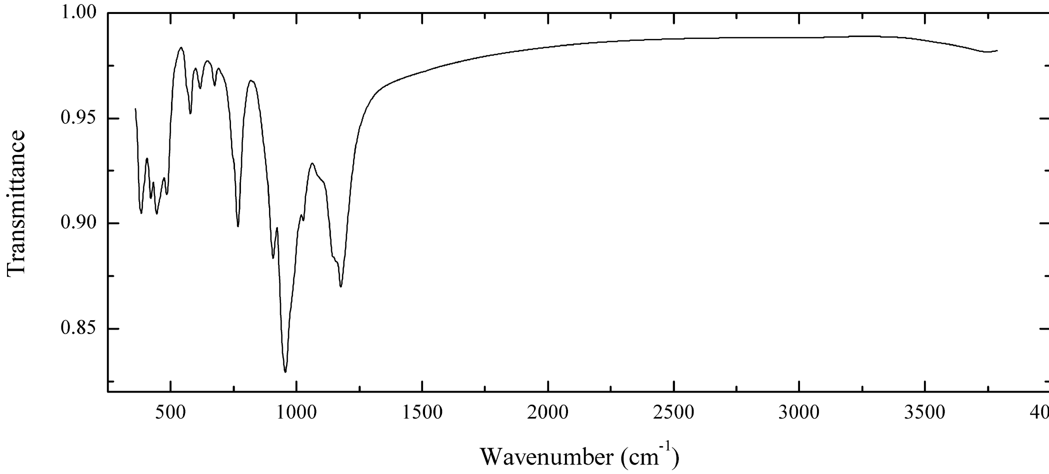
Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See area, Eastern Eifel region, Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Brownish violet short prismatic hexagonal crystal from the association with sanidine, phlogopite, enstatite, sillimanite, fluorapatite, tridymite, zircon and Mg-rich almandine. Holotype sample. The crystal structure is solved. Hexagonal, space group $P6/mcc$; $a = 9.8759(3)$, $c = 9.3102(3)$ Å, $Z = 2$. Optically anomalously biaxial (−), $\alpha = 1.539(2)$, $\beta = 1.552(2)$, $\gamma = 1.554(2)$, $2V = 30°$. $D_{meas} =$

2.66(1) g/cm^3, D_{calc} = 2.667 g/cm^3. The empirical formula is $(K_{0.06}Na_{0.03})(Fe^{2+}{}_{1.12}Mg_{0.78}Mn_{0.10})(Al_{3.79}Fe^{3+}{}_{1.12})Si_{4.98}O_{18}$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 8.59 (100) (100), 4.094 (27) (102), 3.390 (35) (112), 3.147 (19) (202), 3.055 (31) (211), 2.657 (12) (212).

Wavenumbers (cm^{-1}): 1171s, 1143s, 1025s, 980sh, 961s, 909, 759, 750sh, 675w, 639w, 575, 565sh, 481, 435sh, 416s, 383.

Sif118 Indialite $Mg_2Al_4Si_5O_{18}$

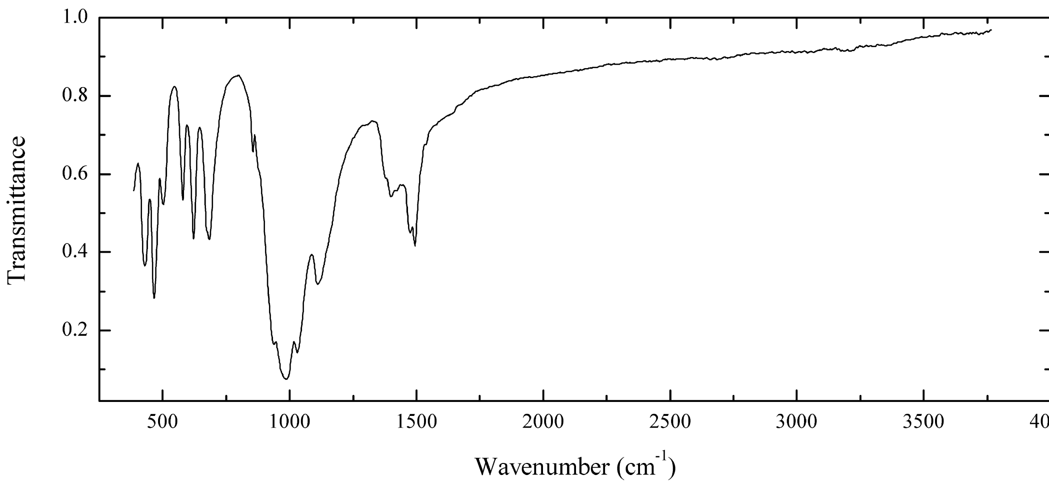


Locality: Nickenicher Weinberg, Eifel volcanic region, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Light blue short prismatic hexagonal crystal from the association with phlogopite and mullite. The empirical formula is $(K_{0.07}Na_{0.04})(Mg_{1.85}Fe_{0.14}Mn_{0.01})(Al_{3.82}Fe^{3+}{}_{0.16}Ti_{0.02})(Si_{4.80}Al_{0.20})O_{18}$.

Wavenumbers (cm^{-1}): 1176s, 1160sh, 1150sh, 1090sh, 1027, 980sh, 956s, 907, 767, 750sh, 675, 617, 578, 570sh, 484, 444, 421, 387.

Sif119 "High cancrinite" (anhydrous) $Na_7Ca[Al_6Si_6O_{24}](CO_3)_{1.5}$

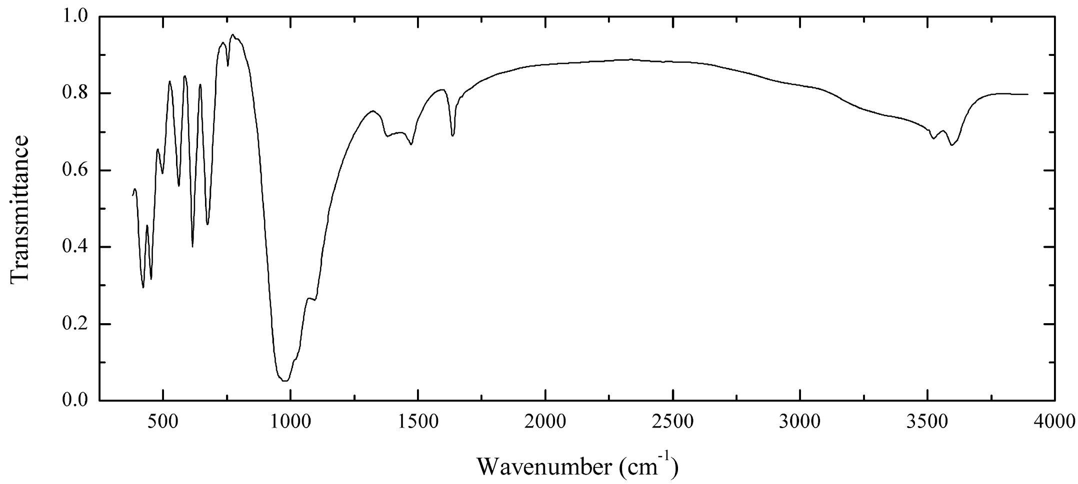


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Beige semitransparent prismatic crystals from sanidinite. High-temperature anhydrous analogue of cancrinite. The crystal structure is solved. Hexagonal, space group $P6_3$, $a = 12.6093(1)$, $c = 5.1221(1)$ Å, $V = 705.278(16)$ Å^3.The empirical formula is $Na_{5.6}K_{0.2}Ca_{1.45}(Si_{6.2}Al_{5.8}O_{24})Cl_{0.1}(CO_3)_{1.4}$.

Wavenumbers (cm^{-1}): 1505, 1485, 1430sh, 1405, 1390sh, 1118, 1035s, 995s, 943s, 858w, 687, 675sh, 624, 582, 503, 467s, 428.

Sif120 Depmeierite $Na_8[Al_6Si_6O_{24}](PO_4,CO_3)_{1-x}\cdot3H_2O$ ($x < 0.5$)

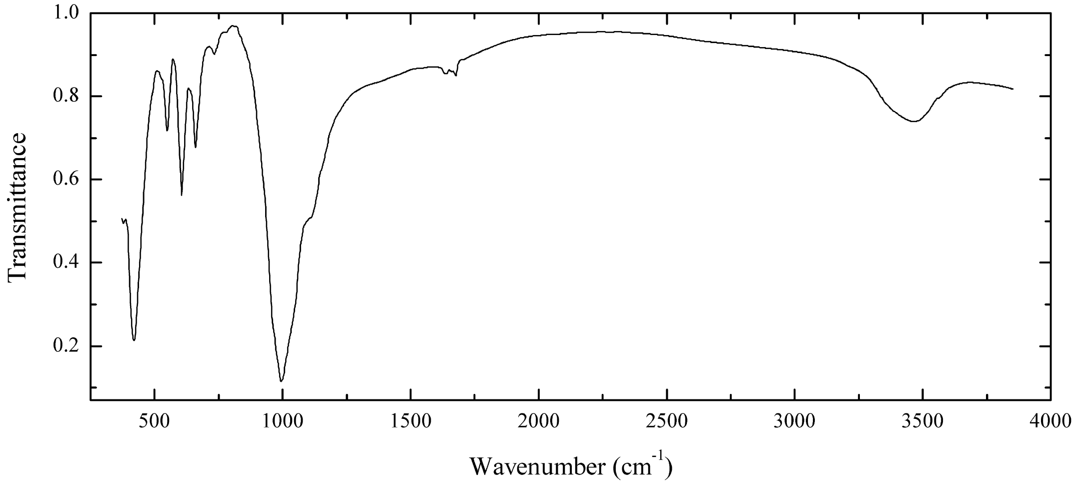


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless grains from a peralkaline hydrothermal veinlet, from the association with steenstrupine-(Ce), vuonnemite, epistolite, sodalite, aegirine, serandite, natisite and vitusite-(Ce). Holotype sample. The crystal structure is solved. Hexagonal, space group $P6_3$, $a = 12.7345(2)$, $c = 5.1798(1)$ Å, $V = 727.46(2)$ Å^3, $Z = 1$. Optically uniaxial (+), $\omega = 1.493(2)$, $\varepsilon = 1.497(2)$. $D_{meas} = 2.32(1)$ g/cm^3, $D_{calc} = 2.313$ g/cm^3. The empirical formula is $(Na_{7.58}K_{0.12})(Si_{6.19}Al_{5.81}O_{24})[(PO_4)_{0.47}(CO_3)_{0.22}(OH)_{0.02}(SO_4)_{0.01}]\cdot3.345H_2O$. The strongest lines of the powder diffraction pattern [d, Å (I, %) (hkl)] are 6.380 (30) (110); 4.695 (91) (101); 3.681 (37) (300); 3.250 (100) (211); 2.758 (33) (400); 2.596 (31) (002); 2.121 (24) (330, 302).

Wavenumbers (cm^{-1}): 3595, 3525, 3350sh, 1740sh, 1637, 1478, 1392, 1104s, 1030sh, 990s, 758, 683, 624, 567, 501, 458s, 428s.

Sif121 Quadridavyne $(Na,K)_6Ca_2[Al_6Si_6O_{24}]Cl_4$

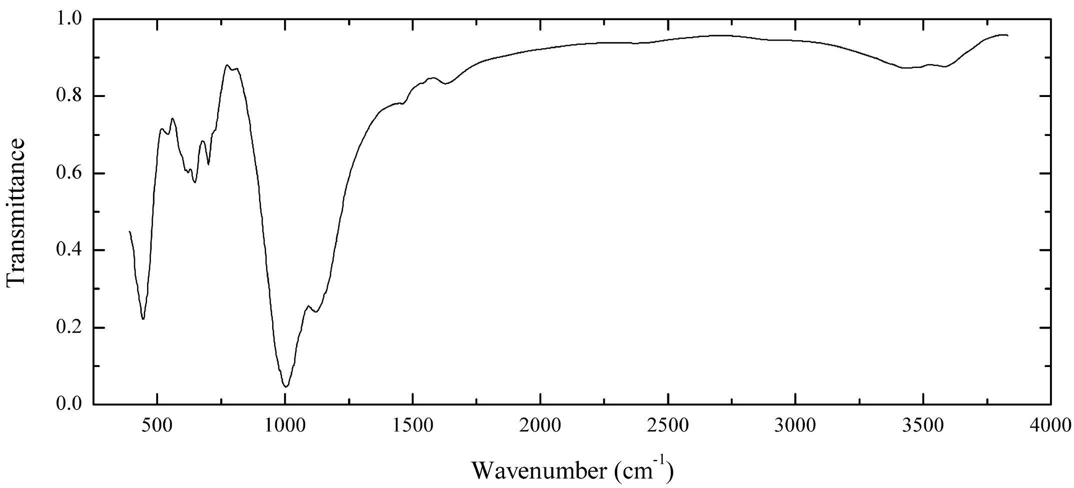


Locality: Bellerberg, Laacher See area, near Ettringen, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Colourless prismatic crystals from a late metasomatic association. Hydrous variety. The empirical formula is $Na_{3.5}K_{2.7}Ca_{1.8}(Si_{6.0}Al_{6.0}O_{24})Cl_{3.6}(SO_4)_{0.1}\cdot nH_2O$ ($n \approx 1$). Hexagonal, $a = 25.81$, $c = 5.38$.

Wavenumbers (cm^{-1}): 3460, 1675w, 1638w, 1115sh, 1050sh, 1010s, 733w, 667, 615, 553, 434s, 390.

Sif122 Sacrofanite $(Na,K,Ca)_8[Al_6Si_6O_{24}](SO_4)_{2-x}(Cl,F,H_2O)_{1+y}$ (x, $y < 0.3$)

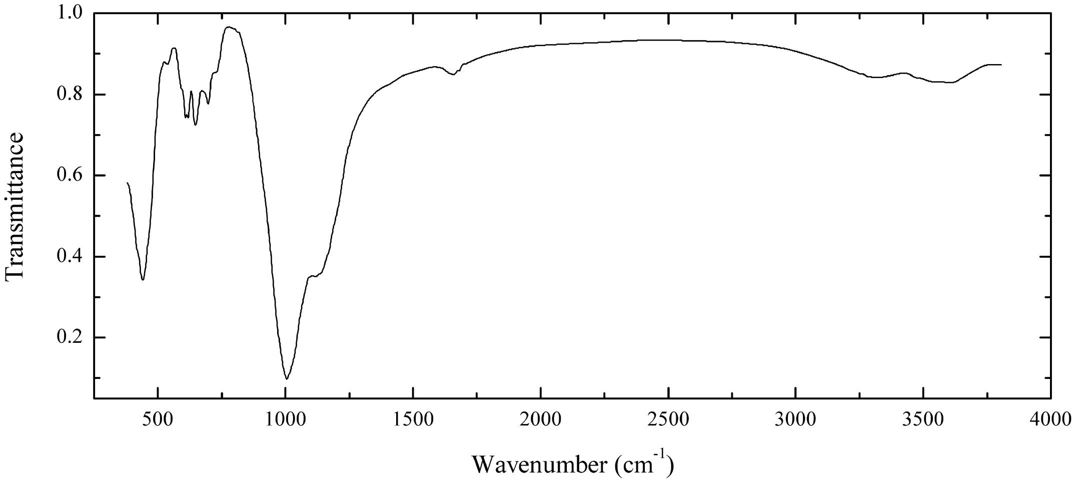


Locality: Biachella valley, Sacrofano Caldera, Sacrofano municipality, Rome Province, Latium, Italy (type locality).

Description: Colourless lenticular crystals from the association with sanidine, haüyne and diopside. Hexagonal, $a \approx 12.9$, $c \approx 74.1$ Å. The empirical formula is (electron microprobe) $Na_{4.2}K_{1.4}Ca_{2.4}(Si_{6.0}Al_{6.0}O_{24})(SO_4)_{1.7}F_{0.7}Cl_{0.2}(OH,CO_3)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3585, 3450, 1625w, 1458w, 1115s, 1004s, 794w, 720sh, 698, 640, 615, 605, 585sh, 538w, 448s.

Sif123 Fantappièite $(Na,Ca,K)_8[Al_6Si_6O_{24}](SO_4)_2{\cdot}nH_2O$ ($n \approx 0.25$)

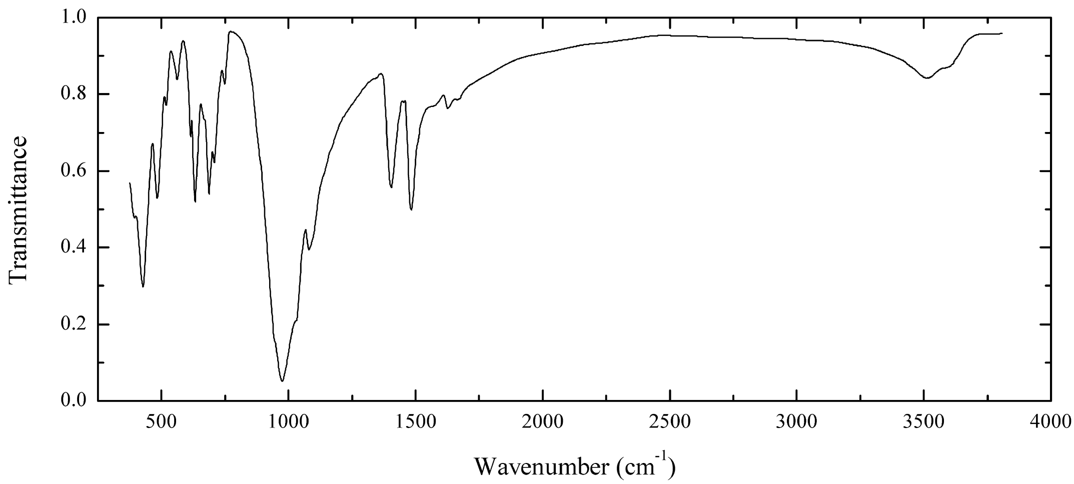


Locality: Biachella valley (Val Biachella), Sacrofano Caldera, Sacrofano municipality, Rome Province, Latium, Italy.

Description: Colourless lenticular crystals. Hexagonal, single-crystal unit-cell parameters are $a = 12.84$, $c = 87.22$ Å.

Wavenumbers (cm^{-1}): 3600, 3320, 1660, 1023, 1009, 725sh, 698, 649, 617, 609, 595sh, 540w, 444s.

Sif124 Carbobystrite $Na_8[Al_6Si_6O_{24}](CO_3){\cdot}4H_2O$

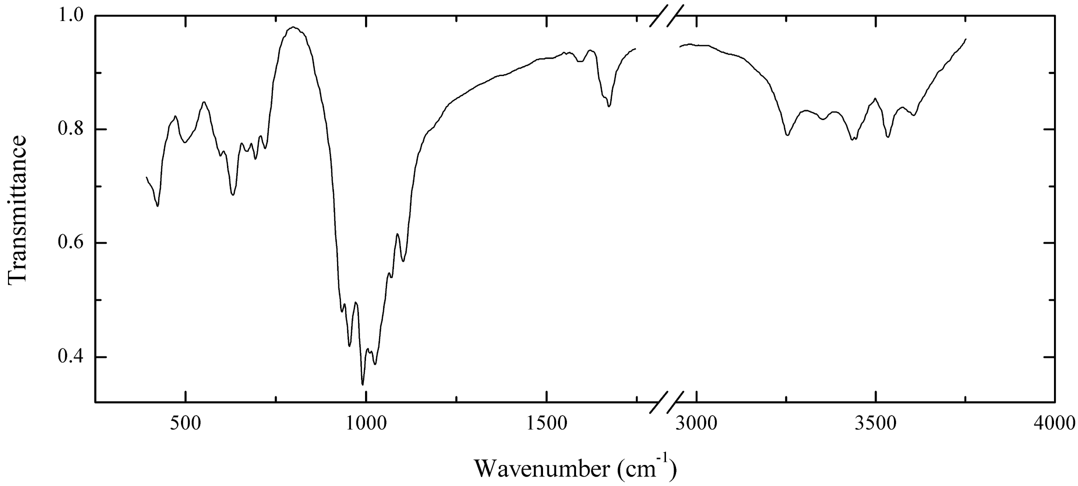


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless grains from the association with microcline, sodalite, megakalsilite, natrolite, pectolite, aegirine, natrite, nacaphite, vitusite-(Ce), fluorcaphite, belovite-(Ce), umbite, lemmleinite-K, lomonosovite, lovozerite, phlogopite, sphalerite and galena. Holotype sample. The crystal structure is solved. Trigonal, space group *P*31c, $a = 12.6678(5)$, $c = 10.3401(4)$ Å, $V = 1437.0(2)$ Å^3, $Z = 1$. Optically uniaxial (−), $\omega = 1.500(2)$, $\varepsilon = 1.488(2)$. $D_{calc} = 2.366$ g/cm^3. The empirical formula is $(Na_{7.40}K_{0.38})(Al_{6.04}Si_{6.02}O_{24})(CO_3){\cdot}3.5H_2O$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.689 (100) (012), 3.249 (100) (-132, 122), 6.378 (80) (-120), 2.661 (80) (041, 123, 133), 3.867 (70) (-131, 121), 3.664 (70) (030).

Wavenumbers (cm^{-1}): 3615sh, 3530, 1673w, 1460w, 1638w, 1570sh, 1510sh, 1484, 1415, 1100sh, 1085, 1040sh, 985s, 945sh, 746w, 706, 687, 670sh, 634, 616, 562w, 518, 485, 430s, 400.

Sif_Z1 Scolecite $Ca(Al_2Si_3O_{10})\cdot 3H_2O$

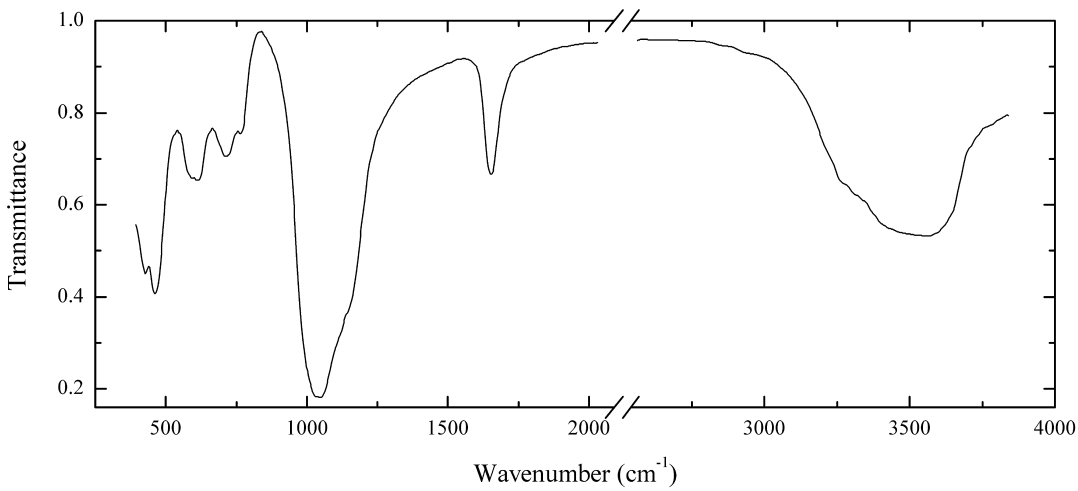


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White columnar aggregate, in the association with stevensite, aqualite and aegirine-augite. The empirical formula is (electron microprobe) $Ca_{0.9}Na_{0.1}(Si_{3.1}Al_{1.9}O_{10})\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3580, 3510, 3410, 3325, 3230, 1670, 1655w, 1590w, 1102s, 1070s, 1050sh, 1023s, 1008s, 990s, 952s, 932s, 719, 691, 669, 630, 596, 520sh, 499, 422, 405sh.

Sif_Z2 Offretite $CaKMg(Al_5Si_{13}O_{36})\cdot 16H_2O$

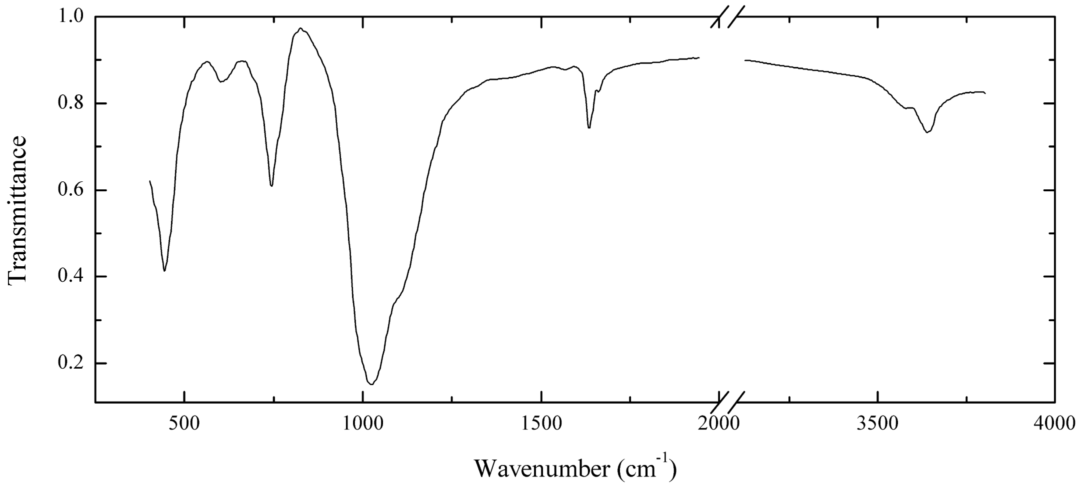


Locality: Vinařice, near Kladno, Central Bohemia, Czech Republic.

Description: Yellowish hexagonal prismatic crystals from in the association with paulingite-Ca and phillipsite-K. The empirical formula is (electron microprobe) $Ca_{1.07}K_{0.90}Mg_{0.89}Si_{13.26}Al_{4.72}O_{36}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3540, 3450sh, 3310sh, 1654, 1150sh, 1045s, 762, 716, 612, 599, 580sh, 462s, 427s.

Sif_Z3 **Analcime** $Na(AlSi_2O_6){\cdot}H_2O$

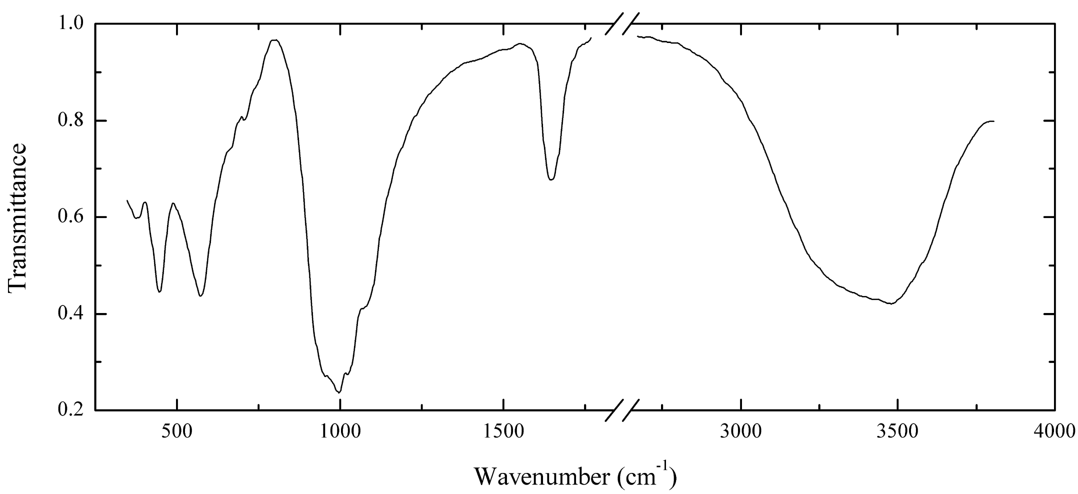


Locality: Noaki, Shizuoka prefecture, Chubu region, Honshu island, Japan.

Description: White grains from the association with tacharanite. Optically anisotropic tetragonal variety.

Wavenumbers (cm^{-1}): 3620, 3560w, 1660w, 1645sh, 1637, 1100sh, 1022s, 765sh, 742, 725sh, 695sh, 607, 445s, 415sh.

Sif_Z4 **Gismondine** $Ca_4(Al_8Si_8O_{32}){\cdot}16H_2O$

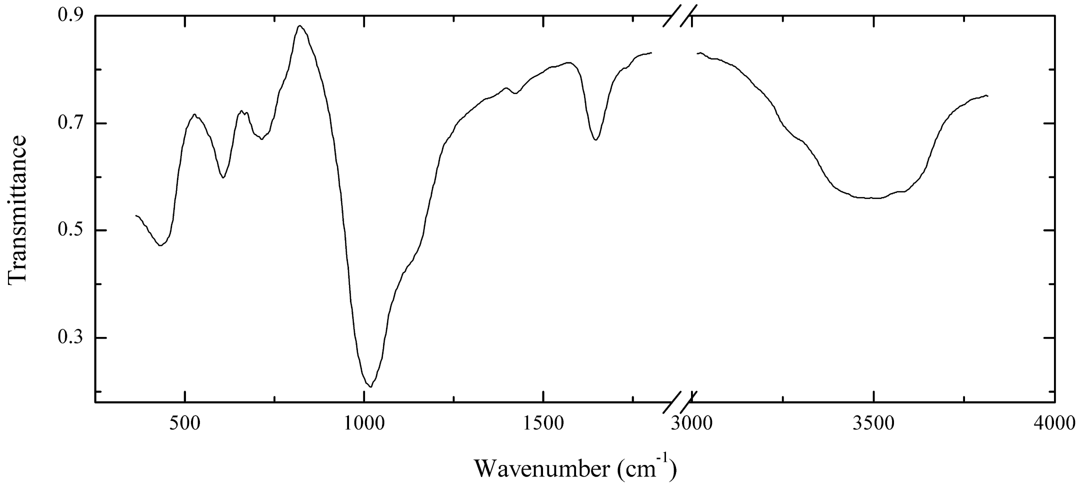


Locality: Arensberg, Zilsdorf, near Hillesheim, Eifel, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Colourless pseudooctahedral crystals from the association with phillipsite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3485, 3350sh, 1657, 1078s, 1026s, 999s, 956s, 745sh, 711w, 660sh, 575s, 445s, 375.

Sif_Z5 **Harmotome** $Ba_2(Na,K,Ca_{0.5})(Al_5Si_{11}O_{32})\cdot 12H_2O$

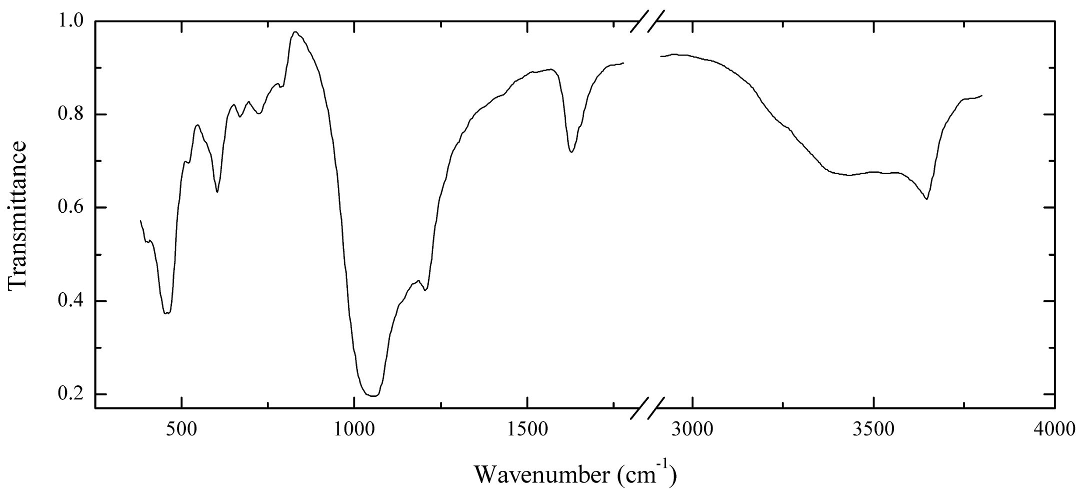


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White split crystals from the association with scolecite and cancrinite. The empirical formula is (electron microprobe) $Ba_{1.93}Na_{0.41}Sr_{0.37}K_{0.19}(Si_{10.84}Al_{5.18})O_{32}\cdot nH_2O$. Weak band at 1,423 cm^{-1} corresponds to the admixture of calcite.

Wavenumbers (cm^{-1}): 3560sh, 3490, 3270sh, 1652, 1423w, 1125sh, 1020s, 713, 615, 433s.

Sif_Z6 **Clinoptilolite-Ca** $Ca_2Na_{1.5}K(Al_{6.5}Si_{29.5}O_{72})\cdot 24H_2O$

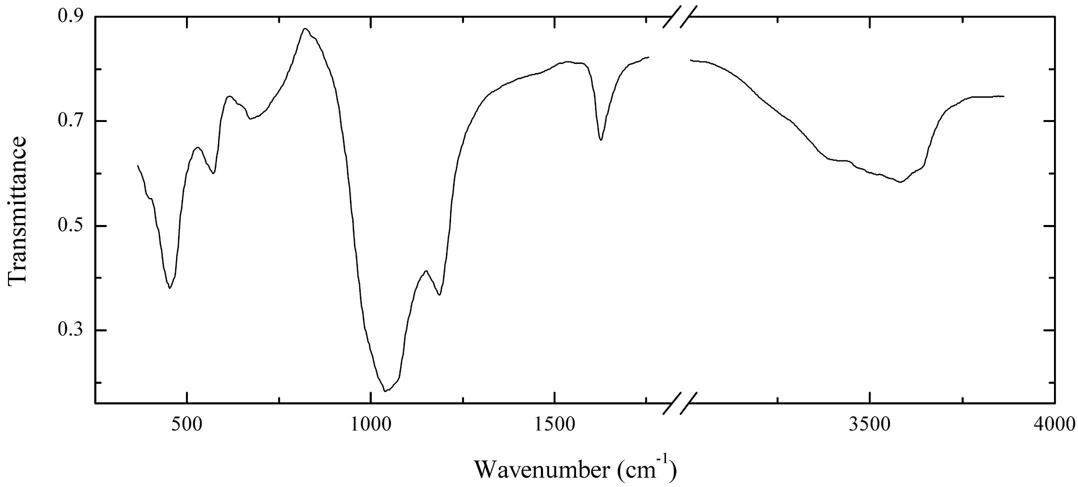


Locality: Netarts bay, Tillamook Co., Oregon, USA.

Description: Beige split platy crystals. The empirical formula is (electron microprobe) $Ca_{2.2}K_{1.5}Na_{0.7}(Si_{29.4}Al_{6.6})O_{72}\cdot nH_2O$.

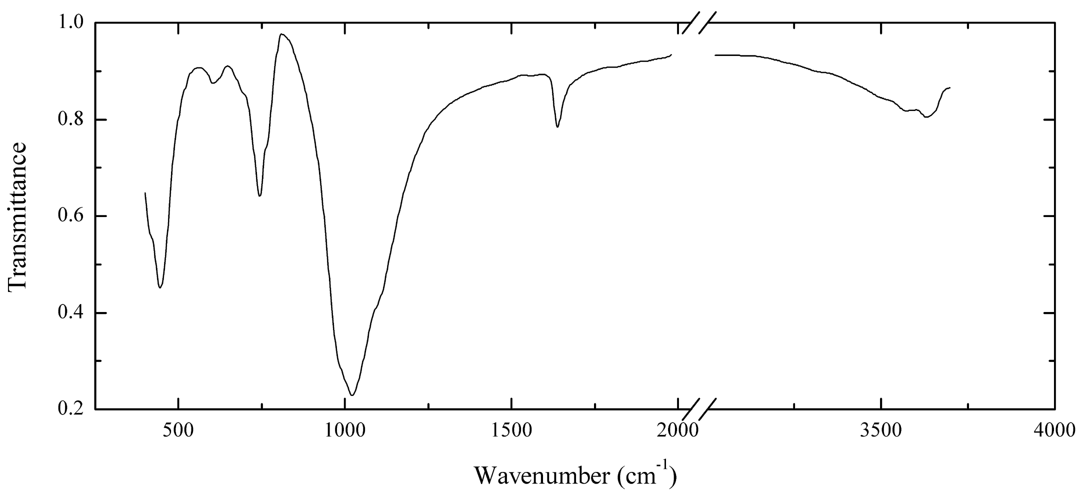
Wavenumbers (cm^{-1}): 3635, 3430, 1633, 1211s, 1061s, 1035sh, 796w, 780sh, 726, 673, 605, 522, 465s, 454s, 403.

Sif_Z7 Epistilbite $Ca_3(Al_6Si_{18}O_{48})\cdot 16H_2O$



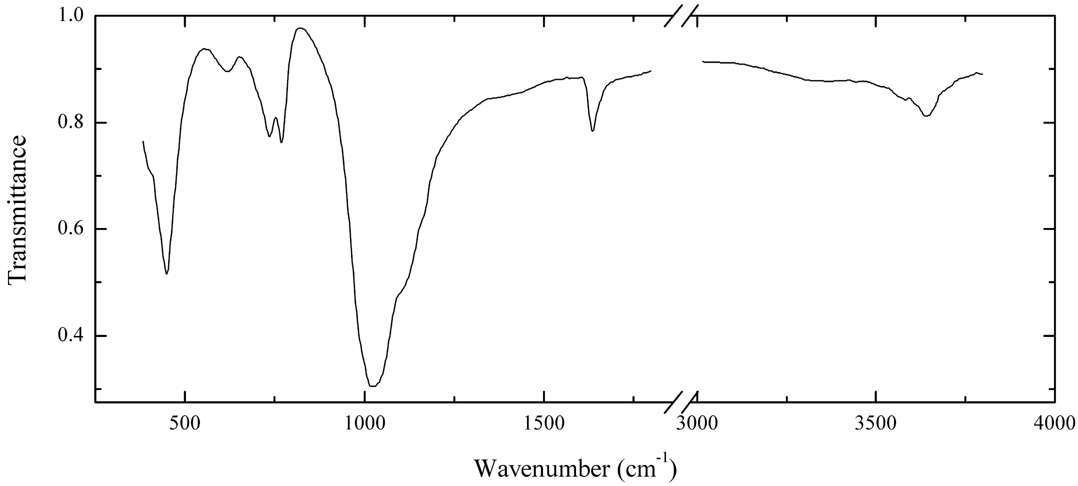
Locality: Syed Pimpri, Nasik district, Maharashtra, India.
Description: Colourless platy crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3630sh, 3570, 3510sh, 3410sh, 3280sh, 1633, 1189s, 1070sh, 1049s, 745sh, 710sh, 679, 650sh, 569, 457s, 400sh.

Sif_Z8 Analcime $Na(AlSi_2O_6)\cdot H_2O$



Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Yellow grains from the association with aegirine and microcline. Confirmed by IR spectrum and single-crystal X-ray diffraction pattern. Tetragonal variety. The empirical formula is (electron microprobe) $Na_{1.1}(Si_{1.9}Al_{1.1}O_6)\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3615, 3550w, 1640, 1100sh, 1020s, 990sh, 760sh, 742, 695sh, 605w, 444s, 420sh.

Sif_Z9 Analcime $Na(AlSi_2O_6)\cdot H_2O$

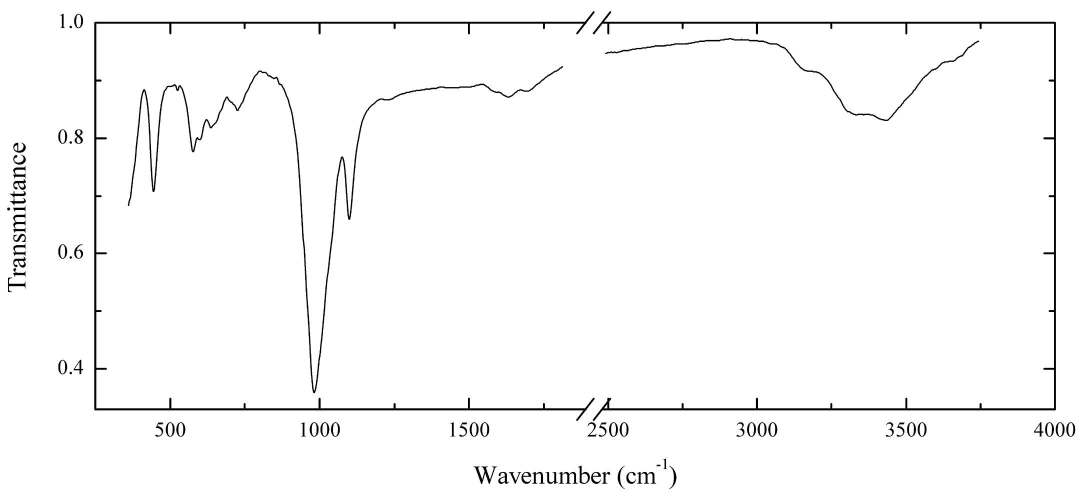


Locality: Tura township, Tunguska river basin, Krasnoyarskiy Krai, Siberia, Russia.

Description: White semitransparent crystal from the association with stilbite. Confirmed by IR spectrum and optical data. Cubic variety.

Wavenumbers (cm^{-1}): 3615, 3555w, 1630, 1160sh, 1105sh, 1025s, 768, 734, 700sh, 618w, 605sh, 444s, 400sh.

Sif_Z10 Amicite $K_4Na_4(Al_8Si_8O_{32})\cdot 10H_2O$

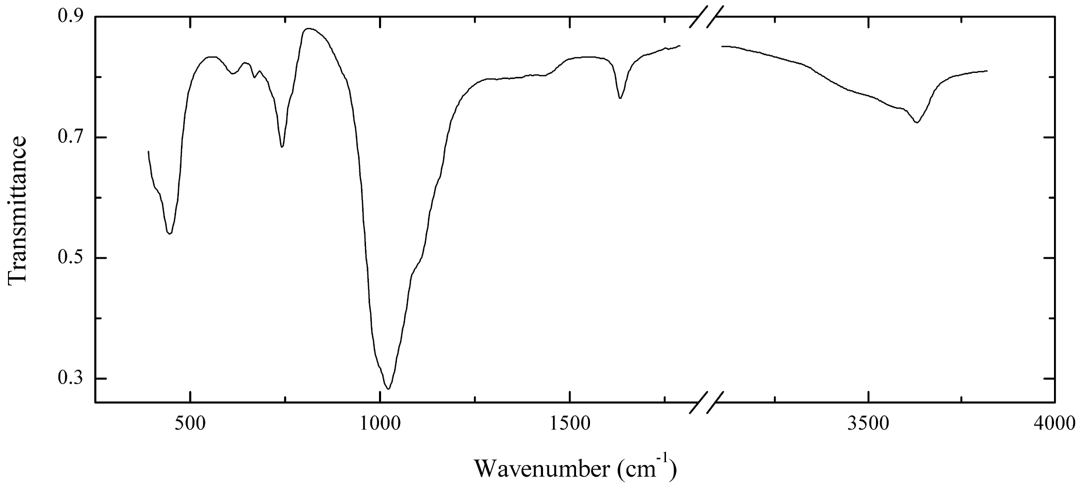


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless pseudotetragonal crystals from the association with aegirine, pectolite and vinogradovite. Investigated by A.P. Khomyakov. Monoclinic, $a = 10.26$, $b = 10.44$, $c = 9.92$ Å, $\beta = 91.5°$. Optically biaxial (−), $\alpha = 1.485$, $\beta = 1.490$, $\gamma = 1.494$, $2V_{meas} = -82°$. $D_{meas} = 2.23$ g/cm^3. Chemical composition is (wt. %) Na_2O 8.65, K_2O 13.30, CaO 0.89, Fe_2O_3 0.18, Al_2O_3 29.89, SiO_2 34.49, H_2O 12.92, total 100.32.

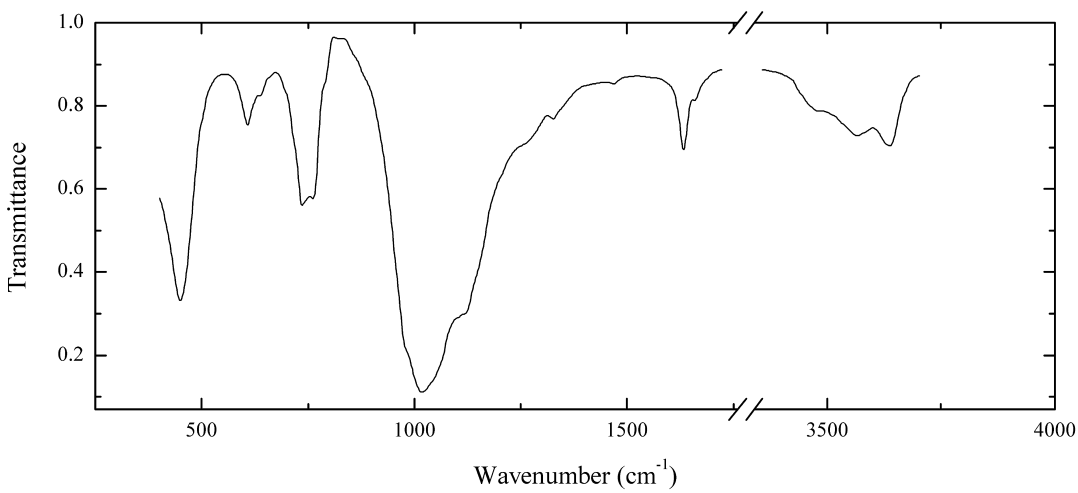
Wavenumbers (cm^{-1}): 3630sh, 3400, 3315, 3150sh, 1687w, 1625w, 1585w, 1098s, 1035sh, 981s, 960sh, 726, 650sh, 640, 602, 578, 525w, 447s.

Sif_Z12 **Analcime** $Na(AlSi_2O_6)\cdot H_2O$



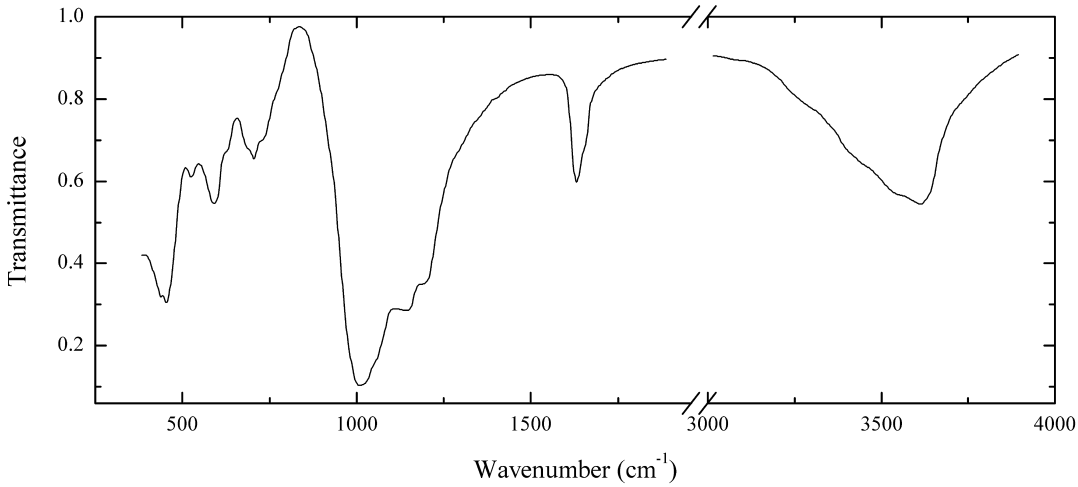
Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Pink transparent grains from the association with tisinalite. Cubic variety. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3610, 3540sh, 1632, 1155sh, 1095sh, 1022s, 995sh, 765sh, 740, 715sh, 668w, 603w, 443s, 400sh.

Sif_Z13 **Analcime** $Na(AlSi_2O_6)\cdot H_2O$



Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White granular aggregate from the association with natrolite. Boron-bearing variety.
Wavenumbers (cm^{-1}): 3625, 3550w, 3465w, 1660w, 1635, 1470w, 1325w, 1250sh, 1121, 1100sh, 1020s, 980sh, 790sh, 765, 745sh, 734, 641w, 609, 470sh, 450s.

Sif_Z14 Brewsterite-Ba $Ba_2(Al_4Si_{12}O_{32})\cdot 10H_2O$

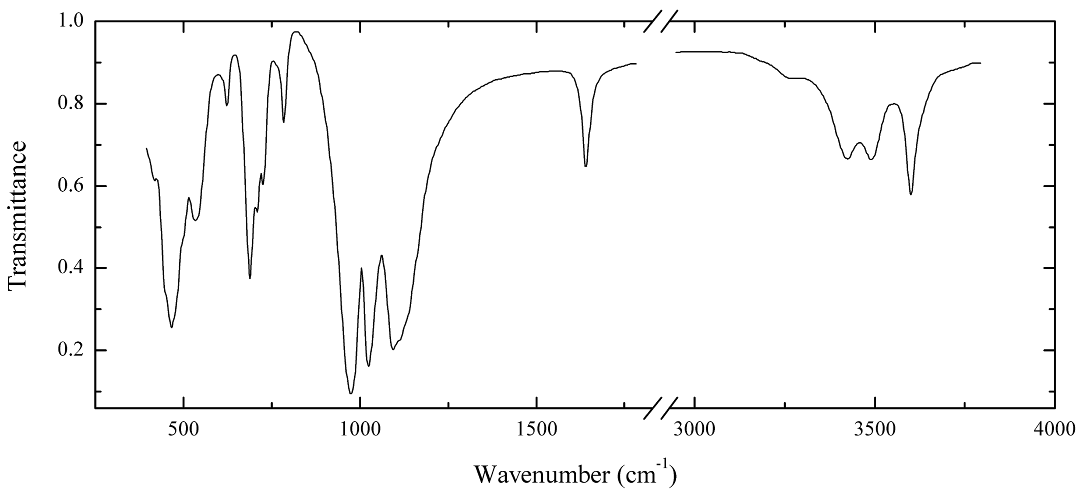


Locality: Whitesmith mine, Strontian, North West Highlands (Argyllshire), Scotland, UK.

Description: Colourless prismatic crystals from the association with harmotome. The empirical formula is (electron microprobe) $(Ba_{1.1}Sr_{0.8}Na_{0.2})(Si_{12.0}Al_{4.0}O_{32})\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3600sh, 3580, 3520sh, 3450sh, 3280sh, 1660sh, 1634, 1193s, 1149s, 1060sh, 1011s, 733, 708, 690sh, 630sh, 591, 535, 456s, 440s, 402.

Sif_Z15 Bikitaite $Li_2(AlSi_2O_6)\cdot H_2O$

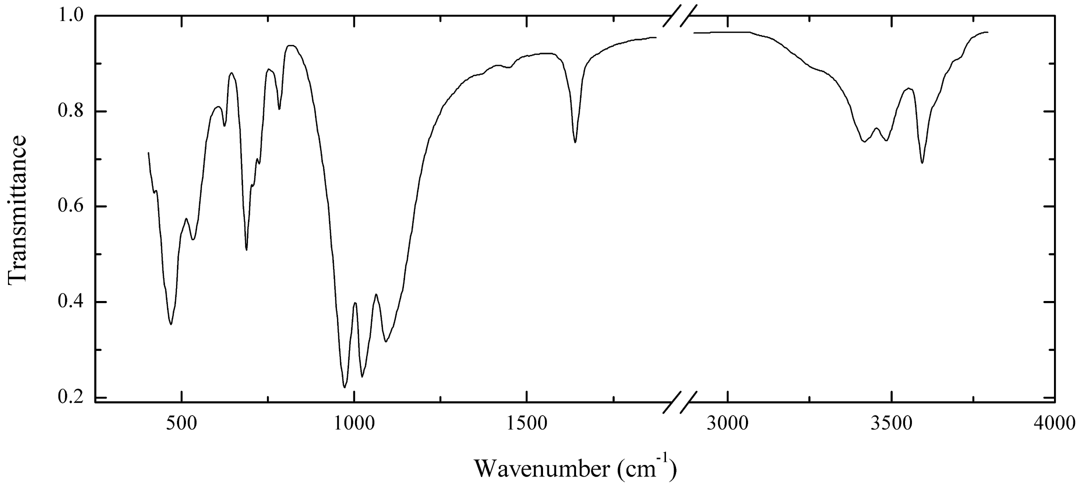


Locality: Bikita mine, Bikita, east of Victoria, Zimbabwe (type locality).

Description: Colourless prismatic crystals from the association with eucriptite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3582, 3476, 3408, 3260w, 1644, 1135sh, 1110sh, 1093s, 1022s, 971s, 784, 724, 708, 685, 622, 532, 495sh, 475sh, 463s, 450sh, 417.

Sif_Z16 Bikitaite $Li_2(AlSi_2O_6)\cdot H_2O$

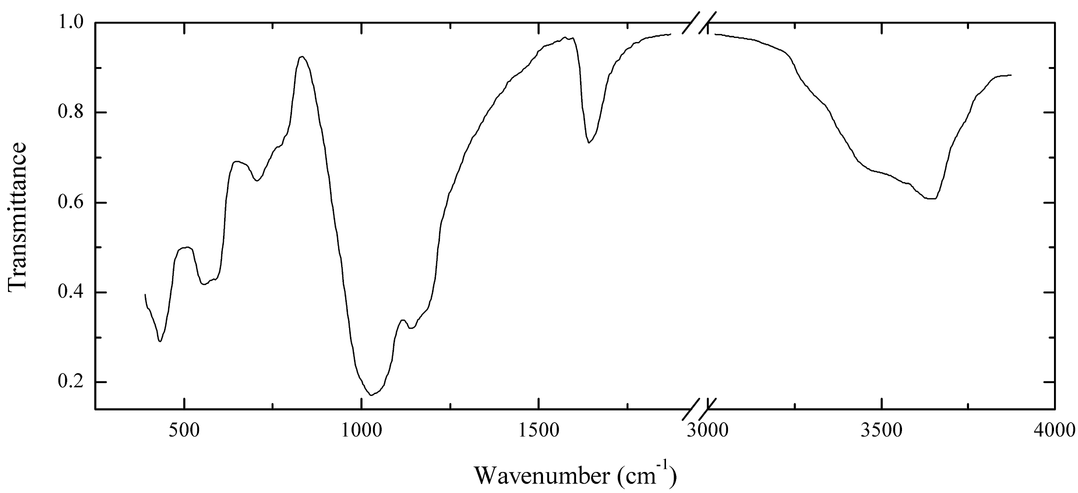


Locality: Bikita mine, Bikita, east of Victoria, Zimbabwe (type locality).

Description: Colourless prismatic crystals from the association with eucryptite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3584, 3475, 3406, 3260sh, 1645, 1135sh, 1105sh, 1092s, 1021s, 970s, 783, 724, 707, 685, 622, 531, 495sh, 475sh, 463s, 450sh, 419.

Sif_Z17 Barrerite $Na_8(Al_8Si_{28}O_{72})\cdot 26H_2O$

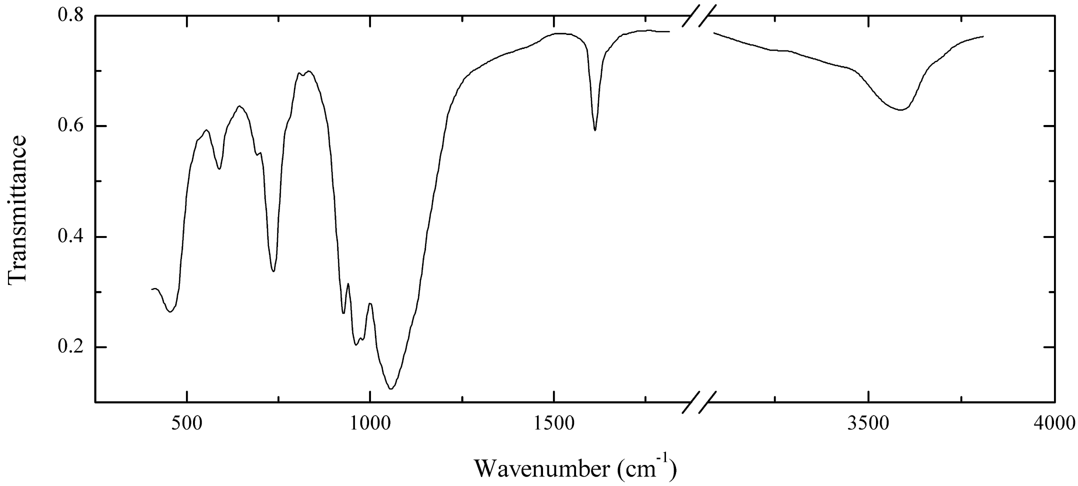


Locality: Kuiu island, Alaska, USA.

Description: Pink split platy crystals. Confirmed by IR spectrum.

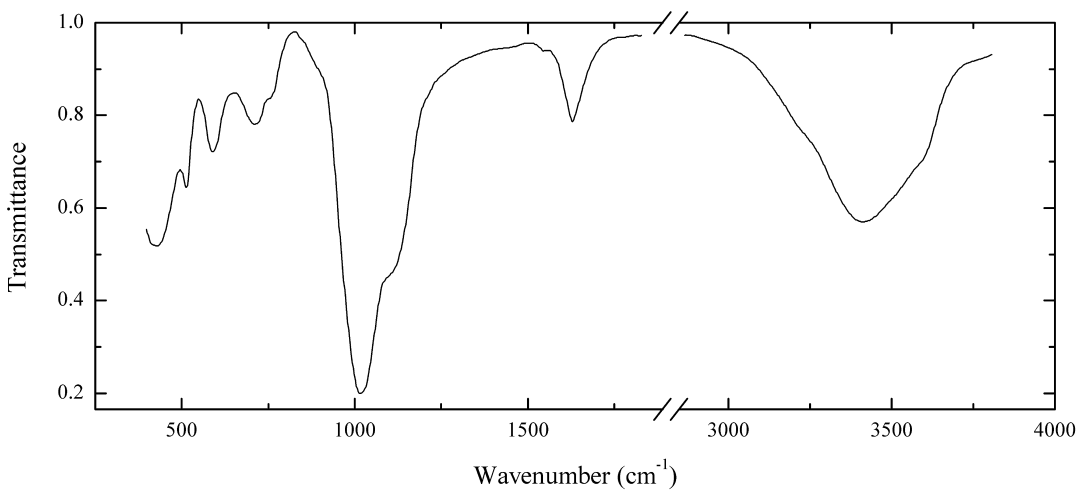
Wavenumbers (cm^{-1}): 3630, 3480sh, 3260sh, 1643, 1185sh, 1149s, 1039s, 995sh, 790sh, 770sh, 713, 595, 568, 438s, 410sh.

Sif_Z18 Wairakite $Ca(Al_2Si_4O_{12})\cdot 2H_2O$



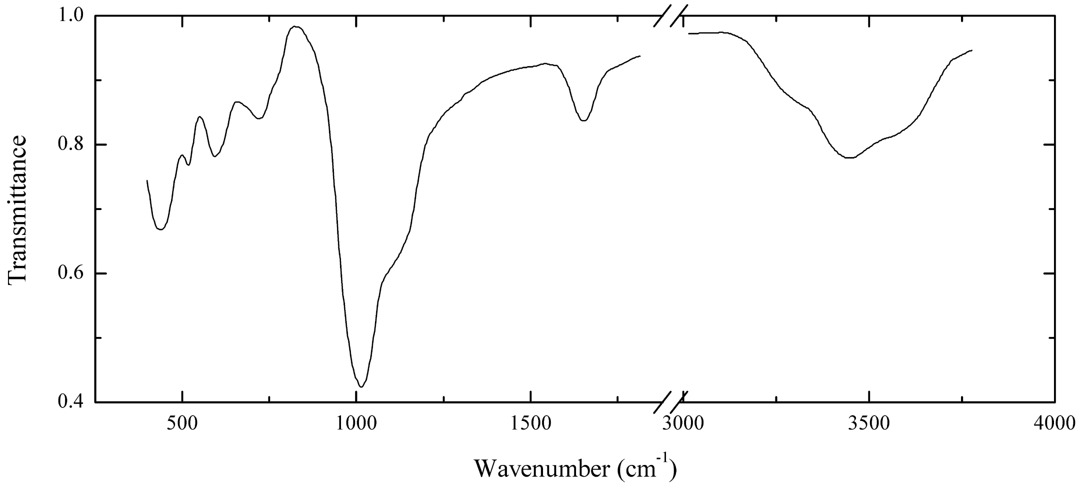
Locality: Bandaiatami, Koriyama, Fukushima prefecture, Tohoku region, Honshu island, Japan.
Description: White crystals from the association with calcite and stilbite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3600, 1620, 1130sh, 1068s, 996s, 975s, 940s, 790sh, 751, 699, 600, 472s.

Sif_Z19 Gmelinite-Na $Na_7(Al_7Si_{17}O_{48})\cdot 22H_2O$



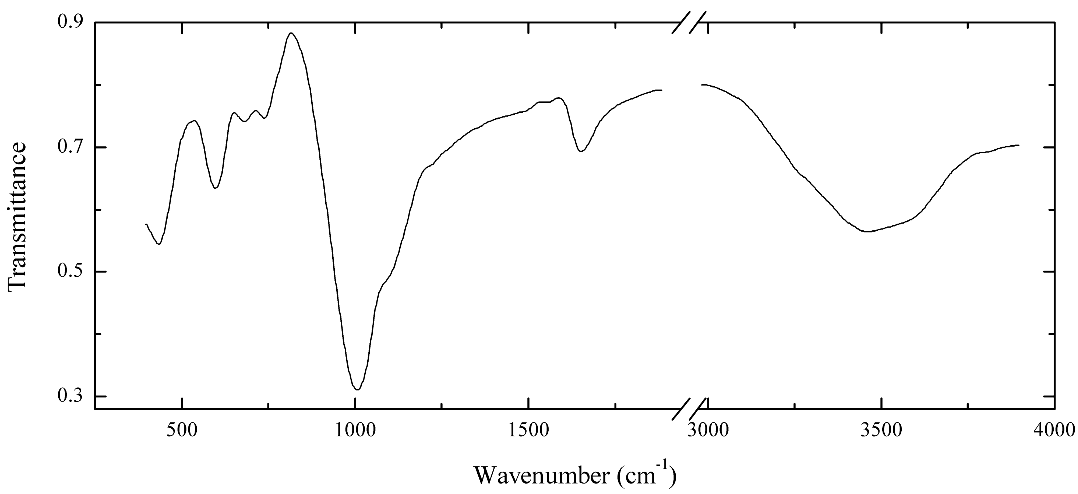
Locality: South Kurtsy quarry, Kurtsy village, Simferopol area, Crimea, Ukraine.
Description: Pink dipyramidal crystals from the association with analcime and calcite. The empirical formula is (electron microprobe) $Na_{6.12}Ca_{0.34}K_{0.11}Si_{17.00}Al_{7.03}O_{48}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3550sh, 3420, 3250sh, 1635, 1535w, 1100sh, 1025s, 770sh, 722, 600, 520, 435s.

Sif_Z20 Gmelinite-Ca $(Ca_{0.5},Sr_{0.5},Na)(Al_7Si_{17}O_{48})\cdot 23H_2O$



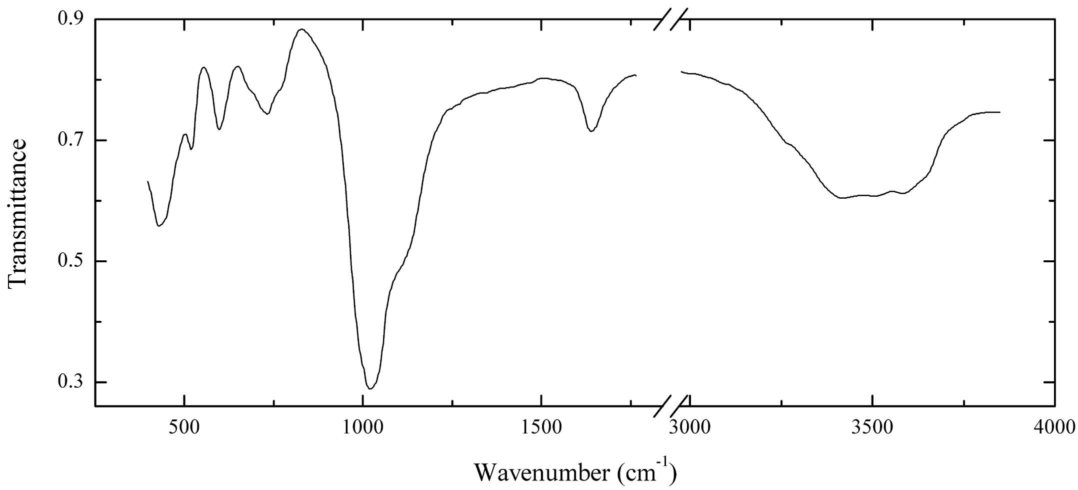
Locality: Dobranka, České Středohoři Mts., Czech Republic.
Description: Colourless dipyramidal crystals. The empirical formula is (electron microprobe) $Ca_{2.4}K_{0.8}Sr_{0.4}Mg_{0.4}Si_{16.8}Al_{7.2}O_{48}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3435, 3300sh, 1655, 1160sh, 1115sh, 1017s, 770sh, 721, 615sh, 595, 519, 437s.

Sif_Z21 Gobbinsite $Na_5(Al_5Si_{11}O_{32})\cdot 12H_2O$



Locality: Garron plateau, Northern Ireland, UK.
Description: White massive. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3435, 1650, 1100sh, 1008s, 775sh, 740, 680, 598, 436s.

Sif_Z22 **Gmelinite-Na** $Na_7(Al_7Si_{17}O_{48})\cdot 22H_2O$

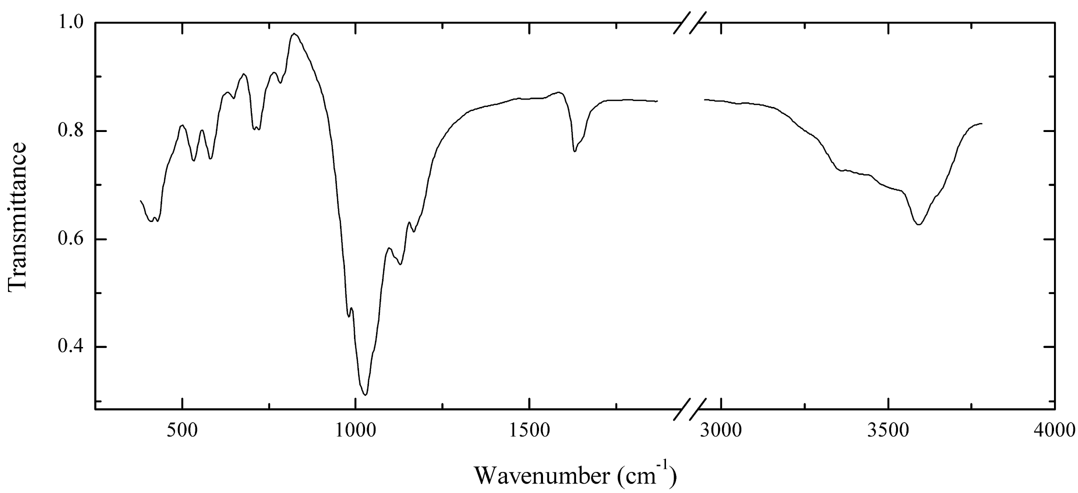


Locality: Port Muck, Magee island, Antrim Co., Northern Ireland, UK.

Description: Pink dipyramidal crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3640sh, 3560, 3490, 3400, 3260sh, 1635, 1100sh, 1022s, 753sh, 732, 700sh, 625sh, 595, 518, 440sh, 426s.

Sif_Z23 **Goosecreekite** $Ca(Al_2Si_6O_{16})\cdot 5H_2O$

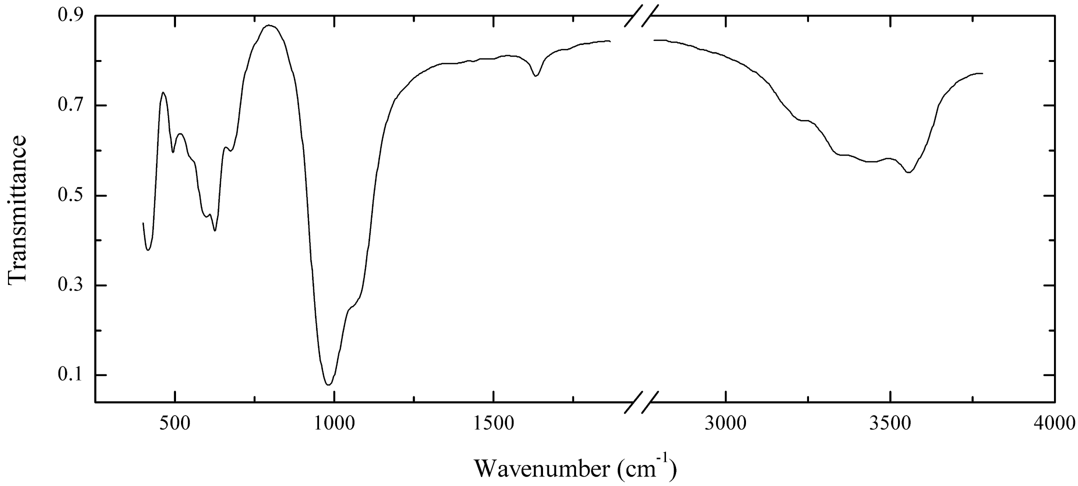


Locality: Jalgaon, Maharashtra, India.

Description: Colourless split crystals from the association with heulandite-Ca and quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3590sh, 3555, 3480sh, 3325, 1645sh, 1627, 1190sh, 1168, 1127s, 1110sh, 1050sh, 1027s, 979s, 795sh, 781w, 723, 709, 648w, 583, 534, 432, 412.

Sif_Z24 Gonnardite $(Na,Ca)_{6-8}[(Si,Al)_{20}O_{40}]\cdot 12H_2O$

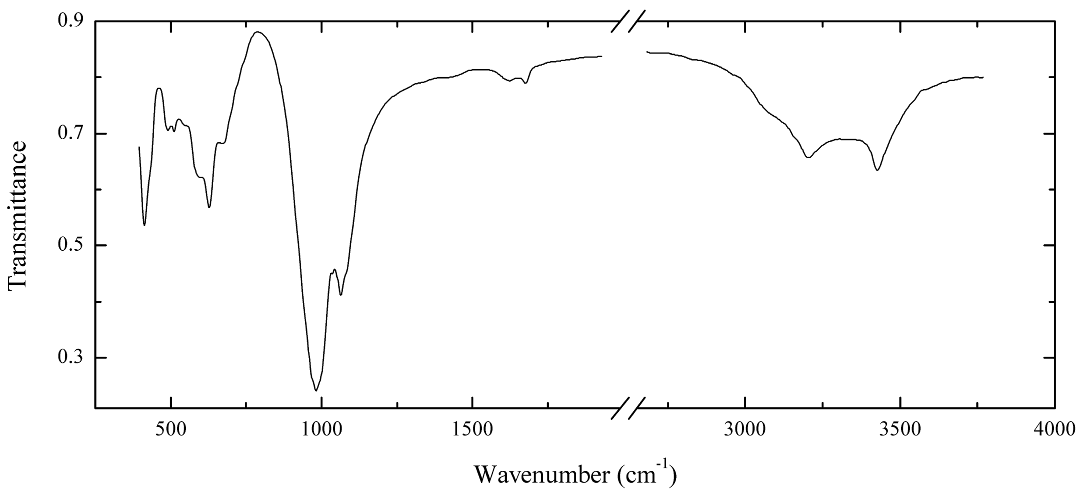


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pale orange crystals. The empirical formula is (electron microprobe) $Na_{6.5}Ca_{0.8}Al_{8.9}Si_{11.3}O_{40}\cdot nH_2O$. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3545, 3430, 3350sh, 3225, 1633, 1080sh, 1057s, 674, 621s, 591, 550sh, 487, 417s.

Sif_Z25 Gonnardite $(Na,Ca)_{6-8}[(Si,Al)_{20}O_{40}]\cdot 12H_2O$

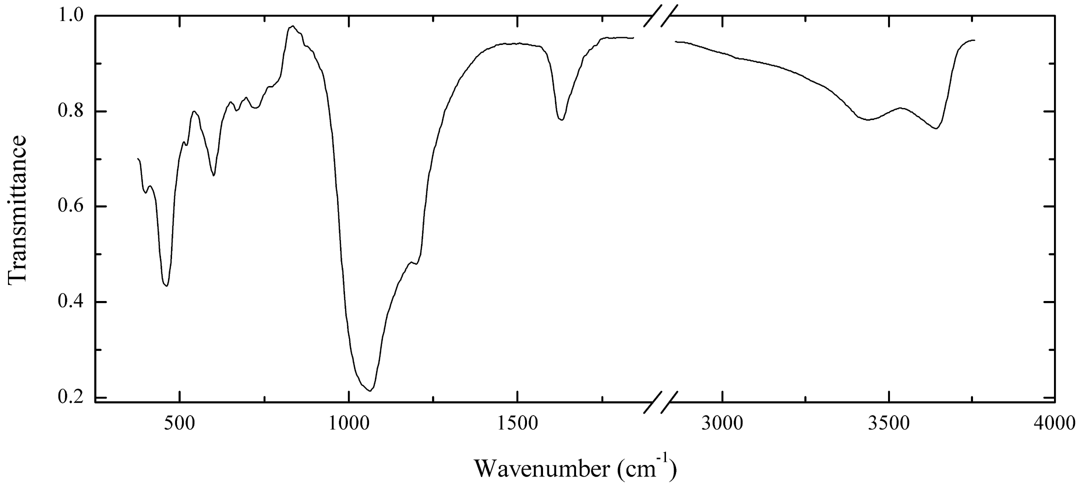


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Pink veinlet. The empirical formula is (wet chemical analysis) $Na_{5.75}Ca_{1.80}Al_{9.29}Fe_{0.02}Si_{10.76}O_{40}\cdot 10.84H_2O$. Confirmed by IR spectrum and powder X-ray diffraction pattern.

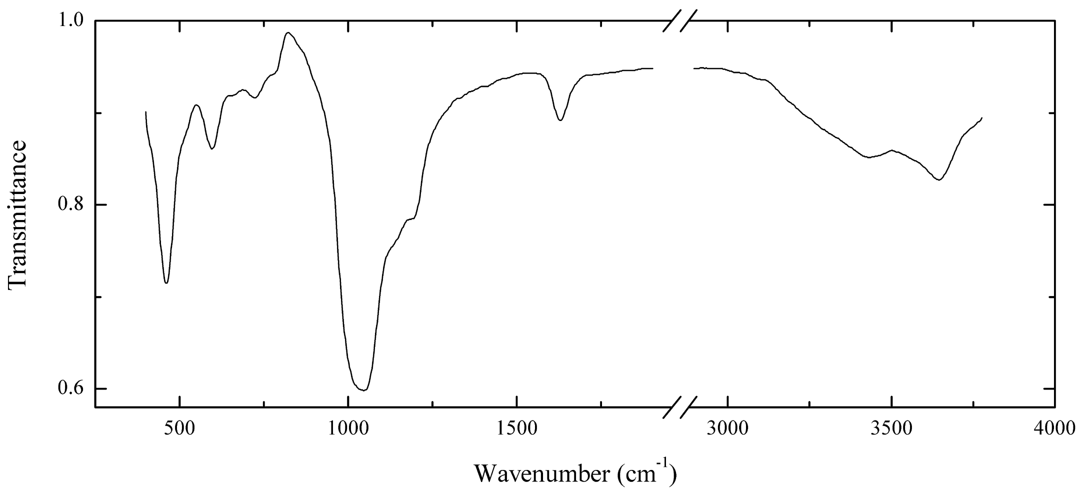
Wavenumbers (cm^{-1}): 3535, 3320, 3280sh, 3210sh, 1677w, 1625w, 1085sh, 1064s, 1040s, 995sh, 980s, 965sh, 945sh, 667, 624, 595, 543w, 509, 488, 435sh, 412.

Sif_Z26 **Heulandite-Ca** $(Ca_{0.5},Na,K)_9(Al_9Si_{27}O_{72})\cdot 24H_2O$



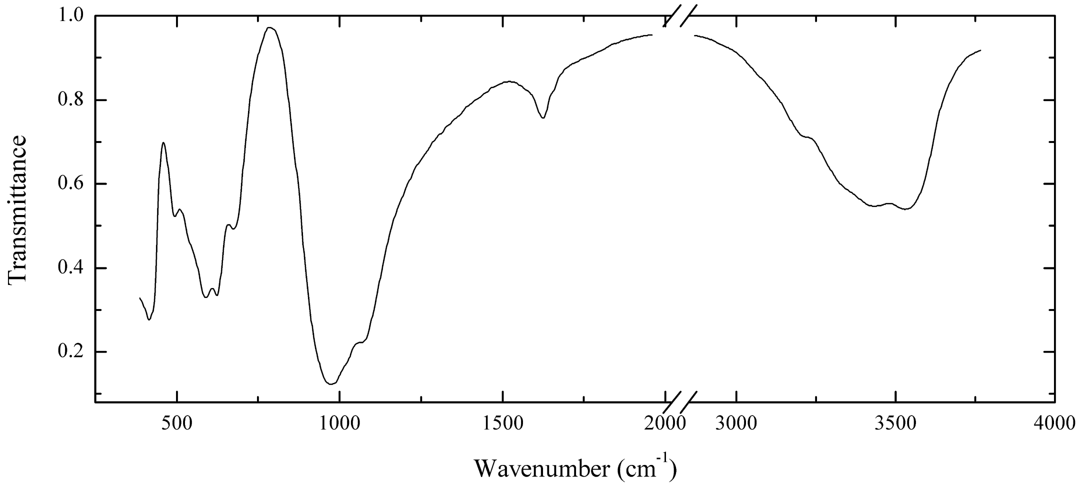
Locality: The mouth of Uraveli river, near Akhaltsikhe, Georgia.
Description: Red platy crystals from the association with apophyllite-(KOH) and thaumasite. Si-rich variety transitional to clinoptilolite-Ca. The empirical formula is (electron microprobe) $Ca_{3.2}Na_{0.8}Si_{28.8}Al_{7.2}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3635, 3420, 1633, 1201s, 1062s, 1040sh, 775w, 723, 671, 600, 518, 461s, 400.

Sif_Z27 **Heulandite-Ca** $(Ca_{0.5},Na,K)_9(Al_9Si_{27}O_{72})\cdot 24H_2O$



Locality: Basin of the river Nizhnyaya Tunguska, Evenkiya, Siberia, Russia.
Description: Pink tabular crystal from the association with stilbite-Ca and mordenite. The empirical formula is (electron microprobe) $Ca_{3.36}Na_{1.38}K_{0.13}Ba_{0.09}Si_{27.44}Al_{8.61}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3625, 3415, 1627, 1193, 1130sh, 1048s, 1020sh, 778, 721, 661, 600, 520sh, 461s, 400sh.

Sif_Z28 Gonnardite $(Na,Ca)_{6-8}[(Si,Al)_{20}O_{40}]\cdot 12H_2O$

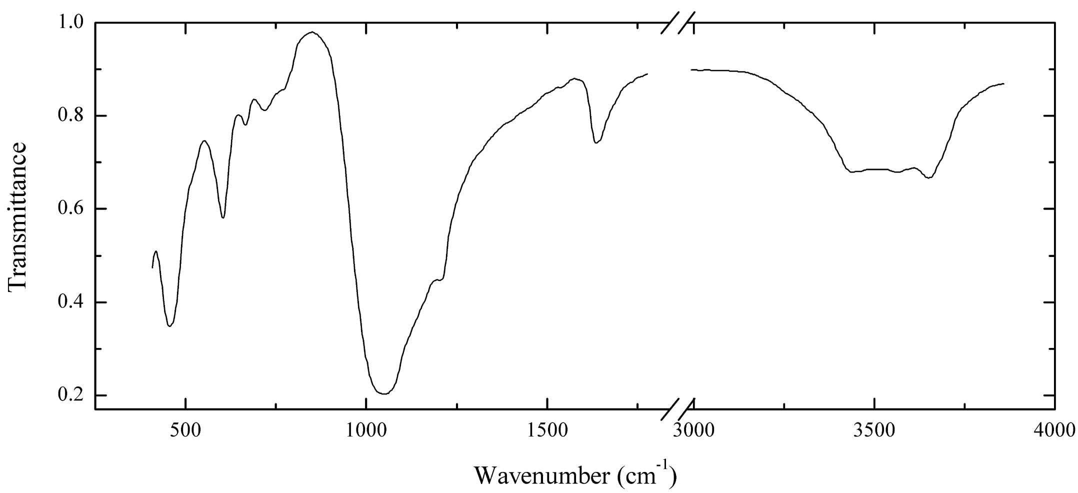


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow aggregates from the association with Nd-rich ancylite-(Ce). The empirical formula is (electron microprobe) $Na_{7.18}Ca_{0.73}Al_{8.84}Si_{11.21}O_{40}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3440, 3230, 1633, 1076s, 1015sh, 977s, 672, 622, 590, 490, 408s.

Sif_Z29 Heulandite-Na $(Na,Ca_{0.5},K)_9(Al_9Si_{27}O_{72})\cdot 24H_2O$

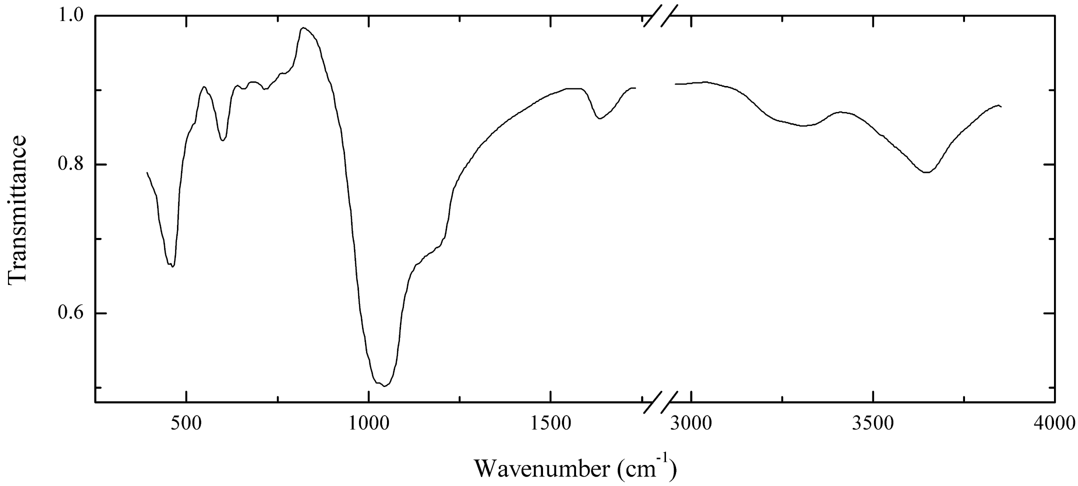


Locality: Valle de la Luna, San Pedro de Atacama, Atacama, Chile.

Description: Pink grains from the association with halite. The empirical formula is (electron microprobe) $Na_{3.29}K_{2.15}Ca_{1.08}Si_{28.61}Al_{7.32}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3632, 3550, 3420, 1640, 1210s, 1070sh, 1055s, 789w, 721, 671, 606, 461s.

Sif_Z30 Heulandite-K $(K,Ca_{0.5},Na)_9(Al_9Si_{27}O_{72})\cdot 24H_2O$

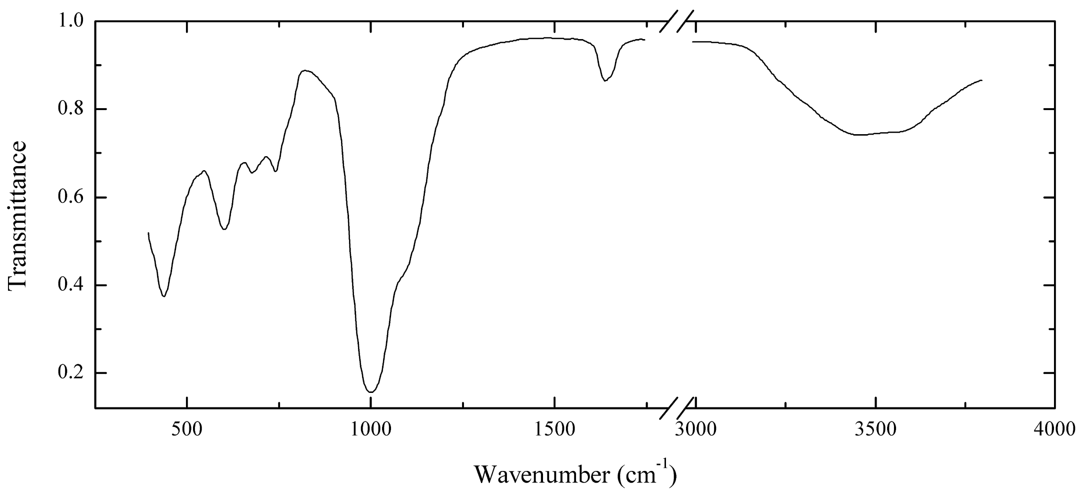


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless tabular crystals from the association with microcline, aegirine, manganbelyankinite, and rhabdophane-(Ce). The empirical formula is (electron microprobe) $K_{2.2}Ca_{1.9}Sr_{0.1}Na_{0.1}Si_{29.7}Al_{6.3}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3630, 3290, 1630, 1175sh, 1044s, 780w, 722, 662, 599, 515sh, 457s.

Sif_Z31 Gobbinsite $Na_5(Al_5Si_{11}O_{32})\cdot 12H_2O$

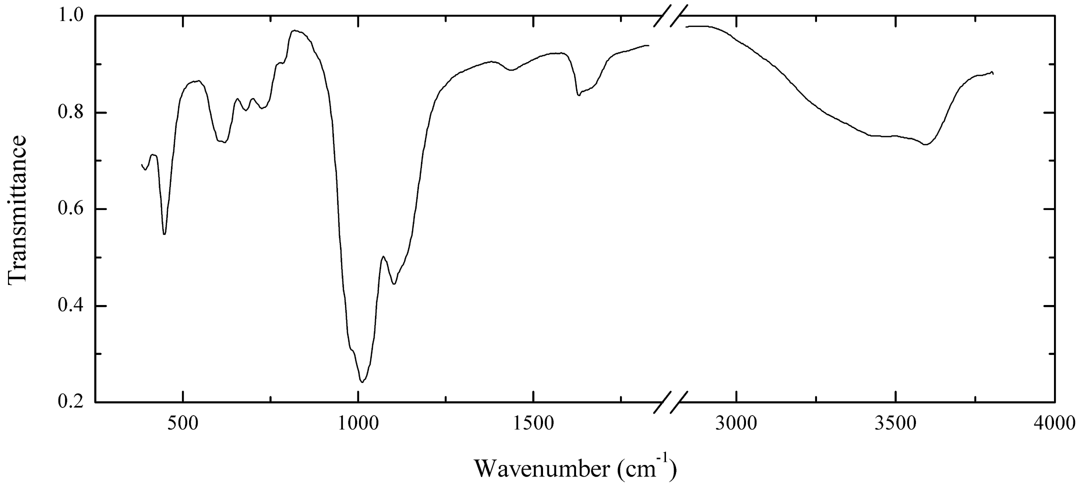


Locality: Diesse quarry, Cerro Sapo, Cochabamba, Bolivia.

Description: White split crystals from carbonatite. Confirmed by IR spectrum. Al-rich variety. The empirical formula is (electron microprobe) $Na_{5.7}Ba_{0.2}Ca_{0.1}Si_{9.7}Al_{6.3}O_{32}\cdot nH_2O$. Strong lines of powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 7.13 (100), 5.06 (70), 4.53 (30), 4.11 (100), 3.20 (100), 3.10 (80), 2.69 (90).

Wavenumbers (cm^{-1}): 3570sh, 3460, 1650sh, 1640, 1100sh, 1003s, 743, 679, 600, 433s, 405sh.

Sif_Z32 Harmotome $Ba_2(Na,K,Ca_{0.5})(Al_5Si_{11}O_{32})\cdot 12H_2O$

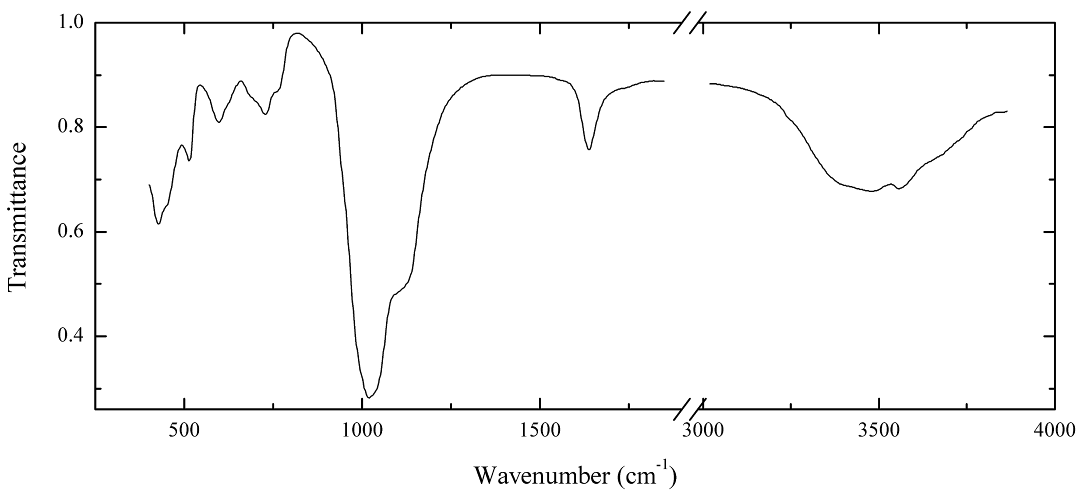


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.

Description: White short-prismatic crystals from rodingite. Investigated by V.A. Popov. Weak band at 1,425 cm^{-1} corresponds to the admixture of calcite.

Wavenumbers (cm^{-1}): 3580, 3450, 1660sh, 1628, 1425w, 1140sh, 1104s, 1035sh, 1014s, 980sh, 960sh, 787w, 728, 682, 622, 600sh, 443s, 394.

Sif_Z33 Gmelinite-Na $Na_7(Al_7Si_{17}O_{48})\cdot 22H_2O$

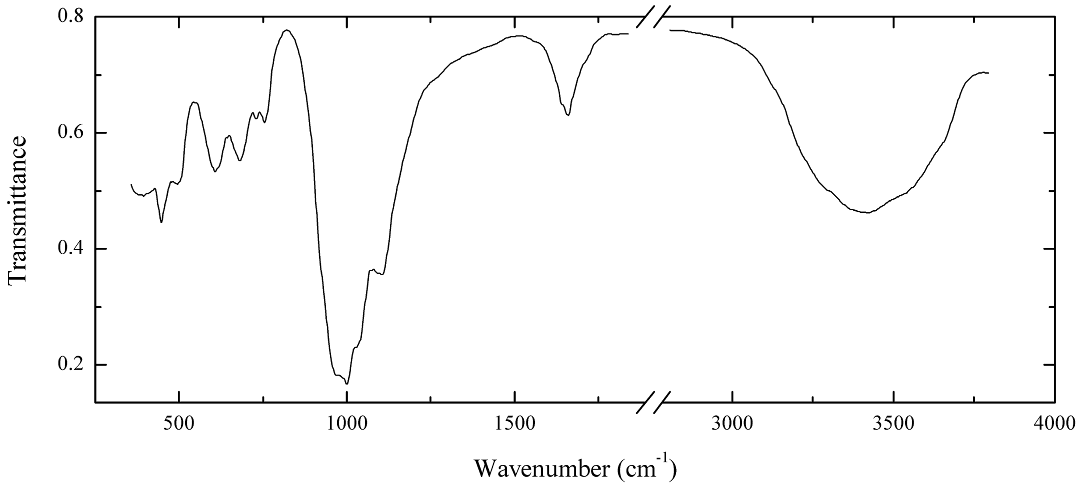


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White dipyramidal crystals from the association with microcline, analcime and gonnardite. K- and Ca-rich variety. The empirical formula is (electron microprobe) $Na_{2.7}K_{1.9}Ca_{1.3}Si_{16.8}Al_{7.2}O_{48}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3545, 3470, 3390sh, 1640, 1110sh, 1026s, 760sh, 728, 700sh, 596, 517, 445sh, 429s.

Sif_Z34 Willhendersonite $(Ca_{0.5},K)_3(Al_3Si_3O_{12})\cdot 5H_2O$

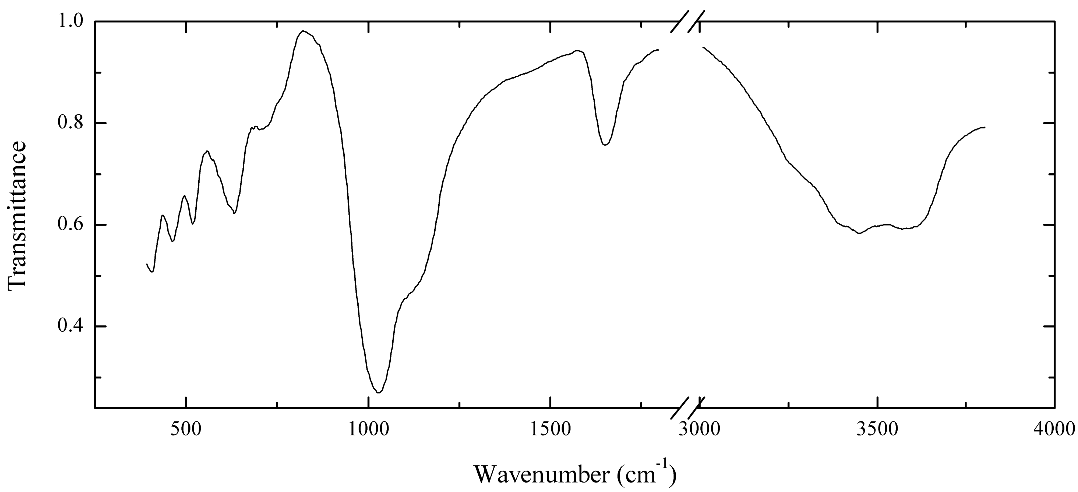


Locality: Vispi quarry, San Venanzo, Terni, Umbria, Italy (type locality).

Description: White semitransparent tabular crystals from the association with phillipsite-K. Confirmed by IR spectrum.

Wavenumbers (**cm**$^{-1}$): 3620sh, 3480sh, 3400, 3290sh, 1660, 1104s, 1025sh, 998s, 985sh, 969s, 755, 729, 679, 490, 447, 408.

Sif_Z35 Chabazite-K $(K,Na,Ca_{0.5})_4(Al_4Si_8O_{24})\cdot 12H_2O$

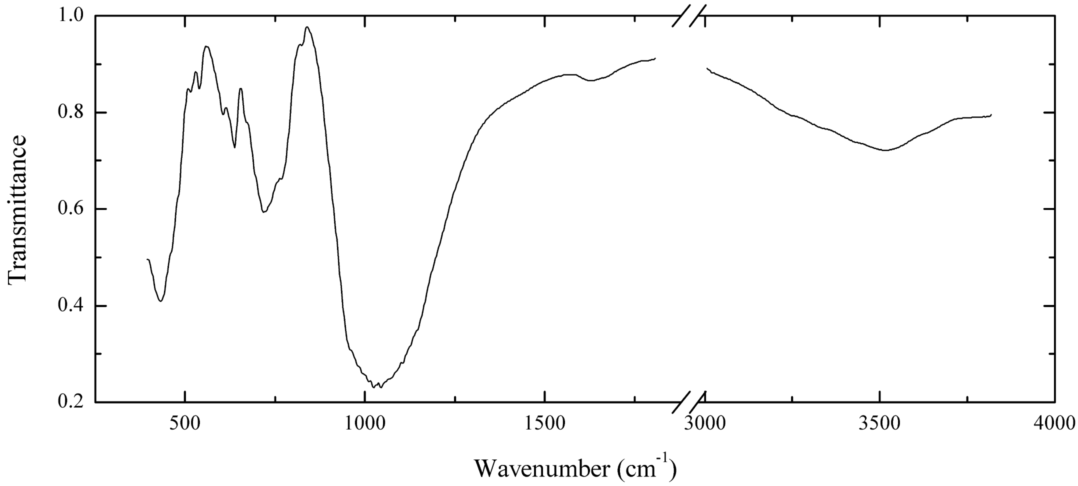


Locality: Aikuaivenchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellowish rhombohedral crystals from the association with albite, analcime, ancylite-(Ce) and aegirine. The empirical formula is (electron microprobe) $K_{1.3}Ca_{0.8}Sr_{0.4}Na_{0.1}Al_{3.8}Si_{8.2}O_{24}\cdot nH_2O$. Confirmed by IR spectrum.

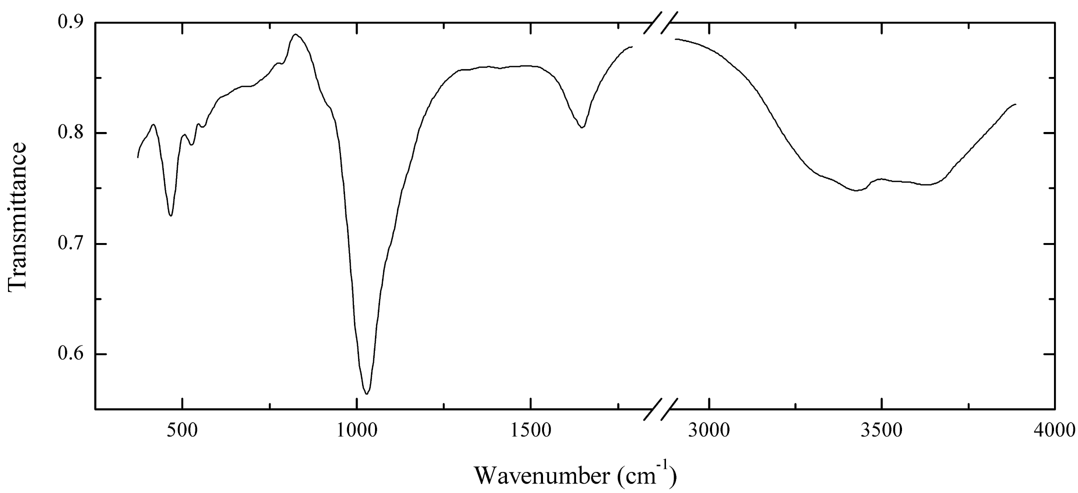
Wavenumbers (**cm**$^{-1}$): 3565, 3435, 3400sh, 3260sh, 1647, 1542w, 1125sh, 1027s, 760sh, 710, 632, 516, 462, 405s.

Sif_Z36 Leucite $K(AlSi_2O_6)$



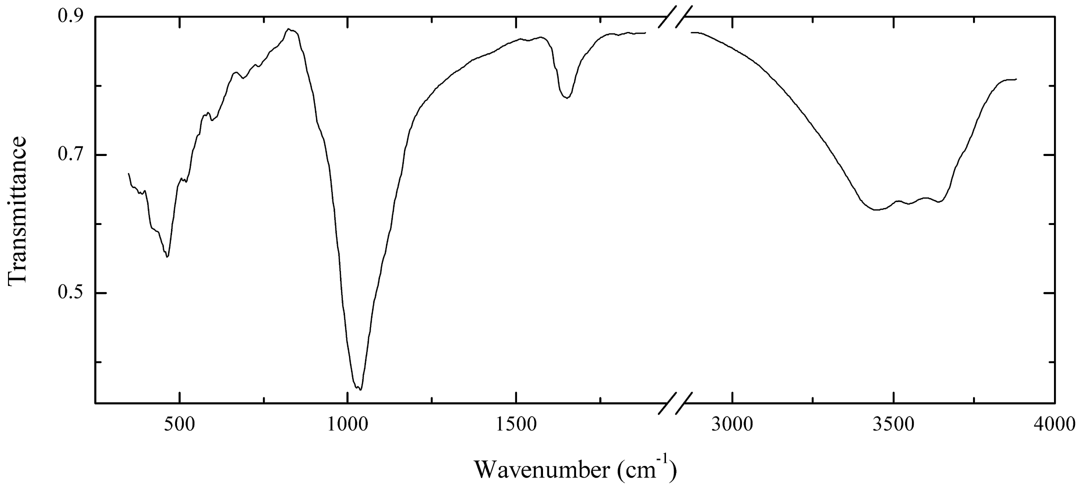
Locality: Vetralla, Vico lake, Viterbo province, Latium, Italy.
Description: White crystals. Confirmed by IR spectrum. H_2O-bearing variety.
Wavenumbers (cm^{-1}): 3500, 1660sh, 1620w, 1026s, 970sh, 825w, 765sh, 721, 670sh, 638, 605, 540w, 515w, 480sh, 460sh, 433s.

Sif_Z37 Faujasite-Na $Na_{13}Ca_{11}Mg_8K_2(Al_{53}Si_{139}O_{384})\cdot243H_2O$



Locality: Sasbach, Kaiserstuhl, Baden-Württemberg, Germany (type locality).
Description: Colourless octahedral crystals from the association with nepheline and pyroxene. The empirical formula is (electron microprobe) $Na_{14.0}Mg_{10.0}Ca_{9.9}K_{0.8}Si_{138.0}Al_{53.8}O_{384}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3600, 3410, 3320sh, 1655, 1140sh, 1100sh, 1027s, 790w, 700w, 560w, 530, 470s.

Sif_Z38 Faujasite-Mg $Mg_{16}Na_7K_7Ca_4(Al_{54}Si_{138}O_{384})\cdot nH_2O$

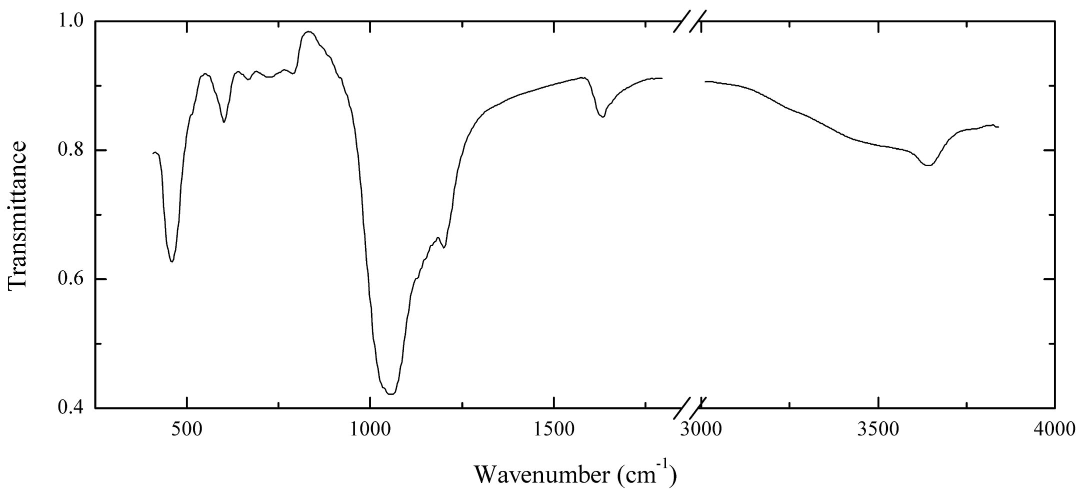


Locality: Sasbach, Kaiserstuhl, Baden-Württemberg, Germany (type locality).

Description: Colourless octahedral crystals from the association with nepheline and pyroxene. The empirical formula is (electron microprobe) $Mg_{13}K_9Na_7Ca_6Si_{138}Al_{54}O_{384}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3620, 3525, 3420, 1650, 1030s, 920sh, 785sh, 730w, 690w, 600w, 517, 465s, 430sh, 380sh.

Sif_Z39 Heulandite-Na $(Na,Ca_{0.5},K)_9(Al_9Si_{27}O_{72})\cdot 24H_2O$

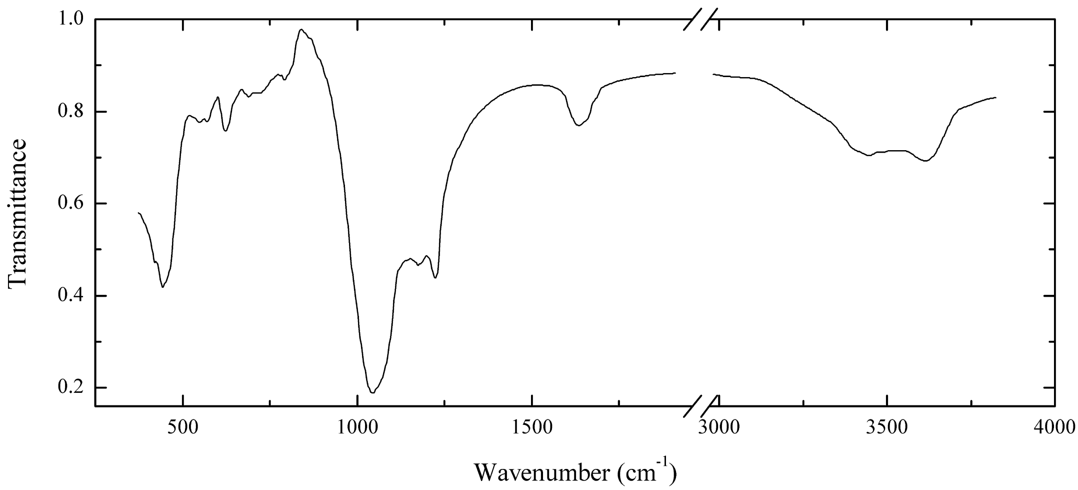


Locality: Red Bird mine, Antelope Springs district, Pershing Co., Nevada, USA.

Description: Beige platy crystals. The empirical formula is (electron microprobe) $Na_{4.2}Ca_{0.8}Mg_{0.4}K_{0.4}Si_{28.4}Al_{7.5}Fe_{0.3}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3635, 3500sh, 1640, 1202s, 1055s, 1040sh, 790w, 724w, 665w, 603, 458s.

Sif_Z40 **Mordenite** $(Na_2,Ca,K_2)_4(Al_8Si_{40}O_{96})\cdot 28H_2O$

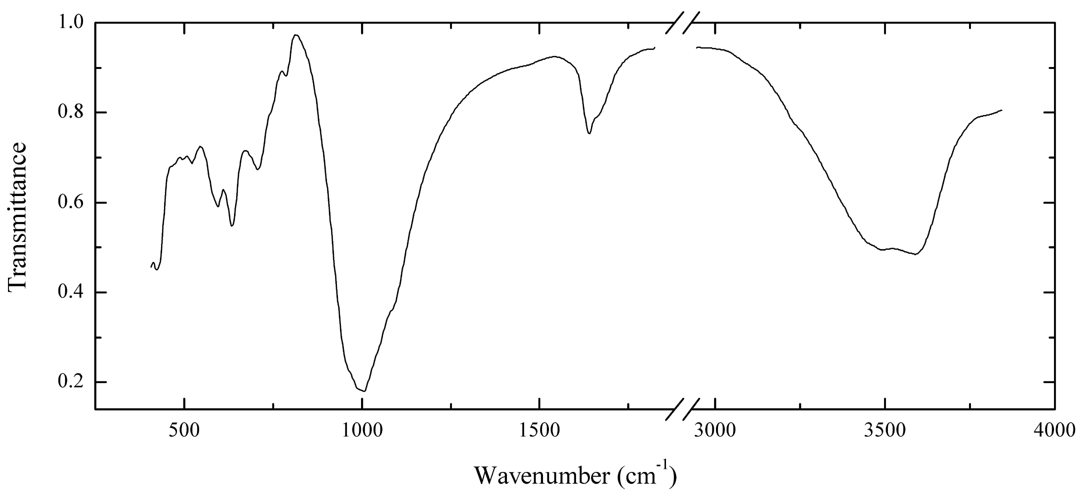


Locality: Newberry Park, Thousand Oaks city, Ventura Co., California, USA.

Description: White fibrous aggregate from the association with hydrated tungusite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3600, 3435, 1640, 1226s, 1179s, 1060sh, 1049s, 788w, 720, 690, 625, 576, 553, 444s, 420sh.

Sif_Z41 **Gonnardite** $(Na,Ca)_{6-8}[(Si,Al)_{20}O_{40}]\cdot 12H_2O$

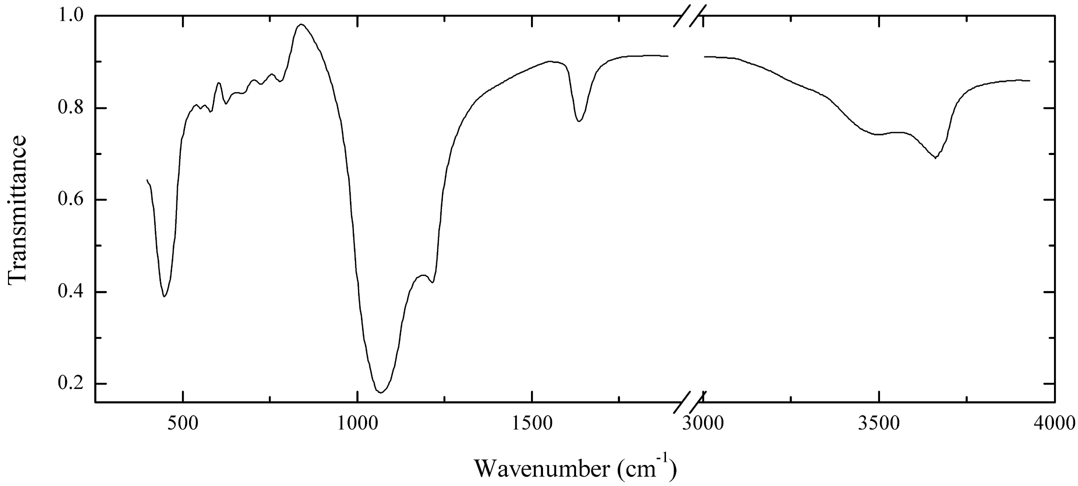


Locality: Inagli alkaline–ultrabasic massif, Aldan shield, Sakha Republic (Yakutia), Eastern Siberia, Russia.

Description: Colourless crystals from the association with innelite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{7.31}Ca_{0.12}Al_{7.63}Si_{12.39}O_{40}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3570, 3465, 1660sh, 1637, 1080sh, 1007s, 995sh, 965sh, 786w, 740sh, 707, 634, 595, 525, 425s.

Sif_Z42 Dachiardite-Na $(Na,K,Ca_{0.5})_4(Al_4Si_{20}O_{48})\cdot 13H_2O$

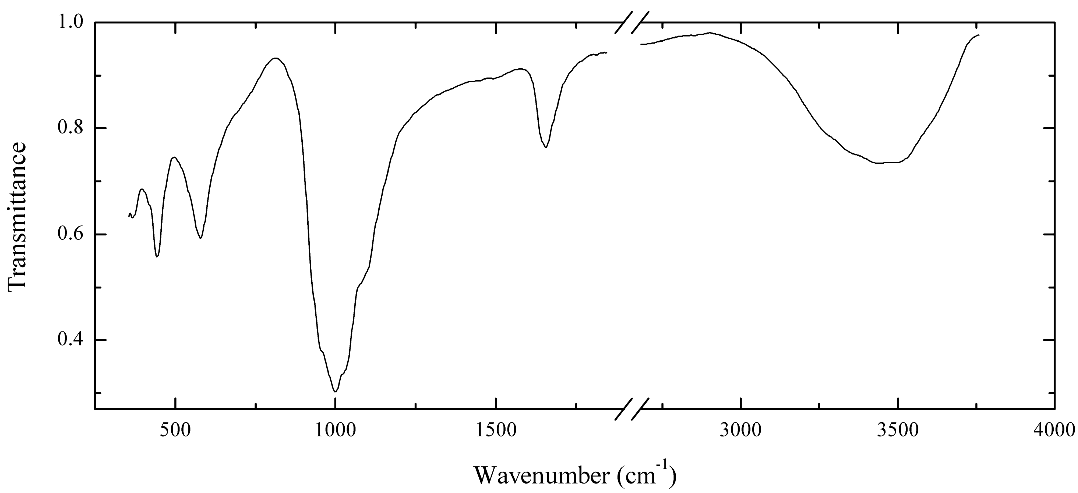


Locality: Zvezdel, Rhodopes, Bulgaria.

Description: White radial-fibrous aggregate from the association with chalcedony and clinoptilolite-Ca. The empirical formula is (electron microprobe) $Na_{2.14}Ka_{1.02}Ca_{0.22}Al_{3.60}Si_{20.40}O_{40}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3655, 3500, 1640, 1215s, 1067s, 780, 725, 671, 628, 582, 555, 445s.

Sif_Z43 Gismondine $Ca_4(Al_8Si_8O_{32})\cdot 16H_2O$

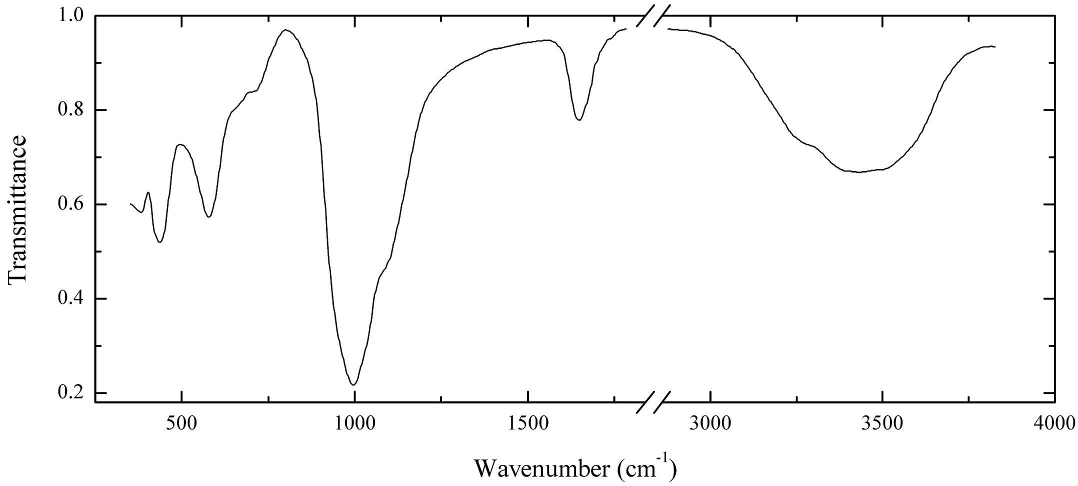


Locality: Dobranka, České Středohoři Mts., Czech Republic.

Description: Yellowish split crystals from the association with thomsonite-Ca. The empirical formula is (electron microprobe) $Ca_{3.3}Na_{0.9}K_{0.4}Al_{7.5}Si_{8.4}O_{32}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3480sh, 3410, 3260sh, 1652, 1090sh, 1025sh, 1000s, 960sh, 710sh, 660sh, 581, 446, 387.

Sif_Z44 Garronite $(Ca_{0.5},Na)_6(Al_6Si_{10}O_{32})\cdot14H_2O$

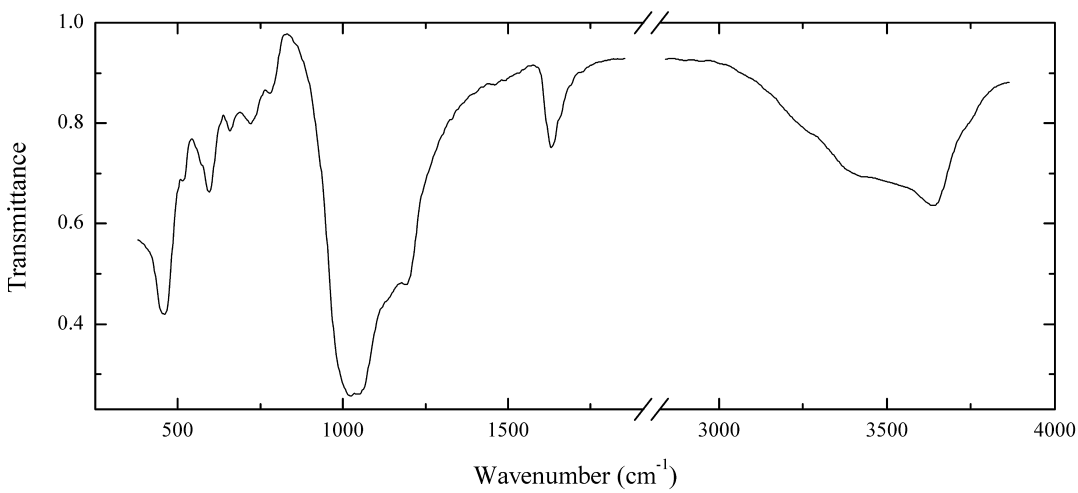


Locality: Kelley Creek, Oregon, USA.

Description: White split crystals. Al-rich variety. The empirical formula is (electron microprobe) $Ca_{3.6}Na_{0.4}Al_{7.6}Si_{8.4}O_{32}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3490sh, 3430, 3280sh, 1655, 1090sh, 1000s, 960sh, 710sh, 660sh, 581, 444s, 397.

Sif_Z45 Heulandite-Ba $Ba_4Na(Al_9Si_{27}O_{72})\cdot24H_2O$

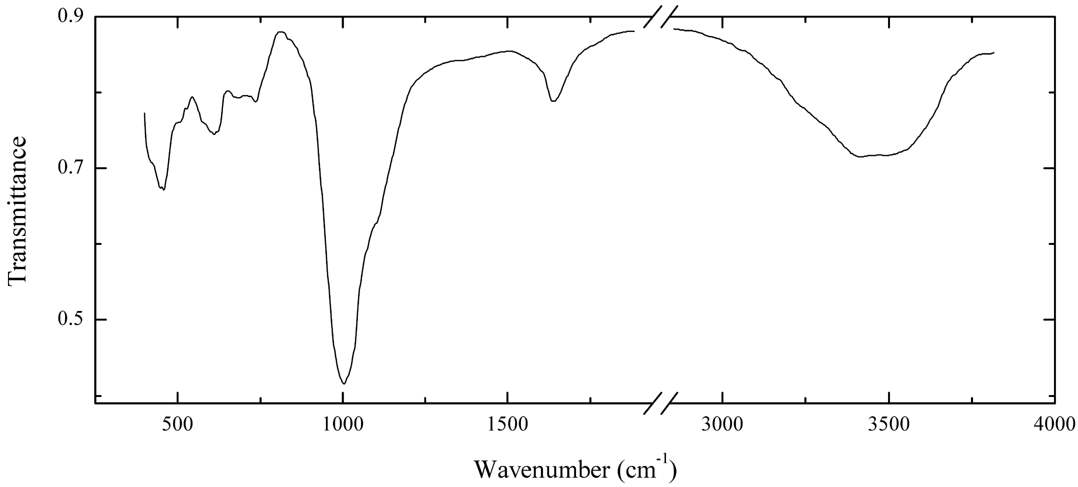


Locality: North Ravnås prospect, Vinoren, Kongsberg, Buskerud, Norway (type locality).

Description: Colourless tabular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3615, 3430sh, 1630, 1191s, 1130sh, 1046s, 1019s, 776w, 718, 662, 596, 517, 460s.

Sif_Z46 Cowlesite $Ca(Al_2Si_3O_{10}) \cdot 5H_2O$

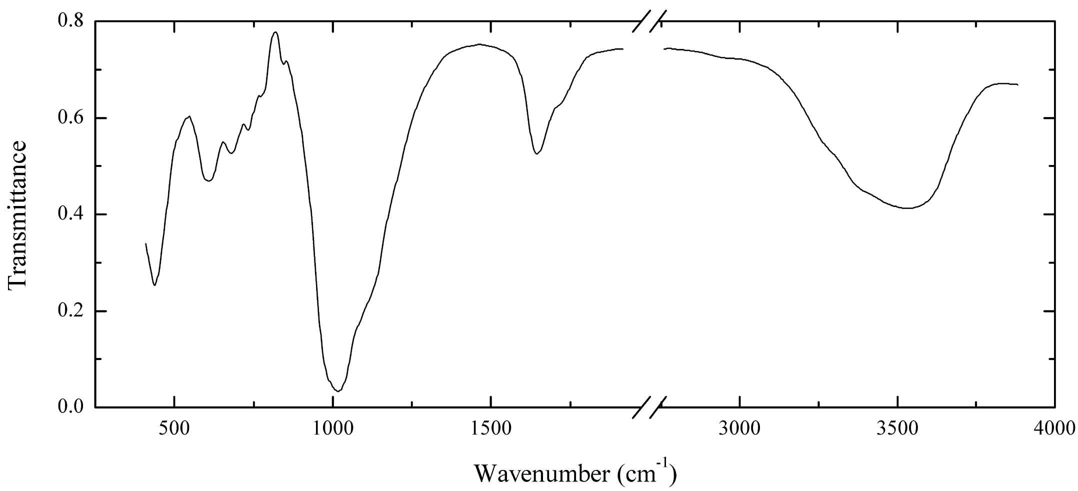


Locality: Ankisuai valley, Suoluaiv Mt., southeastern part of Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow semitransparent crystals from the association with analcime, gonnardite, phillipsite-K, chabazite-Sr, vinogradovite and earlier sanidine, aegirine-augite, lavenite, seidozerite, lorenzenite and fluorapatite. The empirical formula is (electron microprobe) $Ca_{0.87}Na_{0.20}K_{0.05}Al_{2.03}Si_{2.98}O_{10} \cdot nH_2O$. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3495, 3410, 1645, 1100sh, 1005s, 734, 689, 611, 580sh, 500, 453s, 410sh.

Sif_Z47 Phillipsite-Na $(Na,Ca_{0.5},K)_9(Al_9Si_{27}O_{72}) \cdot 24H_2O$

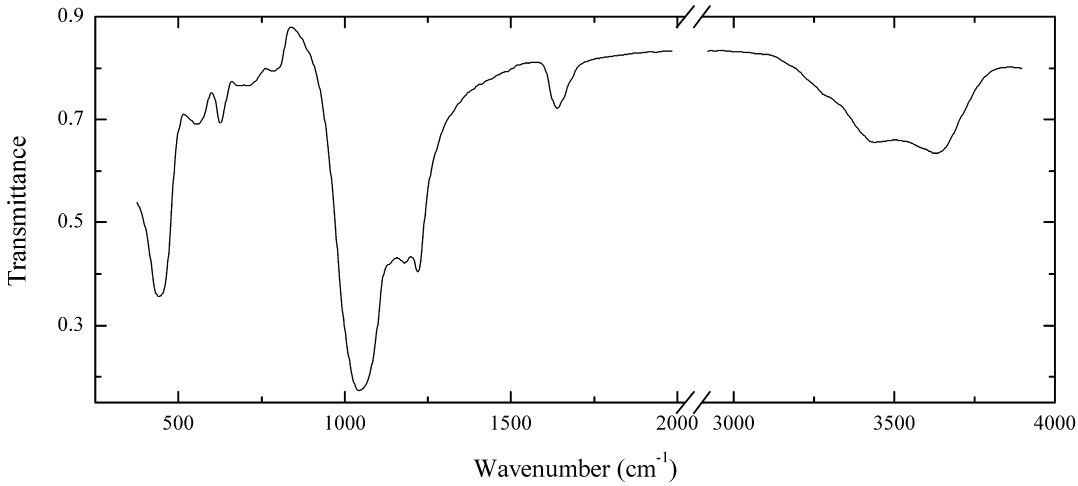


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White acicular crystals from the association with ussingite. The empirical formula is (electron microprobe) $Na_{6.3}K_{3.1}Ca_{0.3}Al_{9.2}Si_{26.6}O_{72} \cdot nH_2O$. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3530, 3400sh, 1720sh, 1650, 1125sh, 1090sh, 1019s, 842w, 775w, 733, 679, 609, 437s.

Sif_Z48 Mordenite $(Na_2,Ca,K_2)_4(Al_8Si_{40}O_{96})\cdot 28H_2O$

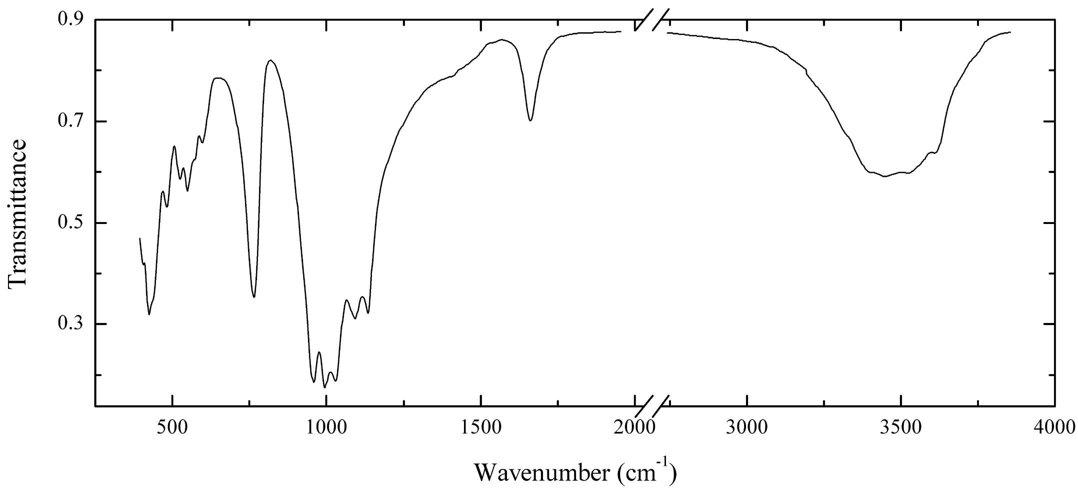


Locality: Tura, Evenkiya, Krasnoyarskiy Kray, Eastern Siberia, Russia.

Description: White fibrous aggregate from the association with stilbite-Ca, quartz and tungusite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3610, 3430, 3270sh, 1637, 1220s, 1178s, 1046s, 786w, 717w, 687w, 622, 570sh, 550, 444s.

Sif_Z49 Laumontite $Ca_4(Al_8Si_{16}O_{48})\cdot 18H_2O$

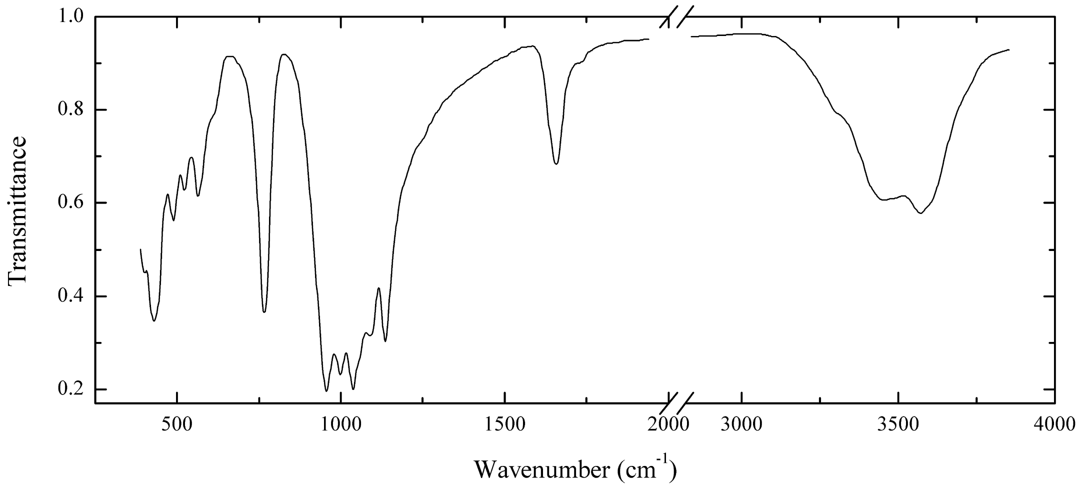


Locality: South Kurtsy quarry, Kurtsy village, Simferopol area, Crimea, Ukraine.

Description: Red radial aggregate from the association with calcite and chlorite. K- and Na-rich variety. The empirical formula is (electron microprobe) $Ca_{2.8}K_{1.4}Na_{0.8}Al_{7.8}Si_{16.2}O_{48}\cdot nH_2O$. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3595, 3510, 3430, 3380, 1661, 1136s, 1094s, 1028s, 993s, 958s, 765s, 596w, 570w, 551, 525, 483, 435sh, 424s, 401.

Sif_Z50 **Laumontite** $Ca_4(Al_8Si_{16}O_{48})\cdot18H_2O$

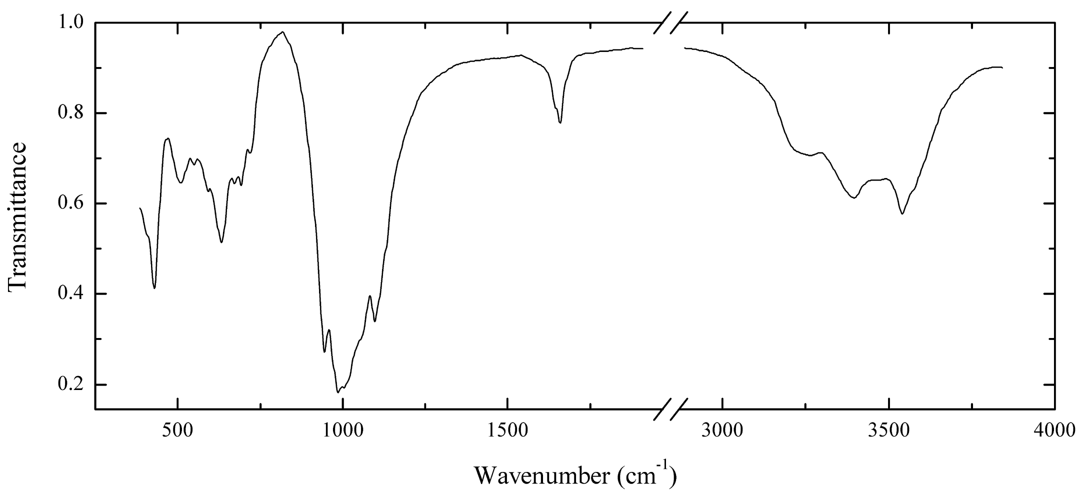


Locality: Sokolovskoe iron mine, Rudnyi, Kostanay region, Kazakhstan.

Description: Pink long-prismatic crystals. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ca_{3.7}Na_{0.4}K_{0.1}Al_{7.9}Si_{16.2}O_{48}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3575, 3555, 3440, 3285sh, 1657, 1132s, 1092s, 1050sh, 1034s, 997s. 954s, 764s, 610sh, 600sh, 570sh, 560, 522, 489, 435sh, 425s, 400sh.

Sif_Z51 **Mesolite** $Na_2Ca_2(Al_6Si_9O_{30})\cdot8H_2O$

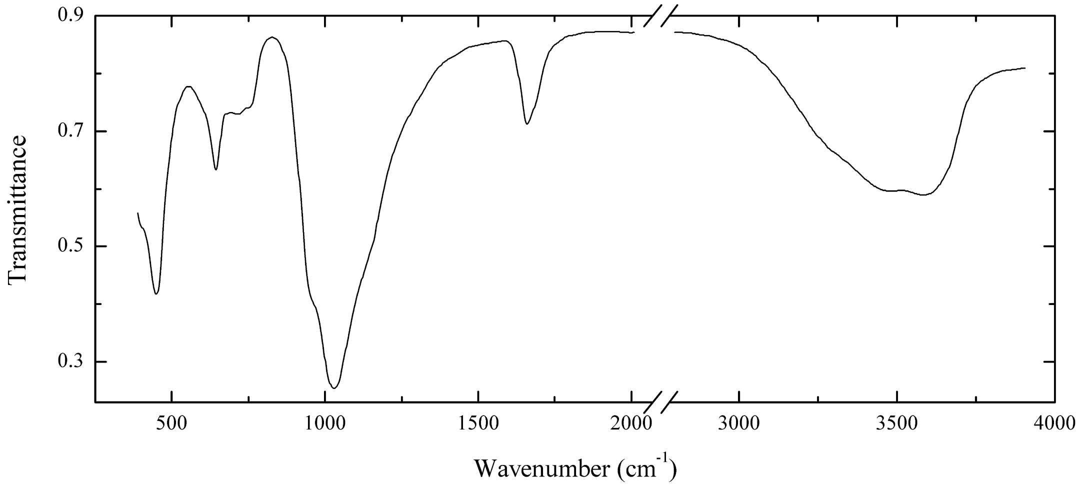


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White veinlet crossing ijolite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{1.9}Ca_{1.7}Sr_{0.1}Al_{5.9}Si_{9.2}O_{30}\cdot nH_2O$.

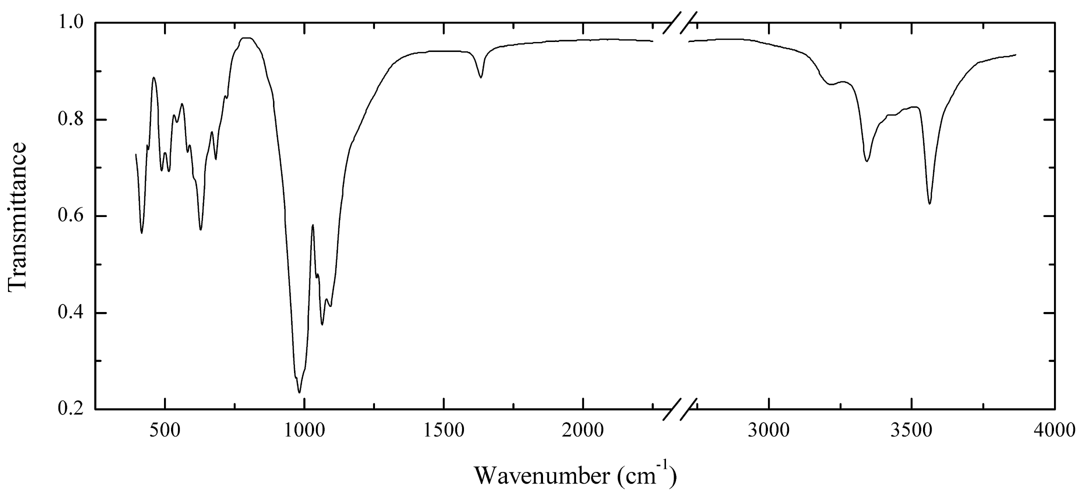
Wavenumbers (cm^{-1}): 3570sh, 3540, 3397, 3260, 1665, 1650, 1096s, 1060sh, 1050sh, 1020sh, 1007s, 983s, 970sh, 944s, 718, 690, 667, 630, 595, 543, 505, 425s, 410sh.

Sif_Z52 Lévyne-Ca $Ca_3(Al_6Si_{12}O_{36})\cdot18H_2O$



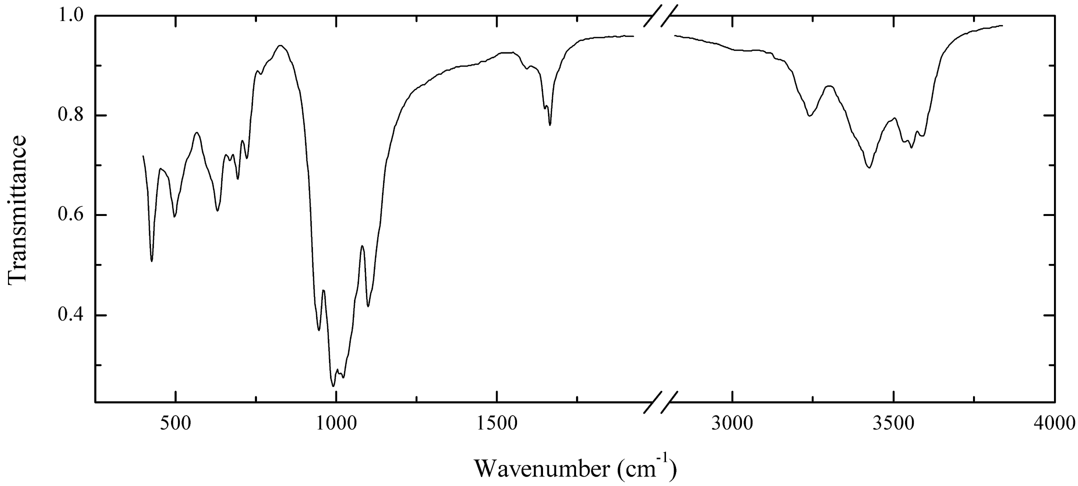
Locality: Old Parkgate quarry, near Templepatrik, Northern Ireland, UK.
Description: White crystals. The empirical formula is (electron microprobe) $Ca_{2.46}Na_{0.81}K_{0.19}Mg_{0.06}(Si_{11.90}Al_{6.02}Fe_{0.11})O_{36}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3545, 3445, 3380sh, 3280sh, 1660sh, 1650, 1160sh, 1028s, 960sh, 752, 711, 642, 480sh, 449s, 405sh.

Sif_Z53 Natrolite $Na_2(Al_2Si_3O_{10})\cdot2H_2O$



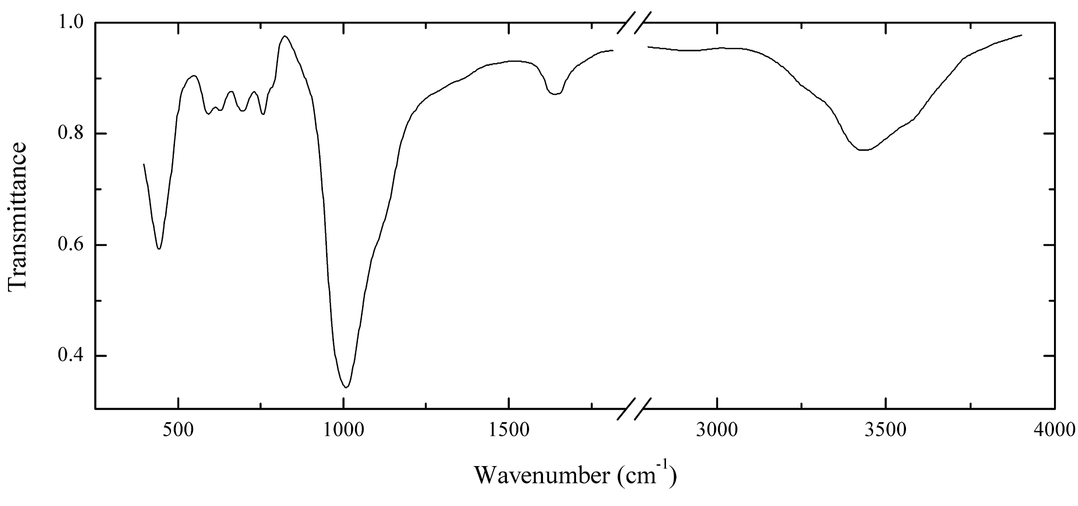
Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White crusts. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3542, 3410w, 3325, 3215w, 1632w, 1110sh, 1089s, 1064s, 1041s, 996s, 981s, 966s, 755sh, 719w, 690sh, 679, 650sh, 625s, 600sh, 577, 538w, 510, 484, 440, 413s.

Sif_Z54 Mesolite $Na_2Ca_2(Al_6Si_9O_{30})\cdot 8H_2O$



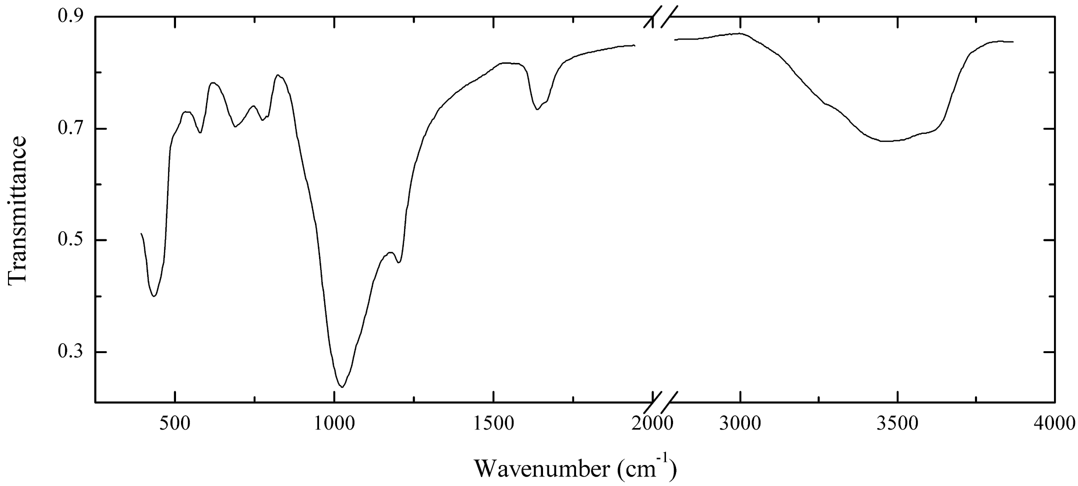
Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.
Description: White long-prismatic crystals from rodingite, from the association with prehnite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{1.8}Ca_{2.0}Al_{5.8}Si_{9.2}O_{30}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3560, 3535, 3515, 3405, 3225, 1665, 1651w, 1592w, 1130sh, 1110sh, 1098s, 1065sh, 1045sh, 1022s, 1008s, 989s, 970sh, 943s, 795w, 765w, 719, 691, 668, 629, 600sh, 495, 423s.

Sif_Z55 Merlinoite $(K,Ca_{0.5})_9(Al_9Si_{23}O_{64})\cdot 22H_2O$



Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless crystal from the association with kalborsite, cancrisilite, villiaumite, pirssonite, rasvumite, pectolite and thermonatrite. K- and Al-rich, Ca-free variety. The empirical formula is (electron microprobe) $H_x(K_8Na_{1.5-2})(Al_{11}Si_{21}O_{32})\cdot nH_2O$. Confirmed by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3520sh, 3410, 3300sh, 1635, 1135sh, 1002s, 780sh, 756, 690, 629, 591, 475sh, 438.

Sif_Z56 Maricopaite $Pb_7Ca_2[Al_{18}Si_{30}(O,OH)_{100}]\cdot 32H_2O$

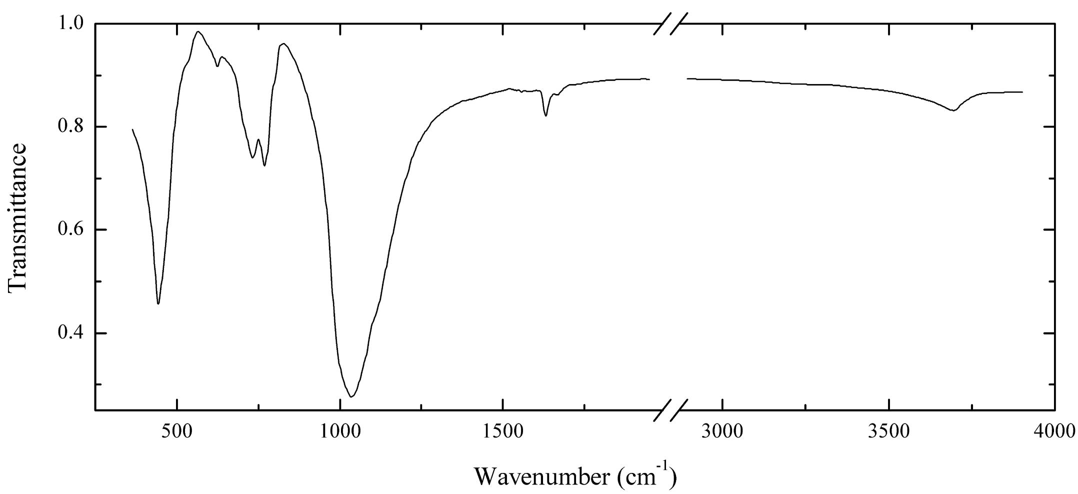


Locality: Moon Anchor mine, near Tonopah, Maricopa Co., Arizona, USA.

Description: Colourless acicular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3570sh, 3450, 3250sh, 1660sh, 1635, 1203s, 1025s, 788w, 775, 715sh, 693, 577, 500sh, 450sh, 435.

Sif_Z57 Pollucite $(Cs,Na)(AlSi_2O_6)\cdot nH_2O$

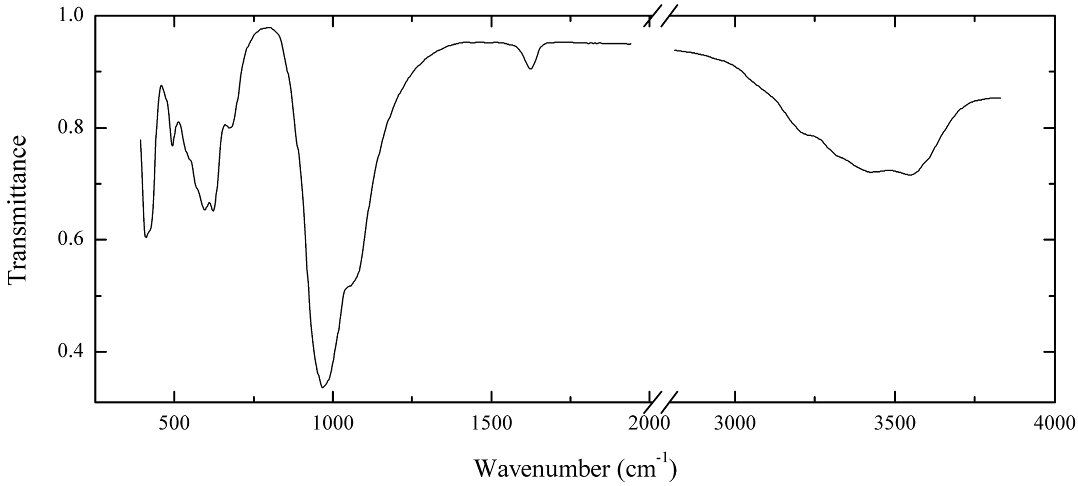


Locality: Belaya Gora, Kalba ridge, Eastern Kazakhstan.

Description: Colourless grains from the association with petalite and lepidolite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

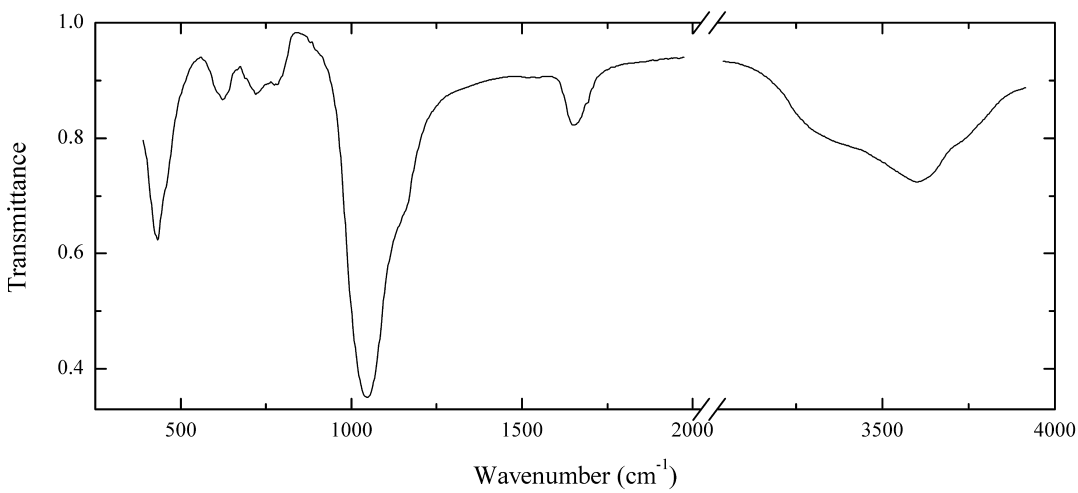
Wavenumbers (cm^{-1}): 3650, 1660w, 1620, 1105sh, 1075sh, 1033s, 790sh, 766, 729, 700sh, 625w, 525sh, 440s.

Sif_Z58 Paranatrolite $(Na,K)_2[(Si,Al)_5O_{10}]\cdot 3H_2O$



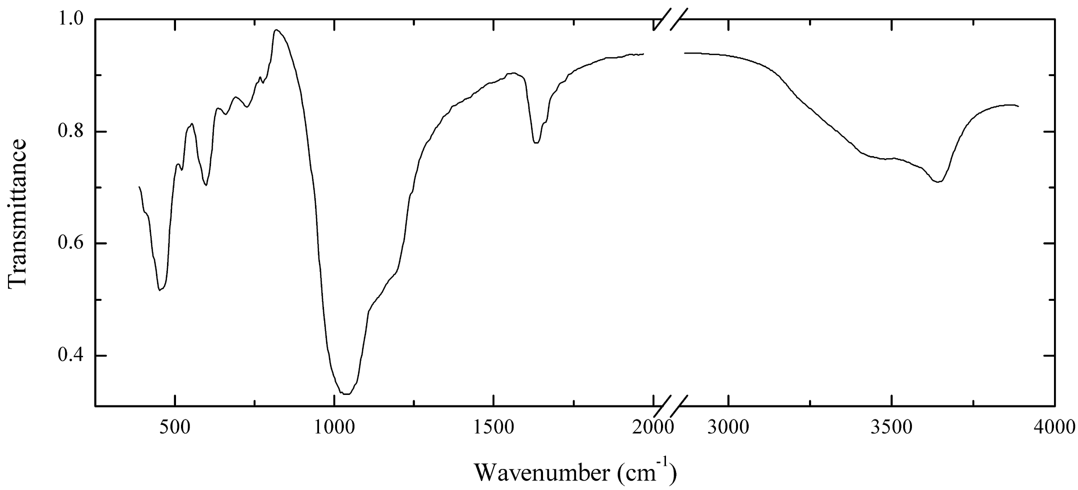
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White massive. The empirical formula is (electron microprobe) $Na_{1.8}K_{0.3}Ca_{0.1}(Al_{2.3}Si_{2.7}O_{10})\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3430, 3330, 3290sh, 3220sh, 1632w, 1070sh, 673, 624, 589, 570sh, 555sh, 495, 420sh, 411s.

Sif_Z59 Paulingite-K $(K,Ca_{0.5},Na)_{10}(Al_{10}Si_{32}O_{84})\cdot nH_2O$



Locality: Dunseverick, Giant's Causeway, Co. Antrim, Northern Ireland, UK.
Description: Colourless isometric crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3595, 3360sh, 1650, 1165sh, 1050s, 783, 727, 624, 455sh, 428s.

Sif_Z60 Heulandite-Sr $(Sr_{0.5},Ca_{0.5},Na,K)_9(Al_9Si_{27}O_{72})\cdot24H_2O$

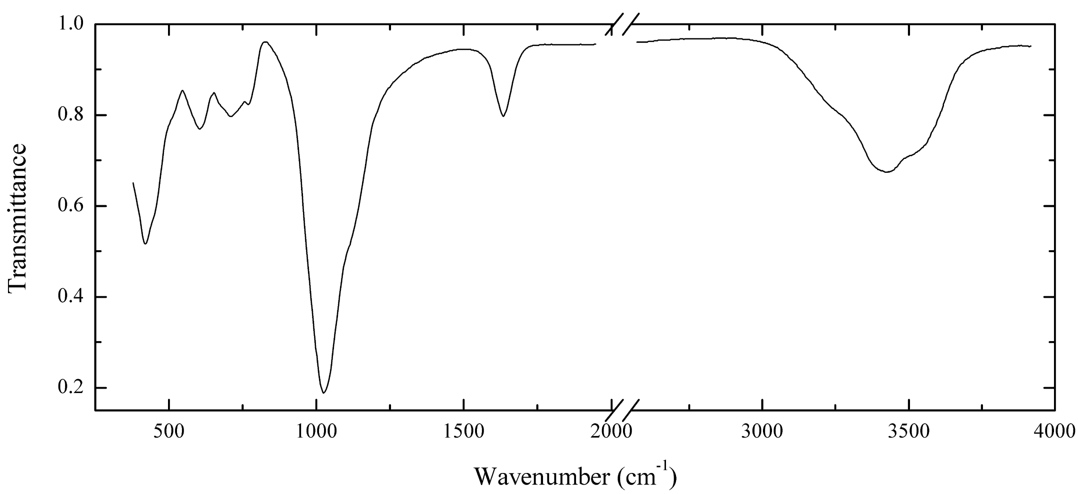


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless tabular crystals from the association with natrolite, aegirine and monazite-(La). The empirical formula is (electron microprobe) $Sr_{1.6}Ca_{1.3}K_{1.0}Na_{0.8}Si_{27.8}Al_{8.4}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3620, 3450, 3200sh, 1660sh, 1633, 1180sh, 1130sh, 1037s, 775w, 724w, 662w, 597, 524, 456s, 410sh.

Sif_Z61 Paulingite-Ca $(Ca_{0.5},K,Na)_{10}(Al_{10}Si_{32}O_{84})\cdot nH_2O$

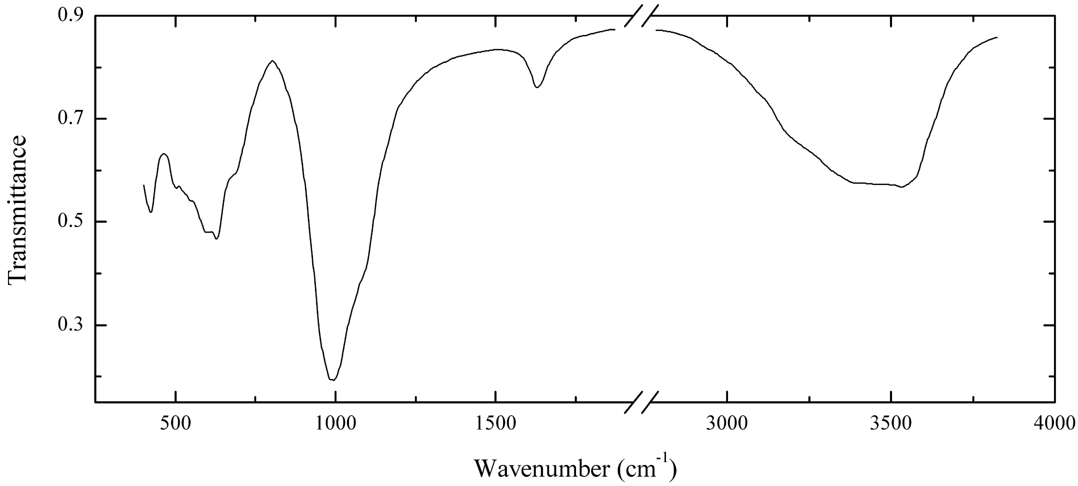


Locality: Vinařice, near Kladno, Central Bohemia, Czech Republic.

Description: Yellowish rhombic dodecahedral crystals from the association with offretite and phillipsite-K. The empirical formula is (electron microprobe) $Ca_{3.1}K_{2.2}Na_{1.5}Si_{31.5}Al_{10.7}O_{84}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3500sh, 3420, 3250sh, 1632, 1160sh, 1038s, 775w, 724, 612, 520, 455sh, 430s.

Sif_Z62 Gonnardite $(Na,Ca)_{6-8}[(Si,Al)_{20}O_{40}]\cdot 12H_2O$

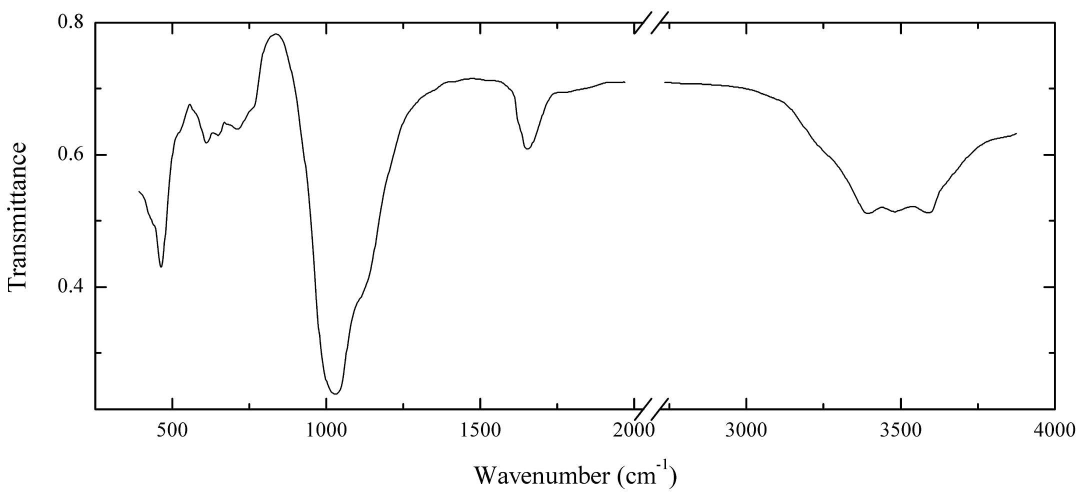


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White spherulites from the association with ussingite and rhabdophane-(La). The empirical formula is (electron microprobe) $Na_{6.5}Ca_{0.5}Al_{7.5}Si_{12.5}O_{40}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3440sh, 3200sh, 1628w, 1085sh, 979s, 675sh, 623, 594, 545sh, 488, 410, 400sh.

Sif_Z63 Lévyne-Na $Na_6(Al_6Si_{12}O_{36})\cdot 18H_2O$

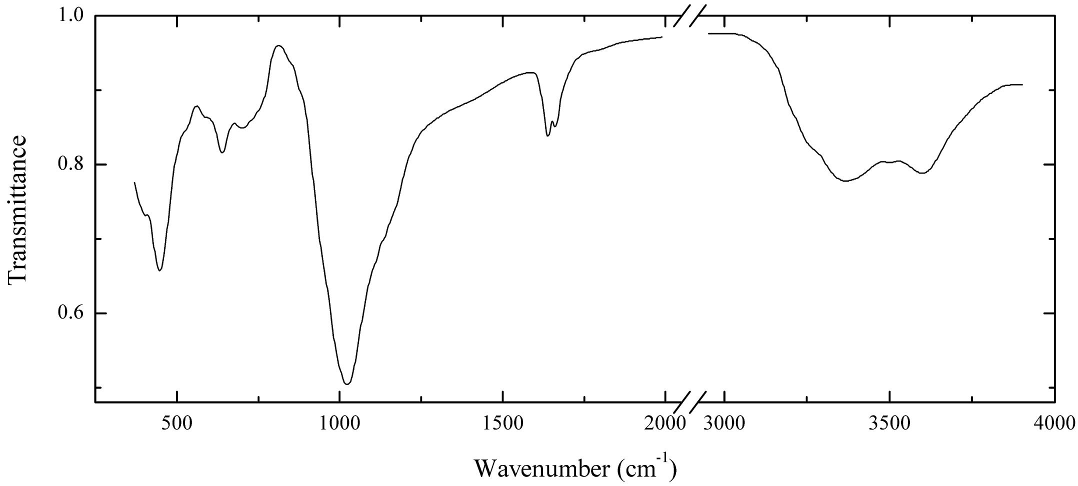


Locality: Ikutsuki-Jima, Hirado island, Nagasaki prefecture, Japan.

Description: White platy crystals from the association with erionite. Confirmed by qualitative electron microprobe analysis.

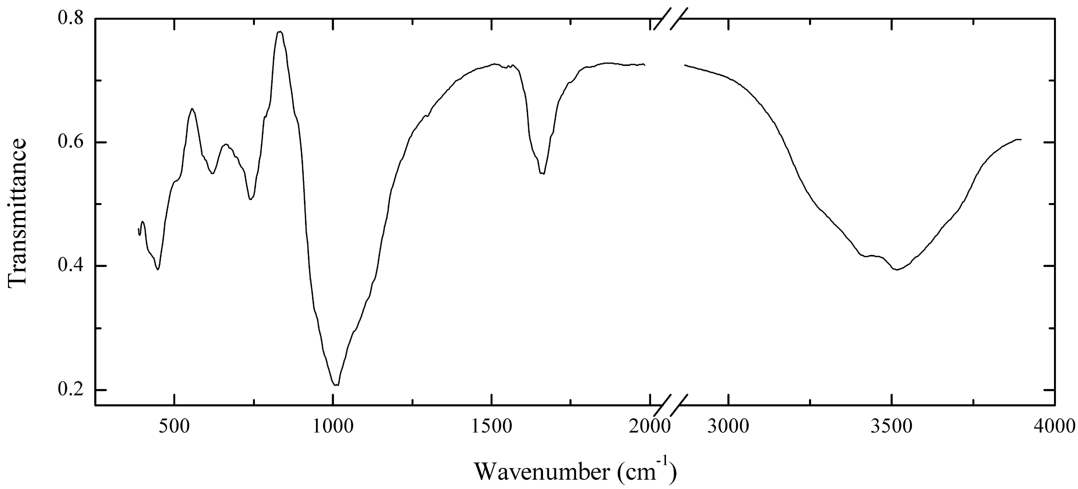
Wavenumbers (cm^{-1}): 3555, 3450, 3365, 3210sh, 1653, 1110sh, 1027s, 1000sh, 760sh, 710, 650, 610, 467s, 440sh.

Sif_Z64 Lévyne-Ca $Ca_3(Al_6Si_{12}O_{36})\cdot 18H_2O$



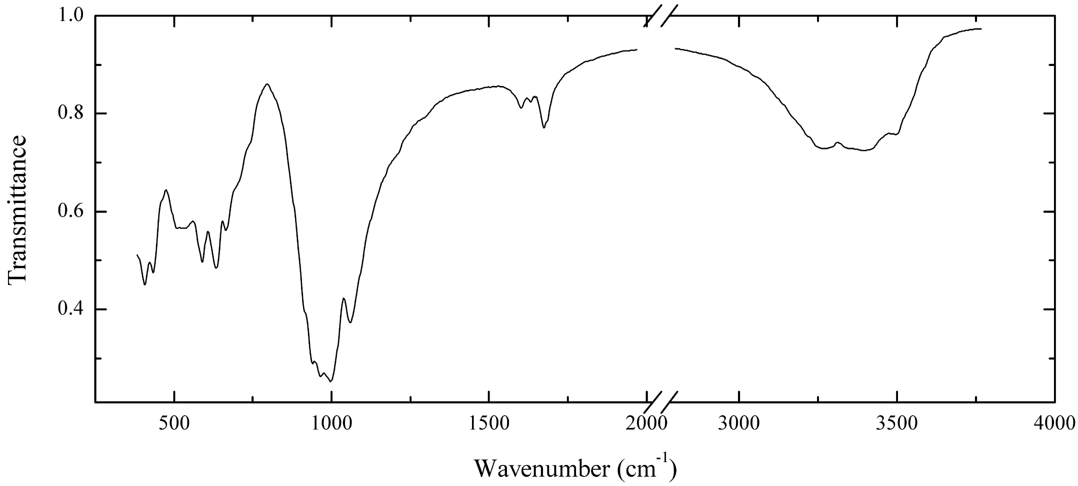
Locality: Ikutsuki-Jima, Hirado island, Nagasaki prefecture, Japan.
Description: Colourless platy crystals from alkaline basalt, from the association with cowlesite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3580, 3470, 3350, 3250sh, 1662, 1640, 1140sh, 1023s, 750sh, 700, 640, 447s, 410sh.

Sif_Z65 Cowlesite $Ca(Al_2Si_3O_{10})\cdot 5H_2O$



Locality: Ikutsuki-Jima, Hirado island, Nagasaki prefecture, Japan.
Description: White spherulites from alkaline basalt, from the association with lévyne-Ca. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3500, 3410, 1658, 1080sh, 1009s, 950sh, 790w, 742, 617, 505sh, 445s, 420.

Sif_Z66 Thomsonite-Ca $Ca_2Na(Al_5Si_5O_{20})\cdot6H_2O$

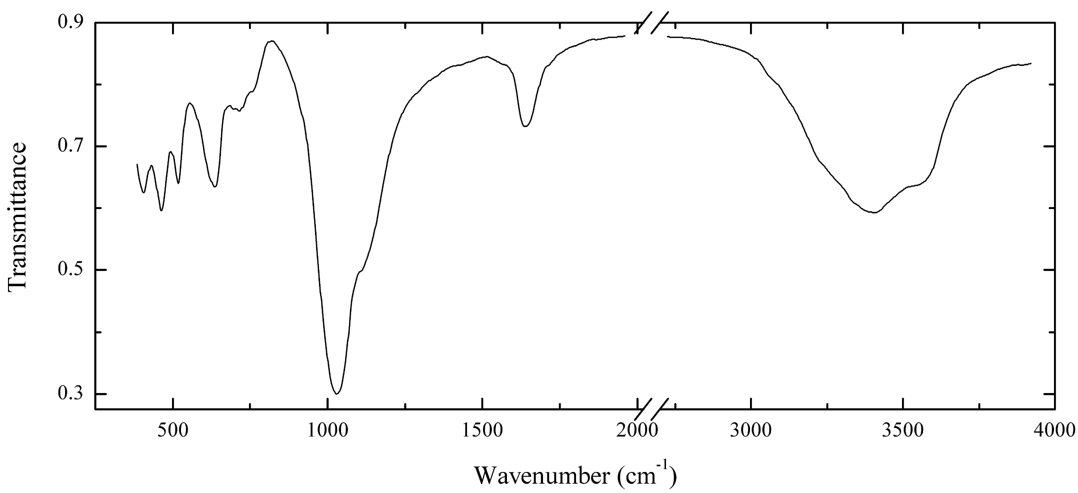


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Pink granular aggregate from the association with calcite and tacharanite. The empirical formula is (electron microprobe) $Ca_{1.81}Na_{1.03}Sr_{0.19}(Si_{5.09}Al_{4.87})O_{20}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3510, 3415, 3365sh, 3275, 1680, 1636w, 1607w, 1063s, 1001s, 967s, 941s, 920sh, 735sh, 690sh, 660, 629, 587, 533, 510, 429, 402s.

Sif_Z67 Chabazite-K $(K,Na,Ca_{0.5})_4(Al_4Si_8O_{24})\cdot12H_2O$

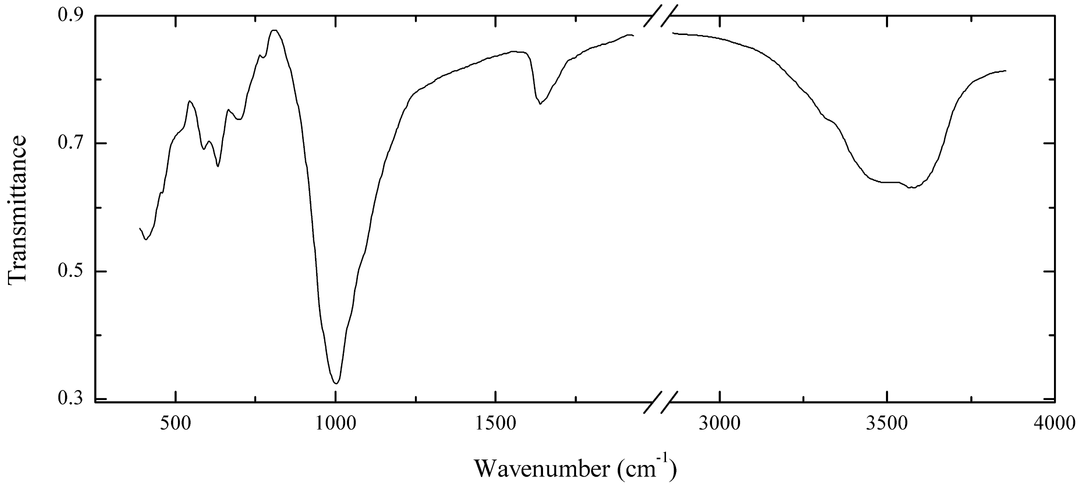


Locality: Pegmatite No. 62, Karnasurt mine, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless rhombohedral crystals from the association with natrolite. The empirical formula is (electron microprobe) $K_{1.3}Ca_{0.9}Na_{0.4}Mg_{0.2}Sr_{0.1}Al_{3.7}Si_{8.2}O_{24}\cdot nH_2O$. Confirmed by IR spectrum.

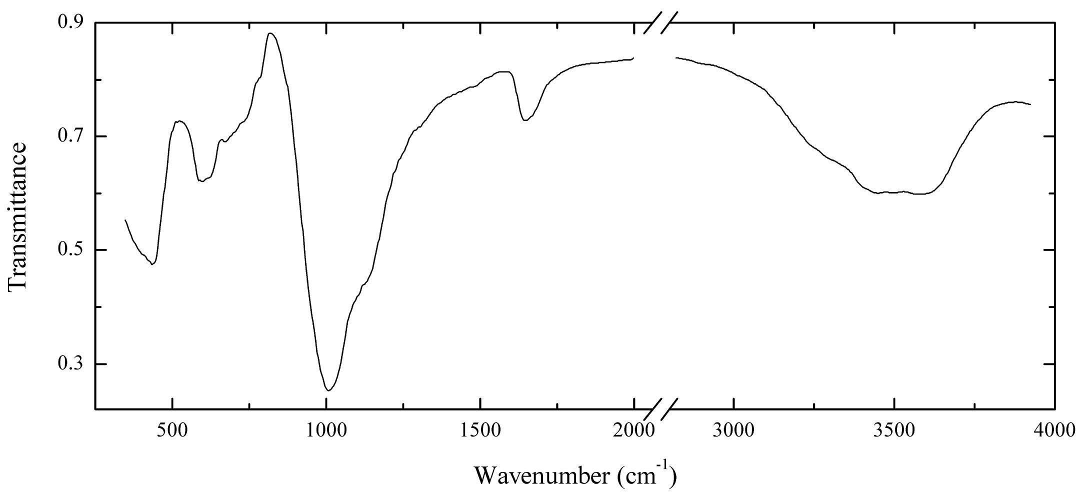
Wavenumbers (cm^{-1}): 3525sh, 3380, 1640, 1125sh, 1031s, 750sh715, 690sh, 634, 518, 462, 407.

Sif_Z68 Edingtonite $Ba(Al_2Si_3O_{10})\cdot 4H_2O$



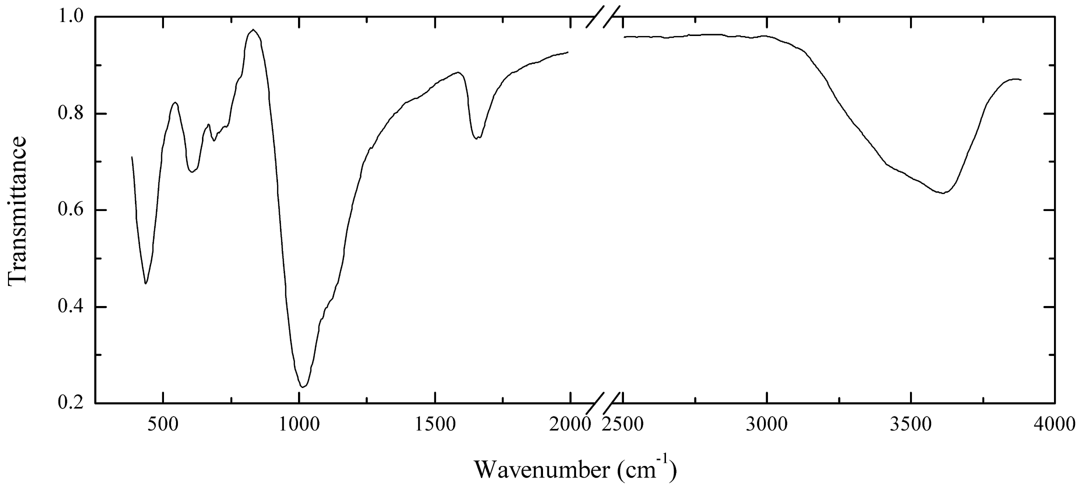
Locality: Afrikanda quarry, Afrikanda massif, Afrikanda, Kola peninsula, Murnansk region, Russia.
Description: Twins composed by tetragonal pyramidal crystals. Confirmed by IR spectrum. Investigated by I.V. Pekov. Identified by powder X-ray diffraction pattern. The chemical composition is (electrom microprobe, ranges, wt. %) BaO 28.4-30.0, Al_2O_3 22-23, SiO_2 39.6-41.0. This mineral should be considered as a separate mineral species, a disordered tetragonal analogue of orthorhombic edingtonite.
Wavenumbers (cm^{-1}): 3560, 3465sh, 3310sh, 1640, 1085sh, 1050sh, 1004s, 960sh, 783w, 745sh, 704, 636, 595, 500sh, 455sh, 393s.

Sif_Z69 Phillipsite-Ca $(Ca_{0.5},Na,K)_9(Al_9Si_{27}O_{72})\cdot 24H_2O$



Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White crusts. The empirical formula is (electron microprobe) $Ca_{2.8}K_{2.5}Na_{1.6}Al_{8.9}Si_{26.9}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3560, 3430, 3260sh, 1648, 1140sh, 1100sh, 1012s, 780sh, 730sh, 675, 620sh, 598, 438s, 420sh.

Sif_Z70 Phillipsite-Na $(Na,Ca_{0.5},K)_9(Al_9Si_{27}O_{72})\cdot 24H_2O$

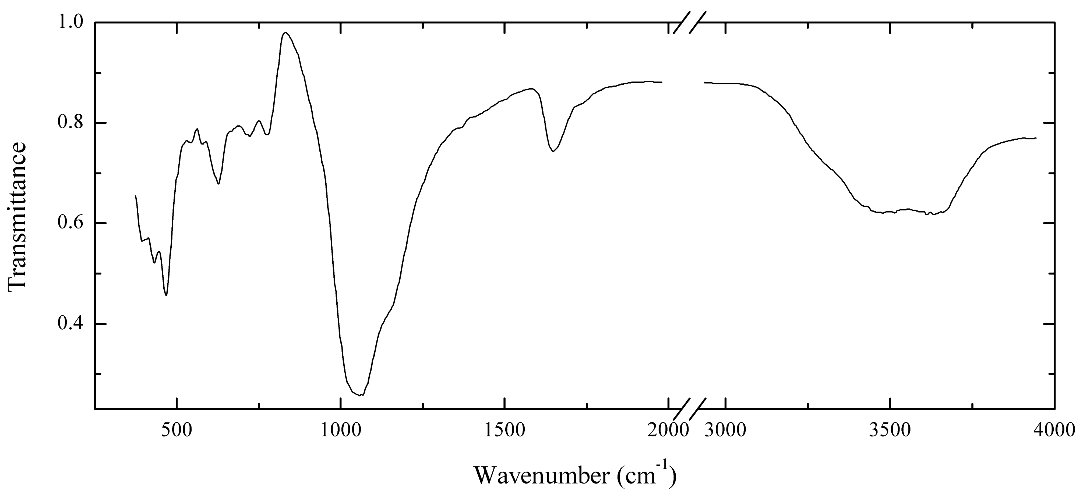


Locality: Scoglio dei Ciclopi, Aci Castello, Catania, Sicily, Italy.

Description: Colourless spherulites from the association with chabazite-Na. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3590, 3450sh, 3310sh, 1650, 1120sh, 1090sh, 1016s, 785sh, 735, 688, 615sh, 601, 433s.

Sif_Z71 Erionite-Ca $(Ca_{0.5},K)_{10}(Al_{10}Si_{26}O_{72})\cdot 32H_2O$

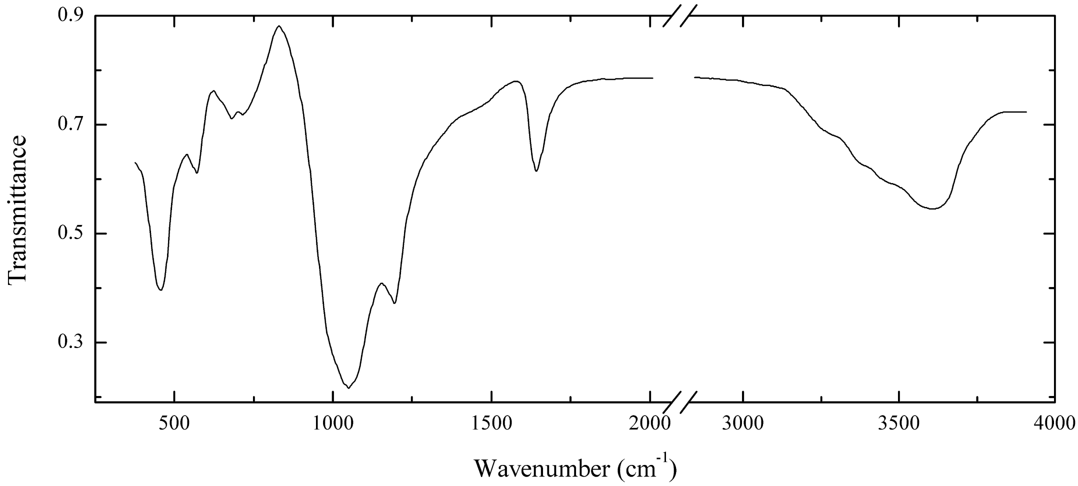


Locality: Shurdo, near Akhaltsikhe, Samtskhe-Javakheti district, Georgia.

Description: White radial-fibrous aggregate from the association with heulandite-Ca. Al-deficient variety. The empirical formula is (electron microprobe) $Ca_{2.5}K_{2.0}Mg_{0.3}Na_{0.1}Al_{8.1}Si_{28.0}O_{72}\cdot nH_2O$. Confirmed by IR spectrum.

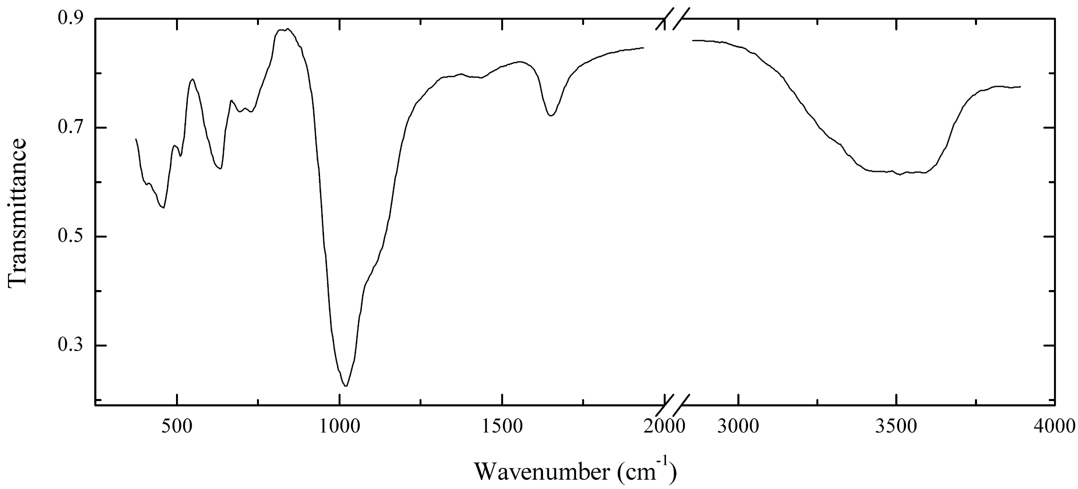
Wavenumbers (cm^{-1}): 3610, 3560, 3260sh, 1647, 1150sh, 1063s, 1035sh, 779, 722, 670sh, 629, 585, 545, 471s, 435, 407.

Sif_Z73 Epistilbite $Ca_3(Al_6Si_{18}O_{48})\cdot 16H_2O$



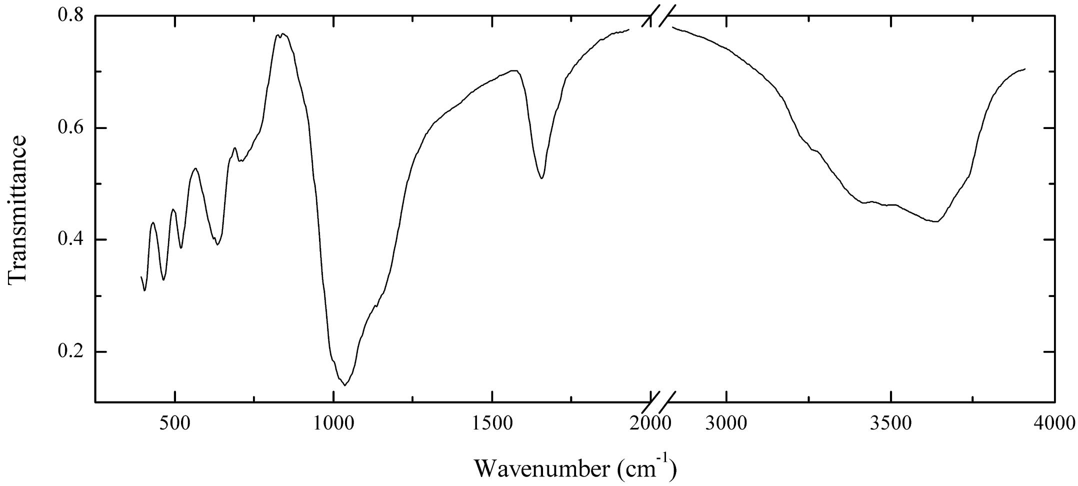
Locality: Siatorská Bukovinka, Slovakia.
Description: Colourless crystal. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3600, 3470sh, 3390sh, 3290sh, 1640, 1190s, 1045s, 995sh, 730sh, 708, 680, 640sh, 565, 447s.

Sif_Z74 Chabazite-Na $(Na,K,Ca_{0.5})_4(Al_4Si_8O_{24})\cdot 12H_2O$



Locality: Scoglio dei Ciclopi, Aci Castello, Catania, Sicily, Italy.
Description: Colourless rhombohedral crystals from the association with phillipsite-Na. The empirical formula is (electron microprobe) $Na_{1.6}K_{1.0}Ca_{0.9}Al_{4.4}Si_{7.6}O_{24}\cdot n H_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3585, 3440, 1650, 1440w, 1125sh, 1100sh, 1018s, 730, 697, 630, 508, 459s, 410sh.

Sif_Z75 Chabazite-Ca $(Ca_{0.5},K,Na)_4(Al_4Si_8O_{24})\cdot 12H_2O$

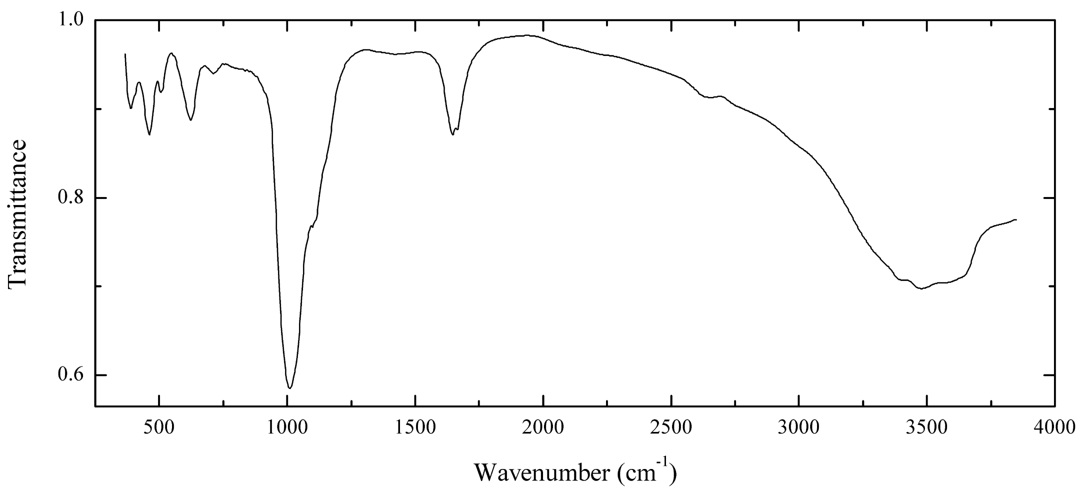


Locality: Pegmatite No. 62, Karnasurt mine, Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless rhombohedral crystals from the association with natrolite. The empirical formula is (electron microprobe) $Ca_{1.0}K_{0.8}Na_{0.2}Mg_{0.1}Al_{3.6}Si_{8.5}O_{24}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3660sh, 3600, 3400, 3260sh, 1660, 1145sh, 1034s, 760sh, 718, 634, 519, 466s, 400s.

Sif_Z76 Chabazite-Sr $(Sr,Ca,K_2)_2(Al_4Si_8O_{24}]\cdot 12H_2O$

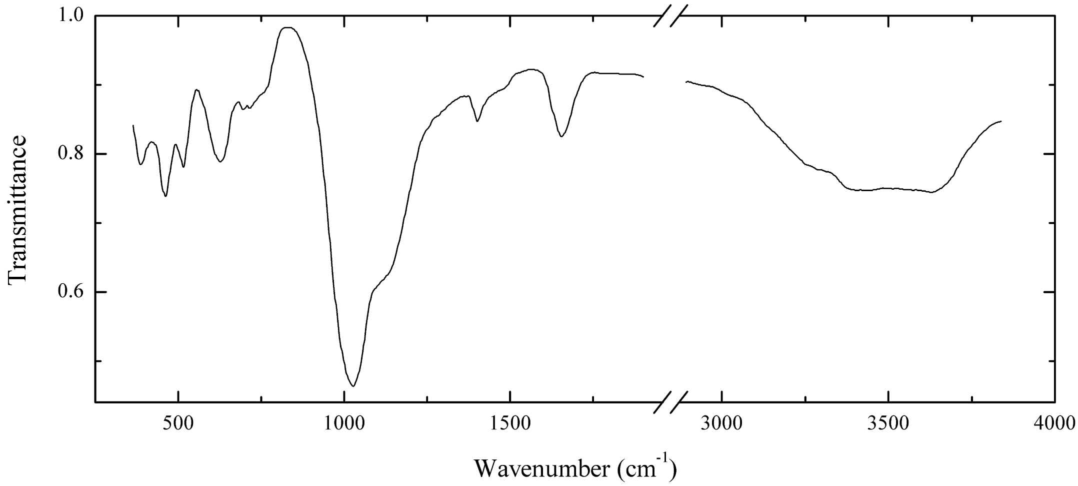


Locality: Suoluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless coarse twinned crystals from the association with analcime, gonnardite, vinogradovite, phillipsite, lavenite, seidozerite and apatite. Holotype sample. Trigonal, space group *R3m*, unit-cell parameters are $a = 13.715(6)$, $c = 15.09(1)$ Å. Optically uniaxial (+), $\omega = 1.503(1)$, $\varepsilon = 1.507(1)$. $D_{meas} = 2.16(1)$ g/cm^3, $D_{calc} = 2.20(1)$ g/cm^3. The empirical formula is $(Sr_{1.08}Ca_{0.92}K_{0.68}Na_{0.30}Ba_{0.02})(Al_{4.62}Si_{7.28}O_{24}]\cdot 11.06H_2O$. The strongest reflexes of powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 9.38 (80) (101), 5.55 (60) (021), 4.34 (70) (211), 2.92 (100) (401), 1.697 (70) (524, 700, 530).

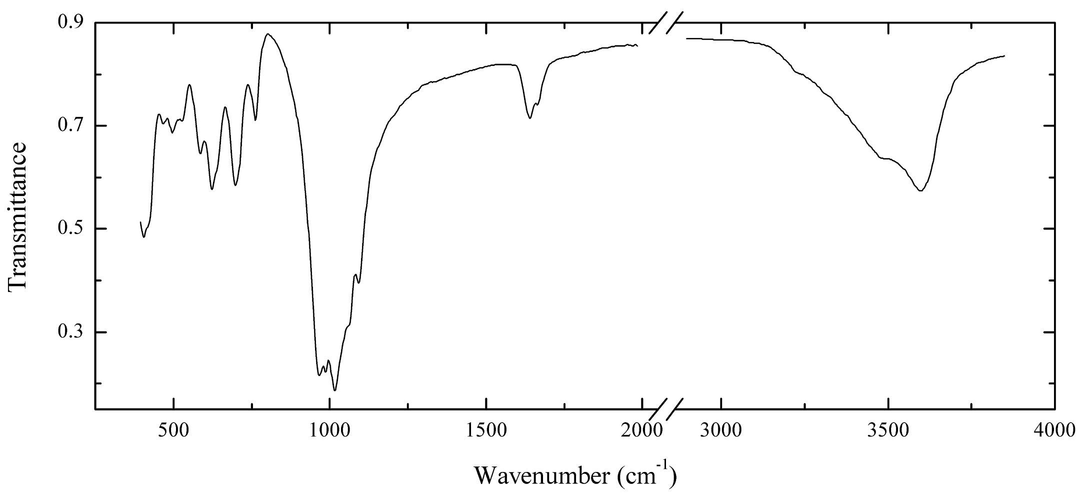
Wavenumbers (cm^{-1}): 3600sh, 3455, 3360sh, 2620w, 1650, 1390w, 1150sh, 1105sh, 1012s, 700w, 614, 505, 460, 401.

Sif_Z77 Chabazite-Ca $(Ca_{0.5},K,Na)_4(Al_4Si_8O_{24})\cdot 12H_2O$



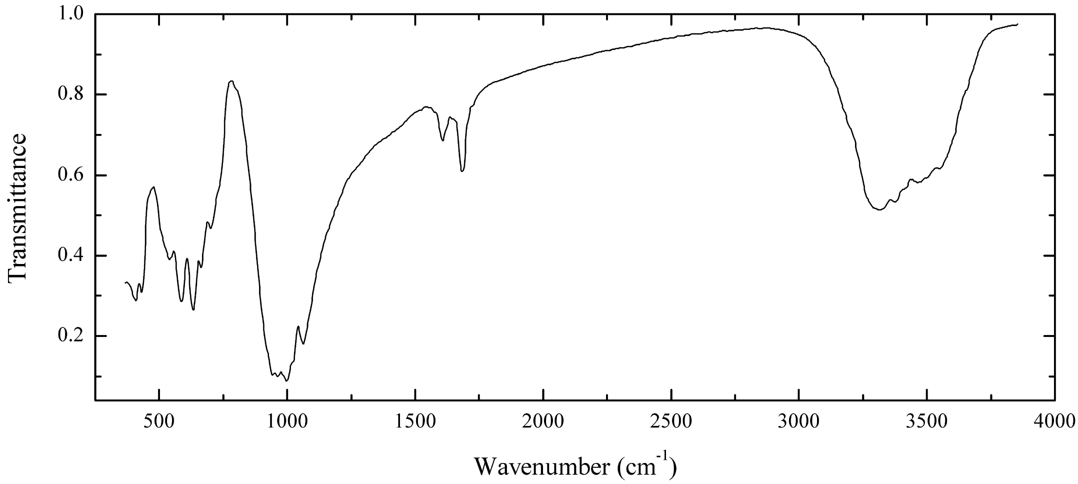
Locality: Yaruta Mt., Mun'-Hambo ridge, Subpolar Urals, Hanty-Mansi autonomous district, Russia.
Description: Colourless crystals from the association with tsaregorodtsevite, clinochlore, anatase and monazite-(Ce). NH_4^+-rich variety. The empirical formula is $Ca_{1.3}(NH_4)_{0.6}K_{0.3}Na_{0.1}(Al_{3.6}Si_{8.4}O_{24})\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3585, 3420, 3250sh, 1652, 1460sh, 1402, 1115sh, 1027s, 760sh, 723, 701, 631, 516, 461, 385.

Sif_Z78 Edingtonite $Ba(Al_2Si_3O_{10})\cdot 4H_2O$



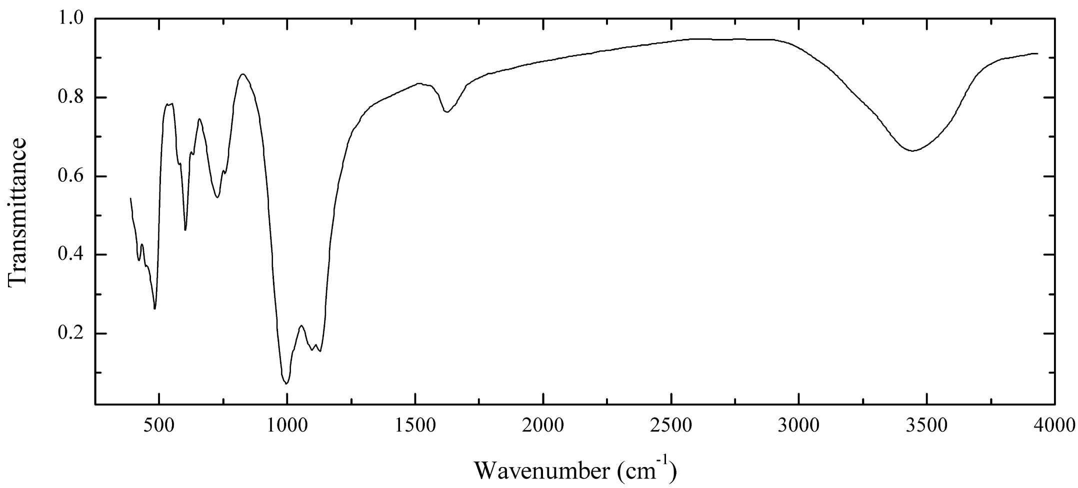
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless prismatic crystals from the association with gonnardite. Orthorhombic variety. Investigated by Yu.P. Menshikov. Identified by electron microprobe analysis and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3575, 3470sh, 3240sh, 1665w, 1632, 1093, 1060sh, 1015s, 987s, 967s, 760, 698, 640sh, 622, 585, 525w, 497w, 464w, 420sh, 405.

Sif_Z79 **Thomsonite-Ca** $Ca_2Na(Al_5Si_5O_{20})\cdot 6H_2O$



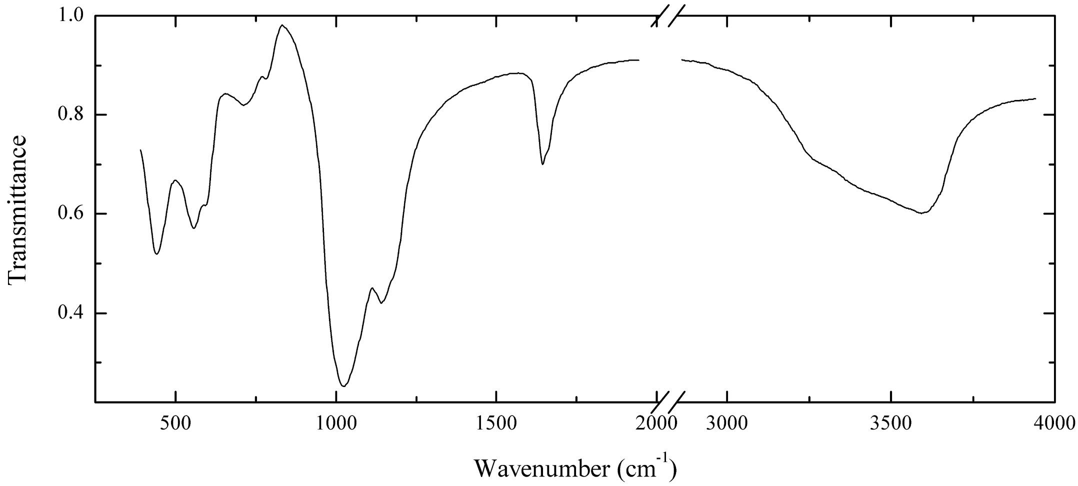
Locality: Tura township, Tunguska river basin, Krasnoyarskiy Krai, Siberia, Russia.
Description: Pink prismatic crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3515, 3450sh, 3430, 3390sh, 3345, 2980, 1686, 1608, 1061s, 1020sh, 997s, 964s, 941s, 915sh, 735sh, 699, 665, 633s, 587s, 540, 433, 406s.

Sif_Z80 **Perlialite** $K_9Na(Ca,Sr)(Al_{12}Si_{24}O_{72})\cdot 15H_2O$



Locality: Yuksporr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: White fibrous aggregate from the association with yuksporite, potash feldspar and nepheline. The empirical formula is $K_{8.1}Ca_{0.7}Na_{0.6}Sr_{0.3}(Si_{24.7}Al_{11.3}Fe_{0.2}O_{72})\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3550sh, 3425, 3250sh, 1630, 1126s, 1096s, 996s, 758, 727, 631, 604, 578, 485s, 448, 420.

Sif_Z81 Stilbite-Ca $(Ca_{0.5},K,Na)_9(Al_9Si_{27}O_{72})\cdot 28H_2O$

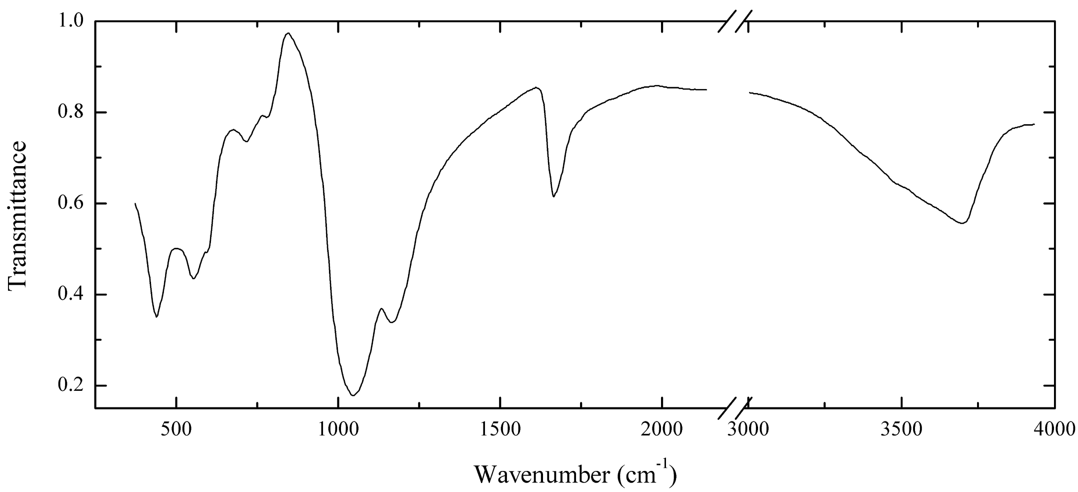


Locality: Sosnovoe deposit, near Skalnoe, Evenkiya, Tunguska river basin, Krasnoyarskiy Krai, Siberia, Russia.

Description: Pink split crystals from the association with heulandite-Ca and mordenite. The empirical formula is (electron microprobe) $Ca_{3.66}Na_{1.28}Mg_{0.13}K_{0.06}(Si_{27.13}Al_{8.85})O_{72}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3595, 3400sh, 3280sh, 1655sh, 1645, 1180sh, 1145s, 1024s, 774w, 708, 585, 550, 436s.

Sif_Z82 Stellerite $Ca_4(Al_8Si_{28}O_{72})\cdot 28H_2O$

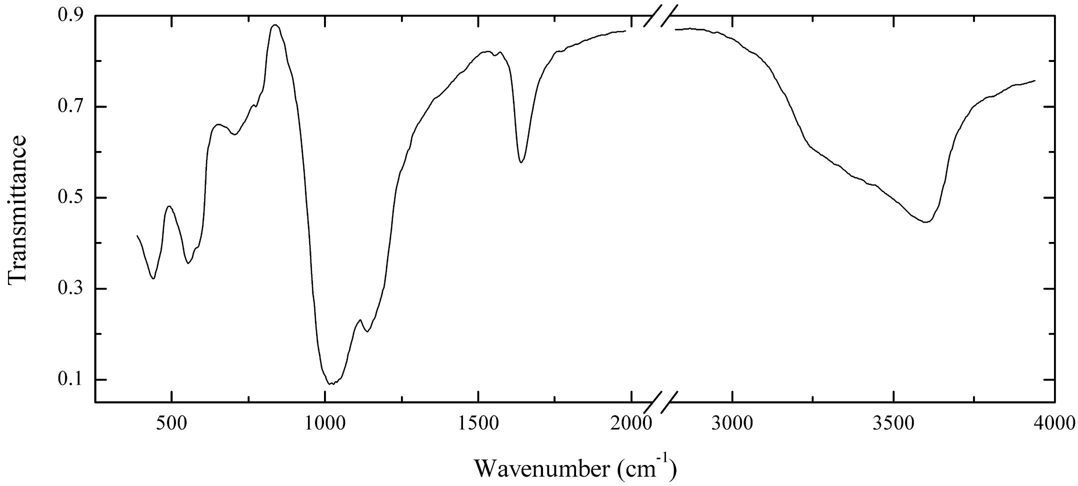


Locality: Klichka, Chita region, Eastern Siberia, Russia.

Description: White split crystals from the association with calcite and pyrite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3630, 3530sh, 3420sh, 3290sh, 1645, 1153s, 1037s, 776w, 712, 587, 533, 438s.

Sif_Z83 Stilbite-Ca $(Ca_{0.5},K,Na)_9(Al_9Si_{27}O_{72})\cdot 28H_2O$

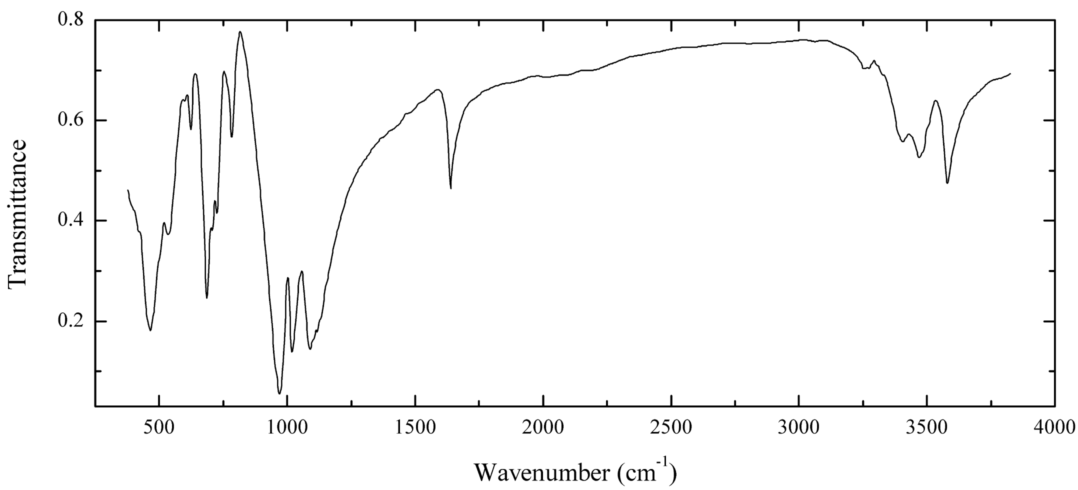


Locality: San Piero, Elba, Italy.

Description: White split platy crystals from the association with heulandite-Ca. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3585, 3420sh, 3300sh, 1643, 1565w, 1139s, 1023s, 795sh, 777w, 710, 580sh, 557, 442s.

Sif_Z84 Bikitaite $Li_2(AlSi_2O_6)\cdot H_2O$

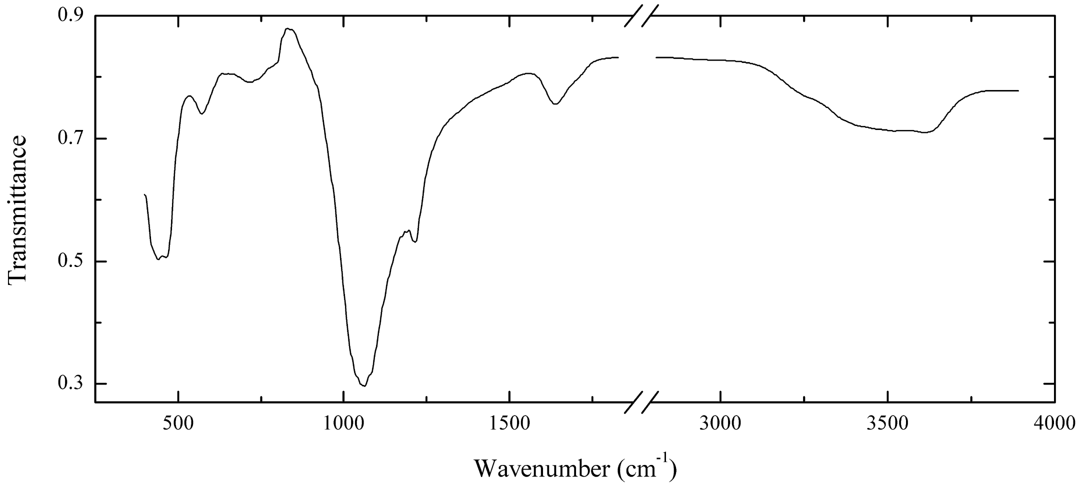


Locality: Bikita mine, Bikita, east of Victoria, Zimbabwe (type locality).

Description: Colourless prismatic crystals from the association with eucriptite and quartz. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3576, 3465, 3400, 3260w, 1645, 1130sh, 1105sh, 1093s, 1021s, 970s, 784, 725, 707, 685s, 623, 531, 500sh, 475sh, 463s, 420sh, 400sh.

Sif_Z85 Ferrierite-Mg $Mg_{2.5}K_{0.5}Na_{0.5}Ca_{0.5}(Al_7Si_{29}O_{72})\cdot 21H_2O$

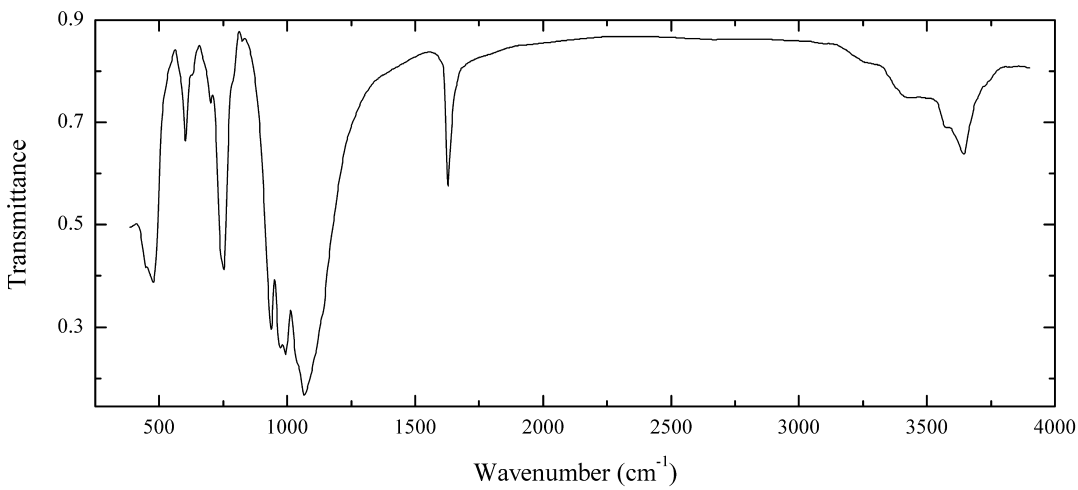


Locality: Andilamena, Tamatave, Madagascar.

Description: Beige split crystals growing on quartz. The empirical formula is (electron microprobe) $Sr_{1.6}Ca_{1.3}K_{1.0}Na_{0.8}Si_{27.8}Al_{8.4}O_{72}\cdot nH_2O$. Confirmed by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3625, 3500, 3270sh, 1700sh, 1645, 1220s, 1060s, 785sh, 740sh, 714, 572, 462s, 442s.

Sif_Z86 Wairakite $Ca(Al_2Si_4O_{12})\cdot 2H_2O$

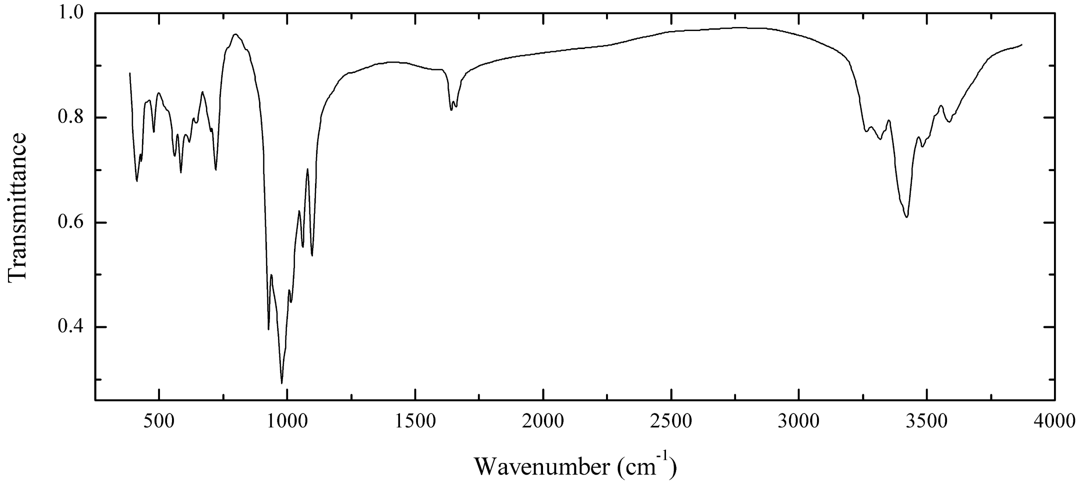


Locality: Kurumazawa gabbro quarry, Katashina, Gunma prefecture, Kanto region, Honshu island, Japan.

Description: White veinlet from the association with dmisteinbergite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3630, 3615sh, 3560, 3430w, 3255w, 1633, 1140sh, 1110sh, 1064s, 1040sh, 994s, 972s, 939s, 823w, 790sh, 753, 720sh, 698w, 626w, 600, 477s, 448.

Sif_Z87 Parthéite $Ca_2[Al_4Si_4O_{15}(OH)_2]\cdot 4H_2O$

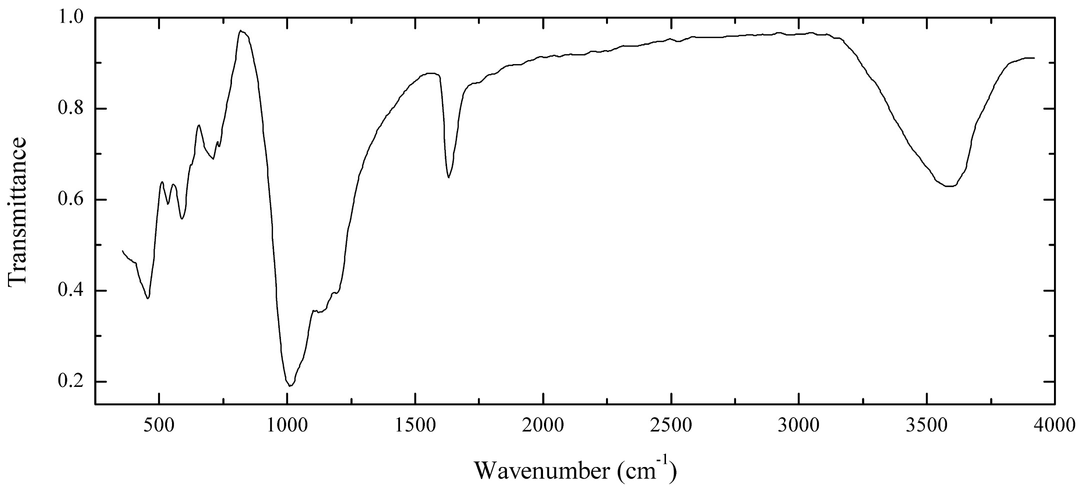


Locality: Zheltaya Sopka, Denezhkin Kamen' massif, North Urals, Russia.

Description: White spherulites from the association with thomsonite and chlorite. Investigated by O.K. Ivanov. The chemical composition is (wet chemical analysis, wt. %): CaO 16.70, Na_2O 0.12, K_2O 0.06, MgO 0.25, FeO 0.04, Fe_2O_3 0.05, Al_2O_3 31.76, SiO_2 36.64, H_2O 14.46. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3570, 3465, 3405, 3300, 3250, 1662, 1645, 1100s, 1064s, 1019s, 995sh, 982s, 932s, 775sh, 720, 699, 646w, 619, 582, 556, 525sh, 476, 432, 414.

Sif_Z88 Brewsterite-Sr $Sr_2(Al_4Si_{12}O_{32})\cdot 10H_2O$

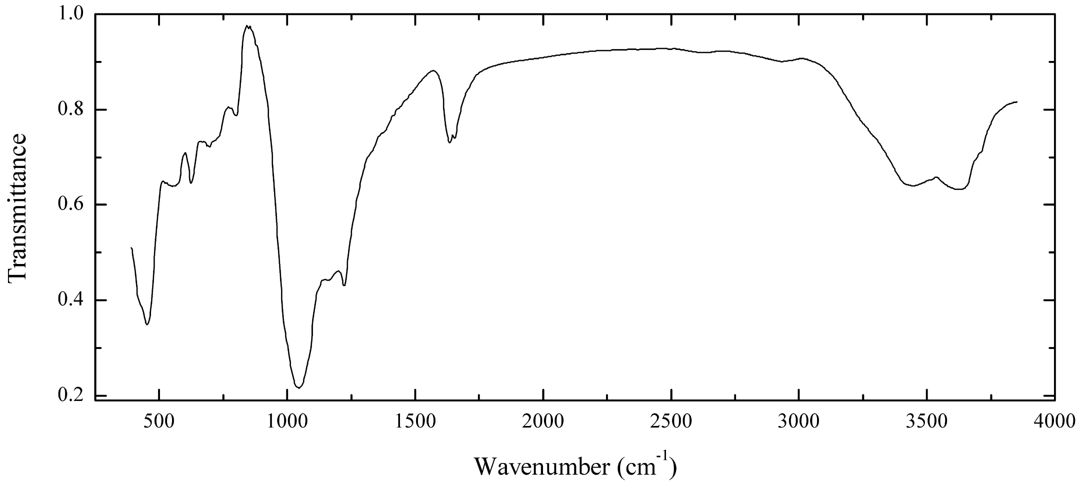


Locality: Whitesmith mine, Strontian, North West Highlands (Argyllshire), Scotland, UK (type locality).

Description: Colourless short-prismatic crystals. The empirical formula is (electron microprobe) $(Sr_{1.29}Ba_{0.60}K_{0.02}Na_{0.02}Mn_{0.02}Mg_{0.01}Ca_{0.01})(Si_{11.93}Al_{4.08}Fe_{0.06}O_{32})\cdot nH_2O$. Confirmed by IR spectrum.

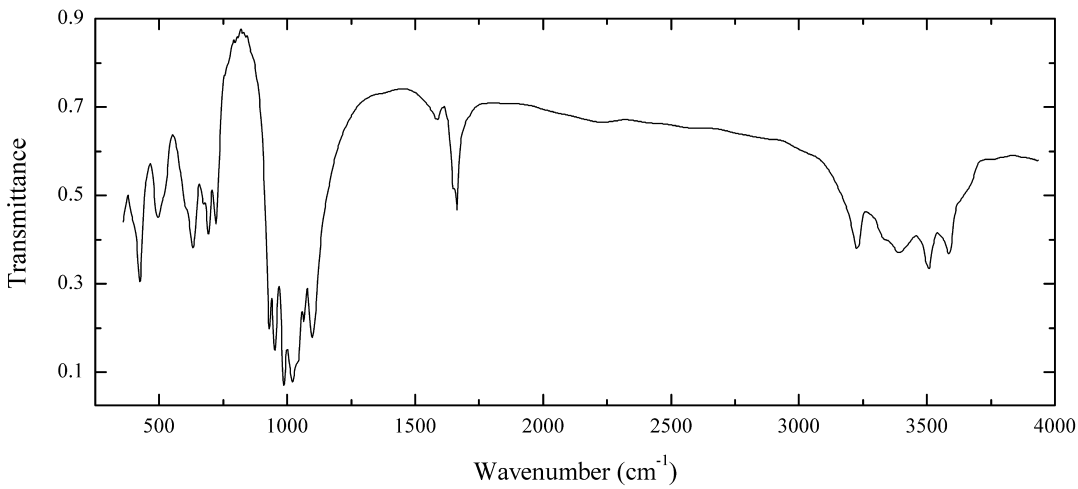
Wavenumbers (cm^{-1}): 3600sh, 3575, 3480sh, 1660sh, 1635, 1195s, 1130s, 1060sh, 1012s, 734, 708, 690sh, 630sh, 589, 535, 456s, 430sh, 400sh.

Sif_Z89 **Mordenite** $(Na_2,Ca,K_2)_4(Al_8Si_{40}O_{96})\cdot 28H_2O$



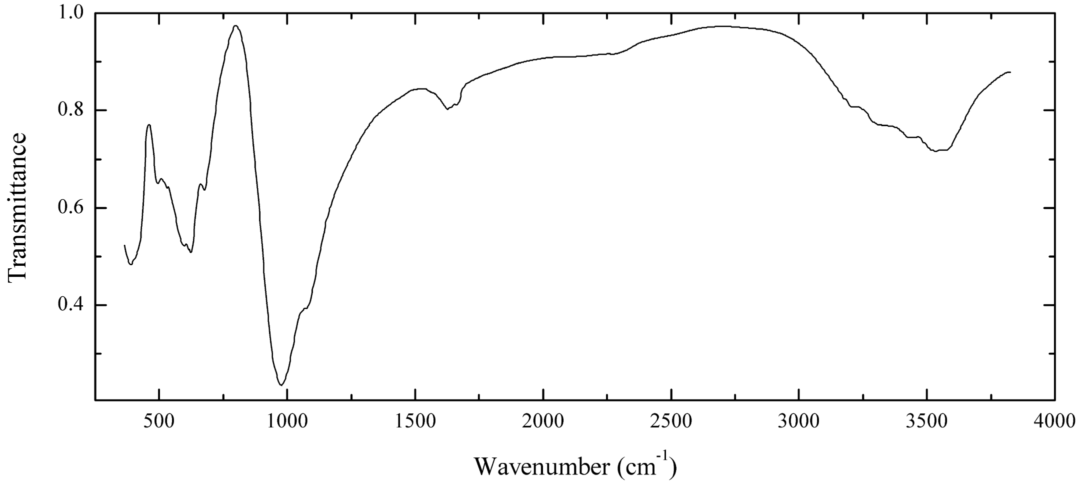
Locality: Pune district, Maharashtra, India.
Description: Rose fibrous aggregate from the association with quartz. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3660sh, 3620, 3430, 1645, 1225s, 1165s, 1046s, 800, 720sh, 695, 623, 553, 452s, 425sh.

Sif_Z90 **Scolecite** $Ca(Al_2Si_3O_{10})\cdot 3H_2O$



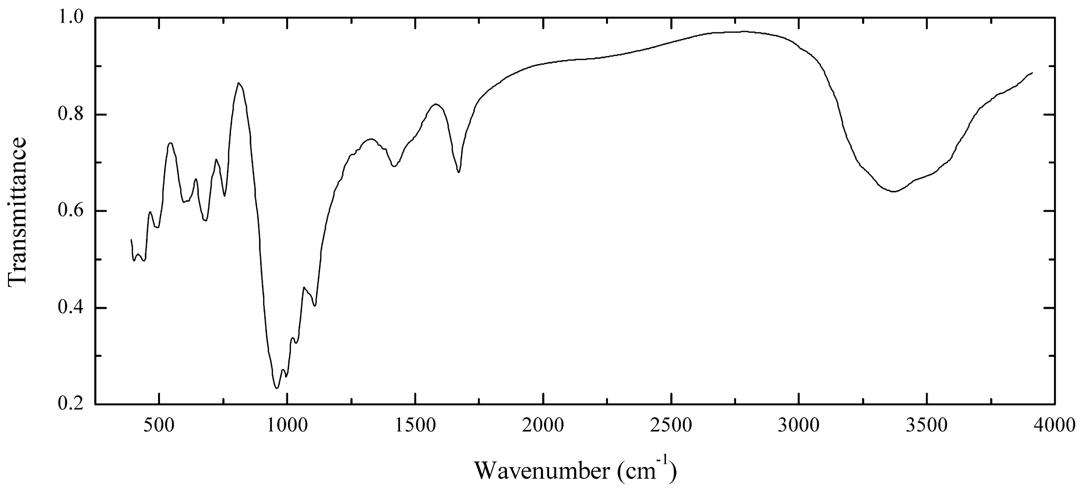
Locality: Nasik district, Maharashtra, India.
Description: Radial aggregate of white semitransparent long-prismatic crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3620sh, 3577, 3500, 3382, 3320sh, 3217, 1668, 1655, 1590w, 1101s, 1066s, 1045sh, 1023s, 990s, 953s, 932s, 723, 693, 673, 631, 600sh, 510sh, 497, 425s.

Sif_Z91 Gonnardite $(Na,Ca)_{6-8}[(Si,Al)_{20}O_{40}]\cdot 12H_2O$



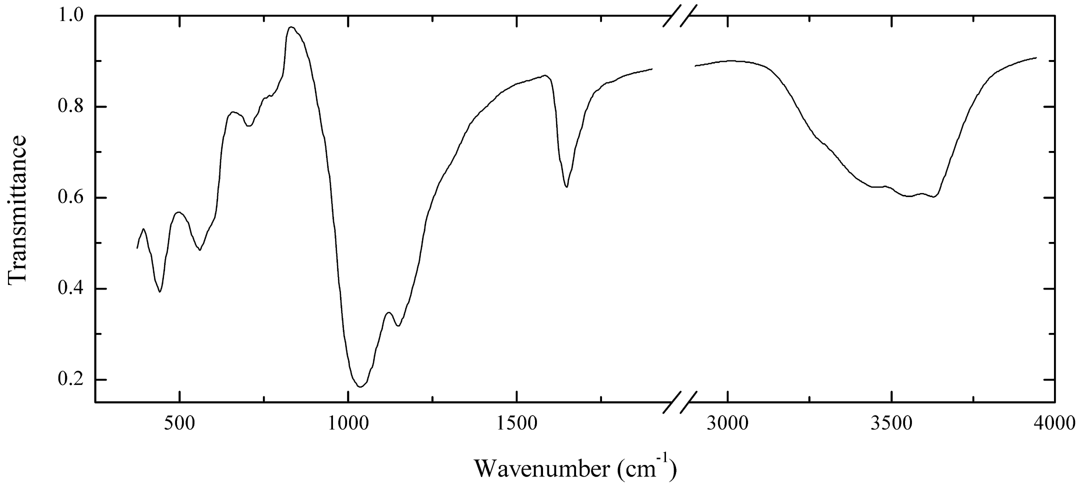
Locality: Schellkopf, near Brenk, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.
Description: White spherulites on phonolite, in the association with brenkite, phillipsite-K and thaumasite. High-calcium variety. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3540, 3510, 3420, 3320, 3200, 2305w, 1660sh, 1635, 1075sh, 975s, 677, 620, 595, 493, 410sh, 388.

Sif_Z92 Willhendersonite $(Ca_{0.5},K)_3(Al_3Si_3O_{12})\cdot 5H_2O$



Locality: Rother Kopf, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.
Description: Colourless crystals from the association with calcite and chabazite-Ca. Confirmed by IR spectrum. The band at 1,423 cm^{-1} corresponds to the admixture of calcite.
Wavenumbers (cm^{-1}): 3500sh, 3350, 3250sh, 1665, 1423, 1105, 1035s, 997s, 960s, 755, 680, 600, 492, 444, 402.

Sif_Z93 **Stellerite** $Ca_4(Al_8Si_{28}O_{72})\cdot 28H_2O$

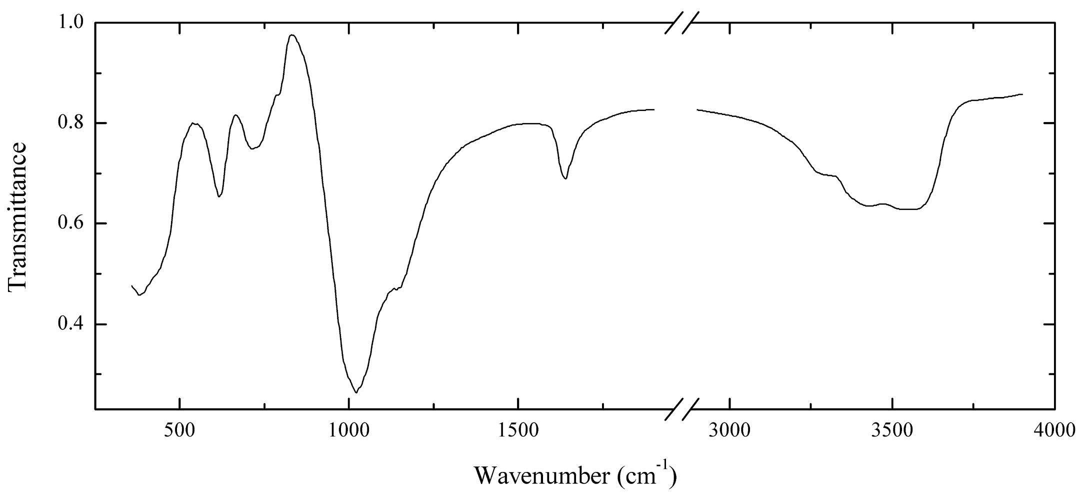


Locality: Pune (Poonah), Maharashtra, India.

Description: White spherulite from the association with calcite celadonite. The empirical formula is (electron microprobe) $Ca_{3.77}Na_{0.13}Mg_{0.06}K_{0.03}(Si_{28.09}Al_{7.94})O_{72}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3600, 3530, 3425, 3270sh, 1640, 1146s, 1036s, 790sh, 760sh, 700, 590sh, 557, 439s.

Sif_Z94 **Harmotome** $Ba_2(Na,K,Ca_{0.5})(Al_5Si_{11}O_{32})\cdot 12H_2O$

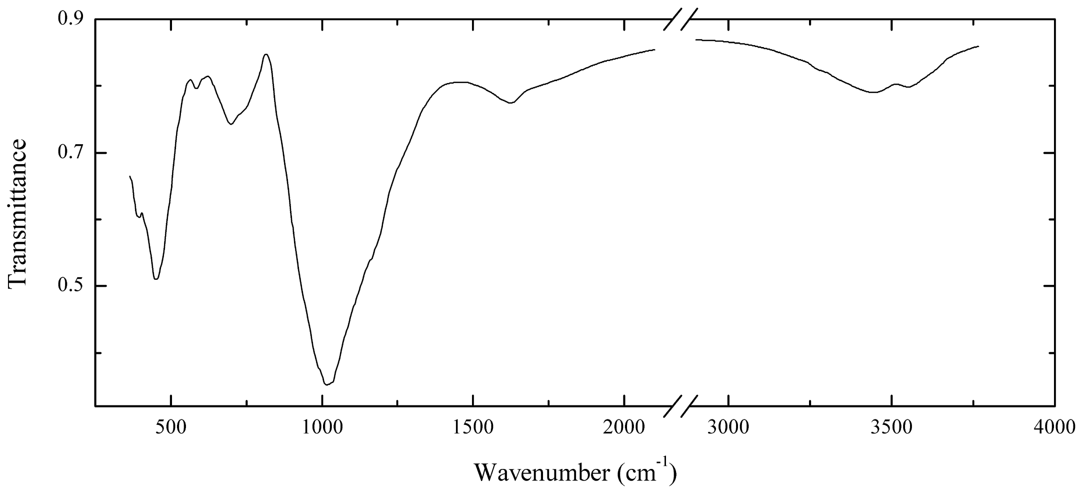


Locality: Whitesmith mine, Strontian, North West Highlands (Argyllshire), Scotland, UK.

Description: Colourless prismatic crystals from the association with brewsterite-Ba. The empirical formula is (electron microprobe) $(Ba_{1.6}Sr_{0.35}Na_{0.5}K_{0.1}Ca_{0.1})(Si_{11.3}Al_{4.7}O_{32})\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3550, 3410, 3270sh, 1640, 1140sh, 1023s, 787w, 715, 614, 430sh, 380s.

Sif_Z95 Analcime $Na(AlSi_2O_6) \cdot H_2O$

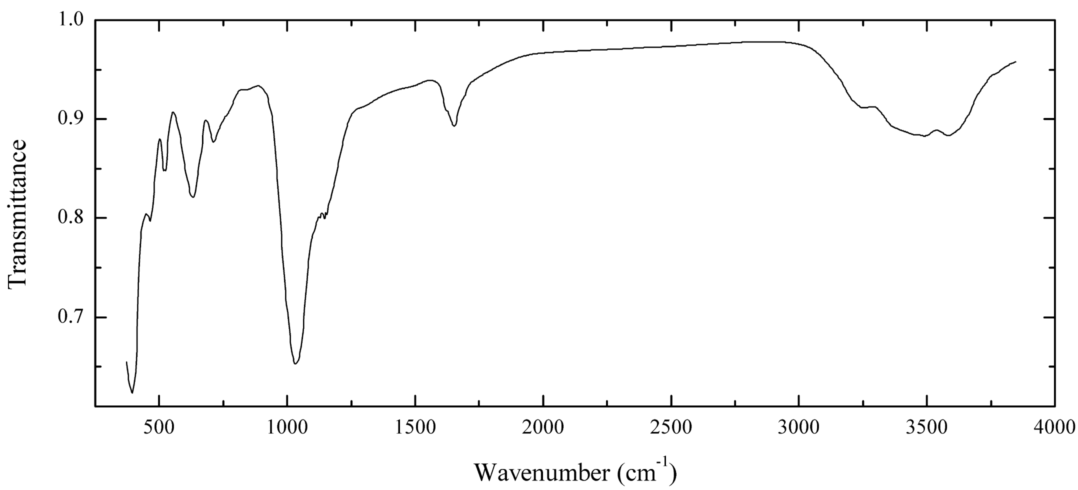


Locality: Bellerberg, Laacher See area, near Ettringen, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: White grains from the association with sanidine, Fe-rich åkermanite, nepheline and calcite. K-rich variety transitional to leucite. The empirical formula is (electron microprobe) $(Na_{0.65}K_{0.24}Mg_{0.02})(Si_{2.07}Al_{0.86}Fe_{0.07}O_6) \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3540, 3410, 1628, 1170sh, 1015s, 735sh, 647, 583w, 450s, 395.

Sif_Z96 Chabazite-Mg $(Mg_{0.5},Ca_{0.5},K,Na)_3(Al_3Si_9O_{24}) \cdot 10H_2O$

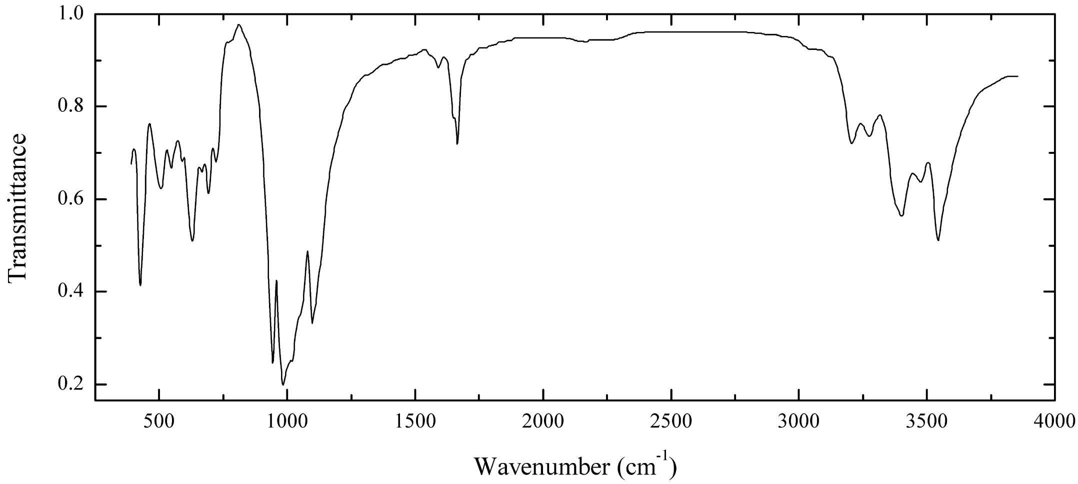


Locality: Karikás Hill quarry, Prága Hill, Bazsi, Veszprém Co., Hungary (type locality).

Description: Yellowish transparent rhombohedral crystals from the association with natrolite. The empirical formula is (electron microprobe) $Mg_{0.7}Ca_{0.5}K_{0.5}Na_{0.1}(Al_{3.0}Si_{9.0}O_{24}) \cdot nH_2O$. Confirmed by IR spectrum.

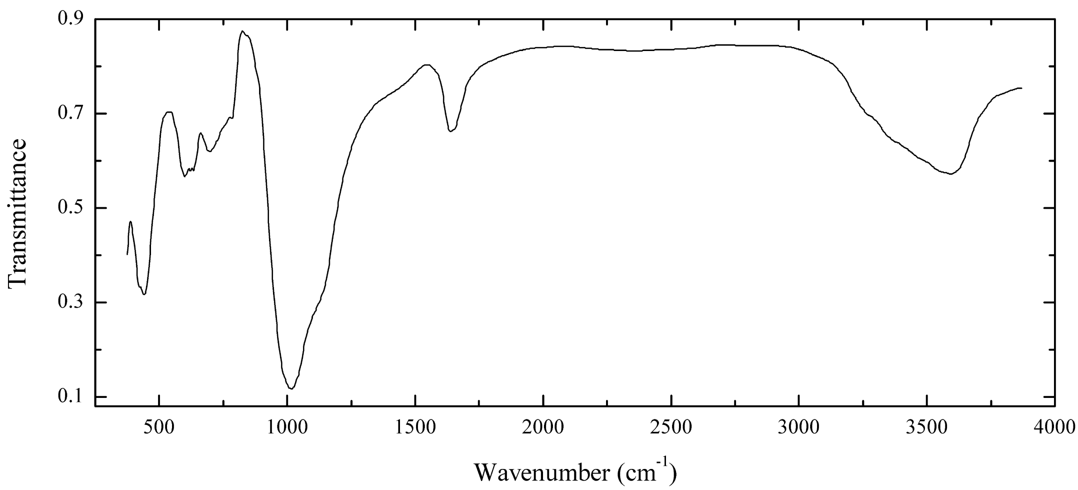
Wavenumbers (cm^{-1}): 3570, 3460, 3240, 1654, 1145, 1033s, 770sh, 712, 632, 520, 465, 395s.

Sif_Z97 Mesolite $Na_2Ca_2(Al_6Si_9O_{30}) \cdot 8H_2O$



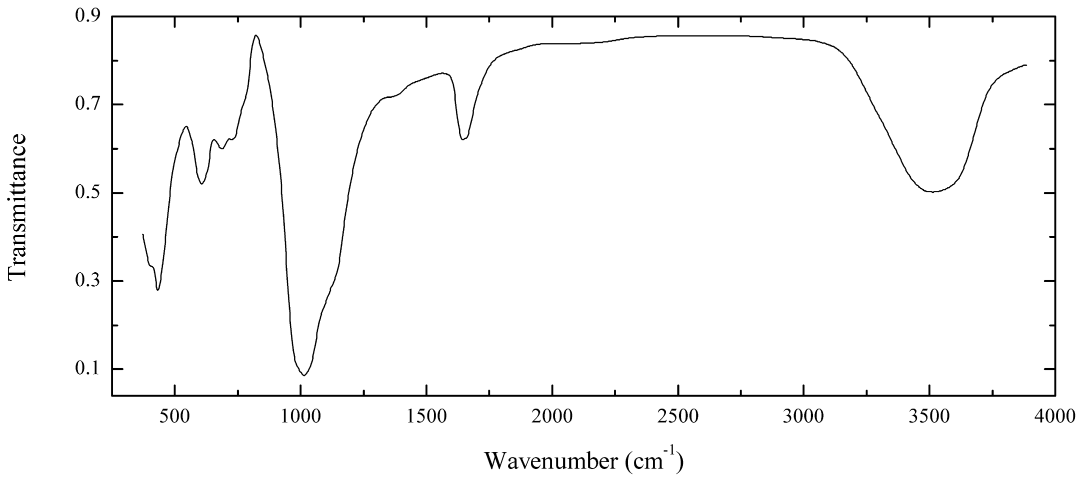
Locality: Pashan, Pune (Poonah) district, Maharashtra, India.
Description: Cluster of colourless acicular crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3536, 3469, 3395, 3380sh, 3274, 3203, 3050w, 1663, 1652w, 1594w, 1140sh, 1110sh, 1097s, 1065sh, 1050sh, 1021s, 1006s, 982s, 941s, 775sh, 720, 690, 663, 626, 589, 545, 503, 424s.

Sif_Z98 Phillipsite-K $(K,Ca_{0.5},Na)_9(Al_9Si_{27}O_{72}] \cdot 24H_2O$



Locality: Pollena quarry, Pollena-Trocchia area, Monte Somma, Somma-Vesuvius complex, Naples province, Campania, Italy.
Description: Colourless twinned crystals from the association with montesommaite. Confirmed by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3590, 3400sh, 1640, 1120sh, 1018s, 785w, 698, 624, 599, 438s, 420s.

Sif_Z99 Phillipsite-Na $(Na,Ca_{0.5},K)_9(Al_9Si_{27}O_{72}]\cdot 24H_2O$

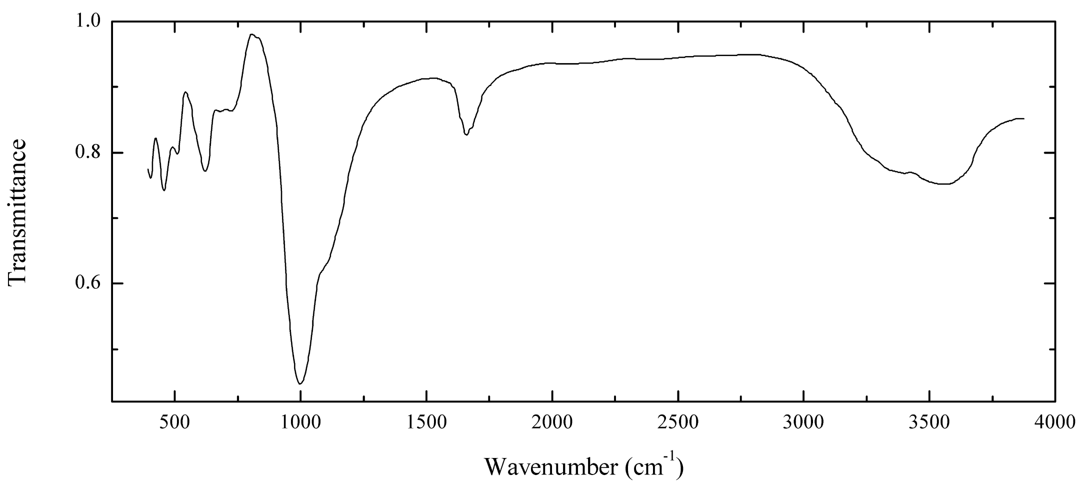


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow crystals from the association with ussingite. The empirical formula is (electron microprobe) $Na_{5.8}K_{2.8}Ca_{0.3}Al_{10.0}Si_{26.2}O_{72}\cdot nH_2O$. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3550sh, 3490, 1645, 1350sh, 1125sh, 1015s, 795sh, 730, 698, 606, 432s, 405sh.

Sif_Z100 Chabazite-Ca $(Ca_{0.5},K,Na)_4(Al_4Si_8O_{24})\cdot 12H_2O$

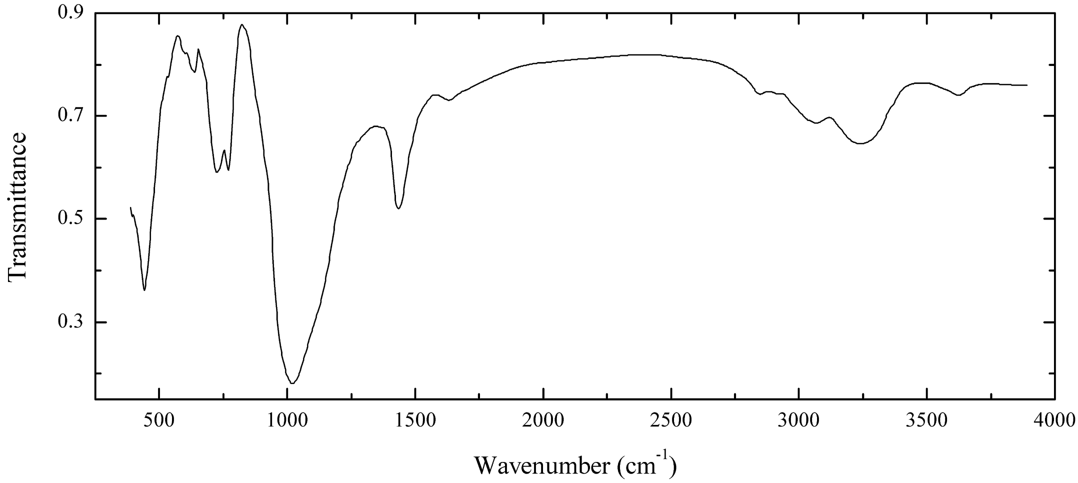


Locality: Rother Kopf, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Colourless rhombohedral crystals from the association with calcite, günterblassite, phillipsite-K and phillipsite-Ca. Al-rich variety. The empirical formula is (electron microprobe) $Ca_{1.26}K_{1.23}Sr_{0.43}Al_{4.58}Si_{7.41}O_{24}\cdot nH_2O$. Confirmed by IR spectrum.

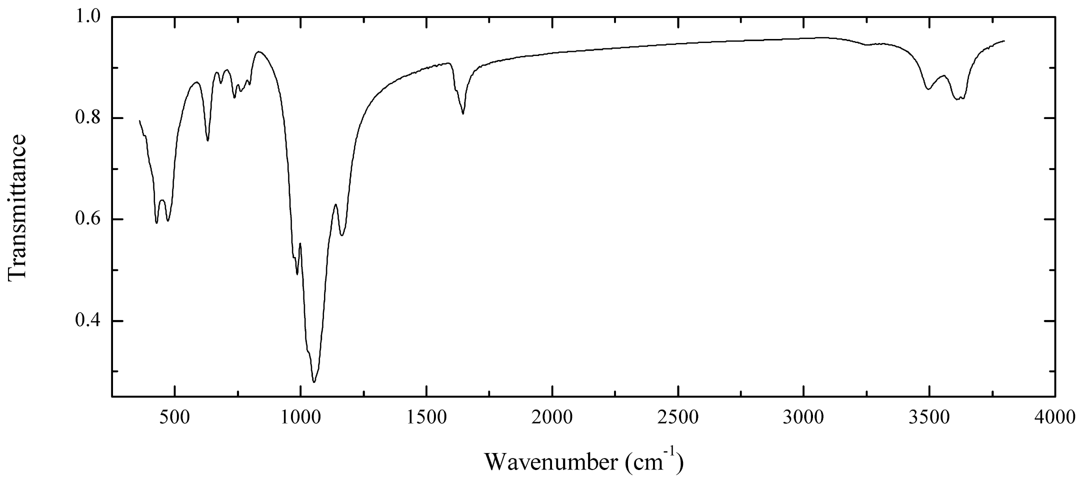
Wavenumbers (cm^{-1}): 3550, 3380, 3250sh, 1652, 1100sh, 998s, 725, 680, 622, 510, 456, 398.

Sif_Z101 Ammonioleucite $(NH_4,K)(AlSi_2O_6)$



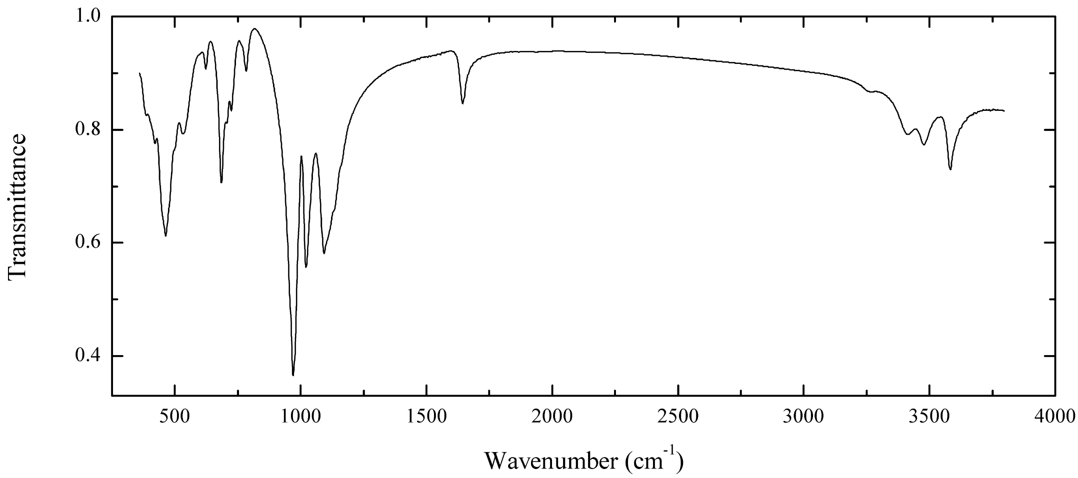
Locality: Tatarazawa quarry, Fujioka, Gunma prefecture, Japan (type locality).
Description: White pseudomorph after analcime crystal from the association with dolomite. The empirical formula is $[(NH)_{0.7}K_{0.2}(H_2O)_{0.1}](Si_{2.1}Al_{0.9}O_6)$.
Wavenumbers (cm^{-1}): 3612w, 3230, 3050, 2840w, 1638w, 1437, 1120sh, 1018s, 769, 726, 630, 605w, 533w, 475sh, 441s.

Sif_Z102 Yugawaralite $Ca_2(Al_4Si_{12}O_{32})\cdot 8H_2O$



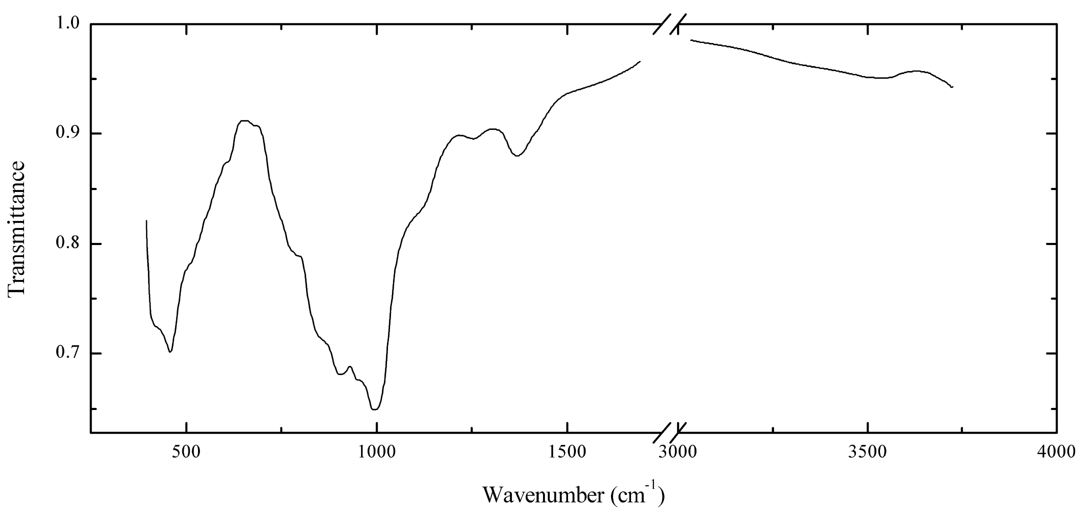
Locality: Kandivali quarry, Malad, Bombay, Maharashtra, India.
Description: Colourless split crystals from the association with quartz and apophyllite.
Wavenumbers (cm^{-1}): 3632, 3609, 3495, 3255w, 1646, 1620sh, 1164, 1070sh, 1053s, 1035sh, 986s, 975sh, 798, 775sh, 763, 737, 683w, 631, 472, 427, 410sh.

Sif_Z103 Bikitaite $Li_2(AlSi_2O_6)\cdot H_2O$



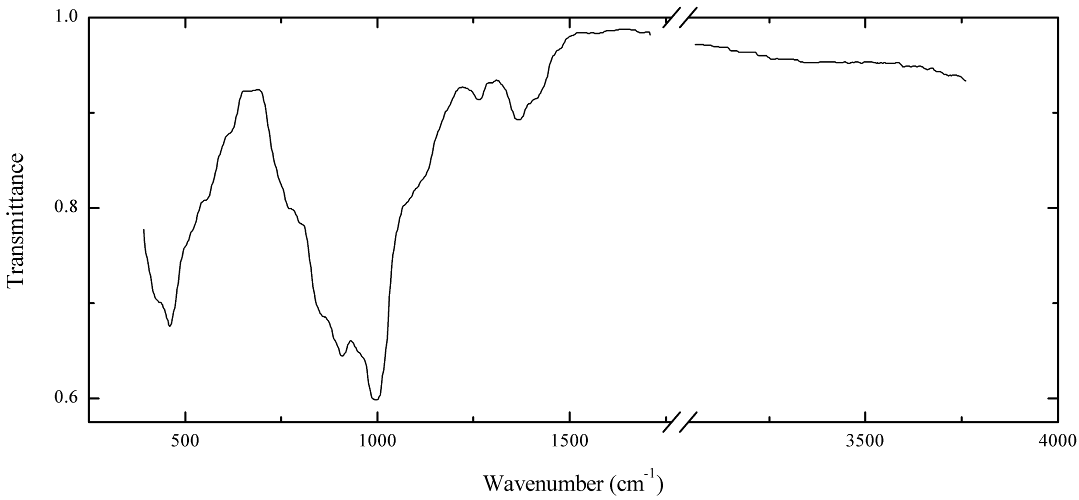
Locality: Foote Mine, Kings Mountain, Cleveland Co., North Carolina, USA.
Description: Colourless prismatic crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3583, 3478, 3415, 3268w, 1645, 1165sh, 1135sh, 1093s, 1021s, 970s, 783, 724, 705, 685, 623, 531, 495sh, 464s, 423, 393.

Siod1 Wiluite $Ca_{19}(Al,Mg,Fe,Ti)_{13}(B,Al,\square)_5Si_{18}O_{68}(O,OH)_{10}$



Locality: The mouth of Akhtaragda river, Wilui river basin, Sakha Republic (Yakutia), Eastern Siberia, Russia (type locality).
Description: Dark greenish-brown short-prismatic crystal from the association with grossular and serpentine. Confirmed by IR spectrum and qualitative electron microprobe analysis. The bands at 1,110, 1,258, 1,368 and 1,420 cm^{-1} correspond to B–O stretching vibrations.
Wavenumbers (cm^{-1}): 1540w, 1420sh, 1368, 1258w, 1110sh, 999s, 955sh, 910s, 860sh, 790sh, 740sh, 615sh, 510sh, 461, 425sh.

Siod2 Wiluite $Ca_{19}(Al,Mg,Fe,Ti)_{13}(B,Al,\square)_5Si_{18}O_{68}(O,OH)_{10}$

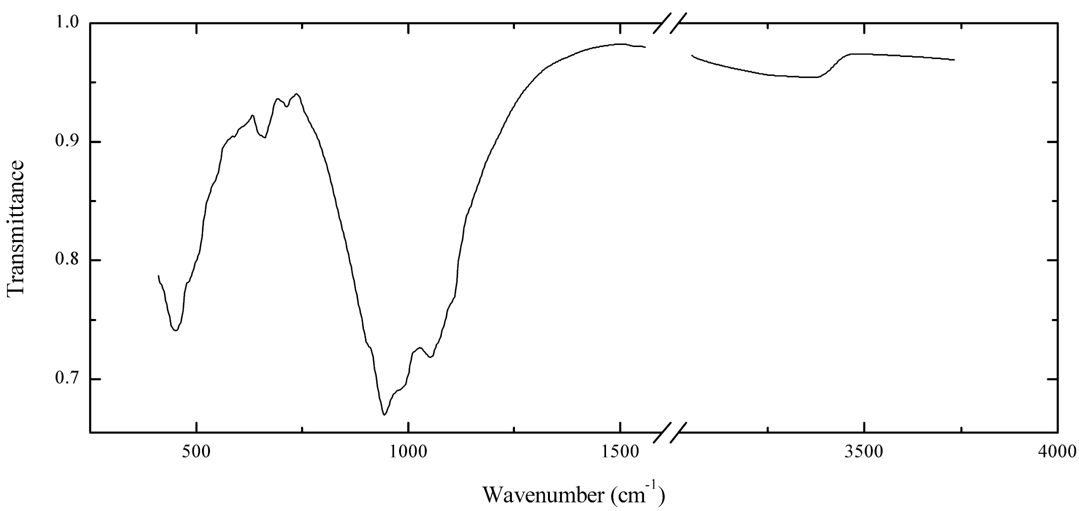


Locality: Siki-Yadunskiy fault, Siki river, the basin of Nizhnyaya Tunguska river, Evenkiya, Siberia, Russia.

Description: Dark brown short-prismatic crystal from the association with grossular, serpentine and prehnite. The empirical formula is (electron microprobe) $Ca_{18.2}Al_{7.9}Mg_{3.1}Fe_{2.0}Mn_{0.3}$-$Ti_{0.3}B_xSi_{18.0}O_{68}(O,OH)_{10}$. Confirmed by IR spectrum. The bands at 1120, 1265, 1370 and 1,415 cm^{-1} correspond to B–O stretching vibrations.

Wavenumbers (cm^{-1}): 1415sh, 1370, 1265w, 1120sh, 1075sh, 999s, 960sh, 913s, 800sh, 780sh, 620sh, 585sh, 510sh, 463, 435sh.

Siod3 Epidote-(Pb) (formerly "hancockite") $PbCa(Al_2Fe^{3+})(Si_2O_7)(SiO_4)O(OH)$

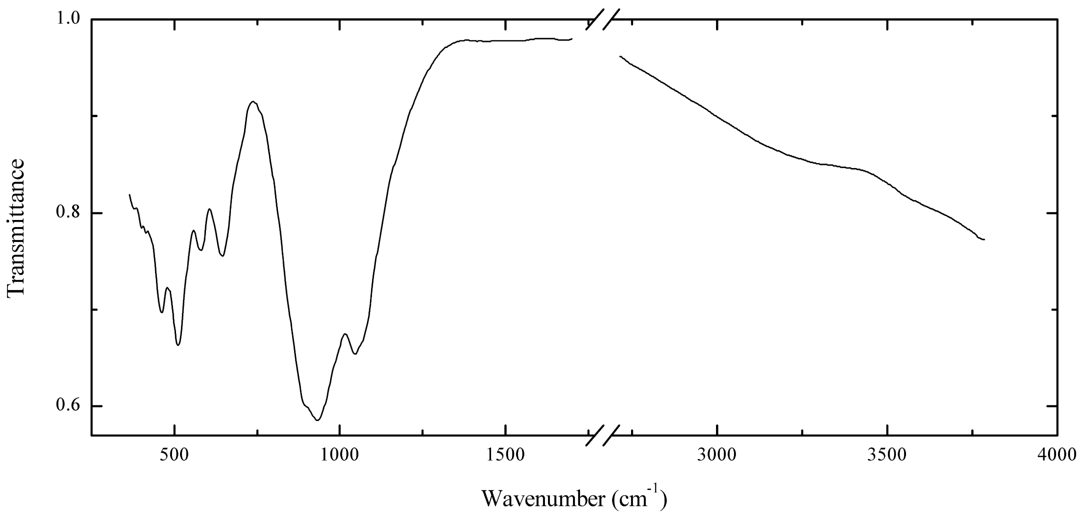


Locality: Jakobsberg mine, Nordmark, Filipstad, Värmland, Sweden.

Description: Olive green grains from the association with hyalophane and aegirine-diopside. The empirical formula is (electron microprobe) $Pb_{1.0}Ca_{1.1}Al_{1.85}Fe_{1.15}Si_{2.95}O_{12}(OH)$. Confirmed by IR spectrum.

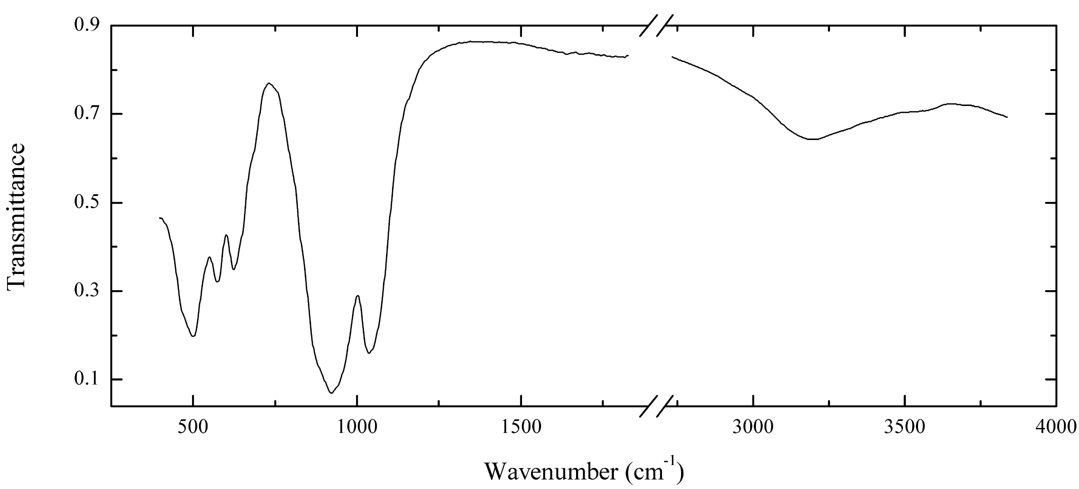
Wavenumbers (cm^{-1}): 3370w, 1100sh, 1050s, 980sh, 945s, 900sh, 720sh, 500sh, 480sh, 455.

Siod4 Allanite-(Nd) $NdCa(Al_2Fe^{2+})(Si_2O_7)(SiO_4)O(OH)$



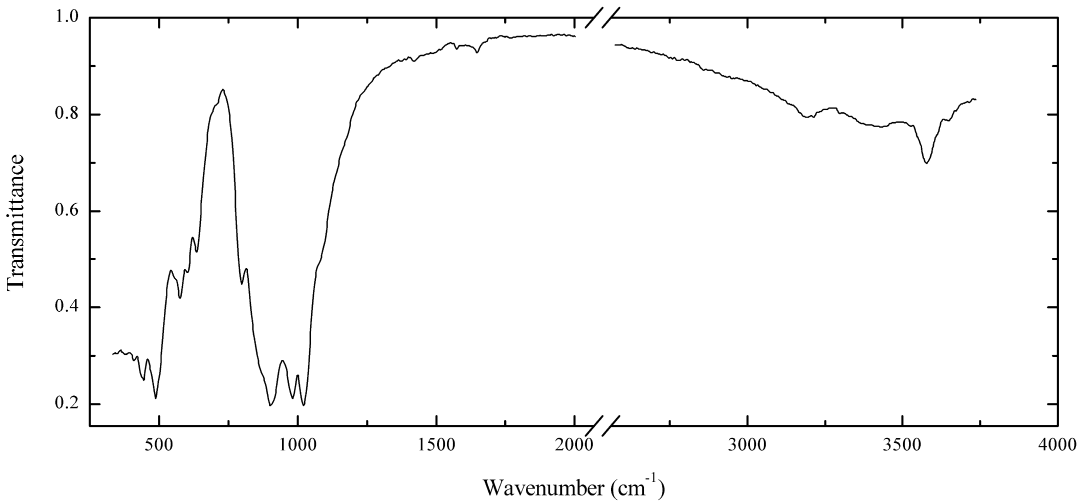
Locality: Ulyn Khuren Mt., Khaldzan Buragtag massif, Altai Mts., Mongolia.
Description: Dark brown grains from metamorphosed pegmatite. Investigated by P.M. Kartashov.
Wavenumbers (cm^{-1}): 3260w, 3170w, 1048s, 933s, 895sh, 644, 578, 507s, 458, 420sh.

Siod5 Allanite-(La) $LaCa(Al_2Fe^{2+})(Si_2O_7)(SiO_4)O(OH)$



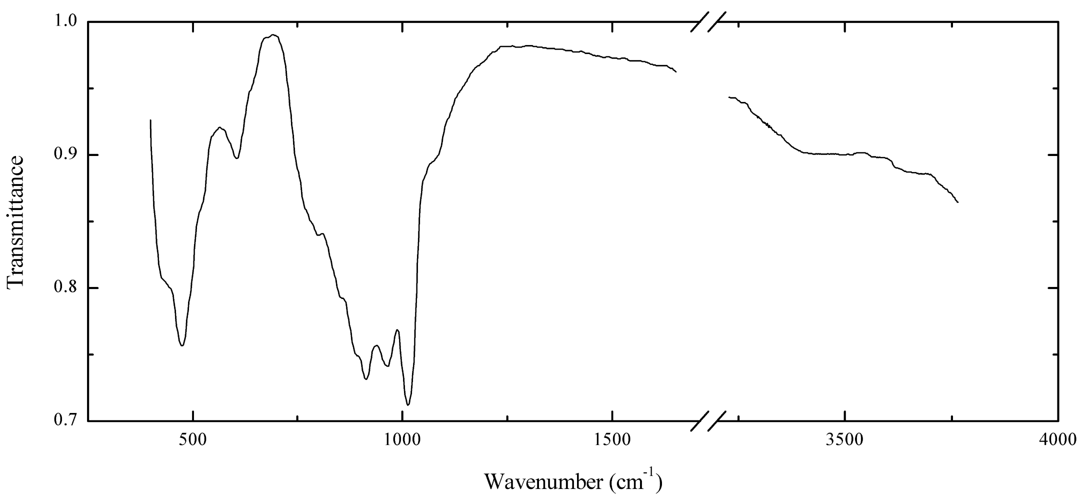
Locality: Mochalin Log (Mochalin ravine), Borzovka, near Kyshtym, Chelyabinsk region, South Urals, Russia.
Description: Black grains from the association with britholite-(La), britholite-(Ce), fluorbritholite-(La), fluorbritholite-(Ce), bastnäsite-(La), bastnäsite-(Ce), hydroxylbastnäsite-(La), hydroxylbastnäsite-(Ce), allanite-(Ce), törnebohmite-(La), gadolinite-(Ce) and monazite-(La). The empirical formula is (electron microprobe) $(La_{0.46}Ce_{0.42}Nd_{0.03}Pr_{0.03})Ca_{1.05}(Al_{1.48}Fe_{1.32}Mg_{0.12}Mn_{0.07})Si_{3.00}O_{12}(OH)$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3180, 1045sh, 1036s, 950sh, 923s, 875sh, 670sh, 645sh, 621, 572, 497s, 460sh.

Siod6 Fluorvesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(F,OH)_9$



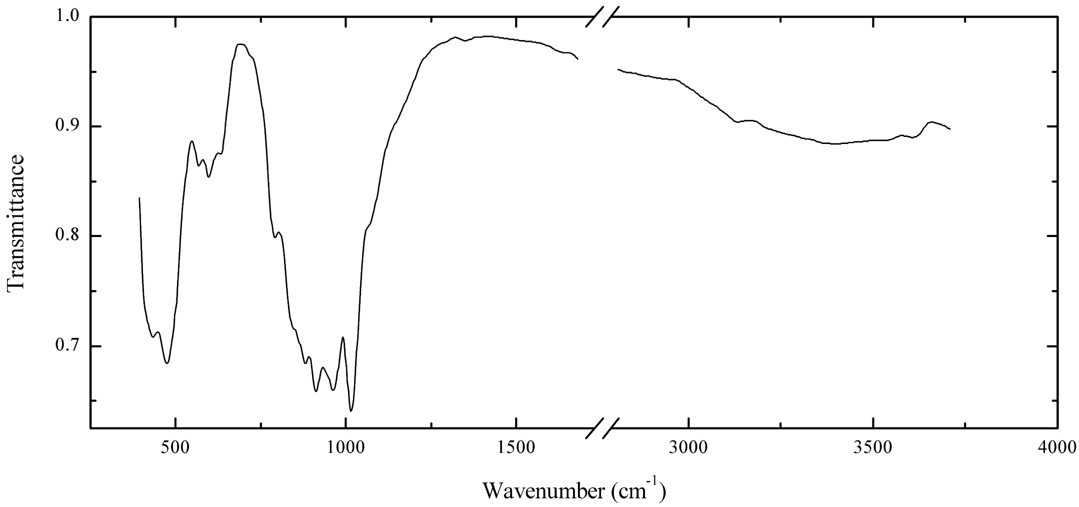
Locality: Abandoned Lupikko iron mine, Pitkäranta, Karelia, Russia (type locality).
Description: Colourless acicular crystals from the association with sphalerite and clinochlore. Holotype sample. Tetragonal, space group *P*4/*nnc*, $a = 15.516(2)$, $c = 11.772(3)$ Å, $Z = 2$. Optically uniaxial (−), $\omega = 1.702(1)$, $\varepsilon = 1.699(1)$. $D_{meas} = 3.46(3)$ g/cm^3, $D_{calc} = 3.41$ g/cm^3. The empirical formula is $Ca_{19.03}(Al_{10.38}Mg_{1.39}Fe^{3+}{}_{1.15}Mn^{2+}{}_{0.04})Si_{18.01}O_{68.00}(F_{7.16}OH_{1.64}O_{0.80})$. The strongest lines of powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 3.465 (30) (420), 3.040 (30) (510), 2.945 (35) (004), 2.743 (90) (432,440), 2.589 (50) (224, 522), 2.453 (100) (620), 1.619 (30) (526, 922).
Wavenumbers (cm^{-1}): 3625w, 3555, 3400, 3170, 1650w, 1575w, 1500w, 1420w, 1080sh, 1021s, 983s, 905s, 870sh, 800, 710sh, 636, 605, 577, 545sh, 490s, 444s, 411, 395, 375.

Siod7 Vesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(OH,O,F)_9$



Locality: Akhmatovskaya pit, Nazyamskie Mts., near Zlatoust, Chelyabinsk region, South Urals, Russia.
Description: Yellow-brown short-prismatic crystals from the association with calcite, diopside, grossular and perovskite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3400, 1075sh, 1014s, 964s, 916s, 890sh, 855sh, 804, 780sh, 630sh, 605, 520sh, 476s, 430sh.

Siod8 Vesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(OH,O,F)_9$

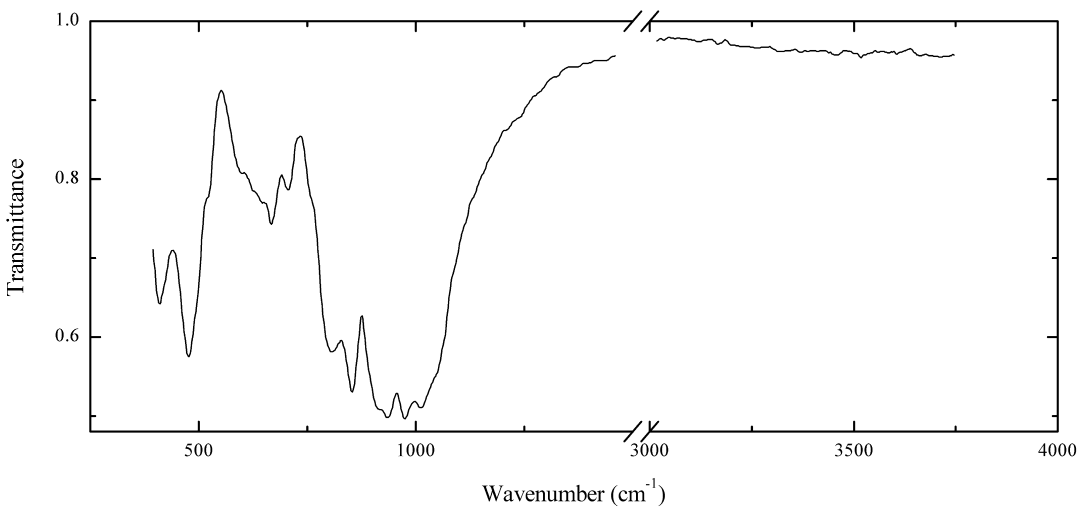


Locality: Bazhenovskoe (Bazhenovskoye) chrysotile asbestos deposit, Asbest, Middle Urals, Russia.

Description: Green short-prismatic crystals from rodingite, from the association with diopside, grossular, prehnite and clinochlore. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3610w, 3380, 3125w, 1140sh, 1075sh, 1018s, 964s, 916s, 886, 855sh, 797, 633, 603, 569, 479, 434.

Siod9 Vesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(OH,O,F)_9$

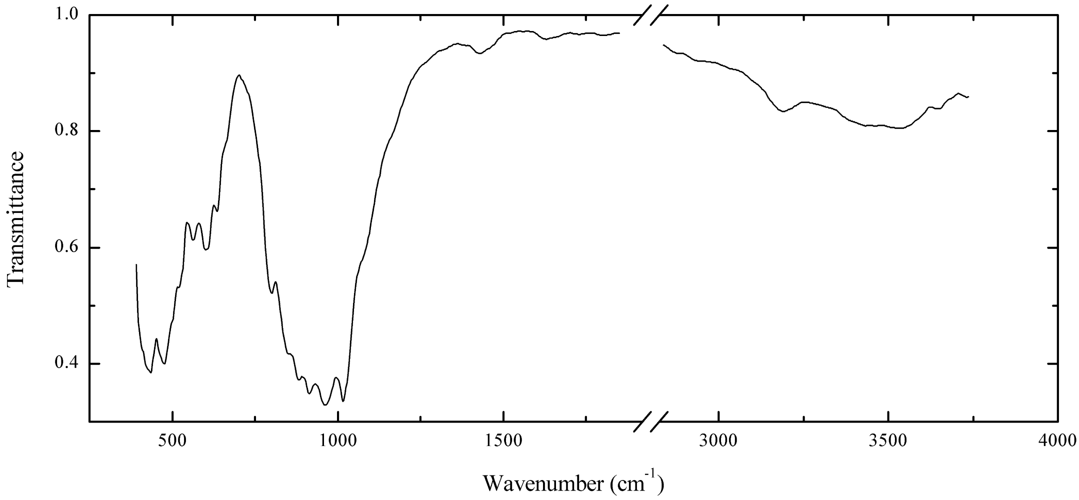


Locality: An unknown locality in Saxony, Germany.

Description: Dark brown grains. Confirmed by IR spectrum. Al-rich, OH-free variety. The empirical formula is $Ca_{19.6}Al_{10.6}Mg_{3.3}Fe_{0.6}Si_{17.2}(O,F)_{78}$.

Wavenumbers (cm^{-1}): 1050sh, 1015s, 978s, 938s, 915sh, 856s, 807, 760sh, 707, 665, 643, 620sh, 600, 520sh, 478, 407.

Siod10 Vesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(OH,O,F)_9$

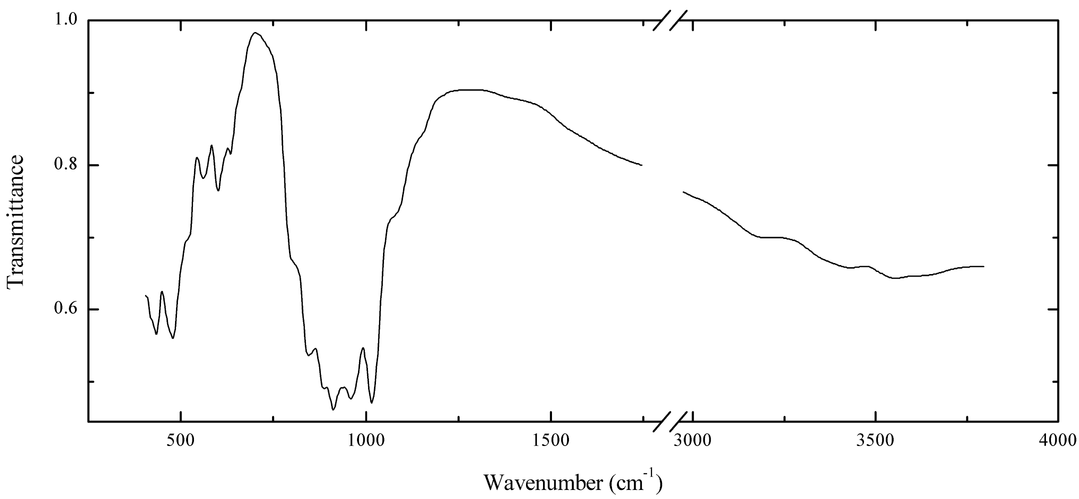


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Green granular aggregate from the association with andradite, glagolevite and calcite. The empirical formula is (electron microprobe) $Ca_{18.1}Al_{7.2}Fe_{3.0}Mg_{2.8}Ti_{0.2}$ $Si_{18.0}(OH,O,F)_{78}$. Weak band at 1,427 cm^{-1} corresponds to the admixture of a carbonate.

Wavenumbers (cm^{-1}): 3640w, 3510, 3425sh, 3175, 1630w, 1427w, 1080sh, 1016s, 963s, 914s, 880s, 850sh, 799, 655sh, 632, 603, 562, 521, 475s, 430s.

Siod11 Vesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(OH,O,F)_9$

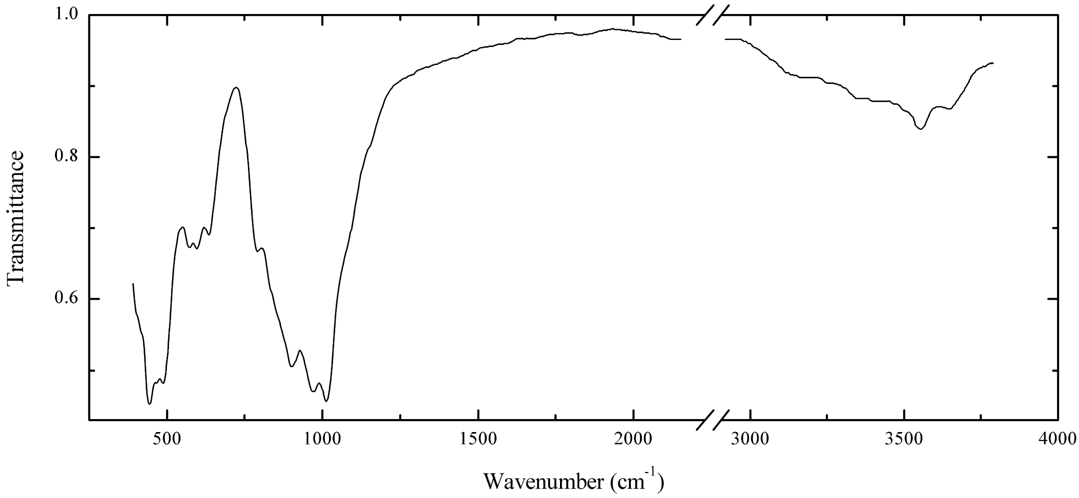


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Green granular aggregate from the association with andradite, clinochlore and later tobermorite and riversideite. Identified by IR spectrum.

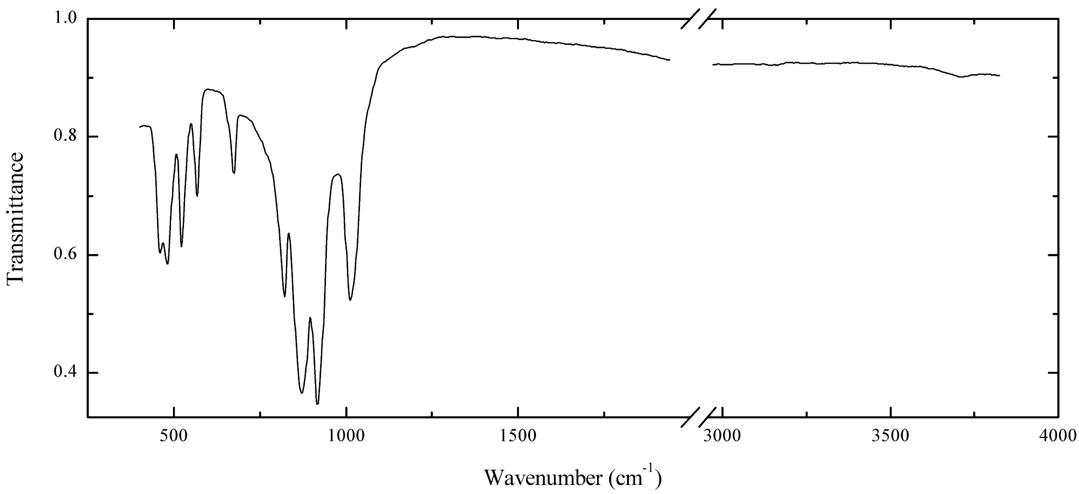
Wavenumbers (cm^{-1}): 3520w, 3420w, 3350w, 3175w, 1070sh, 1017s, 960s, 911s, 887s, 846, 800sh, 633, 601, 562, 515sh, 475s, 429s.

Siod12 Fluorvesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(F,OH)_9$



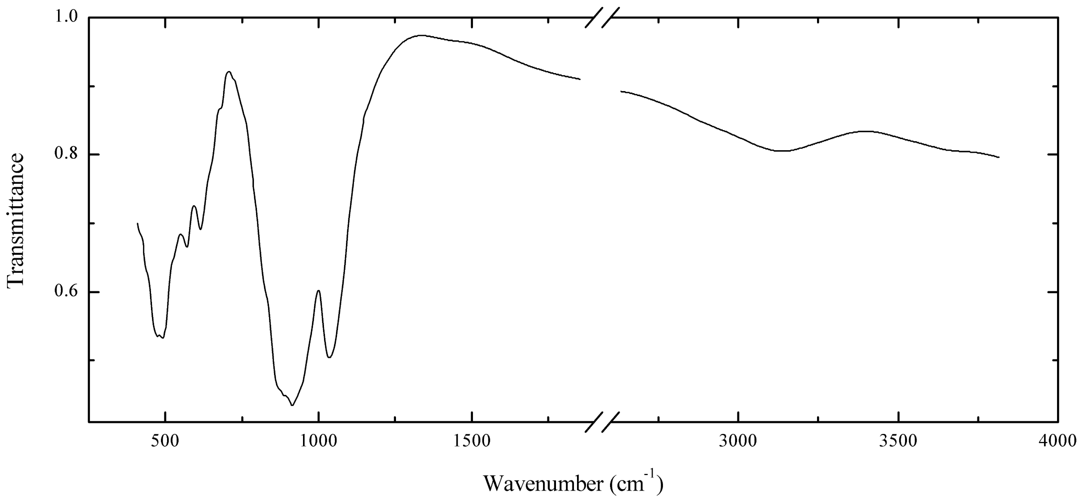
Locality: Abandoned Lupikko iron mine, Pitkäranta, Karelia, Russia (type locality).
Description: Light grey acicular crystals from the association with sphalerite and clinochlore. Optically uniaxial (−), $\omega = 1.692(1)$, $\varepsilon = 1.689(1)$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3620w, 3530, 3380sh, 3160sh, 1080sh, 1017s, 980s, 915sh, 905, 855sh, 797, 640, 605, 580, 490, 473, 447s, 410sh.

Siod13 Ganomalite $Pb_9Ca_5Mn(SiO_4)[Si_2O_7]_4O$



Locality: Jakobsberg mine, Nordmark, Filipstad, Värmland, Sweden.
Description: Colourless grain from skarn. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1009, 915s, 880sh, 867s, 820, 675, 566, 530sh, 522, 480, 460.

Siod14 Ferriallanite-(Ce) $CeCa(Fe^{3+}AlFe^{2+})(Si_2O_7)(SiO_4)O(OH)$

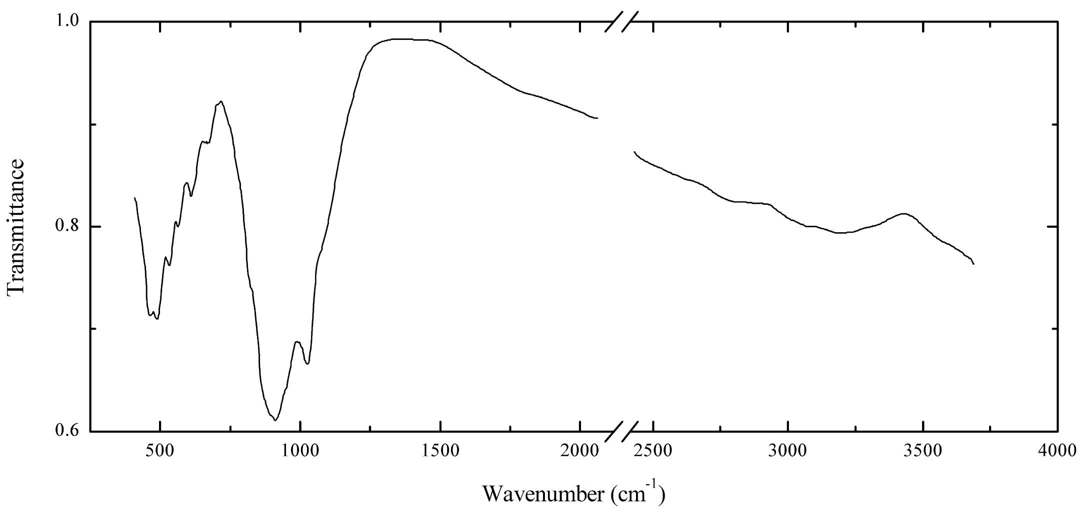


Locality: Biraya deposite, Irkutsk region, Siberia, Russia.

Description: Black grains from the association with biraite-(Ce), cordylite-(Ce), cordylite-(La), aragonite, strontianite, dolomite, ancylite-(Ce), ancylite-(La), hydroxylbastnasite-(Ce), daqingshanite-(Ce), daqingshanite-(La), tremolite, winchite, tornebohmite-(Ce), cerite, chevkinite-(Ce), belkovite, humite, fergusonite-(Ce), fergusonite-(Nd), pyrochlore, barite and monazite-(Ce). Investigated by P.M. Kartashov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3135, 1038s, 945sh, 917s, 894s, 875sh, 830sh, 680sh, 645sh, 614, 567, 530sh, 489s, 478s, 440sh.

Siod15 Soro-nesosilicate Siod15 $Ce_3Ca(Fe,Mg)_2(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)_3(O,OH)_2F$ (?)

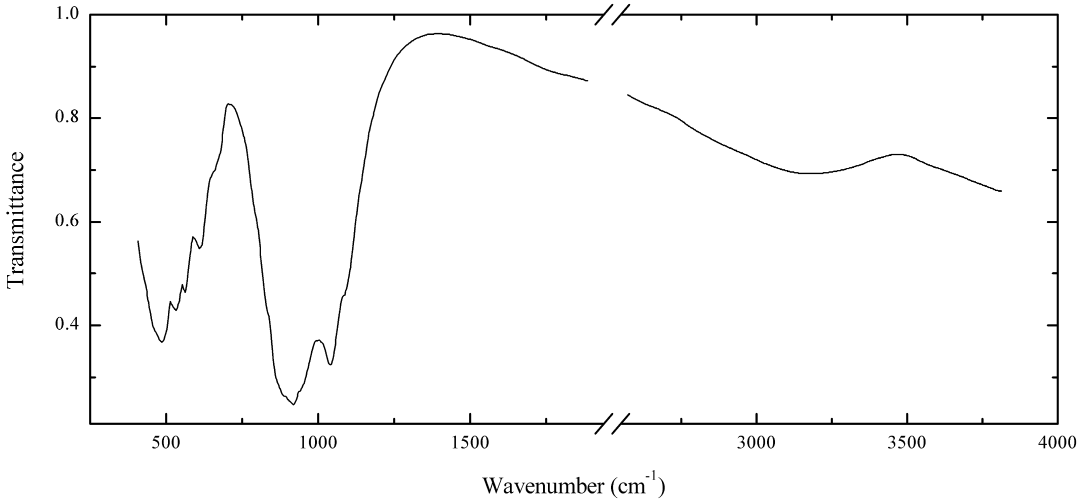


Locality: Biraya deposite, Irkutsk region, Siberia, Russia.

Description: Black grains from the association with ferriallanite-(Ce), biraite-(Ce), cordylite-(Ce), cordylite-(La), aragonite, strontianite, dolomite, ancylite-(Ce), ancylite-(La), hydroxylbastnasite-(Ce), daqingshanite-(Ce), daqingshanite-(La), tremolite, winchite, tornebohmite-(Ce), cerite, chevkinite-(Ce), belkovite, humite, fergusonite-(Ce), fergusonite-(Nd), pyrochlore, barite and monazite-(Ce). Related to västmanlandite-(Ce) and gatelite-(Ce). Investigated by P.M. Kartashov.

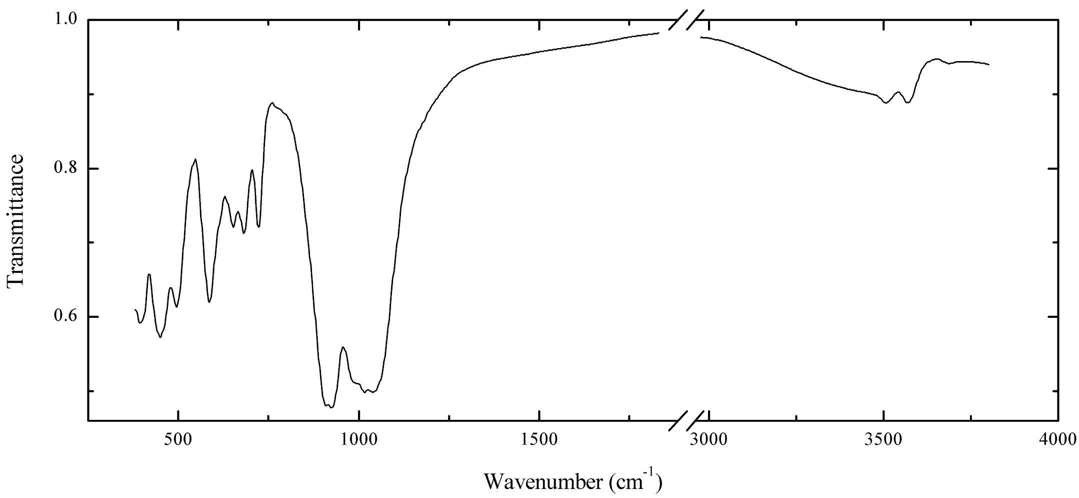
Wavenumbers (cm^{-1}): 3170, 1080sh, 1028s, 945sh, 915s, 895sh, 830sh, 665, 612, 563, 532, 492s, 465s, 420sh.

Siod16 Soro-nesosilicate Siod16 $Ce_3Ca(Fe,Mg)_2(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)_3(O,OH)_2F$ (?)



Locality: Biraya deposite, Irkutsk region, Siberia, Russia.
Description: Black grains from the association with ferriallanite-(Ce), biraite-(Ce), cordylite-(Ce), cordylite-(La), aragonite, strontianite, dolomite, ancylite-(Ce), ancylite-(La), hydroxylbastnasite-(Ce), daqingshanite-(Ce), daqingshanite-(La), tremolite, winchite, tornebohmite-(Ce), cerite, chevkinite-(Ce), belkovite, humite, fergusonite-(Ce), fergusonite-(Nd), pyrochlore, barite and monazite-(Ce). Related to västmanlandite-(Ce) and gatelite-(Ce). Investigated by P.M. Kartashov.
Wavenumbers (cm^{-1}): 3160, 1080sh, 1031s, 945sh, 917s, 895sh, 830sh, 660sh, 613, 562, 532, 492s, 475sh, 420sh.

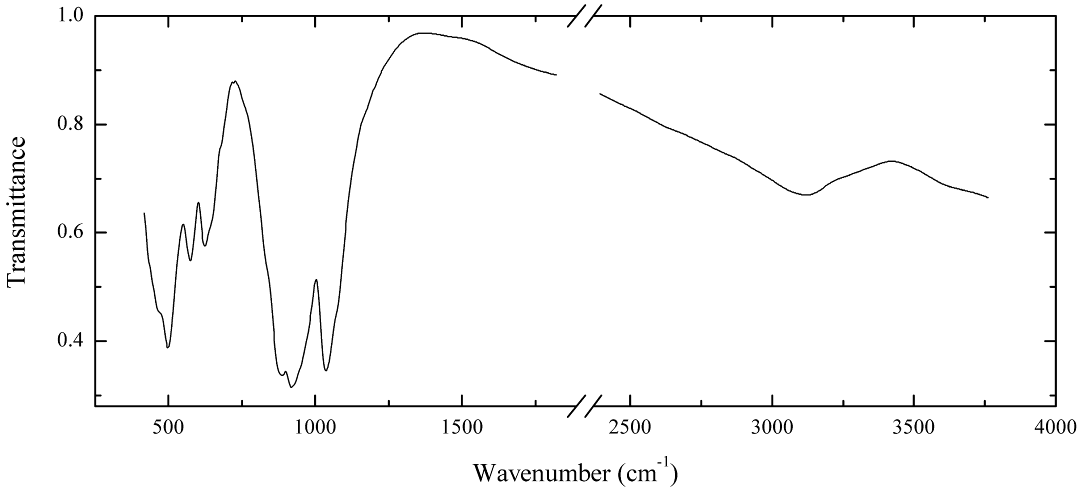
Siod17 Ferridissakisite-(Ce) $CeCa(Fe^{3+}AlMg)(Si_2O_7)(SiO_4)O(OH)$



Locality: Gem mine, San Benito Co., California, USA.
Description: Black grains from the association with other *REE* silicates. The empirical formula is (electron microprobe) $(Ce_{0.5}La_{0.3}Nd_{0.2})$ $Ca_{1.0}(Fe_{0.93}Al_{1.32}Mg_{0.75})Si_{3.00}O_{12}(OH)$.

Wavenumbers (cm^{-1}): 3540, 3475, 1610w, 1037s, 1025s, 985sh, 926s, 910s, 721, 681, 654, 584, 495, 452, 399.

Siod18 Ferriallanite-(Ce) $CeCa(Fe^{3+}AlFe^{2+})(Si_2O_7)(SiO_4)O(OH)$

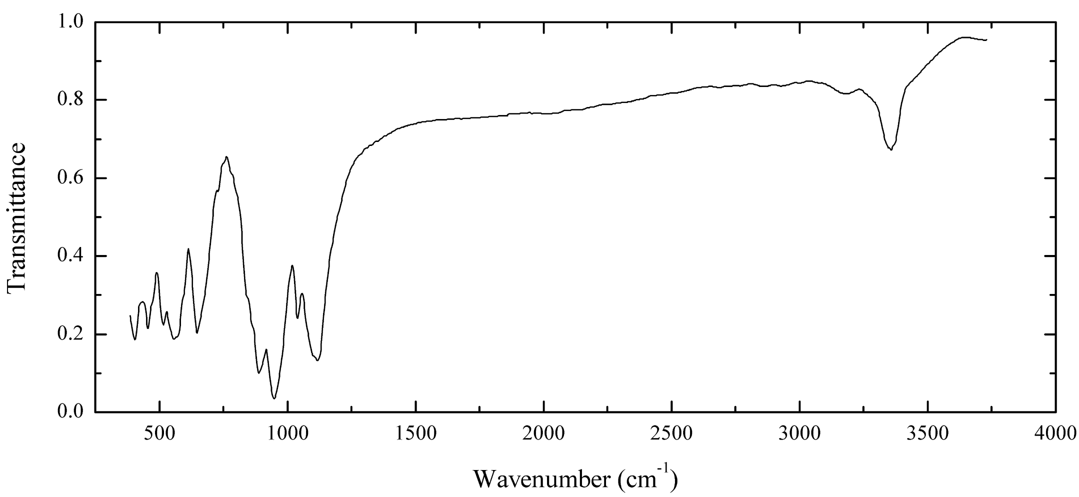


Locality: Barkevik, Langesundsfjorden, Larvik, Vestfold, Norway.

Description: Black grains from the association with amphiboles, biotite and zircon. The empirical formula is (electron microprobe) $(Ce_{0.52}La_{0.31}Nd_{0.13}Pr_{0.07}Sm_{0.04}Y_{0.03})Ca_{0.91}(Fe_{1.78}Al_{1.01}Mg_{0.14}Mn_{0.05})Si_{3.00}O_{12}(OH)$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3115, 1037s, 920s, 888s, 865sh, 680sh, 640sh, 618, 570, 496s, 465sh, 420sh.

Siod19 Clinozoisite $Ca_2Al_3(Si_2O_7)(SiO_4)O(OH)$

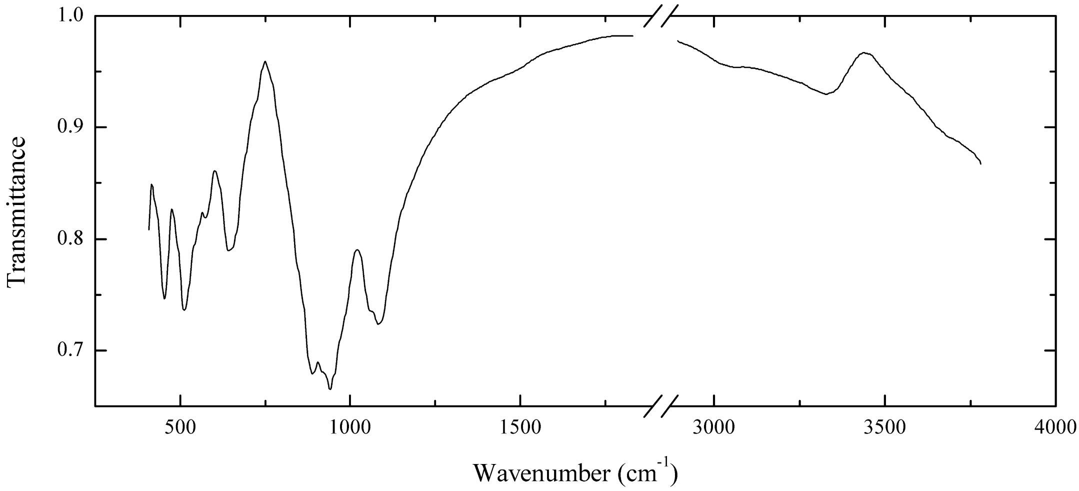


Locality: Crosetto talc mine, Prali, Val Germanasca (Germanasca valley), Torino province, Piedmont, Italy.

Description: Brownish-green crystals from the association with dravite and amphibole. The empirical formula is (electron microprobe) $(Ca_{1.90}Sr_{0.04}Y_{0.04}Na_{0.04})(Al_{2.74}Fe_{0.16}Mn_{0.07}Mg_{0.04})Si_{3.00}O_{12}(OH)$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3340, 3165w, 1121s, 1110sh, 1080sh, 1041, 975sh, 952s, 891s, 867, 845sh, 732w, 675sh, 650, 595sh, 573, 558, 517, 470sh, 456, 404.

Siod20 Allanite-(Ce) $CeCa(Al_2Fe^{2+})(Si_2O_7)(SiO_4)O(OH)$

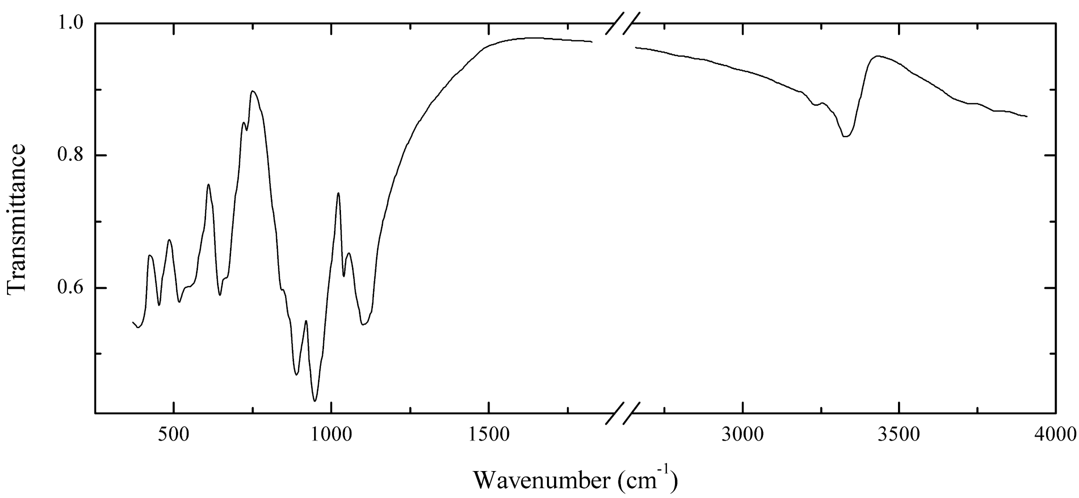


Locality: Crosetto talc mine, Prali, Val Germanasca (Germanasca valley), Torino province, Piedmont, Italy.

Description: Black grain. The empirical formula is (electron microprobe) $(Ce_{0.3}La_{0.1}Nd_{0.1}Y_{0.1})Ca_{1.4}(Al_{2.3}Fe_{0.4}Mg_{0.3})Si_{3.0}O_{12}(OH)$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3300, 1085s, 1060sh, 980sh, 942s, 890s, 645, 574, 513s, 455s.

Siod21 Epidote $Ca_2(Al_2Fe^{3+})(Si_2O_7)(SiO_4)O(OH)$

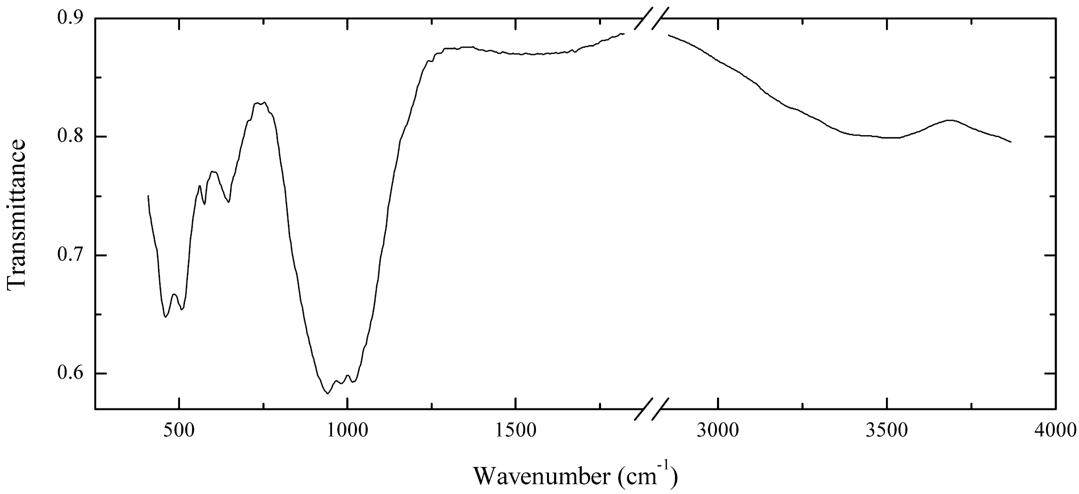


Locality: Crosetto talc mine, Prali, Val Germanasca (Germanasca valley), Torino province, Piedmont, Italy.

Description: Dark green crystals from the association with tourmaline and amphibole. The empirical formula is (electron microprobe) $(Ca_{1.97}Sr_{0.04}Ce_{0.03})(Al_{2.15}Fe_{0.81}Mn_{0.03})Si_{3.00}O_{12}(OH)$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3318, 3220w, 1107s, 1041, 951s, 887s, 865sh, 844, 730w, 665sh, 647, 590sh, 560sh, 516, 456, 380s.

Siod22 Allanite-(Y) $YCa(Al_2Fe^{2+})(Si_2O_7)(SiO_4)O(OH)$

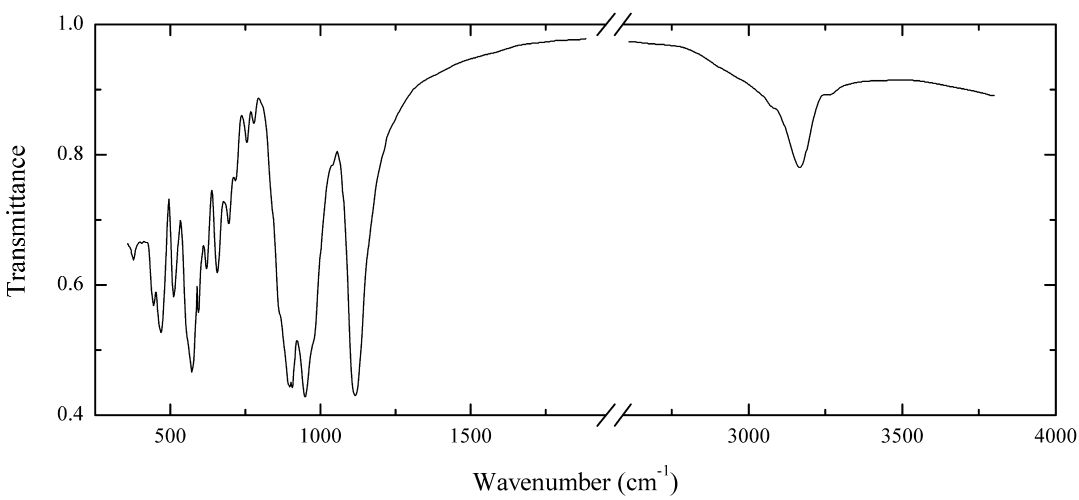


Locality: Åskagen deposit, near Filipstad, Värmland, Sweden.

Description: Black grains from the association with quartz, microcline, iimoriite-(Y), allanite-(Nd) and bastnäsite-(Ce). The empirical formula is (electron microprobe) $(Y_{0.24}Nd_{0.19}Sm_{0.14}Gd_{0.10}Dy_{0.04}Pr_{0.03}Ce_{0.03}Er_{0.02}La_{0.01})Ca_{1.10}Mn_{0.06}(Al_{2.01}Fe_{0.95}Mg_{0.04})Si_{3.00}O_{12}(OH)$.

Wavenumbers (cm^{-1}): 3380, 1050sh, 1015s, 980s, 938s, 647, 576, 509, 457, 425sh.

Siod28 Zoisite $Ca_2Al_3(Si_2O_7)(SiO_4)O(OH)$

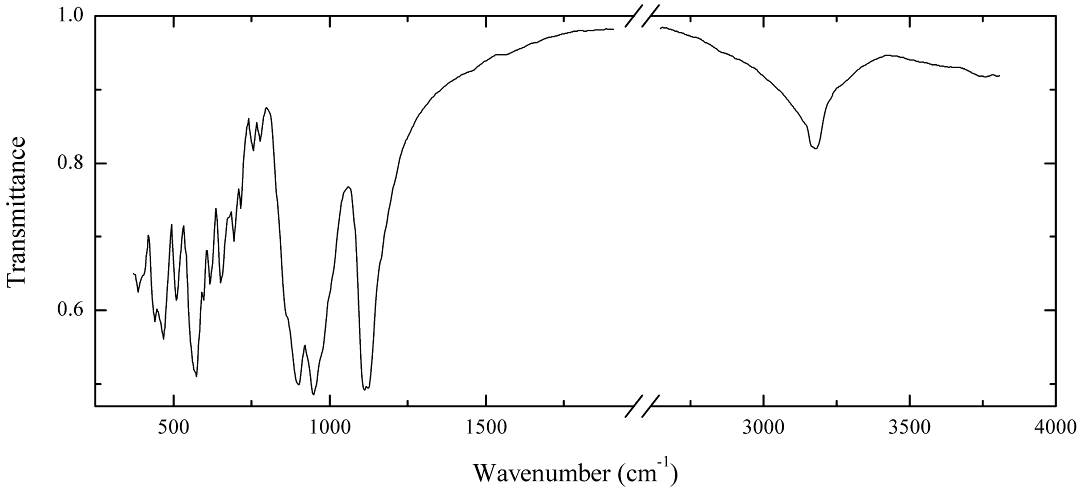


Locality: Tormiq (Tormic, Turmiq) valley, Haramosh Mts., Skardu district, Gilgit, Pakistan.

Description: Pale brownish-green crystal. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3350sh, 3157, 3070sh, 1113s, 975sh, 948s, 906s, 899s, 880sh, 778w, 753w, 715, 694, 654, 619, 594, 572s, 560sh, 509, 468, 443, 377.

Siod29 Zoisite $Ca_2Al_3(Si_2O_7)(SiO_4)O(OH)$

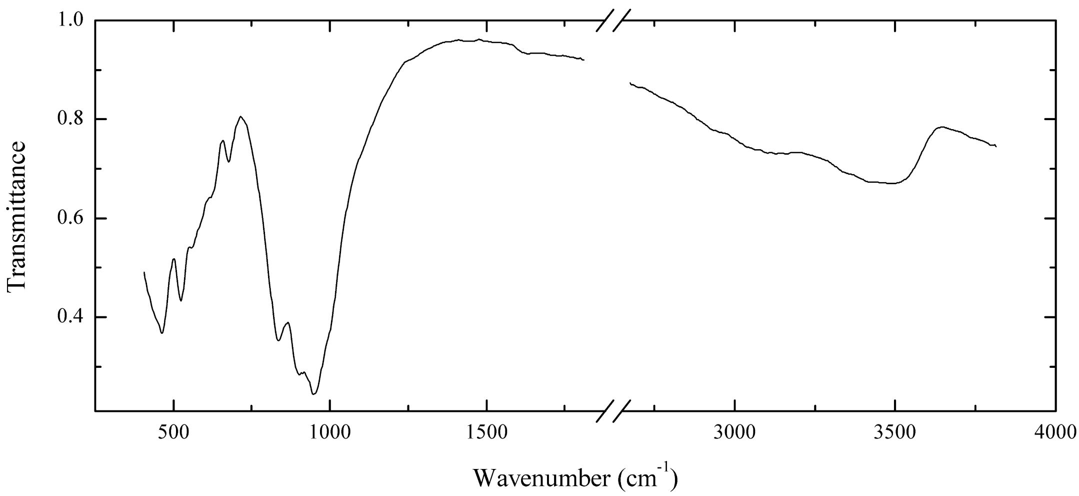


Locality: Merelani Hills, Lelatema Mts., Arusha region, Tanzania.

Description: Bluish-grey transparent crystal. The empirical formula is (electron microprobe) $Ca_{1.98}Al_{2.98}Fe_{0.01}Si_{3.02}O_{12}(OH)$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3150, 1120s, 1112s, 975sh, 948s, 901s, 865sh, 777w, 754w, 715, 694, 654, 619, 603, 574s, 560sh, 509, 467s, 444, 400sh, 379.

Siod30 Pumpellyite-(Fe^{2+}) $Ca_2Fe^{2+}(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)(OH)_2{\cdot}H_2O$

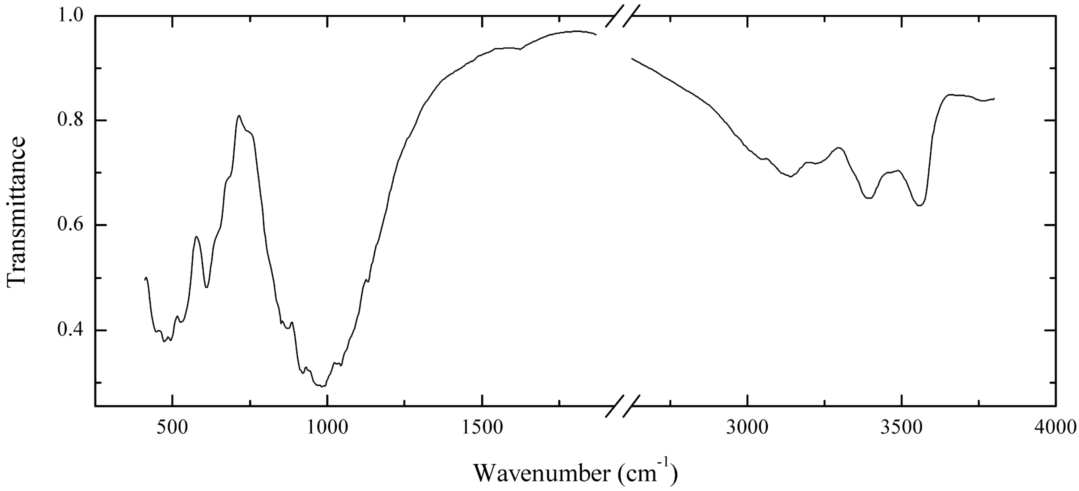


Locality: Ivakin Creek, Noril'sk district, Krasnoyarskiy Krai, Putorana Plateau, Siberia, Russia (type locality).

Description: Dark green spherulites from the association with prehnite, babingtonite, clinopyroxene and calcite. The empirical formula is (electron microprobe) $Ca_{1.97}(Fe_{0.90}Mg_{0.08})(Al_{1.02}Fe_{0.98})Si_{3.00}O_{11}(OH,H_2O)_3$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3450. 3120, 2940sh, 1620w, 948s, 902s, 833s, 675, 610sh, 557, 528, 465s.

Siod31 Pumpellyite-(Mg) $Ca_2Mg(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)(OH)_2{\cdot}H_2O$

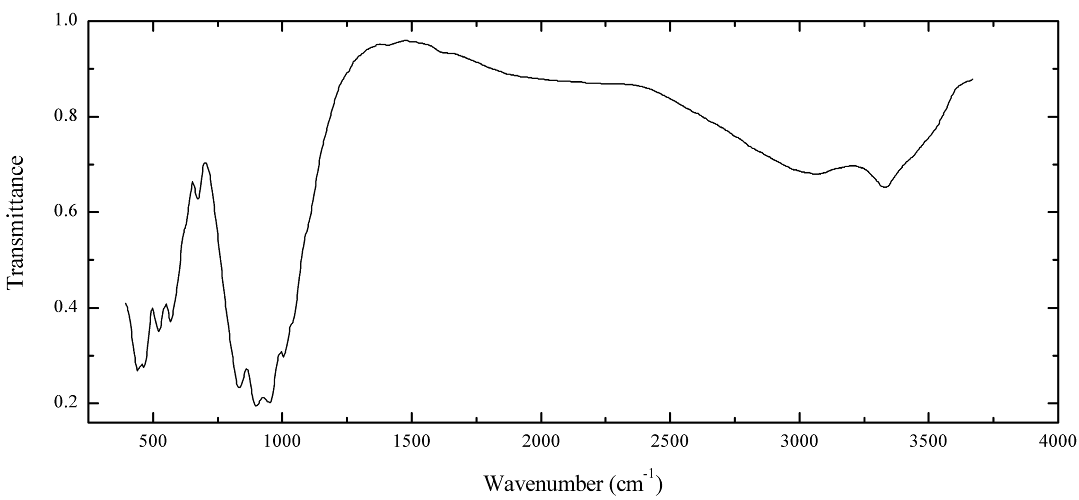


Locality: Shun'ga village, Karelia, Russia.

Description: White fibrous veinlet in shungite. Al-rich variety. The empirical formula is (electron microprobe) $Ca_{2.0}(Mg_{0.5}Al_{0.4}Fe_{0.1})Al_{2.0}Si_{3.0}O_{11}(OH,H_2O)_3$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3545, 3385, 3220, 3125, 3040, 1625w, 1132, 1075sh, 1040s, 977s, 921s, 871, 685sh, 645sh, 610, 528, 495, 473, 450.

Siod32 Julgoldite-(Fe^{2+}) $Ca_2Fe^{2+}Fe^{3+}{}_2(Si_2O_7)(SiO_4)(OH)_2{\cdot}H_2O$

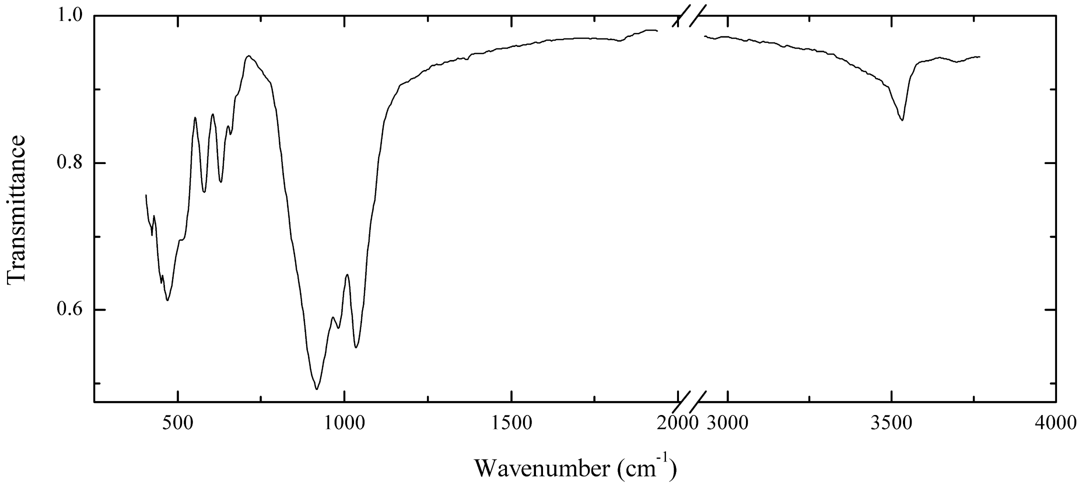


Locality: Kreimbach, Wolfstein, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Black crusts from the association with calcite. The empirical formula is (electron microprobe) $Ca_{1.99}(Fe_{2.77}Al_{0.16}Mg_{0.08})Si_{3.00}O_{11}(OH,H_2O)_3$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3320, 3060, 1636w, 1100sh, 1040sh, 1007, 954s, 897s, 834s, 678w, 620sh, 569, 519, 460s, 442s.

Siod33 Dollaseite-(Ce) $CeCa(Mg_2Al)(Si_2O_7)(SiO_4)F(OH)$

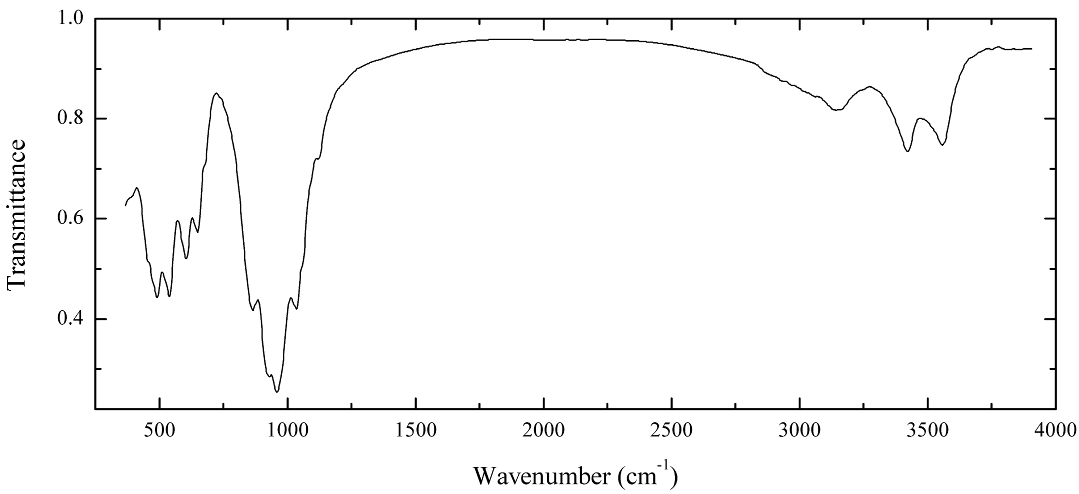


Locality: Östanmossa mine, Morberg district, Västmanland, Sweden (type locality).

Description: Brown grains from the association with dolomite, magnetite and amphibole. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3500, 1085sh, 1036s, 983, 920s, 825sh, 680sh, 660, 629, 579, 515, 470, 450, 422, 395sh.

Siod34 Pumpellyite-(Mg) $Ca_2Mg(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)(OH)_2{\cdot}H_2O$

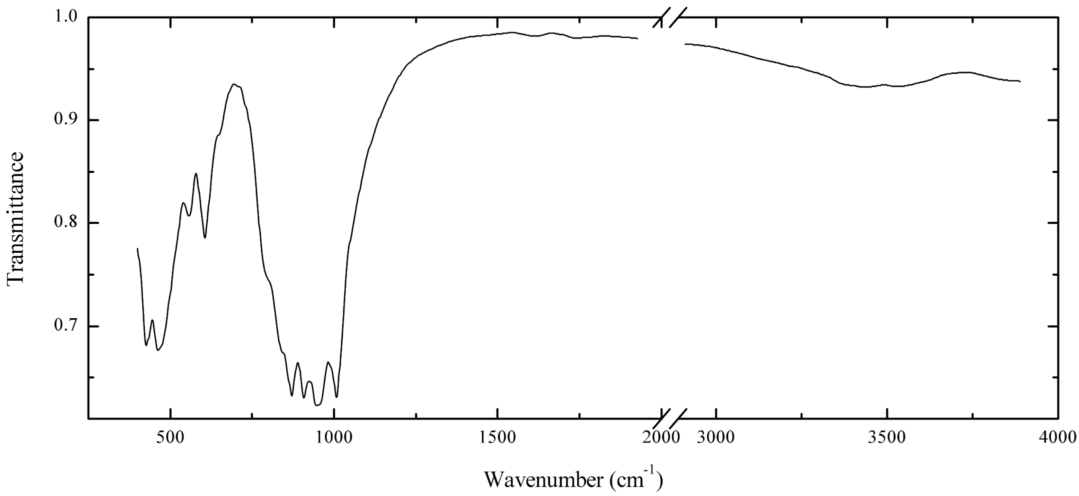


Locality: Isle Royal National Park, Michigan, USA.

Description: Greenish-grey spherulites. Confirmed by IR spectrum and qualitative electron microprobe analysis. H_2O-deficient variety.

Wavenumbers (cm^{-1}): 3535, 3500sh, 3400, 3125, 1125wm 1085sh, 1055sh, 1036s, 960s, 927s, 865s, 680sh, 651, 609, 600sh, 540s, 525sh, 494s, 475sh, 460sh, 400sh.

Siod35 Vesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}[SiO_4]_{10}[Si_2O_7]_4O(OH,O,F)_9$

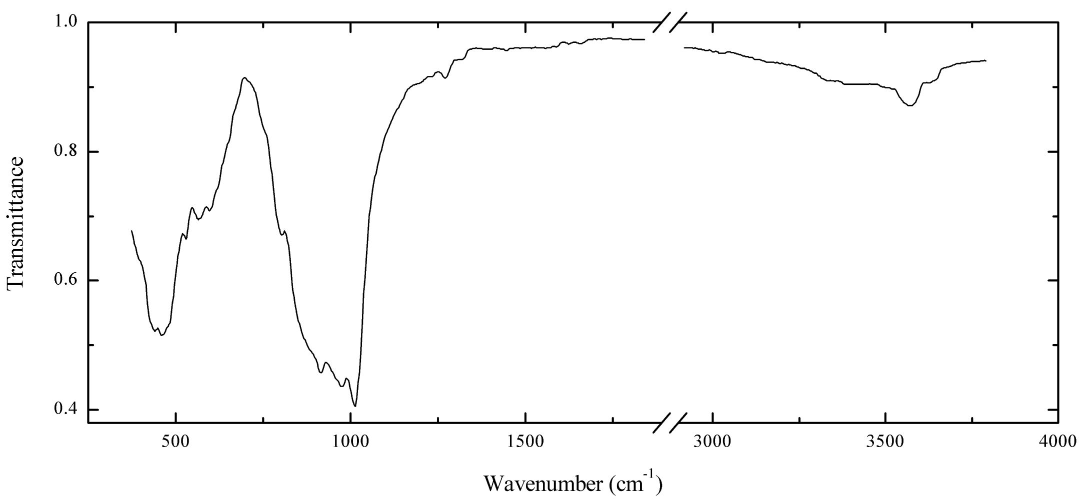


Locality: Kombat mine, Kombat, Grootfontein district, Otjozondjupa region, Namibia.

Description: Brown transparent grains. Confirmed by IR spectrum. The empirical formula is $Ca_{11.7}La_{0.2}Ce_{0.1}(Al_{6.2}Mg_{3.4}Fe_{2.9}Mn_{0.3}Ti_{0.1})Si_{18.0}(O,OH,F)_{78}$.

Wavenumbers (cm^{-1}): 3530w, 3390w, 1009s, 951s, 910s, 869s, 845, 800sh, 645sh, 607, 559, 468, 427.

Siod36 Manganvesuvianite $Ca_{19}Mn^{3+}(Al,Mn^{3+},Fe^{3+})_{10}Mg_2[SiO_4]_{10}[Si_2O_7]_4O(OH)_9$

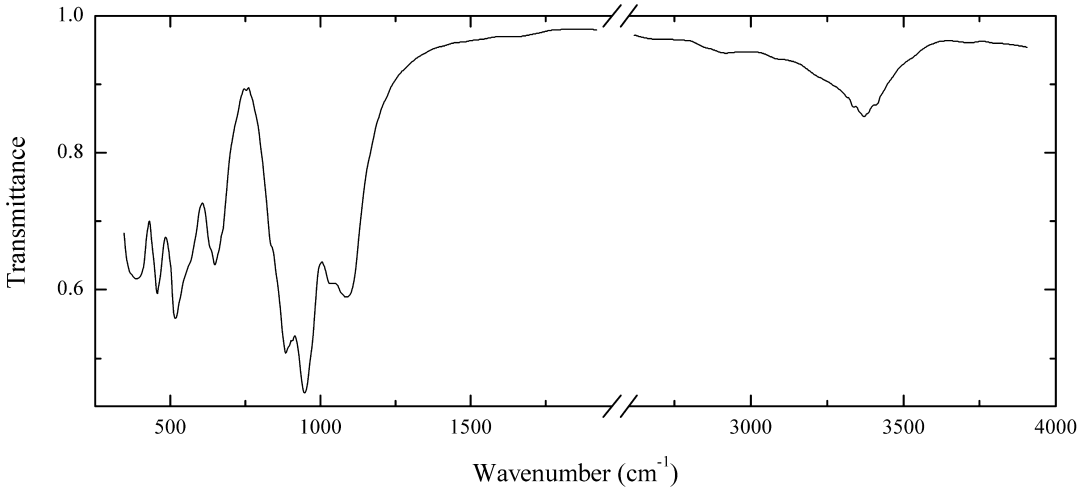


Locality: Franklin mine, Franklin, Sussex Co., New Jersey, USA (type locality).

Description: Reddish-brown grains. Confirmed by IR spectrum. The empirical formula is $Ca_{18.6}Mn_{1.3}Al_{7.8}Mg_{2.5}Fe_{1.5}Zn_{0.7}Si_{17.8}O_{69}(OH)_9$. Weak bands at 1,320, 1,280 and 1,175 cm^{-1} indicate the presence of trace amount of the groups BO_3^{3-}.

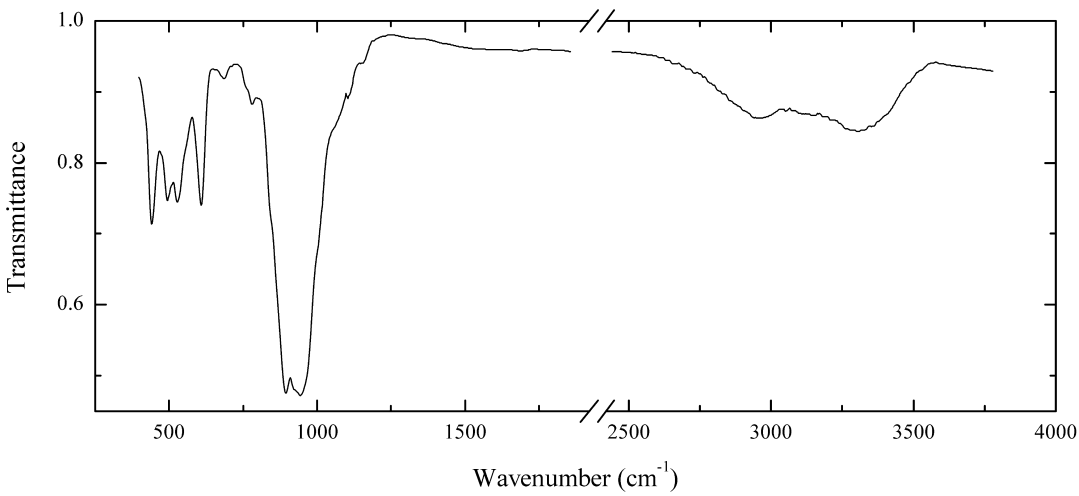
Wavenumbers (cm^{-1}): 3615w, 3555, 3400sh, 3330sh, 1320w, 1280w, 1175sh, 1013s, 978s, 960sh, 916s, 890sh, 880sh, 803, 770sh, 610sh, 592, 569, 523, 480sh, 460, 440.

Siod37 Piemontite $Ca_2(Al_2Mn^{3+})(Si_2O_7)(SiO_4)O(OH)$



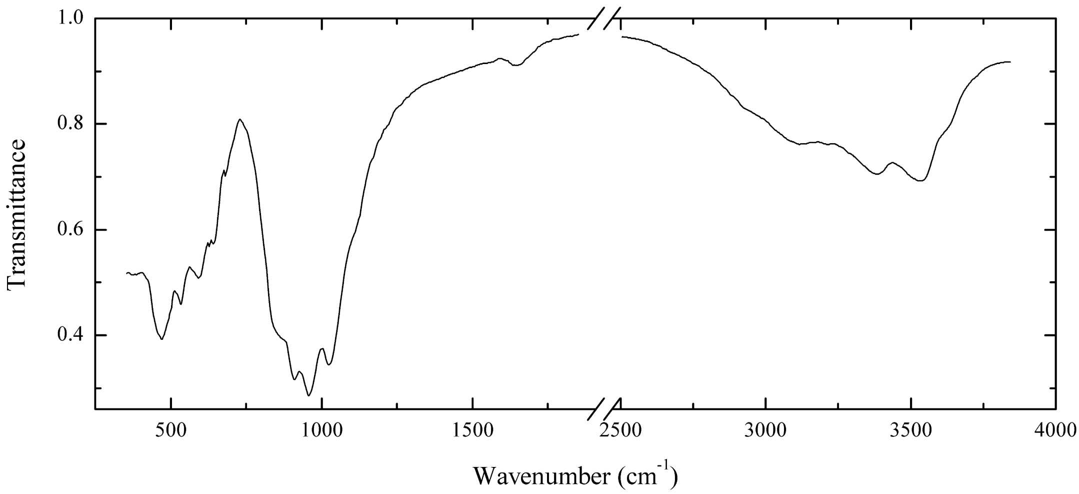
Locality: Gambatesa mine, Reppia, Val Graveglia (Graveglia valley), Genova province, Liguria, Italy.
Description: Purplish-red crystals. The empirical formula is (electron microprobe) $Ca_{1.95}Mn_{0.85}Al_{2.00}Fe_{0.20}Si_{3.0}O_{12}(OH)$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3365, 1087s, 1035, 947s, 876s, 645, 630sh, 550sh, 515s, 454, 385.

Siod38 Macfallite $Ca_2Mn^{3+}{}_3(Si_2O_7)(SiO_4)(OH)_3$



Locality: East of Manganese Lake, Copper Harbor, Keweenaw Co., Michigan, USA (type locality).
Description: Reddish-brown radial aggregate from the association with manganite and braunite.
Wavenumbers (cm^{-1}): 3280, 2930, 1148w, 1103w, 1060sh, 960sh, 941s, 925sh, 892s, 845sh, 780w, 760sh, 681w, 605, 526, 493, 440, 420sh.

Siod39 Pumpellyite-(Mn^{2+}) $Ca_2Mn^{2+}(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)(OH)_2 \cdot H_2O$

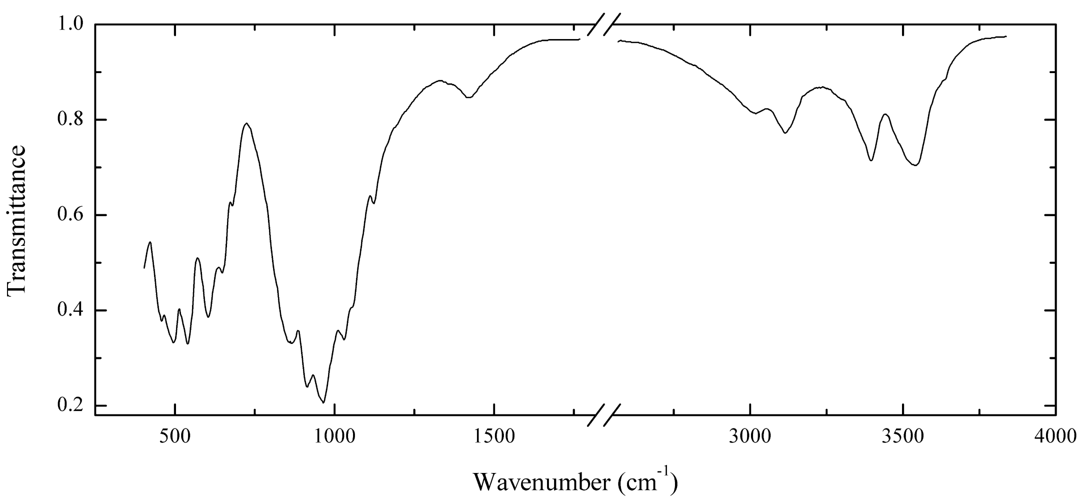


Locality: Bikkulovskoe Mn deposit, South Urals, Russia.

Description: Brownish-grey massive. The empirical formula is (electron microprobe) $Ca_{1.83}(Mn_{0.51}Fe_{0.35}Mg_{0.28})Al_{2.01}Si_{3.00}O_{11}(OH,H_2O)_3$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3600sh, 3522, 3375, 3110, 2950sh, 1640w, 1030s, 963s, 913s, 860sh, 684w, 642, 601, 536, 472s.

Siod40 Pumpellyite-(Mg) $Ca_2Mg(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)(OH)_2 \cdot H_2O$

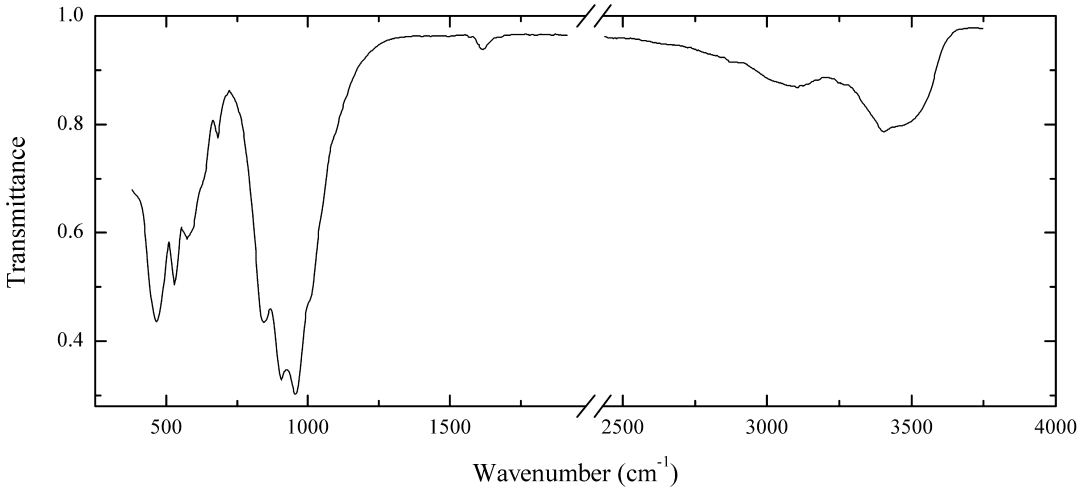


Locality: Saranovskoe Cr deposit, Perm region, Middle Urals, Russia.

Description: Brownish-grey fibrous aggregate from the association with uvarovite, calcite and chromite. Cr-rich variety. The empirical formula is (electron microprobe) $Ca_{1.88}Mg_{0.95}Al_{1.96}Cr_{0.19}Fe_{0.03}Si_{2.94}O_{11}(OH,H_2O)_3$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3545, 3410, 3130, 3050sh, 1630w, 1131, 1065sh, 1036s, 964s, 916s, 870s, 681, 649, 604, 538s, 493s, 455.

Siod41 Pumpellyite-(Fe^{3+}) $Ca_2Fe^{3+}(Al,Fe^{3+})_2(Si_2O_7)(SiO_4)O(OH)\cdot H_2O$

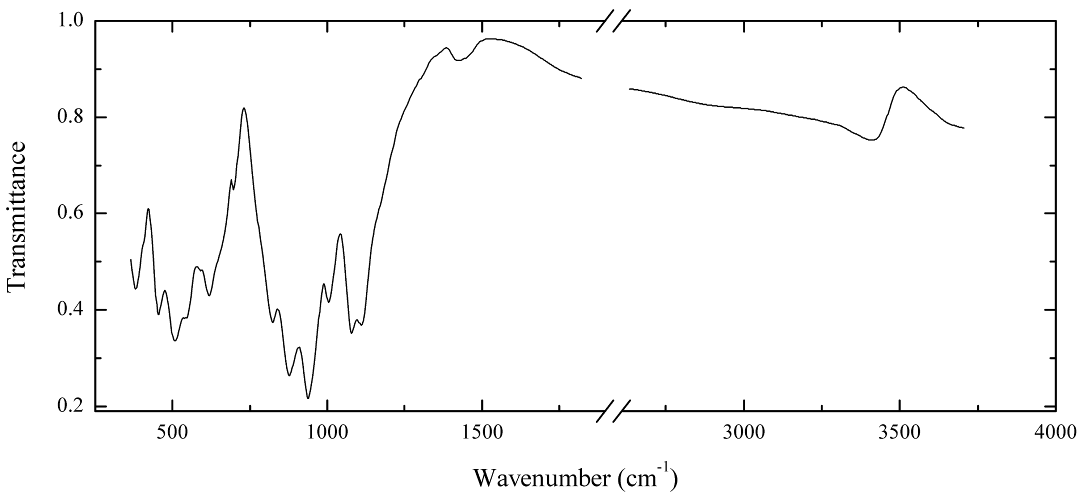


Locality: Rauschenmühle, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

Description: Grey-green spherulites from the association with pectolite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3450sh, 3400, 3090, 1620w, 1100sh, 1005sh, 956s, 906s, 845s, 679, 620sh, 576, 529, 466s.

Siod42 Piemontite-(Sr) $SrCa(Al_2Mn^{3+})(Si_2O_7)(SiO_4)O(OH)$

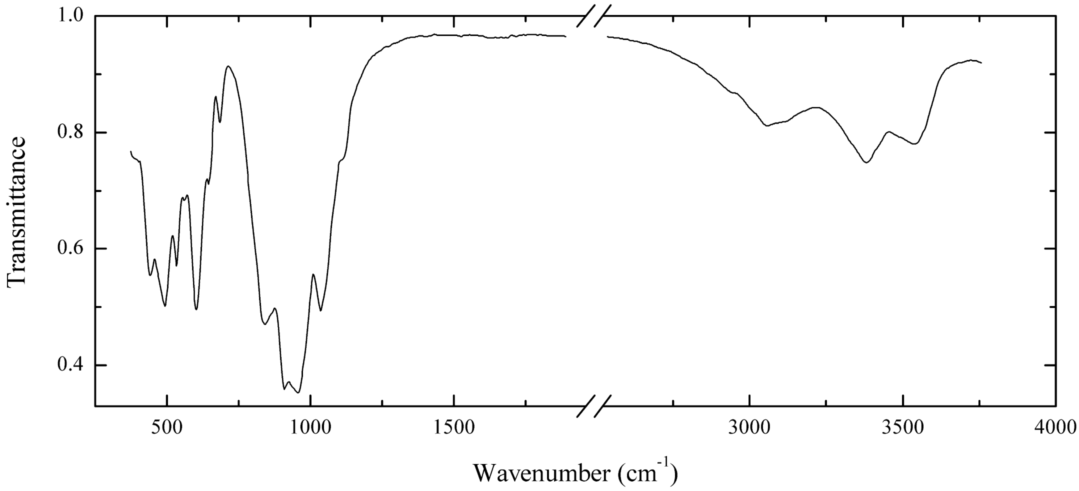


Locality: N'Chwaning mine, Kalahari manganese fields, Northern Cape province, South Africa.

Description: Purplish-red long-prismatic crystals from the association with epidote-(Sr) and rhodochrosite. The empirical formula is (electron microprobe) $Sr_{1.0}Ca_{1.0}Al_{1.5}Mn_{0.9}Fe_{0.6}Si_{3.0}O_{12}(OH)$. Confirmed by IR spectrum. Weak band at 1,430 cm^{-1} corresponds to the admixture of rhodochrosite.

Wavenumbers (cm^{-1}): 3425, 1430w, 1113s, 1082s, 1007, 940s, 878s, 824, 695w, 645sh, 617, 540, 501s, 448, 375.

Siod43 **Shuiskite** $Ca_2Mg(Cr,Al)_2(Si_2O_7)(SiO_4)(OH)_2{\cdot}H_2O$

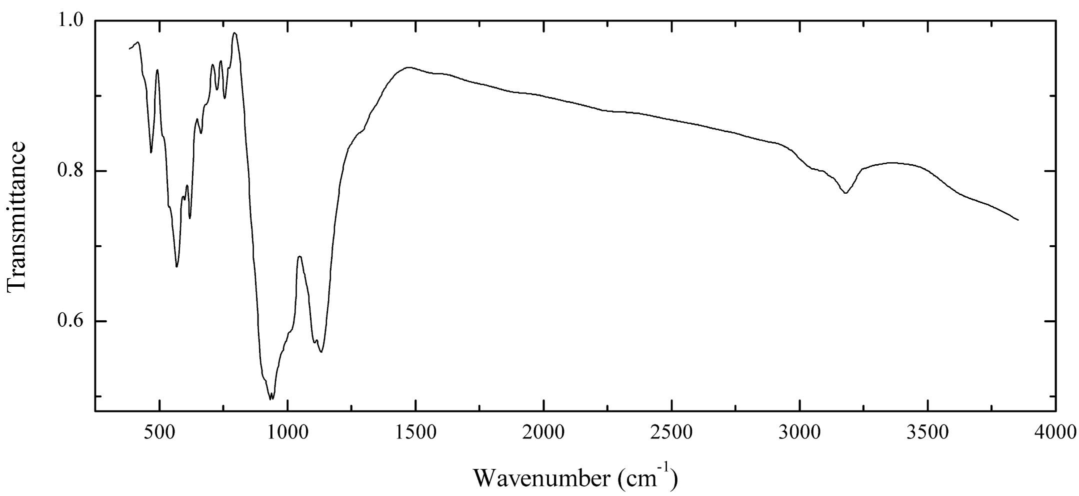


Locality: Saranovskoe Cr deposit, Perm region, Middle Urals, Russia.

Description: Violet-grey acicular crystals from the association with uvarovite, calcite and chromite. Cr-rich variety. The empirical formula is (electron microprobe) $Ca_{2.01}(Mg_{0.59}Al_{0.35}Fe_{0.02})(Cr_{1.17}Al_{0.83})Si_{3.00}O_{11}(OH,O)_2{\cdot}H_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3518, 3360, 3100sh, 3045, 1635w, 1105sh, 1055sh, 1034s, 955s, 940sh, 908s, 860sh, 840s, 682w, 642, 601, 559, 531, 491s, 439.

Siod44 **Zoisite** $Ca_2Al_3(Si_2O_7)(SiO_4)O(OH)$

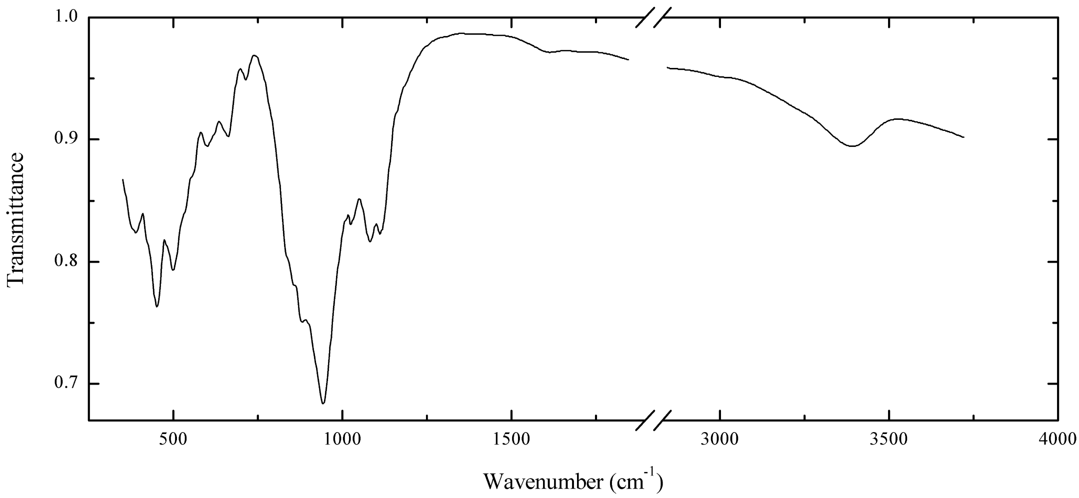


Locality: Unknown.

Description: Pale brownish-lilac crystal. Ca-deficient Na-bearing variety. The empirical formula is (electron microprobe) $Ca_{1.7}Na_{0.2}Al_{2.9}Mn_{0.1}Si_{3.0}O_{11}(OH,O)_2$.

Wavenumbers (cm^{-1}): 3158, 3050sh, 1130s, 1103s, 1010sh, 945s, 931s, 910sh, 774w, 755, 726, 680sh, 662, 621, 600, 573, 542, 511, 469, 440sh.

Siod45 Epidote-(Pb) (formerly "hancockite") $PbCa(Al_2Fe^{3+})(Si_2O_7)(SiO_4)O(OH)$

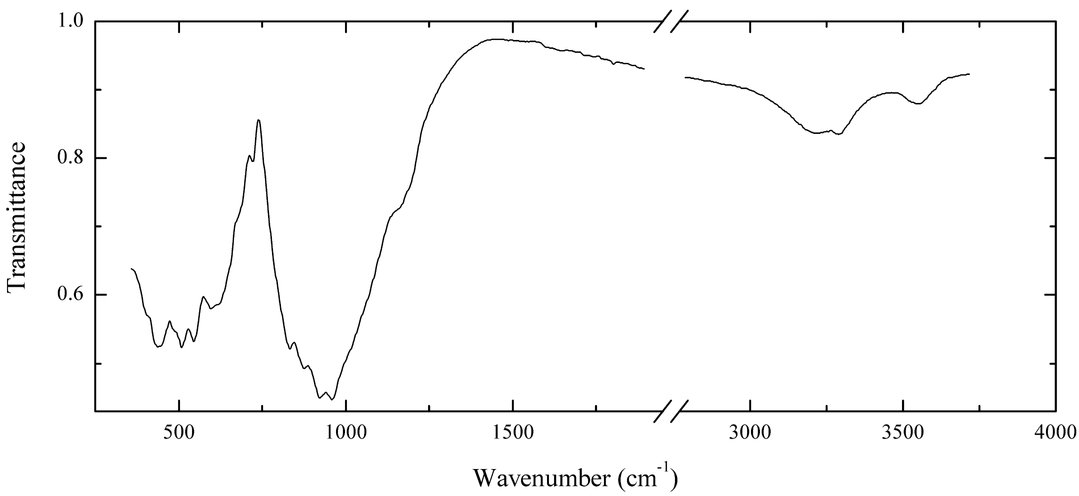


Locality: Franklin mine, Franklin, Sussex Co., New Jersey, USA (type locality).

Description: Brownish-red grains from the association with andradite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3370w, 1115, 1083, 1031, 944s, 884s, 855sh, 840sh, 718w, 663, 606, 560sh, 535sh, 502, 455s, 430sh, 405.

Siod46 Sursassite $Mn^{2+}{}_2Al_3(Si_2O_7)(SiO_4)(OH)_3$

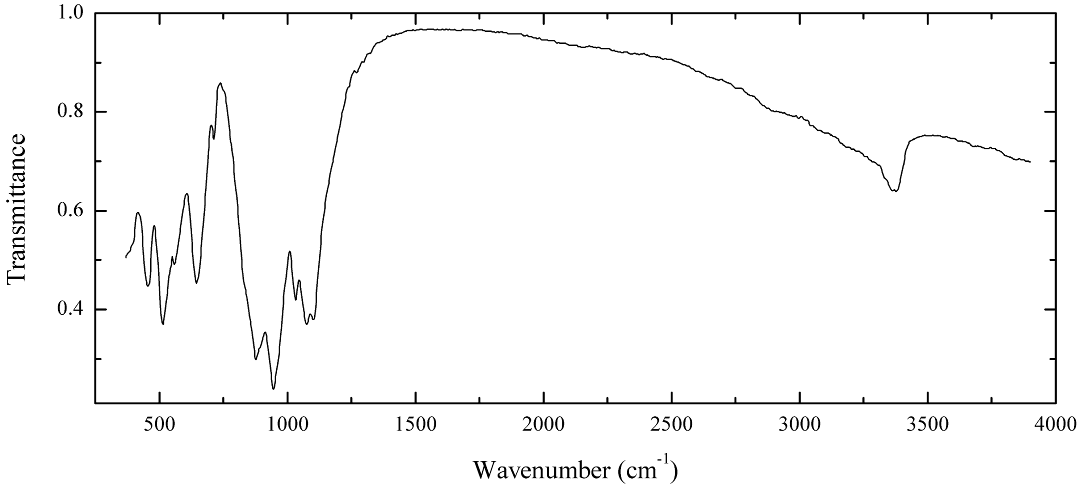


Locality: Oberhalbstein, Albula valley, Grischun (Graubünden), Switzerland (type locality).

Description: Reddish-brown fibrous aggregate from the association with quartz, barite and braunite.

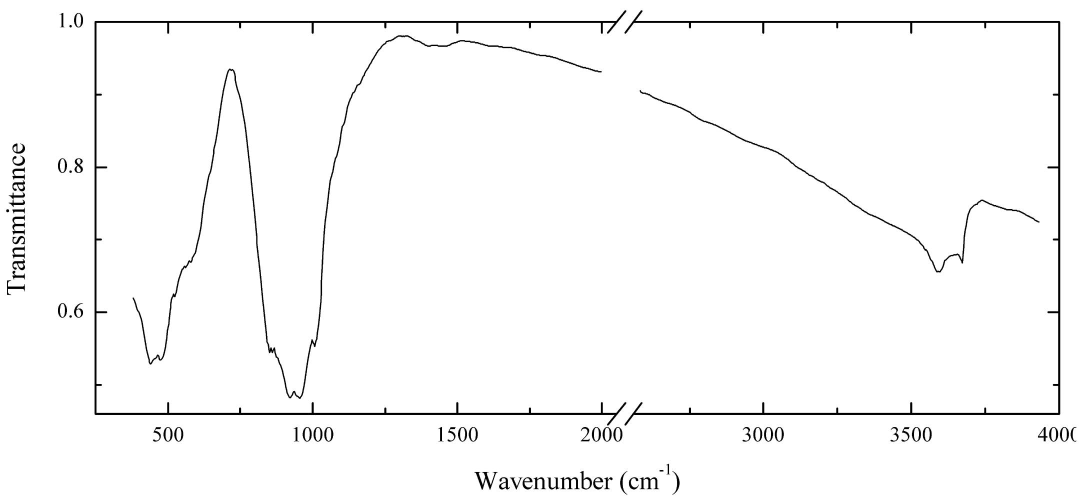
Wavenumbers (cm^{-1}): 3505, 3250, 3190, 1160sh, 1005sh, 961s, 924s, 876, 834, 721w, 680sh, 650sh, 620sh, 598, 546, 510, 485sh, 440, 420sh.

Siod47 Epidote $Ca_2(Al_2Fe^{3+})(Si_2O_7)(SiO_4)O(OH)$



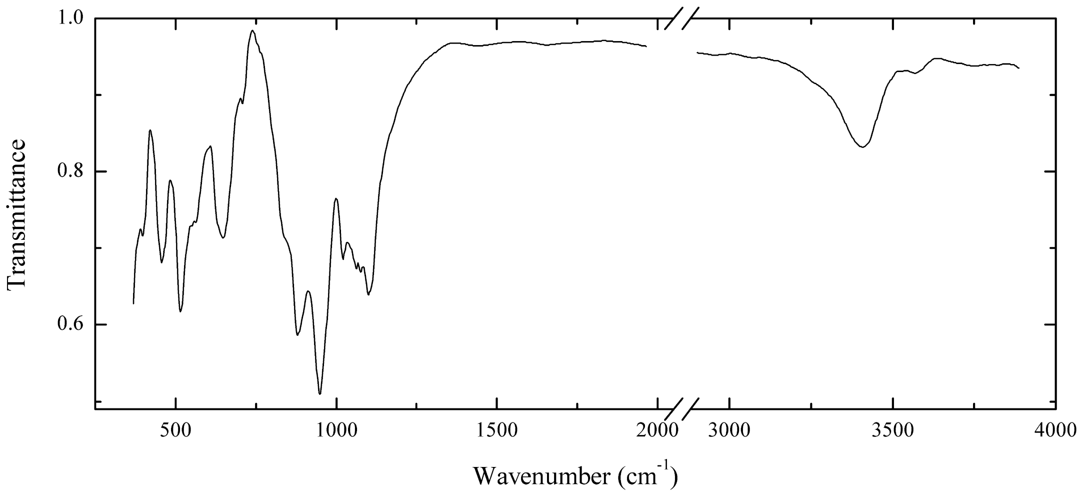
Locality: Tormiq (Tormic, Turmiq) valley, Haramosh Mts., Skardu district, Gilgit, Pakistan.
Description: Greenish-brown twinned crystals. The empirical formula is (electron microprobe) $Ca_{1.94}Sr_{0.02}(Al_{2.47}Fe_{0.54}Mn_{0.02})Si_{3.00}O_{12}(OH)$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3360, 1100s, 1074s, 1035, 945s, 890sh, 878s, 840sh, 711w, 645, 560, 513s, 453.

Siod48 Vesuvianite $Ca_{19}(Al,Mg,Fe^{3+})_{13}(SiO_4)_{10}(Si_2O_7)_4O(OH,O,F)_9$



Locality: Hirata outcrop, Kushiro, near Toyo railway station, northwest of Okayama city, Japan.
Description: Light grey granular aggregate from the association with grossular and gehlenite. Si-deficient variety ("hydrovesuvianite"). The empirical formula is (electron microprobe, OH calculated) $Ca_{18.2}Al_{11.2}Mg_{1.2}Fe_{0.6}(SiO_4)_{5.6}[(OH)_4]_{4.4}(Si_{2.0}O_7)O(OH,O)_9$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3650, 3580, 1450w, 1400w, 1005, 955s, 920s, 854, 570sh, 475s, 442s.

Siod49 Piemontite $Ca_2(Al_2Mn^{3+})(Si_2O_7)(SiO_4)O(OH)$

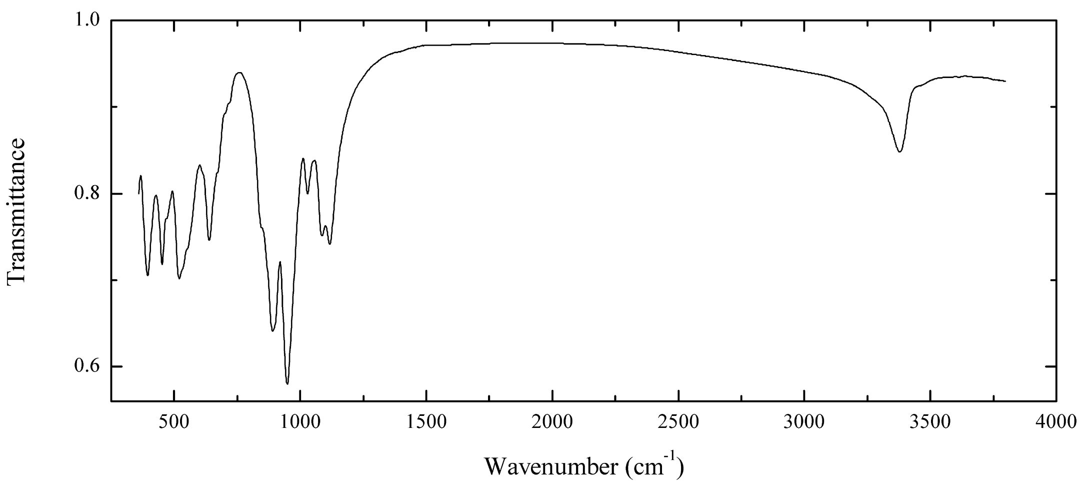


Locality: “Mixed Series” formation, near Nežilovo village, Jacupica Mountains, Macedonia.

Description: Dark red grains from the association with dolomite, barite, hematite, phlogopite, muscovite, richterite, nežilovite, gahnite, franklinite and tilasite. Pb-bearing variety. The empirical formula is (electron microprobe) $Ca_{1.85}Pb_{0.11}Al_{1.75}Mn_{0.80}Fe_{0.56}Si_{3.00}O_{12}(OH)$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3395, 1103s, 1077, 1060, 1023, 948s, 880s, 840sh, 710w, 645, 550sh, 515s, 456.

Siod51 “Galloepidote” $Ca_2Al_2Ga(Si_2O_7)(SiO_4)O(OH)$

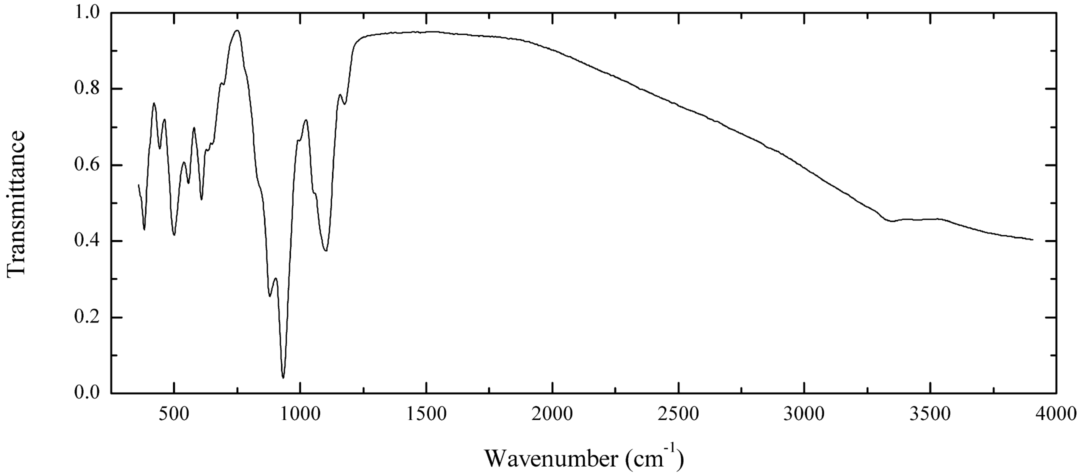


Locality: Synthetic.

Description: Ga-analogue of epidote. White, powdery. Synthesized by A.R. Kotelnikov. Investigated by D.A. Varlamov. The empirical formula is (electron microprobe) $Ca_{2.00}(Al_{2.00}Ga_{1.00})Si_{3.00}O_{12}(OH)$. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3379, 1117, 1087, 1029, 949s, 890s, 850sh, 720sh, 705sh, 670sh, 639, 550sh, 530sh, 520, 470sh, 452, 397.

Siod52 Piemontite-(Pb) $CaPbAl_2Mn^{3+}[Si_2O_7][SiO_4]O(OH)$

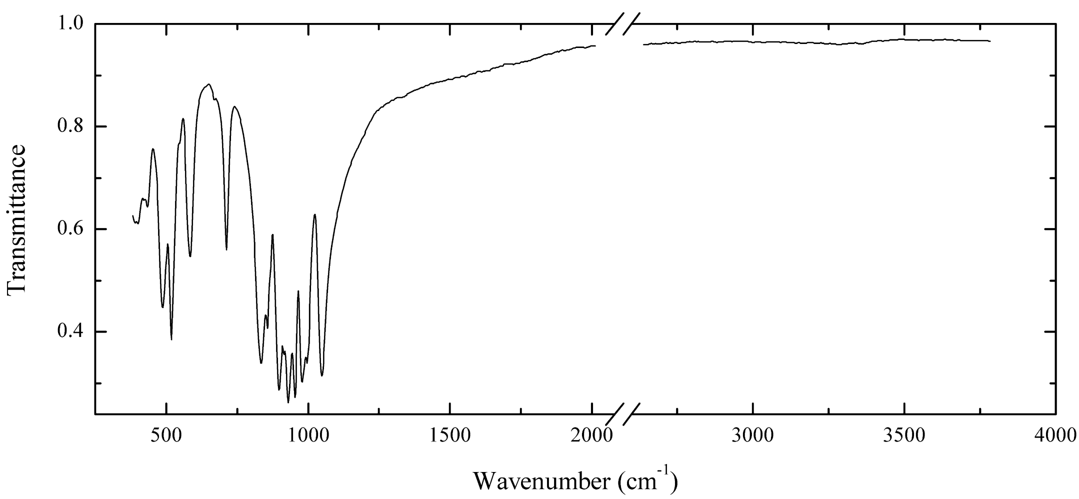


Locality: “Mixed Series” formation, near Nežilovo village, Jacupica Mountains, Macedonia (type locality).

Description: Purplish-red imperfect crystals from the association with barite, dolomite, calcite, hematite, Zn- and Mn-bearing phlogopite, hedyphane, nežilovite, rinmanite, gahnite and braunite. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/m$; $a = 8.938(1)$, $b = 5.6810(6)$, $c = 10.289(1)$ Å, $\beta = 114.17(1)°$, $V = 476.66(9)$ Å^3, $Z = 2$. The empirical formula is $Ca(Pb_{0.73}Ca_{0.30})(Al_{0.65}Fe^{3+}{}_{0.34})Al(Mn^{3+}{}_{0.67}Fe^{3+}{}_{0.33})(Si_{2.96}Al_{0.04})O_{12}(OH)$. Optically (–), $\alpha = 1.835$ (10), $\beta = 1.885(10)$, $\gamma = 1.895(10)$, $2V$ (meas.) = 30°–40°. $D_{calc} = 4.282$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 8.12 (68) (100), 4.67 (53) (110, 11-1), 3.518 (77) (21-1), 2.931 (100) (11-3, 30-2, 020), 2.843 (51) (211), 2.736 (57) (013), 2.610 (66) (31-1).

Wavenumbers (cm^{-1}): 3340, 1177w, 1105s, 1060sh, 1000w, 934s, 880s, 840sh, 698w, 654, 635, 610, 557, 501s, 443, 384s, 370sh.

Siot1 Kilchoanite $Ca_6(Si_3O_{10})(SiO_4)$

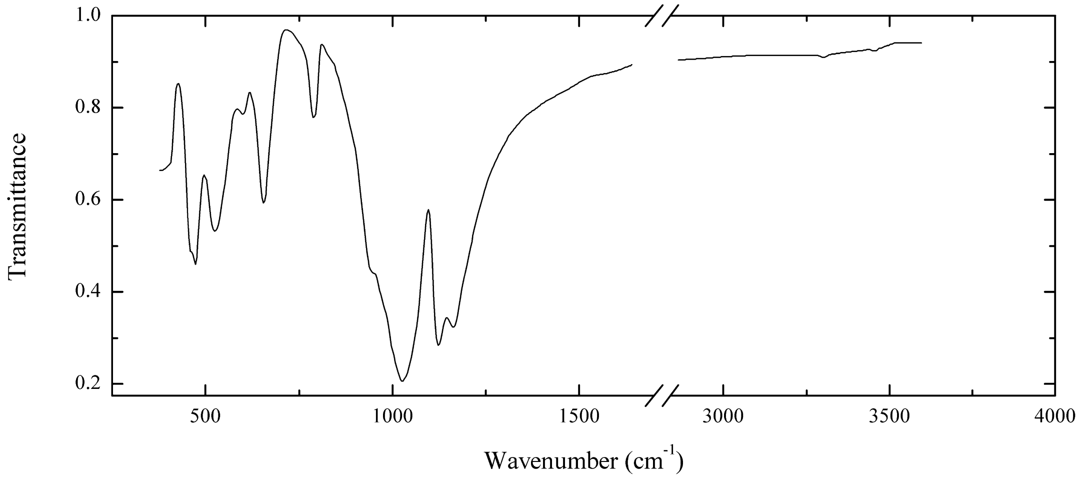


Locality: Ozerskii (Ozerskiy, Ozernovskiy) massif, near Lake Baikal, Eastern Siberia, Russia.

Description: Light grey granular aggregate the association with vesuvianite, calcite and plombierite. Identified by powder X-ray diffraction pattern, electron microprobe analysis and IR spectrum.

Wavenumbers (cm^{-1}): 1047s, 995, 975s, 953s, 928s, 913, 893s, 863, 855, 831, 825sh, 707, 667w, 582, 542w, 512, 481, 427w, 415w, 395, 386.

Sir1 Sugilite $KNa_2(Fe^{2+},Mn^{2+},Al)_2Li_3(Si_{12}O_{30})$

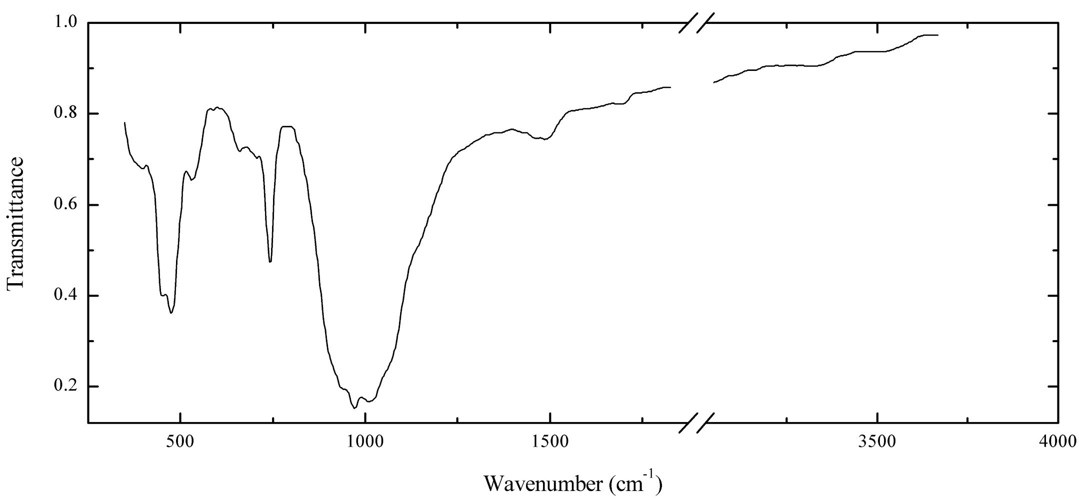


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.

Description: Outer zone of a pink coarse platy sogdianite crystal from the association with quartz, microcline, polylithionite and pyrochlore. Z- and Ti-rich variety. The empirical formula is (electron microprobe) $K_{1.0}Na_{1.2}(Fe_{0.9}Zr_{0.5}Ti_{0.5}Mg_{0.2}Al_{0.2})Li_x(Si_{12.0}O_{30})$.

Wavenumbers (cm^{-1}): 3480w, 3330w, 1165s, 1123s, 1025s, 945sh, 787, 652, 597w, 519, 467, 455sh, 390sh.

Sir7 Eudialyte-group mineral Sir7 $Na_9Ca_9Fe^{3+}{}_2Zr_3(Si,Nb)(Si_{25}O_{73})(OH,O,Cl)_3 \cdot nH_2O$



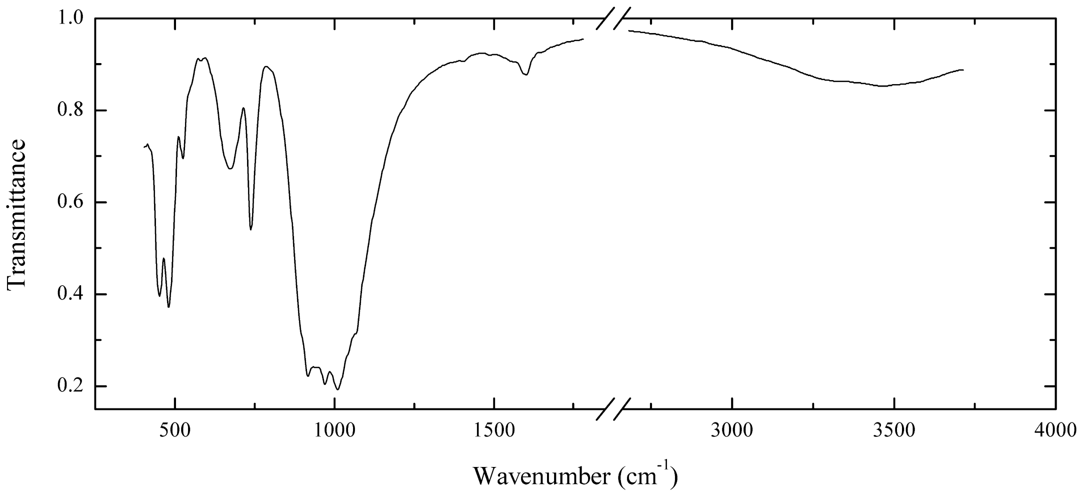
Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Light brown grains from the association with cancrinite, aegirine-augite, calcite and pectolite. Nb-deficient analogue of feklichevite. Identified by electron microprobe analysis and Mössbauer spectrum. The empirical formula is $Na_{8.7}(Ca_{1.4}Na_{0.9}K_{0.6}Y_{0.1})Ca_6(Fe^{3+}{}_{1.2}Fe^{2+}{}_{0.3}Mn_{0.2})$

$Zr_{3.0}Hf_{0.1}Nb_{0.2}Si_{0.1}(Si_{25}O_{73})(SO_4)_{0.1}Cl_{0.5}\cdot nH_2O$. The band at 529 cm^{-1} corresponds to Fe–O stretching vibrations of the tetragonal pyramid $Fe^{3+}O_5$.

Wavenumbers (cm^{-1}): 3500, 3300, 1670w, 1490, 1455, 1140sh, 1060sh, 1017s, 974s, 940sh, 910sh, 740, 705, 663, 529, 476, 450, 390.

Sir8 "Taseqite-(Mn)" $Na_{12}Sr_3Ca_6Mn_3Zr_3Nb(Si_{25}O_{73})(O,OH,H_2O)_3Cl_2$

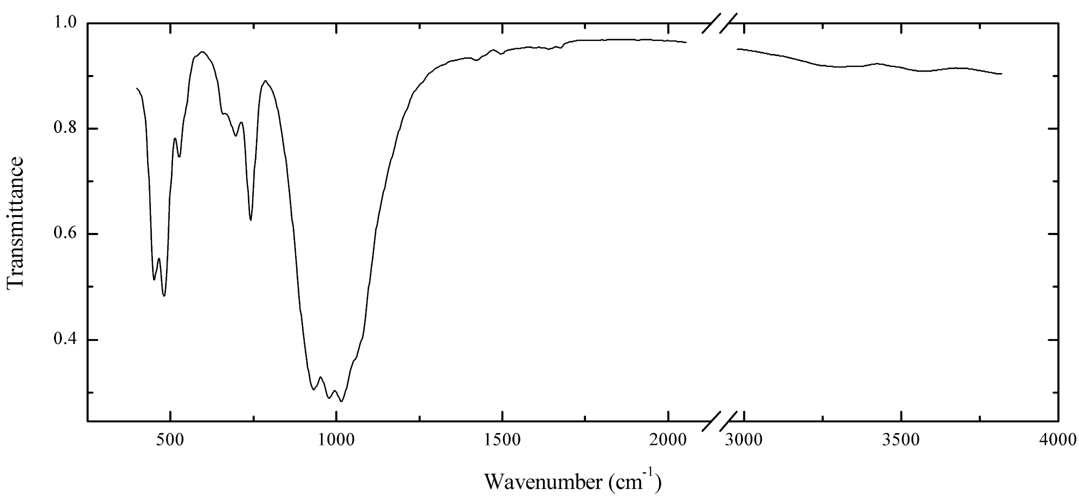


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow grains from peralkaline pegmatite. Mn-analogue of taseqite. Investigated by I.V. Pekov. Identified by electron microprobe analysis.

Wavenumbers (cm^{-1}): 3550w, 3330w, 1600w, 1410w, 1070, 1050sh, 1015s, 976s, 949, 923s, 743, 700sh, 682, 660sh, 597w, 547sh, 530, 486, 458.

Sir9 Manganoeudialyte $Na_{14}Ca_6Mn_3Zr_3[Si_{26}O_{72}(OH)_2]Cl_2\cdot nH_2O$

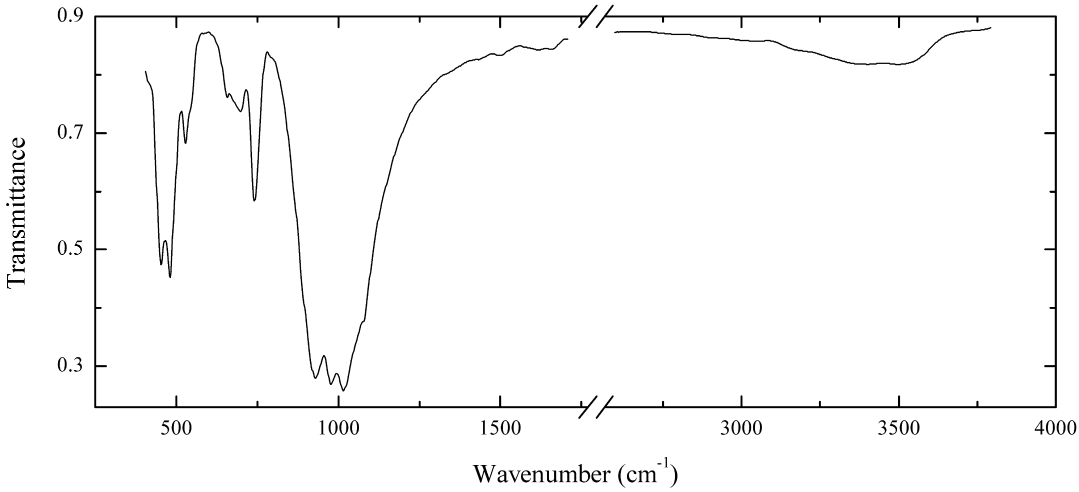


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Purplish-red crystal from peralkaline pegmatite, from the association with microcline, nepheline, aegirine, tundrite-(Ce) *etc*. The empirical formula is (electron microprobe) $Na_{14.1}K_{1.2}Ca_{4.8}Ce_{0.4}La_{0.2}Sr_{0.4}Mn_{2.4}Fe_{1.0}Ti_{0.2}Zr_{2.7}Nb_{0.45}Si_{0.55}(Si_{25}O_{73})Cl_{1.6}(OH,H_2O,CO_3)_x$.

Wavenumbers (cm^{-1}): 3540w, 3290w, 1670w, 1635w, 1495w, 1420w, 1070sh, 1015s, 978s, 931s, 740, 697, 657w, 540sh, 526, 480, 450.

Sir10 Kentbrooksite (Na,*REE*)$_{15}$(Ca,*REE*)$_6$Mn$^{2+}{}_3$Zr$_3$Nb(Si$_{25}$O$_{73}$)OF$_2$·2H$_2$O

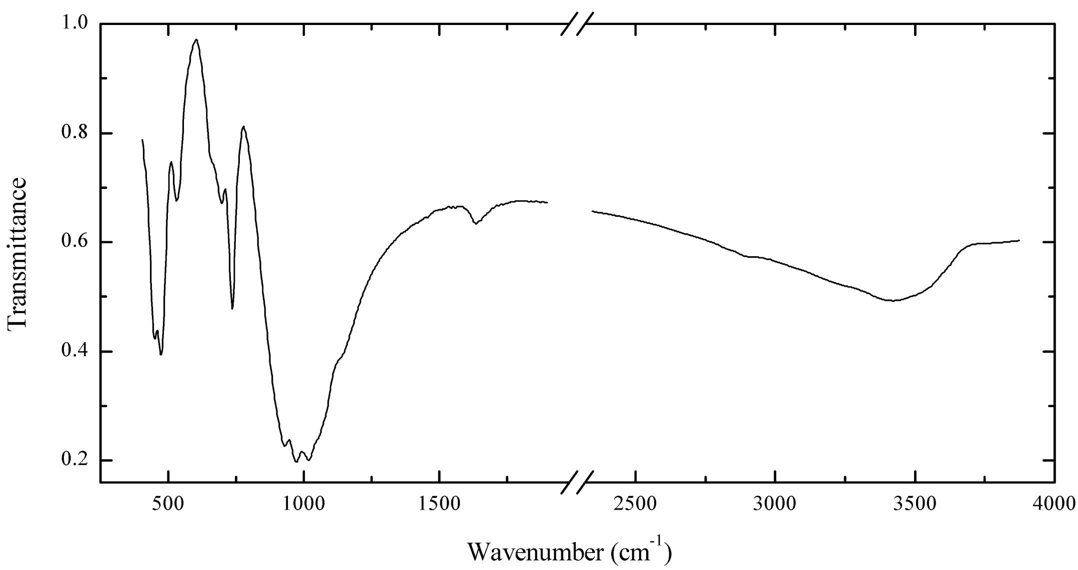


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Red grains from peralkaline pegmatite, from the association with microcline, sodalite, aegirine, keldyshite, parakeldyshite, terskite, loparite-(Ce), *etc*. Na- and Nb-deficient variety. The empirical formula is (electron microprobe) Na$_{9.7}$K$_{0.4}$Ce$_{0.4}$La$_{0.3}$Nd$_{0.1}$Ca$_{4.3}$Mn$_{3.1}$Fe$_{1.0}$Ti$_{0.1}$Zr$_{2.9}$Hf$_{0.1}$Nb$_{0.6}$Si$_{0.3}$(Si$_{25}$O$_{73}$)Cl$_{0.4}$(F,OH,H$_2$O)$_x$.

Wavenumbers (cm^{-1}): 3480w, 3380w, 3200sh, 1660w, 1610w, 1500w, 1075sh, 1055sh, 1016s, 977s, 930s, 740, 695, 657, 540sh, 526, 479, 449, 405sh.

Sir11 Eudialyte Na$_{15}$Ca$_6$Fe$^{2+}{}_3$Zr$_3$(Si,Nb)(Si$_{25}$O$_{73}$)(O,OH,H$_2$O)$_3$(Cl,OH)$_2$

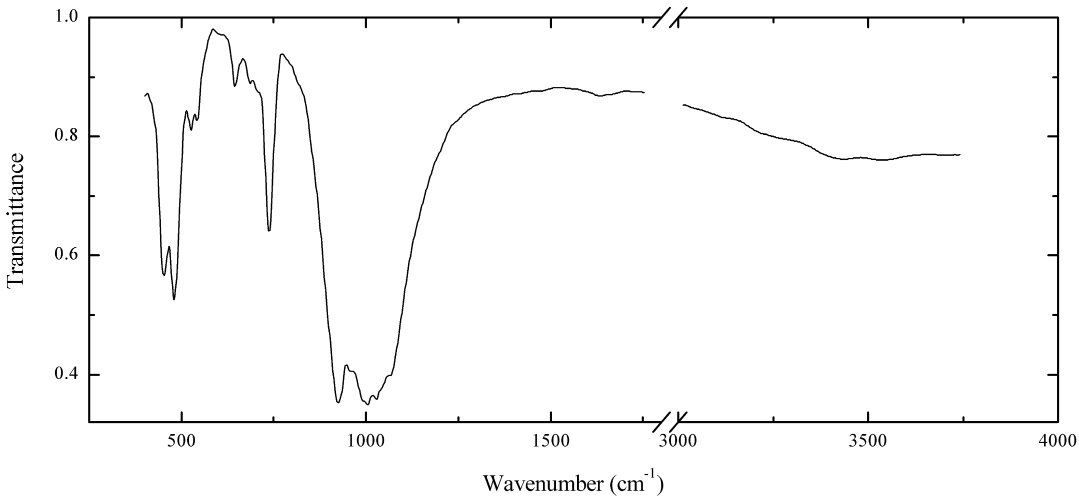


Locality: Poços de Caldas alkaline massif, Brazil.

Description: Red grains from peralkaline pegmatite. The crystal structure is solved. Trigonal, space group *R*3*m*, $a = 14.245$, $c = 30.163$ Å. Ta-bearing H_2O-rich variety. Ta occupies the site *M*2, together with Fe. The empirical formula is (electron microprobe) $Na_{12.7}K_{0.7}Sr_{0.3}Ce_{0.1}Ba_{0.1}Ca_{5.3}Mn_{1.3}Fe_{1.3}Ta_{0.5}Ti_{0.2}Zr_{2.8}Hf_{0.1}Nb_{0.1}W_{0.1}Al_{0.3}Si_{25.3}O_{73}Cl_{0.8}(F,OH,H_2O)_x$.

Wavenumbers (cm^{-1}): 3420, 1636, 1075sh, 1022s, 974s, 930s, 740, 699, 660sh, 534, 475, 451.

Sir12 Rastsvetaevite $Na_{27}K_8Ca_{12}Fe_3Zr_6Si_4[Si_3O_9]_4[Si_9O_{27}]_4(O,OH,H_2O)_6Cl_2$.

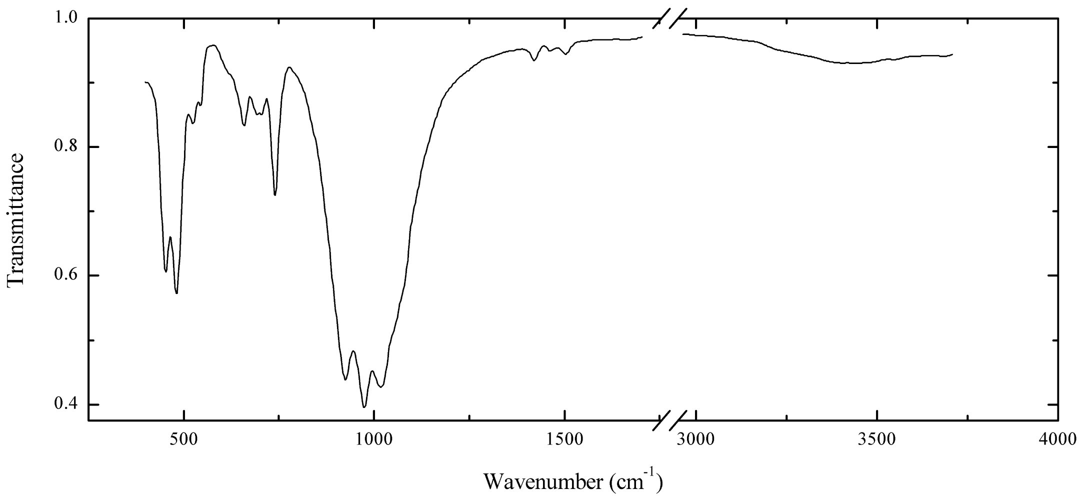


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Red grains from peralkaline pegmatite. The empirical formula is (electron microprobe) $Na_{25.6}K_{6.9}Sr_{1.1}Ce_{0.3}La_{0.2}Ca_{11.9}Mn_{0.3}Fe_{2.7}Mg_{0.9}Ti_{0.6}Zr_{5.3}Si_{50}O_{144}Cl_{3.2}(O,OH,H_2O)_x$. The band at 541 cm^{-1} corresponds to Fe–O stretching vibrations of the flat square $Fe^{2+}O_4$.

Wavenumbers (cm^{-1}): 3520w, 3425w, 3250w, 1640w, 1066s, 1045sh, 1028s, 1006s, 990sh, 961s, 927s, 738, 705w, 685w, 642, 603w, 541, 524, 479, 451.

Sir13 Georgbarsanovite $Na_{12}(Mn,Sr,\mathit{REE})_3Ca_6Fe_2^{3+}Zr_3NbSi_{25}O_{76}Cl_2\cdot H_2O$

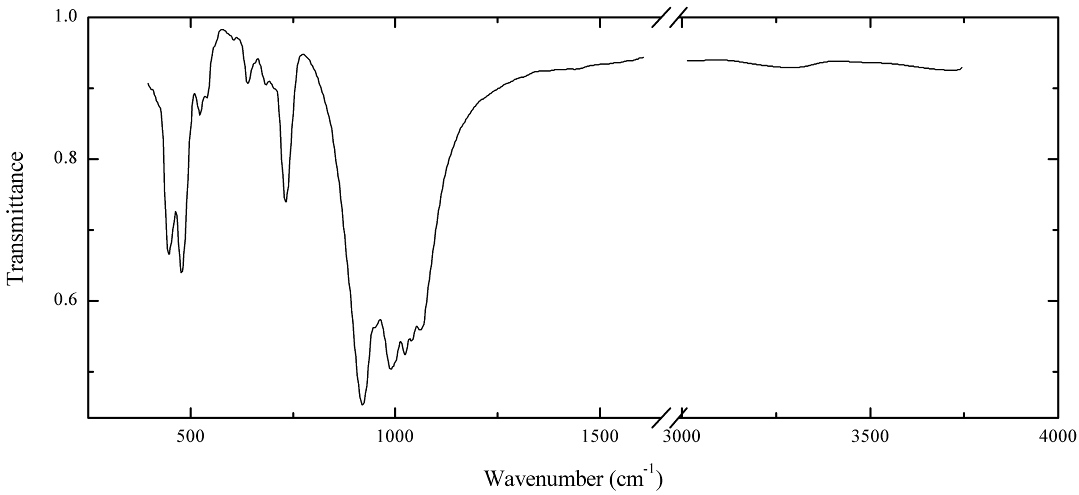


Locality: Outcrop at the Petrelius river, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Yellow-green grains from peralkaline pegmatite. Holotype sample. The crystal structure is solved. Trigonal, space group *R*3*m*, $a = 14.262$, $c = 29.949$ Å. Optically uniaxial (−), $\varepsilon = 1.631(2)$, $\omega = 1.639(2)$. $D_{meas} = 3.05(2)$ g/cm^3, $D_{calc} = 3.11$ g/cm^3. The empirical formula is (electron microprobe) $Na_{11.73}K_{0.24}Mn_{1.19}Sr_{0.71}REE_{0.63}Y_{0.13}Ca_{6.30}Ba_{0.03}Fe^{2+}{}_{2.55}Ti_{0.05}Zr_{3.23}Hf_{0.04}Nb_{0.92}$ $Si_{25.25}O_{76.48}$ $Cl_{1.11}F_{0.61}{\cdot}0.88H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.42 (54) (104), 4.304 (62) (205), 3.202 (100) (208), 3.176 (51) (306), 3.155 (71) (217), 3.017 (51) (119), 2.975 (98) (315), 2.857 (94) (404), 2.591 (54) (039). Weak bands at 1,420, 1,465 and 1,500 cm^{-1} indicate the presence of trace amounts of $CO_3{}^{2-}$ groups. The bands at 546 and 527 cm^{-1} correspond to Fe–O stretching vibrations of the flat square $Fe^{2+}O_4$ and tetragonal pyramid FeO_5, respectively.

Wavenumbers (cm^{-1}): 3410w, 1500w, 1465w, 1420w, 1075sh, 1060sh, 1020s, 976s, 925s, 740, 704, 690, 657, 610sh, 546, 527, 481, 452.

Sir14 Rastsvetaevite $Na_{27}K_8Ca_{12}Fe_3Zr_6Si_4[Si_3O_9]_4[Si_9O_{27}]_4(O,OH,H_2O)_6Cl_2$.

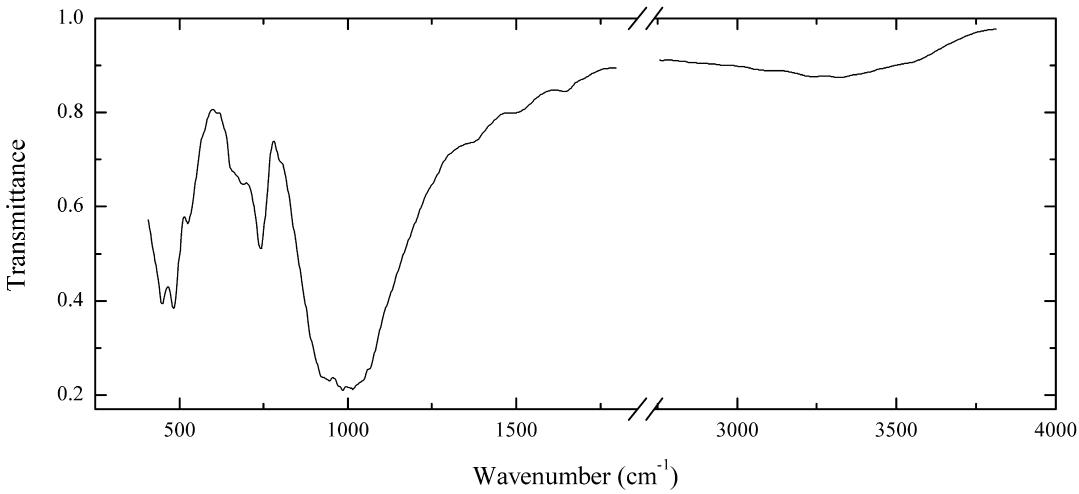


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Purplish-red grains from peralkaline pegmatite, from the association with nepheline, sodalite, potassium feldspar, aegirine, scherbakovite, villiaumitc, natrite, nacaphite, rasvumite *etc*. Holotype sample. Trigonal, space group *R*3*m*, $a = 14.249(1)$, $c = 60.969(7)$ Å, $Z = 3$. Optically uniaxial (+), $\omega = 1.598(1)$, $\varepsilon = 1.600(1)$. $D_{meas} = 2.86(2)$ g/cm^3, $D_{calc} = 2.84$ g/cm^3. The empirical formula is (electron microprobe) $Na_{27.10}K_{7.93}Sr_{0.74}Ba_{0.03}Ce_{0.04}Ca_{11.29}Mn_{0.42}Fe_{2.32}$-$Ti_{0.30}Zr_{5.69}Hf_{0.04}Nb_{0.16}Ta_{0.01}Al_{0.02}Si_{51.53}O_{144}Cl_{2.29}$ $[O_{2.11}(OH)_{1.86}Cl_{2.29}]{\cdot}1.71H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.48 (47) (108), 4.345 (81) (2.0.10), 3.565 (41) (220), 3.249 (57) (2.0.16), 2.987 (100) (3.1.10), 2.861 (73) (408). The band at 544 cm^{-1} corresponds to Fe–O stretching vibrations of the flat square $Fe^{2+}O_4$.

Wavenumbers (cm^{-1}): 3300w, 1066s, 1043s, 1028s, 1005sh, 990s, 955sh, 926s, 738, 707, 684, 643, 604w, 544, 527, 482, 452.

Sir15 Eudialyte-group mineral Sir15 $Na_{15}(Ca_3Mn_3)Fe_3Zr_3\square_2(Si_{24}O_{72})(O,OH,H_2O)_3(OH,Cl,H_2O)_2$

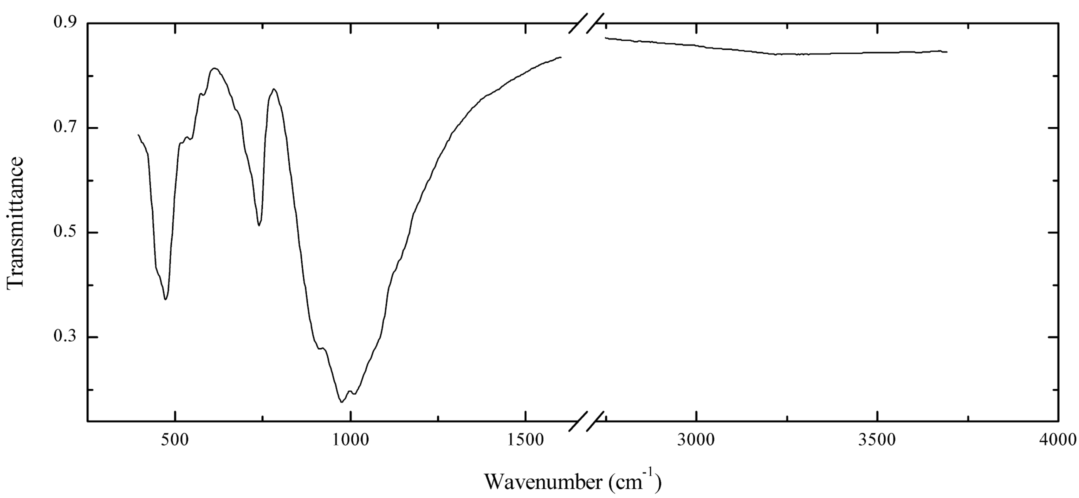


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada.

Description: Orange-red grains from hydrotarmally altered peralkaline pegmatite, from the association with natrolite, analcime, albite and polylithionite. The crystal structure is solved. Trigonal, space group *R*3, $a = 14.134(3)$, $c = 30.178(6)$ Å. The crystal-chemical formula is $(Na_{12.78}Ce_{0.30}K_{0.18})[(Mn_{2.55}Na_{0.45})(Ca_{2.40}Ce_{0.30}Na_{0.30})](^{V}Fe_{1.20}{}^{V}Mn_{0.96}\square_{0.84})Zr_{3.00}(\square_{0.58}Nb_{0.29}Si_{0.13})(\square_{0.47}Si_{0.33}Nb_{0.14}Ti_{0.06})[Si_{24}(O,OH)_{72}][(O,OH)_{1.93}Cl_{0.35}]\cdot 1.95H_2O$. Weak bands at 1,370 and 1,500 cm^{-1} indicate the presence of trace amounts of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3320w, 1647w, 1500w, 1370w, 1060sh, 1040sh, 1010s, 982s, 942s, 920sh, 741, 690, 655sh, 523, 481, 446.

Sir16 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

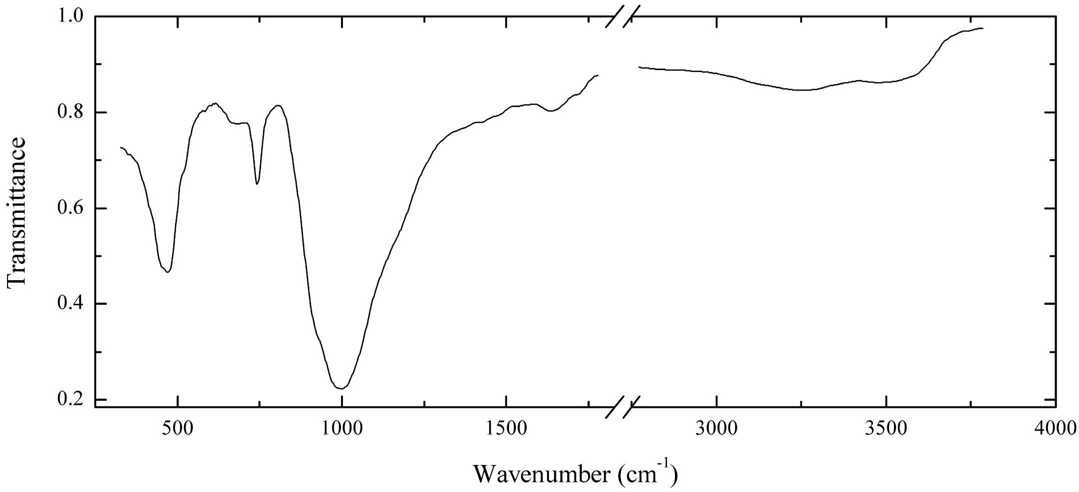


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Violet-red grains from the association with albite and astrophyllite. Mn^{3+}- and Nb-rich variety. The empirical formula is (electron microprobe) $Na_{10.5}K_{0.3}Ca_{5.1}Ce_{0.2}La_{0.1}Sr_{0.6}Mn_{1.8}Fe_{1.7}Ti_{0.2}Zr_{3.1}Nb_{0.4}Si_{25.5}O_{73}Cl_{1.0}(O,OH,H_2O)_x$. The band at 545 cm^{-1} corresponds to Fe–O stretching vibrations of the flat square $Fe^{2+}O_4$.

Wavenumbers (cm^{-1}): 3625w, 3270w, 1110sh, 1070sh, 1010s, 976s, 914, 742, 705sh, 675sh, 583w, 545, 520, 472, 453.

Sir17 Ikranite $(Na,H_3O)_{15}(Ca,Mn,REE)_6Fe^{3+}{}_2Zr_3(\square,Zr)(\square,Si)Si_{24}O_{66}(O,OH)_6Cl\cdot nH_2O$

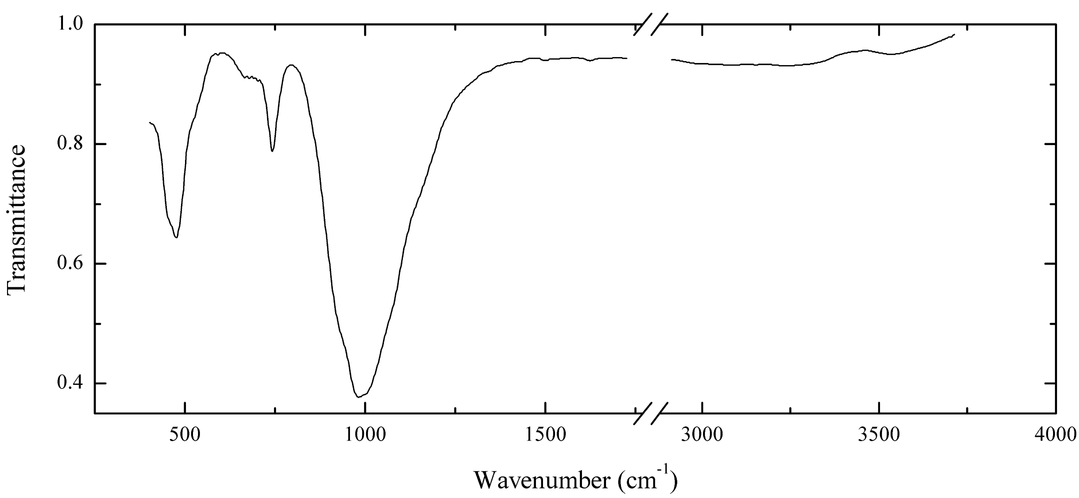


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Cherry-red outer zones of ikranite grains from peralkaline pegmatite, from the association with aegirine, microcline, lorenzenite, nepheline, lamprophyllite, murmanite and arfvedsonite. The empirical formula is (electron microprobe) $Na_{6.4}(H_3O,H_2O)_xK_{0.2}Sr_{0.2}REE_{0.6}(Fe^{3+},Fe^{2+})_{1.6}(Mn^{3+},Mn^{2+})_{1.7}Ca_{3.3}Zr_{3.3}Ti_{0.1}Hf_{0.06}Nb_{0.2}Si_{24.0}O_{72}(OH,H_2O)_yCl_{0.3}$.

Wavenumbers (cm^{-1}): 3500, 3240, 1720w, 1635, 1150sh, 1003s, 980sh, 742, 670, 520sh, 472, 450sh, 420sh.

Sir18 Ikranite $(Na,H_3O)_{15}(Ca,Mn,REE)_6Fe^{3+}{}_2Zr_3(\square,Zr)(\square,Si)Si_{24}O_{66}(O,OH)_6Cl\cdot nH_2O$

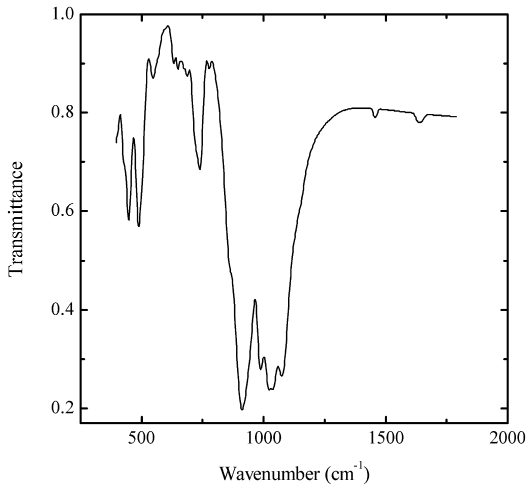


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-yellow grains from peralkaline pegmatite, from the association with aegirine, microcline, lorenzenite, nepheline, lamprophyllite, murmanite and arfvedsonite. Holotype sample. Trigonal, space groups *R*3*m*, *a* = 14.167(2), *c* = 30.081(2) Å. Optically uniaxial (+), = 1.612 (1), = 1.615. D_{meas} = 2.82(3) g/cm^3, D_{calc} = 2.83 g/cm^3. The empirical formula is $Na_{7.56}(H_3O)_{6.64}K_{0.27}Ca_{3.31}Sr_{0.46}Ce_{0.27}La_{0.11}Nd_{0.03}$ $Mn^{2+}{}_{1.41}Fe^{2+}{}_{0.16}Fe^{3+}{}_{1.77}Zr_{3.33}Ti_{0.14}Hf_{0.04}$ $Nb_{0.06}Si_{24}O_{72}Cl_{0.74}\cdot 2.64H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.41 (41) (104), 4.30 (91) (205), 3.521 (57) (027), 3.205 (44) (208), 2.963 (92) (315, 13-5), 2.841 (100) (404). Most part of Fe^{3+} has 6-fold coordination.

Wavenumbers (cm^{-1}): 3510, 3420, 1635w, 1000sh, 979s, 930sh, 743, 700sh, 663, 525sh, 473, 450sh, 420sh.

Sir19 **Alluaivite** $Na_{19}Ca_6(Ti,Nb)_3Si_{26}O_{74}Cl\cdot 2H_2O$

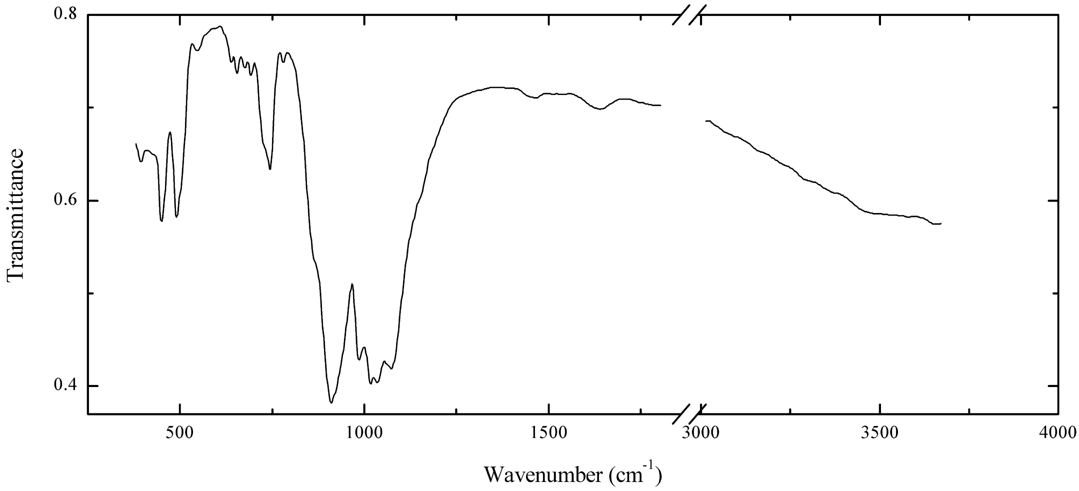


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless grains from peralkaline pegmatite. The empirical formula is $Na_{16.2}Ca_{5.1}Mn_{0.6}Fe_{0.1}Ti_{2.2}Nb_{0.7\ 3}Si_{26}O_{74}Cl_{0.8}\cdot nH_2O$. Weak band at 1,457 cm^{-1} indicates the presence of trace amounts of $CO_3{}^{2-}$ groups. High intensity of the band at 912 cm^{-1} reflects almost complete occupation of the sites *M*(3) and *M*(4) with Si.

Wavenumbers (cm^{-1}): 1640w, 1457w, 1076s, 1041s, 1021s, 988s, 912s, 865sh, 783w, 746, 735sh, 693w, 678w, 657w, 638w, 555, 493, 452, 430.

Sir20 Alluaivite $Na_{19}Ca_6(Ti,Nb)_3Si_{26}O_{74}Cl{\cdot}2H_2O$

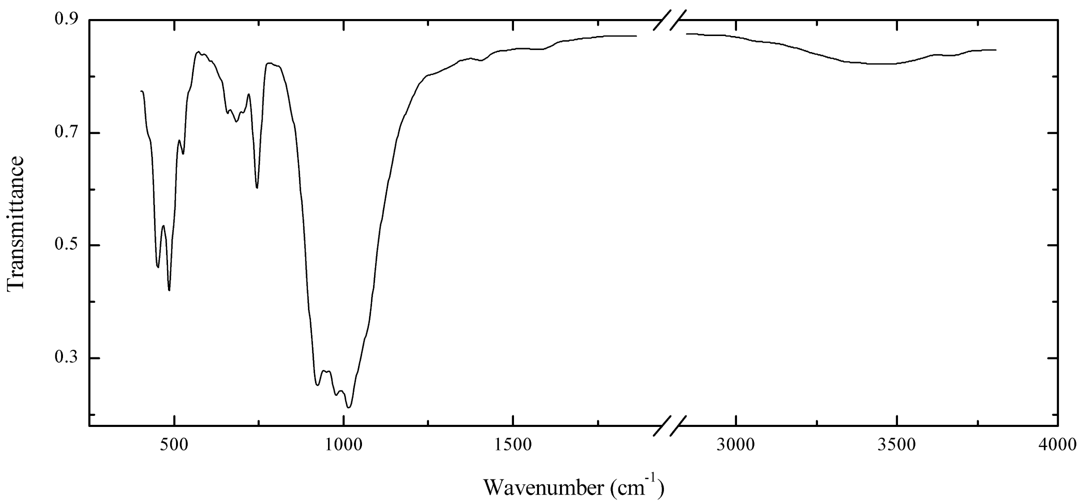


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless grains from peralkaline pegmatite. Investigated by O.A. Ageeva. Weak band at 1,457 cm^{-1} indicates the presence of trace amounts of CO_3^{2-} groups. High intensity of the band at 909 cm^{-1} reflects almost complete occupation of the sites *M*(3) and *M*(4) with Si.

Wavenumbers (cm^{-1}): 3480w, 1640w, 1457w, 1074s, 1040s, 1022s, 987s, 925sh, 909s, 870sh, 782w, 746, 735sh, 693w, 678w, 657w, 638w, 552w, 493, 451, 430sh, 395.

Sir21 Kentbrooksite $(Na,REE)_{15}(Ca,REE)_6Mn^{2+}{}_3Zr_3Nb(Si_{25}O_{73})OF_2{\cdot}2H_2O$

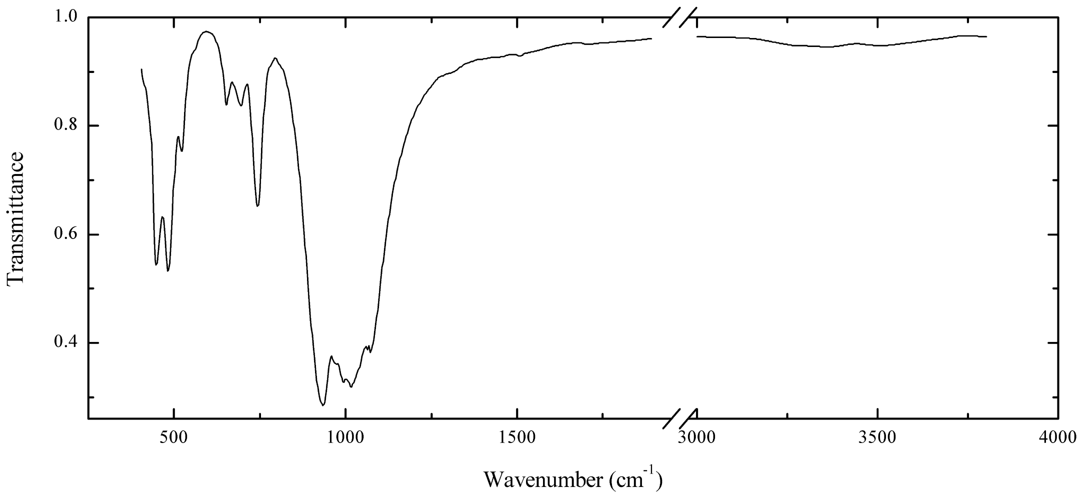


Locality: Amdrup Fjord, Kangerdlugssuaq intrusion, East Greenland (type locality).

Description: Red grains from peralkaline pegmatite. Investigated by O. Johnson. The band at 523 cm^{-1} corresponds to Mn–O stretching vibrations.

Wavenumbers (cm^{-1}): 3650w, 3450w, 1595w, 1410w, 1075sh, 1040sh, 1015s, 979s, 950, 924s, 895sh, 743, 703, 683, 659, 545sh, 523, 483, 450, 405sh.

Sir22 Eudialyte-group mineral Sir15 $Na_{19}Ca_6Zr_3Si_{26}O_{74}Cl\cdot nH_2O$

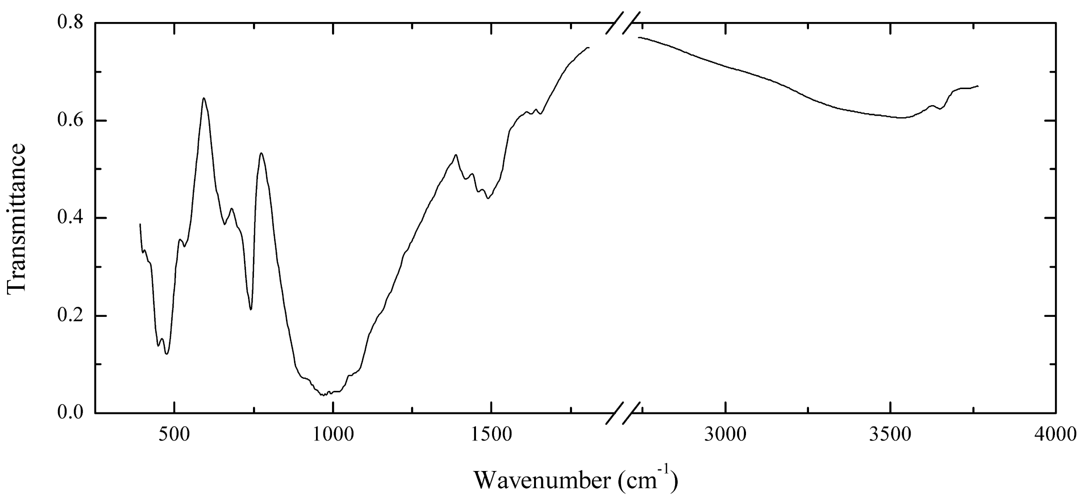


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Very light pink grains with red fluorescence under UV radiation from peralkaline pegmatite. Zr-analogue of alluaivite. The empirical formula is (electron mictoprobe): $Na_{16.1}K_{1.0}Ce_{0.2}Ca_{4.7}Mn_{1.1}Fe_{0.2}Ti_{0.2}Zr_{3.1}Nb_{0.1}Si_{26}O_{74}Cl_{1.3}\cdot nH_2O$. High intensity of the band at 931 cm^{-1} reflects almost complete occupation of the sites M(3) and M(4) with Si.

Wavenumbers (cm^{-1}): 3470w, 3310w, 1500w, 1290sh, 1070s, 1030sh, 1014s, 992s, 970sh, 931s, 742, 692, 650, 522, 482, 447.

Sir25 Golyshevite $(Na,Ca)_{10}Ca_9Fe_2Zr_3NbSi_{25}O_{72}(CO_3)(OH)_3\cdot H_2O$

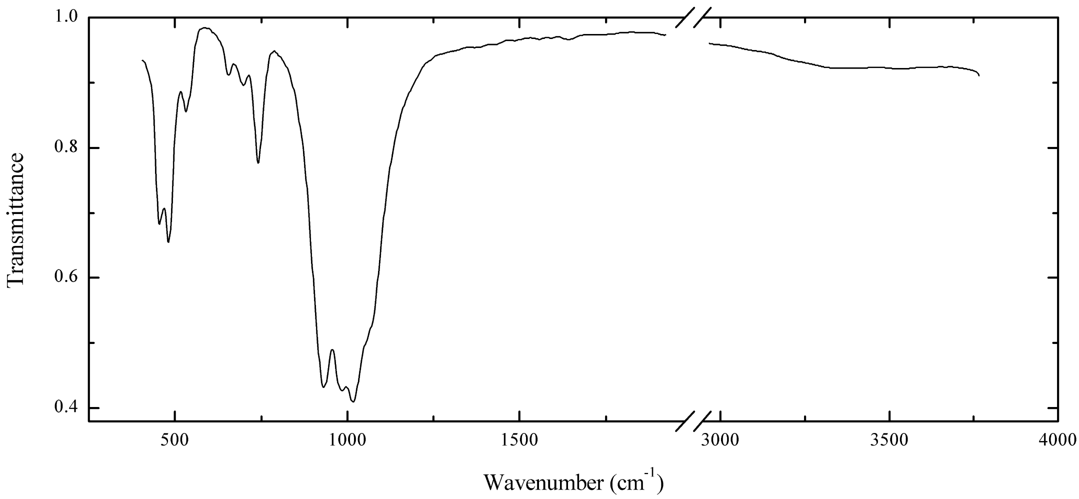


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Brown grains from the association with cancrinite, orthoclase, aegirine-augite, calcite and pectolite. The empirical formula is $Na_{8.3}K_{0.4}Ca_{9.1}Fe_{2.2}Mn_{0.2}Zr_{2.95}Hf_{0.05}Nb_{0.7}Ti_{0.1}Si_{25}O_{72}(CO_3)_{0.8}(OH,H_2O)_xCl_{0.2}$.

Wavenumbers (cm^{-1}): 3635, 3500, 1657w, 1630w, 1520sh, 1493, 1460w, 1420w, 1145sh, 1070sh, 1013s, 971s, 915sh, 742, 705sh, 663, 533, 476, 451, 420sh, 400.

Sir26 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

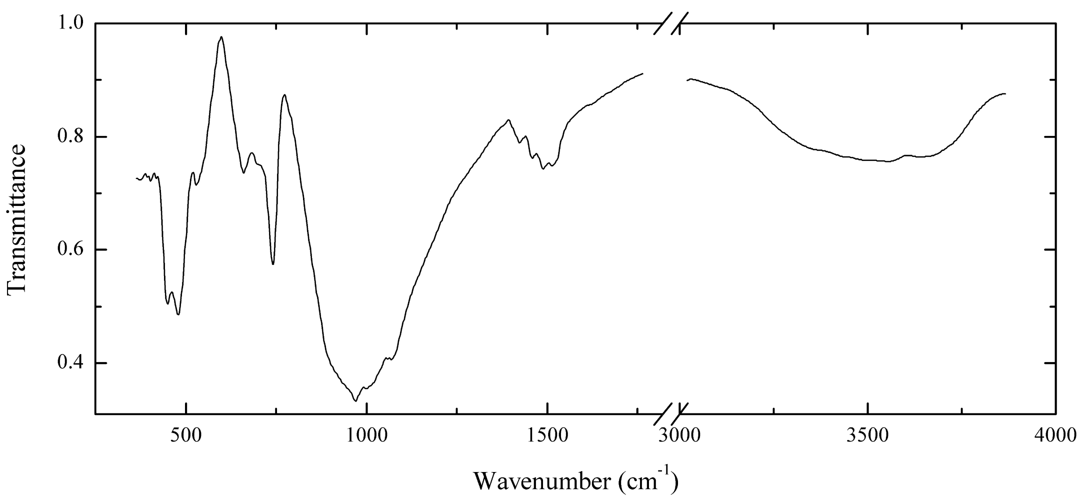


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark red grains from peralkaline pegmatite, from the association with villiaumite, lorenzenite, lintisite, nepheline and aegirine. Fe-deficient Mn-rich variety. The empirical formula is $Na_{15.7-x}K_{0.2}Ce_{0.2}(Ca_{4.0}Mn_{1.7-x}Na_{x+0.3})(Fe_{0.8}Na_{1.3}Mn_x\square_{0.9-x})Zr_{2.9}Ti_{0.1}Nb_{0.1}Si_{0.5}(Si_{25}O_{73})Cl_{0.7}(OH,H_2O,CO_3)_x$.

Wavenumbers (cm^{-1}): 1070sh, 1017s, 986s, 934s, 741, 698, 656, 529, 482, 452.

Sir27 Golyshevite $(Na,Ca)_{10}Ca_9Fe_2Zr_3NbSi_{25}O_{72}(OH)_3(CO_3)\cdot H_2O$

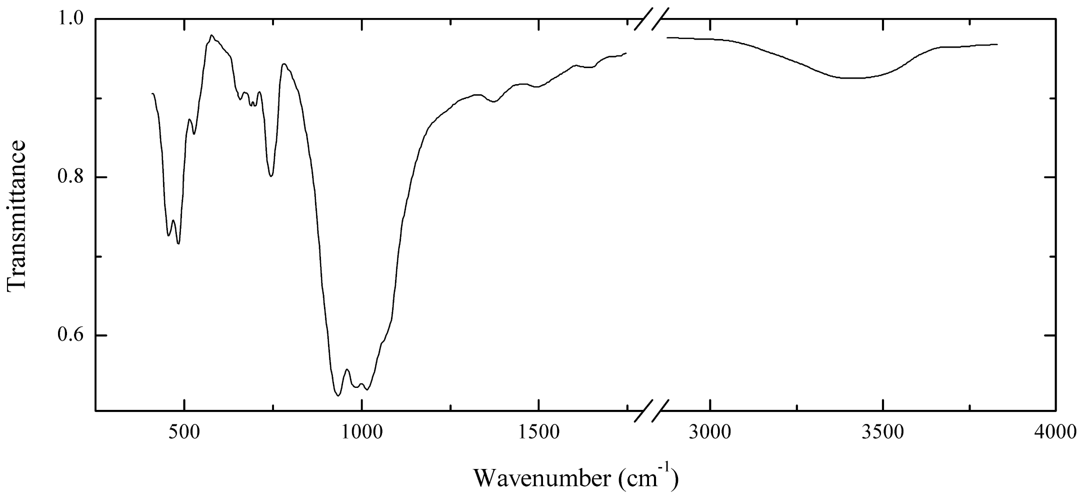


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Brown crystal from peralkaline pegmatite, from the association with cancrinite, aegirine-augite, hedenbergite, orthoclase, pectolite, thomsonite-Ca, tacharanite and calcite. Holotype sample. Trigonal, space group *R*3*m*, $a = 14.231(3)$, $c = 29.984(8)$ Å. Optically uniaxial (−), $\omega = 1.628(1)$, $\varepsilon = 1.618(2)$. $D_{meas} = 2.89(1)$ g/cm^3, $D_{calc} = 2.889$ g/cm^3. The empirical formula is $(Na_{9.02}Ca_{0.43}K_{0.30})(Ca_{5.92}Ce_{0.05}La_{0.03})Fe^{3+}{}_{1.69}Fe^{2+}{}_{0.50}Mn_{0.29}Zr_{2.97}(Nb_{0.60}Si_{0.66}Al_{0.08})Si_{24}O_{72}(OH)_{2.37}(CO_3)_{1.05}Cl_{0.21}\cdot1.01H_2O$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.30 (53) (205), 3.200 (46) (208), 2.971 (78) (315, 13-5), 2.848 (100) (404), 2.597 (43) (143), 2.055 (51) (3.2.10, 2.3.-10).

Wavenumbers (cm^{-1}): 3630, 3510, 3350sh, 1630sh, 1510, 1485, 1453w, 1417wm 1068s, 1006s, 970s, 935sh, 910sh, 741, 710sh, 661, 545sh, 530, 479, 453, 398w.

Sir28 Eudialyte-group mineral Sir28 $Na_{15}(Ca_3Mn_3)(Fe,Zr,\square)_3Zr_3(Si,\square)_2(Si_{24}O_{72})(O,OH)_3\cdot2H_2O$

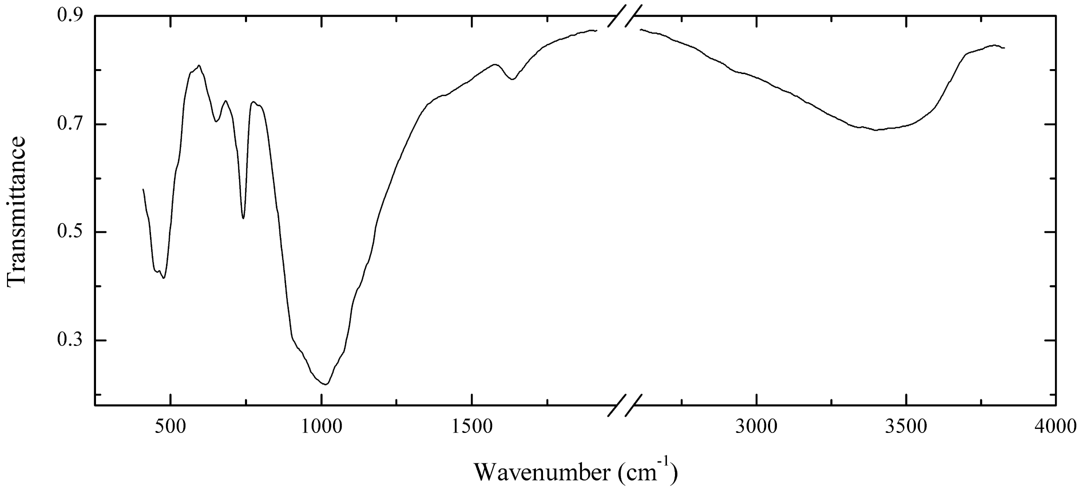


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-orange grains from peralkaline pegmatite, from the association with ussingite, microcline, aegirine, analcime, villiaumite and kogarkoite. The crystal structure is solved. Trigonal, space group *R*3, $a = 14.192(2)$, $c = 30.170(5)$ Å. The crystal-chemical formula is $(Na_{14.6}Ce_{0.2}K_{0.2})[(Mn_{1.35}Ca_{1.2}Na_{0.4}Ce_{0.05})(Ca_{1.8}Na_{0.7}Sr_{0.35}Y_{0.1}Ce_{0.05})](Fe_{1.4}Mn_{0.1}Zr_{0.5}\square_{1.0})Zr_3(Si_{0.4}Ti_{0.2}Zr_{0.1}\square_{0.3})(Si_{0.4}Nb_{0.3}\square_{0.3})[Si_{24}(O,OH)_{72}]O_{1.8}(OH)_{0.9}F_{0.7}Cl_{0.5}\cdot1.9H_2O$. Weak bands at 1,380 and 1,505 cm^{-1} indicate the presence of trace amounts of $CO_3{}^{2-}$ groups. High intensity of the band at 935 cm^{-1} reflects the predominance of Si in the sites *M*(3) and *M*(4).

Wavenumbers (cm^{-1}): 3410, 1647w, 1505w, 1380w, 1065sh, 1012s, 979s, 935s, 742, 693, 655, 524, 481, 454.

Sir29 Aqualite $(H_3O)_8Na_4Ca_6SrZr_3Si_{26}O_{66}(OH)_9Cl\cdot nH_2O$

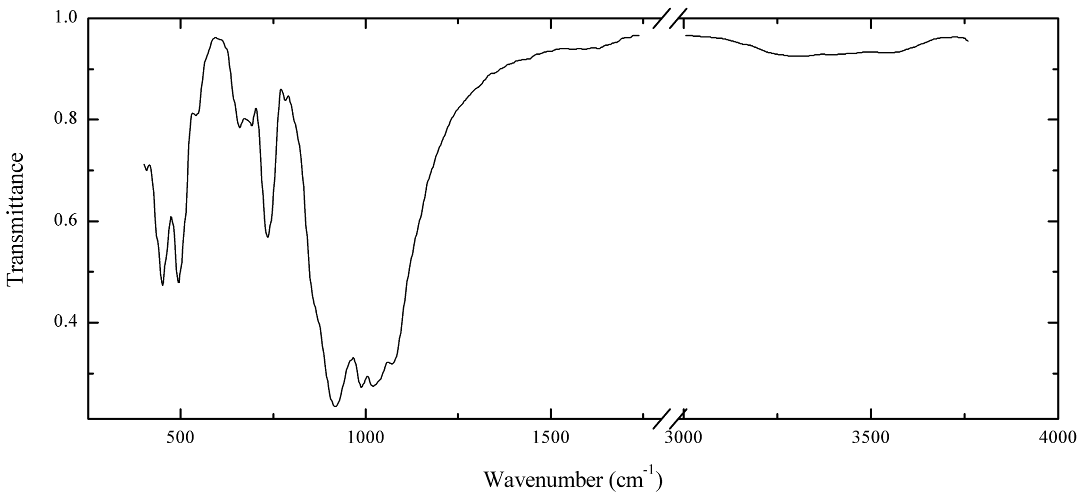


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Lilac grains from hydrothermally altered peralkaline pegmatite, from the association with Fe-deficient eudialyte, stevensite, scolecite, aegirine-augite *etc*. Ba-rich variety. The empirical formula is (electron microprobe) $(H_3O)_xNa_{4.36}Ca_{5.76}Mn_{0.23}Ba_{0.48}Sr_{0.31}Zr_{2.71}Ti_{0.37}Nb_{0.23}Si_{25.19}O_{66}(OH)_yCl_{0.60}(SO_4)_{0.17}\cdot nH_2O$. The absence of absorption bands in the range 520–550 cm^{-1} indicates the absence of Fe and Mn in the M(2) site.

Wavenumbers (cm^{-1}): 3400, 1700sh, 1435w, 1407w, 1160sh, 1060sh, 1013s, 925sh, 738, 651, 517sh, 471, 449.

Sir31 Alluaivite $Na_{19}Ca_6(Ti,Nb)_3Si_{26}O_{74}Cl\cdot 2H_2O$



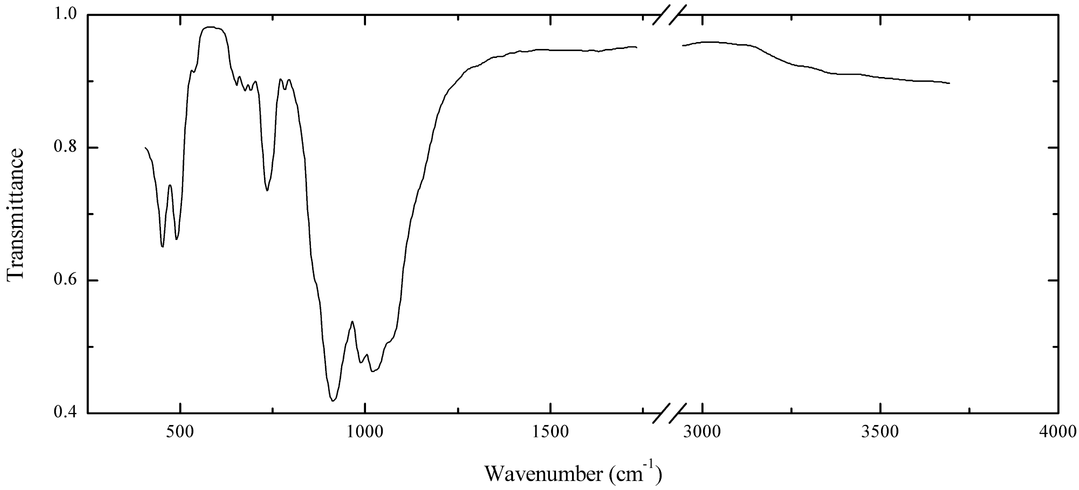
Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Colourless grains from peralkaline pegmatite, from the association with eudialyte, nepheline, sodalite, potassic feldspar, arfvedsonite and aegirine. Holotype sample. Trigonal, space group R-3m, a = 14.046(2), c = 60.60(2) Å, Z = 6. Optically uniaxial (+), ε = 1.626(2), ω = 1.618(2). D_{meas} = 2.76(5) g/cm^3, D_{calc} = 2.78 g/cm^3. The empirical formula is (electron microprobe)

$Na_{17.47}Sr_{0.28}Ce_{0.14}K_{0.12}Ba_{0.11}La_{0.03}(Ca_{4.46}Mn_{1.47})(Ti_{2.18}Nb_{0.85}Zr_{0.05})Si_{25.82}O_{73.26}Cl_{0.66}·2.75H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 7.14 (80), 4.30 (70), 3.36 (50), 2.960 (100), 2.825 (100), 2.148 (70), 1.762 (80).

Wavenumbers (cm^{-1}): 3580, 3300, 1650w, 1074s, 1040sh, 1020s, 988s, 918s, 783w, 745sh, 735, 692, 678w, 657, 645sh, 570sh, 539w, 505sh, 491, 448, 435sh.

Sir32 Alluaivite $Na_{19}Ca_6(Ti,Nb)_3Si_{26}O_{74}Cl·2H_2O$

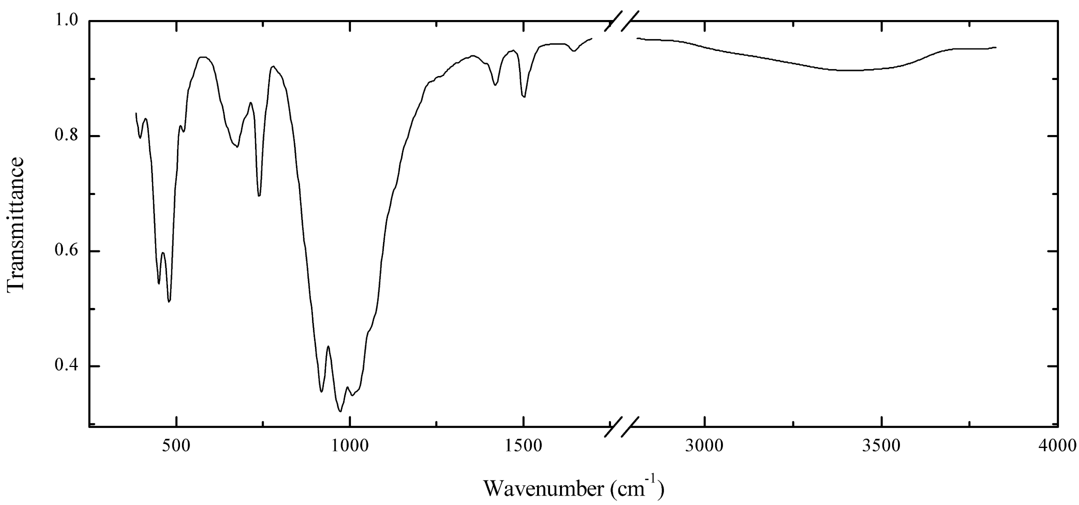


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Colourless grains from peralkaline pegmatite. Investigated by A.P. Khomyakov. Optically uniaxial (+), $\varepsilon = 1.617(2)$, $\omega = 1.609(2)$.

Wavenumbers (cm^{-1}): (3300), 1635w, 1075sh, 1042s, 1021s, 991s, 865sh, 781w, 738, 690w, 677w, 655w, 645sh, 542w, 490, 449, 430sh.

Sir33 Carbokentbrooksite $(Na,\square)_{12}(Na,Ce)_3Ca_6Mn^{2+}{}_3Zr_3Nb(Si_{25}O_{73})(OH)_3(CO_3)·2H_2O$

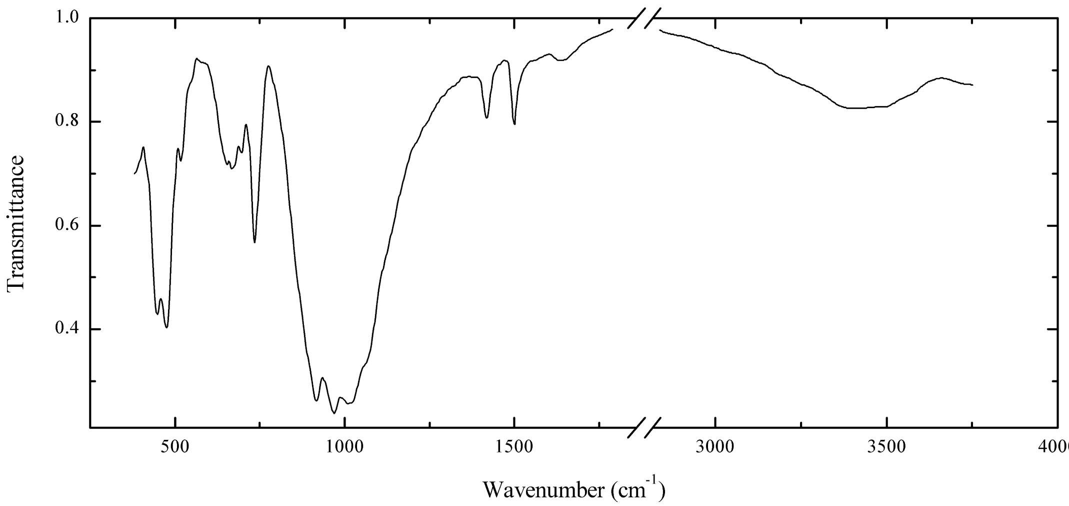


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Pinkish-brown grains from the association with reedmergnerite. The empirical formula is (electron microprobe) $Na_{9.8}K_{0.6}Sr_{0.4}Ce_{0.6}La_{0.4}Nd_{0.2}Ca_{6.4}Mn_{2.5}Fe_{0.8}Zr_{3.0}Ti_{0.1}Nb_{0.9}Si_{25}O_{73}Cl_{0.3}(OH,CO_3,H_2O)_x$. The bands at 1,420 and 1,500 cm^{-1} correspond to C–O-stretching vibrations of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3410, 1645w, 1500, 1420, 1070sh, 1040sh, 1013s, 974s, 922s, 741, 700sh, 676, 660sh, 522, 481, 451, 397.

Sir34 Carbokentbrooksite $(Na,\square)_{12}(Na,Ce)_3Ca_6Mn^{2+}_3Zr_3Nb(Si_{25}O_{73})(OH)_3(CO_3)\cdot 2H_2O$

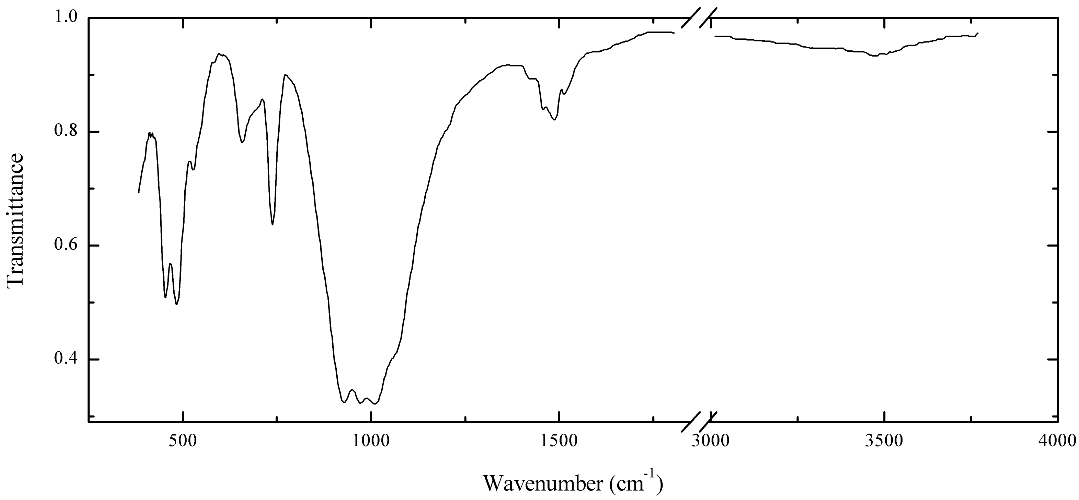


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Dark violet grains from the association with zirsilite-(Ce), quartz, microcline, aegirine, stillwellite-(Ce), ekanite, polylithionite, pyrochlore, fluorite, calcite and galena. Pb-bearing variety. The empirical formula is (electron microprobe) $Na_{10.9}K_{0.4}Sr_{0.4}Ce_{0.4}La_{0.3}Nd_{0.1}Pb_{0.3}Ca_{6.2}Mn_{3.2}Fe_{0.5}Zr_{2.8}Ti_{0.15}Nb_{1.0}Si_{24.8}O_{73}Cl_{0.2}(OH,CO_3,H_2O)_x$. The bands at 1420 and 1,502 cm^{-1} correspond to C–O-stretching vibrations of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3500sh, 3400, 1635w, 1502, 1420, 1060sh, 1024s, 1013s, 971s, 920s, 741, 701, 678, 659, 545sh, 521, 479, 450.

Sir35 Mogovidite $Na_9(Ca,Na)_6Ca_6Fe_2Zr_3\square Si_{25}O_{72}(CO_3)(OH,H_2O)_4$

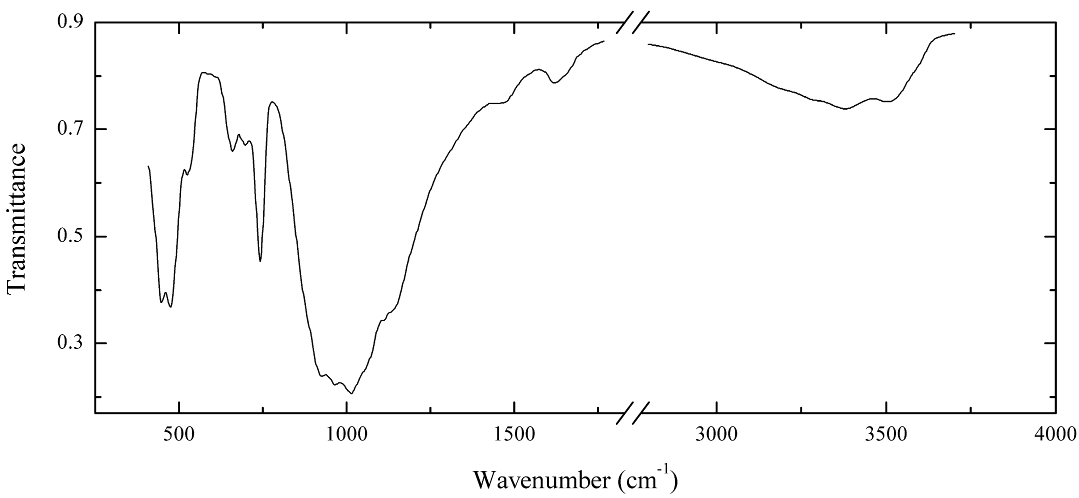


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Reddish-brown grains from the association with cancrinite, nepheline, aegirine-augite, pectolite, zircon, andradite, scolecite and calcite. Holotype sample. The crystal structure is solved. Trigonal, space group *R*3*m*, $a = 14.232(3)$, $c = 30.210(3)$ Å. Optically uniaxial (−), $\omega = 1.618(1)$, $\varepsilon = 1.611(2)$. $D_{meas} = 2.90(1)$ g/cm^3 (volumetric method), $D_{calc} = 2.908$ g/cm^3. The empirical formula is $(Na_{9.87}Ca_{4.05}K_{0.24}Ce_{0.06}La_{0.03})Ca_{6.00}Fe^{3+}{}_{1.48}Fe^{2+}{}_{0.58}Mn_{0.30}Zr_{3.02}Ti_{0.09}(Nb_{0.40}Si_{0.71})Si_{24}O_{72}(OH)_{2.86}(CO_3)_{1.03}$ $Cl_{0.46}{\cdot}0.74H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.31 (64) (205), 3.213 (100) (208, 306, 036), 3.027 (65) (119, 11-9, 042), 2.977 (91) (315, 13-5), 2.859 (79) (404).

Wavenumbers (cm^{-1}): 3460w, 3300sh, 1620sh, 1515, 1490, 1456, 1418w, 1100sh, 1060sh, 1014s, 972s, 928s, 875sh, 738, 700sh, 659, 545sh, 529, 482, 452.

Sir36 Eudialyte-group mineral Sir36 $(Na,H_3O,H_2O)_{15}Ca_6(\square,Fe)_3Zr_3(Si,Nb,\square)(Si_{25}O_{73})(O,OH,H_2O)_3(OH,Cl)_2$

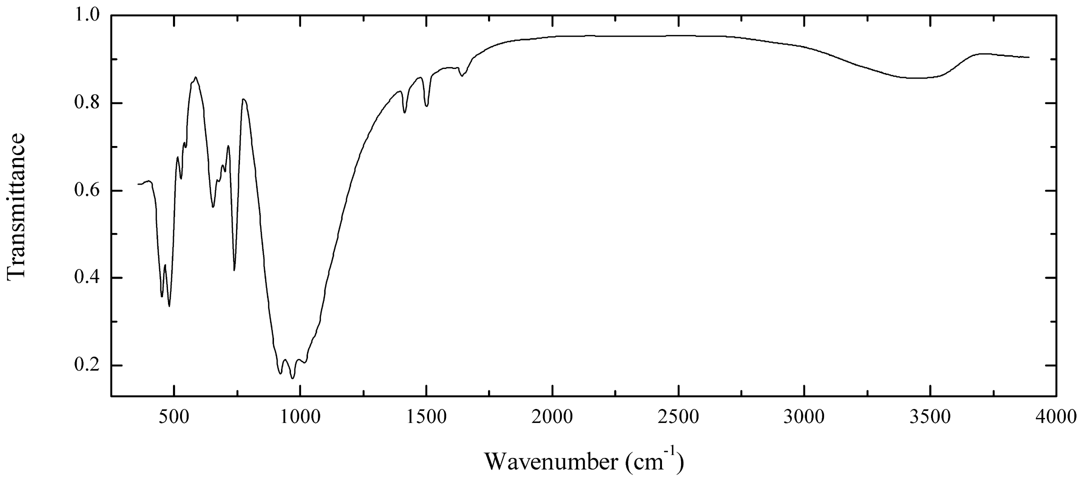


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Black zones in feklichevite from peralkaline pegmatite, from the association with cancrinite, orthoclase, aegirine-augite, pectolite, thorite, lueshite and thomsonite-(Ca). Fe- and Na-deficient analogue of eudialyte. The empirical formula is $(H_3O,H_2O)_xNa_{8.60}Ba_{0.27}Sr_{0.25}K_{0.25}Ca_{6.30}Fe_{0.99}Mn_{0.18}Zr_{3.12}Si_{25.50}O_{73}(SO_4)_{0.21}Cl_{0.79}(OH,H_2O,CO_3)_x$. Weak bands at 1,502, 1,485 and 1,456 cm^{-1} indicate the presence of trace amounts of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3525, 3400, 3230sh, 1670sh, 1632w, 1502w, 1485w, 1456w, 1140sh, 1114, 1018s, 973s, 926s, 740, 703, 663, 527, 476, 450.

Sir37 Taseqite $Na_{12}Sr_3Ca_6Fe^{2+}{}_3Zr_3Nb(Si_{25}O_{73})(O,OH,H_2O)_3Cl_2$

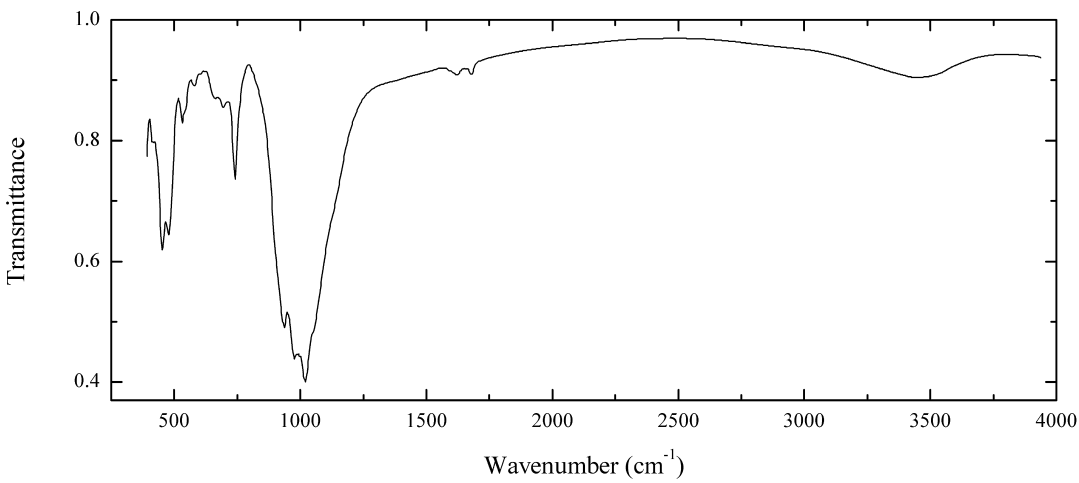


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown grains from the association with ancylite-(Ce), microcline and aegirine. CO_3^{2-}- and H_2O-bearing variety. The empirical formula is $Na_{12.0}(Sr_{1.3}Na_{0.9}K_{0.5}Ca_{0.2}Ba_{0.1})(Ca_{5.7}Mn_{0.3})(Fe_{1.6}Mn_{1.4})Zr_{3.1}Ti_{0.1}Nb_{0.7}Si_{25}O_{73}(O,OH)_xCl_{0.6}(CO_3)_{0.5}\cdot nH_2O$. The bands at 1,420 and 1,508 cm^{-1} confirm the presence of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3450, 1655w, 1508, 1420, 1060sh, 1010s, 969s, 920s, 741, 700, 670sh, 657, 546, 523, 480, 452.

Sir38 Manganoeudialyte $Na_{14}Ca_6Mn_3Zr_3[Si_{26}O_{72}(OH)_2]Cl_2\cdot 4H_2O$

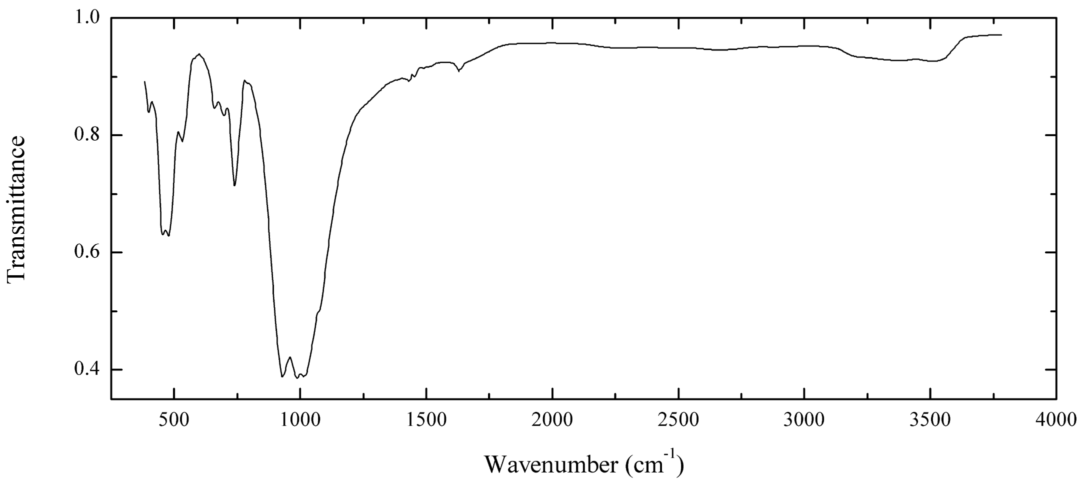


Locality: Poços de Caldas alkaline massif, Minas Gerais, Brazil (type locality).

Description: Purple grain from peralkaline pegmatite, from the association with eudialyte, K-feldspar, nepheline, aegirine, analcime, sodalite, rinkite, lamprophyllite, astrophyllite, titanite, fluorite, and cancrinite. Holotype sample. Trigonal, space group *R*3*m*; $a = 14.2418(1)$, $c = 30.1143(3)$ Å, $Z = 3$. Optically uniaxial (+), $\omega = 1.603(2)$, $\varepsilon = 1.608(2)$. $D_{meas} = 2.89(1)$ g/cm^3, $D_{calc} = 2.935$ g/cm^3. The empirical formula is $H_{12.08}Na_{12.05}Sr_{0.90}K_{0.39}La_{0.03}Ce_{0.02}Ca_{5.93}(Mn_{1.54}Fe_{1.18})Zr_{3.03}Nb_{0.28}Al_{0.25}Hf_{0.04}Ti_{0.18}Si_{25.20}O_{79.40}Cl_{0.87}F_{0.13}$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.421 (37) (104), 4.329 (30) (205), 3.526 (46) (027), 3.218 (100) (208), 3.023 (25) (042), 1.609 (77) (4.1.15), 1.605 (41) (4.0.16).

Wavenumbers (cm^{-1}): 3440, 1677w, 1620w, 1135sh, 1050sh, 1017s, 978s, 933s, 740, 696, 661, 580w, 540sh, 529, 477, 450, 415sh.

Sir39 Voronkovite $Na_{15}(Na,Ca,Ce)_3(Mn,Ca)_3Fe^{2+}{}_3Zr_3Si_{26}O_{72}(OH,O)_4Cl \cdot H_2O$

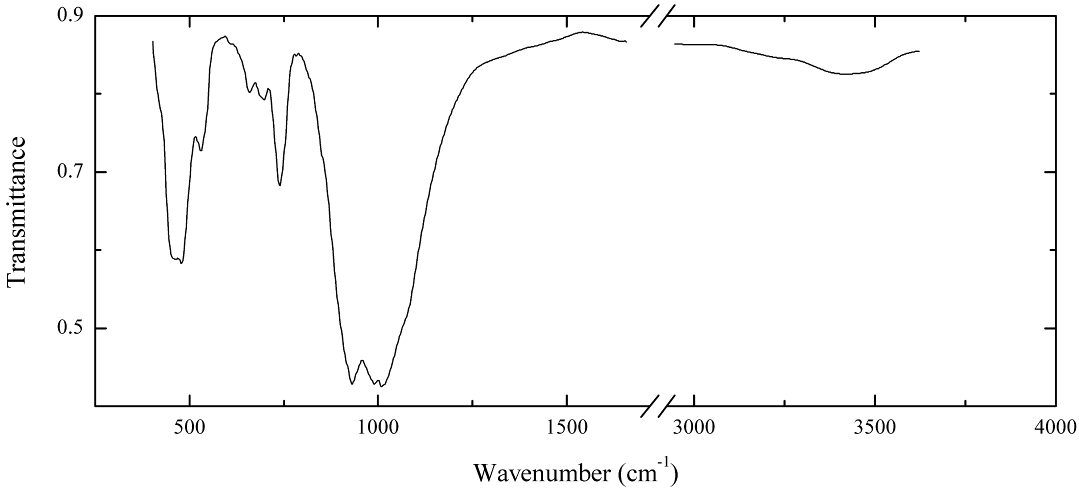


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange-brown grains from peralkaline pegmatite, from the association with microcline, sodalite, nepheline, aegirine, terskite, lomonosovite, vuonnemite, shkatulkalite, mangan-neptunite, sphalerite, *etc*. Holotype sample. Trigonal, space group *R*3, $a = 14.205(7)$, $c = 30.265(15)$ Å, $Z = 3$. Optically uniaxial (+), $\omega = 1.610(2)$, $\varepsilon = 1.619(2)$. $D_{meas} = 2.97(2)$ g/cm^3, $D_{calc} = 2.95$ g/cm^3. The crystal-chemical formula is $(Na_{13.96}Sr_{0.54}K_{0.19})(Na_{1.64}Ca_{0.92}Ce_{0.26}La_{0.18})(Mn_{2.06}Ca_{0.81}REE_{0.13})(Fe_{1.54}Zr_{0.60}Na_{0.48}Nb_{0.21}Ti_{0.13}Hf_{0.04})Zr_{3.00}(Si_{1.91}Al_{0.09})Si_{24}O_{72}[(OH)_{2.98}O_{1.02}](Cl_{0.39}F_{0.35}) \cdot 1.23H_2O$.

Wavenumbers (cm^{-1}): 3500, 3360w, 3200sh, 1685sh, 1630w, 1455w, 1436w, 1380w, 1075sh, 1013s, 994s, 933s, 755sh, 739, 697, 661, 540sh, 530, 481, 457, 397.

Sir40 Eudialyte-group mineral Sir40 $Na_{15}(Ca_3Mn_3)(Na,Mn,Zr)_3Zr_3(Si,Nb)_2(Si_{24}O_{72})(O,OH)_3F{\cdot}H_2O$

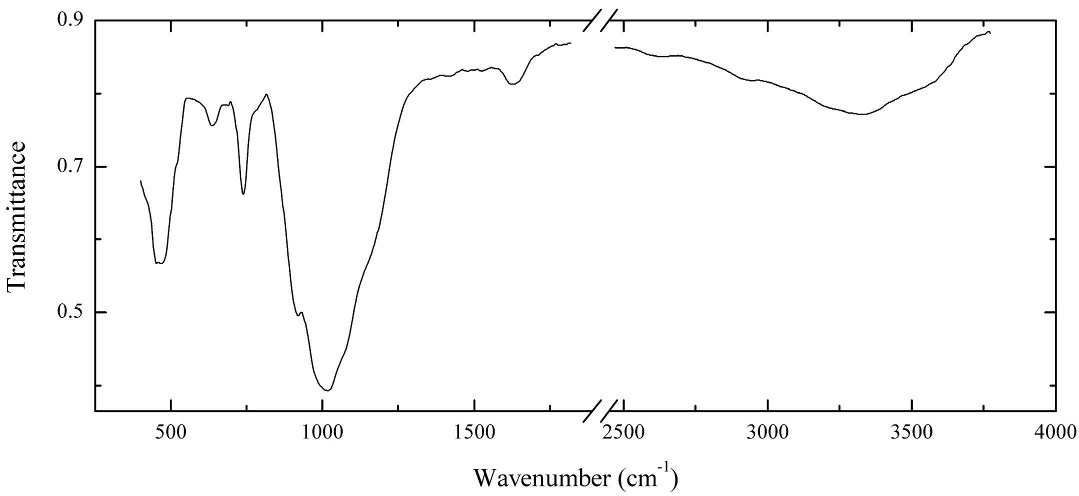


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pink grains from peralkaline pegmatite. Mn-analogue of raslakite. The crystal structure is solved. Trigonal, space group *R*3, $a = 14.182(7)$, $c = 30.37(1)$ Å. Optically uniaxial (+), $\varepsilon = 1.614$, $\omega = 1.611$. The crystal-chemical formula is $(Na_{14.2}Sr_{0.45}REE_{0.25}K_{0.1})[Mn_{3.0}(Ca_{2.1}REE_{0.9})][(Na_{1.8}(Mn_{0.6}Fe_{0.15})(Zr_{0.4}Hf_{0.05})](Zr_{2.9}Ti_{0.1})(Si_{1.6}Nb_{0.4})(Si_{24}O_{72})(O,OH)_{3.35}F_{0.5}Cl_{0.3}{\cdot}0.65H_2O$.

Wavenumbers (cm^{-1}): 3380, 1630w, 1075sh, 1012s, 990s, 934s, 739, 696, 658, 592w, 530, 480, 465, 450sh, 420sh.

Sir42 Aqualite $(H_3O)_8Na_4Ca_6SrZr_3Si_{26}O_{66}(OH)_9Cl{\cdot}nH_2O$

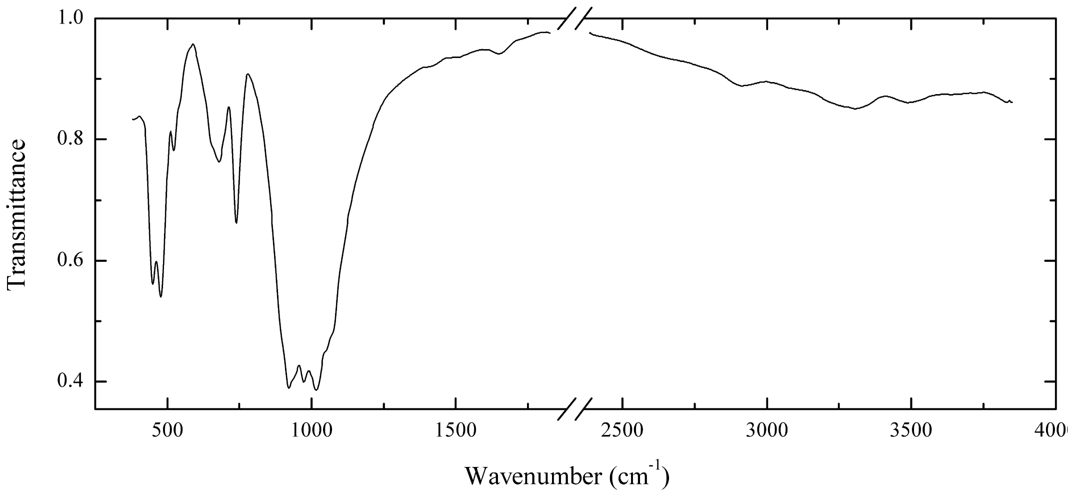


Locality: Inagli alkaline–ultrabasic massif, Aldan shield, Sakha Republic (Yakutia), Eastern Siberia, Russia (type locality).

Description: Pink grains from the association with natrolite, microcline, eckermannite, aegirine, batisite, innelite, lorenzenite, thorite and galena. Holotype sample. The crystal structure is solved. Trigonal, space group $R3$, $a = 14.078(3)$, $c = 30.24(1)$ Å, $Z = 3$. Optically uniaxial (+), $\omega = 1.569(1)$, $\varepsilon = 1.571(2)$, $D_{meas} = 2.58(2)$, $D_{calc} = 2.66$ g/cm^3. The crystal-chemical formula is $[(H_3O)_8Na_{2.7}K_{1.2}Sr_{0.5}Ba_{0.5}]Fe_{0.2}Mn_{0.1}(Ca_{5.8}Ce_{0.2})(Zr_{2.9}Ti_{0.1})(Si_{25.6}Ti_{0.2}Al_{0.2})(O,OH)_{72}(OH)_{2.8}Cl_{1.2}\cdot nH_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 11.43(39), 10.50(44), 7.06(42), 6.63(43), 4.39(100), 3.621(41), 2.987(100), 2.850(79).

Wavenumbers (cm^{-1}): 3550sh, 3325, 2930w, 2640w, 1637, 1140sh, 1075sh, 1020s, 995sh, 930s, 741, 645, 525sh, 477, 450, 415sh.

Sir43 Andrianovite $Na_{12}(K,Sr,Ce)_3Ca_6Mn_3Zr_3Nb(Si_{25}O_{73})(O,H_2O,OH)_5$

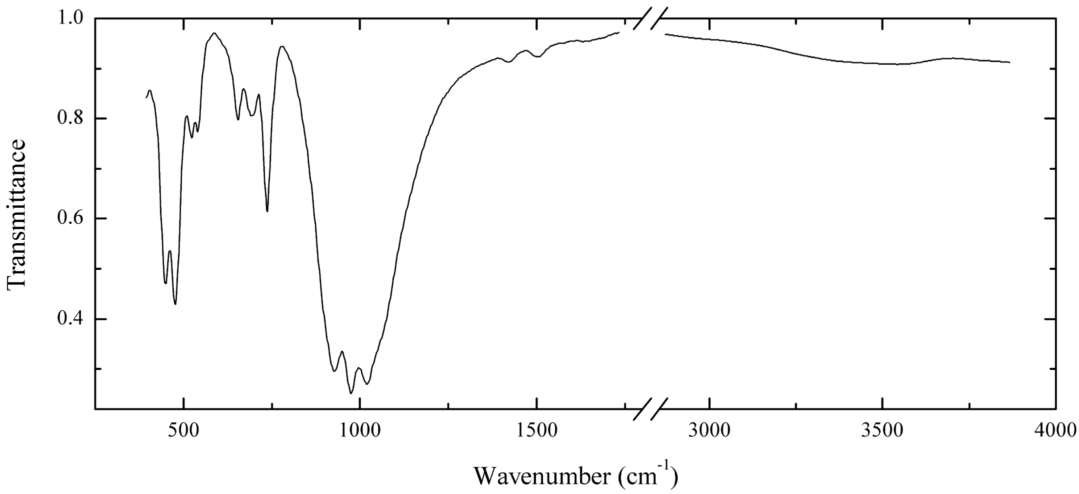


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Yellow rims around eudialyte grains. Holotype sample. Associated minerals are aegirine, sodalite, microcline, natrolite, lomonosovite, lamprophyllite, mosandrite and villiaumite. with cancrinite, nepheline, aegirine-augite, pectolite, zircon, andradite, scolecite and calcite. Holotype sample. The crystal structure is solved. Trigonal, space group $R3m$, $a = 14.281(4)$, $c = 30.243(7)$ Å, $Z = 3$. Optically uniaxial (–), $\omega = 1.622(2)$, $\varepsilon = 1.617(2)$. $D_{meas} = 2.93(2)$ g/cm^3 (volumetric method), $D_{calc} = 3.02$ g/cm^3. The crystal-chemical formula is $Na_{12.09}(K_{1.40}Sr_{0.97}REE_{0.60}Ba_{0.04})(Ca_{5.90}Y_{0.08})(Mn_{1.81}Fe^{2+}{}_{1.19})(Zr_{2.96}Hf_{0.04})(Nb_{0.69}Si_{0.27}Ti_{0.05}Al_{0.01})$ $(Si_{25}O_{73})[O_{2.14}(OH)_{0.52}][(H_2O)_{1.30}(CO_3)_{0.42}Cl_{0.28}]$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 6.447 (60) (104), 5.719 (40) (202), 4.322 (71) (205), 3.540 (38) (027), 3.222 (70) (208), 3.170 (50) (217), 2.982 (100) (315), 2.860 (94) (404).

Wavenumbers (cm^{-1}): 3480, 3290, 2890, 1650w, 1074s, 1050sh, 1017s, 976s, 940sh, 922s, 900sh, 740, 700sh, 680, 660sh, 545w, 526, 480, 452.

Sir45 Ferrokentbrooksite $Na_{15}Ca_6Fe^{2+}{}_3Zr_3Nb(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,F,OH)_2$

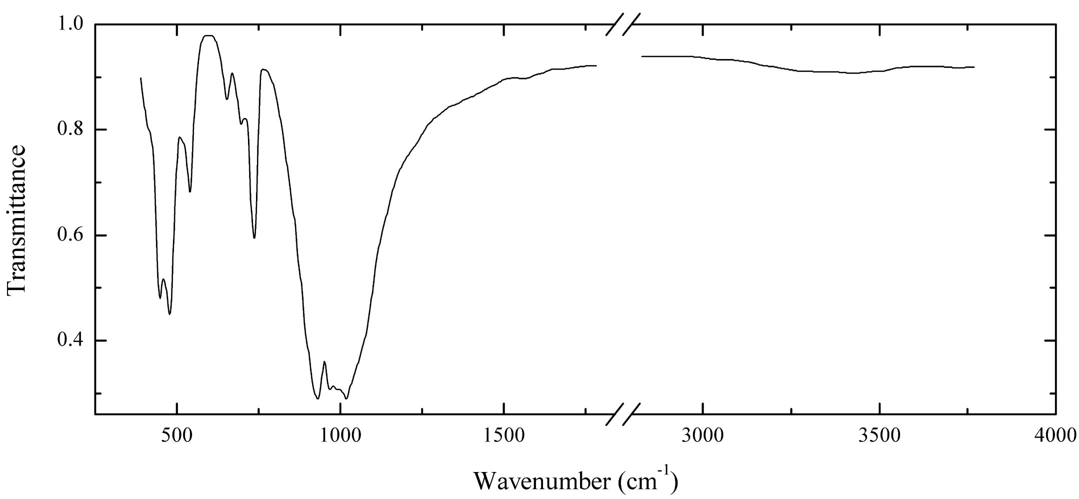


Locality: Outcrop at the Petrelius river, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Reddish-brown grains from the association with georgbarsanovite. The crystal structure is solved. Trigonal, space group *R*3*m*, $a = 14.276(4)$, $c = 29.99(1)$ Å, $Z = 3$. The empirical formula is (electron microprobe) $Na_{13.6}K_{0.3}Sr_{0.6}REE_{0.4}Ca_{6.1}Fe_{1.9}Mn_{1.1}Zr_{3.0}Nb_{0.8}Si_{25}O_{73}Cl_{0.9}(O,OH,H_2O,F)_{4.1}$. Weak bands at 1,423 and 1,502 cm^{-1} indicate the presence of trace amount of CO_3^{2-} groups. The bands at 525 and 545 cm^{-1} correspond to Fe–O stretching vibrations of $[Fe^{3+}O_5]$ (tetragonal pyramid) and $[Fe^{2+}O_4]$ (flat square), respectively.

Wavenumbers (cm^{-1}): 3540w, 3420sh, 1502w, 1423w, 1105sh, 1075sh, 1050sh, 1021s, 976s, 928s, 741, 689, 655, 545, 525, 479, 452.

Sir47 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

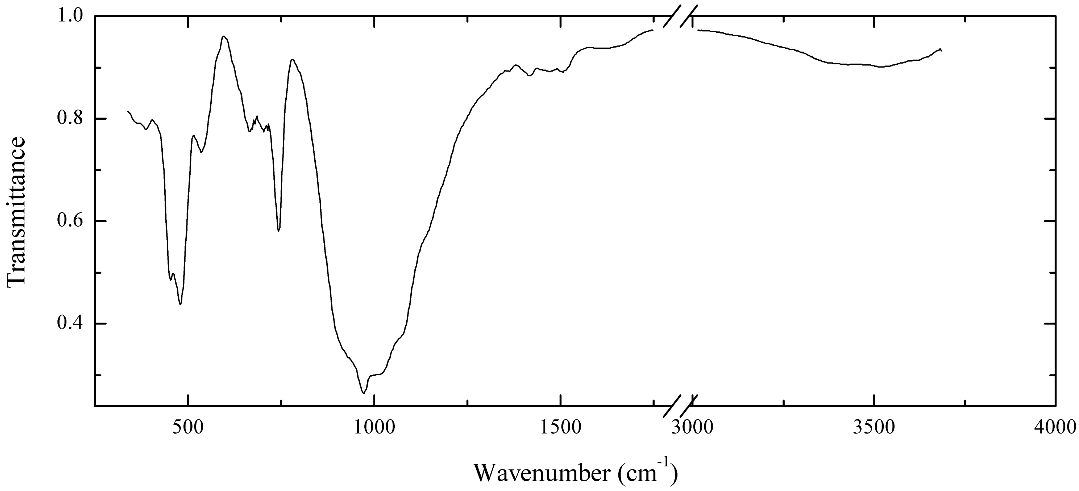


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Raspberry pink grains from peralkaline pegmatite, from the association with microcline, nepheline, aegirine, lamprophyllite and fluorapatite. The crystal structure is solved. Trigonal, space group $R3m$, a = 14.257(3), c = 30.05(2) Å. The band at 542 cm^{-1} corresponds to Fe–O stretching vibrations of the flat square $Fe^{2+}O_4$.

Wavenumbers (cm^{-1}): 3340w, 1075sh, 1050sh, 1020s, 993s, 972s, 933s, 741, 700, 656, 542, 480, 451, 415sh.

Sir49 Feklichevite $Na_{11}Ca_9(Fe^{3+},Fe^{2+})_2Zr_3Nb[Si_{25}O_{73}](OH,H_2O,Cl,O)_5$

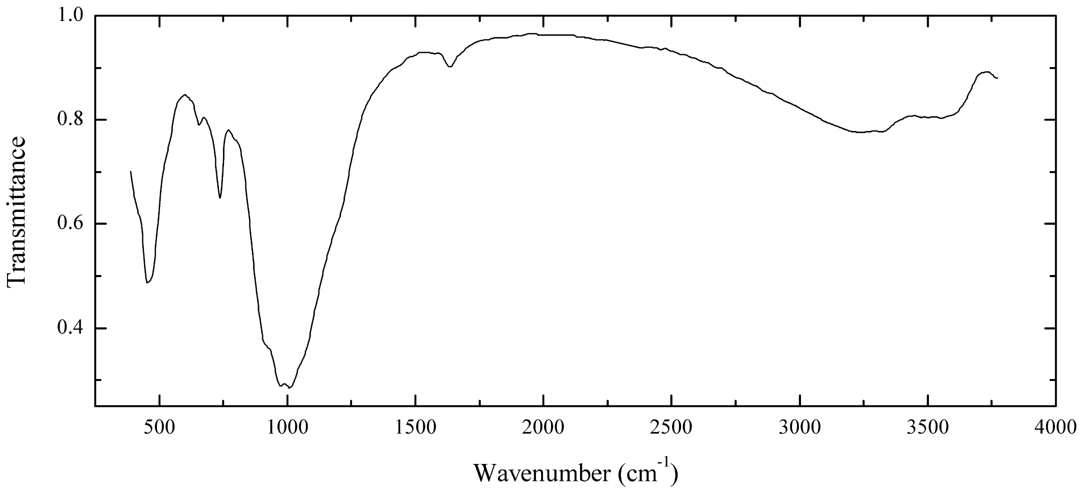


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Dark brown crystals from peralcaline pegmatite, from the association with potassic feldspar, cancrinite, aegirine-diopside, pectolite, titanite, hematite and pyrrhotite. Holotype sample. Trigonal, space groups $R3m$, a = 14.255(1), c = 30.170(2) Å. Optically uniaxial (–), ω = 1.616 (1), ε = 1.620(1). D_{meas} = 2.87 g/cm^3, D_{calc} = 2.869 g/cm^3. The empirical formula is $Na_{10.80}(Ca_{2.35}Na_{0.33}Sr_{0.08}Ce_{0.03}La_{0.02})Ca_6(Fe^{3+}{}_{1.21}Fe^{2+}{}_{0.87})(Zr_{2.85}Hf_{0.09}Ti_{0.05})Nb_{0.55}[(Si_{25.25}Mn_{0.21})O_{73}]$ $[(OH)_{1.12}O_{0.26}$ $(H_2O)_{1.67}][(OH)_{1.29}Cl_{0.52}F_{0.19}]$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 4.31 (55) (205), 3.218 (56) (208), 3.036 (43) (119, 11-9, 042), 2.977 (81) (13-5, 135), 2.854 (100) (404), 2.602 (44) (039, 309). Weak bands at 1,415, 1,480 and 1,510 cm^{-1} indicate the presence of trace amounts of CO_3^{2-} groups.

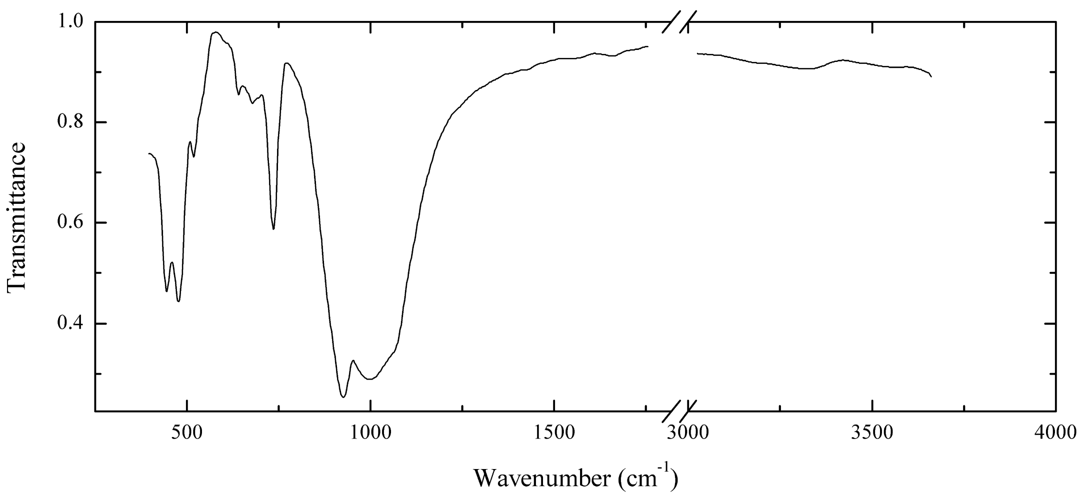
Wavenumbers (cm^{-1}): 3520w, 3400sh, 1650w, 1610w, 1510w, 1480w, 1415w, 1130sh, 1065sh, 1013s, 973s, 930sh, 910sh, 742, 702, 683, 667, 640sh, 533, 479, 454, 387.

Sir50 "Potassic-hydroeudialyte" $(H_3O,Na)_{12}(K,Na)_3Ca_6(Fe^{3+},\square,Zr)_3Zr_3Na(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$



Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Light rose-coloured grains from hydrothermally altered peralkaline pegmatite. The crystal structure is solved. Trigonal, space group *R*3*m*, *a* = 14.245(3), *c* = 30.12(3) Å. The empirical formula is (taking into account structural data) $H_{4.8}(H_3O)_{5.69}Na_{3.30}K_{2.20}Sr_{0.26}REE_{0.05}Fe^{3+}_{1.05}Mn_{0.13}Ca_{5.50}Zr_{3.35}Ti_{0.24}Nb_{0.05}Al_{0.13}Si_{24.87}O_{72}Cl_{1.59}\cdot nH2O$.
Wavenumbers (cm^{-1}): 3565sh, 3520, 3300, 3210, 1632, 1190sh, 1060sh, 1009s, 975s, 920sh, 800sh, 736, 656, 520sh, 464, 450, 410sh.

Sir51 Labyrinthite $(Na,K,Sr)_{35}Ca_{12}Fe_3Zr_6Ti(Si_{51}O_{144})(O,OH,H_2O)_9Cl_3$

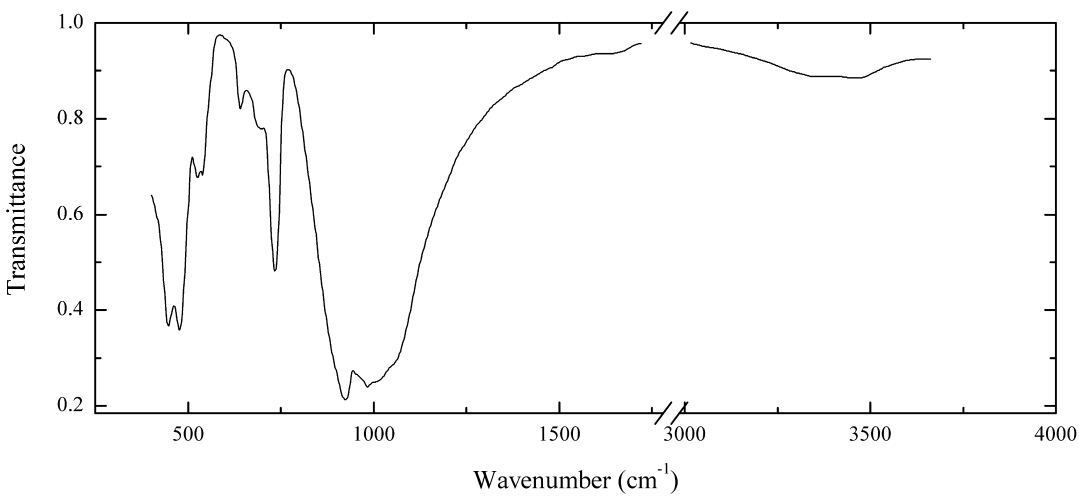


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Dichroic (raspberry pink to greyish-brown) grains in a rim around a large grain of eudialyte from peralcaline pegmatite, from the association with villiaumite, microcline, nepheline, aegirine, barytolamprophyllite, belovite-(Ce) and lomonisovite. The crystal structure is solved. Centrosymmetric variety. Trigonal, space group $R\text{-}3m$, $a = 14.243(3)$, $c = 60.907(8)$ Å. The crystal-chemical formula is ($Z = 1$) $\{(Na_{43.38}Y_{1.62})(Ca_{17.1}REE_{0.9})(Zr_{8.55}Nb_{0.45})[(K_{4.44}Sr_{1.5})Fe_{3.06}]$ $[Si_{3.84}(OH)_{3.84}Ti_{1.32}Nb_{0.36}(OH)_{5.04}][Si_3O_9]_6[Si_9O_{27}]_6F_{3.6}Cl_{2.4}\}\{(Na_{42.3}Ca_{2.7})(Ca_{17.1}REE_{0.9})$ $(Zr_{8.55}Nb_{0.45})[Mn_{4.86}Fe_{2.61}(OH)_{4.86}][Si_{6.0}(OH)_{6.0}][Si_3O_9]_6[Si_9O_{27}]_6F_{3.0}H_2O_{1.8}\}$. High intensity of the band at 929 cm^{-1} reflects the predominance of Si in the sites $M(3)$, $M(3)'$, $M(4)$ and $M(4)'$.

Wavenumbers (cm^{-1}): 3320w, 1655w, 1060sh, 1007s, 992s, 970sh, 929s, 737, 679, 641, 540sh, 522, 479, 447.

Sir53 Labyrinthite $(Na,K,Sr)_{35}Ca_{12}Fe_3Zr_6TiSi_{51}O_{144})(O,OH,H_2O)_9Cl_3$

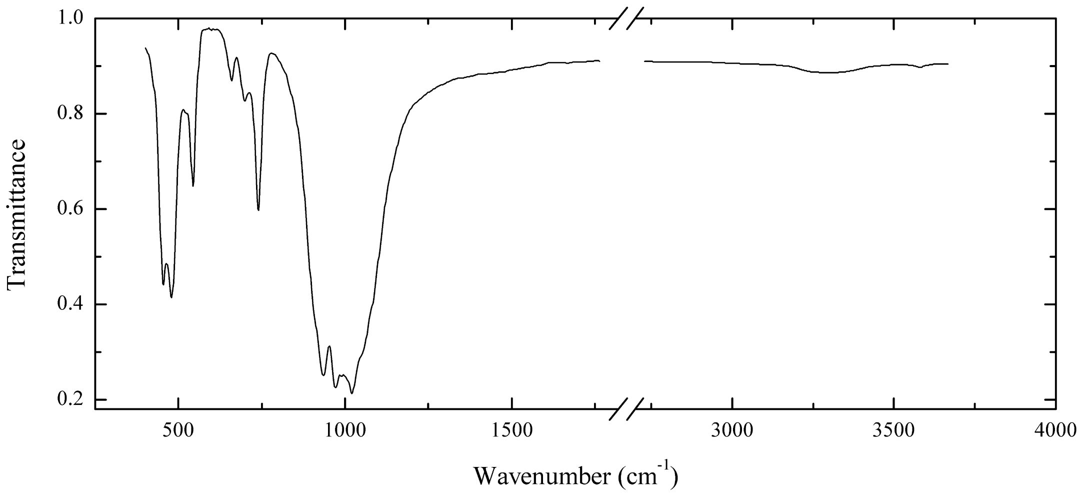


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pink grains from the association with villiaumite, aegirine and barytolamprophyllite. Confirmed by single-crystal X-ray diffraction pattern. The empirical formula is ($Z = 6$) $Na_{15.3}Sr_{0.1}Ce_{0.1}Y_{0.1}Ca_{6.2}Mn_{0.7}Fe_{1.4}Zr_{3.1}Ti_{0.3}Si_{25.7}O_{72}(O,F,OH,H_2O)_yCl_{0.7}$. High intensity of the band at 928 cm^{-1} reflects the predominance of Si in the sites $M(3)$, $M(3)'$, $M(4)$ and $M(4)'$.

Wavenumbers (cm^{-1}): 3445w, 3330w, 3060sh, 1640w, 1065sh, 1015sh, 989s, 970sh, 928s, 737, 699, 643, 541, 526, 478, 449, 410sh.

Sir54 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

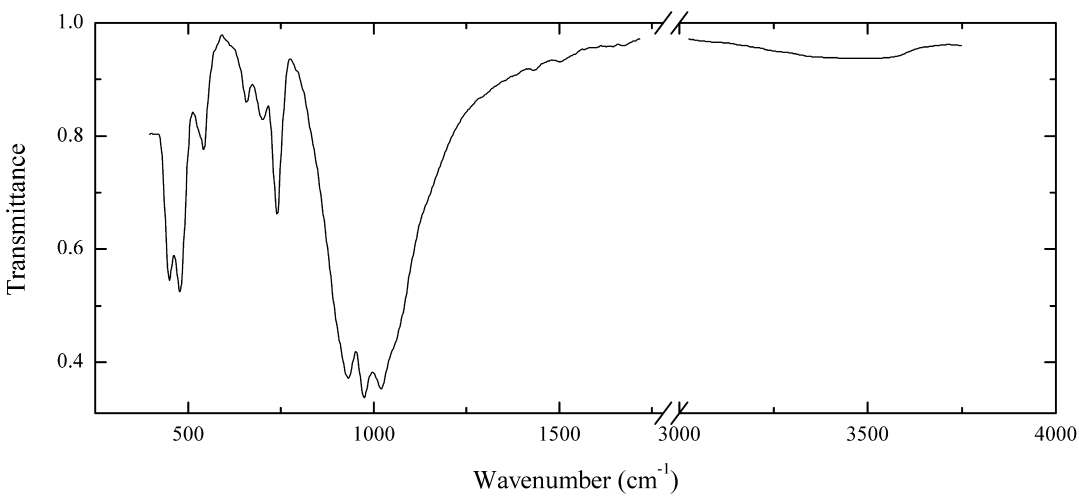


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Purplish-red grains from peralcaline pegmatite, from the association with microcline, nepheline, aegirine, magnesio-arfvedsonite and lamprophyllite. The empirical formula is (electron microprobe) $Na_{14.4}K_{0.3}Ce_{0.13}Ca_{6.0}Mn_{0.8}Fe_{1.9}Zr_{2.7}Ti_{0.3}Nb_{0.2}Si_{25.8}O_{72}(O,OH,H_2O)_xCl_{0.9}$. The band at 542 cm^{-1} corresponds to Fe^{2+}–O stretching vibrations.

Wavenumbers (cm^{-1}): 3565w, 3300w, 1080sh, 1050sh, 1021s, 996, 972s, 935s, 905sh, 741, 700, 659, 542, 480, 453.

Sir55 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

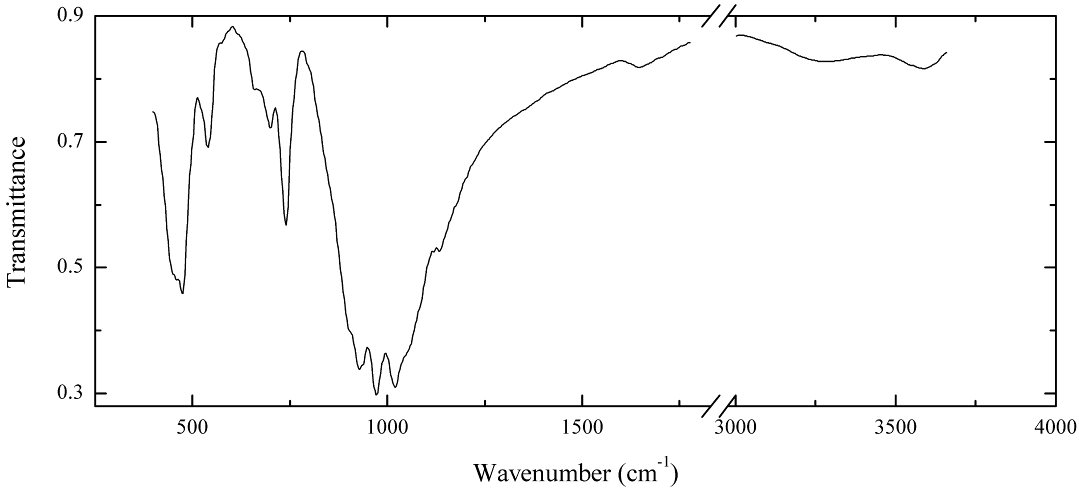


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-red crystal from the association with nepheline, aegirine, lorenzenite and lamprophyllite. The empirical formula is (electron microprobe) $Na_{14.3}K_{0.3}Ce_{0.3}La_{0.2}Nd_{0.1}(Ca_{5.6}Mn_{0.4})(Fe_{2.5}Mn_{0.5})Zr_{3.0}Ti_{0.1}Nb_{0.3}Si_{25.4}O_{72}(O,OH,H_2O)_xCl_{1.2}$. The bands at 546 and 535 cm^{-1} corresponds to $M(2)$–O stretching vibrations, where $M(2) = Fe^{2+}$ and Mn^{2+}, respectively. Weak bands at 1,433 and 1,500 cm^{-1} indicate the presence of trace amounts of $CO_3{}^{2-}$ groups.

Wavenumbers (cm^{-1}): 3460w, 1500w, 1433w, 1080sh, 1050sh, 1020s, 976s, 922s, 741, 702, 658, 546, 535sh, 481, 454.

Sir56 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

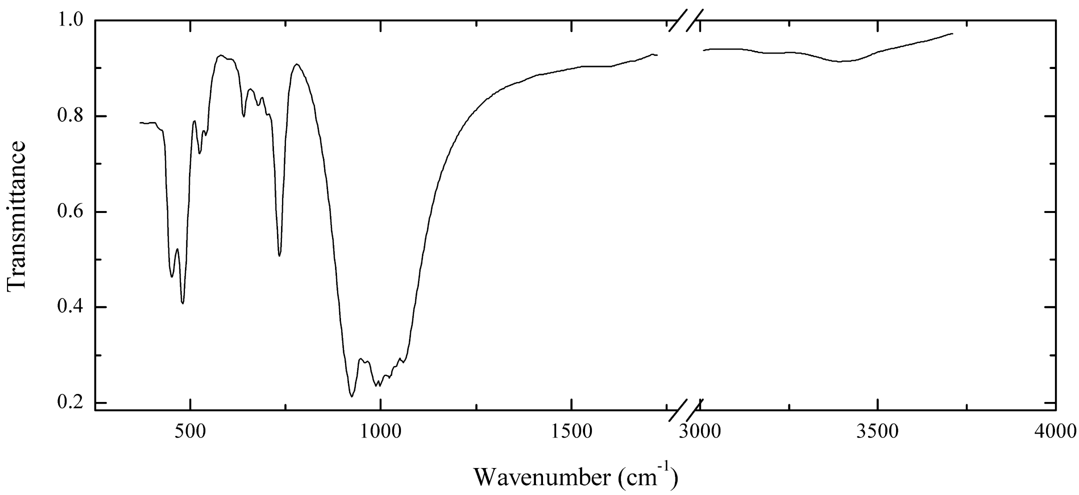


Locality: Norra Kärr, Gränna, Jönköping, Småland, Sweden**.**

Description: Orange-brown grains from peralkaline pegmatite. The empirical formula is (electron microprobe) $Na_{13.9}K_{0.3}Ce_{0.2}La_{0.1}(Ca_{5.2}Mn_{0.8})(Fe_{2.5}Mn_{0.2})Zr_{3.4}Nb_{0.3}Si_{25.4}O_{72}(O,OH,H_2O)_xCl_{1.1}$.

Wavenumbers (cm^{-1}): 3670w, 3260w, 1650w, 1125sh, 1050sh, 1018s, 972s, 932s, 905sh, 740, 697, 661w, 541, 475, 456.

Sir57 Davinciite $Na_{12}K_3Ca_6Fe^{2+}{}_3Zr_3[Si_{26}O_{73}(OH)](O,OH)_2Cl_2$.

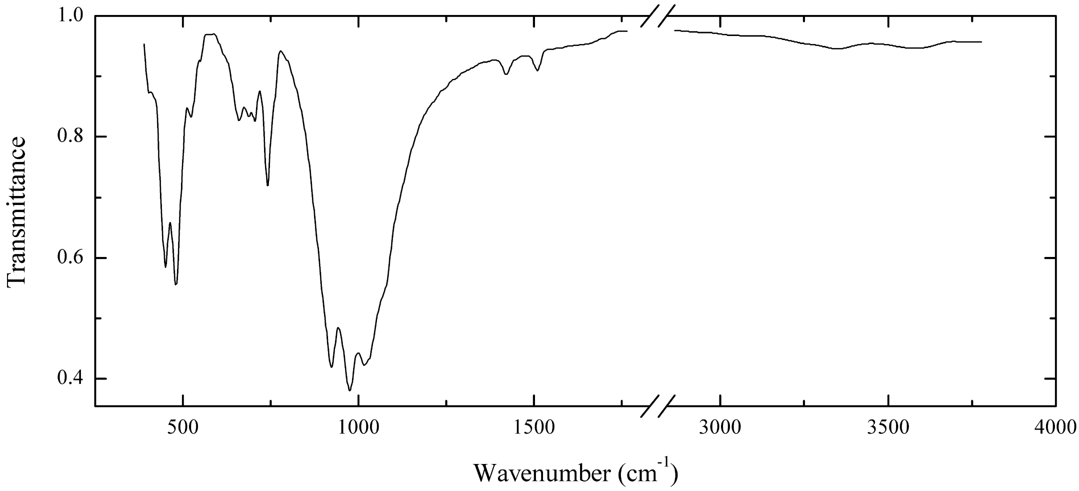


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Red grains from peralkaline pegmatite. The empirical formula is (electron microprobe) $Na_{11.7}K_{3.8}Sr_{0.2}Ce_{0.1}Ca_{6.0}Fe_{1.7}Mn_{0.1}Zr_{3.0}[Si_{26}O_{73}(OH)](O,OH)_xCl_{1.6}$. The bands at 545 and 528 cm^{-1} correspond to stretching vibrations of the flat square $Fe^{2+}O_4$ and tetragonal pyramid $(Mn,Fe)O_5$, respectively. High intensity of the band at 927 cm^{-1} reflects almost complete occupation of the sites *M*(3) and *M*(4) with Si.

Wavenumbers (cm^{-1}): 3410, 3250w, 1064s, 1043s, 1027s, 1004s, 991s, 959, 927s, 738, 707, 683, 643, 545, 528, 482, 455.

Sir58 Manganokhomyakovite $Na_{12}Sr_3Ca_6Mn^{2+}{}_3Zr_3W(Si_{25}O_{73})(O,OH,H_2O)_3(OH,Cl)_2$

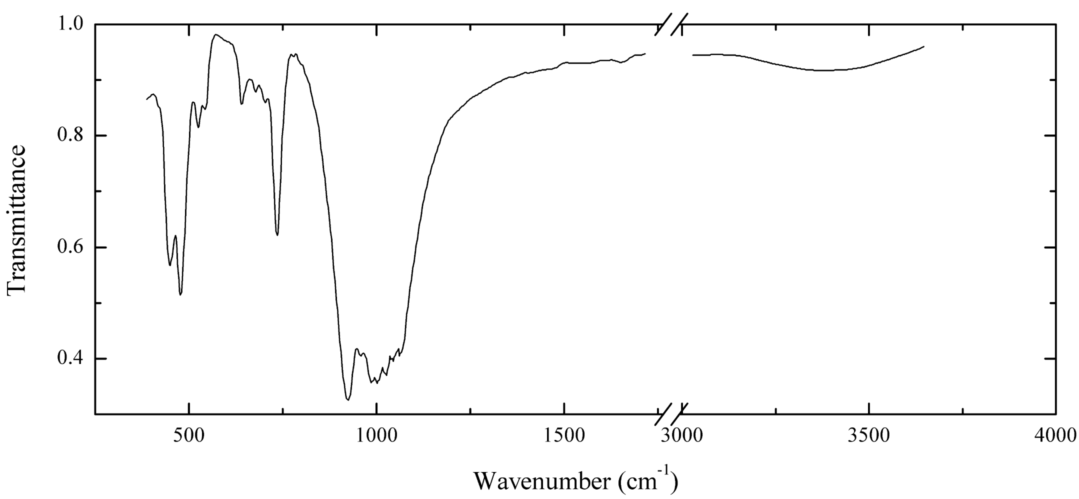


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Orange-red grains from peralkaline pegmatite, from the association with aegirine, albite, analcime, annite, cerussite, galena, kupletskite, microcline, molybdenite, natrolite, pyrite, pyrrhotite, sodalite, sphalerite, titanite, wöhlerite and zircon. Holotype sample. Investigated by O. Johnsen with coauthors. Trigonal, space group *R*3*m*, $a = 14.282(3)$, $c = 30.12(1)$ Å, $Z = 3$. Optically uniaxial (–), $\omega = 1.629(1)$, $\varepsilon = 1.626(2)$. $D_{meas} = 2.90(1)$ g/cm^3, $D_{calc} = 2.908$ g/cm^3. The empirical formula is $(Na_{11.51}K_{0.30}Ca_{0.25}Sr_{0.04}REE_{0.07})Sr_3Ca_6(Mn_{2.04}Fe_{1.23})$ $(Zr_{2.91}Hf_{0.03}Ti_{0.01})$ $(W_{0.66}Nb_{0.41}Ta_{0.01})(Si_{24.60}Al_{0.01})O_{73}(O,OH,H_2O)_{3.70}(OH_{1.19}Cl_{0.81})$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.500 (90) (101), 9.535 (70) (012), 6.452 (50) (104), 6.072 (50) (021), 5.735 (50) (202), 3.406 (50) (131), 3.213 (50) (208), 3.167 (50) (217), 2.980 (100) (315), 2.856 (50) (104). The bands at 1,420 and 1,510 cm^{-1} indicate the presence of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3550w, 3325w, 1510w, 1420w, 1075sh, 1060sh, 1017s, 975s, 922s, 740, 701, 683, 656, 545w, 523, 479, 450, 398.

Sir59 Davinciite $Na_{12}K_3Ca_6Fe^{2+}{}_3Zr_3[Si_{26}O_{73}(OH)](O,OH)_2Cl_2$.

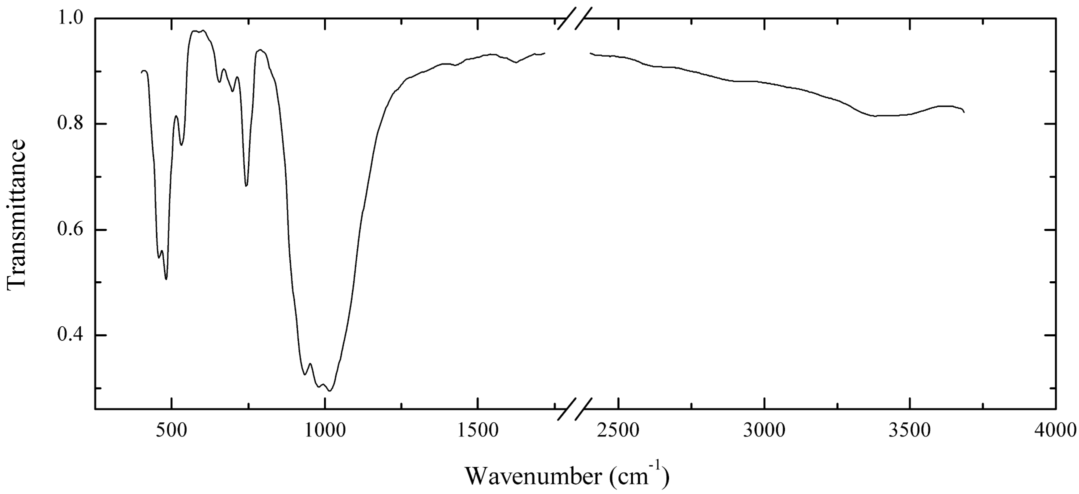


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark red grains from peralkaline pegmatite. The empirical formula is (electron microprobe) $Na_{13.0}K_{4.2}Ca_{5.9}Sr_{0.4}Mn_{0.2}Ca_{5.8}Fe_{1.6}Ti_{0.1}Zr_{2.9}Nb_{0.1}[Si_{26}O_{73}(OH)](O,OH)_xCl_{1.7}$. The bands at 545 and 527 cm^{-1} correspond to stretching vibrations of the flat square $Fe^{2+}O_4$ and tetragonal pyramid $(Mn,Fe)O_5$, respectively. High intensity of the band at 927 cm^{-1} reflects almost complete occupation of the sites *M*(3) and *M*(4) with Si.

Wavenumbers (cm^{-1}): 3490w, 3260w, 1645w, 1066s, 1044s, 1026s, 1005s, 990s, 961s, 927, 738, 707, 682, 643, 545, 527, 480, 454.

Sir61 Raslakite $Na_{15}Ca_3Fe_3(Na,Zr)_3Zr_3(Si,Nb)(Si_{25}O_{73})(OH,H_2O)_3(Cl,OH)$

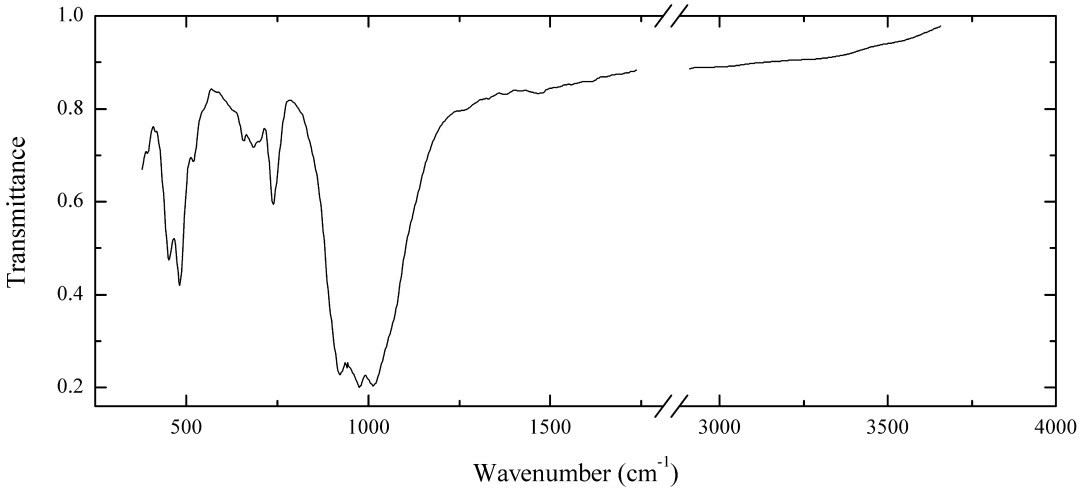


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Red grains with rims of terskite from peralkaline pegmatite, from the association with microcline, aegirine, nepheline, lamprophyllite, kazakovite and fluorcaphite. Holotype sample. The crystal structure is solved. Trigonal, space group *R*3, $a = 14.229(7)$, $c = 30.019(15)$ Å, $Z = 3$. Optically uniaxial (+), $\omega = 1.608$, $\varepsilon = 1.611$. $D_{meas} = 2.95(1)$ g/cm^3, $D_{calc} = 2.945$ g/cm^3. The empirical formula is $Na_{16.02}K_{0.32}Ca_{3.13}Sr_{0.21}Mg_{0.22}Fe_{2.17}Mn_{0.88}Ce_{0.16}La_{0.08}Nd_{0.08}Ti_{0.14}Zr_{3.80}Hf_{0.06}$ $Nb_{0.17}Al_{0.16}$ $Si_{25.40}$ $Cl_{1.18}H_{4.66}O_{76.465}$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.311 (66) (205), 4.095 (37) (116, 11-6), 3.209 (58) (208), 3.023 (40) (119, 11-9), 2.974 (86) (315, 13-5), 2.853 (100) (404). Weak band at 1,435 cm^{-1} indicates the presence of trace amounts of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3480w, 3370w, 1620w, 1435w, 1075sh, 1050sh, 1018s, 980s, 936s, 742, 696, 657, 531, 479, 458.

Sir62 Oneillite $Na_{15}Ca_3Mn_3Fe_3Zr_3Nb(Si_{25}O_{73})(O,OH,H_2O)_3(OH)_2$

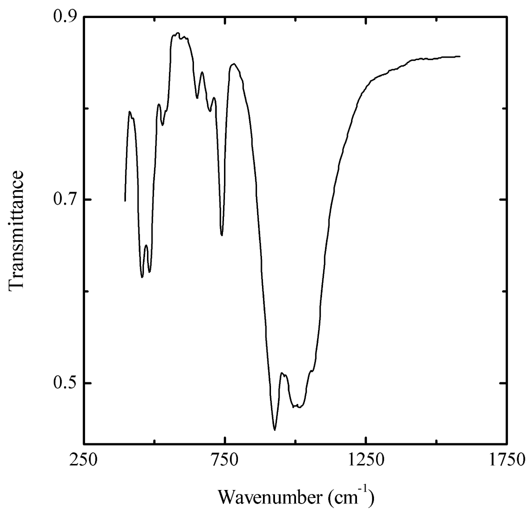


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Yellowish brown grain from the association with albite, sodalite, pyrite and aegirine. Holotype sample. The crystal structure is solved. Trigonal, space group *R*3, $a = 14.192(1)$, $c = 29.983(3)$ Å, $Z = 3$. Optically uniaxial (−), $\omega = 1.6450(3)$, $\varepsilon = 1.6406(3)$. $D_{meas} = 3.20(3)$ g/cm^3, $D_{calc} = 3.22$ g/cm^3. The empirical formula is $Na_{14.37}REE_{1.53}Ca_{3.13}Sr_{0.21}Mg_{0.22}Fe_{2.17}Mn_{0.88}Ce_{0.16}La_{0.08}Nd_{0.08}Ti_{0.14}Zr_{3.80}Hf_{0.06}Nb_{0.17}Al_{0.16}Si_{25.40}Cl_{1.18}H_{4.66}O_{76.465}$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.348 (44) (101), 7.100 (33)(110), 6.021 (36) (021), 5.683 (31) (202), 4.291 (36) (205), 3.389 (43) (-141), 3.199 (31) (208), 3.150 (35) (-237), 2.964 (100) (-345), 2.844 (89)(404). Confirmed by IR spectrum. Weak bands at 1,454 and 1,473 cm^{-1} indicate the presence of trace amounts of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3310w, 1473w, 1454w, 1070sh, 1014s, 977s, 925s, 741, 703, 687, 660, 630sh, 540sh, 522, 484, 454, 406.

Sir63 Labyrinthite $(Na,K,Sr)_{35}Ca_{12}Fe_3Zr_6TiSi_{51}O_{144})(O,OH,H_2O)_9Cl_3$

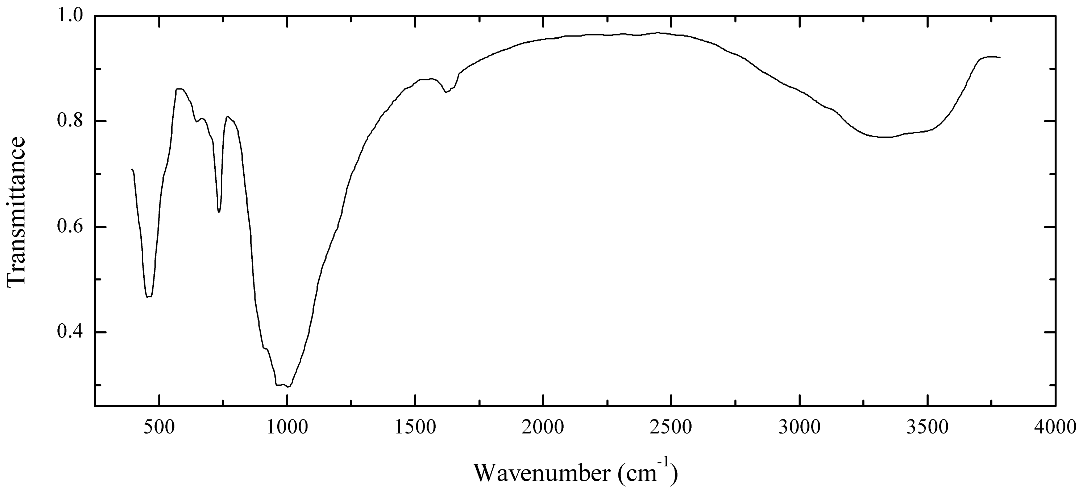


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pink grain from the association with K-feldspar, sodalite, alkali amphiboles, aegirine, pectolite, lamprophyllite, lomonosovite, villiaumite and lovozerite-group minerals. Holotype sample. The crystal structure is solved. Trigonal, space group *R*3, $a = 14.239(1)$, $c = 60.733(7)$ Å, $Z = 3$. Optically uniaxial (+), $\omega = 1.597(1)$, $\varepsilon = 1.601(1)$. $D_{meas} = 2.88(2)$ g/cm^3, $D_{calc} = 2.87$ g/cm^3. The empirical formula is $(Na_{33.30}K_{1.45}Sr_{0.74})(Ca_{11.77}Ce_{0.10})(Fe_{2.19}Mn_{0.87})Zr_{5.94}Ti_{0.52}Si_{51.26}O_{144.48}(OH)_{4.80}\ Cl_{2.95}F_{0.36}{\cdot}3H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.70 (34) (024), 4.324 (68) (0.2.10), 3.550 (39) (220), 3.230 (44) (0.2.16), 3.173 (34) (1.2.14), 3.049 (36) (1.1.18), 2.977 (100) (1.3.10), 2.853 (88) (048), 2.685 (38) (140), 2.605 (36) (0.3.18).

Wavenumbers (cm^{-1}): 1064s, 1023s, 993s, 961, 929s, 740, 696, 650, 540, 527, 481, 453.

Sir64 "Hydroeudialyte" $(H_3O,H_2O,Na)_{15}Ca_6(\square,Fe^{3+})_3Zr_3Si_{26}(O,OH)_{73}(OH,Cl)$

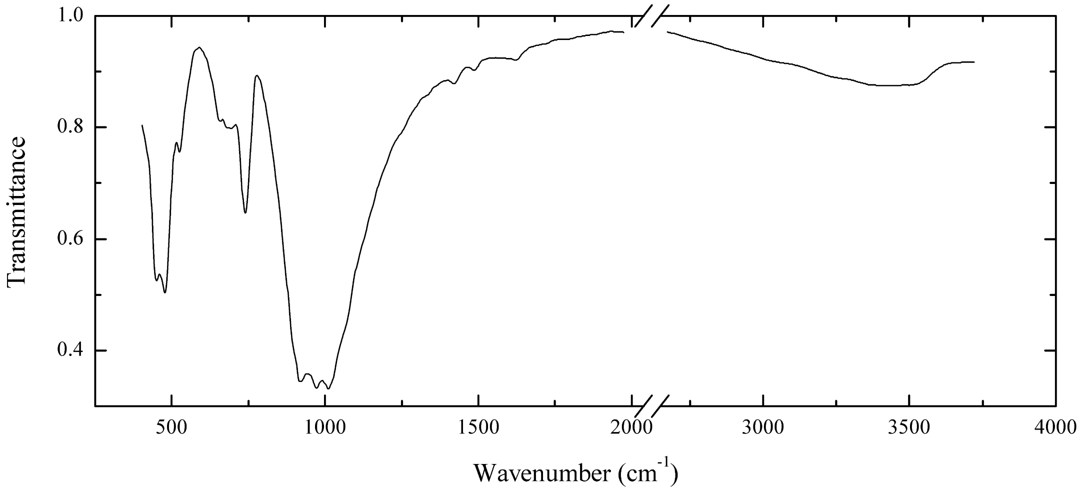


Locality: Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Light rose-coloured grains from hydrothermally altered peralkaline pegmatite. The crystal structure is solved. The analogue of aqualite with doubled *c* parameter. The empirical formula is (electron microprobe) $Na_{2.3}K_{2.0}REE_{0.1}Sr_{0.6}Ca_{11.1}Mn_{0.2}Fe_{2.2}Zr_{5.8}Ti_{0.3}Al_{0.2}Si_{51.8}Nb_{0.15}O_{144}(O,OH,H_2O)_x$.

Wavenumbers (cm^{-1}): 3645sh, 3440sh, 3330, 3100sh, 1650sh, 1627w, 1490sh, 1155sh, 1050sh, 1007s, 973s, 920sh, 738, 695sh, 655w, 530sh, 471, 455, 415sh.

Sir65 Ferrokentbrooksite $(Na,\mathit{REE})_{15}Ca_6Fe^{2+}{}_3Zr_3Nb(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,F,OH)_2$

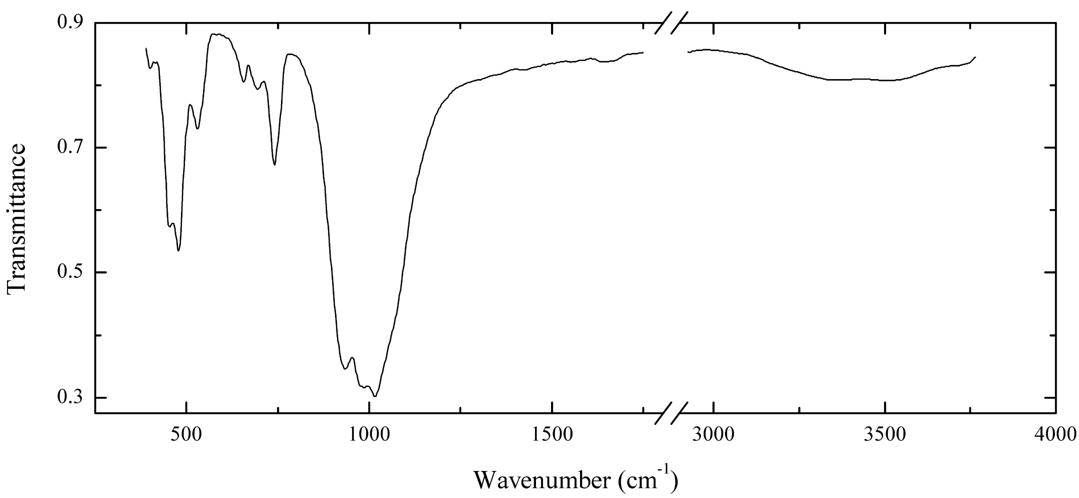


Locality: Zaangarskiy (Srednetatarskiy) alkaline massif, Eastern Siberia, Russia.

Description: Brown-red grains from peralkaline pegmatite. The empirical formula is $Na_{10.85}(Na_{1.15}REE_{0.99}K_{0.34}Ca_{0.33}Sr_{0.19})(Ca_{4.24}Mn_{1.76})(Fe^{2+}{}_{1.13}Mn_{0.92}Fe^{3+}{}_{0.63}Zr_{0.32})(Zr_{2.94}Ti_{0.06})$ $Nb_{0.56}$ $Si_{0.02}Al_{0.34}(Si_{25}O_{73})Cl_{0.8}(O,OH,H_2O,F)_x$.

Wavenumbers (cm^{-1}): 3505, 3410w, 3240sh, 3030sh, 1625w, 1490w, 1423w, 1140sh, 1070sh, 1014s, 974s, 929s, 895sh, 742, 699, 686, 657, 525, 480, 452, 400sh.

Sir66 Raslakite $Na_{15}Ca_3Fe_3(Na,Zr)_3Zr_3(Si,Nb)(Si_{25}O_{73})(OH,H_2O)_3(Cl,OH)$

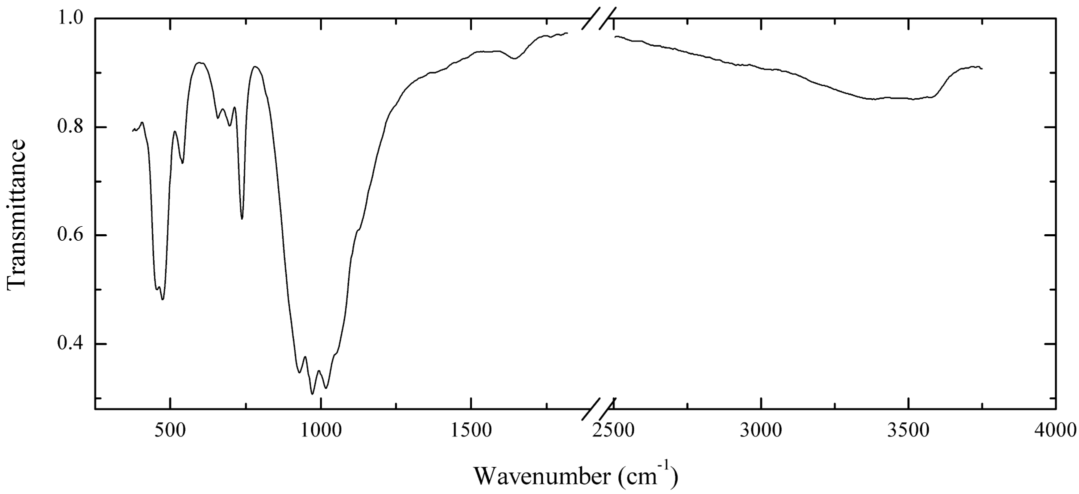


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Red grains from the association with microcline, aegirine, nepheline, barytolamprophyllite, tisinalite and lorenzenite. The empirical formula is $Na_{16.3}K_{0.4}Ce_{0.2}La_{0.1}(Ca_{2.9}Mn_{0.1})$ $(Fe_{2.2}Mn_{0.8})Zr_{3.6}Ti_{0.3}Fe_{0.1}Nb_{0.1}Si_{25.9}O_{73}(OH,H_2O)_xCl_{1.2}$.

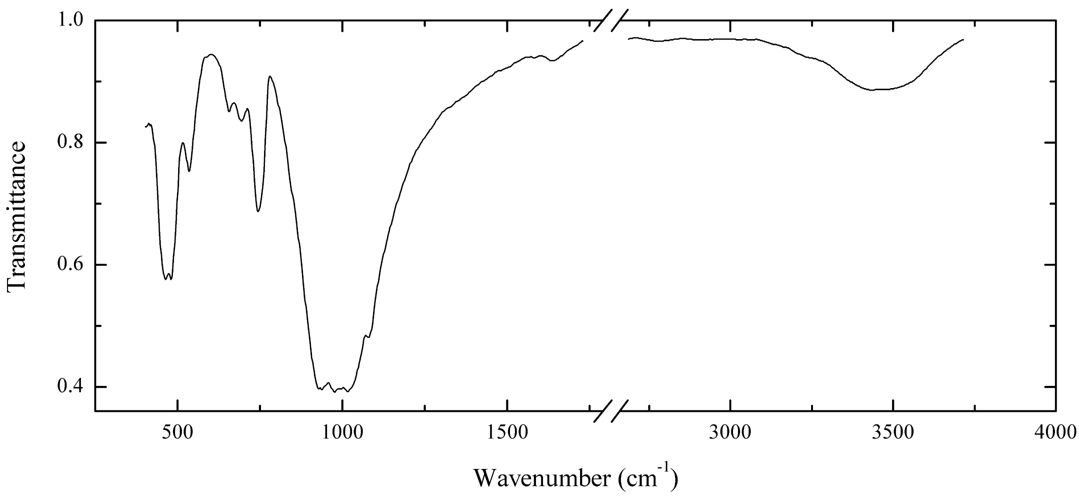
Wavenumbers (cm^{-1}): 3490w, 3345w, 1640w, 1075sh, 1055sh, 1019s, 983s, 937s, 743, 697, 658, 545sh, 531, 480, 456, 397w.

Sir67 Eudialyte-group mineral Sir67 $Na_{12}(\mathit{REE},Na)_3Ca_6(Fe^{2+},Mn,Na)_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(OH,Cl)_2$



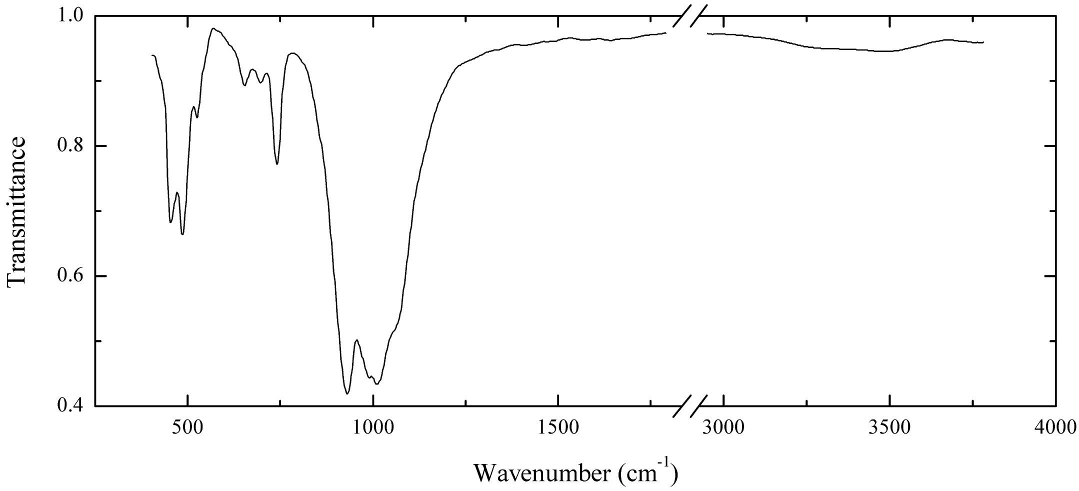
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Pink grains from the association with fersmanite. *REE*-analogue of eudialyte. The empirical formula is (electron microprobe) $Na_{12.68}[(Ce_{0.60}La_{0.30}Nd_{0.19}Y_{0.32})Na_{1.42}K_{0.17}]Ca_{3.63}Mn_{0.79}Fe_{1.08}Zr_{2.89}Ti_{0.02}Nb_{0.29}Al_{0.02}Si_{25.77}O_{73}Cl_{0.55}(O,OH,H_2O)_x$.
Wavenumbers (cm^{-1}): 3580, 3515, 3375, 1647, 1135sh, 1080sh, 1055sh, 1019s, 973s, 932s, 900sh, 740, 697, 662, 540, 475, 456.

Sir68 Eudialyte-group mineral Sir68 $Na_{15}Ca_3Fe_3(Zr,Na)_3(Zr,Ti)_3(Si,Nb)(Si_{25}O_{73})(OH,H_2O)_3(Cl,OH)$



Locality: Shkatulka pegmatite, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Red grains from peralkaline pegmatite. Hyperzirconium analogue of raslakite. The empirical formula is $Na_{15.3}K_{0.2}Sr_{0.4}Y_{0.4}Ca_{2.6}Fe_{1.7}Mn_{0.8}Zr_{4.7}Ti_{0.3}Nb_{0.3}Si_{25.7}O_{73}Cl_{0.8}(OH,H_2O)_x$.
Wavenumbers (cm^{-1}): 3450, 1628, 1073, 1017s, 975s, 937s, 744, 693, 656, 529, 477, 462.

Sir71 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

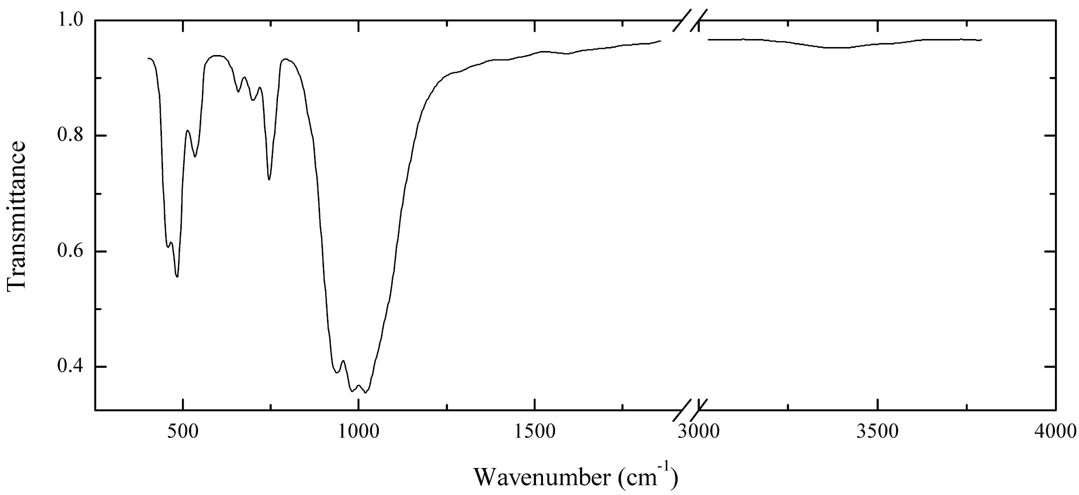


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-yellow grains from peralkaline pegmatite, from the association with villiaumite, lorenzenite and lintisite. The empirical formula is (electron microprobe) $Na_{12}K_{0.7}Sr_{0.1}(Ca_{4.2}Mn_{1.5}Ce_{0.2}La_{0.1})(Fe_{1.3}Zr_{0.4}Mn_{0.3}Na_{1.0})(Zr_{2.9}Hf_{0.1})(Si_{0.8}Nb_{0.1}Al_{0.1})Si_{25}O_{73}Cl_{1.1}(O,OH,H_2O)_x$.

Wavenumbers (cm^{-1}): 3500w, 1065sh, 1015s, 993s, 932s, 741, 693, 653, 524, 484, 450.

Sir73 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

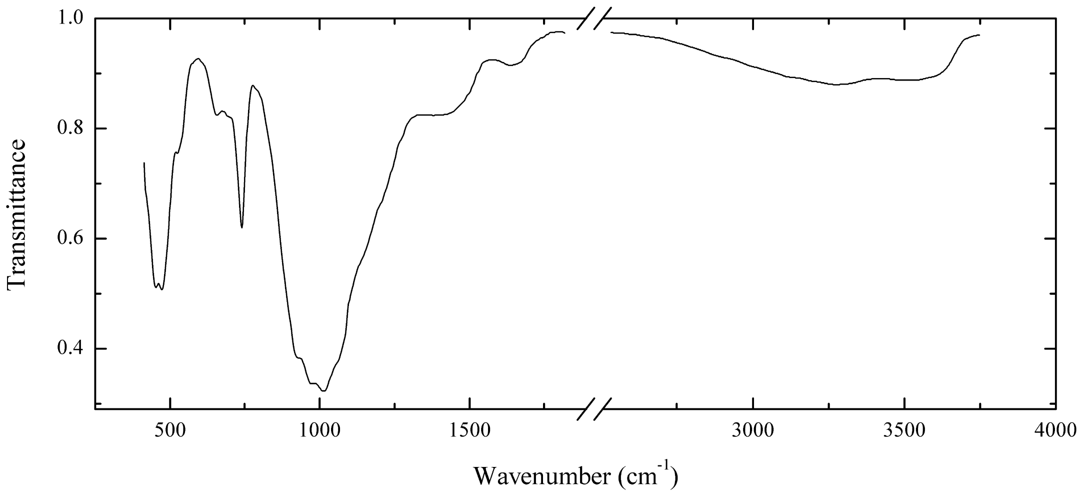


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark brownish-red coarse-grained aggregate forming core of peralkaline pegmatite. Associated minerals are ussingite, murmanite, sodalite, microcline, nepheline, aegirine, arfvedsonite, ilmenite and belovite-(Ce). The empirical formula is (electron microprobe) $Na_{15.8}K_{0.2}Sr_{0.5}REE_{0.3}Ca_{4.5}Mn_{1.0}Fe_{2.3}Zr_{3.4}Ti_{0.2}Nb_{0.2}Si_{25.3}O_{72}(O,OH,H_2O,F)_yCl_{1.1}$. The band at 533 indicates that iron has 5-fold coordination.

Wavenumbers (cm^{-1}): 3390w, 1050sh, 1018s, 979s, 936s, 744, 700, 657, 533, 481, 455.

Sir75 Eudialyte-group mineral Sir75 $(Na,H_3O,H_2O)_{15}Ca_6(\square,Fe)_3Zr_3(Si,Nb,\square)(Si_{25}O_{73})(O,OH,H_2O)_3(OH,Cl)_2$

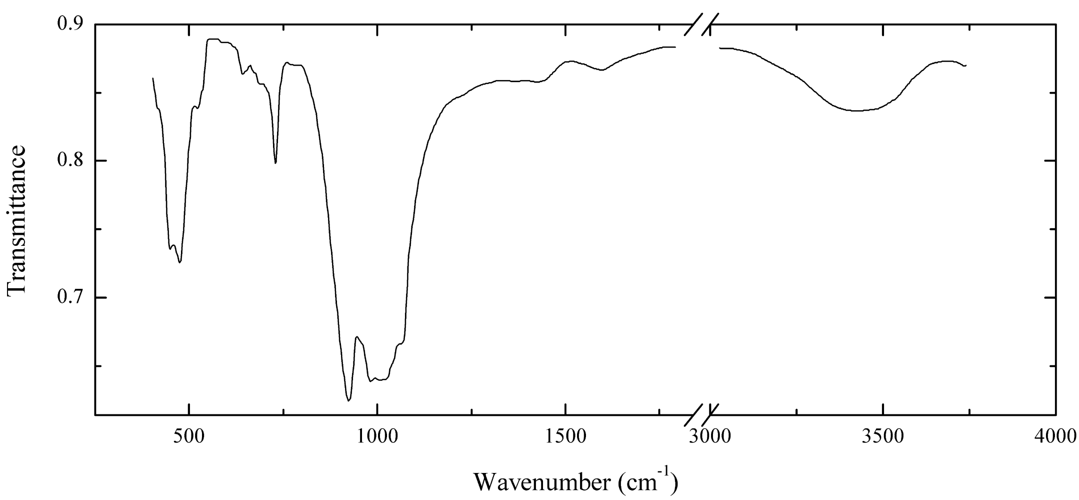


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Dark brown grains from the association with cancrinite, aegirine-augite, pectolite and zeolites. Fe- and Na-deficient analogue of eudialyte. The empirical formula is $(H_3O,H_2O)_x Na_{7.2}Ba_{0.1}K_{0.1}REE_{0.3}Ca_{6.2}Fe_{1.0}Mn_{0.2}Zr_{2.85}Ti_{0.15}Nb_{0.2}Al_{0.1}Si_{25.0}O_{73}(SO_4)_{0.25}Cl_{0.7}(OH,H_2O,CO_3)_x$. Compare eudialyte-group mineral Sir36.

Wavenumbers (cm^{-1}): 3520, 3260, 1640w, 1400, 1200sh, 1140sh, 1055sh, 1014s, 977s, 930s, 740, 693, 657, 523, 476, 451, 420sh.

Sir77 Eudialyte $Na_{15}Ca_6Fe^{2+}{}_3Zr_3(Si,Nb)(Si_{25}O_{73})(O,OH,H_2O)_3(Cl,OH)_2$

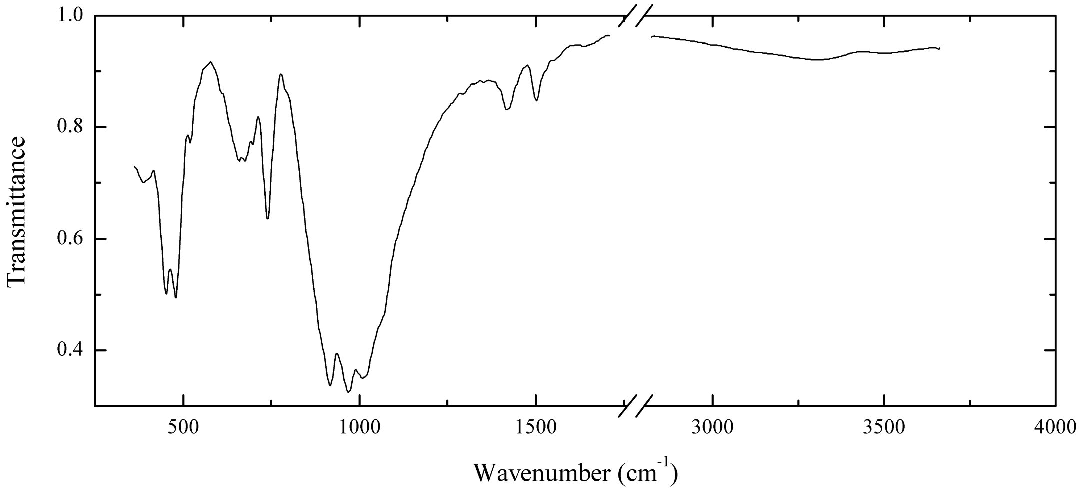


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pink grains from peralkaline pegmatite. K- and Ti-rich variety. The empirical formula is (electron microprobe) $Na_{14.5}K_{2.2}Sr_{0.4}Ca_{6.0}Fe_{1.2}Mn_{0.3}Zr_{1.9}Ti_{1.1}Si_{0.5}(Si_{25}O_{73})Cl_{1.3}(O,OH,H_2O)_x$.

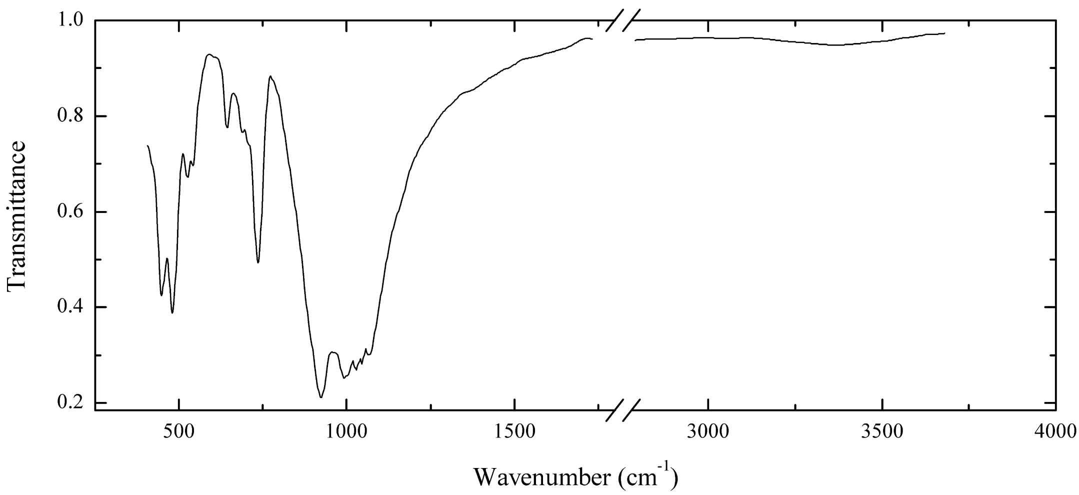
Wavenumbers (cm^{-1}): 3420, 1630w, 1450w, 1064, 1026, 1010sh, 993s, 927s, 738, 700sh, 647, 520sh, 527, 483, 455, 400sh.

Sir78 Zirsilite-(Ce) $(Na,\square)_{12}(Ce,Na)_3Ca_6Mn^{2+}{}_3Zr_3Nb(Si_{25}O_{73})(OH)_3(CO_3)\cdot H_2O$



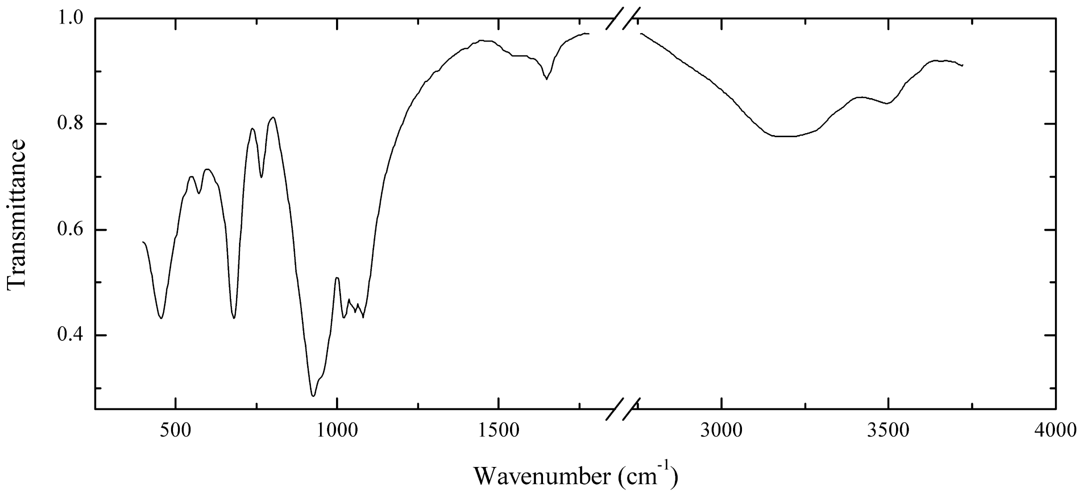
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).
Description: Pinkish-brown grains from the association with reedmergnerite. The empirical formula is (electron microprobe) $H^+_xNa_{10.9}K_{0.3}Sr_{0.6}REE_{1.1}Y_{0.1}Ca_{5.8}Mn_{3.3}Fe_{0.5}Zr_{2.7}Ti_{0.15}Nb_{1.0}Si_{24.8}O_{72}(O,OH,H_2O,CO_3)_yCl_{0.2}$. The bands at 1,415, 1,427 and 1,502 cm^{-1} correspond to C–O-stretching vibrations of CO_3^{2-} groups.
Wavenumbers (cm^{-1}): 3475w, 3300w, 1640w, 1502, 1427, 1415, 1075sh, 1018s, 973s, 920s, 738, 669, 676, 654, 521, 477, 449, 398.

Sir80 Rastsvetaevite $Na_{27}K_8Ca_{12}Fe_3Zr_6Si_4(Si_3O_9)_4(Si_9O_{27})_4(O,OH,H_2O)_6Cl_2$



Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Purplish-red grains from peralkaline pegmatite, from the association with nepheline, sodalite, potassium feldspar, aegirine, ilmenite, *etc*. The empirical formula is (electron microprobe, Z = 3) $Na_{29.2}K_{7.5}REE_{0.2}Sr_{0.6}Ca_{11.29}Mn_{0.4}Fe_{3.1}Zr_{5.6}Ti_{0.6}Si_{52}Nb_{0.1}O_{144}(O,OH,H_2O)_xCl_{3.2}$.
Wavenumbers (cm^{-1}): 3350w, 1071s, 1041s, 1030s, 1005sh, 993s, 961, 925s, 736, 705sh, 687, 640, 541, 526, 479, 447.

Sir81 Labuntsovite-□ $Na_2K_2(\square,Ba)_2(\square,Mn)Ti_4(Si_4O_{12})_2(O,OH)_4 \cdot nH_2O$

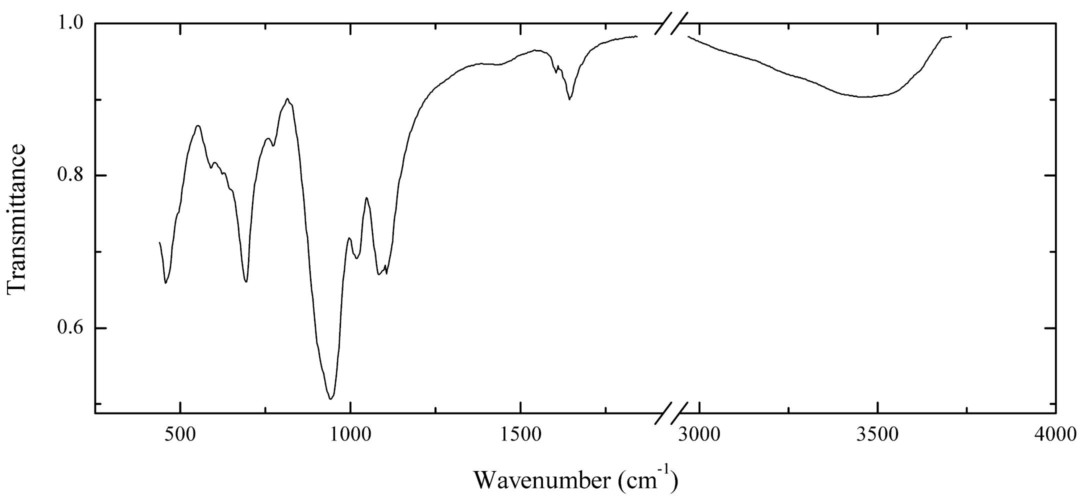


Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Orange crystals from the association with natrolite, aegirine, catapleiite, clinobarylite, fluorite and galena. The empirical formula is (electron microprobe, $Z = 1$) $Na_{4.09}K_{3.88}Ba_{1.51}Mn_{0.61}Fe_{0.18}Ti_{6.29}Nb_{1.77}(O_{6.58}OH_{1.42})[Si_4O_{12}]_4 \cdot nH_2O$. The crystal structure is solved. Monoclinic, space group $C2/m$, $a = 14.298(7)$, $b = 13.816(7)$, $c = 7.792(3)$. The crystal-chemical formula is $Na_{3.5}K_4[Ba_{1.5}(Mn,Fe)_{0.9}(H_2O)_{1.8}][Ti_{7.8}Nb_{0.2}(O,OH)_8][Si_4O_{12}]_4 \cdot 5.4H_2O$.

Wavenumbers (cm^{-1}): 3470, 3180, 1645, 1560w, 1079s, 1055s, 1022s, 950sh, 928s, 769, 679s, 573, 456s.

Sir82 Gjerdingenite-Fe $K_2(Fe,Mn)(Nb,Ti)_4(Si_4O_{12})_2(O,OH)_4 \cdot 6H_2O$

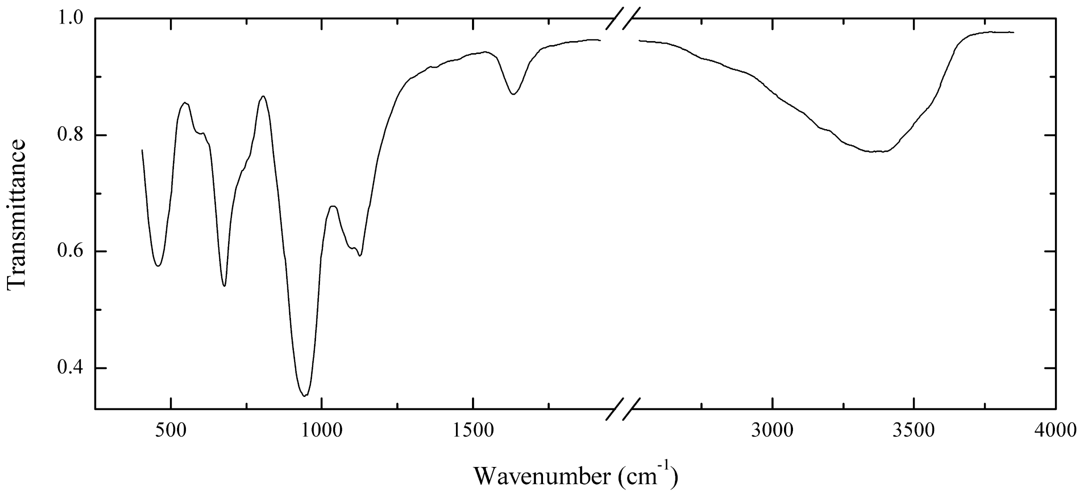


Locality: Gjerdingselva, Lunner, Oppland, Norway (type locality).

Description: Orange-yellow crystals from the association with quartz, orthoclase, albite, aegirine, kupletskite, elpidite, lorenzenite, pyrochlore, monazite-(Ce), gagarinite-(Y), ralstonite, gearksutite, and molybdenite. The empirical formula is (electron microprobe, $Z = 1$) $(K_{2.53}Na_{1.78}Ba_{0.20})(Fe_{0.91}Mn_{0.78}Mg_{0.32}Zn_{0.26})(Nb_{5.76}Ti_{2.24})(Si_4O_{12})_4(O,OH)_8 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3625w, 3470, 1640, 1600w, 1104s, 1089s, 1022, 945s, 920sh, 779w, 695s, 597, 490sh, 467s.

Sir83 Gjerdingenite-Ca $K_2Ca(Nb,Ti)_4(Si_4O_{12})_2(O,OH)_4{\cdot}6H_2O$

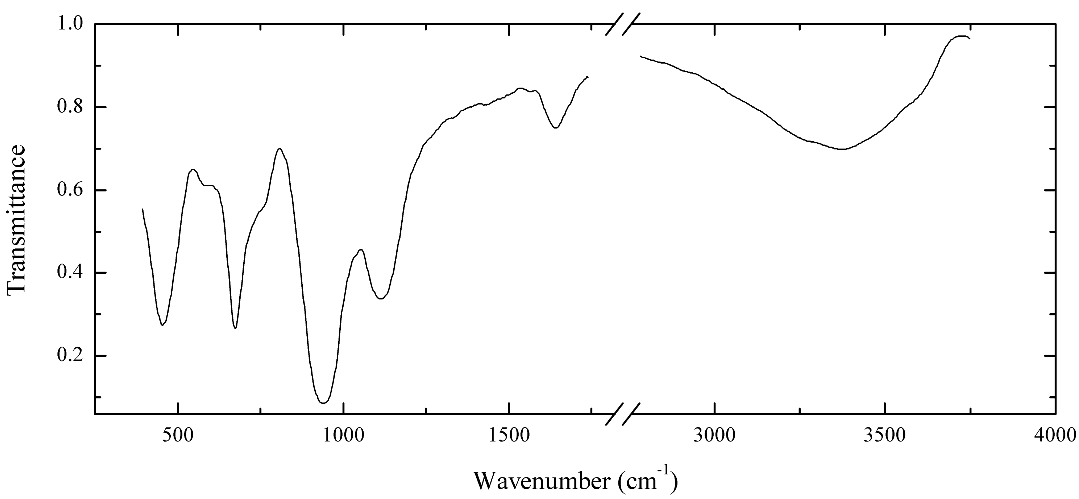


Locality: Pegmatite No. 61, Mountain Karnasurt, Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Pinkish-brown pseudomorph after vuonnemite from the association with microcline, natrolite, aegirine, altered steenstrupine-(Ce), organovaite-Mn, organovaite-Zn, beryllite, epididymite, ranciéite (pseudomorph after serandite) and yakhontovite. Holotype sample. Monoclinic, space group $C2/m$, $a = 14.6365(6)$, $b = 14.2049(5)$, $c = 7.8919(4)$ Å, $\beta = 117.467(5)°$, $Z = 2$. Optically biaxial (+), $\alpha = 1.680(1)$, $\beta = 1.682(2)$, $\gamma = 1.762(3)$, $2V_{meas} = 25(10)°$. $D_{meas} = 2.79(1)$ g/cm^3, $D_{calc} = 2.775$ g/cm^3. The empirical formula is $(K_{0.93}Na_{0.45}Sr_{0.41}Ca_{0.15}Ba_{0.08})(Ca_{0.62}Mn_{0.14}Fe_{0.03}Zn_{0.01})(Nb_{2.51}Ti_{1.52})(Si_{7.97}Al_{0.03})O_{24}[O_{2.86}(OH)_{1.14}]{\cdot}5.67H_2O$.

Wavenumbers (cm^{-1}): 3550sh, 3360, 1637, 1129s, 1100, 945s, 930sh, 750sh, 680s, 600, 459s.

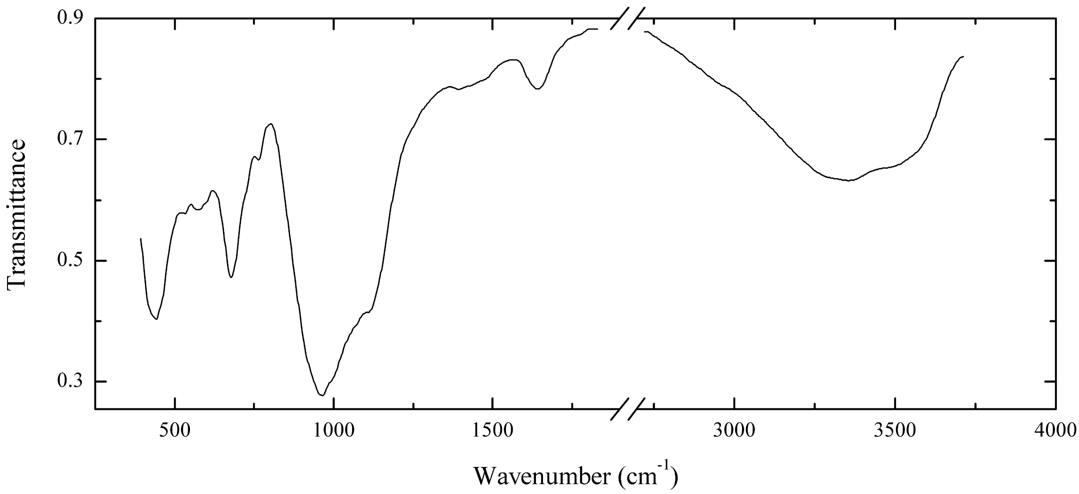
Sir84 Vuoriyarvite-Ca $(Ca,K,Na)_2(Nb,Ti)_2(Si_4O_{12})(O,OH)_2{\cdot}4H_2O$



Locality: Pegmatite #61, Karnasurt Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.

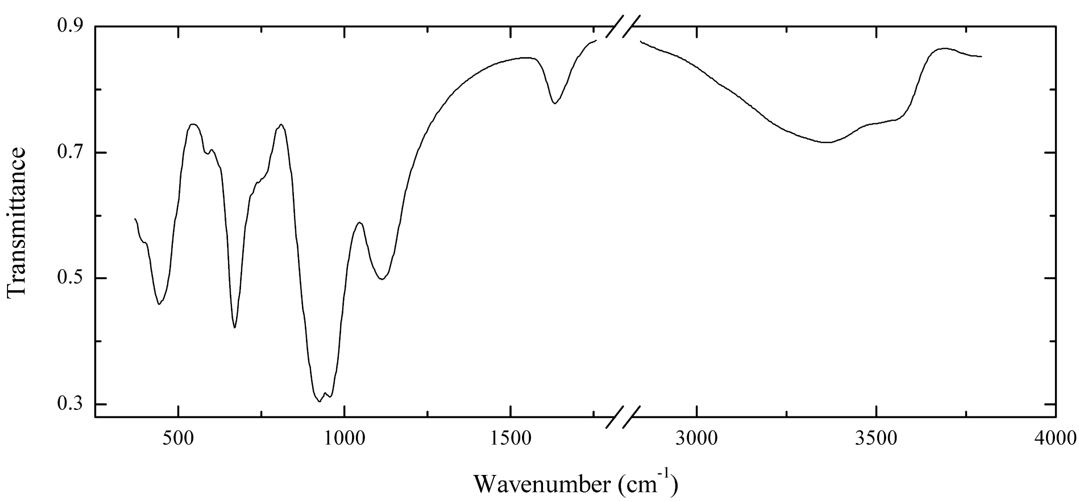
Description: Brown pseudomorph after vuonnemite from the association with microcline, natrolite, aegirine, altered steenstrupine-(Ce), organovaite-Mn, organovaite-Zn, beryllite, epididymite, ranciéite (pseudomorph after serandite) and yakhontovite. Investigated by I.V. Pekov. Confirmed by electron microprobe analysis. Low wavenumber of the absorption maximum of (Nb,Ti)-stretching vibrations (674 cm^{-1}) indicates the predominance of vacancies in the *D* site.
Wavenumbers (cm^{-1}): 3360, 1635, 1560w, 1122s, 936s, 755sh, 674s, 585w, 457s.

Sir85 Tsepinite-K $(K,Na,Ca,Ba)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2 \cdot 3H_2O$



Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brownish crystals from the association with natrolite. Investigated by I.V. Pekov. Confirmed by electron microprobe analysis. K- and Na-deficient variety. The band at 1,390 cm^{-1} indicates possible presence of H^+ cation.
Wavenumbers (cm^{-1}): 3475, 3330, 3270sh, 1637, 1470sh, 1425sh, 1390w, 1108s, 965s, 766w, 681, 579, 532, 438s.

Sir86 Nenadkevichite $Na_2(Nb,Ti)_2(Si_4O_{12})(O,OH)_2 \cdot 4H_2O$

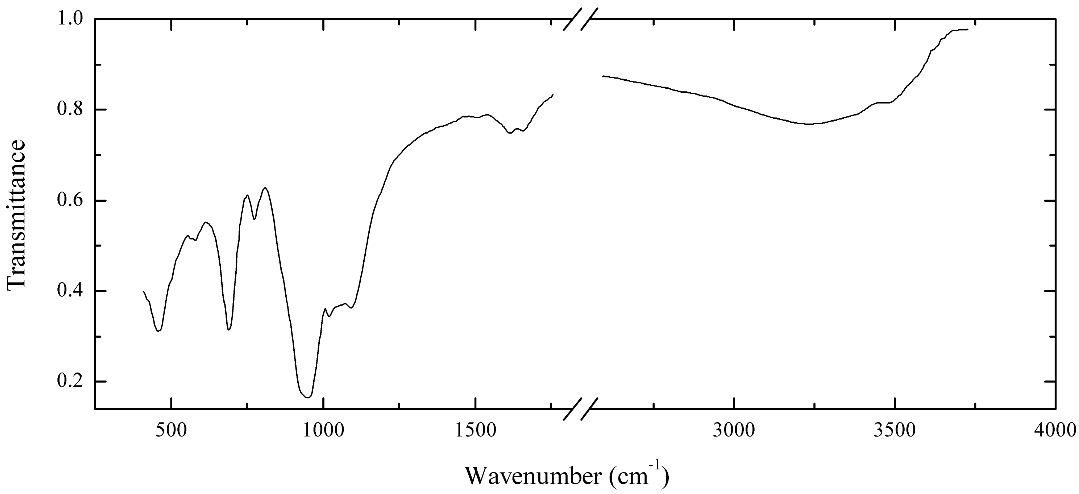


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish crystals from the association with komarovite, aegirine, fluorite, calcite and tsepinite-Na. Investigated by I.V. Pekov. K- and Sr-bearing variety (with 2.4 wt.% K_2O, 1.5 wt.% SrO).

Wavenumbers (cm^{-1}): 3550sh, 3465sh, 3345, 1635, 1120s, 958s, 925s, 760sh, 671s, 589, 449s, 400sh.

Sir87 Tsepinite-K $(K,Na,Ca,Ba)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2 \cdot 3H_2O$

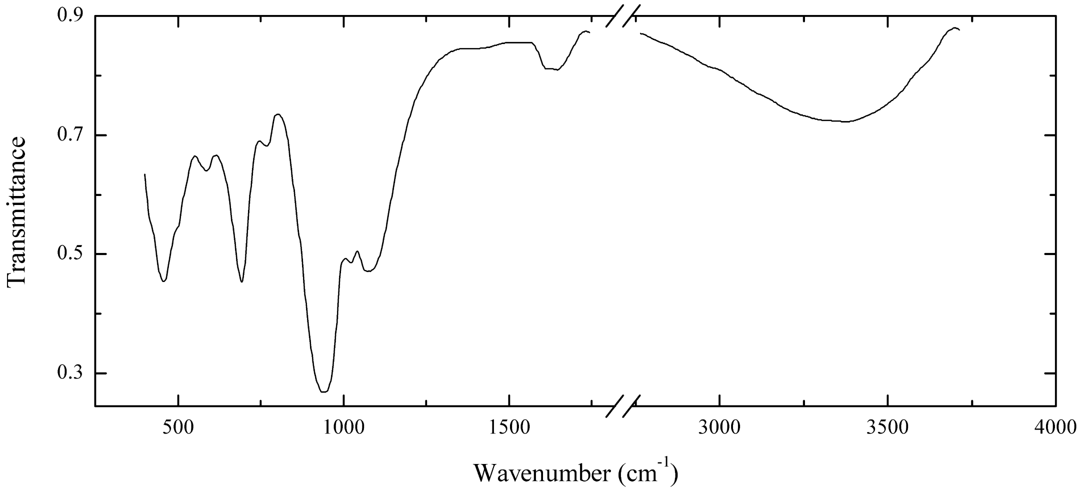


Locality: Pegmatite No. 62, Karnasurt Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Short-prismatic colourless crystals in pseudomorphs after murmanite, from the association with other kuzmenkoite-Mn, manganoneptunite, aegirine, natrolite and chabasite-Ca. Holotype sample. The crystal structure is solved. Monoclinic, space group *Cm*, $a = 14.327(3)$, $b = 13.802(2)$, $c = 7.783(1)$ Å, $\beta = 116.95(1)°$. Optically biaxial (+), $\alpha = 1.690(3)$, $\beta = 1.701(3)$, $\gamma = 1.800(5)$, $2V_{meas} \approx 25\text{-}40°$. $D_{meas} = 2.88(3)$ g/cm^3, $D_{calc} = 2.97$ g/cm^3. The empirical formula is $(K_{0.86}Ba_{0.46}Na_{0.43}Mn_{0.10})(Ti_{1.66}Nb_{0.33}Fe^{3+}_{0.03})Si_4O_{12}(OH)_{1.21}O_{0.79} \cdot 2.94H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.87 (100) (001, 020), 3.20 (60) (400), 3.05 (80) (022, 041), 3.00 (60) (240, 24-1), 2.56 (90) (241, 24-2, 20-3, 331).

Wavenumbers (cm^{-1}): 3460, 3360sh, 3250, 1655, 1610, 1089s, 1055sh, 1018s, 951s, 930sh, 771, 678s, 582, 465.

Sir88 Lepkhenelmite-Zn $Ba_2Zn(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4 \cdot 7H_2O$

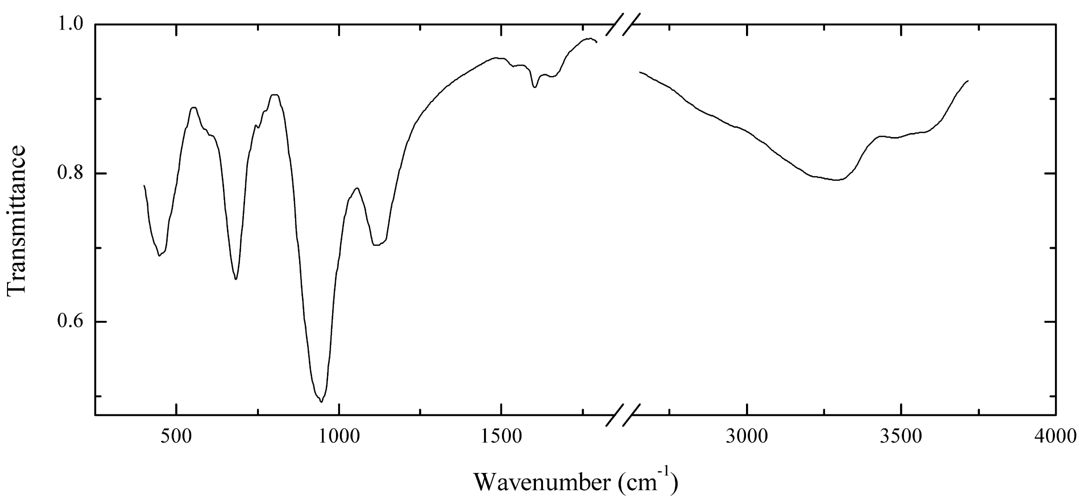


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Flattened-prismatic crystals from the association with lamprophyllite, natrolite, halloysite, rancieite, kuzmenkoite-Zn, tsepinite-Na, paratsepinite-Ba, vinogradovite and fluorapatite. Holotype sample. The crystal structure is solved. Monoclinic, space group *Cm*, $a = 14.381(3)$, $b = 13.889(3)$, $c = 7.793(2)$ A, $\beta = 117.52(3)°$. Optically biaxial (+), $\alpha = 1.690(3)$, $\beta = 1.701(3)$, $\gamma = 1.800(5)$, $2V_{meas} \approx 25\text{-}40°$. $D_{meas} = 2.96$ g/cm^3, $D_{calc} =$ 3.07 g/cm^3. The empirical formula is $(Ba_{0.92}K_{0.54}Ca_{0.26}Na_{0.24}Sr_{0.22})(Zn_{0.58}Mn_{0.15}Fe_{0.04}Mg_{0.01})$ $(Ti_{2.97}Nb_{1.02})(Si_{7.89}Al_{0.11})O_{24}$ $[O_{2.01}(OH)_{1.99}] \cdot 7.39H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.95 (37) (020, 001), 6.39 (10) (20-1, 200), 3.194 (100) (42-1, 40-2, 400), 3.101 (22) (041, 022), 3.050 (8) (24-1, 240), 2.906 (6) (42-2, 420), 2.585 (6) (24-2, 420).

Wavenumbers (cm^{-1}): 3580sh, 3330, 1638, 1605, 1076s, 1020, 940s, 771, 690s, 587, 505sh, 463s, 420sh.

Sir89 Tsepinite-Sr $(Sr,Ba,K)(Ti,Nb)_2(Si_4O_{12})(OH,O)_2 \cdot 3H_2O$

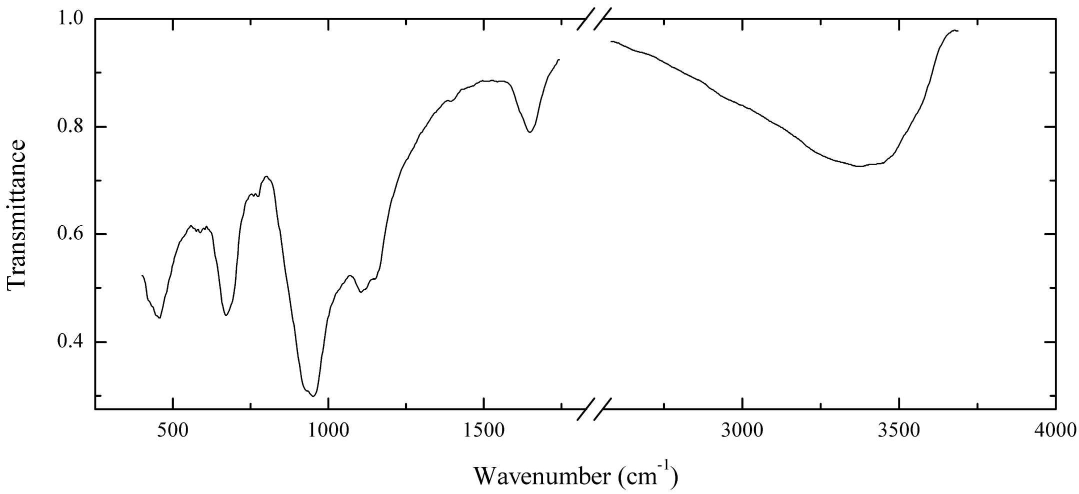


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Colourless coarse prismatic crystals from the association with microcline, albite, natrolite, analcime, eudialyte, leifite, vuoriyarvite-K, tsepinite-Ca, kuzmenkoite-Zn, paratsepinite-Ba and takanelite. Holotype sample. The crystal structure is solved. Monoclinic, space group Cm, $a = 14.490(3)$, $b = 14.23(1)$, $c = 7.881(3)$ Å, $\beta = 117.28(2)°$. Optically biaxial (+), $\alpha = 1.649(2)$, $\beta = 1.651(2)$, $\gamma = 1.770(4)$, $2V_{meas} = 20(5)°$. $D_{meas} = 2.67(2)$ g/cm^3, $D_{calc} =$ 2.63 g/cm^3. The empirical formula is $(Sr_{0.28}Ba_{0.16}K_{0.16}Na_{0.11}Ca_{0.09}Zn_{0.02})(Ti_{1.32}Nb_{0.69}Fe_{0.01})(Si_{3.98}Al_{0.02})O_{12}[(OH)_{1.89}O_{0.11}]{\cdot}2.59H_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 7.10 (90) (020, 001), 6.45 (50) (200, 20-1), 5.01 (40) (021), 3.230 (100) (42-1, 400, 40-2), 3.135 (80) (022, 041, 24-1), 2.510 (80) (44-1, 401, 40-3, 042), 1.728 (50) (461, 46-3, 081, 442, 44-4), 1.570 (45) (84-1, 820, 84-3, 190, 82-4).

Wavenumbers (cm^{-1}): 3545, 3475, 3290, 1665w, 1606, 1537w, 1135sh, 1120s, 949s, 935sh, 760sh, 675s, 610sh, 450s.

Sir90 Paratsepinite-Ba $(K,Na,Ca,Ba)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2{\cdot}3H_2O$

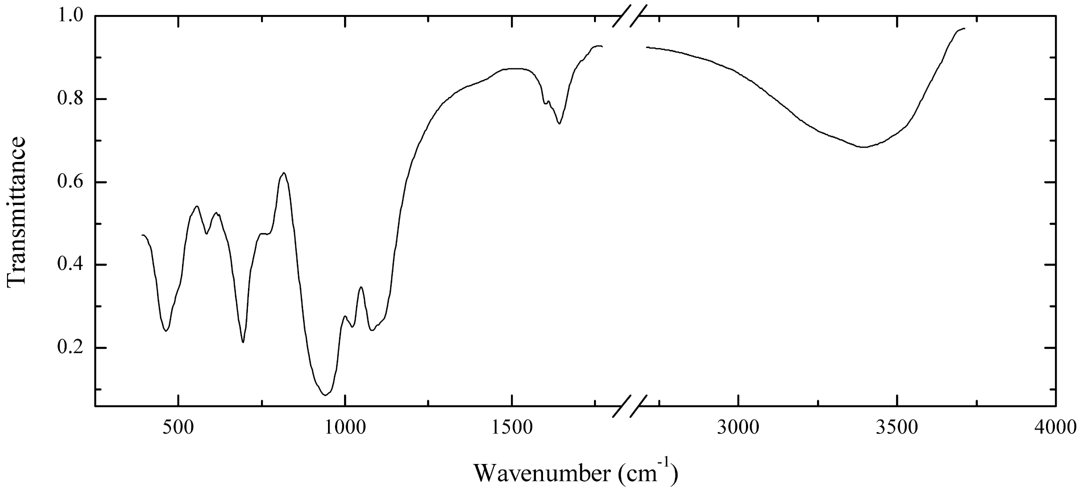


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Long-prismatic brown crystals from the association with other labuntsovite-group minerals, titanite, aegirine, eudialyte, lamprophyllite, lorenzenite, natrolite, vinogradovite and tundrite-(Ce). Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/m$, $a = 14.551(2)$, $b = 14.001(2)$, $c = 15.702(3)$ Å, $\beta = 117.58(1)°$. Optically biaxial (+), $\alpha = 1.667(2)$, $\beta = 1.674(2)$, $\gamma = 1.770(5)$, $2V_{meas} \approx 25\text{-}40°$. $D_{meas} = 2.88(3)$ g/cm^3, $D_{calc} = 2.91$ g/cm^3. The empirical formula is $(Ba_{0.46}Na_{0.37}K_{0.23}Sr_{0.12}Mn_{0.10}Ca_{0.06})(Ti_{1.40}Nb_{0.55})(Si_{3.97}Al_{0.03}O_{12})(OH)_{1.58}O_{0.42}{\cdot}3.7H_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 7.11 (100) (020), 4.08 (80) (310), 3.95 (100) (202, 20-4), 3.24 (90) (400, 40-4), 3.11 (80) (042, 024), 2.403 (80) (60-2).

Wavenumbers (cm^{-1}): 3540sh, 3350, 1647, 1145, 1105s, 951s, 925sh, 769w, 730sh, 690sh, 669s, 580, 452s, 420sh.

Sir91 Organovaite-Zn $K_2Zn(Nb,Ti)_4(Si_4O_{12})_2(O,OH)_4{\cdot}6H_2O$

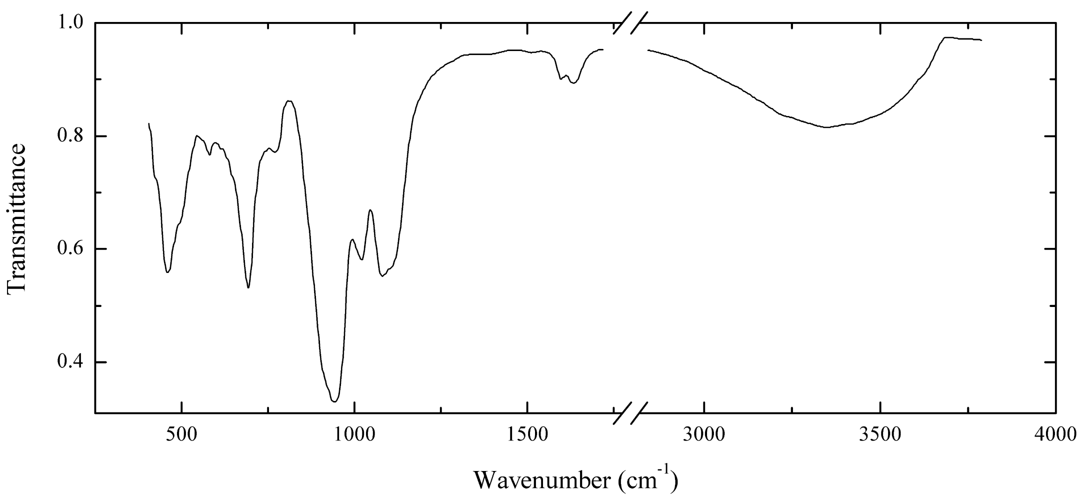


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Brownish-pink pseudomorph after vuonnemite from the association with microcline, natrolite, aegirine, altered steenstrupine-(Ce), organovaite-Mn, organovaite-Zn, beryllite, epididymite, ranciéite (pseudomorph after serandite) and yakhontovite. A hyper-zinc variety. Zn occupies both *D* site and, as complex $[Zn(H_2O)_2]^{2+}$ cation, an extra-framework site. The empirical formula is ($Z = 2$) $(K_{1.8}Na_{0.9}Ca_{0.4}Ba_{0.3})[Zn(H_2O)_2]_{0.4}(Zn_{1.5}Mn_{0.4}Fe_{0.1})(Nb_{5.3}Ti_{2.7})(Si_{3.94}Al_{0.06}O_{12})_4(O,OH)_8{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3370, 1715sh, 1640, 1598w, 1105sh, 1083s, 1024s, 946s, 777, 696s, 589, 500sh, 465.

Sir92 Organovaite-Zn $K_2Zn(Nb,Ti)_4(Si_4O_{12})_2(O,OH)_4{\cdot}6H_2O$

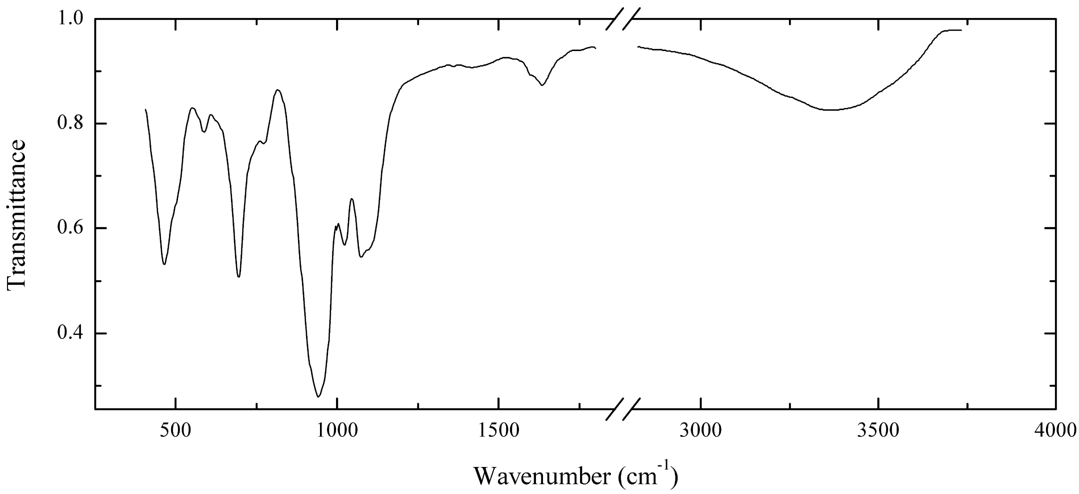


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Brown crystals from the association with microcline, natrolite, aegirine, altered steenstrupine-(Ce), organovaite-Mn, organovaite-Zn, beryllite, epididymite, ranciéite and yakhontovite. A hyper-zinc variety. Investigated by I.V. Pekov.

Wavenumbers (cm^{-1}): 3350, 1635, 1600, 1115sh, 1105sh, 1086s, 1027, 948s, 920sh, 774, 696s, 586, 500sh, 465, 420sh.

Sir93 Organovaite-Zn $K_2Zn(Nb,Ti)_4(Si_4O_{12})_2(O,OH)_4 \cdot 6H_2O$

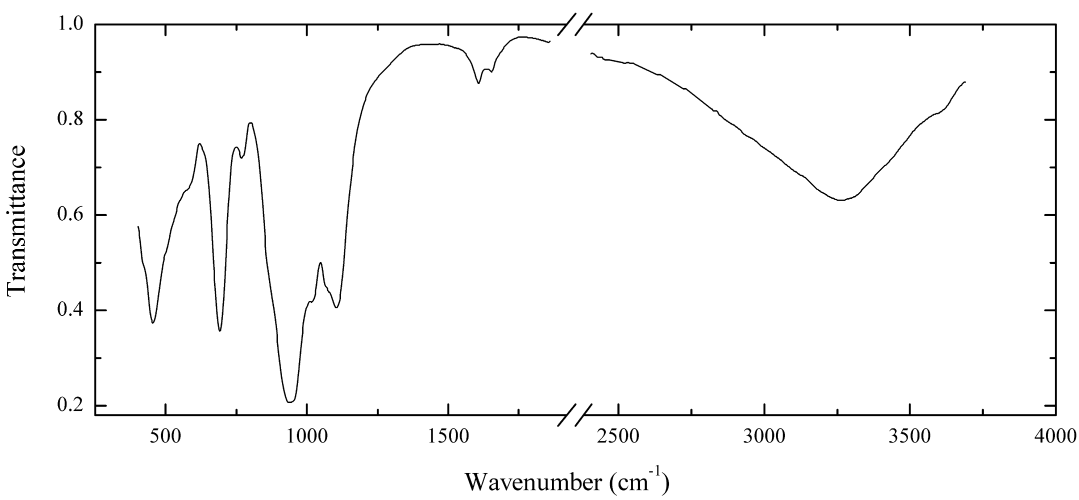


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Pink pseudomorph after vuonnemite. Investigated by A.P. Khomyakov.

Wavenumbers (cm^{-1}): 3365, 3260sh, 1655sh, 1635w, 1600sh, 1100sh, 1077s, 1022, 942s, 773, 693s, 568, 500sh, 464s.

Sir95 Kuzmenkoite-Mn $K_2Mn(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4 \cdot 5H_2O$

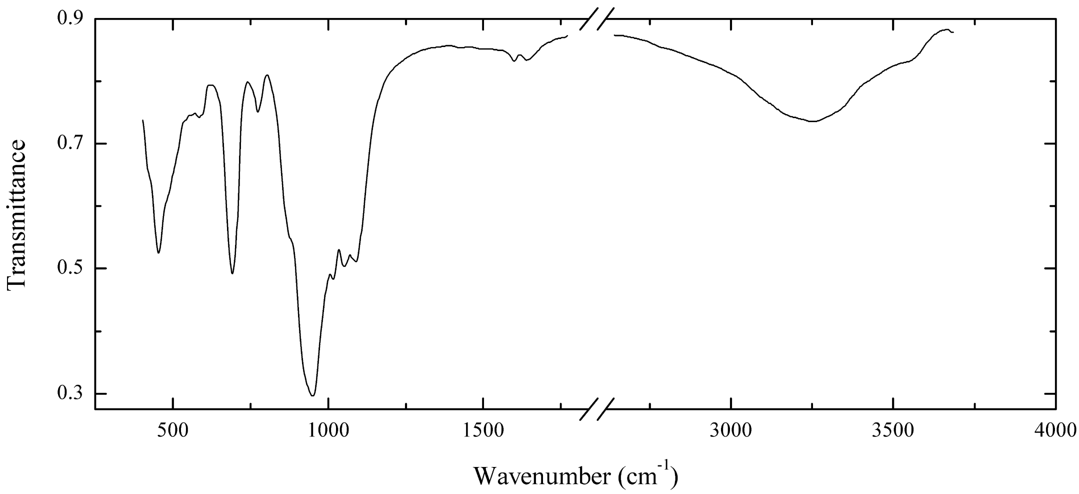


Locality: Selsurt (Flora) Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Yellow, transparent prismatic crystals from the association with labuntsovite, natrolite, calciohilairite, aegirine, eudialyte, lorenzenite, murmanite, feldspar, *etc*. Holotype sample. The crystal structure is solved. Monoclinic, space group *C*2/*m*, $a = 14.369(3)$, $b = 13.906(3)$, $c = 7.812(1)$ Å, $= 117.09(2)$. Optically biaxial (+), $= 1.683(1)$, $= 1.687(2)$, $= 1.775(2)$. $D_{meas} = 2.67(2)$ g/cm^3, $D_{calc} = 2.63$ g/cm^3. The empirical formula is $(K_{3.43}Na_{0.46}Ba_{0.17})(Mn_{1.26}Fe_{0.36}Mg_{0.17})(Ti_{7.11}Nb_{0.81})[Si_{4.00}O_{12}]_4[(OH)_{7.70}O_{0.30}]\cdot 9.54H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.98 (100) (001), 6.35 (65) (020), 3.20 (90) (400), 3.11 (75) (022), 2.49 (65) (40-3).

Wavenumbers (cm^{-1}): 3600sh, 3250, 1655w, 1610, 1104s, 1075sh, 1014, 941s, 870sh, 772, 691s, 580sh, 540sh, 452s, 420sh.

Sir96 Neskevaaraite-Mn $NaK_3Mn(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4\cdot 6H_2O$

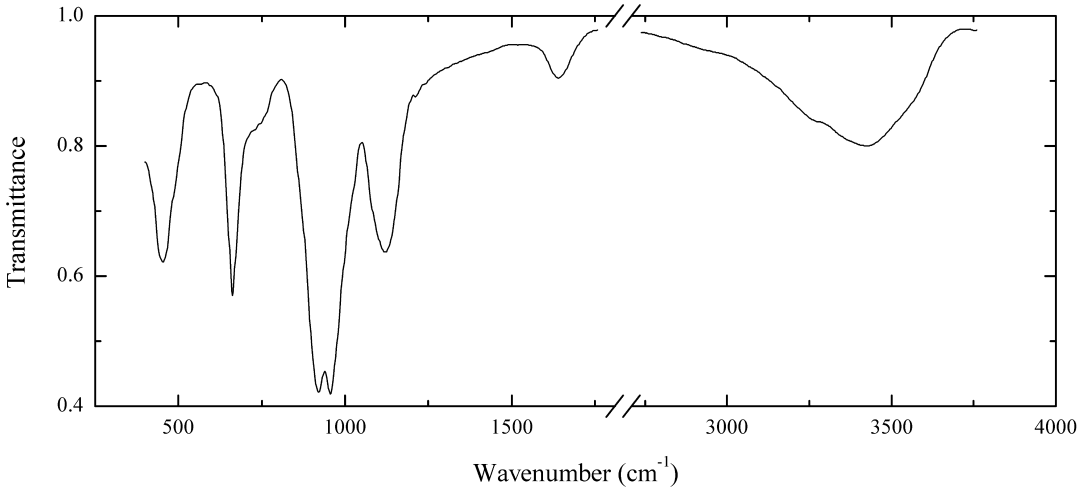


Locality: Nyorkpakhk Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown short-prismatic crystals from the association with microcline, nepheline and aegirine. The empirical formula is (electron microprobe, $Z = 1$) $Na_{1.42}K_{4.70}Ba_{0.15}(Mn_{1.14}Fe_{0.12}Mg_{0.12})(Ti_{7.09}Nb_{0.94}Fe_{0.04})(Si_{4.00}O_{12})_4(O,OH)_8\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3550w, 3250, 1645w, 1600w, 1092s, 1054s, 1019s, 952s, 880sh, 774, 689s, 584, 490sh, 456, 420sh.

Sir97 Korobitsynite $Na_3(Ti,Nb)_2(Si_4O_{12})(O,OH)_2 \cdot 3–4H_2O$

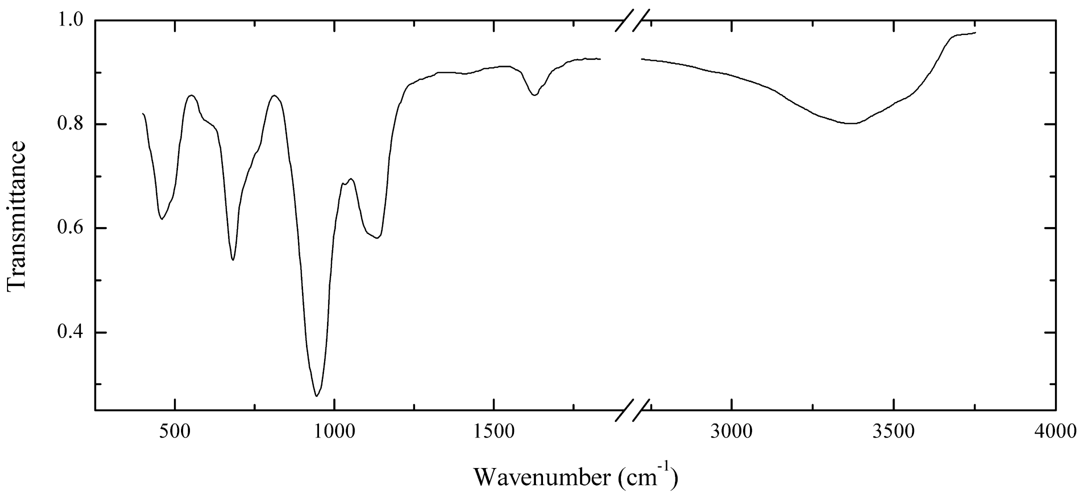


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Colourless crystals. The empirical formula is (electron microprobe) $Na_{2.6}Sr_{0.15}K_{0.05}(Ti_{1.2}Nb_{0.8})(Si_{4.00}O_{12})_4(O,OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3410, 3265sh, 1650sh, 1635, 1120, 1020sh, 980sh, 960s, 922s, 740sh, 670sh, 664s, 454.

Sir98 Karupmøllerite-Ca $(Na,Ca,K)_2Ca(Nb,Ti)_4(Si_4O_{12})_2(O,OH)_4 \cdot 7H_2O$



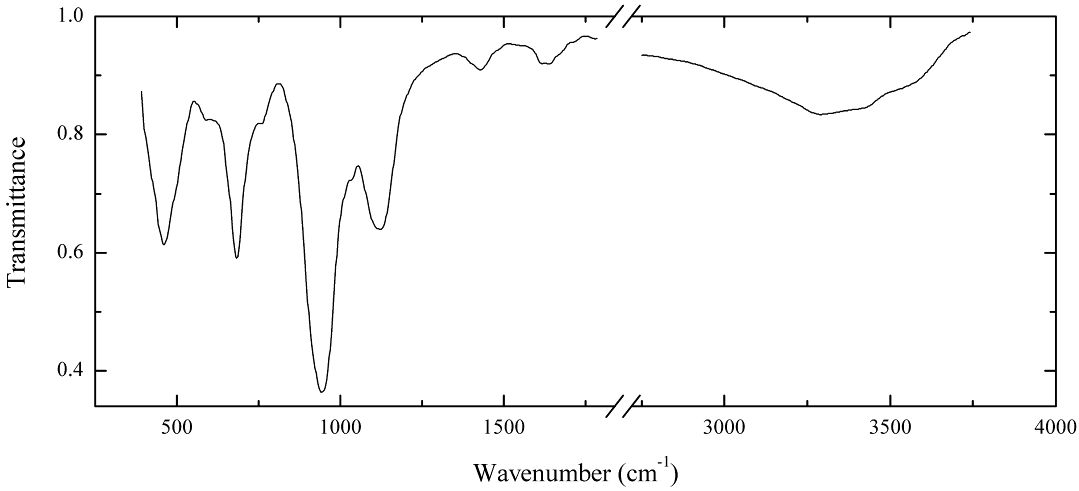
Locality: Mellemelv stream valley, Kangerluarsuk area, Ilímaussaq alkaline complex, South Greenland (type locality).

Description: Light grey pseudomorph after epistolite from the association with aegirine, arfvedsonite, eudialyte, potassic feldspar, sodalite, albite, carbonate-fluorapatite, lueshite, natrolite, and tuperssuatsiaite. Holotype sample. Monoclinic, space group $C2/m$, $a = 14.641(1)$, $b = 14.214(1)$, $c = 7.9148(2)$ Å, $\beta = 117.36(1)°$. Optically biaxial (+), $\alpha = 1.656(2)$, $\beta = 1.662(2)$, $\gamma = 1.755(3)$, $2V_{meas} = 30 \pm 15°$. $D_{meas} = 2.71(1)$ g/cm^3, $D_{calc} = 2.74$g/cm^3. The empirical formula is $(Na_{1.68}Ca_{1.28}K_{0.88}Ba_{0.04}Sr_{0.02})(Ca_{1.28}Mn_{0.10}Zn_{0.02})(Nb_{5.39}Ti_{2.55}Fe^{3+}{}_{0.14})(Si_{15.88}Al_{0.12})$

$O_{48}[O_{5.49}(OH)_{2.51}]\cdot13.80H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 7.104 (73) (020), 7.026 (100) (001), 6.482 (45) (20-1), 4.996 (74) (02-1, 021), 3.253 (38) (42-1), 3.171 (56) (04-1), 3.150 (38) (02-2, 022).

Wavenumbers (cm^{-1}): 3520sh, 3360, 1630, 1138s, 1110sh, 1040, 948s, 755sh, 730sh, 680s, 590sh, 490sh, 455.

Sir99 Kuzmenkoite-Ca $K_2Ca(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4\cdot5H_2O$

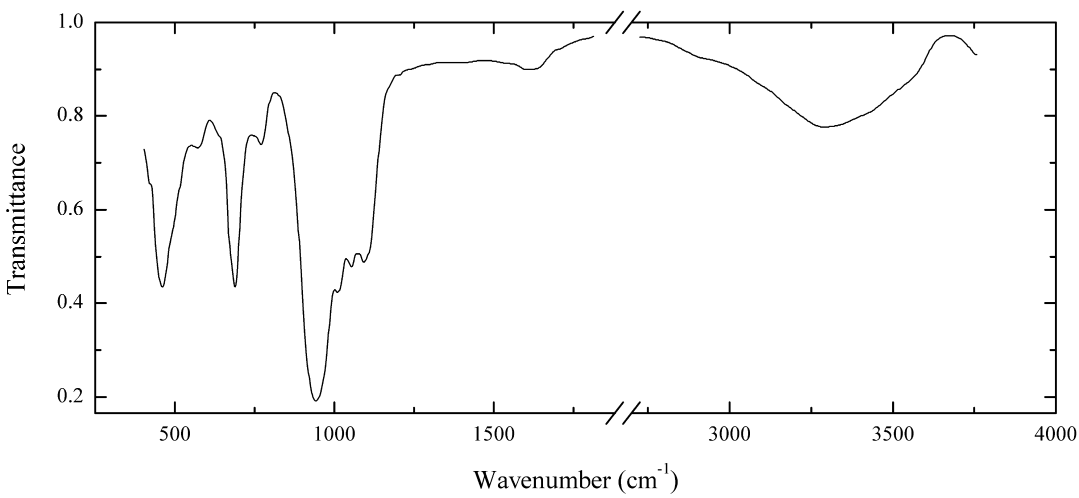


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish crystals. K-deficient variety. The empirical formula is (electron microprobe) $(H_xK_{0.5}Na_{0.3}Ba_{0.1})(Ca_{0.8}Mg_{0.05})(Ti_{2.8}Nb_{1.2})[Si_{4.00}O_{12}]_2(OH,O)_4\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3500sh, 3370sh, 3260, 1640w, 1610w, 1425w, 1123s, 1105sh, 1030sh, 943s, 761, 683s, 602, 460s, 420sh, 390sh.

Sir100 Kuzmenkoite-Zn $K_2Zn(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4\cdot6\text{–}8H_2O$

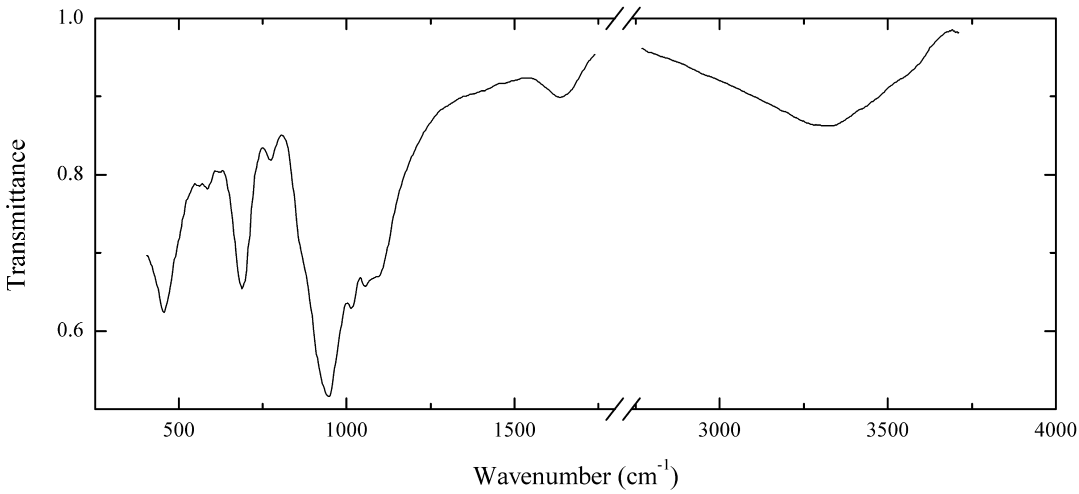


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Light grey pseudomorphs after murmanite from the association with natrolite, microcline, albite, aegirine, nepheline, arfvedsonite, sodalite, eudialyte and lorenzenite. Holotype sample. Monoclinic, space group *Cm*, $a = 14.400$, $b = 13.851$, $c = 7.781$ A, $\beta = 117.33°$. Optically biaxial (+), $\alpha = 1.680–1.683$, $\beta = 1.686–1.688$, $\gamma = 1.783–1.787$, $2V_{meas} = 25(10)°$. $D_{meas} = 2.85(2)$ g/cm^3, $D_{calc} = 2.98$ g/cm^3. The empirical formula is $(K_{3.00}Ca_{0.97}Na_{0.39}Ba_{0.32}Sr_{0.05})(Zn_{1.14}Mn_{0.73}Fe_{0.19}Mg_{0.02})(Ti_{5.50}Nb_{2.35})[(Si_{15.79}Al_{0.21})O_{48}][(OH)_{4.07}O_{3.93}]\cdot 17H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.92 (75) (020, 001), 6.40 (60) (200, 20-1), 3.19 (100) (400, 42-1, 40-2), 3.09 (91) (041, 022), 2.58 (35) (241), 2.49 (35) (44-1, 40-3).

Wavenumbers (cm^{-1}): 3540sh, 3270, 1635w, 1600w, 1100, 1058, 1011s, 975sh, 946s, 772, 690s, 581, 490sh, 463s, 420sh.

Sir101 Kuzmenkoite-Mn $K_2Mn(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4\cdot 5H_2O$

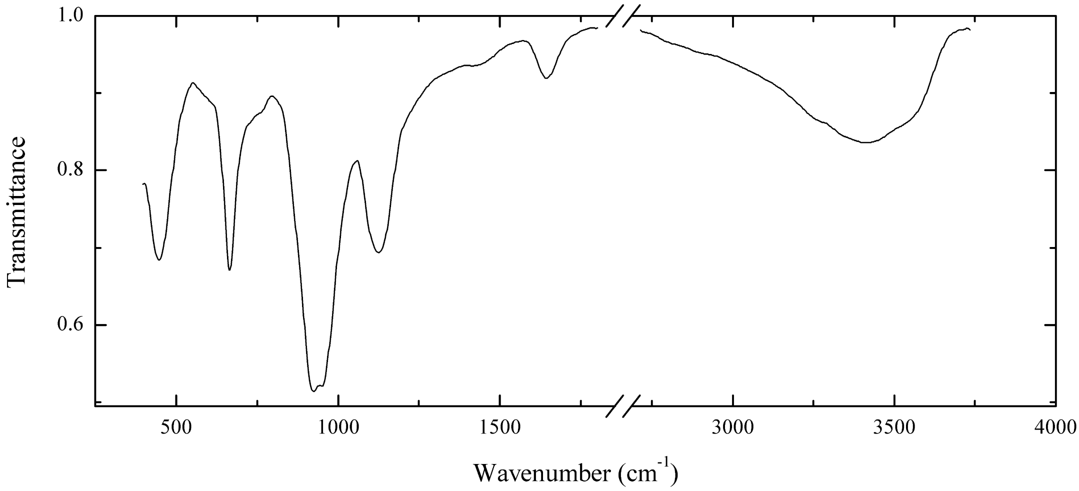


Locality: Northern quarry, Alluaiv Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Pseudomorph after murmanite from the association with gonnardite, gmelinite-K, analcime and raite. The empirical formula is (electron microprobe) $(K_{2.18}Ca_{0.06}Ba_{0.03})(Mn_{0.72}Zn_{0.16})(Ti_{3.48}Nb_{0.46}Fe_{0.06})[Si_{3.93}Al_{0.07}O_{12}]_2(OH,O)_4\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3555w, 3280, 1650, 1610sh, 1091, 1078sh, 1057s, 1016s, 950s, 950sh, 773, 690s, 590, 458.

Sir102 Korobitsynite $Na_3(Ti,Nb)_2(Si_4O_{12})(O,OH)_2 \cdot 3–4H_2O$

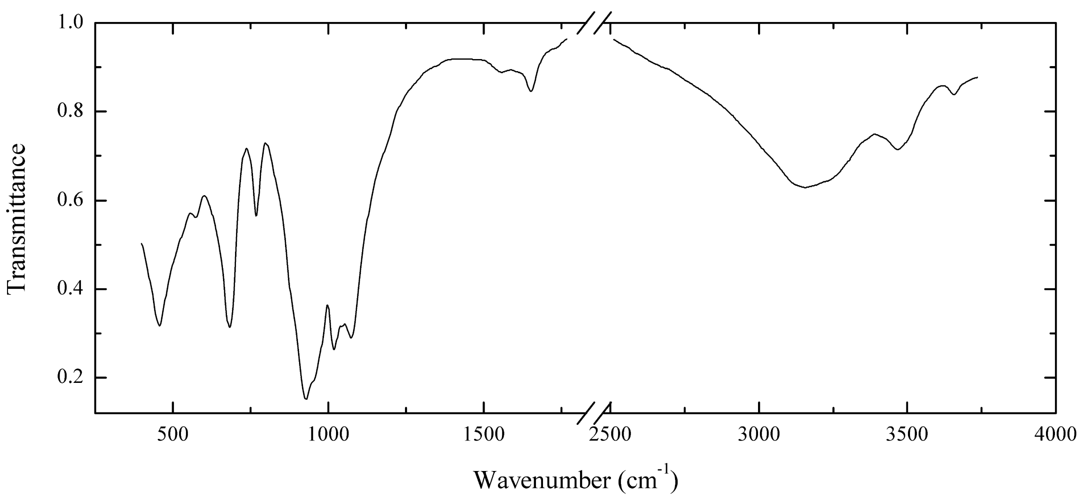


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless crystals from fenite, from the association with labuntsovite-Fe, calcite and elpidite. The empirical formula is (electron microprobe) $Na_{2.8}Ca_{0.1}(Ti_{1.1}Nb_{0.9})(Si_{4.0}O_{12})(O,OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3250sh, 3400, 1643, 1128s, 955s, 926s, 750sh, 667s, 446s.

Sir103 Labuntsovite-Mg $Na_2K_2Mg(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4 \cdot 5H_2O$

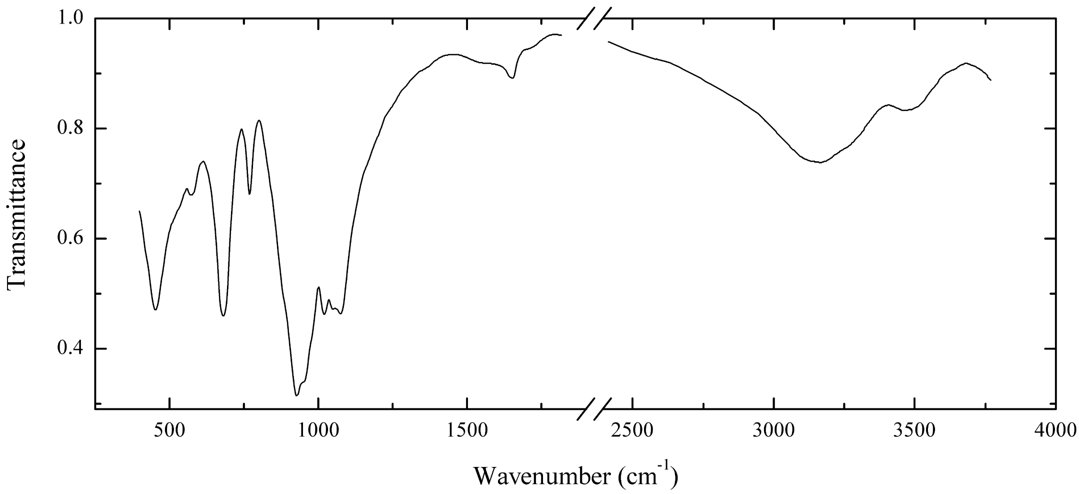


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Orange prismatic crystals from the association with dolomite and catapleiite. The empirical formula is (electron microprobe) $Na_{1.8}K_{2.1}Ba_{0.3}(Mg_{0.6}Fe_{0.2})(Ti_{3.8}Nb_{0.2})(Si_{4.0}O_{12})_2(OH,O)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3630w, 3455, 3150, 1652, 1565w, 1074s, 1045sh, 1020s, 955sh, 929s, 890sh, 768, 681s, 576, 457s.

Sir104 Labuntsovite-Mg $Na_2K_2Mg(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4{\cdot}5H_2O$

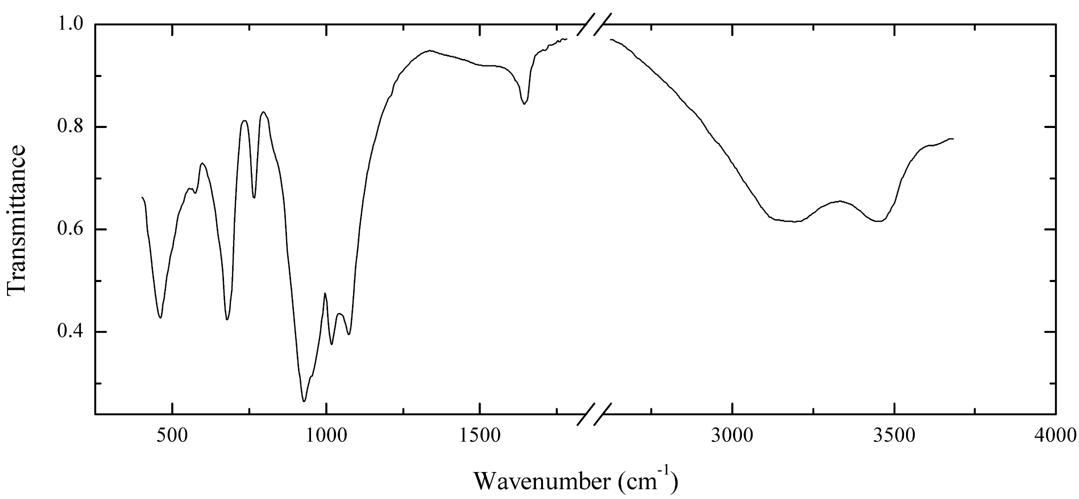


Locality: Malyi Murun (Malomurunskiy) alkaline pluton, Irkutsk region, Eastern Siberia, Russia.

Description: White semitransparent prismatic crystals from calcite carbonatite. The empirical formula is (electron microprobe) $Na_{2.0}K_{2.4}Ba_{0.3}(Mg_{0.35}Fe_{0.2})(Ti_{3.9}Fe_{0.1})(Si_{4.0}O_{12})_2(OH,O)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3620w, 3450, 3150, 1652, 1550w, 1074s, 1050s, 1020s, 955sh, 927s, 768, 680s, 574, 530sh, 454.

Sir107 Lemmleinite-Ba $Na_2K_2Ba_{1+x}Ti_4(Si_4O_{12})_2(O,OH)_4{\cdot}5H_2O$

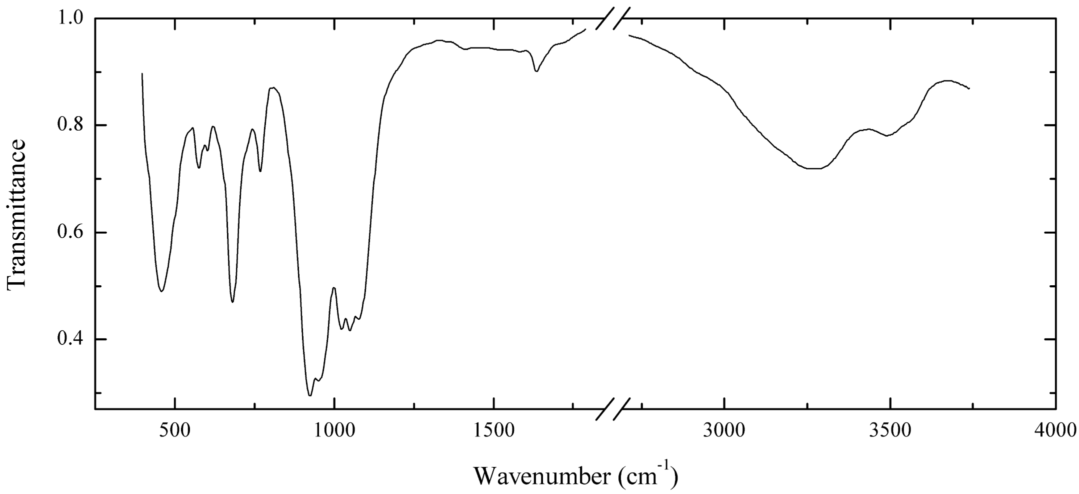


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Orange short-prismatic crystals from calcite carbonatite, from the association with natrolite and ancylite-(Ce). The empirical formula is (electron microprobe) $Na_{2.11}K_{1.95}Ba_{1.00}(Mg_{0.21}Mn_{0.12}Fe_{0.06})(Ti_{3.85}Nb_{0.11}Fe_{0.04})(Si_{4.00}O_{12})_2(OH,O)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3630w, 3454, 3187, 1640, 1075s, 1019s, 955sh, 930s, 767, 678s, 574, 459.

Sir108 Lemmleinite-K $Na_2K_2K_{2-x}(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4 \cdot 5H_2O$

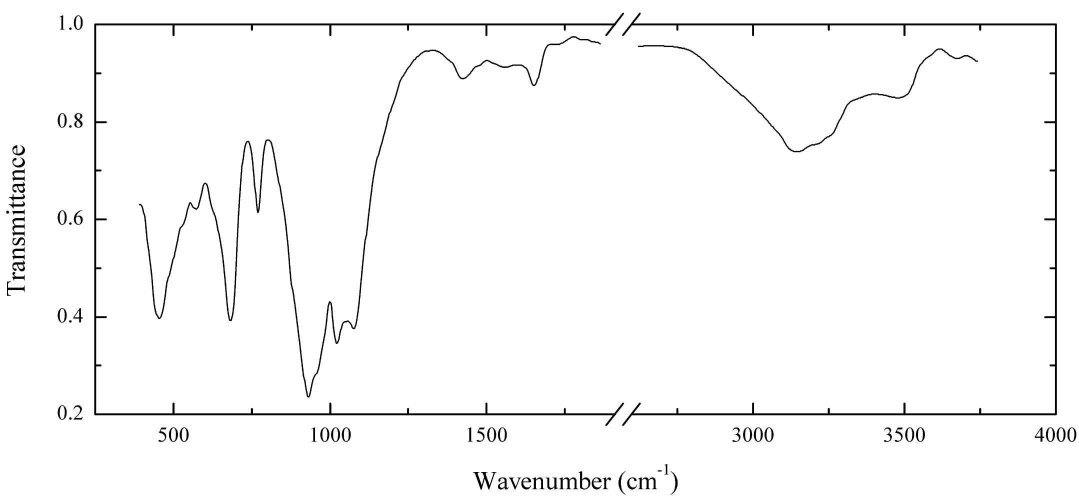


Locality: Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.

Description: Red prismatic, epitaxy on korobitsynite crystals from calcite carbonatite. The empirical formula is (electron microprobe) $Na_{2.6}K_{2.8}Ba_{0.05}(Mg_{0.2}Fe_{0.1})(Ti_{2.15}Nb_{1.8}Fe_{0.05})(Si_{4.00}O_{12})_2(O,OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3550, 3490, 3265, 1715w, 1635, 1410w, 1078s, 1052s, 1026s, 958s, 925s, 769, 683s, 600, 576, 458s.

Sir110 Labuntsovite-□ $Na_2K_2(\square,Ba)_2(\square,Mn)Ti_4(Si_4O_{12})_2(O,OH)_4 \cdot nH_2O$

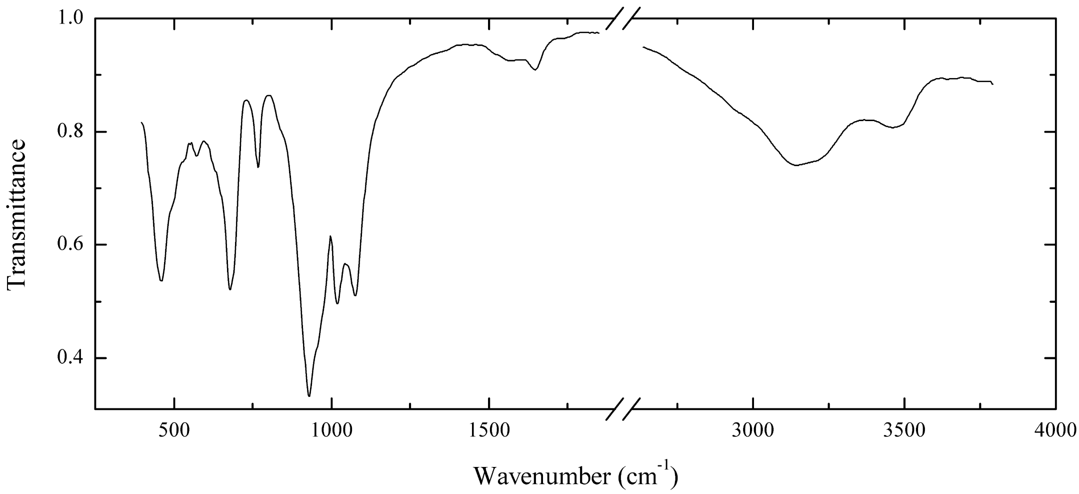


Locality: Turii (Turiy) alkaline massif, Turii cape, Kola peninsula, Murmansk region, Russia.

Description: Orange crystals from the association with natrolite, calcite and aegirine. The empirical formula is (electron microprobe, $Z = 1$) $Na_{3.32}K_{3.43}Ba_{1.90}(Fe_{0.48}Mg_{0.46})(Ti_{7.91}Nb_{0.10})(Si_4O_{12})_4(O,OH)_8 \cdot nH_2O$. Weak band at 1,423 cm^{-1} corresponds to the admixture of calcite.

Wavenumbers (cm^{-1}): 3645w, 3455, 3230sh, 3180sh, 3125, 1730w, 1648, 1555w, 1423w, 1075s, 1019s, 950sh, 928s, 768, 679s, 572, 458s.

Sir111 Lemmleinite-Ba $Na_2K_2Ba_{1+x}Ti_4(Si_4O_{12})_2(O,OH)_4 \cdot 5H_2O$

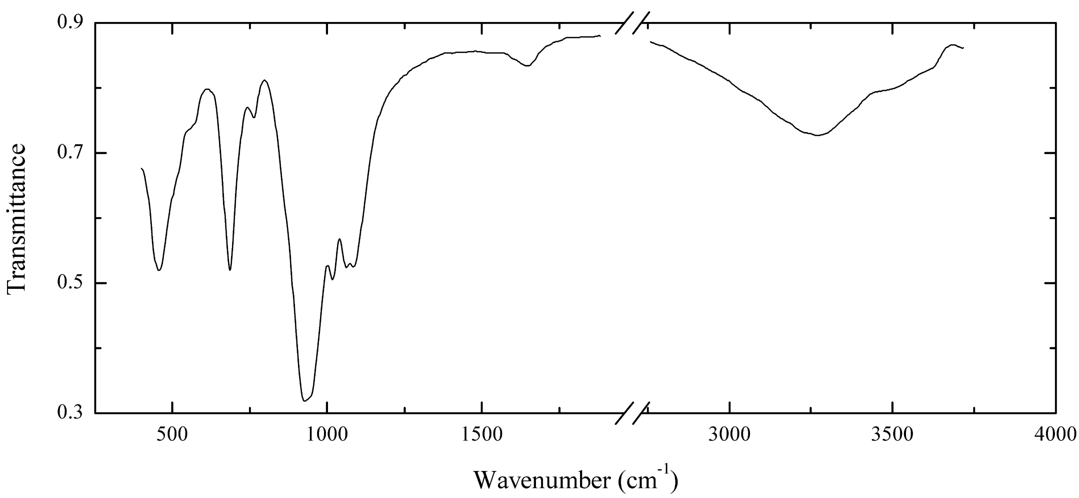


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange long-prismatic crystals from the association with a raite-like mineral and natrolite. The empirical formula is (electron microprobe) $Na_{2.1}K_{1.9}Ba_{1.1}(Mn_{0.2}Mg_{0.1}Fe_{0.1})(Ti_{3.9}Nb_{0.1})(Si_{4.00}O_{12})_2(O,OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3440, 3200sh, 3125, 1645, 1570w, 1076s, 1020s, 970sh, 950sh, 929s, 767, 677s, 645sh, 574, 530sh, 490sh, 459s.

Sir112 Neskevaaraite-Mn $NaK_3Fe(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4 \cdot 6H_2O$

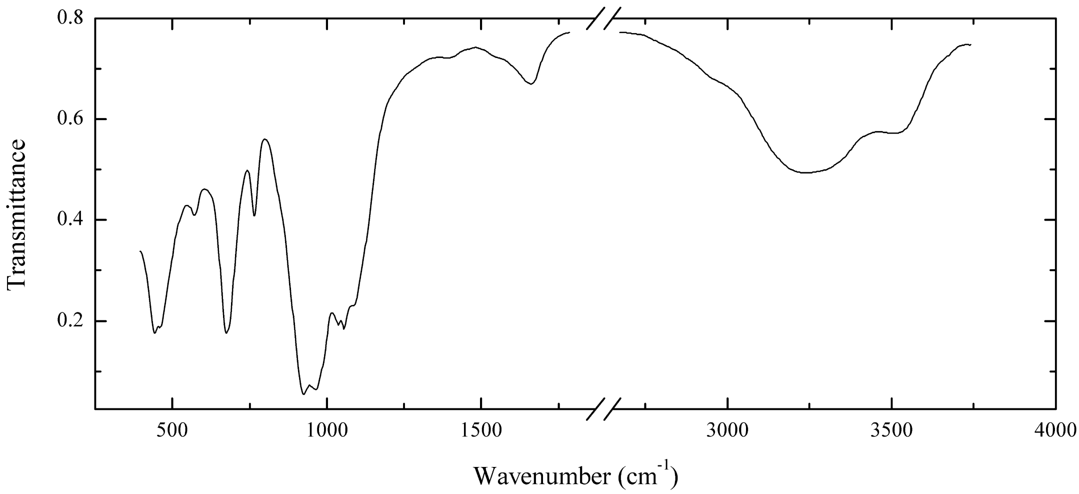


Locality: Selsurt (Flora) Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Orange short-prismatic crystals from the association with kuzmenkoite-Mn, microcline, aegirine, fluorapatite and calciohilairite. The empirical formula is (electron microprobe, $Z = 1$) $Na_{2.76}K_{3.97}Ba_{0.10}(Mn_{1.46}Fe_{0.22}Mg_{0.07})(Ti_{6.48}Nb_{1.62})(Si_{4.00}O_{12})_4(O,OH)_8 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3615w, 3490sh, 3255, 1650, 1088s, 1062s, 1014s, 940sh, 928s, 765, 685s, 570sh, 455s.

Sir113 Lemmleinite-K $Na_2K_2K_{2-x}(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4{\cdot}5H_2O$

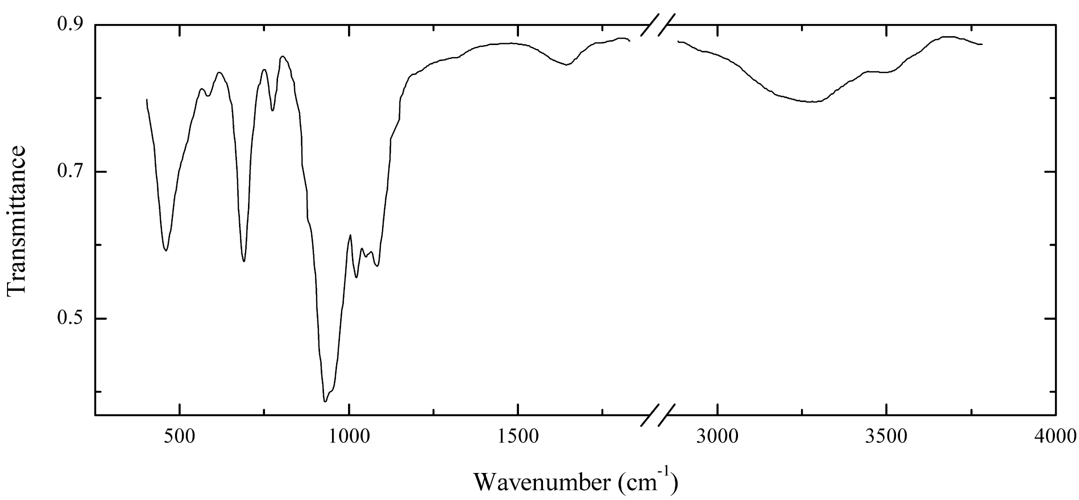


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Colourless crystals from peralkaline pegmatite. Holotype sample. Monoclinic, space group $C2/m$, $a = 14.39$, $b = 13.90$, $c = 7.825$ A, $\beta = 117.6°$. Optically biaxial (+), $\alpha = 1.667$, $\beta = 1.677$, $\gamma = 1.802$. $D_{meas} = 2.80$ g/cm^3.

Wavenumbers (cm^{-1}): 3510, 3280, 3195, 1655, 1118, 1080, 1053s, 1035s, 961s, 924s, 766, 685sh, 672s, 575, 458, 439s.

Sir114 Labuntsovite-Mg $Na_2K_2Mg(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4{\cdot}5H_2O$

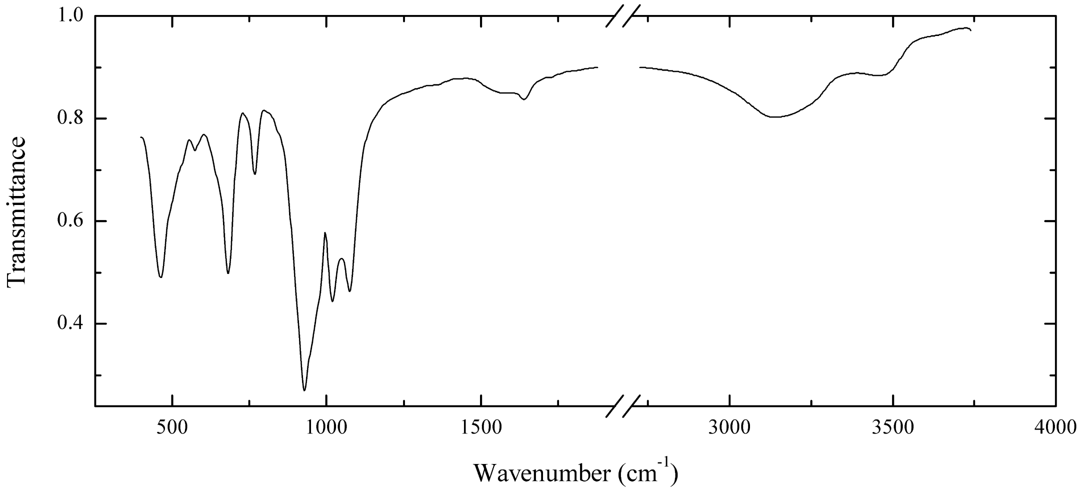


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Beige prismatic crystals from the association with dolomite, catapleiite, anatase and strontianite. The empirical formula is (electron microprobe) $Na_{1.83}K_{1.97}Ba_{0.32}(Mg_{0.63}Fe_{0.22})(Ti_{3.9}Nb_{0.1})(Si_{4.0}O_{12})_2(OH,O)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3510w, 3380, 1640, 1081s, 1050s, 1022s, 950sh, 930s, 771, 686s, 581, 505sh, 454s.

Sir116 Lemmleinite-Ba $Na_2K_2Ba_{1+x}Ti_4(Si_4O_{12})_2(O,OH)_4 \cdot 5H_2O$

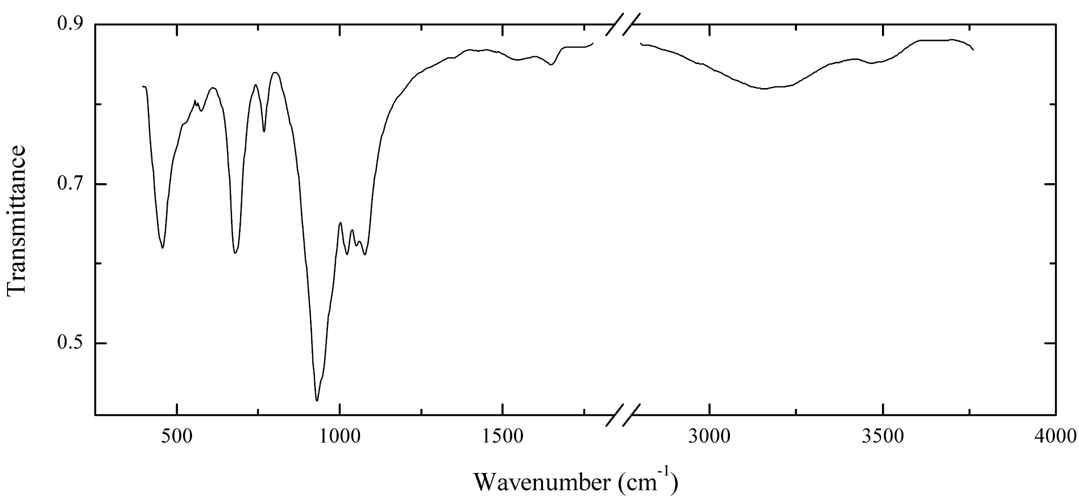


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange long-prismatic crystals from the association with calcite, strontianite, aegirine, microcline and nepheline. Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/m, a = 14.216(2), b = 13.755(3), c = 7.767(5)$ Å, $\beta = 116.7(1)°, Z = 2$. Optically biaxial (+), $\alpha = 1.684(2)$, $\beta = 1.690(2)$, $\gamma = 1.820(5)$, $2V_{meas} = 37(10)°$. $D_{meas} = 3.03(1)$ g/cm^3, $D_{calc} = 3.05$ g/cm^3. The empirical formula is ($Z = 1$) $Na_{4.34}K_{3.74}(Ba_{2.08}Sr_{0.03})(\square_{1.07}Mn_{0.56}Mg_{0.24}Fe_{0.13})[(Ti_{7.94}Nb_{0.08}Zr_{0.02})O_{6.40}(OH)_{1.60}][Si_4O_{12}]_4 \cdot 10.46H_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 6.93 (26) (001), 6.31 (28) (20-1), 3.55 (24) (40-1), 3.16 (100) (42-1, 402), 3.09 (24) (022, 041), 3.02 (25) (240), 2.577 (25) (20-3, 241).

Wavenumbers (cm^{-1}): 3450, 3235sh, 3130, 1642, 1570w, 1075s, 1019s, 975sh, 955sh, 929s, 766, 678s, 574, 461s.

Sir117 Labuntsovite-□ $Na_2K_2(\square,Ba)_2(\square,Mn)Ti_4(Si_4O_{12})_2(O,OH)_4 \cdot nH_2O$

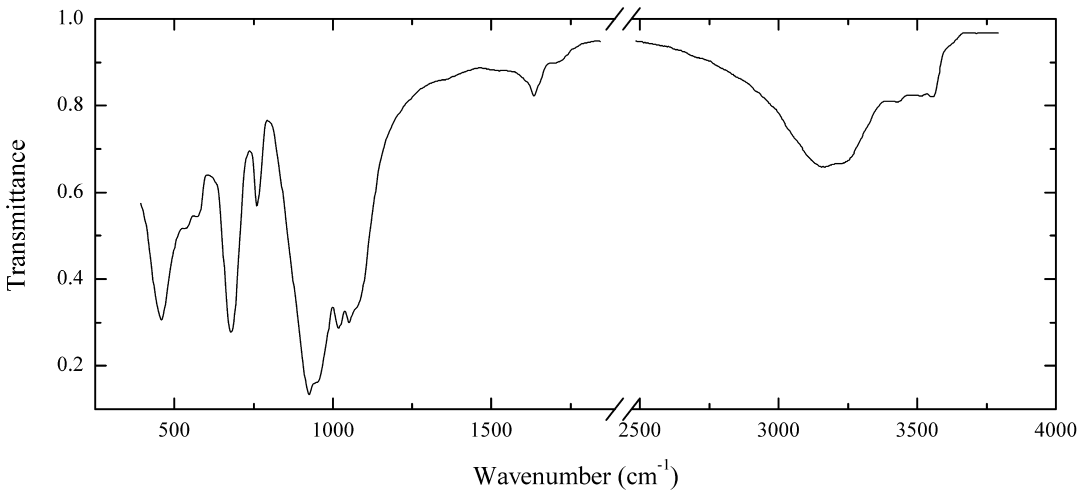


Locality: Malyi Murun (Malomurunskiy) alkaline pluton, Irkutsk region, Eastern Siberia, Russia.

Description: Orange crystals. The empirical formula is (electron microprobe, $Z = 1$) $Na_{3.98}K_{4.86}Ba_{1.07}(Fe_{0.60}Mg_{0.22})Ti_{8.01}[Si_{4.00}O_{12}]_4(O,OH)_8{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3625w, 3500sh, 3440, 3145, 1650, 1545w, 1076s, 1051s, 1021s, 945sh, 930s, 765, 679s, 571w, 525sh, 453s.

Sir118 Labuntsovite-Mn $Na_2K_2Mn(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4{\cdot}5H_2O$

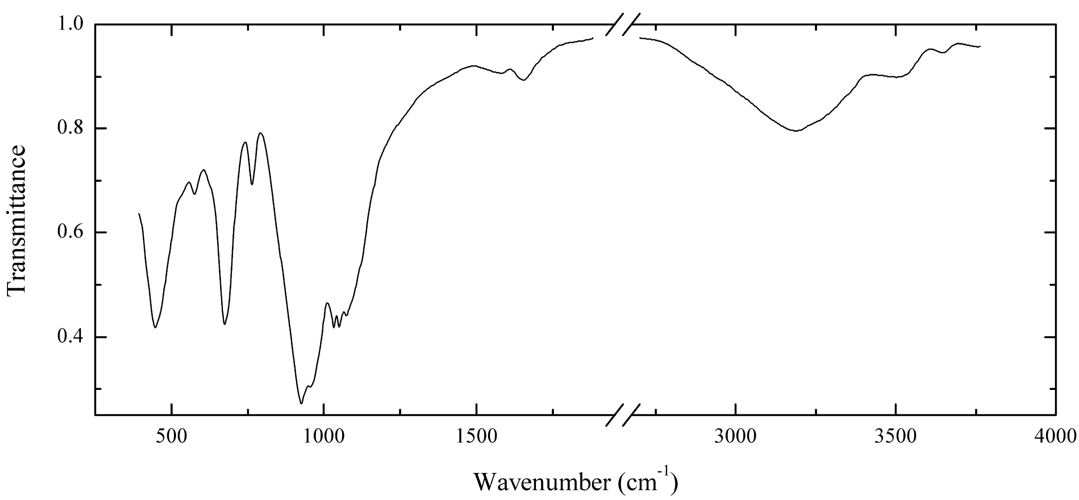


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Orange prismatic crystals from the association with clinochlore, calcite, natrolite, pectolite, feldspar, fluorite and sphalerite. The empirical formula is (electron microprobe) $Na_{2.21}K_{2.56}Ba_{0.13}(Mn_{0.38}Fe_{0.21}Mg_{0.06})(Ti_{3.85}Nb_{0.13})(Si_{4.00}O_{12})_2(OH,O)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3545w, 3503w, 3420w, 3220sh, 3155, 1710w, 1645, 1075sh, 1051s, 1020s, 947sh, 917s, 761, 679, 572, 530sh, 458.

Sir119 Lemmleinite-K $Na_2K_2K_{2-x}(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4{\cdot}5H_2O$

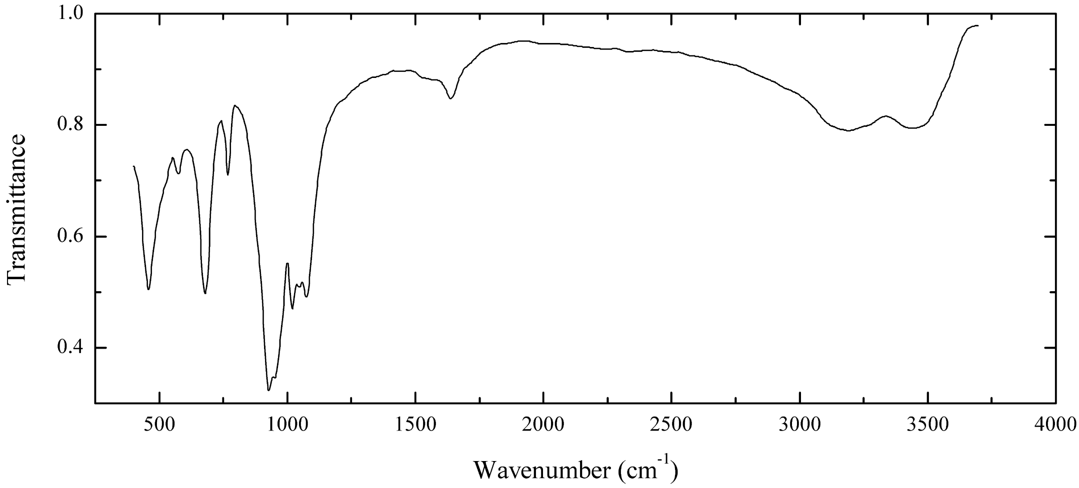


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange crystals from the association with pectolite and microcline. Mn- and Ba-bearing variety. The empirical formula is (electron microprobe) $Na_{2.25}K_{3.18}Ba_{0.20}(Mn_{0.12}Fe_{0.06}Mg_{0.03})(Ti_{3.55}Nb_{0.41}Fe_{0.04})(Si_{4.00}O_{12})_2(O,OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3615w, 3460, 3330sh, 3220sh, 3170, 1652, 1580w, 1120sh, 1075, 1050s, 1030s, 957s, 926s, 766, 685sh, 674s, 573, 446s.

Sir120 Labuntsovite-Fe $Na_2K_2Fe(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4 \cdot 5H_2O$

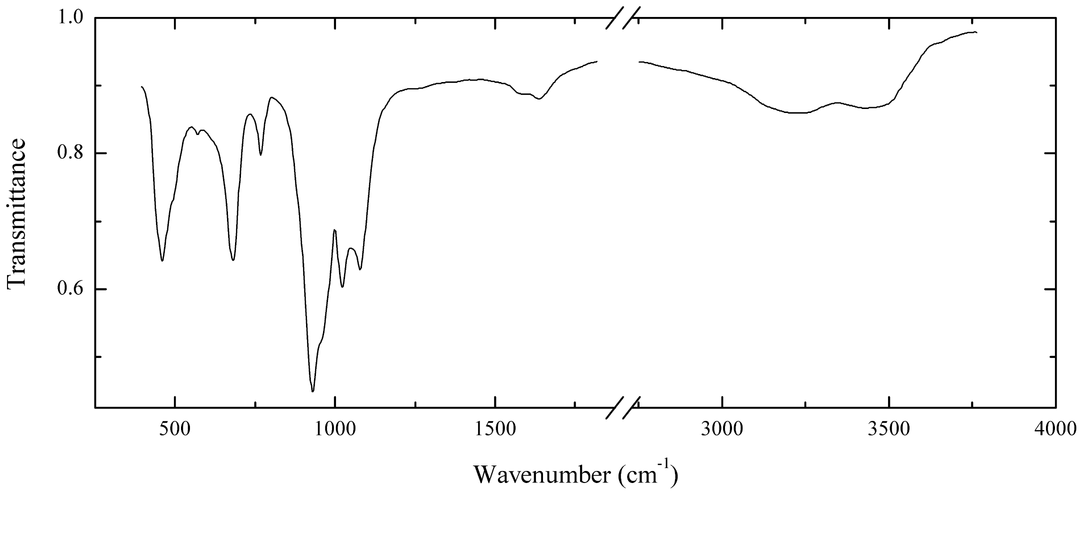


Locality: Nyorkpakhk Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark red long-prismatic crystals from the association with aegirine, microcline and natrolite. The empirical formula is (electron microprobe) $Na_{2.0}K_{2.1}Ba_{0.7}(Fe_{0.5}Ti_{0.1}Mg_{0.05})(Ti_{3.9}Nb_{0.1})(Si_{4.0}O_{12})_2(OH,O)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3550sh, 3425, 3175, 1720sh, 1640, 1540sh, 1076s, 1049s, 1021s, 975sh, 952s, 929s, 890sh, 769, 680s, 578, 505sh, 457s.

Sir121 Paralabuntsovite-□ $Na_2K_2(\square,Ba)_2(\square,Mn)Ti_4(Si_4O_{12})_2(O,OH)_4 \cdot nH_2O$

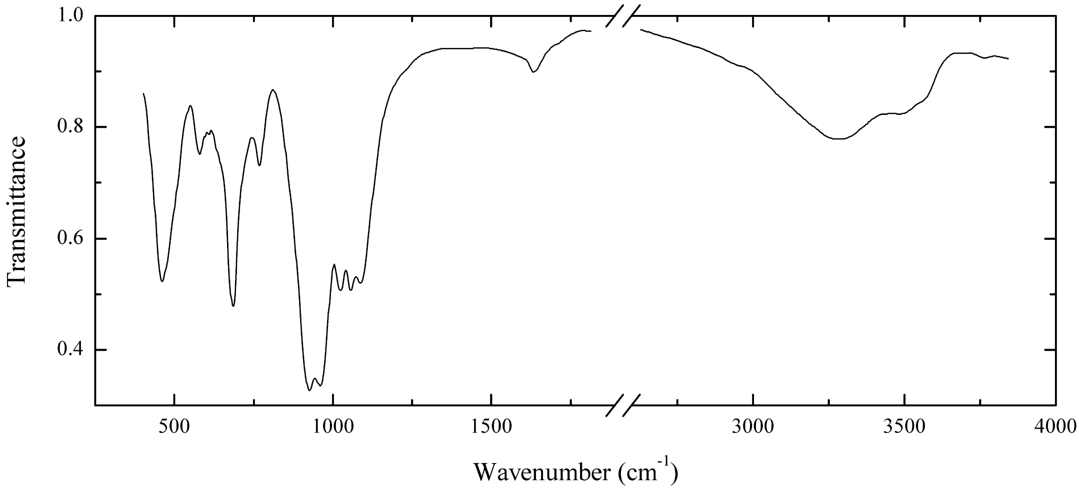


Locality: Khibinpakhkchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Orange prismatic crystals from the association with tsepinite-Na, analcime, apophyllite, natrolite, epididymite and catapleiite. Identified by single-crystal X-ray diffraction pattern and electron microprobe analysis. The empirical formula is ($Z = 2$) $Na_{4+x}K_{3.77}Ba_{1.68}(Mn_{0.76}Mg_{0.07})(Ti_{7.44}Nb_{0.33}Fe_{0.20}Mg_{0.03})(Si_{4.00}O_{12})_4(O,OH)_8 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3440, 3200, 3105sh, 1645, 1555w, 1078s, 1056, 1021s, 955sh, 928, 768, 681s, 630sh, 573, 515sh, 459s.

Sir123 Labuntsovite-Fe $Na_2K_2Fe(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4 \cdot 5H_2O$

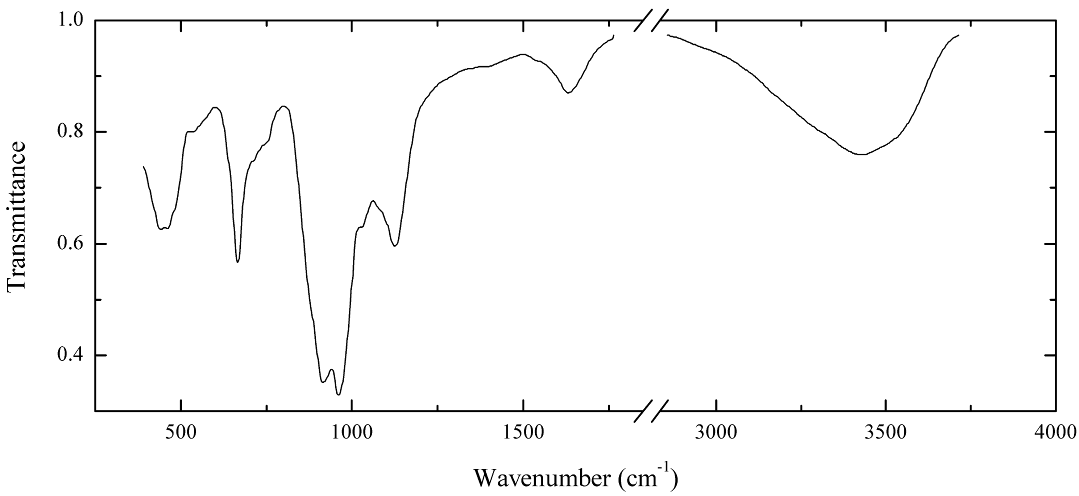


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Brown prismatic crystals from the association with aegirine, microcline and natrolite. Nb-rich variety. The empirical formula is (electron microprobe) $Na_{1.5}K_{2.3}Ba_{0.4}(Fe_{0.35}Mg_{0.2})(Ti_{2.2}Nb_{1.7})(Si_{4.0}O_{12})_2(OH,O)_4 \cdot nH_2O$.

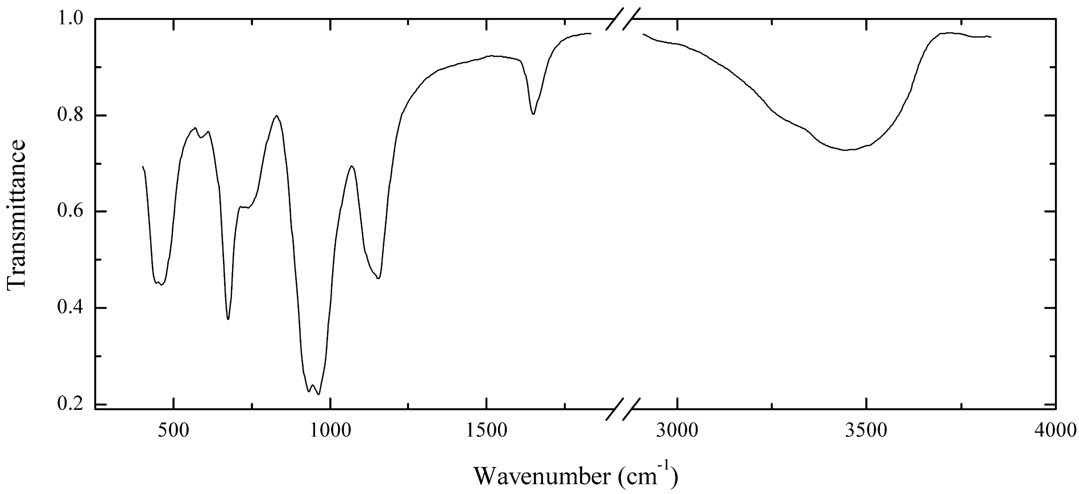
Wavenumbers (cm^{-1}): 3550, 3470, 3270, 1635, 1087s, 1055s, 1025s, 957s, 925s, 766, 683s, 578, 459s.

Sir124 Nenadkevichite $Na_3(Nb,Ti)_2(Si_4O_{12})(O,OH)_2 \cdot 3–4H_2O$



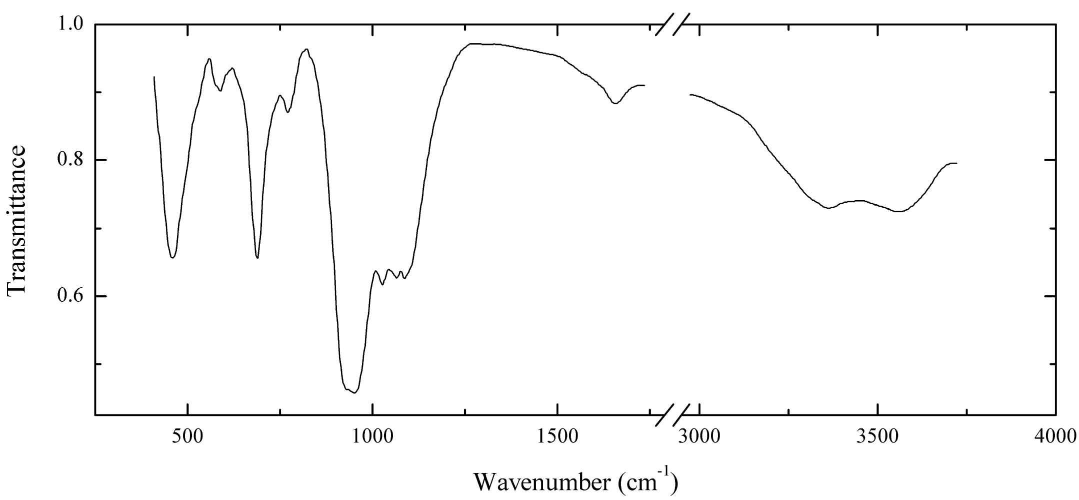
Locality: Karnasurt Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.
Description: Colourless crystals. The empirical formula is (electron microprobe) $Na_{2.7}Sr_{0.05}(Nb_{1.15}Nb_{0.85})(Si_{4.0}O_{12})(O,OH)_2\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3510sh, 3405, 1655sh, 1628, 1124s, 1080sh, 1025sh, 964s, 917s, 755sh, 720sh, 668s, 542, 468, 449.

Sir125 Nenadkevichite $Na_3(Nb,Ti)_2(Si_4O_{12})(OH,O)_2\cdot3–4H_2O$



Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia.
Description: Colourless crystals. The empirical formula is (electron microprobe) $Na_{2.55}Sr_{0.2}K_{0.1}Mn_{0.1}(Nb_{1.2}Ti_{0.8})(Si_{4.0}O_{12})(O,OH)_2\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3430, 3300sh, 1635, 1146s, 1125sh, 961s, 932s, 732, 670sh, 665s, 583w, 461s, 444s.

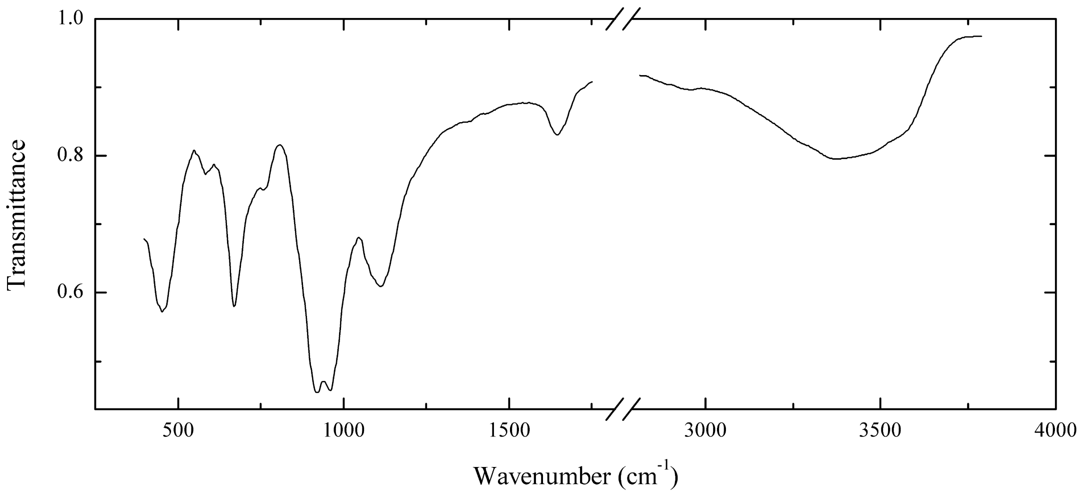
Sir126 Neskevaaraite-Fe $NaK_3Fe(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4\cdot6H_2O$



Locality: Neskevaara Hill, Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia (type locality).

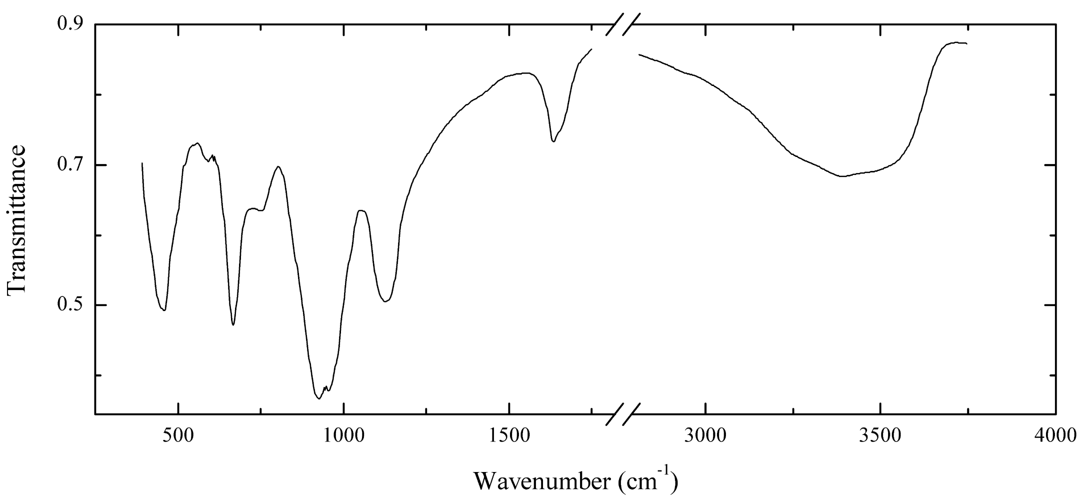
Description: Yellow-brown, flattened prismatic crystals from the association with dolomite, calcite, phlogopite, fluorapatite, pyrite, pyrrhotite, chalcopyrite, pyrochlore, serpentine and nenadkevichite. Holotype sample. The crystal structure is solved. Monoclinic, space group *Cm*, $a = 14.450(6)$, $b = 13.910(6)$, $c = 7.836(4)$ A, $\beta = 117.42(1)°$, $Z = 2$. Optically biaxial (+), $\alpha = 1.677(1)$, $\beta = 1.684(2)$, $\gamma = 1.790(5)$, $2V_{meas} = 25(10)°$. $D_{meas} = 2.88(3)$ g/cm^3, $D_{calc} =$ 2.90 g/cm^3. The empirical formula is ($Z = 2$) $Na_{1.22}K_{2.29}Ba_{0.26}(Fe_{0.31}Mg_{0.23}Mn_{0.09})(Ti_{2.31}Nb_{1.65})(Si_{8.00}O_{24})[O_{2.78}(OH)_{1.22}]·5.68H_2O$. The strongest lines of the powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 6.93 (100) (020, 001), 4.93 (80) (021), 3.21 (100) (400, 42-1, 40-2), 3.11 (90) (041, 022), 2.62 (60) (15-1, 241, 24-2, 202), 2.49 (50) (44-1, 401, 40-3).
Wavenumbers (cm^{-1}): 3530, 3340, 1653, 1083s, 1059s, 1025s, 951s, 930sh, 770, 686s, 584, 458s.

Sir127 Nenadkevichite $Na_3(Nb,Ti)_2(Si_4O_{12})(OH,O)_2·3–4H_2O$



Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia.
Description: Yellow short-prismatic crystals. The empirical formula is (electron microprobe) $Na_{1.75}K_{0.14}Sr_{0.11}Ba_{0.03}(Nb_{1.44}Ti_{0.56})(Si_{4.0}O_{12})(O,OH)_2·nH_2O$.
Wavenumbers (cm^{-1}): 3530sh, 3350, 1635, 1114s, 961s, 925s, 761, 670s, 585, 452s.

Sir128 Nenadkevichite $Na_3(Nb,Ti)_2(Si_4O_{12})(OH,O)_2·3–4H_2O$

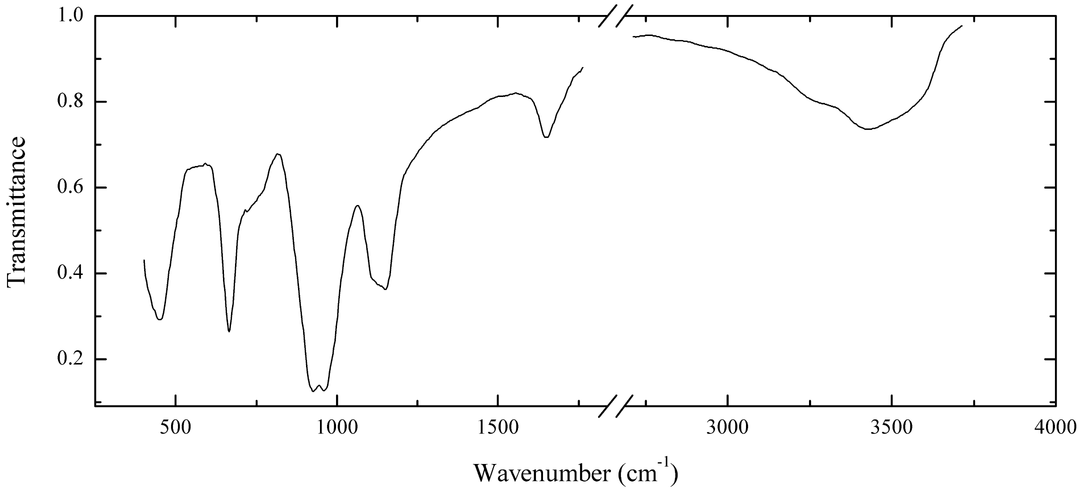


Locality: Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.

Description: Yellowish prismatic crystals from the association with calcite, clinochlore and labuntsovite-Fe. The empirical formula is (electron microprobe) $Na_{2.25}K_{0.05}(Nb_{1.6}Ti_{0.4})(Si_{4.0}O_{12})(O,OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3460sh, 3380, 3270sh, 1655sh, 1635, 1129s, 985sh, 960s, 927s, 751, 668s, 595, 459s, 410sh.

Sir130 Nenadkevichite $Na_3(Nb,Ti)_2(Si_4O_{12})(OH,O)_2 \cdot 3–4H_2O$

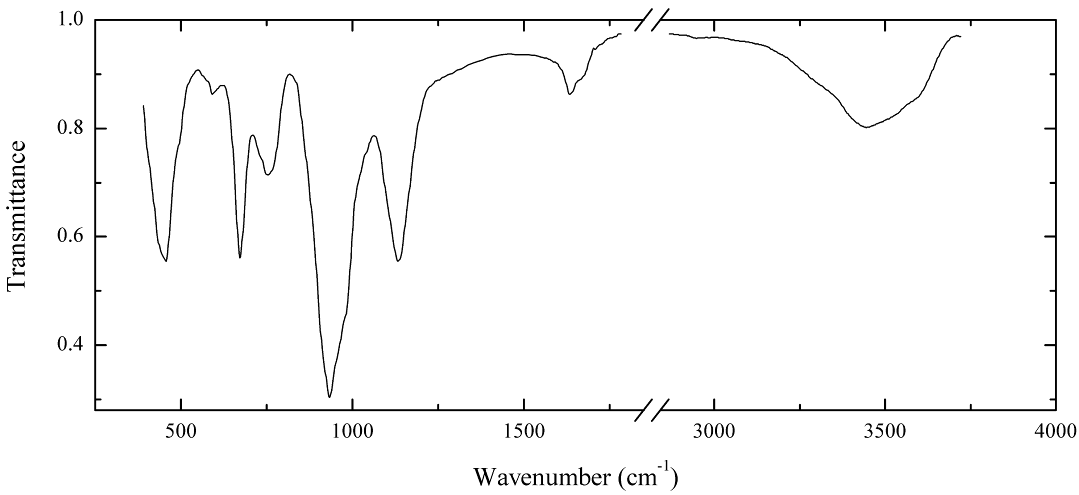


Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Yellowish prismatic crystals. The empirical formula is (electron microprobe) $Na_{1.27}Sr_{0.18}Ca_{0.12}K_{0.03}Ba_{0.02}(Nb_{1.15}Ti_{0.84})(Si_{4.0}O_{12})(O,OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3480sh, 3390, 3250sh, 1640, 1144s, 1115sh, 1090sh, 958s, 928s, 750sh, 725sh, 665s, 581w, 457s, 445sh, 410sh.

Sir131 Nenadkevichite $Na_3(Nb,Ti)_2(Si_4O_{12})(OH,O)_2 \cdot 3–4H_2O$

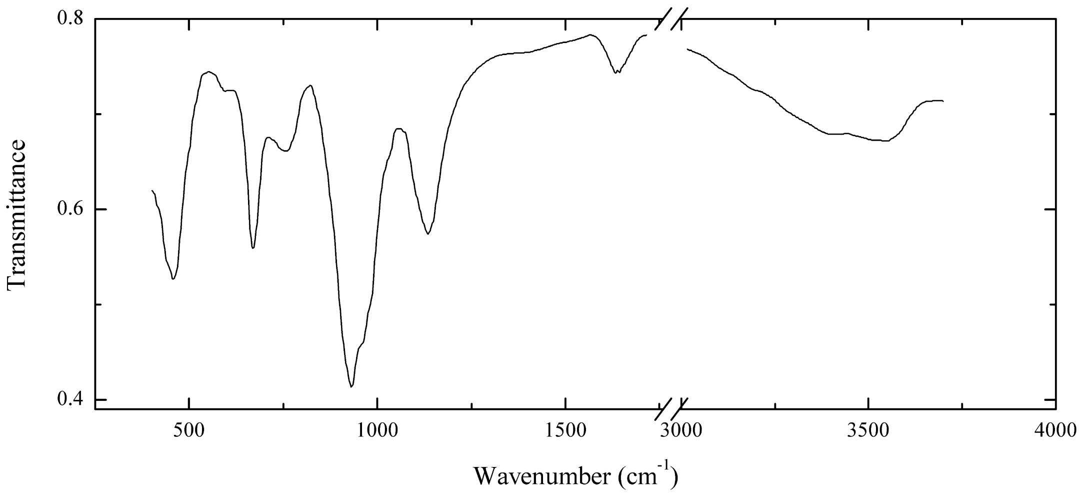


Locality: Neskevaara Hill, Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia.

Description: Yellow-green prismatic crystals from the association with dolomite, calcite, phlogopite, fluorapatite, pyrite, pyrrhotite, chalcopyrite, pyrochlore, serpentine and vuoriyarvite-Fe. Nb-rich variety. The empirical formula is (electron microprobe) $Na_{2.09}Ca_{0.19}Sr_{0.05}K_{0.02}(Nb_{1.89}Ti_{0.14})(Si_{4.00}O_{12})(O,OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3555sh, 3420, 1660sh, 1630, 1340w, 1136s, 980sh, 960sh, 934s, 759, 740sh, 671s, 597, 459s, 440sh.

Sir132 Nenadkevichite $Na_3(Nb,Ti)_2(Si_4O_{12})(OH,O)_2{\cdot}3–4H_2O$

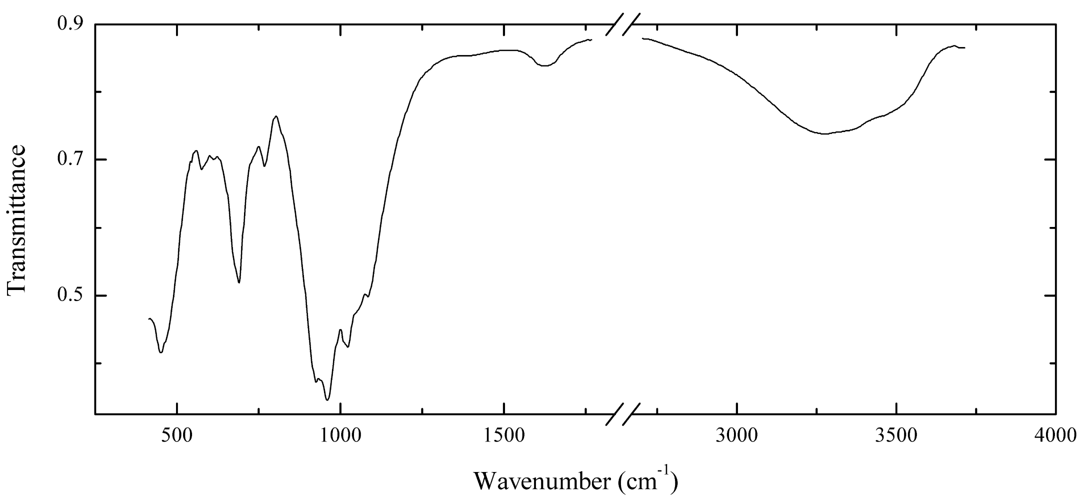


Locality: Vishnevye (Vishnyovye) Mts., Chelyabinsk region, South Urals, Russia.

Description: White prismatic crystals from the association with microcline, albite, cklorite, calcite, ankerite, quartz, aegirine, amphibole, rutile, zircon, strontianite, burbankite and pyrite. Nb-rich variety. The empirical formula is (electron microprobe) $Na_{2.58}K_{0.03}Fe_{0.01}(Nb_{1.80}Ti_{0.18})(Si_{4.00}O_{12})(O,OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3530, 3400, 3190sh, 1643, 1135s, 985sh, 958sh, 930s, 756, 669s, 600w, 460s, 445sh.

Sir133 Neskevaaraite-Fe $NaK_3Fe(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4{\cdot}6H_2O$

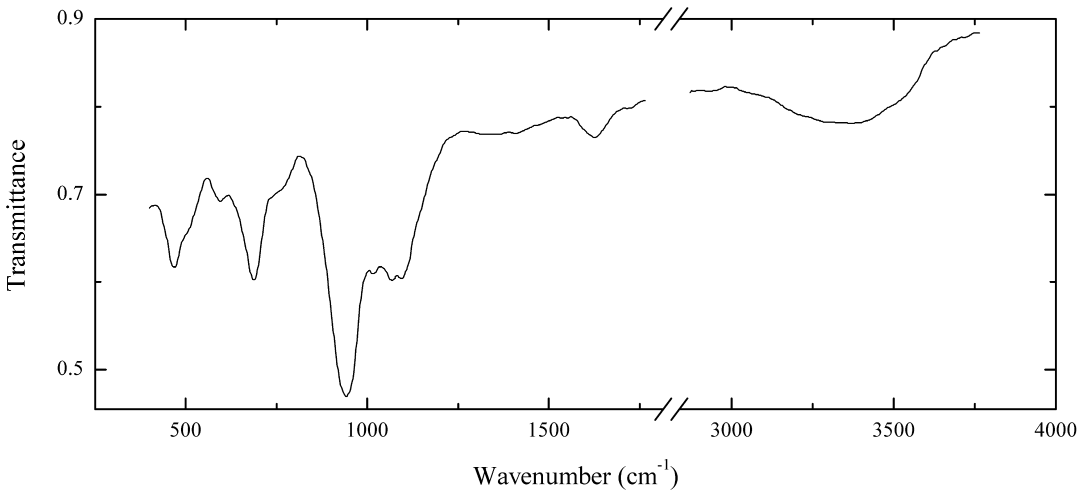


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (cotype locality).

Description: Yellow-brown crystals intergrown with labuntsovite-Fe. The empirical formula is (electron microprobe, $Z = 2$) $Na_{1.41}K_{2.45}Ba_{0.42}Sr_{0.01}(Fe_{0.35}Mn_{0.19}Mg_{0.02}Zn_{0.01})(Ti_{2.25}Nb_{1.70})(Si_{8.00}O_{24})(O,OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3460sh, 3275, 1630, 1580sh, 1085s, 1055sh, 1022s, 961s, 928s, 769, 683s, 577, 485sh, 450s.

Sir134 Alsakharovite-Zn $NaSrKZn(Ti,Nb)_4[Si_4O_{12}]_2(O,OH)_4 \cdot 7H_2O$

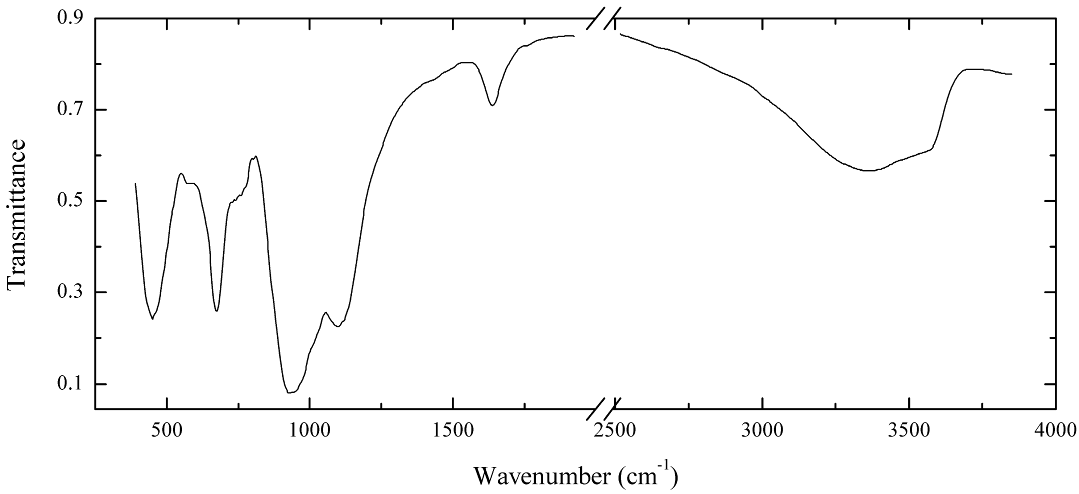


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pale brown, flattened prismatic crystals from the association with lamprophyllite, natrolite, halloysite, ranciéite, kuzmenkoite-Zn, tsepinite-Na and vinogradovite. Holotype sample. The crystal structure is solved. Monoclinic, space group *Cm*, $a = 14.495(10)$, $b = 13.945(10)$, $c = 7.838(8)$ Å, $\beta = 117.75(7)°$. Optically biaxial (+), $\alpha = 1.680$, $\beta = 1.687$, $\gamma = 1.785$, $2V_{meas} = 25(10)°$. $D_{meas} = 2.90$ g/cm^3, $D_{calc} = 2.93$ g/cm^3. The empirical formula is ($Z = 2$) $(Na_{0.68}Ca_{0.32})(Sr_{0.53}Na_{0.12})(K_{0.63}Ba_{0.29})(Zn_{0.75}Fe_{0.04}Mn_{0.02}Mg_{0.01})(Ti_{2.88}Nb_{1.15})(Si_{7.96}Al_{0.04})O_{24}[O_{2.58}(OH)_{1.42}] \cdot 6.80H_2O$. The strongest lines of the powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 6.96 (7) (020, 001), 3.22 (80) (402, 421, 400), 3.11 (90) (041, 022, 240), 2.60 (35) (151, 241, 202), 2.50 (40) (441, 403), 1.74 (30) (080, 004), 1.70 (40) (463, 444, 461, 442).

Wavenumbers (cm^{-1}): 3360, 1635, 1090s, 1071s, 1022s, 949s, 765sh, 689s, 598, 500sh, 467s.

Sir135 Gjerdingenite-Na $(K,Na)_2Na(Nb,Ti)_4(Si_4O_{12})_2(OH,O)_4\cdot 5H_2O$

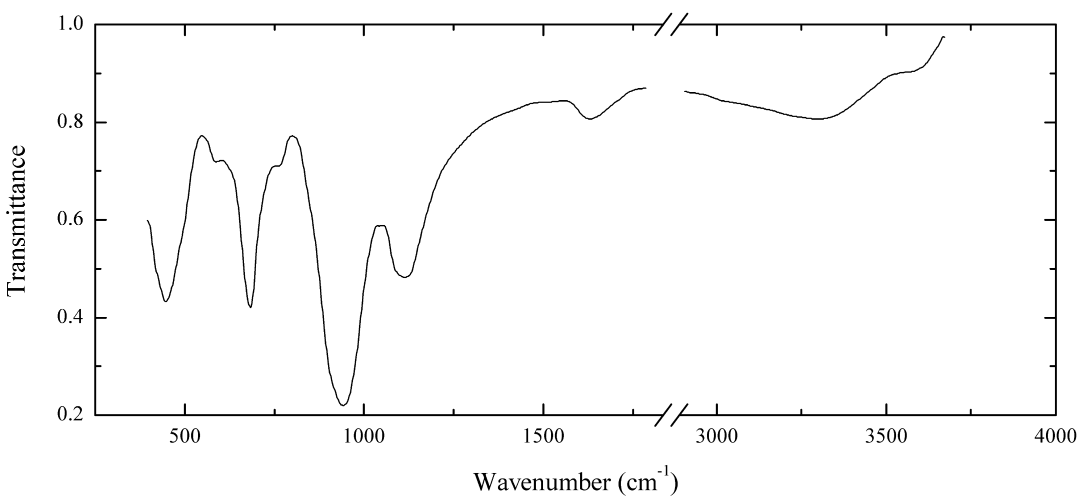


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Pale pink pseudomorph after vuonnemite crystal from the association with microcline, albite, aegirine, analcime, eudialyte, natrolite, epistolite and polylithionite. Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/m$, a = 14.495(10), b = 13.945(10), c = 7.838(8) Å, β = 117.75(7)°. Optically biaxial (+), α = 1.647(2), β = 1.653(2), γ = 1.755(3), $2V_{meas}$ = 25(10)°. D_{meas} = 2.71(1) g/cm³, D_{calc} = 2.69 g/cm³. The empirical formula is (Z = 2) $(K_{0.98}Na_{0.62}Ca_{0.37}Ba_{0.07})(Na_{0.90}Ca_{0.04}Mn_{0.04}Zn_{0.02})(Nb_{2.43}Ti_{1.49}Fe^{3+}_{0.09})(Si_{7.95}Al_{0.05}O_{24})$ $[(OH)_{2.09}O_{1.91}]\cdot 5.32H_2O$. The strongest lines of the powder X-ray diffraction pattern are [d, Å (I, %) (hkl)] 7.102 (29) (020), 7.044 (54) (001), 6.510 (42) (200), 4.995 (44) (02-1, 021), 3.252 (51) (42-1), 3.249 (100) (400), 3.148 (28) (02-2, 022).

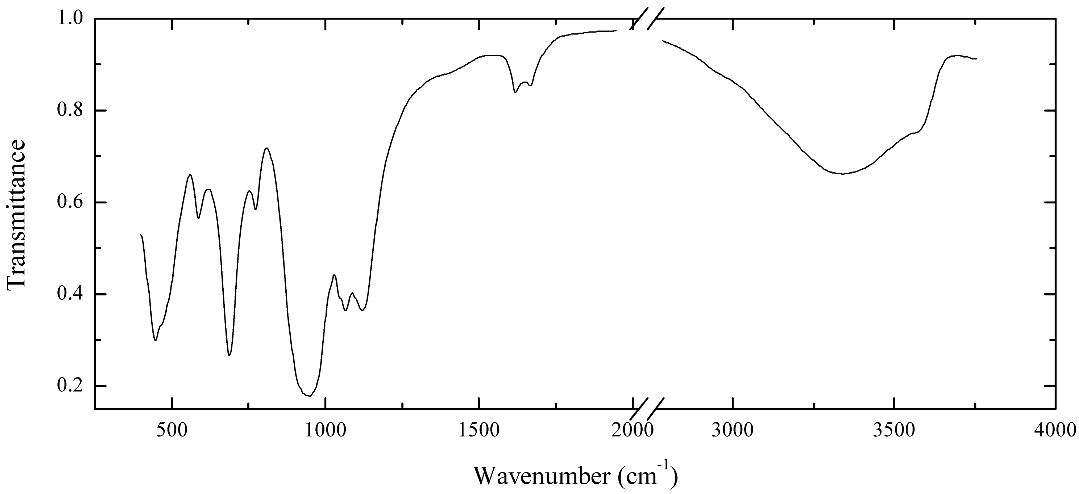
Wavenumbers (cm^{-1}): 3540sh, 3345, 1640, 1115sh, 1098s, 945sh, 925s, 750sh, 677s, 580, 449s.

Sir136 Vuoriyarvite-K $(K,Na)_2(Nb,Ti)_2(Si_4O_{12})(O,OH)_2\cdot 4H_2O$



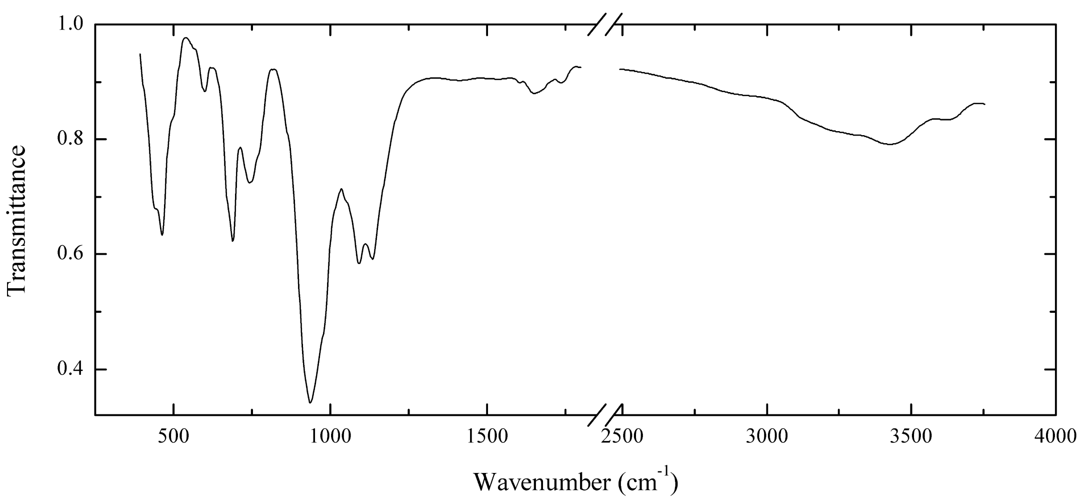
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia.
Description: Cream-coloured pseudomorph after vuonnemite from the association with tsepinite-K and natrolite. The empirical formula is (electron microprobe) $(K_{0.67}Na_{0.39}Ba_{0.10}Sr_{0.09})(Nb_{1.17}Ti_{0.83})(Si_{4.00}O_{12})(O,OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3560w, 3270, 1660sh, 1640, 1615, 1116s, 1042, 942s, 760sh, 681s, 593, 447s, 405sh.

Sir137 Vuoriyarvite-K $(K,Na)_2(Nb,Ti)_2(Si_4O_{12})(O,OH)_2 \cdot 4H_2O$



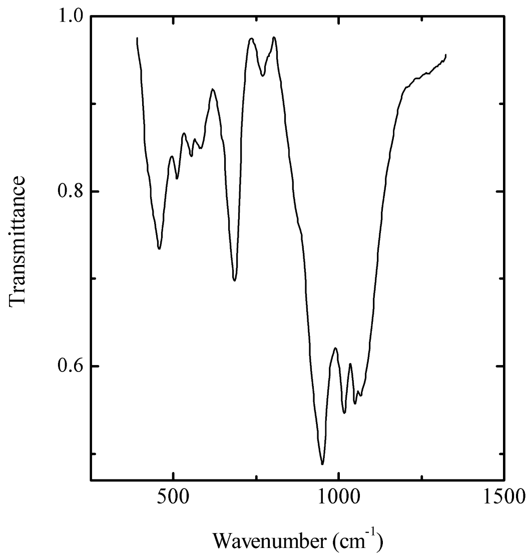
Locality: Neskevaara Hill, Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia (type locality).
Description: Beige crystals from the association with dolomite, calcite, siderite, chlorite, serpentine, fluorapatite, barite and pyrite. The empirical formula is (electron microprobe) $(K_{1.7}Na_{0.3})(Nb_{1.1}Ti_{0.9})(Si_{4.00}O_{12})(O,OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3550, 3490sh, 3325, 1660, 1615, 1110s, 1060s, 1040sh, 1015sh, 943s, 920sh, 769, 685s, 585, 460sh, 444s.

Sir138 Vuoriyarvite-K $(K,Na)_2(Nb,Ti)_2(Si_4O_{12})(O,OH)_2 \cdot 4H_2O$



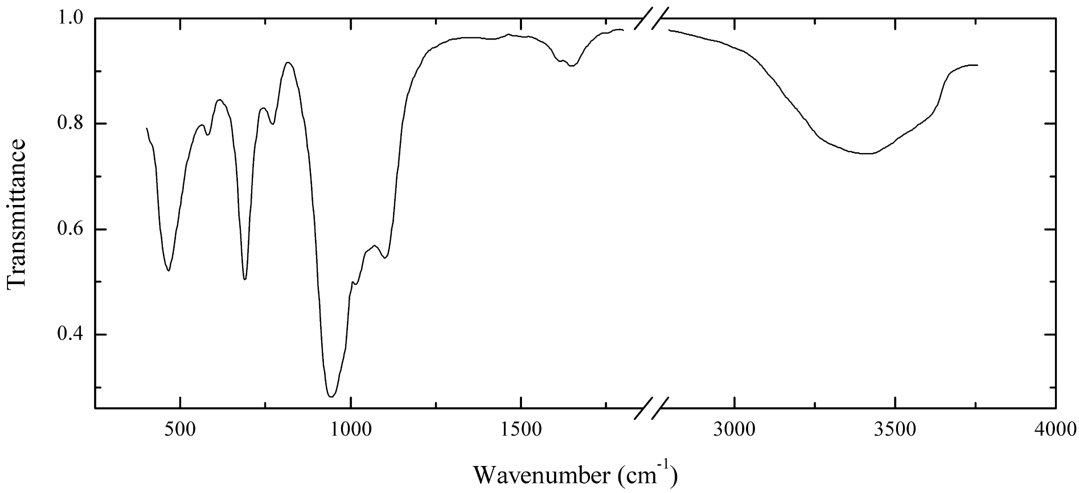
Locality: Neskevaara Hill, Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia (type locality).
Description: Holotype sample.
Wavenumbers (cm^{-1}): 3625sh, 3590, 3400, 3250sh, 1740w, 1648, 1600w, 1134s, 1089s, 1050sh, 970sh, 936s, 860sh, 770sh, 743, 690s, 675sh, 599, 500sh, 467s, 443.

Sir139 Gutkovaite-Mn $CaK_2Mn(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4·5H_2O$



Locality: Malyi Mannepakhk Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).
Description: Pale yellowish-pink prismatic crystals from nepheline syenite, with microcline, aegirine, arfvedsonite, nepheline, eudialyte, albite, lorenzenite, loparite, aenigmatite, manganneptunite, murmanite, analcime, natrolite, stilbite, chabazite, kuzmenkoite-Mn and nontronite. Holotype sample. The crystal structure is solved. Monoclinic, space group *Cm*, $a = 14.30$, $b = 13.889$, $c = 7.760$ A, $\beta = 117.51°$. Optically biaxial (+), $\alpha = 1.688$, $\beta = 1.700$, $\gamma = 1.805$; $2V_{meas} = 35(10)°$. $D_{meas} = 2.83$ g/cm^3, $D_{calc} = 2.79$ g/cm^3. The empirical formula is ($Z = 2$) $(Ca_{2.00}Na_{0.14})(K_{3.24}Ba_{0.16}Sr_{0.12})(Mn^{2+}{}_{1.63}Fe_{0.20}Mg_{0.10}Zn_{0.04})(Ti_{7.14}Nb_{0.90}Zr_{0.02})$ $[(Si_{15.92}Al_{0.08})O_{48}]$ $[O_{4.94}(OH)_{3.06}]·9.7H_2O$. The strongest lines of the powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 67.0 (70) (020, 001), 6.33 (50) (20-1, 200) 4.90 (40) (021), 3.22 (90) (42-1, 40-2, 400), 3.05 (100) (022, 24-1, 240) 2.57 (50) (24-2, 241), 2.48 (60) (44-1, 40-3, 401).
Wavenumbers (cm^{-1}): 1075s, 1053s, 1022s, 953s, 885sh, 783, 692s, 592, 555, 519, 461.

Sir140 Kuzmenkoite-Zn $K_2Zn(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4·6–8H_2O$

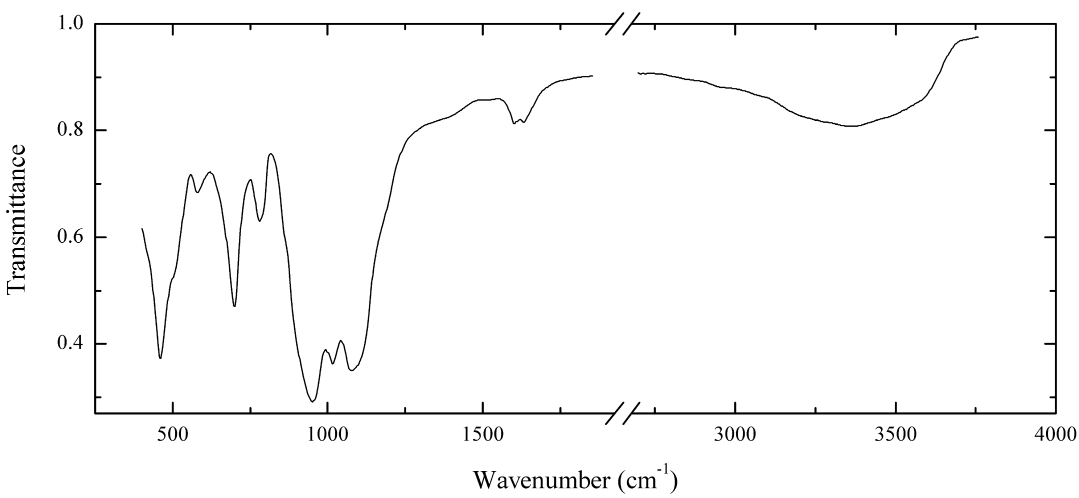


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Beige pseudomorph after murmanite from the association with natrolite, microcline, aegirine, eudialyte and lorenzenite. Confirmed by electron microprobe analysis.

Wavenumbers (cm^{-1}): 3540sh, 3400, 1640, 1610w, 1100s, 1055sh, 1011s, 946s, 771, 690s, 582, 462s, 410sh.

Sir141 Parakuzmenkoite-Fe $CaK_2Mn(Ti,Nb)_4(Si_4O_{12})_2(O,OH)_4·5H_2O$



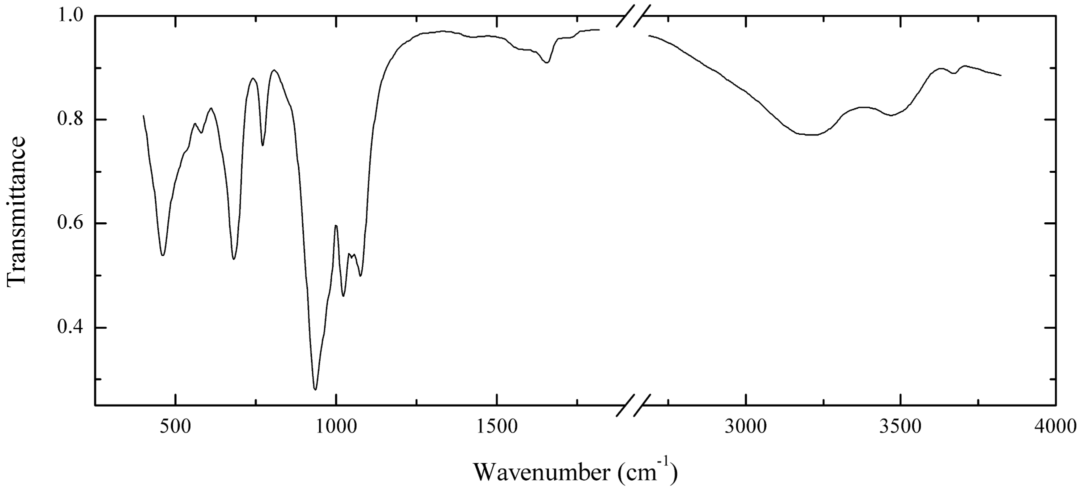
Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Orange prismatic crystals from the association with microcline, aegirine, eudialyte, lorenzenite, sodalite, natrolite, elpidite, ranciéite and halloysite. Holotype sample. The crystal structure is solved. Monoclinic, space group *C*2/*m*, $a = 14.410$ (2), $b = 13.880$ (2), $c = 15.587$ (2) Å, $\beta = 117.53$ (1)°. Optically biaxial (+), $\alpha = 1.687(1)$, $\beta = 1.689(2)$, $\gamma = 1.805(5)$, $2V_{meas} = 22(10)°$. $D_{meas} = 3.00(3)$ g/cm^3, $D_{calc} = 3.07$ g/cm^3. The empirical formula is ($Z = 2$)

$(K_{1.56}Na_{0.36}Ba_{1.47}Sr_{0.11}Ca_{0.11}Zn_{0.07})(Fe^{2+}{}_{1.58}Mn_{0.65}Mg_{0.09})(Ti_{4.44}Nb_{3.41}Fe^{3+}{}_{0.16})[Si_4O_{12}]_4[O_{6.40}(OH)_{1.60}] \cdot 14.29H_2O$. The strongest lines of the powder X-ray diffraction pattern are [*d*, Å (*I*, %) (*hkl*)] 6.91 (100) (021, 002); 3.19 (100) (42-2, 400, 40-1); 3.09 (100) (042, 024); 1.524 (90) (480, 48-4, 426, 42-10); 1.422 (80) (482, 48-6, 446, 86-4, 4.4.-10).

Wavenumbers (cm^{-1}): 3510sh, 3330, 3220sh, 1630, 1600, 1095sh, 1080s, 1016s, 954s, 778, 694s, 586, 510sh, 464s, 420sh.

Sir142 Paralabuntsovite-Mg $Na_2K_2Mg(Ti,Nb)_4(Si_4O_{12})_2(OH,O)_4{\cdot}5H_2O$

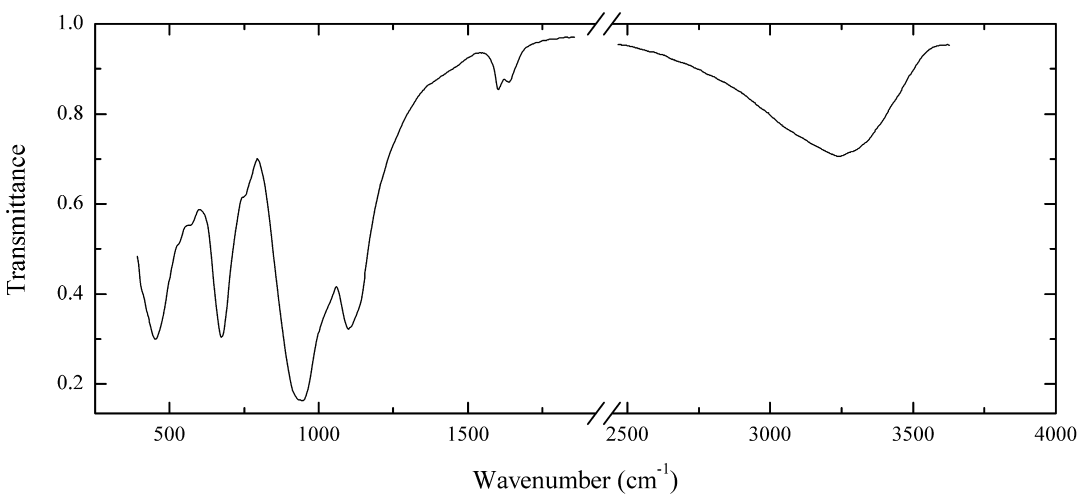


Locality: Green River formation, Sweetwater Co., Wyoming, USA (type locality).

Description: Brownish-orange prismatic crystals. Holotype sample. Monoclinic, space group *I*2/*m*, $a = 15.57$, $b = 13.75$, $c = 14.27$ Å, $\beta = 116.0°$. The empirical formula is (electron microprobe, $Z = 2$) $Na_{4.39}K_{3.65}Ca_{0.01}Ba_{1.45}(Mg_{1.11}Fe_{0.13})(Ti_{7.68}Nb_{0.05})(Si_{3.95}Al_{0.05}O_{12})_2(OH,O)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3645w, 3440, 3185, 1715sh, 1652, 1580sh, 1425w, 1073s, 1046, 1019s, 980sh, 950sh, 932s, 768, 678s, 580, 530sh, 495sh, 460s, 420sh.

Sir143 Tsepinite-Ca $(Ca,K,Na,\square)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2{\cdot}4H_2O$

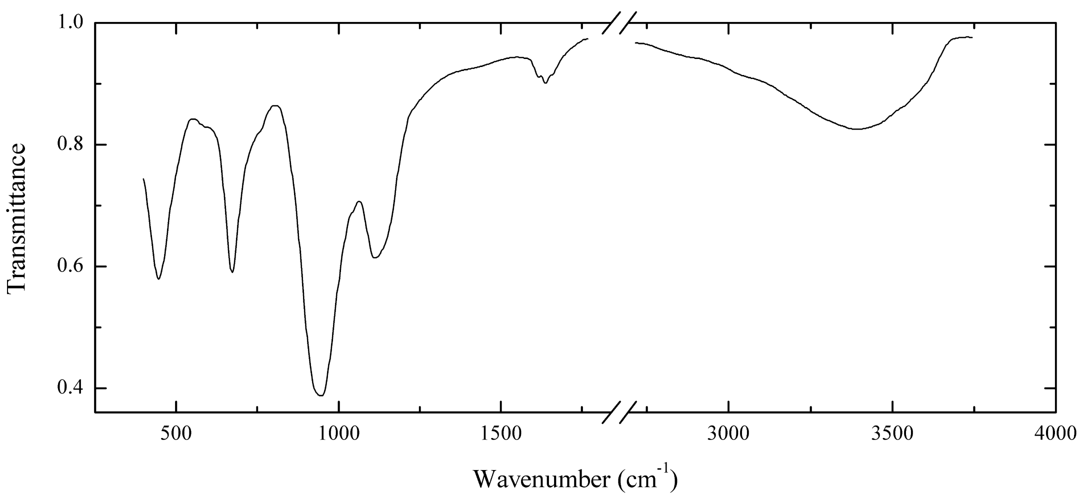


Locality: Lovchorrite mine, Hackman Valley, Yukspor Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Colourless coarse long-prismatic crystals from the association with microcline, aegirine, natrolite, kentbrooksite, kupletskite, Mn-rich lamprophyllite, fluorapatite, catapleiite, ancylite-(Ce), ancylite-(La), fluorapophyllite, leucophanite and chabazite-Ca. Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/m$, $a = 14.484(4)$, $b = 14.191(4)$, $c = 7.907(2)$ Å, $\beta = 117.26(2)°$. Optically biaxial (+), $\alpha = 1.666(2)$, $\beta = 1.676(2)$, $\gamma = 1.780(4)$, $2V_{meas} = 30(10)°$. $D_{meas} = 2.73(1)$ g/cm^3, $D_{calc} = 2.72$ g/cm^3. The empirical formula is ($Z = 2$) $(Ca_{1.10}K_{0.55}Na_{0.50}Sr_{0.34}Ba_{0.27}Mn_{0.03}Zn_{0.02}Fe_{0.01})(Ti_{3.21}Nb_{0.80})(Si_{7.99}Al_{0.01})O_{24}[(OH)_{2.58}O_{1.42}]\cdot7.35H_2O$. The strongest lines of the powder X-ray diffraction pattern are [d, Å (I, %) (hkl)] 7.02 (60) (020, 001), 6.38 (40) (20-1, 200), 3.53 (45) (131); 3.16 (100) (041, 022), 2.62 (45) (20-3, 202), 2.51 (85) (44-1, 40-3, 042), 1.718 (50) (46-3, 461, 44-4, 442, 081).

Wavenumbers (cm^{-1}): 3260, 1655, 1610, 1140sh, 1103s, 1030sh, 946s, 930sh, 745sh, 673s, 572, 530sh, 455s, 425sh.

Sir144 Tsepinite-Na $(Na,K,Ca,Ba,Sr)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2\cdot3H_2O$

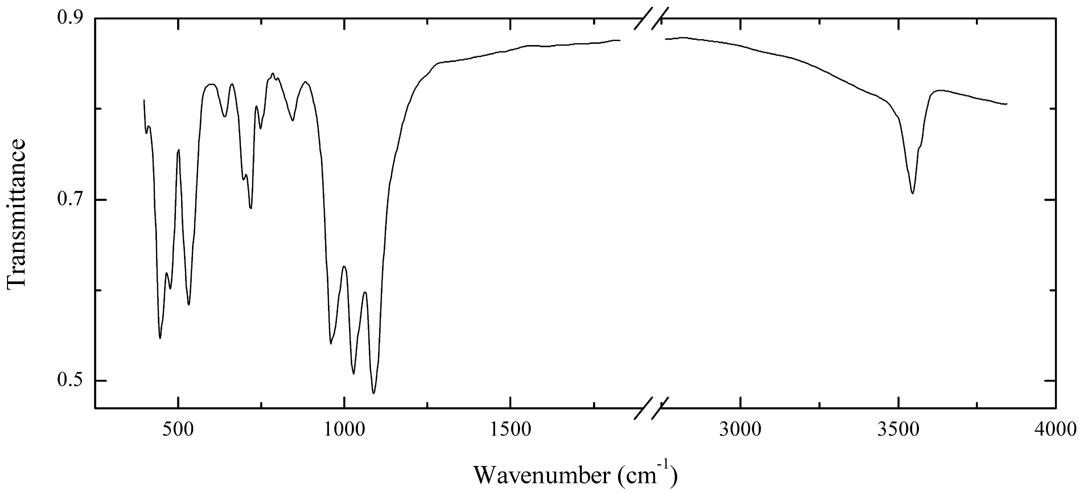


Locality: Takhtarvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: White crystals from the association with microcline, albite, aegirine, natrolite, analcime, vinogradovite and ancylite-(Ce). The crystal structure is solved. Monoclinic, space group Cm, $a = 14.75$, $b = 14.37$, $c = 8.01$ Å, $\beta = 117.4°$. The crystal-chemical formula is ($Z = 1$) $(Na_3\square)(\square_{3.5}K_{0.5})[Ca_{1.5}K(H_2O)_3\square_{0.5}](Ti_{4.6}Nb_{3.4})(Si_4O_{12})_4(OH,O)_8\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3490sh, 3360, 1655sh, 1635, 1614w, 1145sh, 1111s, 948s, 935sh, 750sh, 671s, 600sh, 447s.

Sir145 Papagoite $CaCu^{2+}AlSi_2O_6(OH)_3$

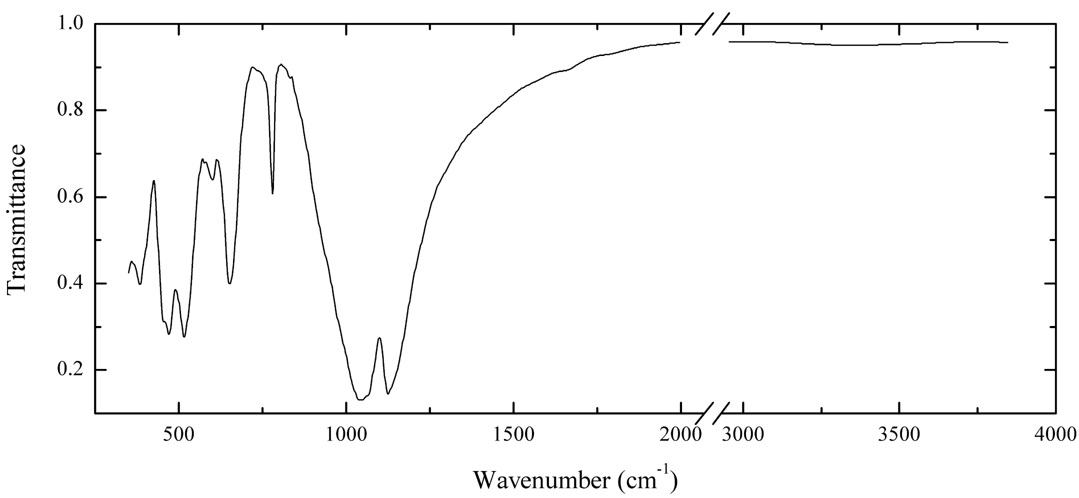


Locality: New Cornelia mine, Ajo, Pima Co., Arizona, USA (type locality).

Description: Blue crusts from the association with aurichalcite and barite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3570sh, 3545, 1088s, 1029s, 970sh, 961s, 845, 750, 719, 697, 641, 531, 510sh, 477, 445s, 405w.

Sir146 Sugilite $KNa_2(Fe^{2+},Mn^{2+},Al)_2Li_3(Si_{12}O_{30})$

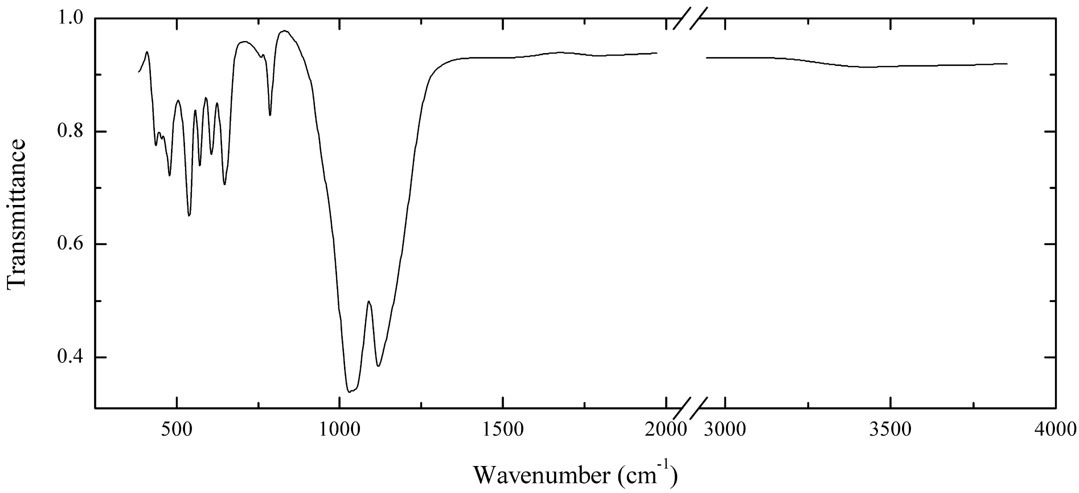


Locality: Wessels mine, Hotazel, Kalahari manganese fields, Northern Cape province, South Africa.

Description: Green grains from the association with strontianite, barite, aegirine, aegirine-augite, hibschite and pectolite. The empirical formula is (electron microprobe) $(K_{0.89}Na_{0.11})(Na_{1.94}Ca_{0.06})(Fe_{1.44}Al_{0.47}Na_{0.09})Li_x(Si_{12.00}O_{30})$.

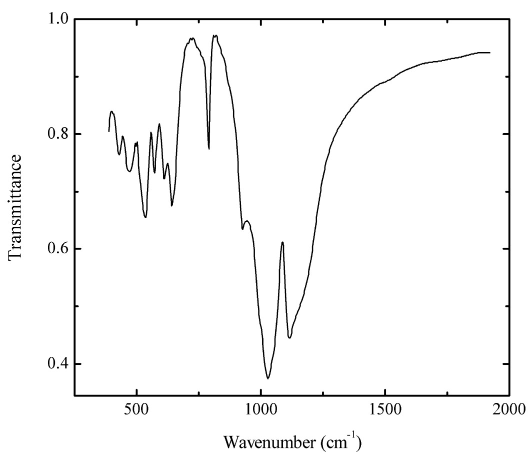
Wavenumbers (cm^{-1}): 1150sh, 1125s, 1043s, 779, 652, 600, 512s, 470s, 453, 400.

Sir147 Roedderite $KNa(Mg,Fe^{2+})_5(Si_{12}O_{30})$



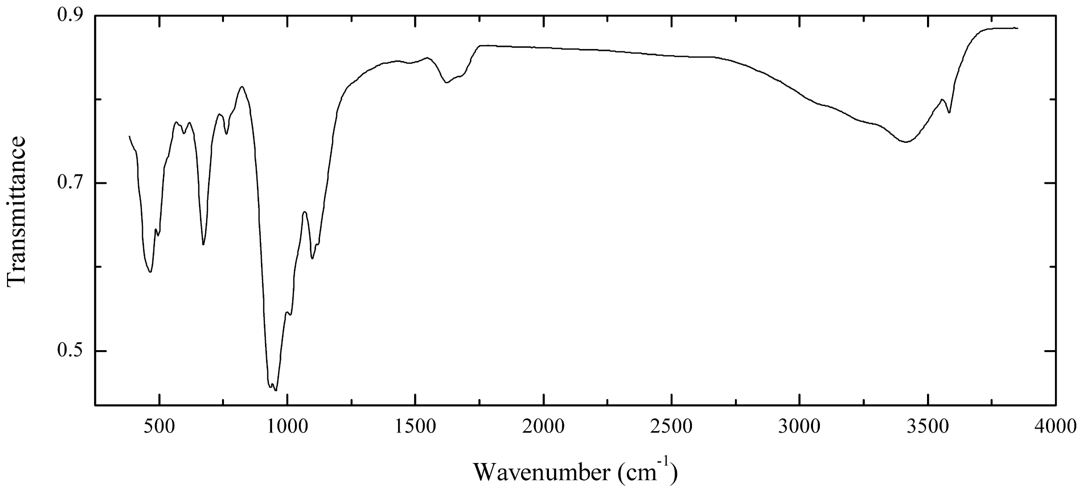
Locality: Emmelberg, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.
Description: Transparent pale brownish tabular hexagonal crystals from the association with strontianite, barite, aegirine, aegirine-augite, hibschite and pectolite. The empirical formula is (electron microprobe) $K_{0.9}Na_{1.4}(Mg_{4.7}Fe_{0.1})(Si_{12.0}O_{30})$.
Wavenumbers (cm^{-1}): 1140sh, 1117s, 1045sh, 1029s, 786, 757w, 644, 604, 568, 534, 476, 448, 431.

Sir148 Roedderite $KNa(Mg,Fe^{2+})_5(Si_{12}O_{30})$



Locality: Nagy Hill, Tarpa, Szabolcs-Szatmár Bereg Co., Hungary.
Description: Transparent brownish tabular hexagonal crystals from the association with osumilite and tridymite. Na-deficient and probably Li-bearing variety. The empirical formula is (electron microprobe) $K_{0.9}Na_{0.6}Li_x(Mg_{3.8}Fe_{0.9}Mn_{0.2}Al_{0.1})(Si_{12.0}O_{30})$.
Wavenumbers (cm^{-1}): 1155sh, 1117s, 1033s, 1005sh, 930, 788, 643, 612, 570, 533, 479, 431.

Sir149 Tsepinite-Na $(Na,K,Ca,Ba,Sr)_2(Ti,Nb)_2(Si_4O_{12})(OH,O)_2{\cdot}3H_2O$

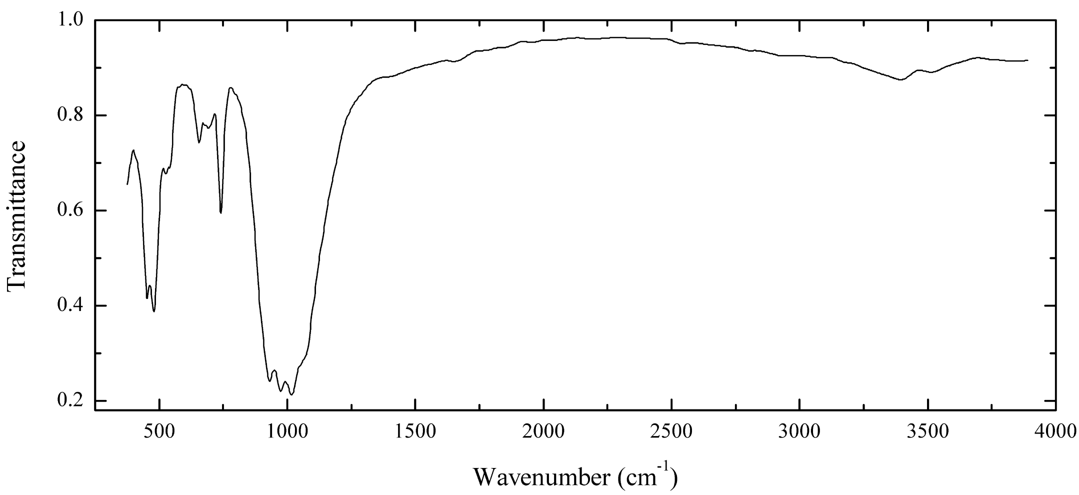


Locality: Khibinpakhkchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: White crystals from the association with microcline, aegirine, analcime, natrolite, catapleiite, apophyllite, labuntsovite-Mn, epididymite, fluorite and sphalerite. The empirical formula is (electron microprobe) $H_{34.83}(Na_{1.1}K_{0.2}Sr_{0.2}Ba_{0.1})(Ti_{4.9}Nb_{3.1})(Si_4O_{12})(OH,O)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3546, 3375, 3235sh, 3100sh, 1675sh, 1615w, 1120, 1096s, 1013s, 950s, 930s, 790sh, 763, 671, 597w, 530sh, 496, 469s, 450sh.

Sir150 Taseqite $Na_{12}Sr_3Ca_6Fe^{2+}{}_3Zr_3Nb(Si_{25}O_{73})(O,OH,H_2O)_3Cl_2$

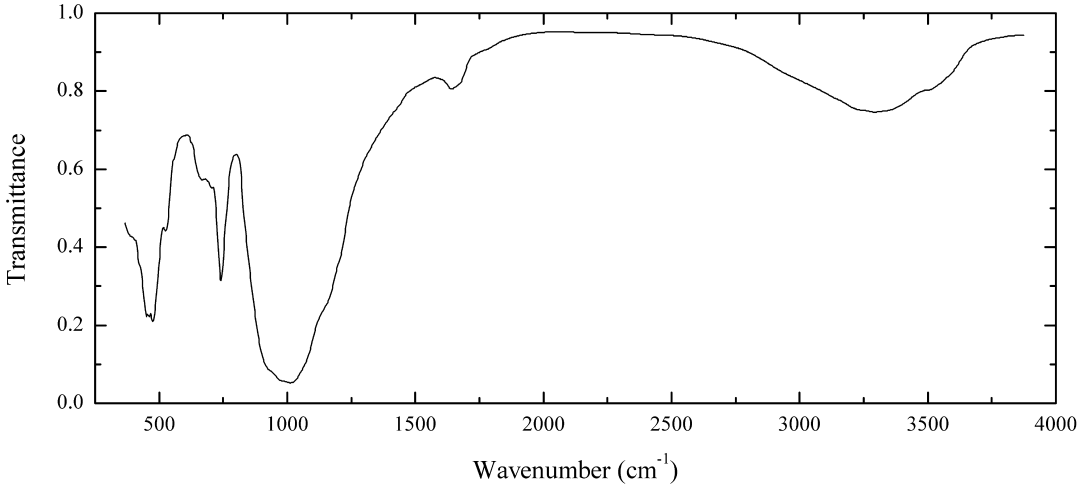


Locality: Odikhincha alkaline–ultrabasic massif, Maimecha and Kotui rivers basin, Krasnoyarskiy Kray, Eastern Siberia, Russia.

Description: Brown-red crystals from peralkaline pegmatite. The empirical formula is $Na_{12.35}(Sr_{1.6}Na_{0.6}K_{0.5}Ca_{0.2}Ba_{0.1})Ca_{6.0}(Fe_{2.15}Mn_{0.6})(Zr_{2.6}Ti_{0.4})Nb_{0.55}Si_{25.4}O_{73}Cl_{0.75}(O,OH,H_2O)_{4.25}$.

Wavenumbers (cm^{-1}): 3490w, 3365w, 1655w, 1410w, 1060sh, 1015s, 974s, 931s, 742, 693, 655, 541, 527, 480s, 453.

Sir151 Aqualite $(H_3O)_8Na_4Ca_6SrZr_3Si_{26}O_{66}(OH)_9Cl{\cdot}nH_2O$

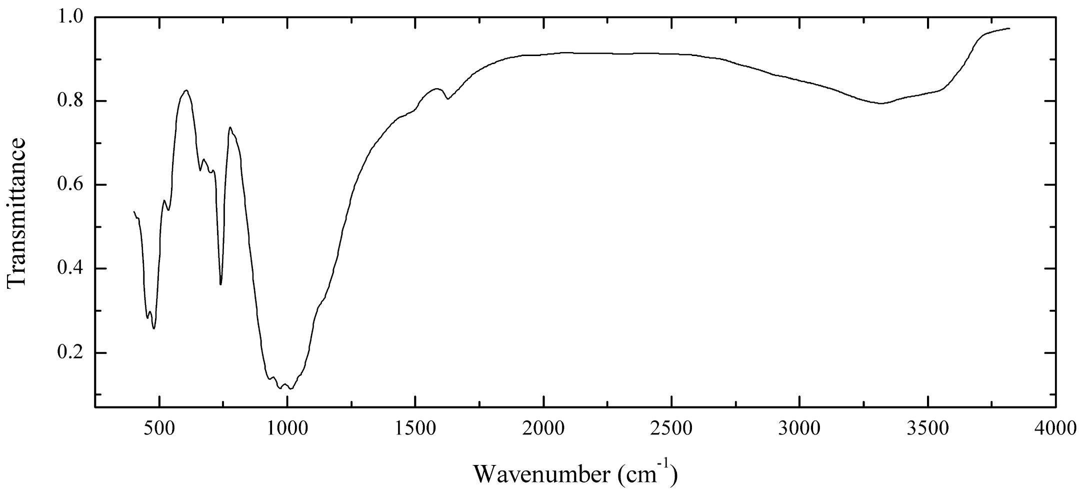


Locality: Selsurt (Flora) Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Brown grains from the association with albite, lamprophyllite, altered murmanite and fluorapatite. The empirical formula is (electron microprobe) $(H_3O)_xNa_{4.3}K_{0.4}Sr_{0.5}Fe_{0.7}(Ca_{4.5}Mn_{1.5})Zr_{3.1}Si_{25.7}Cl_{0.7}(OH,O,H_2O)_y$.

Wavenumbers (cm^{-1}): 3480sh, 3270, 1660sh, 1640, 1200sh, 1140sh, 1015s, 975sh, 930sh, 742, 700, 670, 525, 479s, 455, 400sh.

Sir152 Fengchengite $Na_{12}\square_3Ca_6Fe^{3+}{}_3Zr_3Si(Si_{25}O_{73})(H_2O,OH)_3(OH,Cl)_2$

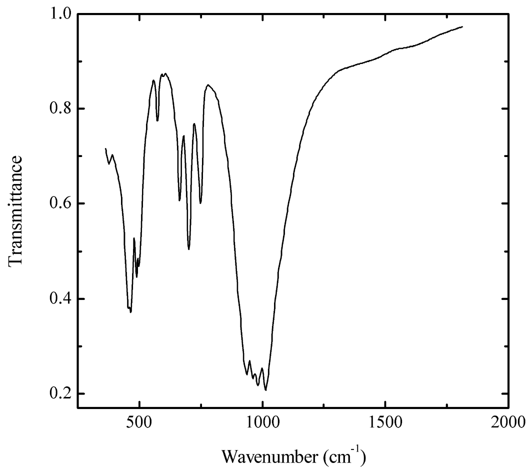


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Yellowish-brown grains from the association with cancrinite, orthoclase, aegirine-augite and pectolite. Identified by electron microprobe analysis and Mössbauer spectrum. The empirical formula is $(Na_{10.38}Ca_{1.16}K_{0.69}Ce_{0.02})Ca_6(Fe^{3+}{}_{1.37}Fe^{2+}{}_{0.34}Zr_{0.44}Al_{0.19}Mn_{0.17})(Zr_{2.70}Hf_{0.27}Ti_{0.03})Nb_{0.15}Si(Si_{25}O_{73})(SO_4)_{0.14}Cl_{0.57}(OH,H_2O,CO_3)_x$. The band at 529 cm^{-1} corresponds to Fe^{3+}–O stretching vibrations of the tetragonal pyramid $Fe^{3+}O_5$.

Wavenumbers (cm^{-1}): 3510sh, 3310w, 1630w, 1490w, 1140sh, 1060sh, 1016s, 971s, 933s, 740, 698, 657, 529, 477, 452.

Sir153 Margarosanite $Pb(Ca,Mn^{2+})_2(Si_3O_9)$

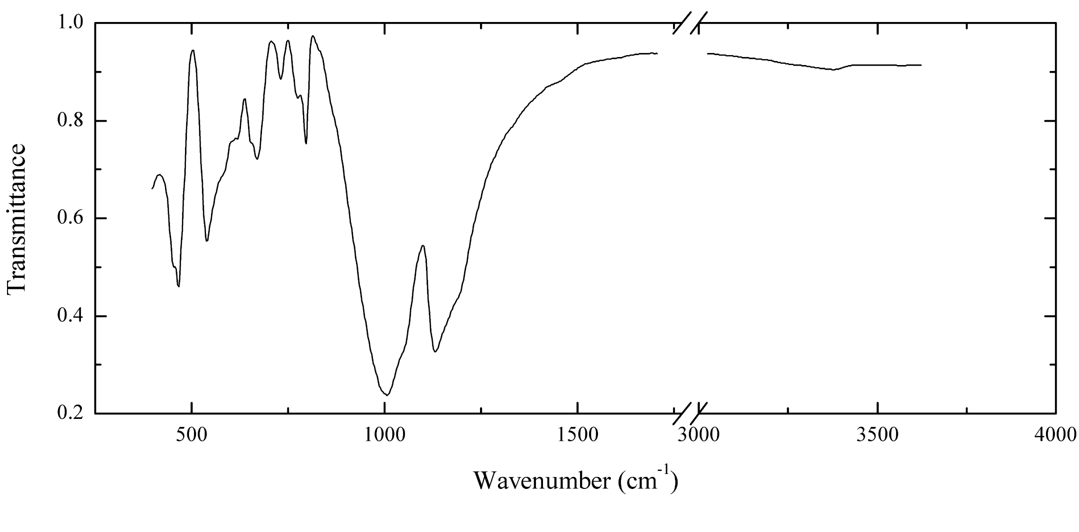


Locality: Jakobsberg mine, Nordmark (Nordmarksberg), Filipstad, Värmland, Sweden.

Description: White veinlet in skarn. Displays light blue fluorescence under UV radiation. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1014s, 982s, 962s, 938s, 749, 700, 663, 572, 505sh, 497, 487, 465sh, 461, 454, 381.

Sir154 Berezanskite $KLi_3Ti_2(Si_{12}O_{30})$

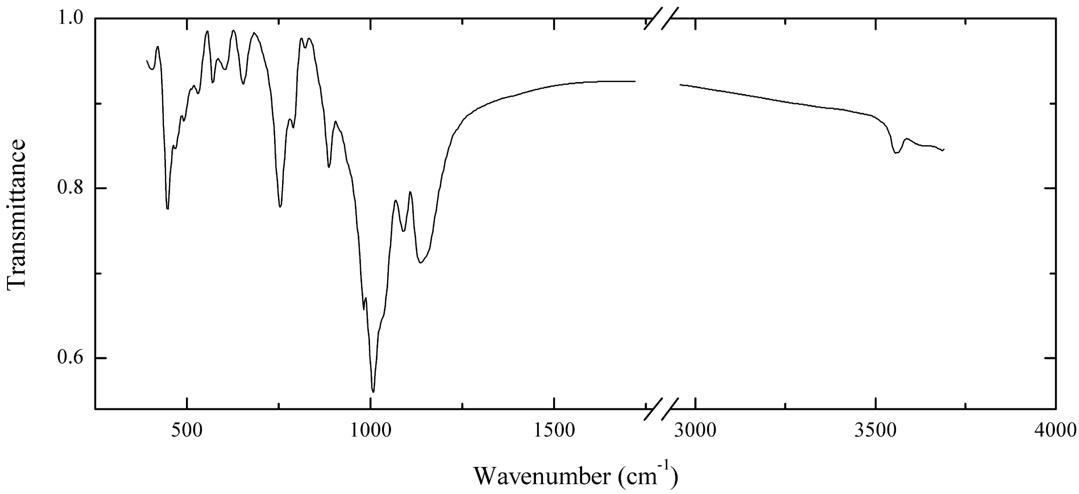


Locality: Moraine of the Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: White granular aggregate with bright bluish-white fluorescence under short-wave UV radiation from the association with pyrophanite, aegirine, microcline and tienshanite. Displays light blue fluorescence under UV radiation. Confirmed by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3350w, 1180sh, 1131s, 1050sh, 1002s, 990sh, 794, 773, 728, 668, 650, 618, 605, 575sh, 536, 466s, 454.

Sir155 Brannockite $KLi_3Sn_2(Si_{12}O_{30})$

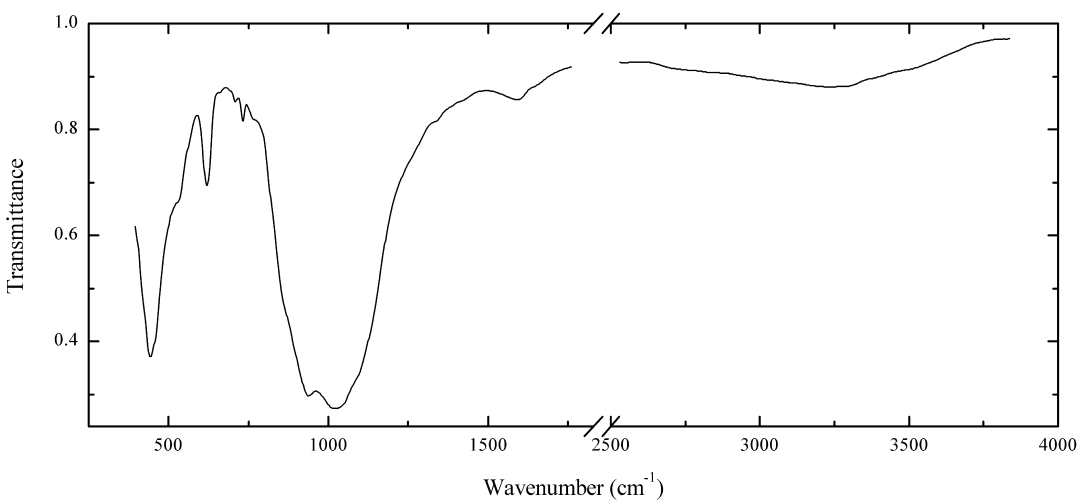


Locality: Foote Mine, Kings Mountain, Cleveland Co., North Carolina, USA (type locality).

Description: Aggregate of colourless platelets from the association with albite, quartz and titanite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $K_{0.93}Na_{0.03}Li_3(Sn_{1.94}Al_{0.04}Ti_{0.03})[Si_{12.00}(O,OH)_{30}]$.

Wavenumbers (cm^{-1}): 3535w, 1155sh, 1137s, 1088s, 1035sh, 1007s, 981s, 886, 820w, 788, 755s, 652, 600, 570, 530, 490, 469, 444s, 405w.

Sir156 Imandrite $Na_{12-x}Ca_3(Fe^{3+},Ti)_2(Si_6O_{18})_2$

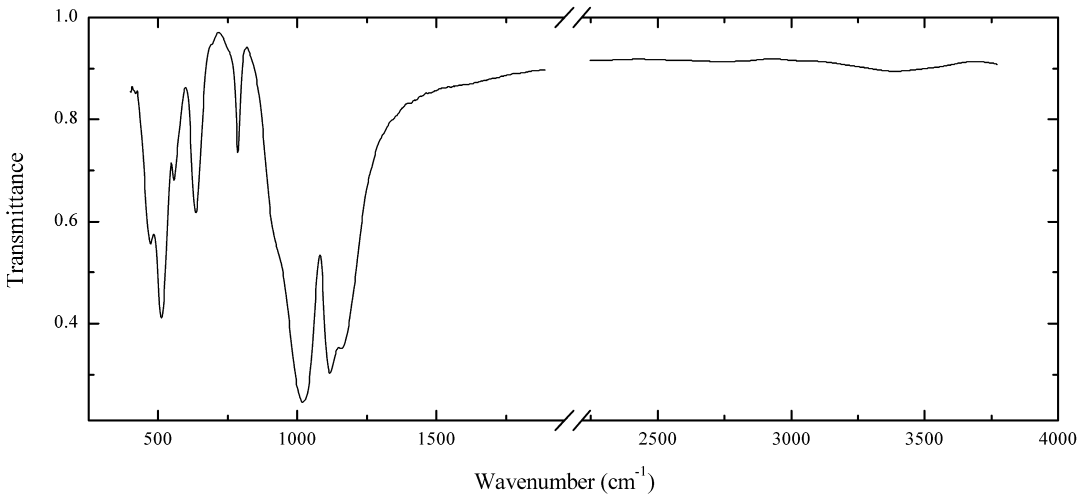


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Olive green transparent grains from peralkaline pegmatite, from the association with nepheline, sodalite, aegirine, alkaline amphibole, lamprophyllite, lomonosovite, villiaumite, phosinaite-(Ce), rasvumite and djerfisherite. Ca-deficient variety. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $Na_{5.74}K_{0.01}Ca_{0.40}Mn_{0.22}Mg_{0.04}(Fe_{0.50}Ti_{0.43})[Si_{6.00}(O,OH)_{18}]\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3460sh, 3250, 1595w, 1085sh, 1030s, 939s, 735w, 712w, 621, 530sh, 441s.

Sir157 Dusmatovite $K(K,Na,\square)(Mn^{2+},Y,Zr)_2(Zn,Li)_3(Si_{12}O_{30})$

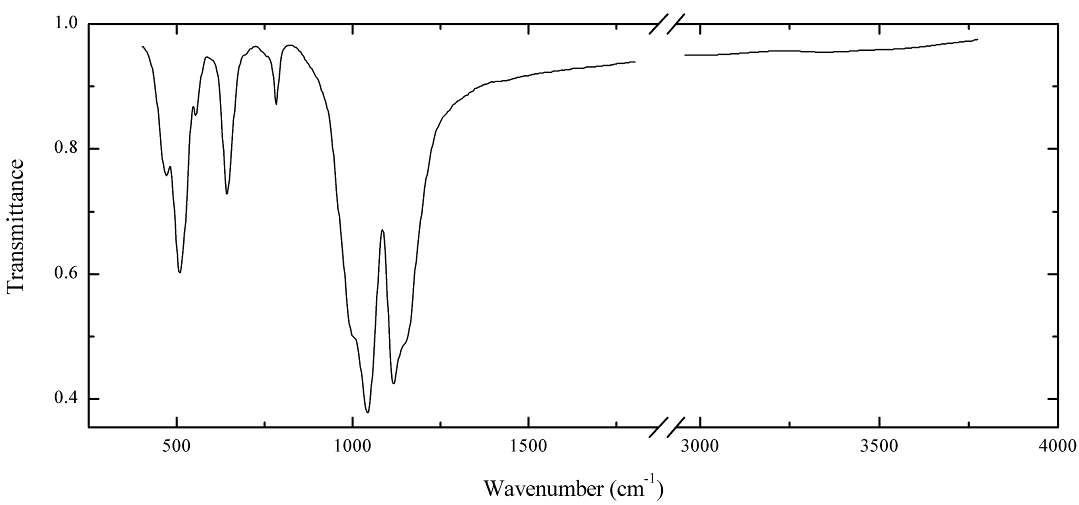


Locality: Moraine of the Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Dark blue grains from alkaline pegmatite, from the association with quartz, microcline, aegirine, tadzhikite-(Y), kupletskite-(Cs), hyalotekite, betafite and polylithionite. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $K_{1.6}Na_{0.5}Mn_{1.5}Y_{0.1}Zr_{0.1}Fe_{0.1}Zn_{1.9}Li_x(Si_{12.0}O_{30})$.

Wavenumbers (cm^{-1}): 1160s, 1116s, 1021s, 930sh, 788, 740sh, 690sh, 634, 555, 509s, 471, 410sh.

Sir158 Dusmatovite $K(K,Na,\square)(Mn^{2+},Y,Zr)_2(Zn,Li)_3(Si_{12}O_{30})$

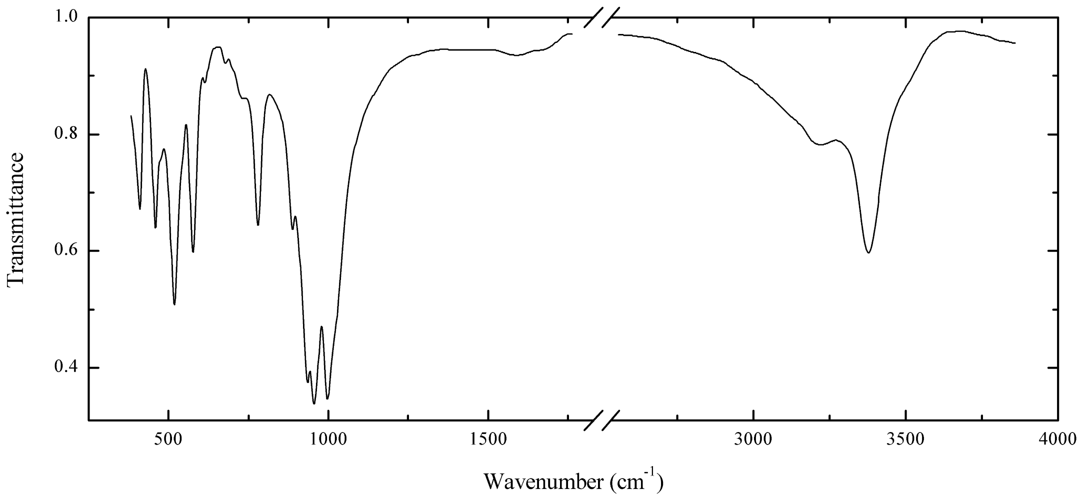


Locality: Moraine of the Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Pink grain from alkaline pegmatite. Na-rich variety. The empirical formula is (electron microprobe) $K_{1.72}Na_{1.08}Mn_{1.79}Zn_{1.75}Fe_{0.32}Mg_{0.05}Zr_{0.02}Li_x(Si_{12.00}O_{30})$.

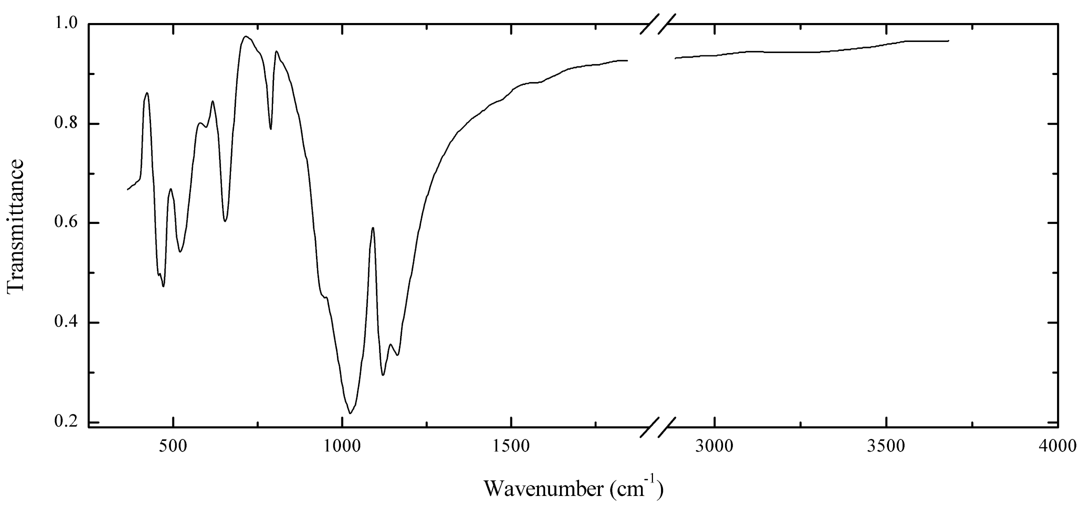
Wavenumbers (cm^{-1}): 1150sh, 1115s, 1041s, 1001s, 782, 642, 555, 508s, 470.

Sir159 Dioptase $Cu_6(Si_6O_{18}) \cdot 6H_2O$



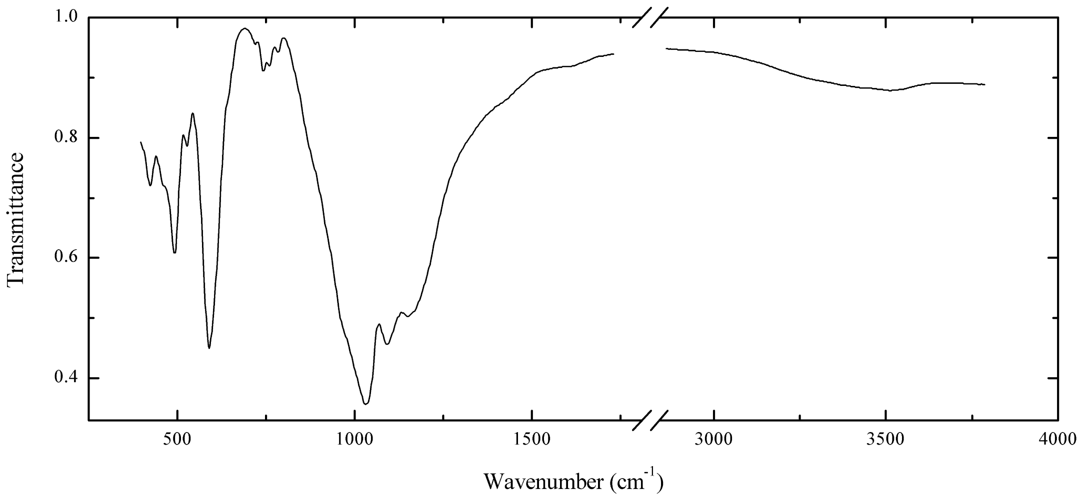
Locality: Altyn-Tyube deposit, Karagandy region, Kazakhstan (type locality).
Description: Bluish-green crystals from the association with calcite, quartz and chrysocolla. Na-rich variety. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3363, 3217, 1665sh, 1595w, 1020sh, 998s, 956s, 935s, 887, 779, 732w, 677w, 610w, 573, 516s, 475sh, 455, 410.

Sir160 Sugilite $KNa_2(Fe^{2+},Mn^{2+},Al)_2Li_3(Si_{12}O_{30})$



Locality: Moraine of the Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Pink rim around single-crystal grain of sogdianite. Na-deficient variety. The empirical formula is (electron microprobe) $K_{1.0}Na_{1.3}(Fe_{0.9}Zr_{0.5}Ti_{0.5}Al_{0.2})Li_3(Si_{12.0}O_{30})$.
Wavenumbers (cm^{-1}): 1165s, 1123s, 1025s, 945sh, 787, 652, 597, 519, 467s, 453, 390.

Sir161 Turkestanite $Th(Ca,Na)_2K_{1-x}(Si_8O_{20})\cdot nH_2O$

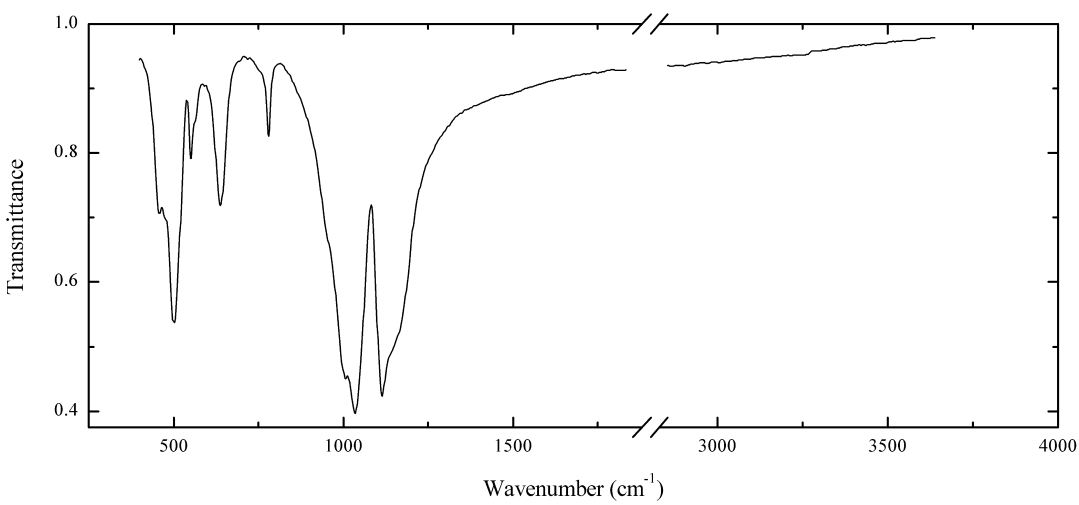


Locality: Khodzha-Achkan township, near Gumush river, Alai ridge, Kyrgyzstan.

Description: Red prismatic crystals. The empirical formula is (electron microprobe) $Th_{1.15}Ca_{1.3}Na_{0.7}K_{0.45}Pb_{0.1}(Si_{7.5}Fe_{0.3}Al_{0.2}O_{20})\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3500w, 1160s, 1094s, 1034s, 970sh, 788w, 762w, 746w, 724w, 647w, 590s, 527, 497, 465sh, 425.

Sir162 Shibkovite $K(Ca,Mn,Na)_2K_{2-x}Zn_3(Si_{12}O_{30})$

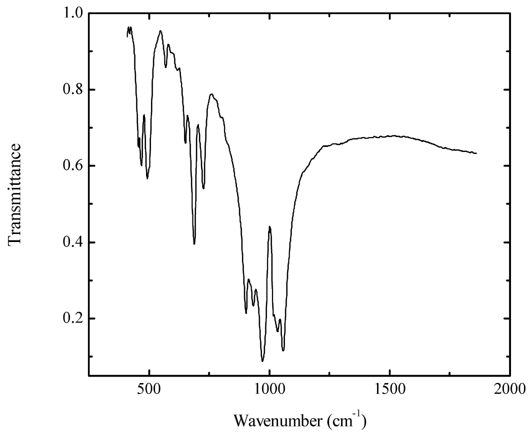


Locality: Moraine of the Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: White grains from the association with quartz, microcline, albite, aegirine, polylithionite, reedmergnerite, sogdianite, pyrochlore and eudialyte-group minerals. Holotype sample. Hexagonal, space group $P6/mcc$, $a = 10.505(1)$. $c = 14.185(3)$, $Z = 2$. Optically uniaxial (+), $\omega = 1.561(2)$, $\varepsilon = 1.563(2)$. $D_{meas} = 2.89$ g/cm^3, $D_{calc} = 2.90$ g/cm^3.

Wavenumbers (cm^{-1}): 1180sh, 1155sh, 1113s, 1033s, 1004s, 950sh, 779, 750sh, 638, 560sh, 550, 499s, 475sh, 460.

Sir163 Walstromite $BaCa(Si_3O_9)$

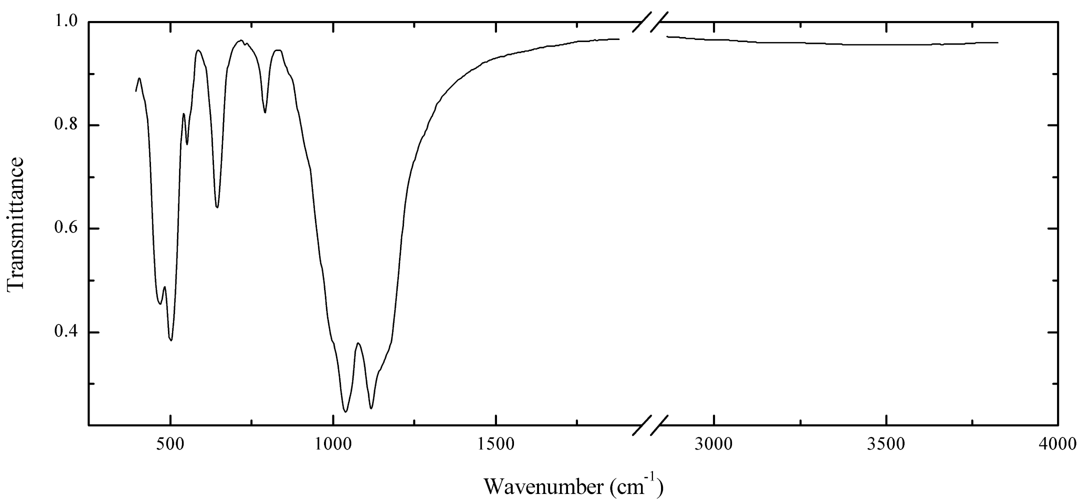


Locality: Big Creek, Fresno Co., California, USA (type locality).

Description: White granular aggregate from the association with sanbornite. Displays orange fluorescence under UV radiation. The empirical formula is (electron microprobe) $Ba_{1.02}Ca_{1.94}Mg_{0.02}Si_{3.01}O_9$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1059s, 1038s, 1020s, 974s, 935s, 908s, 730, 690, 657, 610w, 572, 505sh, 495, 470, 457.

Sir164 Dusmatovite $K(K,Na,\square)(Mn^{2+},Y,Zr)_2(Zn,Li)_3(Si_{12}O_{30})$

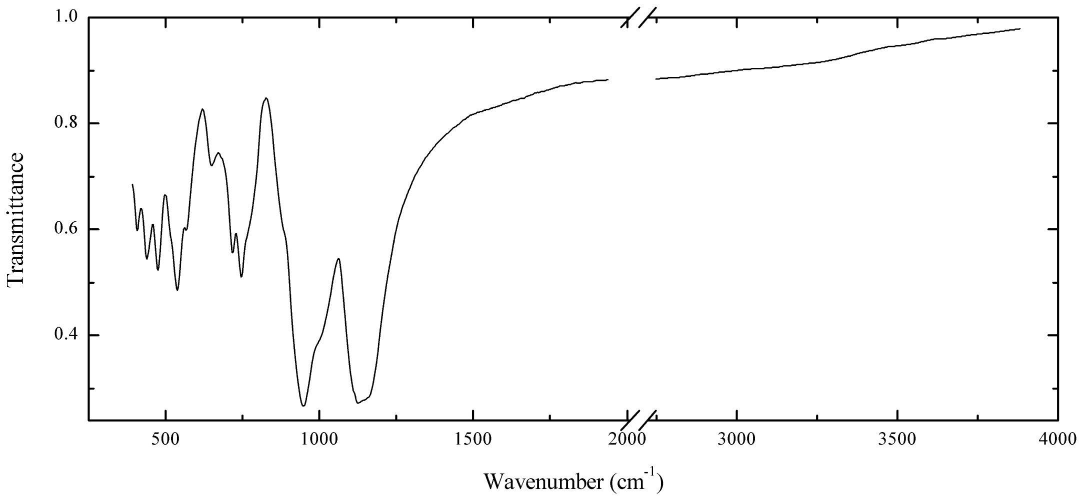


Locality: Moraine of the Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Grey grains from granular aggregate of reedmergnerite. Investigated by D.I. Belakovskiy. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1160sh, 1145sh, 1112s, 1036s, 1000sh, 865sh, 780, 641, 560sh, 549, 500s, 468.

Sir165 Osumilite-(Mg) $KMg_2Al_3(Al_2Si_{10}O_{30})$

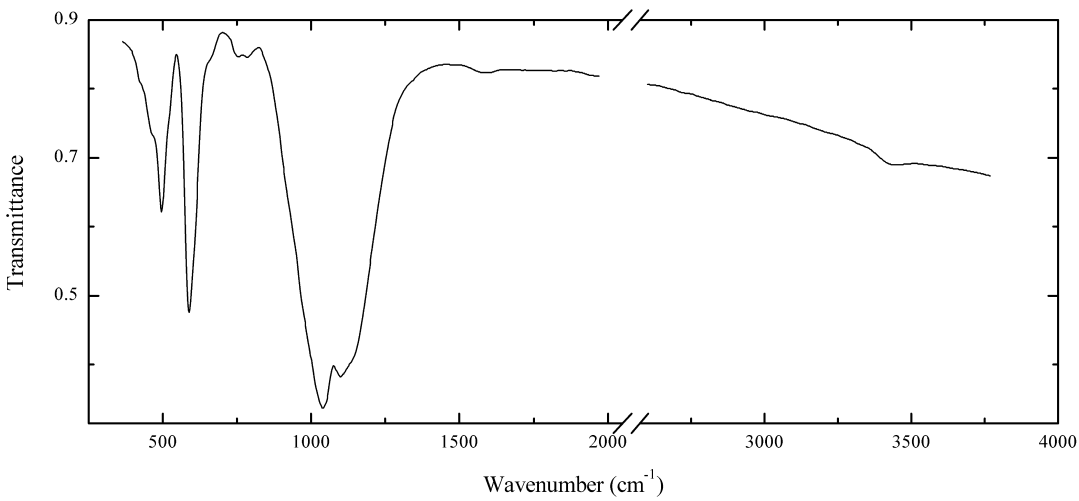


Locality: Vikesdal, Vikeså, Bjerkreim, Rogaland, Norway.

Description: Grey (with violet tint) granular aggregate. The empirical formula is (electron microprobe) $K_{0.8}Na_{0.1}(Mg_{1.7}Fe_{0.3})(Al_{2.5}Fe_{0.5})(Si_{10.2}Al_{1.8})O_{30}$.

Wavenumbers (cm^{-1}): 1160sh, 1132s, 1000sh, 950s, 885sh, 765sh, 744, 714, 650, 560, 540, 515sh, 472, 438, 400.

Sir166 Turkestanite $Th(Ca,Na)_2K_{1-x}(Si_8O_{20})\cdot nH_2O$

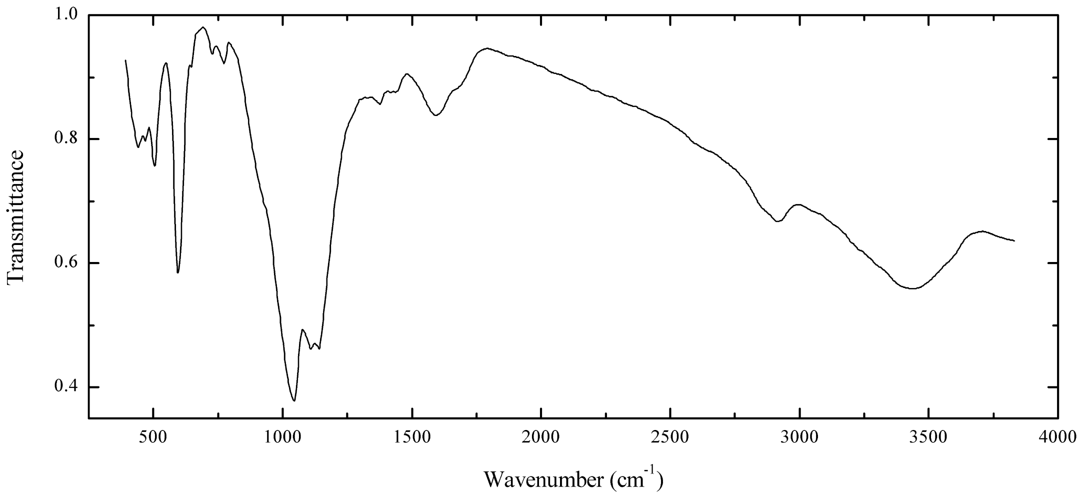


Locality: Moraine of the Dara-i Pioz glacier, Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Green crystals from the association with fluorite, quartz and pectolite. The empirical formula is (electron microprobe) $Th_{0.99}U_{0.07}Ca_{1.22}Na_{0.87}K_{0.93}Si_{7.88}O_{20.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3410w, 1600w, 1140sh, 1097s, 1038s, 970sh, 780w, 760w, 670sh, 605sh, 588s, 520sh, 496, 460sh, 425sh.

Sir167 Steacyite $Th(Na,Ca)_2K_{1-x}(Si_8O_{20})\cdot nH_2O$

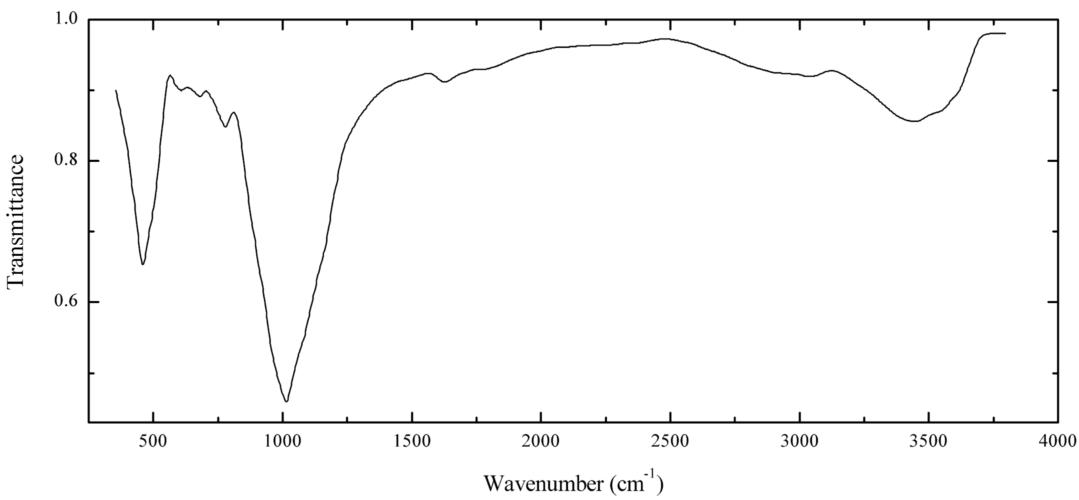


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown grains with inclusions of bitumen from the association with pyatenkoite-(Y). The empirical formula is (electron microprobe) $Th_{1.1}Na_{1.2}Ca_{0.9}K_{0.8}Fe_{0.1}Si_{7.9}O_{20.0}\cdot nH_2O$. The bands at 1,375, 1,430, 1,597, 2,875 and 2,932 cm^{-1} correspond to inclusions of bituminous substance.

Wavenumbers (cm^{-1}): 3450, 2932, 2875w, 1665sh, 1597, 1430w, 1375w, 1134s, 1116s, 1043s, 1020sh, 925sh, 771w, 730w, 641w, 591s, 497, 450, 430, 410sh.

Sir168 Turkestanite $Th(Ca,Na)_2K_{1-x}(Si_8O_{20})\cdot nH_2O$

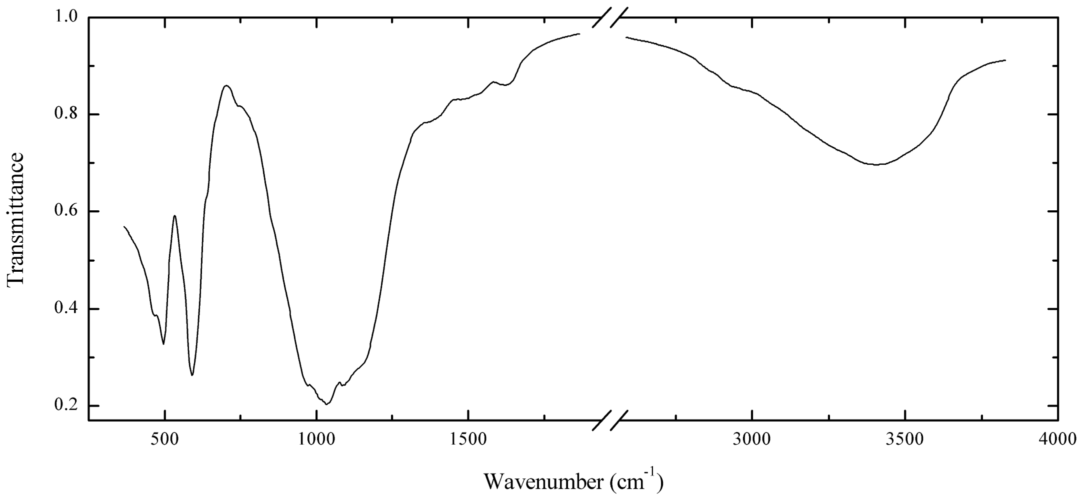


Locality: Malyi Murun (Malomurunskiy) alkaline pluton, Irkutsk region, Eastern Siberia, Russia.

Description: Yellow twin from charoitite, from the association with charoite, quartz, aegirine and tinaksite. Metamict, amorphous. K-rich variety. The empirical formula is (electron microprobe) $Th_{0.9}Ca_{1.5}K_{1.4}Na_{0.4}Si_{7.9}O_{20}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3450, 3050w, 2900sh, 1800w, 1640w, 1140sh, 1070sh, 1016s, 975sh, 780, 693w, 600w, 500sh, 460s.

Sir169 Turkestanite $Th(Ca,Na)_2K_{1-x}(Si_8O_{20})\cdot nH_2O$

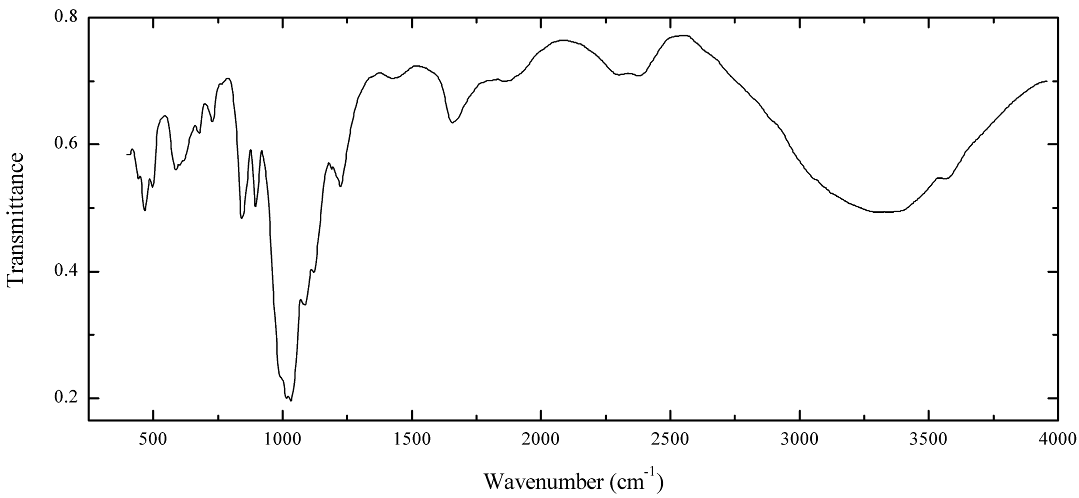


Locality: Narssârssuk (Narsarsuk) pegmatite, Igaliku, Narsaq, Kitaa (West Greenland) province, Greenland.

Description: Grains from alkaline pegmatite. The empirical formula is (electron microprobe) $Th_{1.15}(Ca_{1.14}Na_{0.67}Mn_{0.20})K_{0.70}Si_{7.84}O_{20}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3570sh, 3430, 1635w, 1510w, 1370sh, 1150sh, 1094s, 1040s, 1015sh, 976s, 750sh, 640sh, 589s, 520sh, 493s, 469.

Sir170 Megacyclite $Na_8K[Si_9O_{18}(OH)_9]\cdot 19H_2O$



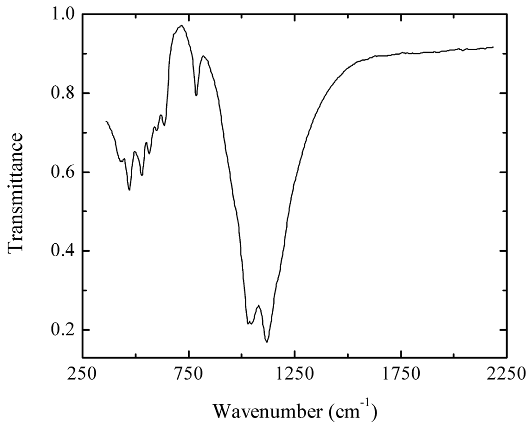
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: White aggregate of platy crystals from peralkaline pegmatite, from the association with microcline, aegirine, sodalite, lamprophyllite, lomonosovite, shcherbakovite, villiaumite, delhayelite, phosinaite-(Ce), clinophosinaite, natisite, lovozerite, tisinalite, nacaphite, rasvumite and revdite. The empirical formula is $K_{0.99}Na_{8.11}Si_9O_{18.10}(OH)_{8.90}\cdot 18.75H_2O$. The crystal structure is solved.

Monoclinic, space group $P2_1/c$, a = 24.8219(16), b = 11.9236(8), c = 14.8765(9) Å, β = 94.486 (5)°. The crystal-chemical formula is (Z = 2) $K_2Na_{16}Si_{18}O_{34}(OH)_{18}[O_{0.75}(OH)_{0.25}]_2$ $(H_2O)_{36}$ $[(H_2O)_{0.75}$ $(OH)_{0.25}]_2$. The strongest lines of the powder X-ray diffraction pattern are [d, Å (I, %) (hkl)] 5.957 (35) (020), 4.275 (40) (511), 3.464 (36) (114), 3.089 (100) (124), 2.976 (40) (040).

Wavenumbers (cm^{-1}): 3560, 3330, 2380, 2290, 1850, 1710sh, 1680sh, 1654, 1437w, 1225, 1122s, 1086s, 1045sh, 1031s, 1015s, 990sh, 892, 855sh, 841, 725, 673, 615sh, 587, 498, 468, 441.

Sir172 Chayesite $KMg_2(Mg,Fe^{2+},Fe^{3+})_3(Si_{12}O_{30})$

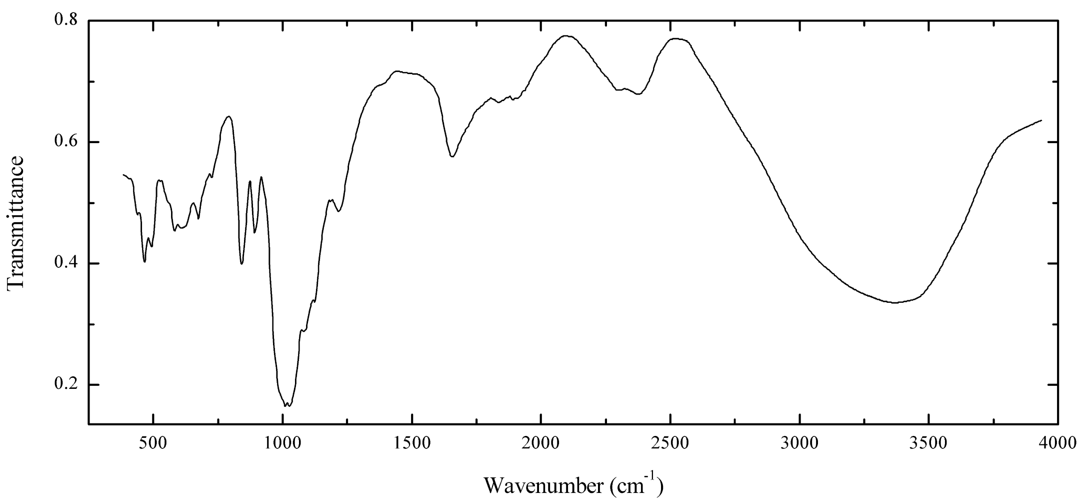


Locality: Pauliberg Mt., Kobersdorf, Oberpullendorf, Burgenland, Austria.

Description: Brown tabular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1115s, 1052s, 1026s, 789, 639, 603, 571, 535, 478, 430.

Sir173 Megacyclite $Na_8K[Si_9O_{18}(OH)_9]\cdot19H_2O$

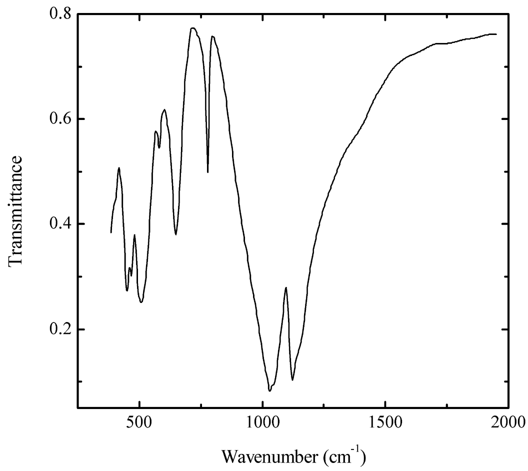


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: White aggregate of lamellar crystals. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540sh, 3320s, 3200sh, 3030sh, 2375, 2290, 1890, 1835, 1705sh, 1656, 1223, 1122s, 1085s, 1030s, 1012s, 990sh, 892, 842, 727, 673, 612, 585, 497, 468, 440.

Sir175 Sugilite $KNa_2(Fe^{2+},Mn^{2+},Al)_2Li_3(Si_{12}O_{30})$

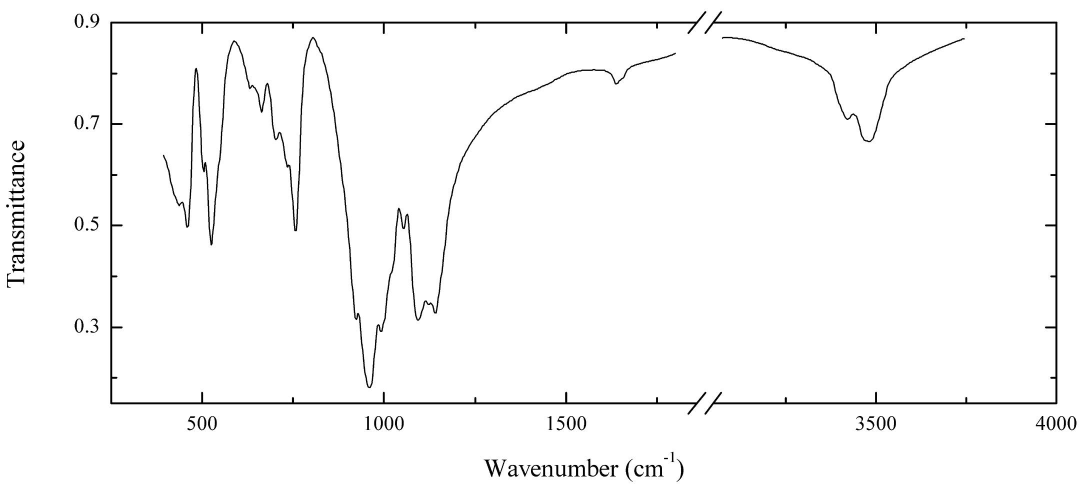


Locality: Mpumalanga province, South Africa.

Description: Purple granular aggregate. The empirical formula is (electron microprobe) $K_{1.08}Na_{2.10}(Fe_{1.65}Al_{0.22}Mn_{0.05})Li_x(Si_{12.00}O_{30})$.

Wavenumbers (cm^{-1}): 1160sh, 1123s, 1040sh, 1033s, 778, 647, 580, 507s, 467, 447, 400sh.

Sir176 Armenite $BaCa_2Al_6Si_9O_{30}\cdot 2H_2O$

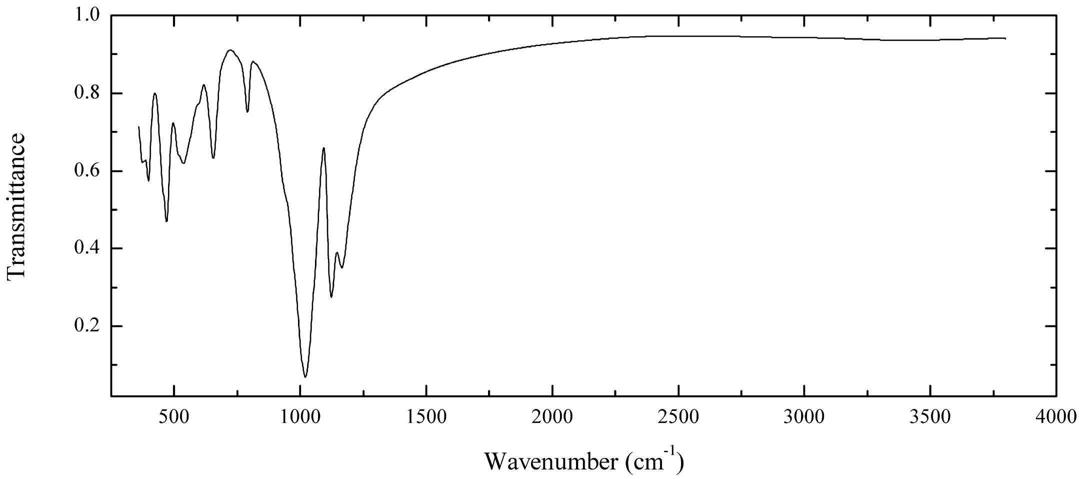


Locality: Berisal Complex, Simplon Region, Switzerland**.**

Description: White prismatic crystals on quartz. Investigated by P.M. Kartashov.

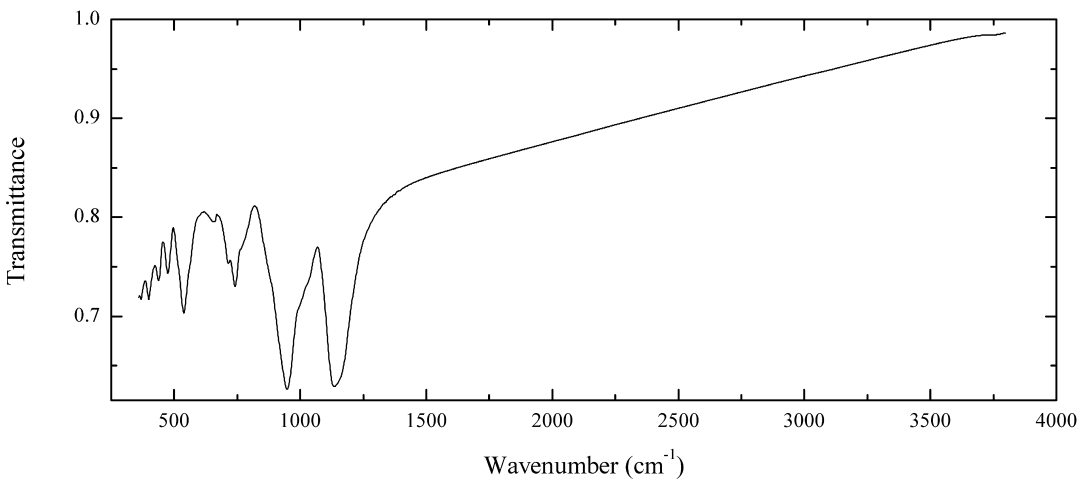
Wavenumbers (cm^{-1}): 3453, 3394, 1635w, 1143s, 1123, 1095s, 1056, 1020sh, 990s, 959s, 921s, 756, 733, 703, 665, 632w, 524, 502, 457, 437.

Sir177 Sogdianite $KNa(Zr, Fe^{3+},Ti,Al)Li_3(Si_{12}O_{30})$



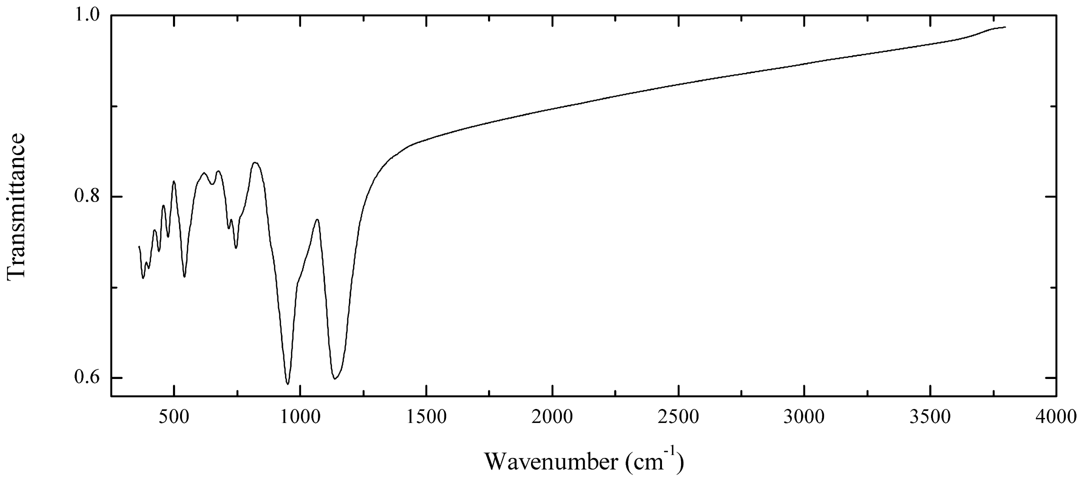
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Pink coarse platy crystals from the association with quartz, microcline, polylithionite and pyrochlore. The empirical formula is (electron microprobe) $K_{0.95}Na_{0.67}Ca_{0.02}(Zr_{1.06}Fe_{0.54}Ti_{0.31}Al_{0.12})Li_x(Si_{12.00}O_{30})$.
Wavenumbers (cm^{-1}): 1165s, 1124s, 1020s, 950sh, 791, 655, 600sh, 536, 520sh, 470, 399, 379.

Sir178 Osumilite $KFe^{2+}{}_2Al_3(Al_2Si_{10}O_{30})$



Locality: Sakkabira, Kyushu, Japan (type locality).
Description: Dark green tabular crystal. The empirical formula is (electron microprobe) $(K_{0.7}Na_{0.3})(Fe_{1.1}Mg_{0.8}Mn_{0.1})(Al_{2.5}Fe_{0.3})(Al_{1.7}Si_{10.3})O_{30}$.
Wavenumbers (cm^{-1}): 1135s, 1030sh, 1000sh, 948s, 770sh, 742, 717, 652w, 538, 474, 438, 440, 467.

Sir179 Osumilite-(Mg) $KMg_2Al_3(Al_2Si_{10})O_{30}$

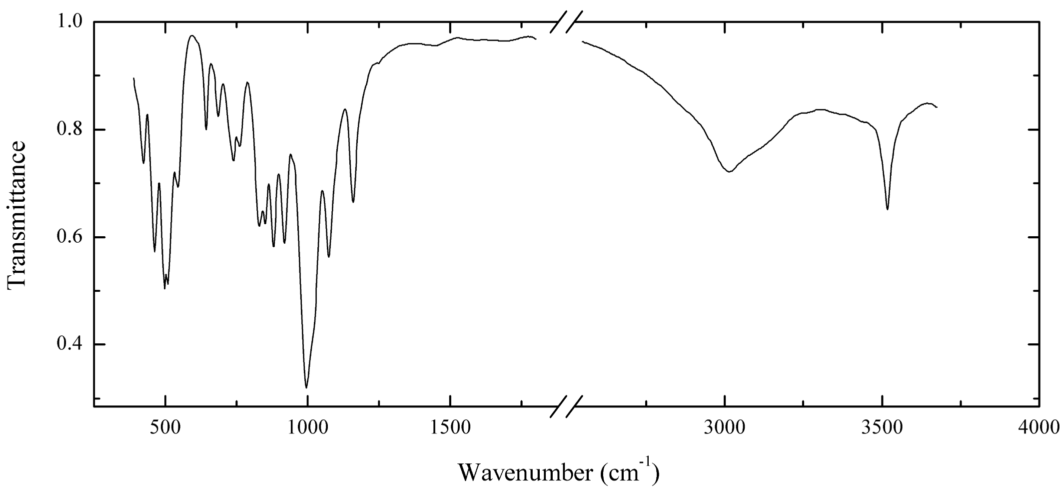


Locality: Bellerberg, Eifel volcanic area, Germany (neotype locality).

Description: Light blue short prismatic hexagonal crystals from the association with fluorophlogopite, sanidine, cordierite, mullite, sillimanite, topaz, pseudobrookite and hematite. The empirical formula is $(K_{0.72}Na_{0.03}Ca_{0.01})(Mg_{1.97}Mn_{0.04})[Al_{4.21}Fe^{3+}_{0.45}Si_{10.32}]O_{30}$. The crystal structure is solved. Hexagonal, space group $P6/mcc$; $a = 10.0959(1)$, $c = 14.3282(2)$ Å, $V = 1264.79(6)$ Å^3, $Z = 2$. Optically uniaxial (+), $\omega = 1.539(2)$, $\varepsilon = 1.547(2)$. $D_{meas} = 2.59(1)$ g/cm^3, $D_{calc} = 2.592$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern are [d, Å (I, %) (hkl)] 7.21 (37) (002), 5.064 (85) (110), 4.137 (45) (112), 3.736 (43) (202), 3.234 (100) (211), 2.932 (42) (114), 2.767 (51) (204).

Wavenumbers (cm^{-1}): 1138s, 1100sh, 950sh, 770sh, 745, 717, 652w, 541, 475, 440, 401, 378.

Sit1 Kinoite $Ca_2Cu_2Si_3O_8(OH)_4$

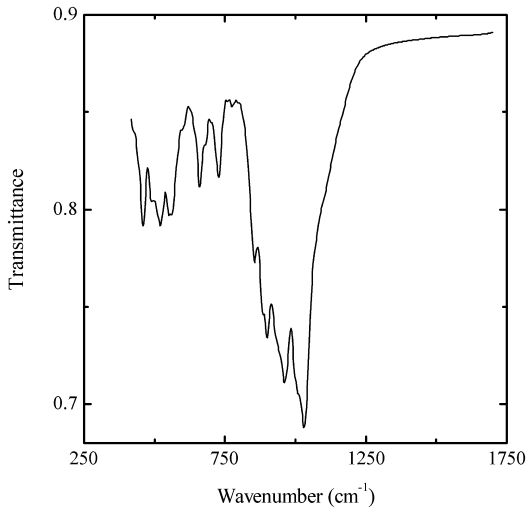


Locality: Christmas copper mine, Gila Co., Arizona, USA

Description: Blue crystals. The empirical formula is (electron microprobe) $Ca_{2.01}(Cu_{1.98}Zn_{0.02}Mg_{0.02})Si_{2.94}Al_{0.01}Fe_{0.01}O_8(OH)_4$.

Wavenumbers (cm^{-1}): 3523, 3013, 1164, 1078, 1020sh, 999s, 922, 882, 855, 833, 765, 740, 690, 646, 544, 508s, 498s, 462, 424.

Sit2 Fluorthalénite-(Y) $Y_3(Si_3O_{10})F$

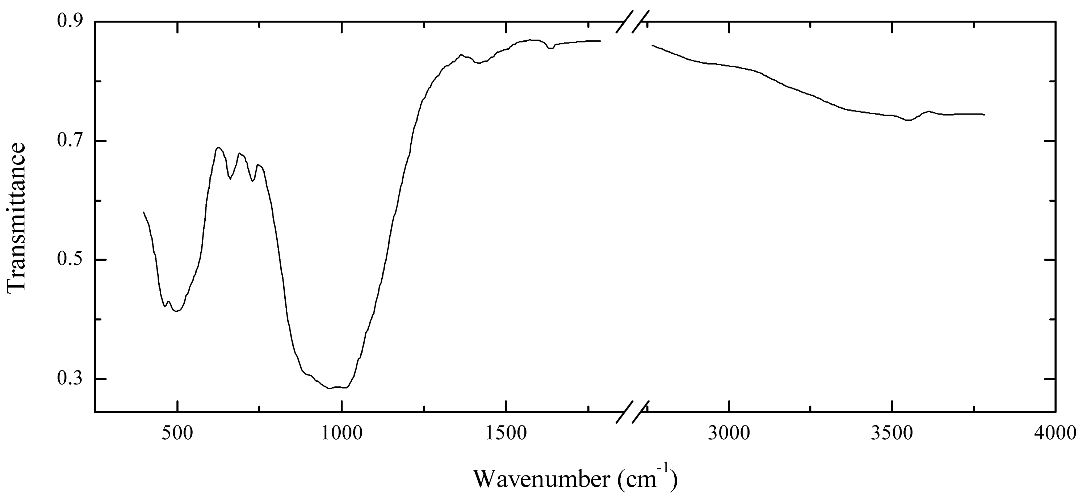


Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: White crusts from the association with amazonite, zinnwaldite, quartz and Y-rich fluorite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1165sh, 1120sh, 1032s, 1005sh, 963s, 945sh, 899, 883, 853, 727, 678, 657, 562, 550, 520, 495sh, 462.

Sit3 Thalénite-(Y) $Y_3(Si_3O_{10})(OH)$

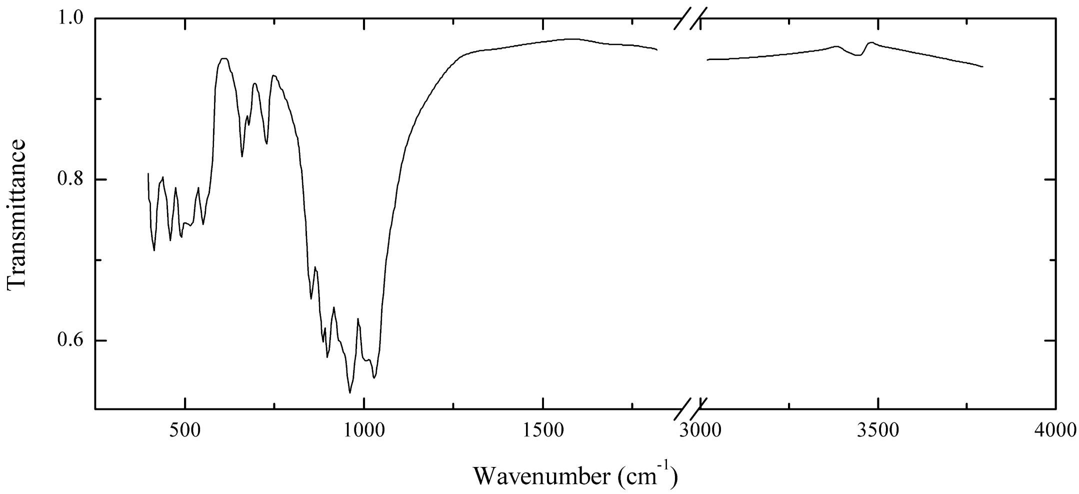


Locality: Hundholmen, Tysfjord, Norway.

Description: Yellow transparent grains. Investigated by I.V. Pekov.

Wavenumbers (cm^{-1}): 3510w, 3400sh, 2950sh, 1640w, 1422w, 1010s, 967s, 890sh, 727, 659, 535sh, 503, 462.

Sit4 Fluorthalénite-(Y) $Y_3(Si_3O_{10})F$

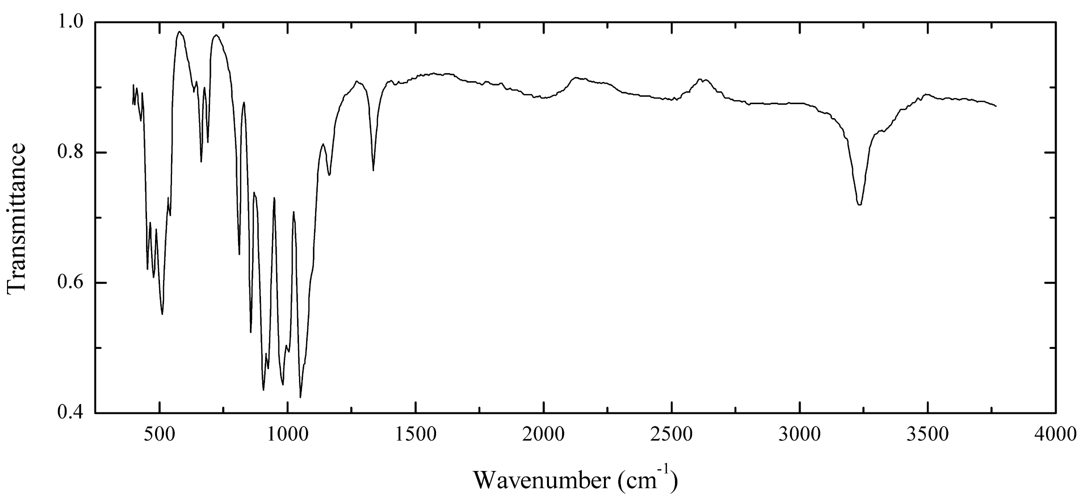


Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: Cream-coloured crystals from the association with amazonite, zinnwaldite, quartz, albite, bastnaesite-(Ce) and Y-rich fluorite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $(Y_{2.36}Dy_{0.20}Yb_{0.16}Er_{0.13}Gd_{0.04}Lu_{0.03}Eu_{0.03}Th_{0.03}Ca_{0.05})Si_{3.00}O_{10}[F_{0.78}(OH)_{0.22}]$.

Wavenumbers (cm^{-1}): 3427w, 1029s, 1002s, 961s, 930sh, 899s, 885, 853, 731, 681, 662, 570sh, 553, 518, 490, 460, 408, 400sh.

Sit5 Rosenhahnite $Ca_3[Si_3O_8(OH)_2]$

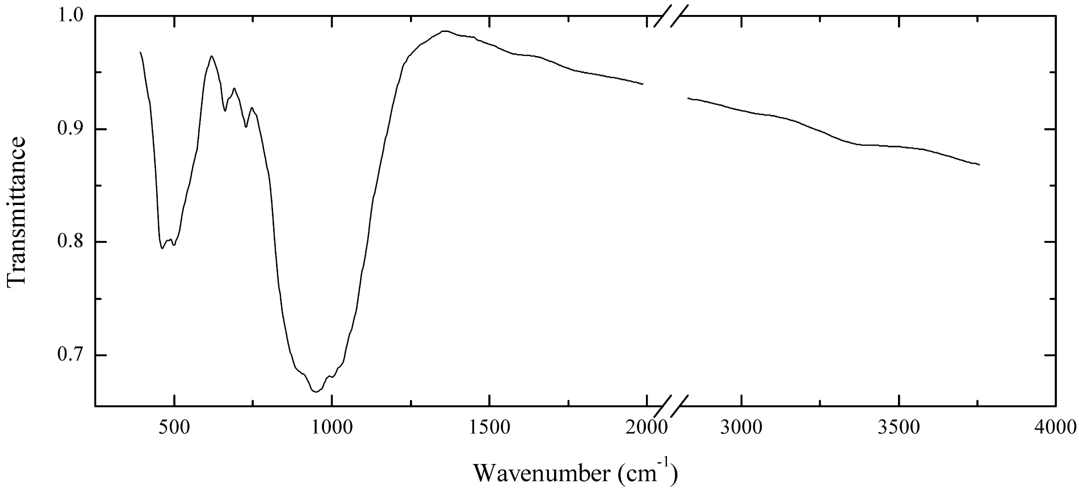


Locality: Russian river, Mendocino Co., California, USA (type locality).

Description: White platy crystals from the association with pectolite, xonotlite and datolite. Investigated by A.E. Zadov. Identified by IR spectrum, powder X-ray diffraction pattern and optical data.

Wavenumbers (cm^{-1}): 3300sh, 3205, 2950w, 2460w, 2330sh, 1990w, 1332, 1161, 1090sh, 1065sh, 1046s, 1001s, 976s, 921s, 904s, 855, 807, 686, 660, 634w, 537, 507, 495sh, 475, 453, 424w, 398w.

Sit6 Fluorthalénite-(Y) $Y_3(Si_3O_{10})F$

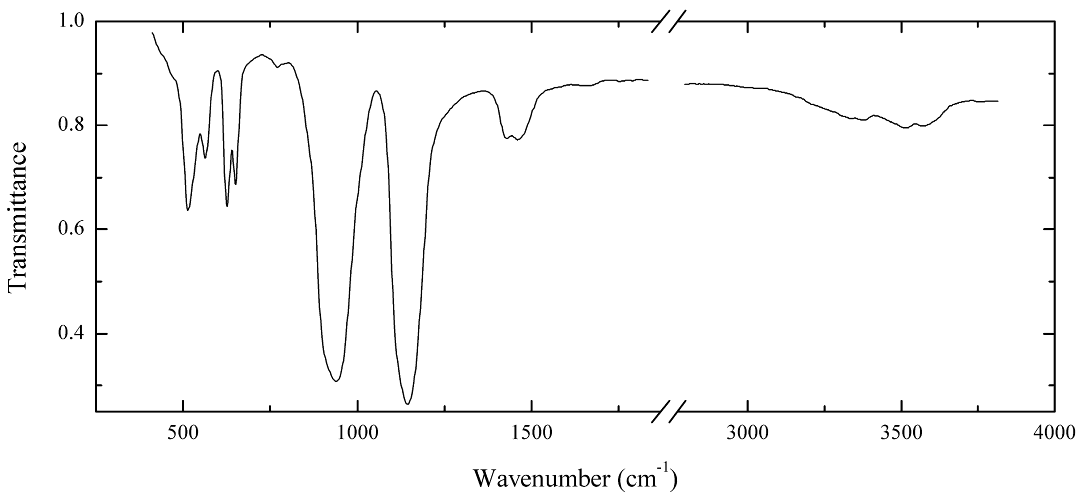


Locality: Hundholmen, Tysfjord, Norway.

Description: Pink transparent grains. Investigated by A.V. Voloshin.

Wavenumbers (cm^{-1}): 3320w, 1085sh, 1025sh, 1000sh, 963s, 900sh, 729, 675sh, 661, 545sh, 503, 461.

SSi1 Ellestadite-(OH) (Hydroxylellestadite) $Ca_{10}[(SiO_4)_3(SO_4)_3](OH)_2$

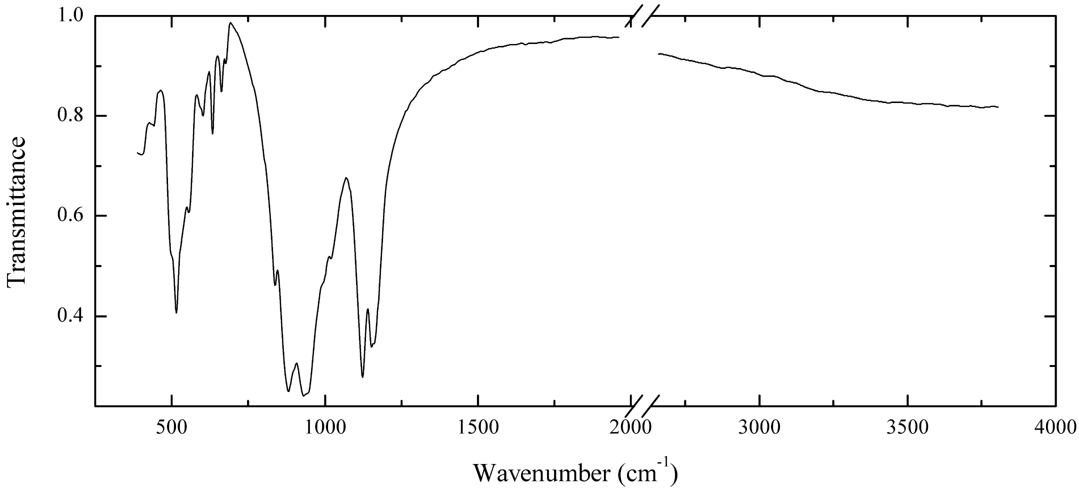


Locality: Arimao-Norte, Cienfuegos province, Cuba.

Description: Light violet granular aggregate from the association with calcite, wollastonite, grossular, vesuvianite, diopside, xonotlite, prehnite, zeolites and pyrite. The crystal structure is solved. Monoclinic, pseudohexagonal, $a = 9.526$, $b = 9.506$, $c = 6.922$ Å, $\gamma \approx 119.99°$. The empirical formula is $Ca_{9.99}Na_{0.01}[(SiO_4)_{2.955}(SO_4)_{2.955}(CO_3)_{0.09}][(OH,O)_{1.68}Cl_{0.31}F_{0.03}]$. Optically uniaxial (−), $\omega = 1.651(2)$, $\varepsilon = 1.647(2)$. $D_{calc} = 3.05$ g/cm^3, $D_{meas} = 3.02(2)$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 3.458 (90) (002), 2.842 (100) (211), 2.792 (90) (112), 2.746 (90) (300), 2.651 (80) (202), 2.284 (80) (130), 1.963 (90) (222).

Wavenumbers (cm^{-1}): 3565w, 3505w, 3375w, 3330sh, 1459, 1422, 1145s, 938s, 920sh, 770w, 641, 617, 555, 505, 480sh.

SSi2 Ternesite $Ca_5(SiO_4)_2(SO_4)$

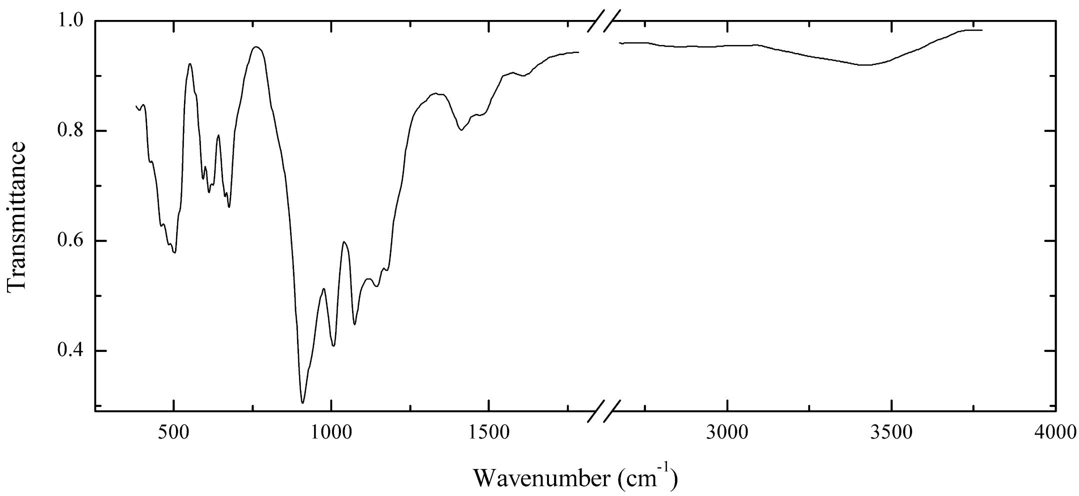


Locality: Burned dump of the shaft No. 45, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: White veinlets from the association with anhydrite and ellestadite-(F). Investigated by B.V. Chesnokov (described under the name "rukavishnikovite"). Orthorhombic, $a = 10.16(1)$, $b = 15.38(1)$, $c = 6.80(1)$ Å, $Z = 4$. Optically biaxial (−), $\alpha = 1.634$, $\beta = 1.638$, $\gamma = 1.639$. $D_{calc} = 2.972$ g/cm^3. The empirical formula is $Ca_{5.00}(SiO_4)_{1.97}(SO_4)_{0.96}Cl_{0.04}O_{0.08}$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 3.178 (65) (141), 2.834 (100) (202), 2.828 (96) (330), 2.730 (44) (132), 2.663 (42) (222), 2.600 (50) (331), 2.565 (45) (060).

Wavenumbers (cm^{-1}): 1162s, 1153s, 1124s, 1021, 992, 945s, 927s, 881s, 837, 677, 661, 631, 613w, 603, 595w, 556, 515s, 499, 435, 400.

SSi3 Tuscanite $(K,Sr,H_2O)_2(Ca,Na)_6[(Si,Al)_{10}O_{22}][SO_4,CO_3,(OH)_4]$

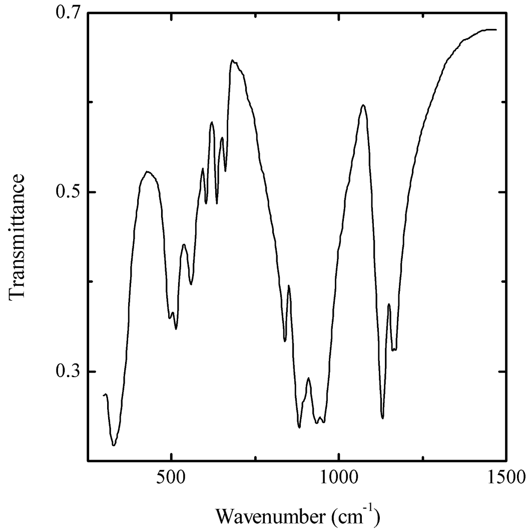


Locality: Razzano Mt., Sacrofano Caldera, Sacrofano municipality, Rome Province, Latium, Italy.

Description: Elongated platy crystals. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3405, 1600w, 1475sh, 1410, 1210sh, 1177, 1146, 1006s, 940sh, 908s, 720sh, 675, 660, 626, 612, 591, 565w, 520sh, 501, 498, 458, 426, 410w.

SSi4 Ternesite $Ca_5(SiO_4)_2(SO_4)$

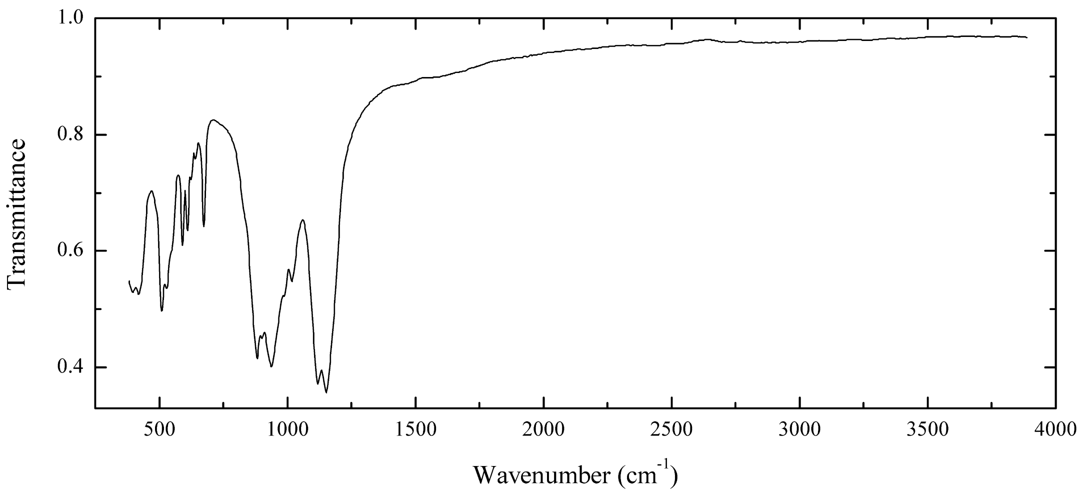


Locality: Ettringer Bellerberg, near Kottenheim, 2 km north of Mayen, Laacher See region, Eastern Eifel area, Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Blue grains from the calcium-rich xenolith in leucite tephrite lava. Associated minerals are calcio-olivine, brearleyite and ellestadite-(F). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1165s, 1124s, 955s, 930s, 880s, 836, 660, 632, 600, 550, 516, 485, 332.

SSi5 Ternesite $Ca_5(SiO_4)_2(SO_4)$

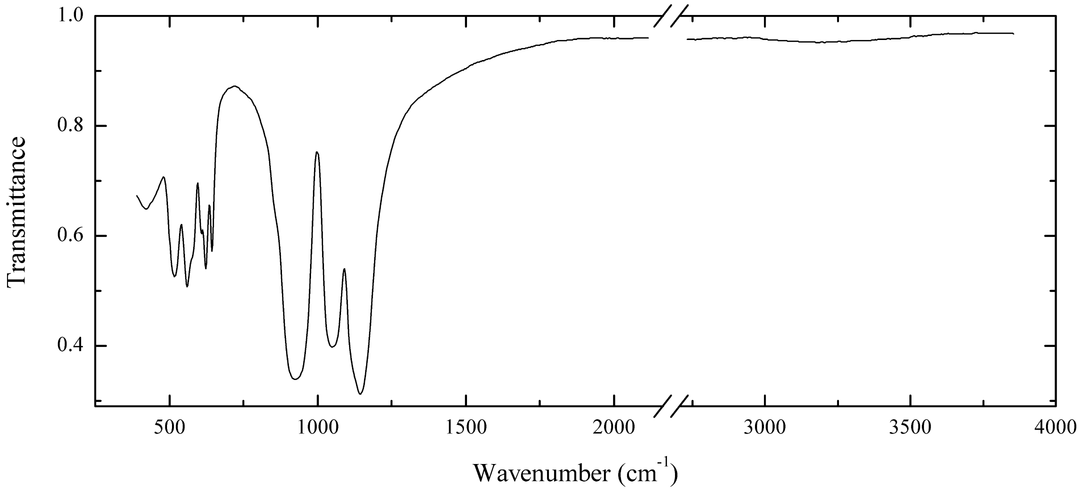


Locality: Burned dump of the shaft No. 45, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Bluish grains from the association with anhydrite and ellestadite-(F). Investigated by B.V. Chesnokov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1159s, 1124s, 1024, 995, 941s, 904, 886s, 840sh, 675, 659w, 639w, 610, 591, 550sh, 528, 511, 420, 406.

SSi6 Ellestadite-(F) (Fluorellestadite) $Ca_{10}[(SiO_4)_3(SO_4)_3]F_2$

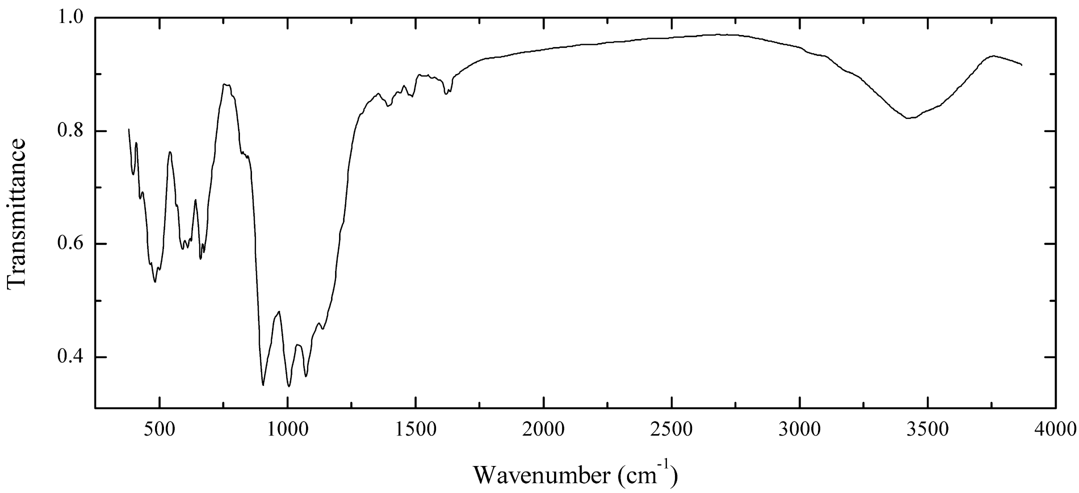


Locality: Burned dump of the shaft No. 44, Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Bright blue granular aggregate from the association with periclase, lime, formicaite, srebrodolskite, spurrite and anhydrite. Investigated by B.V. Chesnokov. Hexagonal, $a = 9.485(2)$, $c = 6.916(2)$ Å. The empirical formula was given by B.V. Chesnokov as $Ca_{9.97}Mg_{0.03}[(SO_4)_{2.84}(SiO_4)_{2.79}(PO_4)_{0.20}(CO_3)_{0.17}]F_{2.08}$. However, the admixture of carbon in analyzed sample was due to the presence of associated formicaite. Optically uniaxial (−), $\omega = 1.638(2)$, $\varepsilon = 1.632(2)$. $D_{calc} = 3.090$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 2.84 (100) (211), 2.80 (60) (112), 2.74 (60) (300), 2.28 (60) (310), 1.954 (70) (222), 1.852 (80) (213), 1.766 (60) (401), 1.729 (70) (004).

Wavenumbers (cm^{-1}): 1150s, 1130sh, 1052s, 926s, 641, 618, 602, 575sh, 555, 514, 431.

SSi7 Tuscanite $(K,Sr,H_2O)_2(Ca,Na)_6[(Si,Al)_{10}O_{22}][SO_4,CO_3,(OH)_4]$

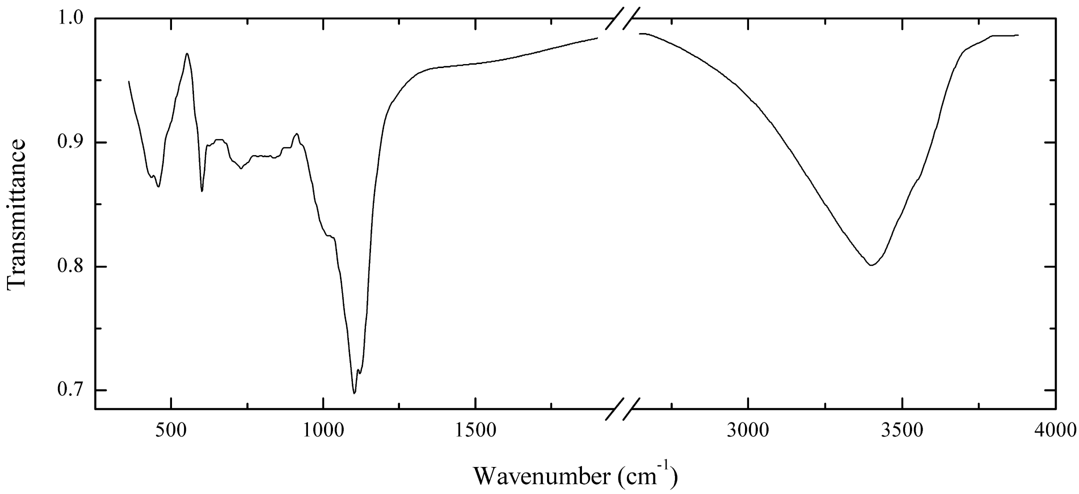


Locality: Biachella valley, Sacrofano Caldera, Sacrofano municipality, Rome Province, Latium, Italy.

Description: Elongated platy crystals. Confirmed by IR spectrum. A hydrated variety.

Wavenumbers (cm^{-1}): 3435, 1630w, 1486w, 1402w, 1210sh, 1160sh, 1138s, 1074s, 1006s, 906s, 835sh, 675, 663, 624, 610, 590, 564, 501, 493, 460, 426, 397.

SSi8 Bechererite $Zn_7Cu[(S,Si)(O,OH)_4]_2(OH)_{13}$

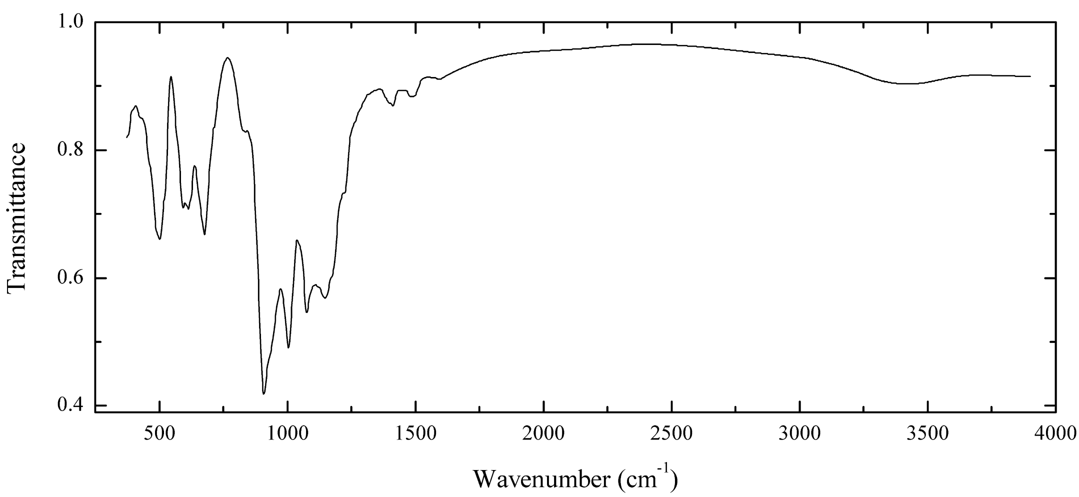


Locality: South mine, Broken Hill, New South Wales, Australia.

Description: Blue crust. Probably contaminated by other minerals. The empirical formula is (electron microprobe) $(Zn_{4.5}Cu_{1.6}Fe_{0.4}Ca_{0.1})(Cu_{0.8}Al_{0.2})(Si_{1.2}S_{1.0})(OH,O)_x$.

Wavenumbers (cm^{-1}): 3550sh, 3385, 1122s, 1103s, 1020sh, 840, 727, 603, 455, 430.

SSi9 Latiumite $K_2Ca_6Al[(Si,Al)_{10}O_{25}](SO_4,CO_3)$

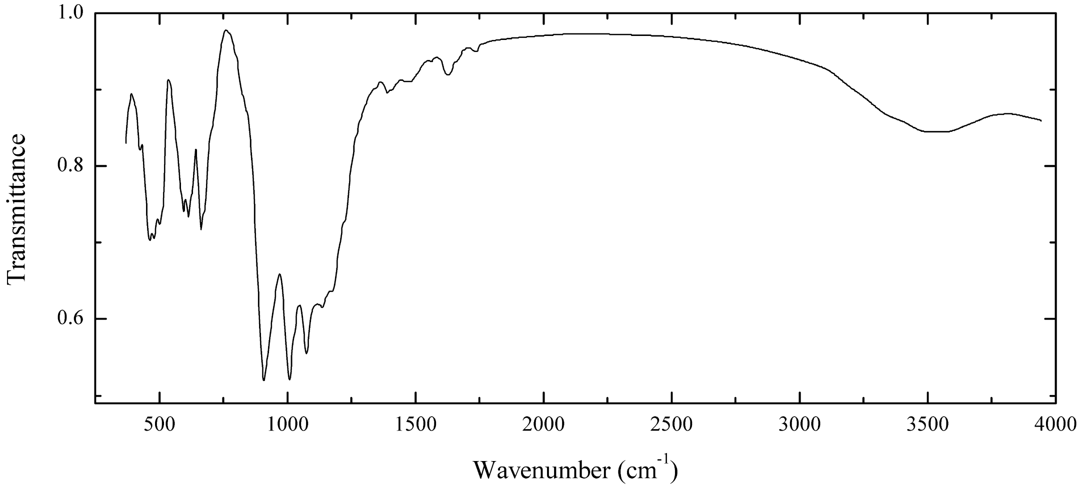


Locality: Biachella valley, Sacrofano Caldera, Sacrofano municipality, Rome Province, Latium, Italy.

Description: Elongated platy crystals from the association with sanidine, clinopyroxene, haüyne and andradite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3355w, 1600w, 1490w, 1413w, 1490w, 1222, 1160sh, 1147s, 1076s, 1005s, 920sh, 908s, 835sh, 678, 613, 593, 503, 430sh, 380.

SSi10 Tuscanite $(K,Sr,H_2O)_2(Ca,Na)_6[(Si,Al)_{10}O_{22}][SO_4,CO_3,(OH)_4]$

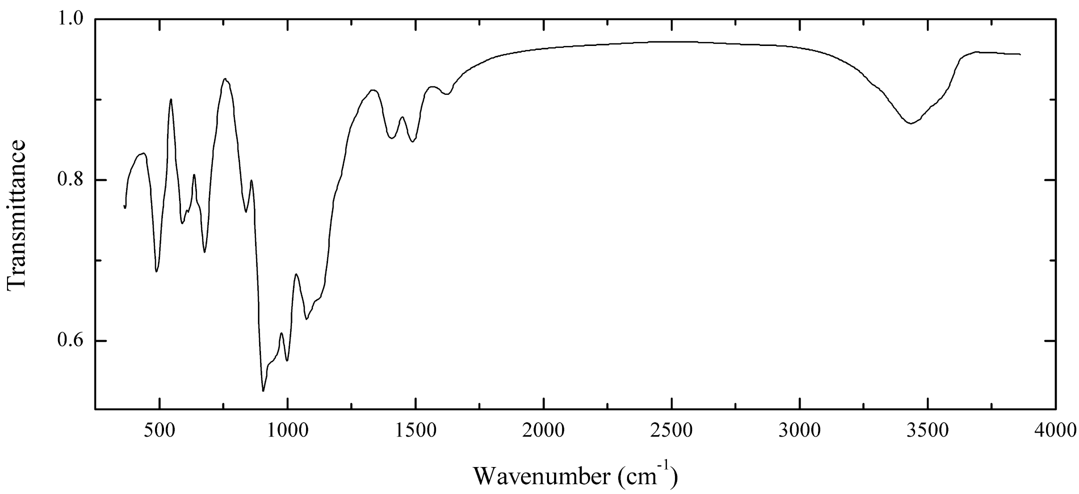


Locality: Razzano Mt., Campagnano, Rome Province, Latium, Italy.

Description: Colourless prismatic crystal from the association with sanidine, clinopyroxene, latiumite and andradite. Confirmed by IR spectrum. A hydrated variety.

Wavenumbers (cm^{-1}): 3500, 3360sh, 1738w, 1630w, 1485w, 1400w, 1220sh, 1175sh, 1135s, 1074s, 1007s, 908s, 710sh, 675sh, 664, 630sh, 613, 594, 585sh, 515sh, 502, 479, 460, 425.

SSi11 Latiumite $K_2Ca_6Al[(Si,Al)_{10}O_{25}](SO_4,CO_3)$

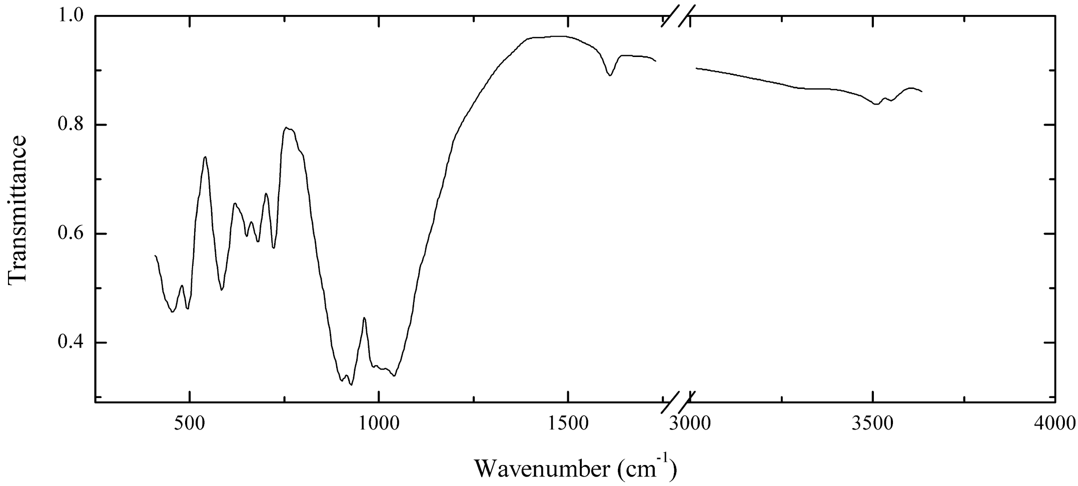


Locality: Albano, Alban Hills, Rome Province, Latium, Italy (type locality).

Description: Elongated platy crystals from the association with hedenbergite, grossular-andradite, melilite, leucite, kaliophilite and haüyne. Confirmed by IR spectrum. A hydrated variety.

Wavenumbers (cm^{-1}): 3530sh, 3410, 1630w, 1492, 1410, 1200sh, 1125sh, 1076s, 1002s, 940sh, 906s, 836, 676, 650sh, 620sh, 592, 515sh, 490.

TiSi2 Orthojoaquinite-(La) $Ba_2NaLa_2Fe^{2+}Ti_2Si_8O_{26}(OH,F)\cdot H_2O$

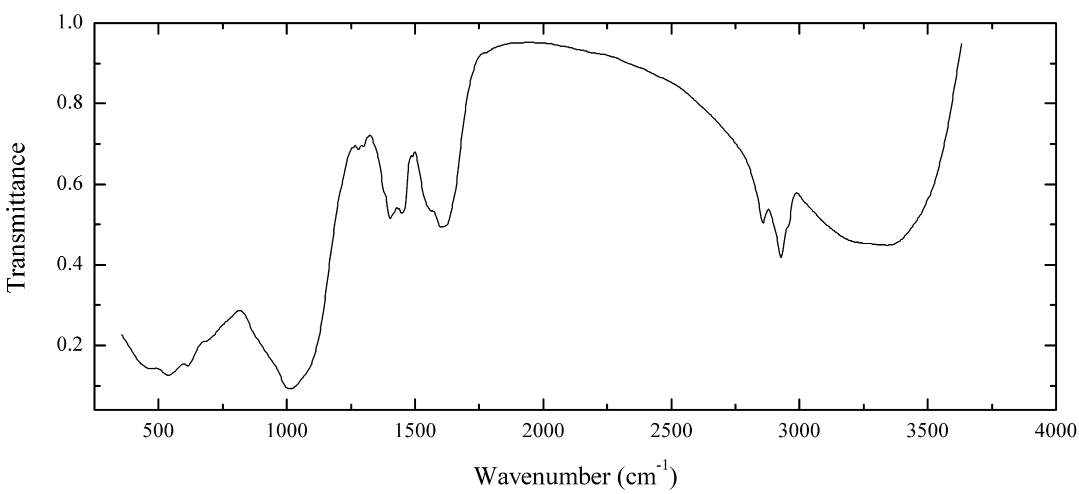


Locality: Narssaq river, Kvanefjeld Mt., Ilímaussaq alkaline complex, South Greenland (type locality).

Description: Greyish-brown columnar aggregate from the association with riebeckite, analcime, sodalite and steenstrupine-(Ce). Holotype sample. Orthorhombic, space group *Ccmm*, $a = 10.539$, $b = 9.680$, $c = 22.345$ Å, $Z = 4$. Optically biaxial (+), $\alpha = 1.754$, $\beta = 1.760$, $\gamma = 1.797$, $2V_{meas} = 40°$. $D_{calc} = 4.14$ g/cm^3, $D_{meas} = 4.1$ g/cm^3. The empirical formula is $(Ba_{1.99}Ca_{0.01})(Na_{1.11}K_{0.07})(La_{0.88}Ce_{0.81}Nd_{0.18}Pr_{0.09})(Fe^{2+}_{0.95}Mn_{0.14})(Ti_{1.64}Nb_{0.25}Fe^{3+}_{0.07}Th_{0.02})(Si_{8.01}O_{26.00})[(OH)_{0.37}O_{0.35}F_{0.28}]\cdot 1.00H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.58 (68) (004), 3.00 (9) (224), 2.95 (17) (206), 2.91 (11) (117), 2.80 (100) (313, 008, 225), 2.232 (8) (0.0.10), 1.596 (13) (0.0.14, 602).

Wavenumbers (cm^{-1}): 3535w, 3490w, 3300w, 1610w, 1038s, 1015s, 987s, 925s, 903s, 790sh, 718, 676, 648, 582, 490, 450.

TiSi3 Karnasurtite-(Ce) $(Ce,La,Th)(Ti,Nb)(Al,Fe^{3+})(Si,P)_2O_7(OH)_4\cdot 3H_2O$ (?)

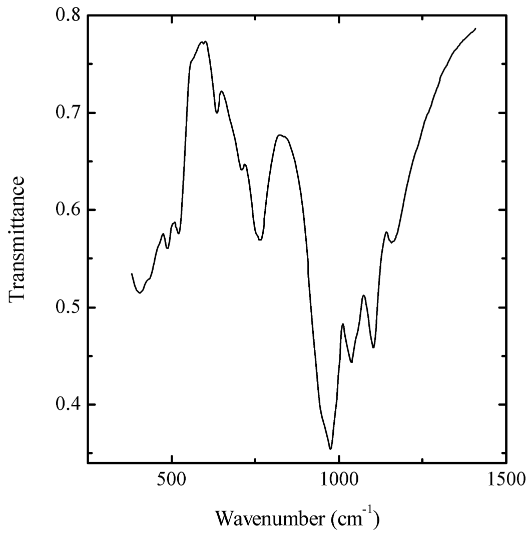


Locality: Pegmatite No. 62, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange-yellow hexagonal plates from the association with natrolite, sodalite, polylithionite and Mn^{4+}-oxides. Identified by IR spectrum and semiquantitative electron microprobe analysis. The bands at 1,280, 1,380, 1,404, 1,450, 1,567, 1,612, 2,855, 2,925 and 2,957 cm^{-1} correspond to inclusions of bituminous substance.

Wavenumbers (cm^{-1}): 3350, 3235sh, 2957, 2925, 2855, 1625sh, 1612, 1567, 1450, 1405, 1280w, 1050sh, 1012s, 875sh, 675sh, 614, 531s, 466, 425sh.

TiSi4 Batisite $Na_2BaTi_2(Si_4O_{12})O_2$

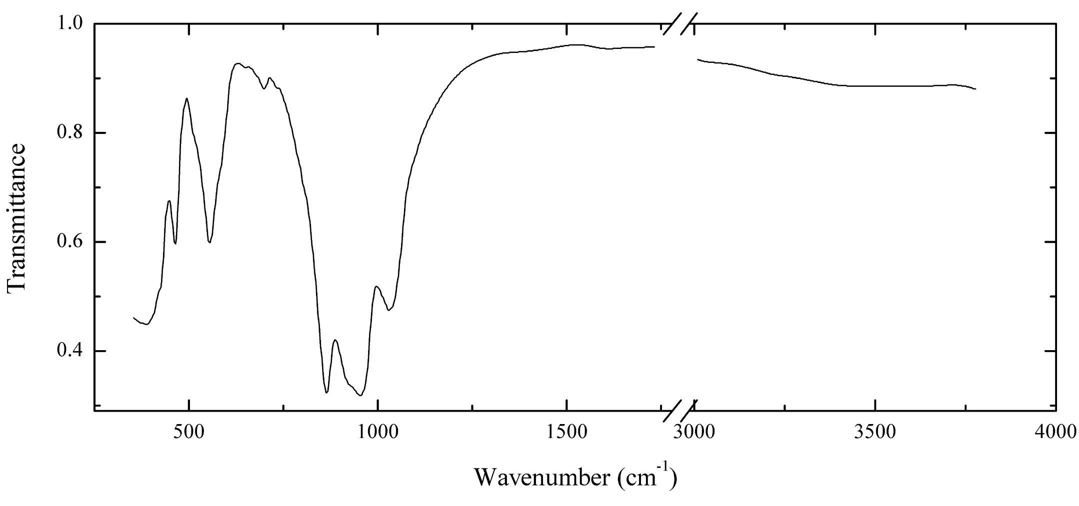


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Pink grains from the association with cancrinite, pectolite, aegirine-diopside, calcite and natrolite. Identified by IR spectrum and electron microprobe analysis. K-rich variety. The empirical formula is $Na(Na_{0.6}K_{0.4})(Ba_{0.8}K_{0.2})(Ti_{1.8}Nb_{0.2})(Si_{4.0}O_{12})O_2$.

Wavenumbers (cm^{-1}): 1165, 1105, 1039s, 978s, 955sh, 764, 708, 637, 574w, 522, 485, 420sh, 399.

TiSi5 Barytolamprophyllite $(Ba,Sr,K)_2Na(Na,Fe^{2+},Mn^{2+})_2(Ti,Fe^{3+},Mg)Ti_2(Si_2O_7)_2O_2(OH,O,F)_2$

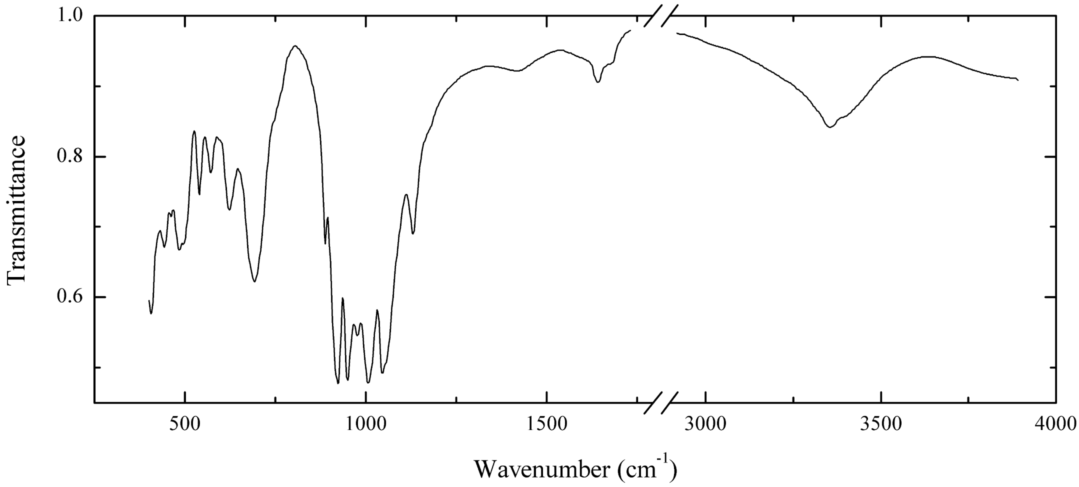


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Prismatic crystals from peralkaline pegmatite. The empirical formula is $(Ba_{0.9}K_{0.5}Sr_{0.4}Na_{0.1})Na(Na_{1.7}Mn_{0.2}Ca_{0.1})(Ti_{2.7}Fe_{0.2}Nb_{0.1})(Si_2O_7)_2O_2F_{0.6}(O,OH)_{1.5}$.

Wavenumbers (cm^{-1}): 1035, 956s, 925sh, 863s, 697w, 580sh, 552, 510sh, 458, 420sh, 395.

TiSi6 Kukisvumite $Na_6ZnTi_4Si_8O_{28}\cdot 4H_2O$

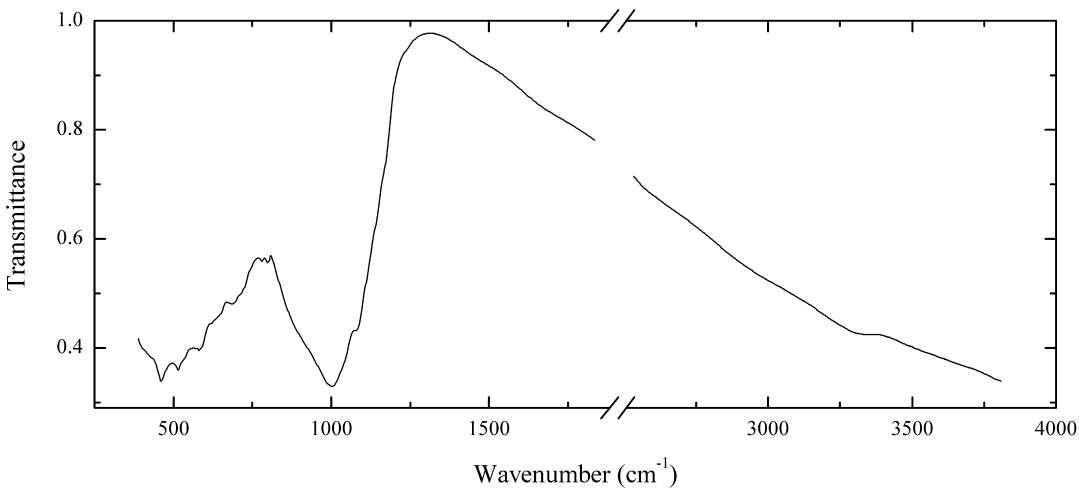


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless scaly aggregate from the association with natrolite, calcite, aegirine, lamprophyllite, fluorite, sphalerite, catapleiite, donnayite, narsarsukite, labuntsovite-Mn, tainiolite, polylithionite, *etc*. The empirical formula is (electron microprobe) $Na_{6.00}(Zn_{0.86}Mn_{0.08})Ti_{4.08}Si_{8.00}O_{28}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3400sh, 3350, 1670sh, 1635w, 1132, 1055sh, 1045s, 1007s, 976, 947s, 921s, 887, 689, 619, 570, 537, 495, 482, 457, 440, 404.

TiSi7 Perrierite-(La) $(La,Ce,Ca)_4Fe^{2+}(Ti,Fe)_4(Si_2O_7)_2O_8$

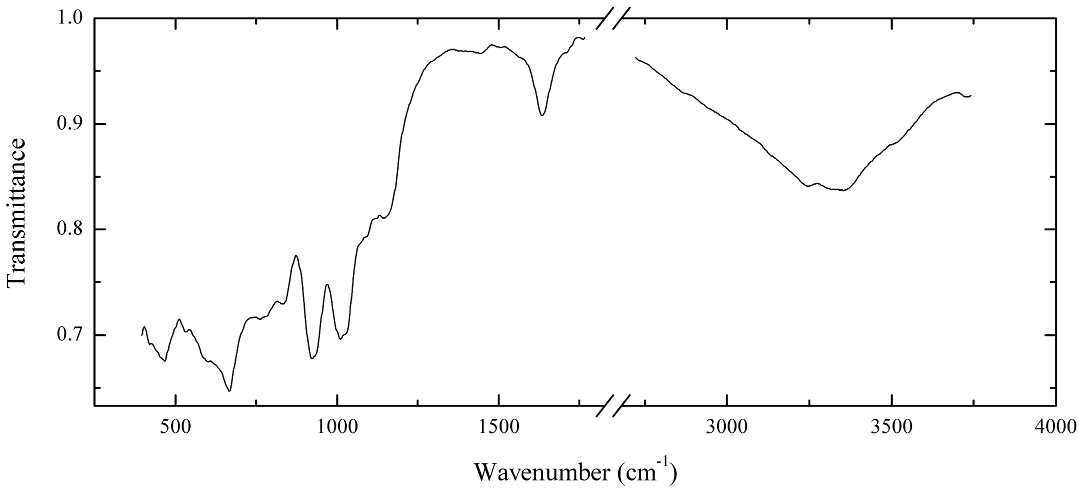


Locality: Kaskasnyunachorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark brown grains from hornfels. Investigated by Yu.P. Menshikov. Metamict, amorphous, gives powder X-ray diffraction pattern of perrierite after ignition. The empirical formula is (electron microprobe) $La_{1.8}Ce_{1.4}Nd_{0.2}Ca_{0.5}Th_{0.1}(Fe_{0.8}Mg_{0.1}Y_{0.1})(Ti_{2.6}Al_{1.2}Zr_{0.2})(Si_{3.9}Al_{0.1})O_{22}$.

Wavenumbers (cm^{-1}): 3325w, 1080, 1003s, 925sh, 796w, 777w, 705sh, 687, 635sh, 580, 509, 461s.

TiSi8 Komarovite $(\square,Na,K)(\square,Ca,Na)_6Li_x(Nb,Ti)_6Si_4O_{26}(OH,F)_2{\cdot}nH_2O$ (?)

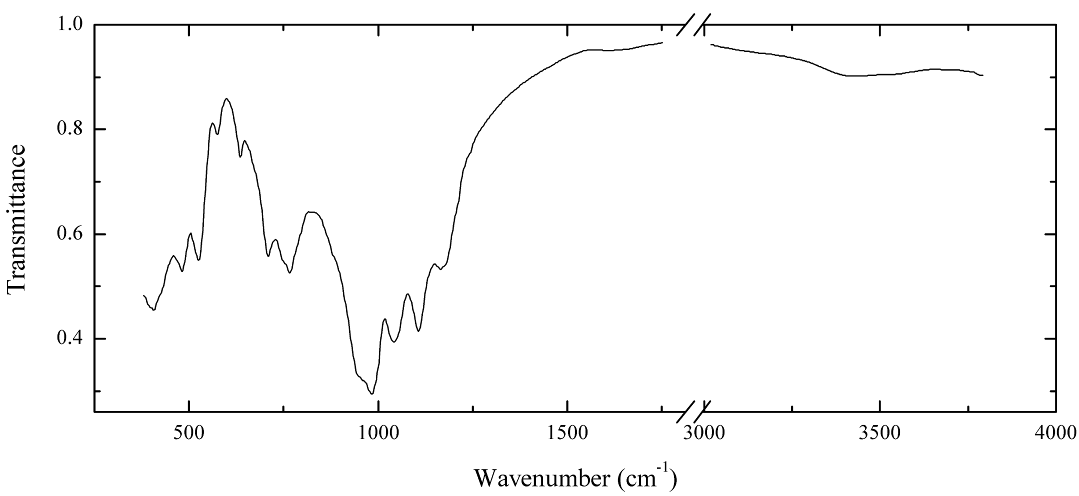


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Cream-coloured pseudomorphs after platy crystals of vuonnemite from the association with natrolite, albite, yofortierite, leifite, *etc*. The empirical formula is (electron microprobe) $Ca_{1.2}Sr_{0.6}Na_{0.3}K_{0.3}Li_x(Nb_{5.4}Ti_{0.6})(Si_{3.8}Al_{0.2})O_{26}(OH,F)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3310, 3225, 1636, 1142, 1080sh, 1025sh, 1008, 924s, 833, 755, 664s, 595sh, 466.

TiSi9 Noonkanbahite $NaKBaTi_2(Si_4O_{12})O_2$

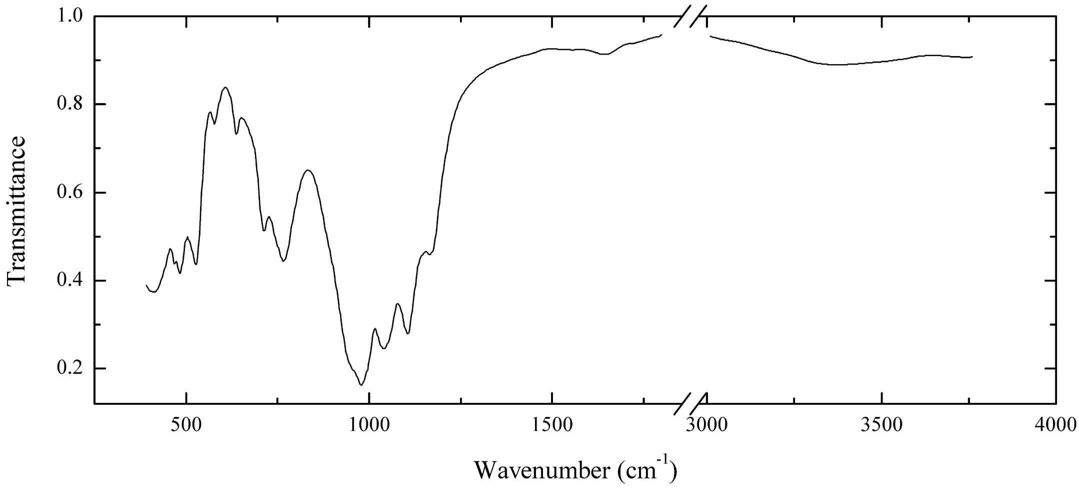


Locality: Mica mine, Kovdor, Kovdor alkaline ultrabasic complex, Kola peninsula, Murmansk region, Russia.

Description: Brown grains from the association with georgechaoite, cancrinite, pectolite, aegirine-diopside, calcite and natrolite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Na_{1.00}(K_{0.59}Na_{0.41})(Ba_{0.54}K_{0.46})(Ti_{1.61}Nb_{0.41}Fe_{0.05})(Si_{4.00}O_{12})O_2$.

Wavenumbers (cm^{-1}): 3390w, 1170, 1109s, 1050sh, 1040s, 983s, 960sh, 945sh, 764, 711, 634w, 575w, 524, 479, 415sh, 397.

TiSi10 Noonkanbahite $NaKBaTi_2(Si_4O_{12})O_2$

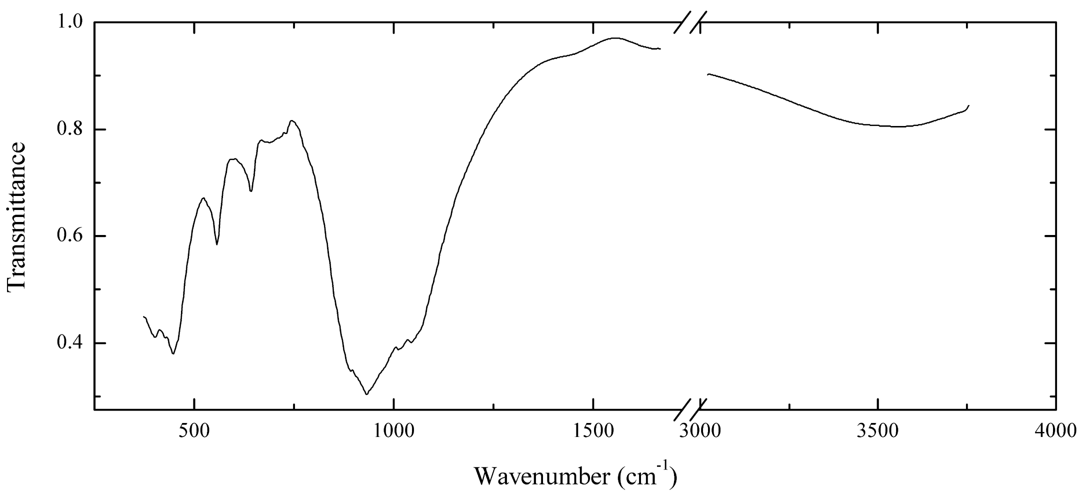


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Brown grains from the association with cancrinite, pectolite and aegirine-diopside. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Na_{0.94}(K_{0.63}Na_{0.37})(Ba_{0.65}K_{0.35})(Ti_{1.70}Nb_{0.32}Fe_{0.02})(Si_{4.00}O_{12})O_2$.

Wavenumbers (cm^{-1}): 3390w, 1630w, 1168, 1109s, 1043s, 982s, 955sh, 766, 711, 635w, 577w, 526, 480, 466, 398.

TiSi11 Kupletskite $K_2Na(Mn,Fe^{2+})_7(Ti,Nb)_2Si_8O_{24}(OH,O,F)_7$

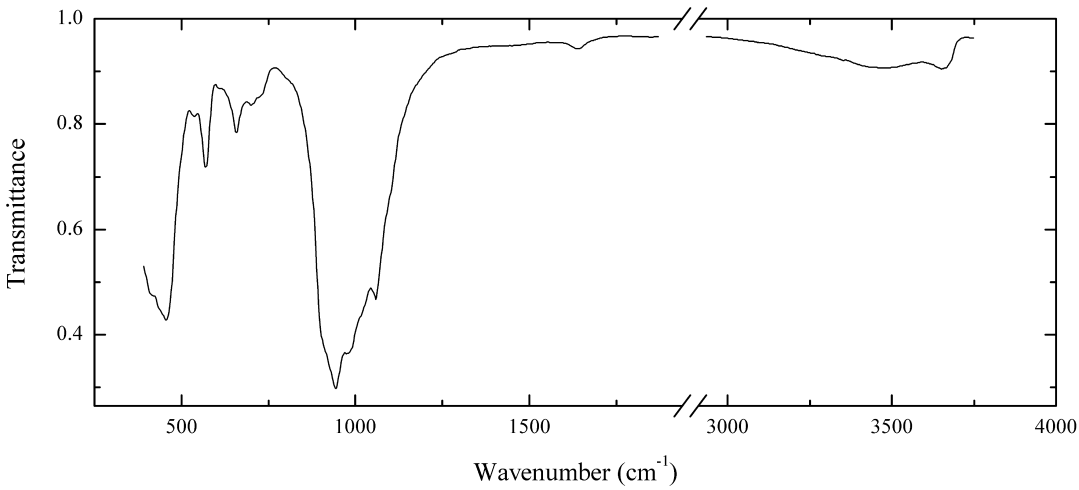


Locality: Rouma (Roume, Ruma) island, Los Archipelago, Guinea.

Description: Brown scaly aggregate from the association with villiaumite. Identified by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3600w, 3520sh, 1645w, 1450w, 1045, 1020, 934s, 897s, 720w, 646, 560, 450s, 404.

TiSi12 Astrophyllite $K_2Na(Fe^{2+},Mn)_7Ti_2Si_8O_{24}(OH,O,F)_7$

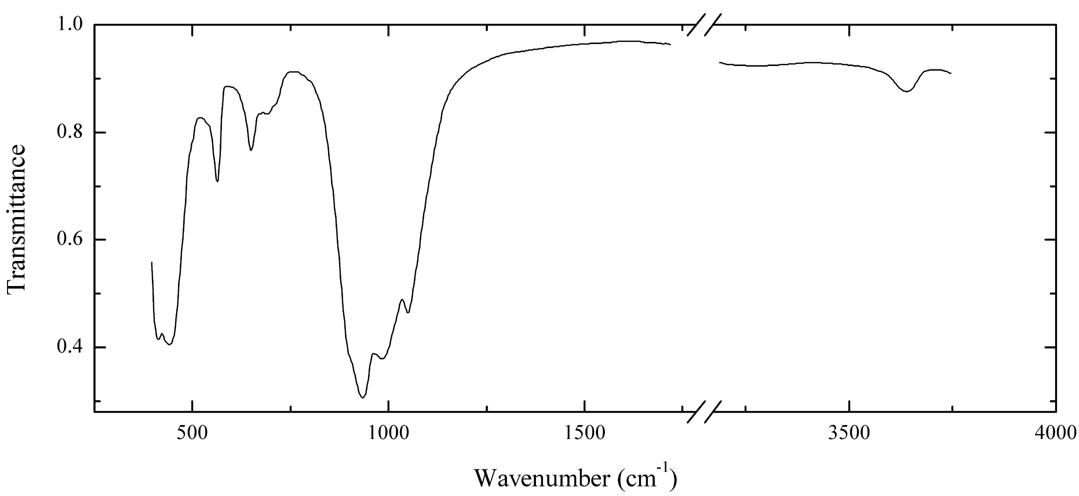


Locality: Verkhnee Espe deposit, Akzhailyautas Mts., Tarbagatai range, Eastern Kazakhstan region, Kazakhstan.

Description: Reddish-brown grains with perfect cleavage. Investigated by I.V. Pekov. Fe:Mn ≈ 7:1.

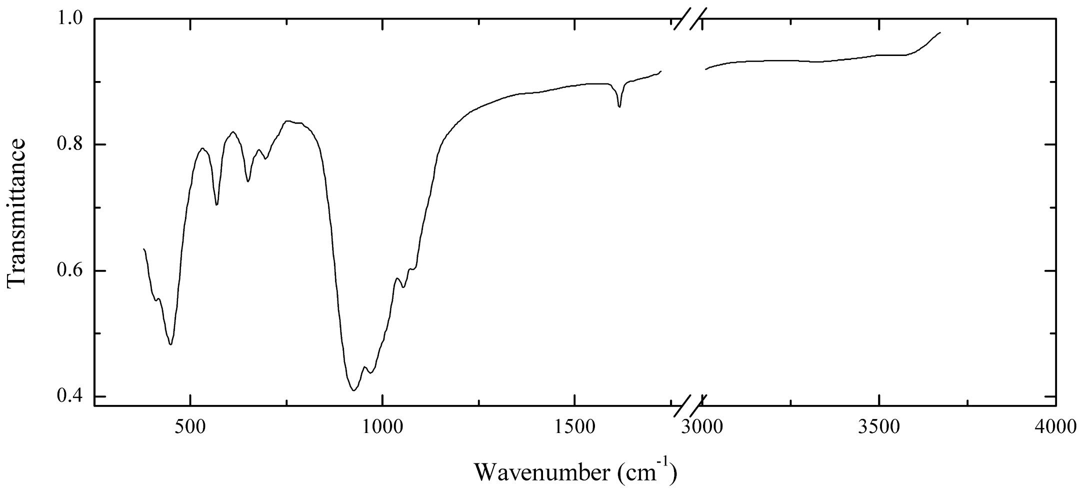
Wavenumbers (cm^{-1}): 3614w, 3440w, 1631w, 1052, 1010sh, 970s, 935s, 905sh, 710sh, 687w, 648, 560, 529w, 448s, 430sh, 405sh.

TiSi13 Astrophyllite $K_2Na(Fe^{2+},Mn)_7Ti_2Si_8O_{24}(OH,O,F)_7$



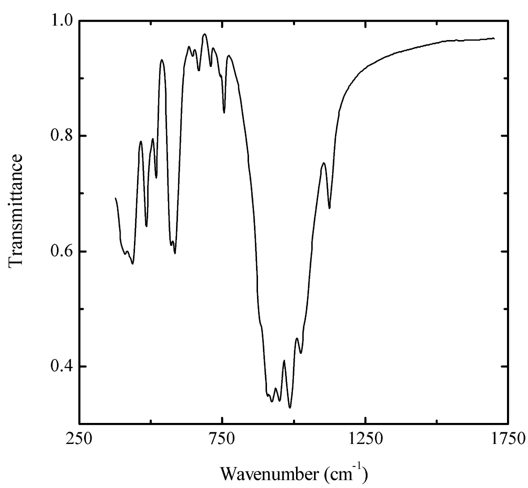
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown prismatic crystal from the association with albite, aenigmatite, aegirine and loparite-(Ce). Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $K_{1.8}Na_{0.9}Ca_{0.25}(Fe_{5.8}Mn_{1.0})(Ti_{2.1}Nb_{0.1})Si_{8.0}O_{24}(OH,O,F)_7$.
Wavenumbers (cm^{-1}): 3615, 1052, 985s, 935s, 900sh, 690w, 651, 563, 441s, 411s.

TiSi14 **Astrophyllite** $K_2Na(Fe^{2+},Mn)_7Ti_2Si_8O_{24}(OH,O,F)_7$



Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: K-deficient variety.
Wavenumbers (cm^{-1}): 3625sh, 3580w, 1620w, 1084, 1058, 1010sh, 974s, 930s, 696w, 649, 566, 446s, 405.

TiSi17 **Altisite** $Na_3K_6Ti_2Al_2Si_8O_{26}Cl_3$

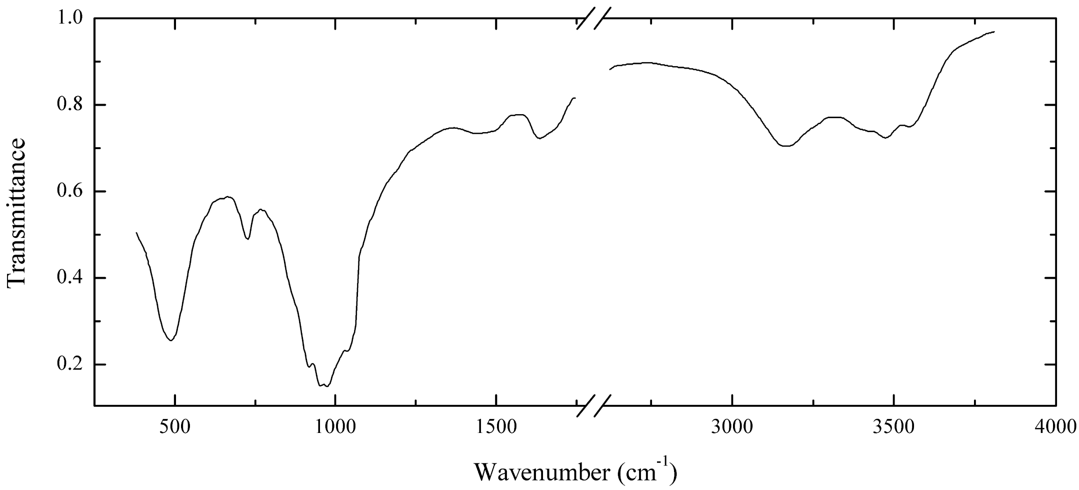


Locality: Oleniy Stream apatite deposit, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Colourless grains from the association with sodalite, nepheline, potassium feldspar, pectolite, aegirine, shcherbakovite, tinaksite, arfvedsonite, nefedovite, villiaumite, natrite and

rasvumite. Holotype sample. Monoclinic, space group $C2/m$, $a = 10.37(1)$, $b = 16.32(3)$, $c = 9.16(2)$ Å, $\beta = 105.6°$. Optically biaxial (+), $\alpha = 1.601(2)$, $\beta = 1.625(2)$, $\gamma = 1.654(2)$, $2V_{meas} = 85(1)°$. $D_{calc} = 2.67 g/cm^3$, $D_{meas} = 2.64(2) g/cm^3$. The empirical formula is $Na_{3..57}K_{5.23}Ba_{0.08}(Ti_{1.95}Nb_{0.04}Zr_{0.01})Al_{2.03}Si_{7.98}O_{26.10}Cl_{1.89}$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 8.22 (71) (020), 3.50 (42) (221, -222), 3.049 (100) (132, -312), 2.900 (71) (-331, -203), 2.835 (84) (151).

Wavenumbers (cm^{-1}): 1125, 1040sh, 1024s, 985s, 952s, 924s, 910s, 885sh, 757, 742w, 709w, 667w, 645w, 583, 568, 515, 483, 434, 407.

TiSi18 Hilairite $Na_2ZrSi_3O_9 \cdot 3H_2O$

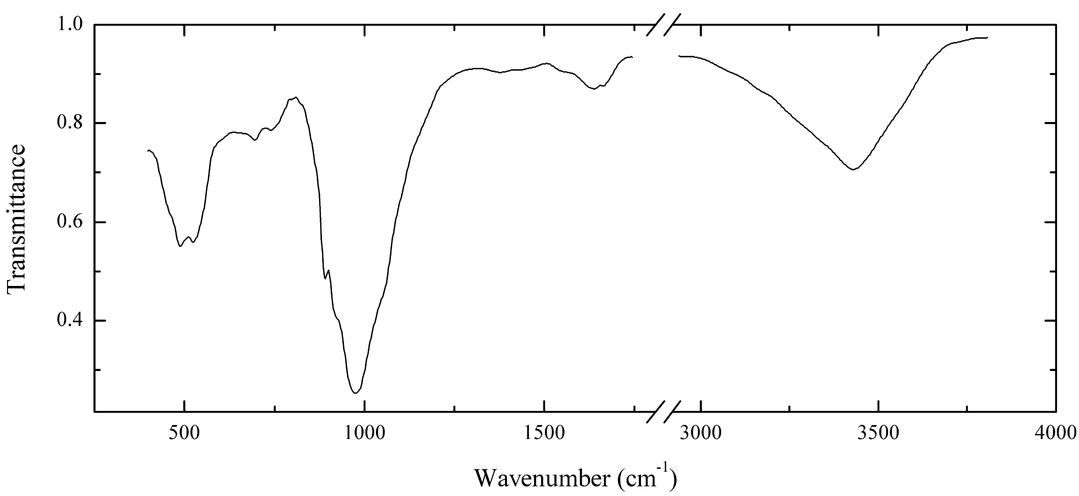


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Pale brown crystals from the association with catapleiite, aegirine, microcline, *etc*. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3465, 3410, 3155, 1675sh, 1640, 1455w, 1042, 979s, 956s, 922s, 731, 494.

TiSi19 Georgechaoite $KNaZr(Si_3O_9) \cdot 2H_2O$

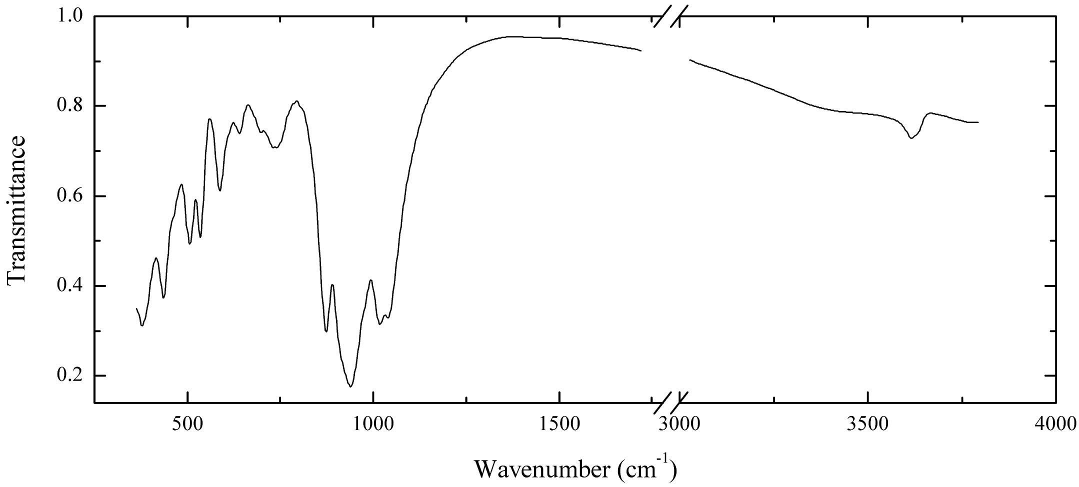


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Brown grains from the association with noonkanbahite, cancrinite, pectolite, aegirine-diopside, calcite and natrolite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(K_{0.6}Th_{0.1}Ba_{0.05})(Na_{0.6}Ca_{0.3})(Zr_{0.8}Ti_{0.2})(Si_{2.9}Al_{0.1}O_9)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3425, 1665w, 1640, 1560sh, 1430w, 1370w, 1050sh, 973s, 892, 742w, 699, 521, 490, 460sh.

TiSi20 Surkhobite $(Ba,K)_2CaNa(Mn,Fe^{2+},Fe^{3+})_8Ti_4(Si_2O_7)_4O_4(F,OH,O)_6$

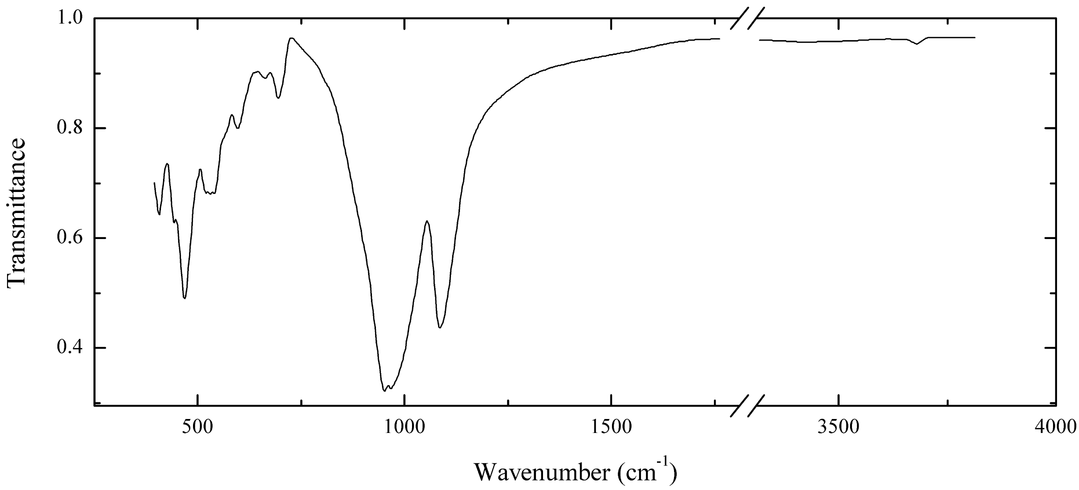


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Brownish-red platy crystals from the association with aegirine, microcline, albite, quartz, amphibole, annite, bafertisite, astrophyllite, zircon, fluorite, polylithionite, stillwelite-(Ce), sogdianite and tadzhikite-(Ce). Holotype sample. The crystal structure is solved. It is characterized by the ordering of Ba, K, Ca and Na. Monoclinic, space group $C2$, $a = 10.723(1)$, $b = 13.826(2)$, $c = 20.791(4)$ Å, $\beta = 95.00(1)°$, $Z = 4$. Optically biaxial (–), $\alpha = 1.790$, $\beta = 1.858(10)$, $\gamma = 1.888(10)$, $2V_{meas} = 65(5)°$. $D_{calc} = 3.98$ g/cm^3. The empirical formula is $Na_{2.60}K_{1.41}Ca_{1.60}Sr_{0.09}Ba_{2.58}$ $(Mn_{8.17}Fe^{2+}{}_{6.88}Fe^{3+}{}_{0.94}Mg_{0.115}Al_{0.01})(Ti_{7.17}Nb_{0.57}Zr_{0.10})Si_{16.06}H_{4.61}$ $F_{5.49}O_{70.51}$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 10.39 (20) (002), 3.454 (100) (006), 3.186 (15) (321), 2.862 (15) (225), 2.592 (70) (008), 2.074 (40) (048).

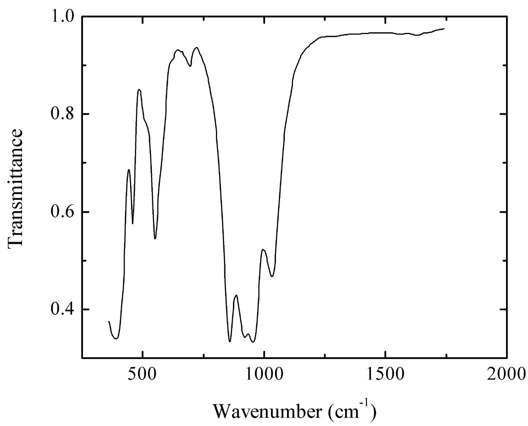
Wavenumbers (cm^{-1}): 3590, 1033s, 1013s, 970sh, 937s, 871s, 733, 690sh, 633, 583, 532, 504, 435s, 381s.

TiSi22 Baratovite $KLi_3Ca_7Ti_2(Si_6O_{18})_2(OH,F)_2$



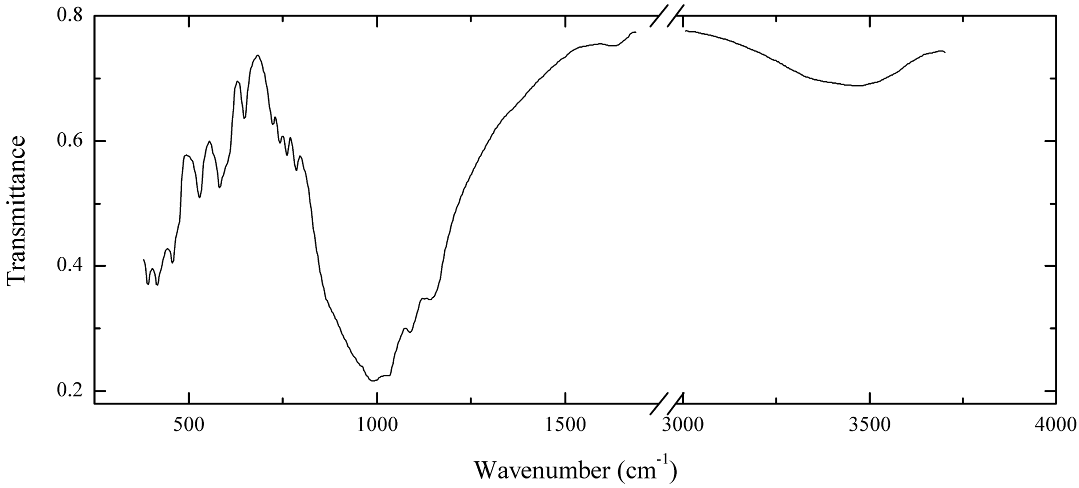
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Brownish brittle plates with perfect mica-like cleavage from the association with aegirine, microcline, quartz, polylithionite and stillwelite-(Ce). Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3660w, 1086s, 968s, 950s, 689, 659w, 538, 529, 518, 467s, 442, 406.

TiSi23 Barytolamprophyllite noncentrosymmetric $Ba(Ba,Na)\{Na_3Ti[Ti_2O_2Si_4O_{14}](F,OH,O)_2\}$



Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Radial aggregate of yellow prismatic crystals from the association with calcite, feklichevite, aegirine-diopside and pectolite. The empirical formula is $Ba(Ba_{0.4}Na_{0.35}Kr_{0.2})(Na_{2.7}Mg_{0.15}Mn_{0.15})(Ti_{2.8}Fe_{0.2})Si_{4.0}O_{14}(F,OH,O)_2$.
Wavenumbers (cm^{-1}): 1032, 952s, 920s, 856s, 696w, 620sh, 580sh, 551, 510sh, 459, 395s.

TiSi24 Burpalite $Na_2CaZr(Si_2O_7)F_2$

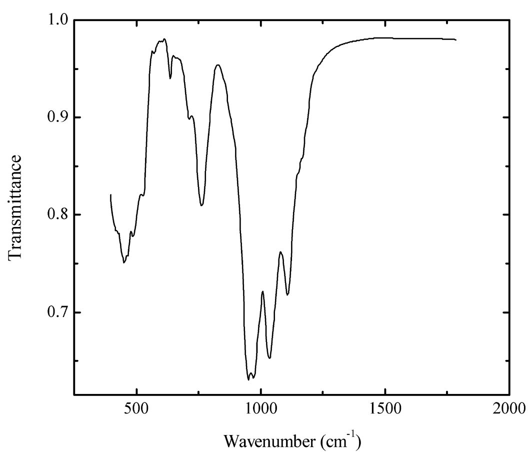


Locality: Burpala (Burpalinskii) alkaline massif, Transbaikal territory, Siberia, Russia (type locality).

Description: Yellowish grains from the association with låvenite, albite, nepheline, aegirine, alkalic amphibole, biotite, catapleiite, astrophyllite, fluorite and loparite-(Ce). Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/a$, $a = 10.1173(8)$, $b = 10.4446(6)$, $c = 7.2555(3)$ Å, $\beta = 90.039(7)°$, $Z = 4$. Optically biaxial (−), $\alpha = 1.627(2)$, $\beta = 1.634(2)$, $\gamma = 1.639(2)$, $2V_{meas} = 82°$. $D_{meas} = 3.33(15)$ g/cm^3, $D_{calc} = 3.27$ g/cm^3. The empirical formula is $(Na_{1.69}Mn_{0.03}Fe_{0.02}Y_{0.01})Ca_{0.98}(Zr_{0.96}Ti_{0.05}Nb_{0.01})(Si_{2.00}O_7)[F_{1.61}(OH)_{0.26}]\cdot 0.13H_2O$. Strong lines of the powder X-ray diffraction pattern correspond to d values of 3.306, 3.035, 2.962, 1.886, 1.787, 1.678 and 1.556 Å.

Wavenumbers (cm^{-1}): 3460, 1640w, 1144s, 1095s, 1035s, 991s, 930sh, 880sh, 788, 762, 744, 724, 649, 605sh, 586, 529, 475sh, 460, 425sh, 417s, 393s.

TiSi25 Batisite $Na_2BaTi_2(Si_4O_{12})O_2$

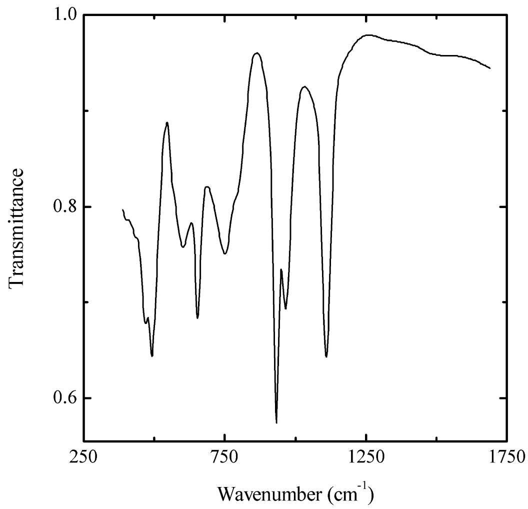


Locality: Inagli alkaline-ulthabasic massif, Sakha (Yakutia) Republic, Siberia, Russia (type locality).

Description: Rose-brown grains from the association with microcline, orthoclase, nepheline, aegirine, arfvedsonite, lorenzenite, thorite, eudialyte and fluorapatite. Holotype sample. Orthorhombic, space group *Ima*2 or *Imam*, $a = 10.41$, $b = 13.85$, $c = 8.06$ Å, $Z = 4$. Optically biaxial (+), $\alpha = 1.730(1)$, $\beta = 1.735(1)$, $\gamma = 1.791(1)$, $2V_{meas} = 7°$. $D_{meas} = 3.43$ g/cm^3, $D_{calc} = 3.49$ g/cm^3. The empirical formula is $(Na_{1.66}K_{0.34})(Ba_{0.88}Ca_{0.03}Mn_{0.01})(Ti_{1.68}Fe^{3+}{}_{0.14}Al_{0.11}Zr_{0.09})Si_{3.97}O_{13.66}(OH)_{0.34}$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.39 (50), 3.20 (30), 2.91 (100), 2.62 (30), 2.16 (50), 2.09 (40), 1.68 (50).

Wavenumbers (cm^{-1}): 1170sh, 1105, 1031s, 972s, 950s, 762, 712, 634, 576w, 526, 486, 466, 448, 405sh.

TiSi26 Baotite $Ba_4Ti_4(Ti,Nb,Fe)_4(Si_4O_{12})O_{16}Cl$

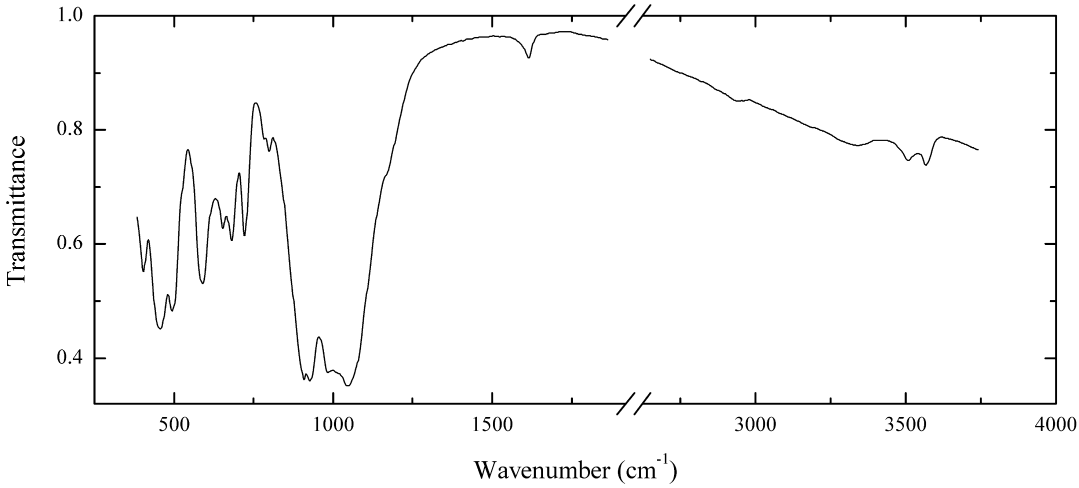


Locality: Bayan Obo *REE*–Fe–Nb deposit, Inner Mongolia, China (type locality).

Description: Dark brown grains from the association with quartz, calcite, aegirine, galena, pyrite and alkalic amphiboles. Holotype sample. Tetragonal, space group $I4_1/a$, $a = 20.02$, $b = 6.01$ Å. Optically biaxial (+), $\omega = 1.94$, $\varepsilon = 2.16$. $D_{calc} = 4.79$ g/cm^3. The empirical formula is $(Ba_{3.82}Ca_{0.11})(Ti_{5.84}Nba_{1.35}Fe_{0.60}Al_{0.18})(Si_{3.68}Al_{0.32})O_{28}Cl_{0.88}$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.39 (50), 3.20 (30), 2.91 (100), 2.62 (30), 2.16 (50), 2.09 (40), 1.68 (50).

Wavenumbers (cm^{-1}): 1109s, 964, 931s, 790sh, 747, 949, 600, 560sh, 489s, 467, 430sh, 400sh.

TiSi27 Byelorussite-(Ce) $NaMn^{2+}Ba_2Ce_2Ti_2Si_8O_{26}(F,OH){\cdot}H_2O$

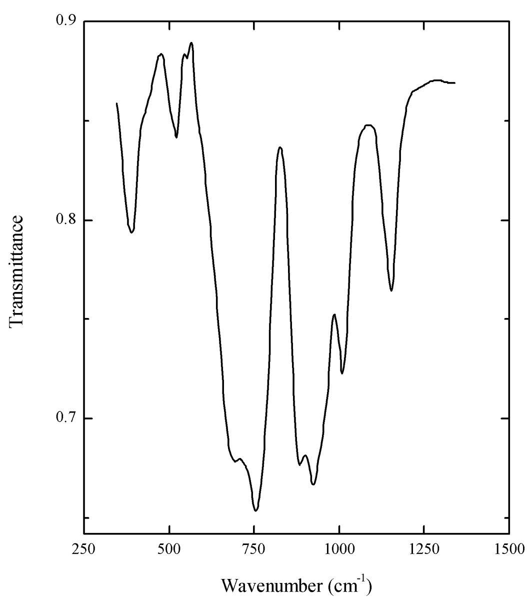


Locality: Zhitkovichi, Gomel region, Byelarus (type locality).

Description: Pale brown tabular crystals from the association with brookite, bastnäsite, montmorillonite, quartz, magnesioriebeckite, aegirine, albite, leucophanite and titanite. Holotype sample. Orthorhombic, space group $P2_12_12_1$, a = 10.57(6), b = 9.69(6), c = 22.38(10) Å. Optically biaxial (+), $\alpha = 1.743$, $\beta = 1.760$, $\gamma = 1.820$, $2V_{meas} \approx 60°$. $D_{meas} = 3.92$ g/cm^3, D_{calc} = 4.09 g/cm^3. The empirical formula is $(Na_{0.95}K_{0.12})(Mn_{0.52}Zn_{0.27}Fe_{0.16}Mg_{0.05})(Ba_{1.90}Sr_{0.06})$ $REE_{2.03}Ti_{2.01}Si_{8.00}O_{26}$ $[F_{0.73}(OH)_{0.27}]{\cdot}H_2O$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 4.42 (59), 3.30 (45), 3.00 (68), 2.95 (63), 2.91 (52), 2.783 (100), 2.606 (52).

Wavenumbers (cm^{-1}): 3540w, 3485w, 3320w, 2930w, 1615wm 1160sh, 1044s, 1025sh, 984s, 927s, 908s, 797, 779w, 719, 680, 652, 587, 530sh, 505sh, 495, 449s, 407.

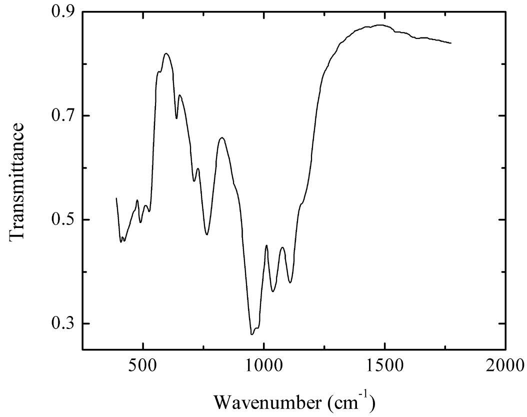
TiSi28 Belkovite $Ba_2(Nb,Ti)_6(Si_2O_7)O_{12}$



Locality: Sebl'yavr massif, Kola peninsula, Murmansk region, Russia.

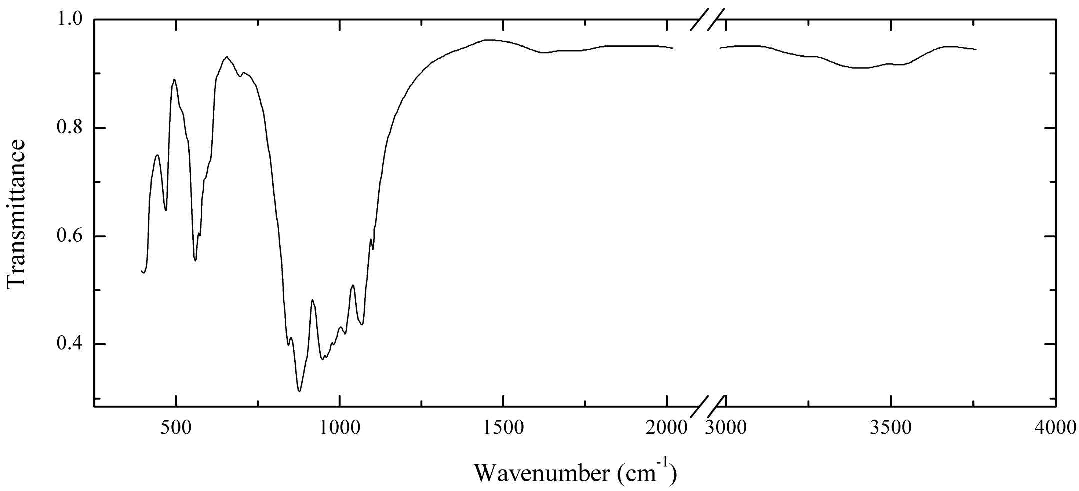
Description: Brown crystals. Investigated by N.V. Sorokhtina.
Wavenumbers (cm^{-1}): 1152, 1012, 960sh, 927s, 887s, 758s, 697s, 558w, 519, 450sh, 405.

TiSi29 Batisite $Na_2BaTi_2(Si_4O_{12})O_2$



Locality: Inagli alkaline-ulthabasic massif, Sakha (Yakutia) Republic, Siberia, Russia (type locality).
Description: Brown grains from peralkaline pegmatite. Confirmed by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 1160sh, 1106s, 1037s, 973s, 950s, 880sh, 763, 708, 633, 573w, 525, 486, 465sh, 410.

TiSi30 Bornemanite $BaNa_3(Na,Ti,Mn^{2+})_4(Ti,Nb)_2(Si_2O_7)_2(PO_4)O_2(F,OH)_2$

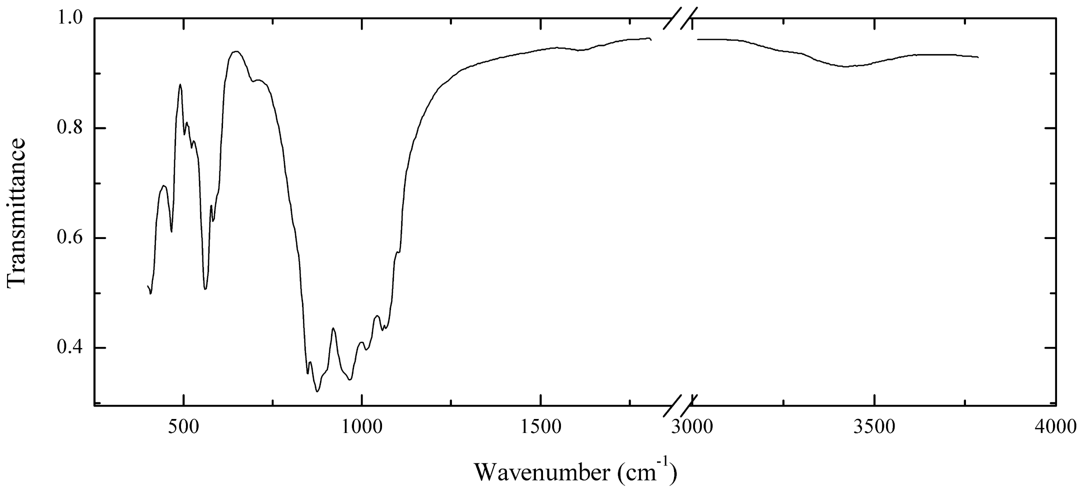


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Straw-yellow aggregate of elongated plates forming pseudomorph after lomonosovite. Associated minerals are lomonosovite, natrolite, raite, zorite, mountainite, penkvilksite, terskite, *etc*. Holotype sample. Orthorhombic, $a = 5.48(5)$, $b = 7.10(5)$, $c = 48.2(1)$ Å. Optically biaxial (+), $\alpha = 1.682–1.683$, $\beta = 1.687–1.695$, $\gamma = 1.718-1.720$, $2V_{meas} = 40°$. $D_{calc} = 3.49$ g/cm^3. Strong

lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 24.1 (100), 8.04 (100), 3.44 (100), 3.02 (100), 2.682 (80), 1.781 (70), 1.610 (80).

Wavenumbers (cm^{-1}): 3520w, 3390w, 3230w, 1715w, 1620w, 1101, 1063s, 1011s, 980s, 958s, 943s, 871s, 836s, 684w, 595sh, 580sh, 561, 548, 520sh, 500sh, 455, 392.

TiSi31 Bornemanite $BaNa_3(Na,Ti,Mn^{2+})_4(Ti,Nb)_2(Si_2O_7)_2(PO_4)O_2(F,OH)_2$

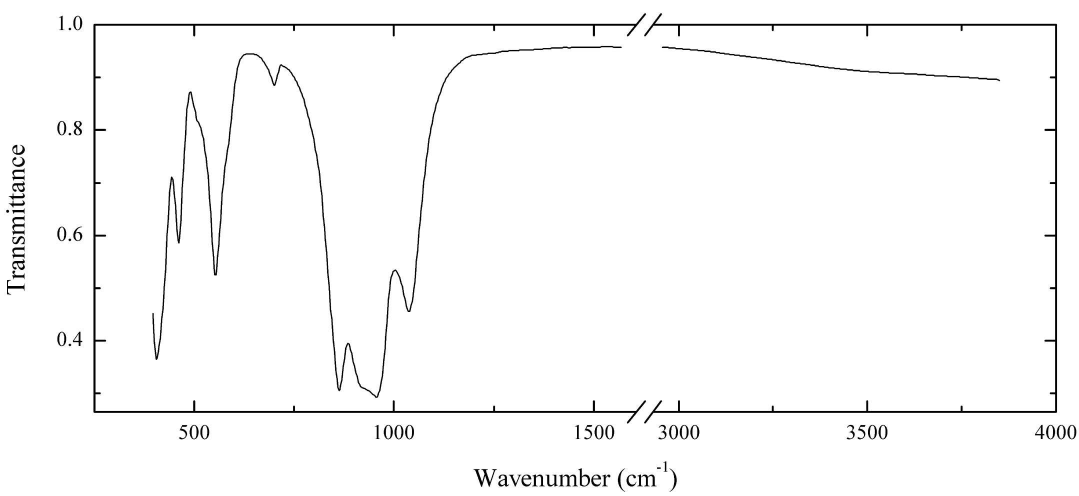


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pale-yellow pseudomorph after lomonosovite. Investigated by A.P. Khomyakov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3400w, 3220sh, 1620w, 1104, 1067, 1057s, 1011s, 960s, 945sh, 890sh, 870s, 846s, 805sh, 690w, 590sh, 581, 560sh, 551, 520sh, 500sh, 455, 394.

TiSi32 Barytolamprophyllite $(Ba,Sr,K)_2Na(Na,Fe^{2+},Mn^{2+})_2(Ti,Fe^{3+},Mg)Ti_2(Si_2O_7)_2O_2(OH,O,F)_2$

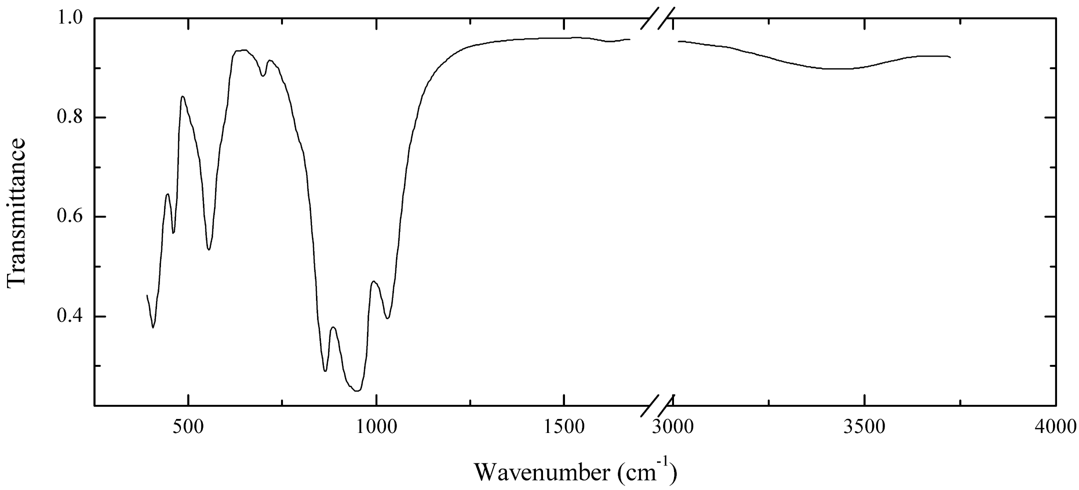


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow scaly aggregate from peralkaline pegmatite, from the association with villiaumite, lomonosovite and aegirine. The empirical formula is $(Ba_{1.1}K_{0.4}Sr_{0.4}Na_{0.1})Na(Na_{1.8}Mn_{0.2})(Ti_{2.6}Mn_{0.2}Fe_{0.1}Nb_{0.1})(Si_2O_7)_2O_2(O,F,OH)_2$.

Wavenumbers (cm^{-1}): 1036, 954s, 921s, 860s, 695, 550, 500sh, 456, 404s.

TiSi33 Barytolamprophyllite $(Ba,Sr,K)_2Na(Na,Fe^{2+},Mn^{2+})_2(Ti,Fe^{3+},Mg)Ti_2(Si_2O_7)_2O_2(OH,O,F)_2$

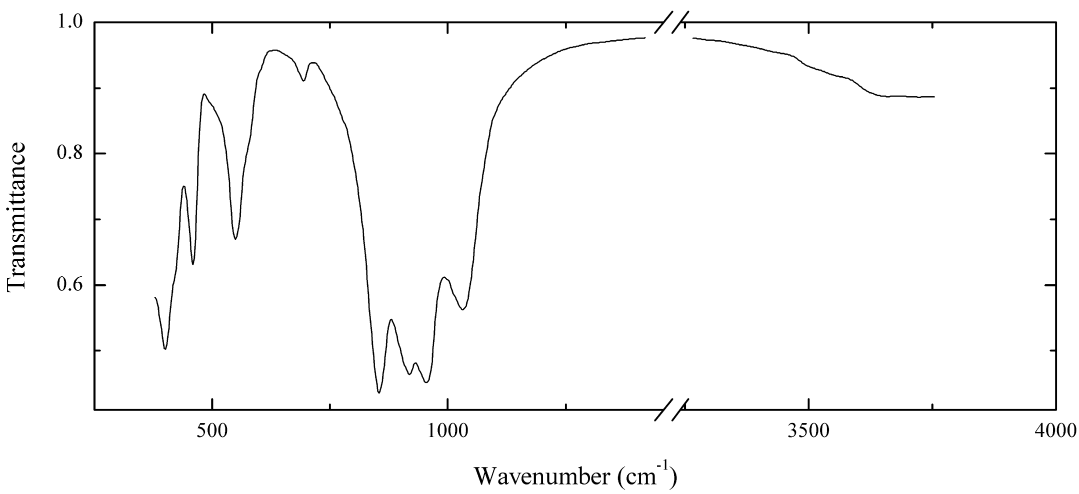


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow-brown long-prismatic crystal from peralkaline pegmatite, from the association with villiaumite, lomonosovite and aegirine. The empirical formula is $(Ba_{0.77}K_{0.47}Sr_{0.39}Na_{0.22})Na(Na_{1.54}Mn_{0.42}Ca_{0.04})(Ti_{2.43}Fe_{0.33}Mg_{0.17}Mn_{0.07})(Si_2O_7)_2O_2(O,F,OH)_2$.

Wavenumbers (cm^{-1}): 1032s, 948s, 930sh, 864s, 700w, 575sh, 553, 505sh, 459, 402s.

TiSi34 Nabalamprophyllite $Ba(Na,Ba)\{Na_3Ti[Ti_2O_2Si_4O_{14}](F,OH,O)_2\}$

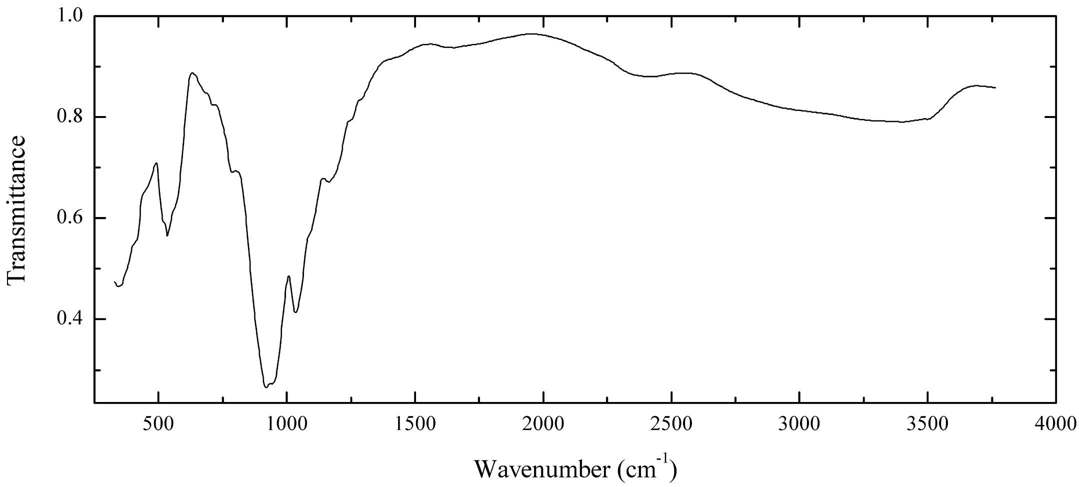


Locality: Inagli alkaline-ulthabasic massif, Sakha (Yakutia) Republic, Siberia, Russia (type locality).

Description: Brown coarse prismatic crystal from the association with albite, orthoclase, pyroxene, batisite, innelite, neptunite, leucosphenite, fluorstrophite, *etc*. Holotype sample. The crystal structure is solved. Na and Ba are ordered in interlayer sites. Monoclinic, space group $P2/m$, $a = 19.741(5)$, $b = 7.105(4)$, $c = 5.408(2)$ Å, $\beta = 96.67(1)°$, $Z = 2$. Optically biaxial (−), $\alpha = 1.750$, $\beta = 1.784$, $\gamma = 1.799$, $2V_{meas} = 40°$. $D_{meas} = 3.62(2)$ g/cm^3, $D_{calc} = 3.58$ g/cm^3. The empirical formula is $Na_{2.95}K_{0.17}Ca_{0.05}Sr_{0.05}Ba_{1.29}Mn_{0.13}(Ti_{2.86}Fe_{0.08}Mg_{0.07})[(Si_{3.93}Al_{0.07})O_{14.00}]\ O_{1.94}(OH)_{1.67}F_{0.51}$. The strongest lines of the powder X-ray diffraction pattern are [d, Å (I, %) (hkl)] 9.87 (96) (200), 3.75 (65) (31-1), 3.45 (90) (311, 510), 3.275 (78) (600), 2.797 (100) (221).

Wavenumbers (cm^{-1}): 3610w, 1033, 954s, 921s, 854s, 692w, 575sh, 549, 459, 420sh, 402s.

TiSi35 “Betalomonosovite” $Na_7Ti_4(Si_2O_7)_2(HPO_4)(H_2PO_4)O_4$

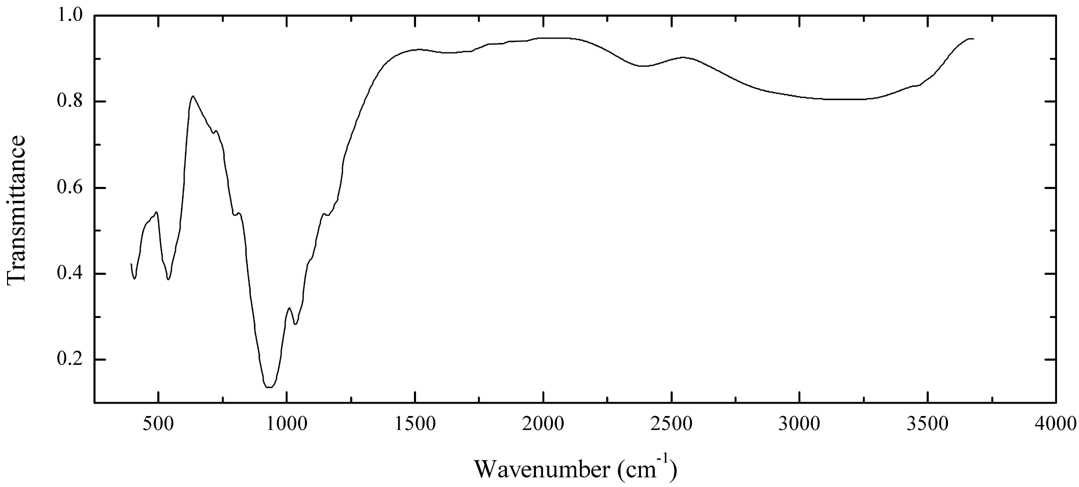


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Analogue of lomonosovite with acid phosphate groups. The crystal structure is solved. Confirmed by IR spectrum.

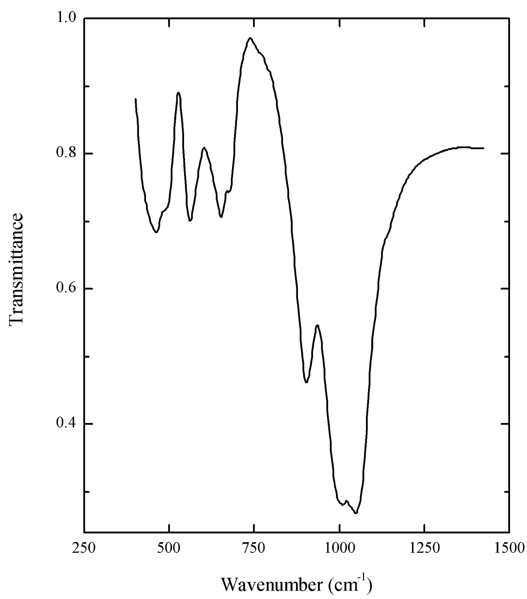
Wavenumbers (cm^{-1}): 3500sh, 3250, 2950sh, 2400w, 1660w, 1425w, 1285sh, 1250sh, 1164, 1090sh, 1033s, 946s, 917s, 794, 715w, 680sh, 565sh, 540, 520sh, 460sh, 420sh, 390.

TiSi36 "Betalomonosovite" $Na_7Ti_4(Si_2O_7)_2(HPO_4)(H_2PO_4)O_4$



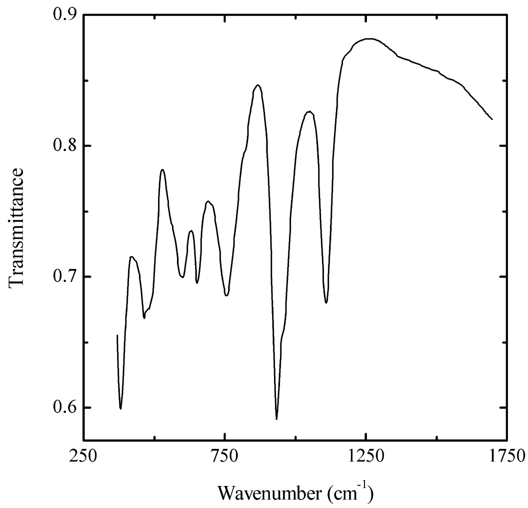
Locality: Nyorkpakhk Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Analogue of lomonosovite with acid phosphate groups. Identified by IR spectrum.
Wavenumbers ($\mathbf{cm^{-1}}$): 3460, 3200, 3000, 2910sh, 2380, 1710w, 1620w, 1290sh, 1240sh, 1162, 1090sh, 1034s, 940sh, 925s, 795, 716w, 570sh, 539, 520sh, 390.

TiSi38 Bario-orthojoaquinite $(Ba,Sr)_4Fe^{2+}{}_2Ti_2Si_8O_{26}{\cdot}H_2O$



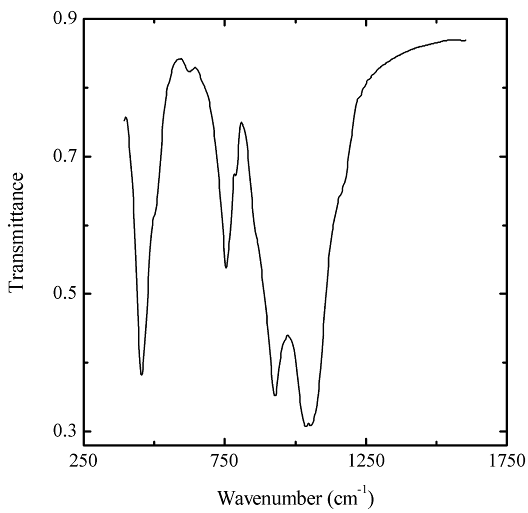
Locality: Benitoite Gem mine, Joaquin Ridge, Diablo Range, San Benito Co. California, USA (type locality).
Description: Brown crystals from the association with strontio-orthojoaquinite and benitoite. The empirical formula is $(Ba_{2.5}Sr_{1.5})(Fe_{1.1}Na_{0.4}Mn_{0.2}Ca_{0.1})Ti_{2.2}Si_{7.8}Al_{0.2}O_{26}{\cdot}nH_2O$. Confirmed by IR spectrum.
Wavenumbers ($\mathbf{cm^{-1}}$): 1054s, 1011s, 908s, 689, 668, 572, 490sh, 465.

TiSi39 Baotite $Ba_4Ti_4(Ti,Nb,Fe)_4(Si_4O_{12})O_{16}Cl$



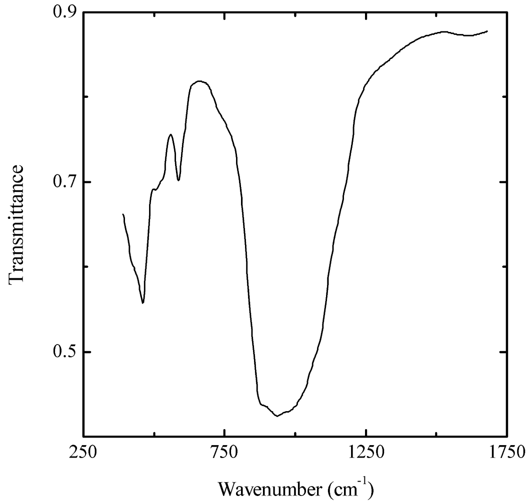
Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Dark brown acicular crystals from the association with natrolite, aegirine, microcline, titanite, lorenzenite, henrymeyerite, ancylite and barite. Identified by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 1110s, 960sh, 935s, 820sh, 759, 654, 600, 545sh, 490sh, 470, 370s.

TiSi40 Bazirite $BaZrSi_3O_9$



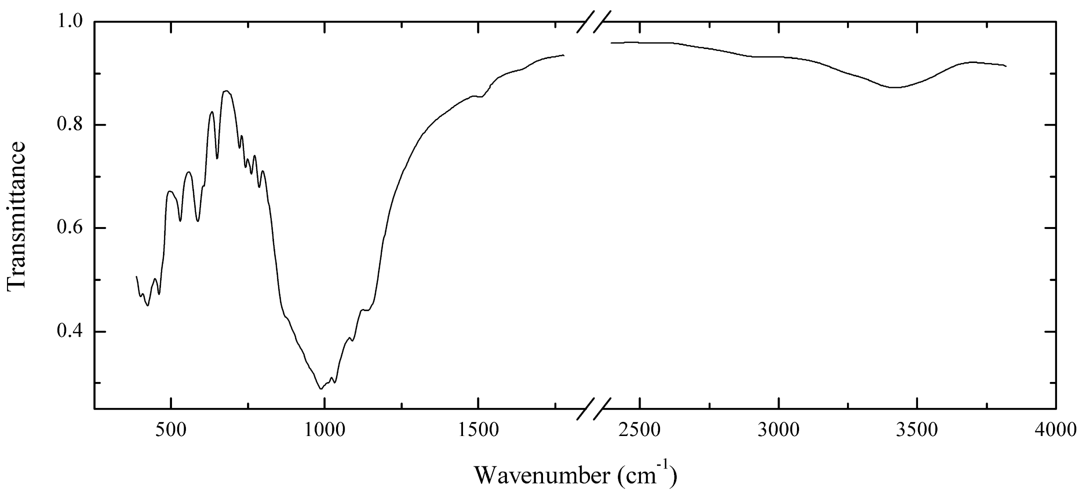
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Brownish pseudomorph after eudialyte from the association with titanite, aegirine and calcite.
Wavenumbers (cm^{-1}): 1170sh, 1051s, 1038s, 930s, 797, 759, 640w, 505sh, 455s.

TiSi41 Burpalite $Na_2CaZr(Si_2O_7)F_2$



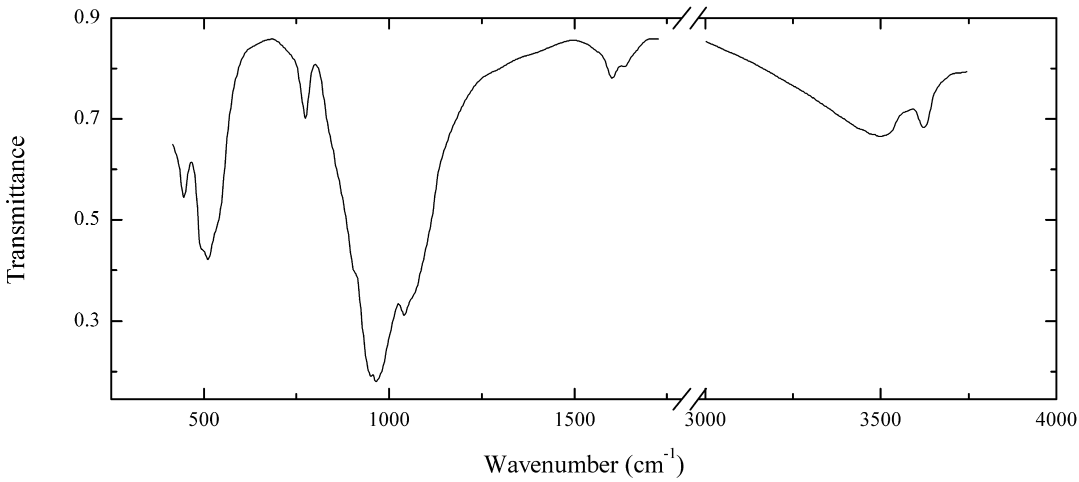
Locality: Burpala (Burpalinskii) alkaline massif, Transbaikal territory, Siberia, Russia (type locality).
Description: Yellowish grains from the association with albite, nepheline, aegirine, catapleiite and astrophyllite. Cotype sample. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1150sh, 1085sh, 936s, 880sh, 583, 530sh, 508, 452s, 425sh.

TiSi42 Burpalite $Na_2CaZr(Si_2O_7)F_2$



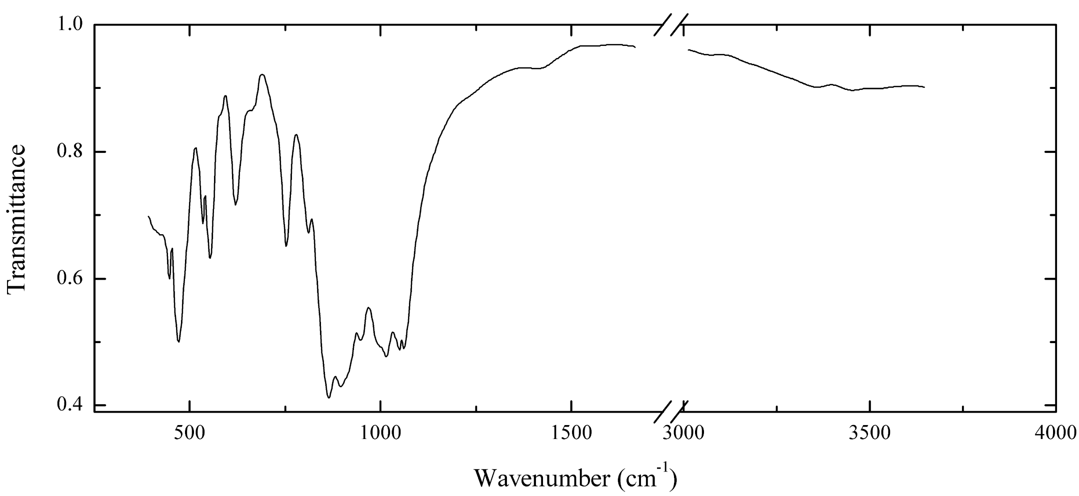
Locality: Burpala (Burpalinskii) alkaline massif, Transbaikal territory, Siberia, Russia (type locality).
Description: Brown massive. Metamict, amorphous. Investigated by A.P. Khomyakov.
Wavenumbers (cm^{-1}): 3420, 2915w, 1640w, 1508w, 1141, 1093s, 1034s, 1015sh, 992s, 930sh, 885sh, 879, 763, 746, 724, 651, 608, 588, 532, 588, 532, 475sh, 462, 422s, 390.

TiSi43 Petarasite $Na_5Zr_2Si_6O_{18}(Cl,OH)·2H_2O$



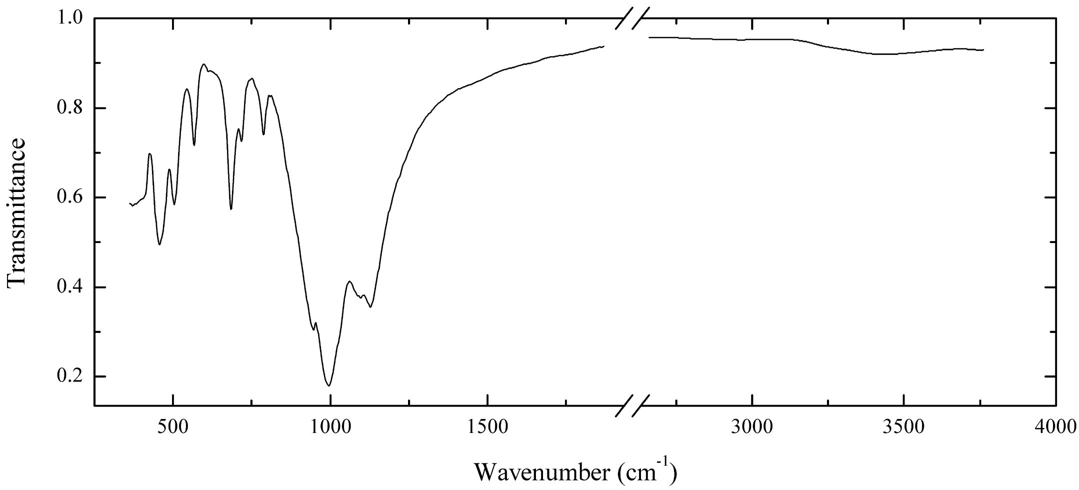
Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Pink pseudomorph after kentbrooksite from the association with analcime, catapleiite and aegirine. The empirical formula is $(Na_{3.74}K_{0.11}Ca_{0.11}Mn_{0.12})(Zr_{1.95}Nb_{0.04})Si_6(O,OH)_{18}$ $[Cl_{0.82}(OH)_{0.18}]·nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3620, 3500, 1645w, 1608, 1075sh, 1044, 974s, 954s, 910sh, 777, 535sh, 511, 491, 442.

TiSi44 Wöhlerite $Na_2Ca_4ZrNb(Si_2O_7)_2(O,F)_4$



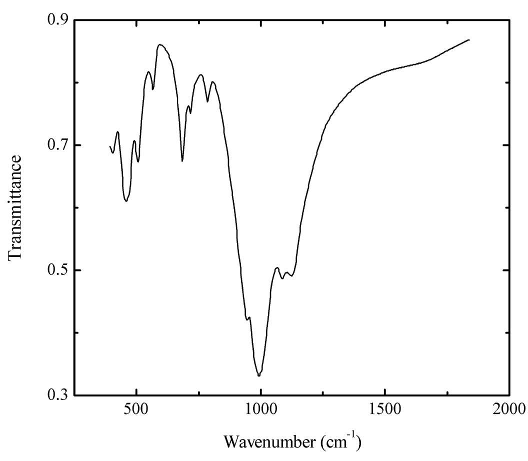
Locality: Langesundsfjorden, Larvik, Vestfold, Norway (type locality).
Description: Yellow grains from the association with aegirine, eudialyte, catapleiite, rosenbuschite, zircon, albite, nepheline and biotite. The empirical formula is $Na_{2.2}Ca_{3.8}Mn_{0.1}Zr_{1.0}Nb_{0.8}Fe_{0.25}$ $(Si_{2.0}O_7)_2(O,OH,F)_4$.
Wavenumbers (cm^{-1}): 3420w, 3350w, 1620w, 1061s, 1050s, 1015s, 995sh, 949s, 915sh, 898s, 867s, 812, 755, 660sh, 621, 580sh, 554, 534, 472s, 447, 425sh, 415sh.

TiSi45 Vlasovite $Na_2ZrSi_4O_{11}$



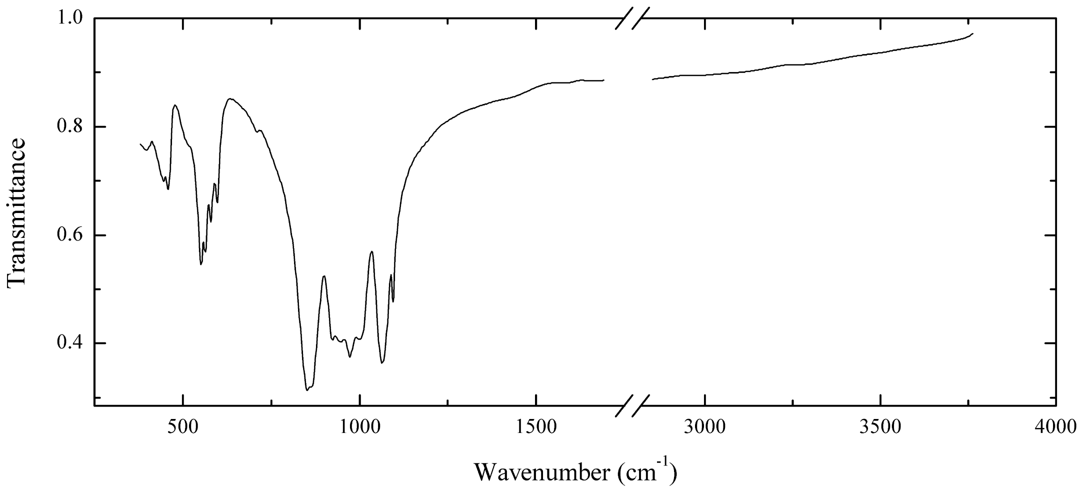
Locality: Kipawa alkaline complex, Les Lacs-du-Témiscamingue, Québec, Canada.
Description: Grey grains from the association with gittinsite and eudialyte. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1126s, 1093s, 991s, 942s, 785, 714, 680, 565, 500, 451, 405sh.

TiSi46 Vlasovite $Na_2ZrSi_4O_{11}$



Locality: Kipawa alkaline complex, Québec, Canada..
Description: Grey grains from the association with gittinsite and eudialyte. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1124s, 1090s, 990s, 944s, 783, 716, 680, 565, 500, 455, 408sh.

TiSi47 Vuonnemite $Na_{11}TiNb_2(Si_2O_7)_2(PO_4)_2O_3(F,OH)$

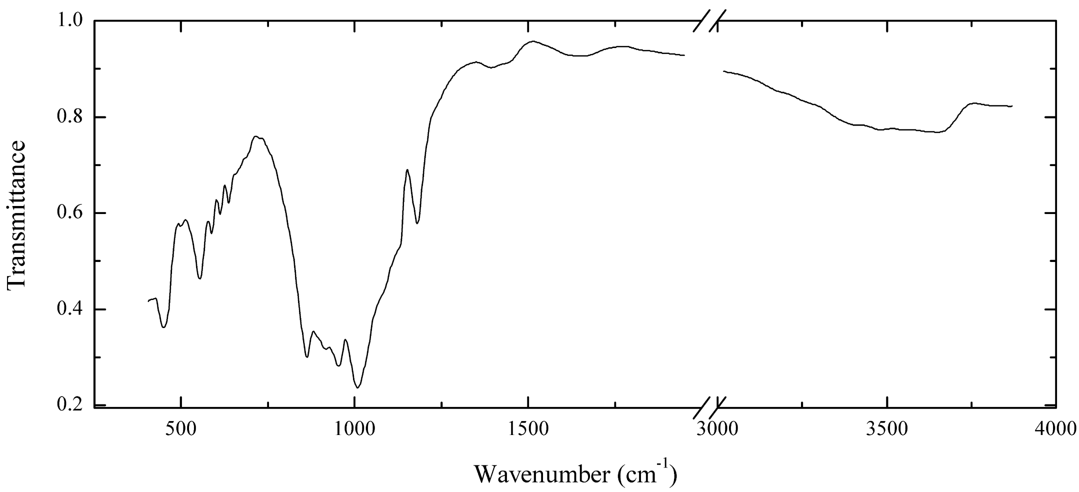


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow platy crystals from the association with villiaumite, eudialyte, lorenzenite, lamprophyllite, *etc*. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1096, 1064s, 1001, 974s, 947, 924, 866s, 853s, 707w, 596, 580, 564, 551, 515sh, 460, 445, 401.

TiSi48 Innelite $(Ba,K)_4(Na,Fe,Mn,Ca)_3Ti_3(Si_2O_7)_2(SO_4)_2O_3(OH,F)$

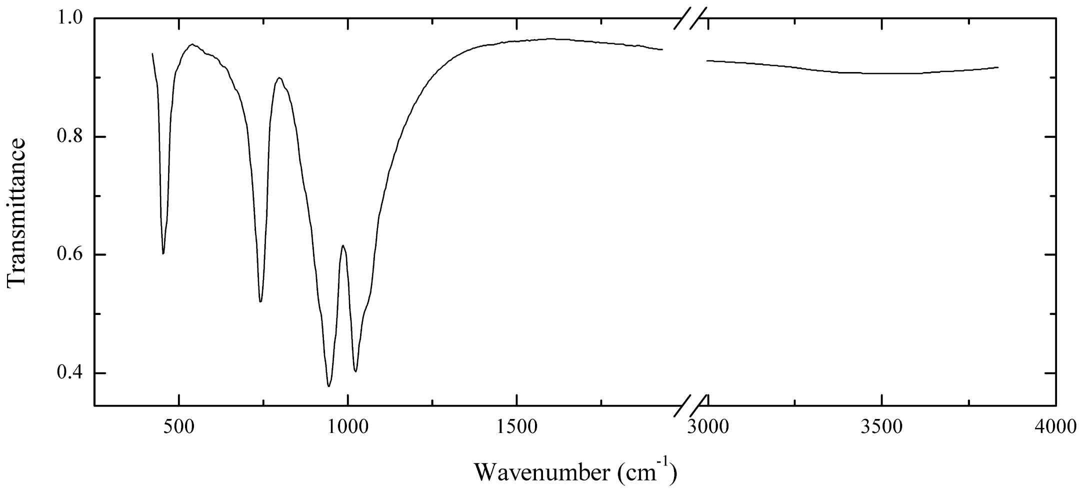


Locality: Inagli alkaline-ulthabasic massif, Sakha (Yakutia) Republic, Siberia, Russia (type locality).

Description: Brown grains from the association with natrolite, albite, lorenzenite and batisite. PO_4-rich variety. The empirical formula is (electron microprobe) $Ba_{3.89}K_{0.04}Na_{1.91}Fe_{0.54}Mg_{0.13}Mn_{0.01}Ca_{0.06}Ti_{3.29}Al_{0.11}Si_{3.83}(SO_4)_{1.00}(PO_4)_{0.90}(CO_3)_xO_3(OH,F)\cdot nH_2O$.

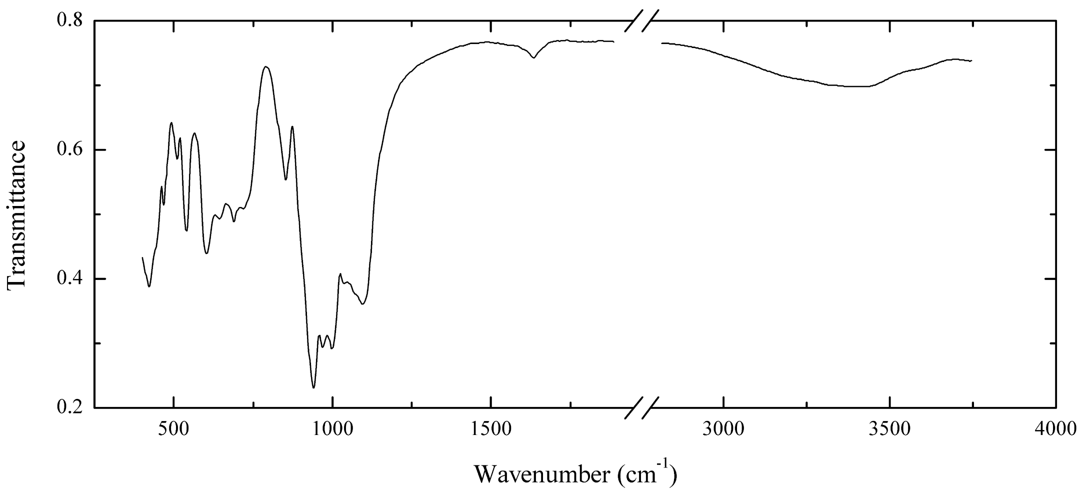
Wavenumbers (cm^{-1}): 3630, 3540, 3475, 3400w, 1675w, 1630w, 1450w, 1400w, 1187, 1132, 1085sh, 1011s, 957s, 921s, 864s, 660sh, 636, 613, 588, 553, 449s.

TiSi49 Wadeite $K_3Zr(Si_3O_9){\cdot}nH_2O$ (n ≪1)



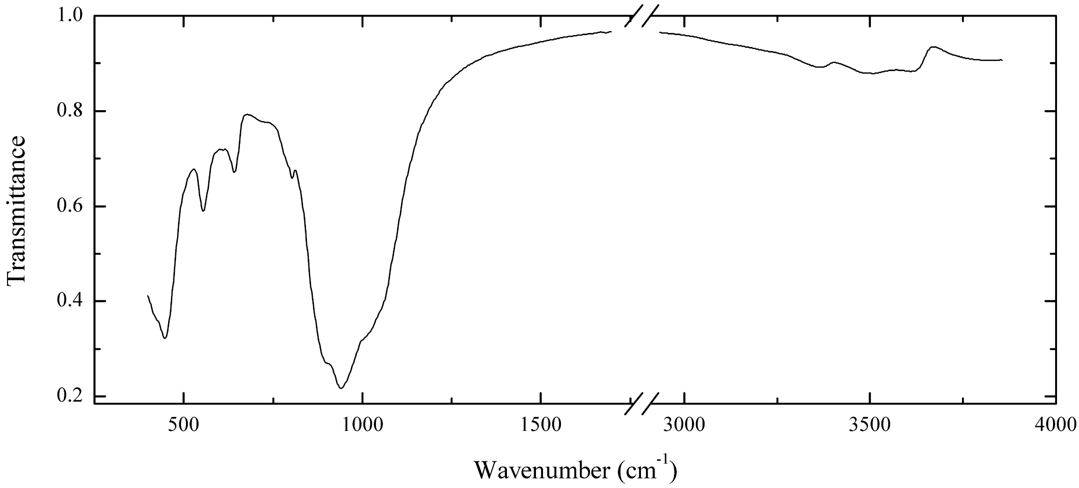
Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: White tabular crystals from the association with aegirine and natrolite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1050sh, 1018s, 938s, 738, 452.

TiSi50 Vinogradovite $(Na,Ca)_4Ti_4(Si_2O_6)_2[(Si,Al)_4O_{10}]O_4{\cdot}H_2O$



Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Pink crystals from the association with lorenzenite, lamprophyllite, catapleiite titanite and natrolite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3590sh, 3400w, 3220sh, 1645w, 1097s, 1075sh, 1033, 1005sh, 995s, 965s, 938s, 905sh, 849, 730sh, 716, 683, 642, 598, 534, 504, 468, 435sh, 419.

TiSi51 Niobokupletskite $K_2Na(Mn,Zn,Fe)_7(Nb,Zr,Ti)_2Si_8O_{26}(OH)_4(O,F)$

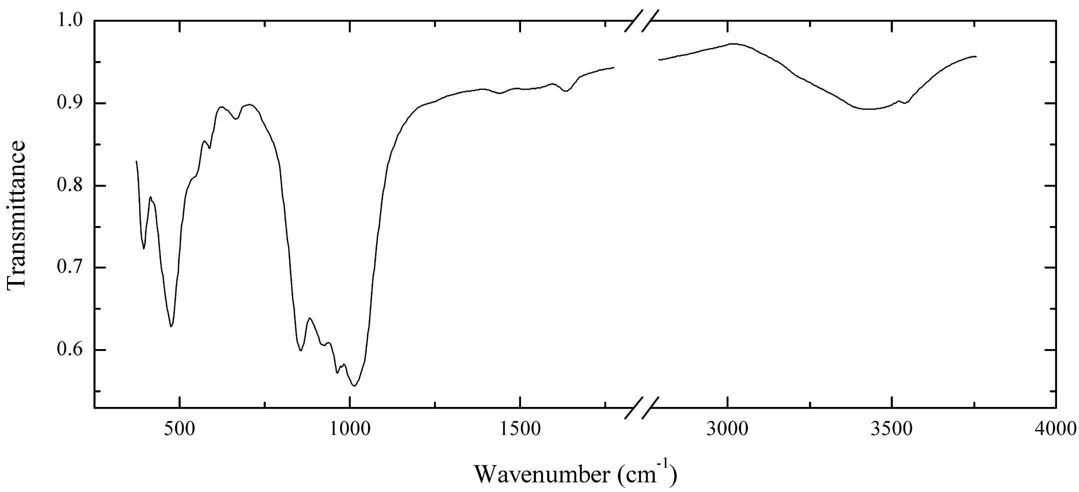


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Brown prismatic crystals from the association with calcioancylite-(Ce) and catapleiite. Confirmed by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3605, 3495, 3355, 1055sh, 1015sh, 943s, 905s, 803, 728w, 646, 556, 449s, 425sh.

TiSi52 Götzenite $Na_2Ca_5Ti(Si_2O_7)_2(F,OH)_4$

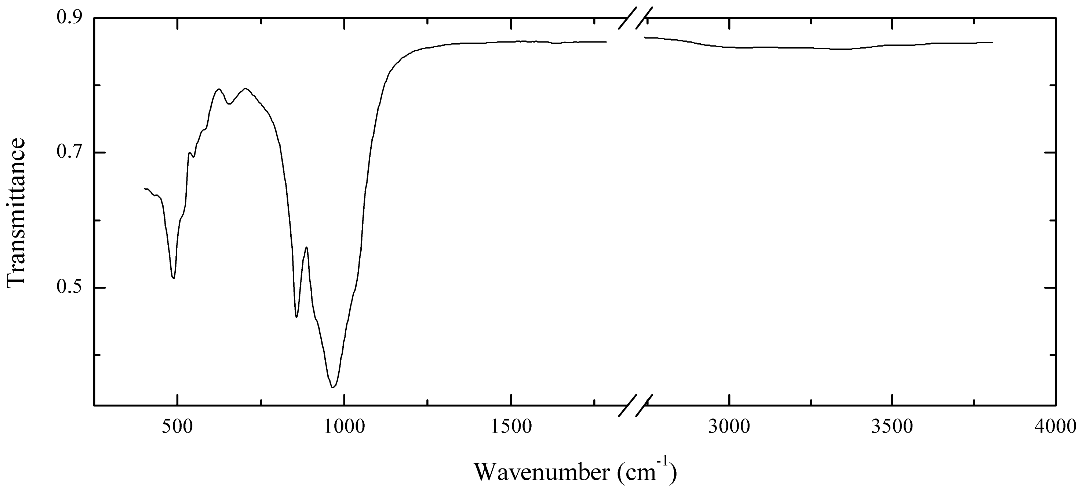


Locality: Poços de Caldas alkaline massif, Brazil.

Description: Yellow-brown coarse prismatic crystals. Hydrated variety. The empirical formula is (electron microprobe) $Na_{2.49}Ca_{3.85}Mn_{0.10}Sr_{0.07}Ba_{0.04}K_{0.03}(Ti_{1.51}Zr_{0.39}Fe_{0.10})Si_{4.00}O_{14}F_{3.87}(OH,H_2O)_x$. Confirmed by IR spectrum.

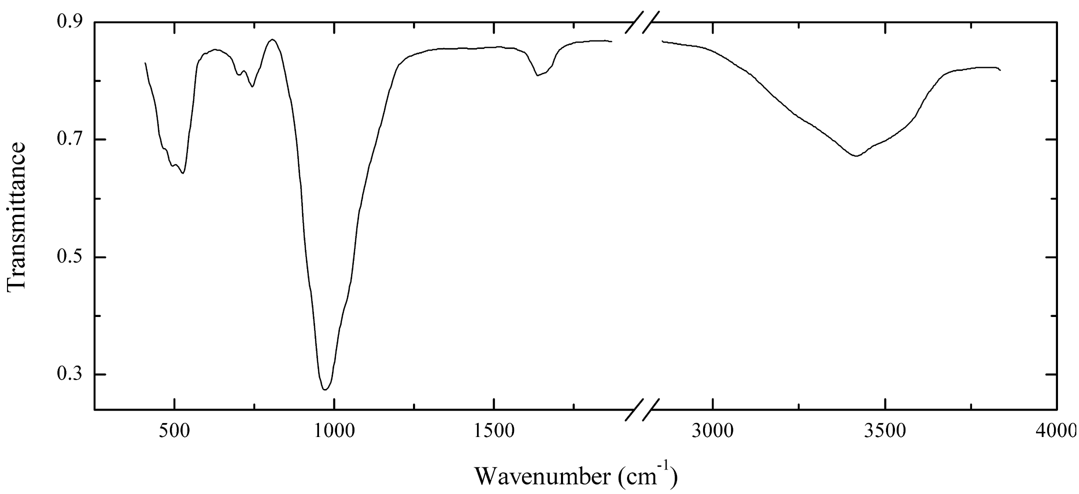
Wavenumbers (cm^{-1}): 3535, 3430, 1635w, 1455w, 1015s, 965s, 924s, 857s, 663w, 585, 540sh, 474s, 395.

TiSi53 Rinkite $(Ca,Ce)_4Na(Na,Ca)_2Ti(Si_2O_7)_2F_2(O,F)_2$



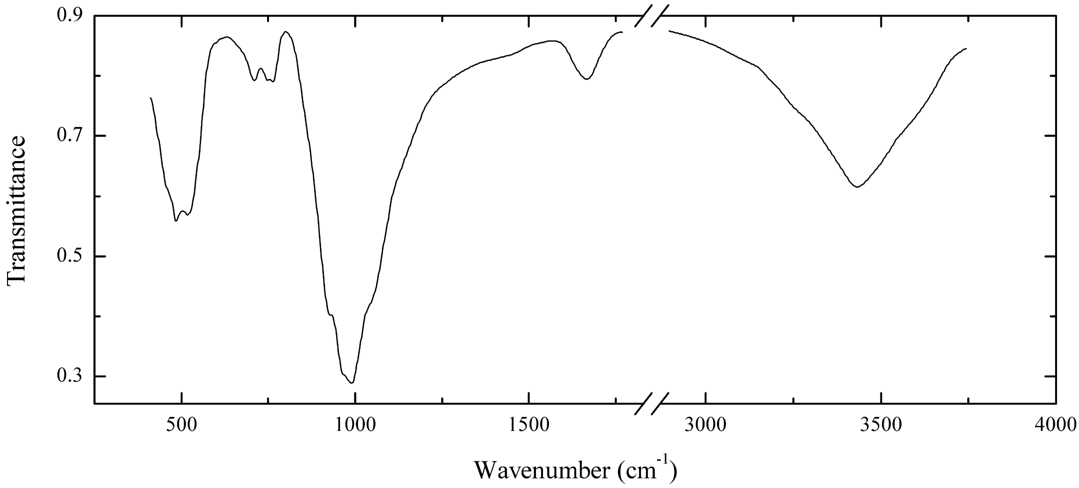
Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Yellow coarse platy crystals. Investigated by P.M. Kartashov. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1030sh, 978s, 930sh, 870s, 660, 585, 557, 515sh, 486s, 435.

TiSi54 Gaidonnayite $Na_2Zr(Si_3O_9){\cdot}2H_2O$



Locality: Shkatulka pegmatite, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Lilac grains from the association with terskite, eudialyte and ussingite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3550sh, 3435, 3300sh, 1660sh, 1640, 1040sh, 974s, 759sh, 743, 698, 523, 486, 460sh.

TiSi55 Gaidonnayite $Na_2Zr(Si_3O_9)\cdot 2H_2O$

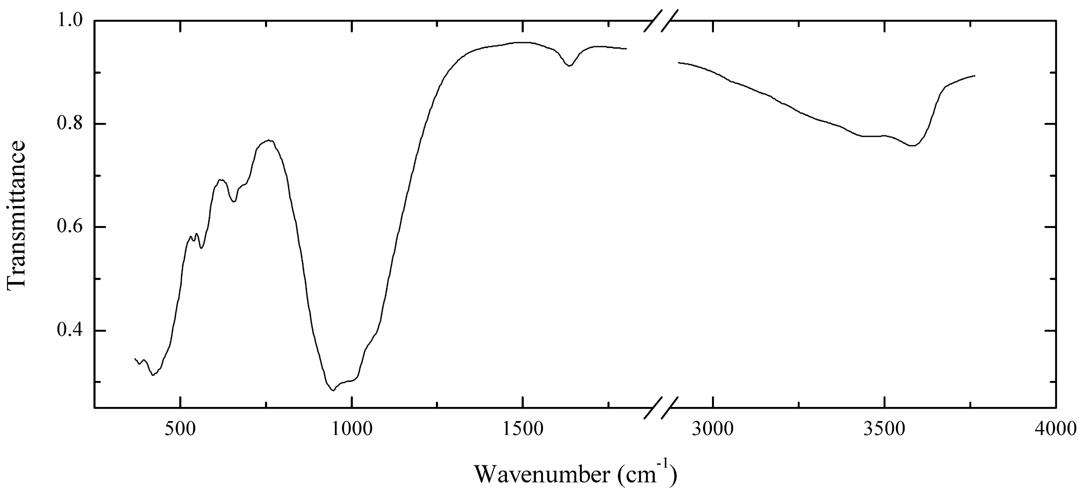


Locality: Shkatulka pegmatite, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Lilac pseudomorph after eudialyte from the association with terskite, amphibole, aegirine and ussingite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3550sh, 3425, 1665, 1050sh, 989s, 965sh, 925s, 761, 743, 705, 540sh, 517, 485, 450sh.

TiSi56 Hydroastrophyllite $(H_3O,H_2O,K,Ca)_3(Fe^{3+},Mn,\square)_7(Ti,Nb)_2(Si,\square)_8(O,OH,F)_{31}$?

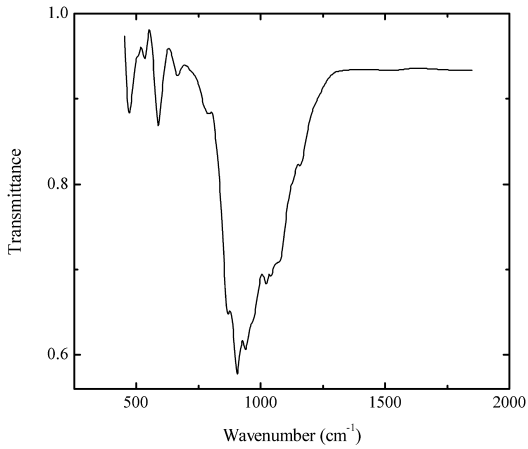


Locality: Verkhnee Espe deposit, Akzhaylyautas Mts., Tarbagatai range, Eastern Kazakhstan region, Kazakhstan.

Description: Brown grains. Investigated by I.V. Pekov.

Wavenumbers (cm^{-1}): 3560, 3450sh, 1628w, 1070sh, 1050sh, 1006s, 941s, 680sh, 650, 560, 535, 455sh, 435s, 406s.

TiSi57 Gittinsite $CaZrSi_2O_7$

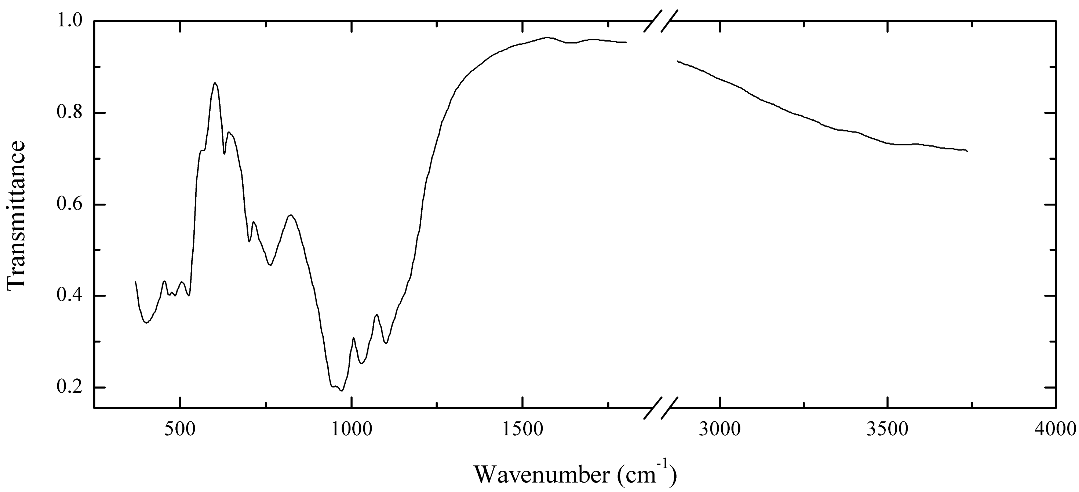


Locality: Kipawa alkaline complex, Québec, Canada.

Description: White aggregate from the association with vlasovite and eudialyte. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1160, 1075sh, 1043, 1023, 965sh, 938s, 905s, 870s, 795, 665, 594, 535, 500sh, 475.

TiSi58 Noonkanbahite $NaKBaTi_2(Si_4O_{12})O_2$

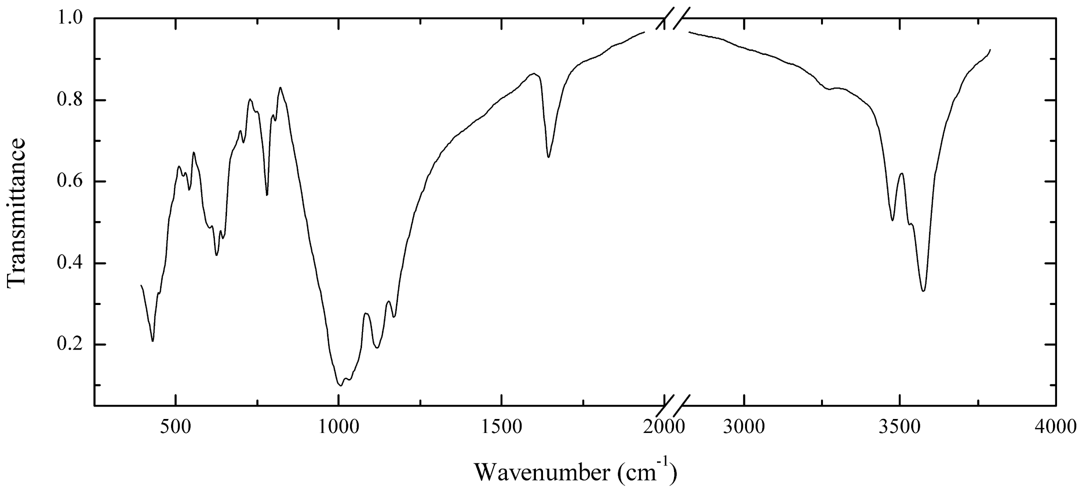


Locality: Malyi Murun (Malomurunskiy) alkaline pluton, Irkutsk region, Eastern Siberia, Russia (cotype locality).

Description: Brown grains from the association with kalsilite and aegirine. Identified by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 1150sh, 1105s, 1035s, 976s, 952s, 769, 706, 635, 574w, 523, 484, 469, 407.

TiSi60 Elpidite $Na_2Zr(Si_6O_{15})\cdot3H_2O$

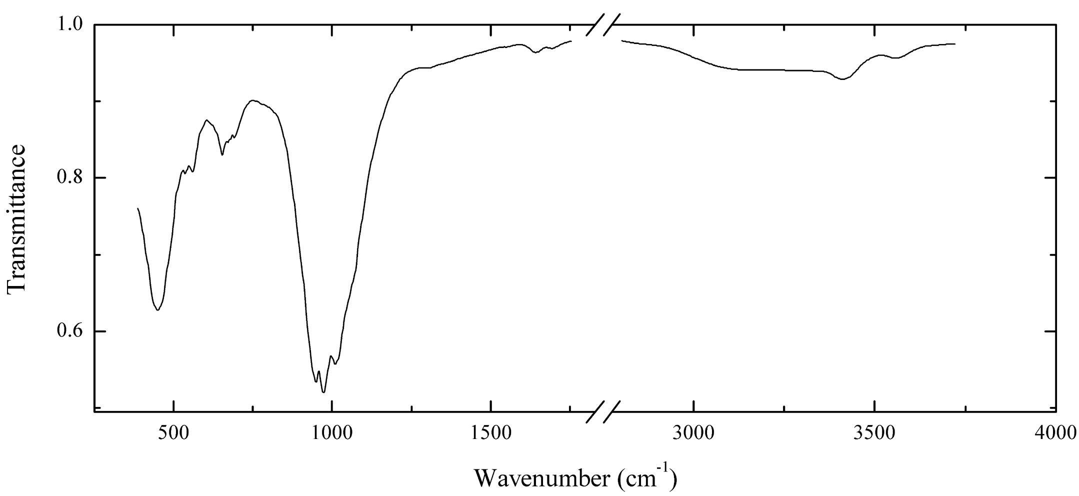


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Clusters of colourless acicular crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3550, 3505, 3450, 3245w, 1645, 1168s, 1114s, 1050sh, 1031s, 1009s, 808w, 778, 741w, 709, 645, 626, 599, 542, 522, 490sh, 460sh, 450sh, 430.

TiSi61 Astrophyllite $K_2Na(Fe^{2+},Mn)_7Ti_2Si_8O_{24}(OH,O,F)_7$

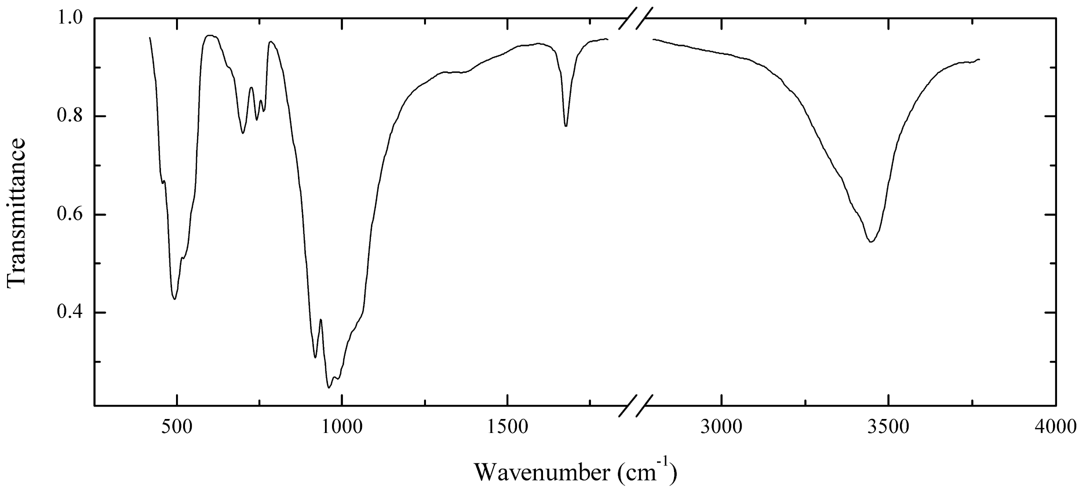


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark brown massive from the association with aegirine, fluorite and catapleiite. Al-rich, K-deficient variety. The empirical formula is (electron microprobe) $[K_{1.14}(H_3O,H_2O)_x](Na_{0.69}Ca_{0.16})(Fe_{5.54}Al_{0.78}Mg_{0.55}Mn_{0.18})(Ti_{1.30}Fe_{0.41}Nb_{0.19})Si_{8.00}O_{24}(OH,O,F)_7$.

Wavenumbers (cm^{-1}): 3390, 1050sh, 1016s, 973s, 947s, 685sh, 654, 561, 542, 437.

TiSi62 Georgechaoite $KNaZr(Si_3O_9){\cdot}2H_2O$

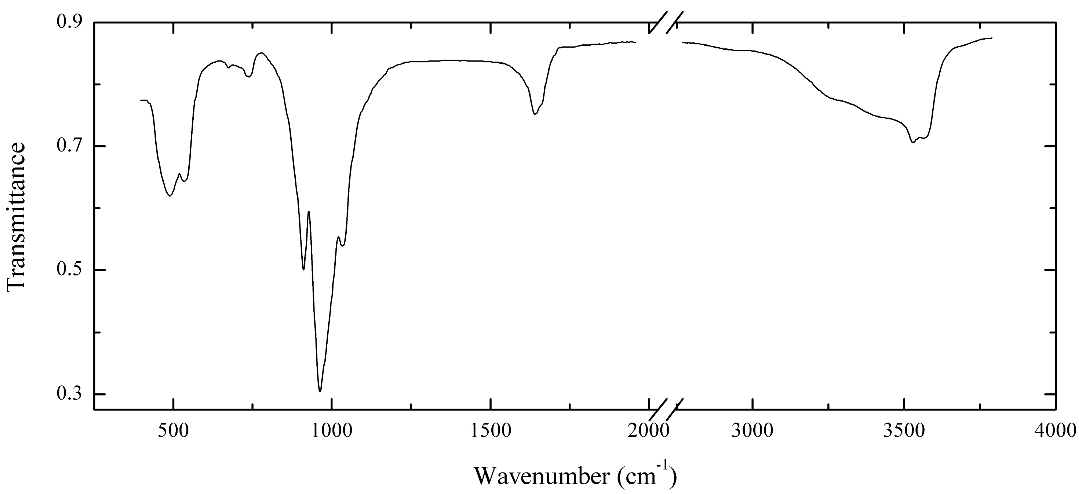


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless crystals from a pseudomorph after eudialyte. Investigated by I.V. Pekov. K:Na ≈ 0.75:1.25 in atomic units. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3415, 3380sh, 3330sh, 1670, 1360w, 1050sh, 985s, 956s, 916s, 763, 740, 698, 655sh, 545sh, 517, 490s, 485sh, 450.

TiSi63 Komkovite $BaZr(Si_3O_9){\cdot}3H_2O$



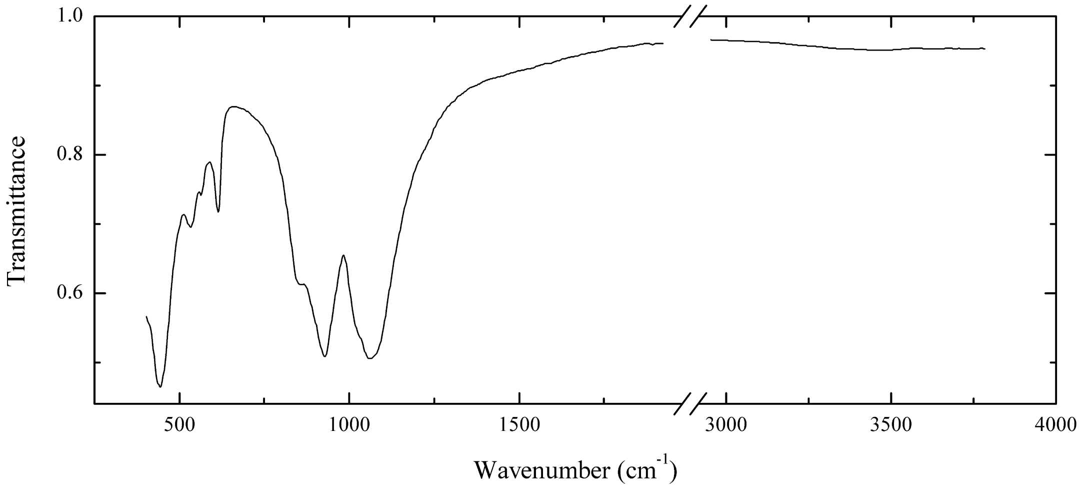
Locality: Vuoriyarvi alkaline–ultrabasic massif, Northern Karelia, Russia (type locality).

Description: Brown crystals from the association with dolomite, strontianite, phlogopite, barite, georgechaoite and pyrite. Holotype sample. Trigonal, space group *R*32, $a = 10.526(6)$, $c = 15.736(9)$ Å, $Z = 6$. Optically uniaxial (–), $\omega = 1.671(1)$, $\varepsilon = 1.644(1)$. $D_{meas} = 3.31(5)$ g/cm^3, $D_{calc} = 3.31$ g/cm^3. The empirical formula is $(Ba_{0.95}K_{0.01}Ca_{0.01}K_{0.01})Fe_{0.02}Zr_{1.04}Hf_{0.01}Si_{2.95}O_9{\cdot}3.08H_2O$.

Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 5.23 (100), 3.59 (80), 3.02 (80), 2.96 (90), 2.57 (60), 2.106 (60).

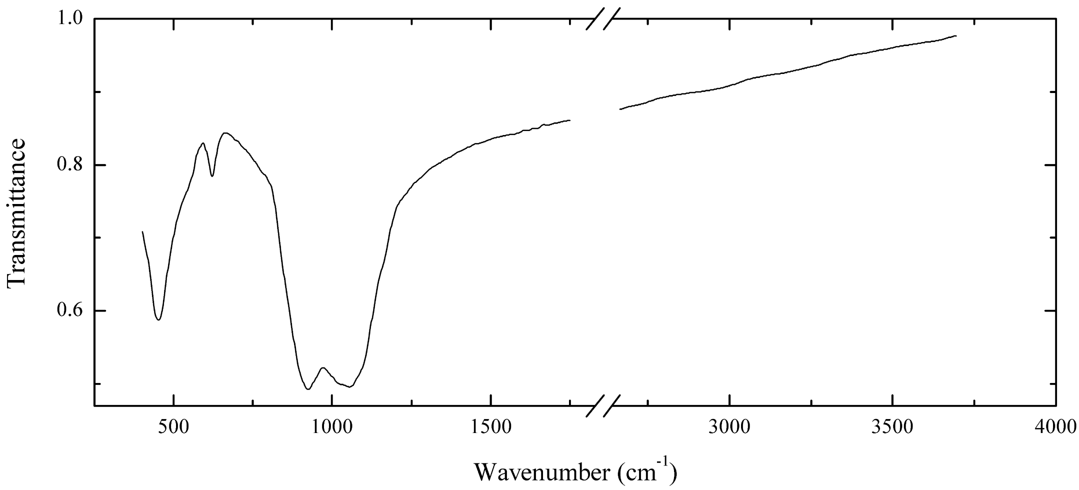
Wavenumbers (cm^{-1}): 3530, 3495, 3410sh, 3265sh, 1660sh, 1635, 1033, 980sh, 961s, 912s, 738, 682w, 537, 498, 480sh.

TiSi65 Kazakovite $Na_6MnTi(Si_6O_{18})$



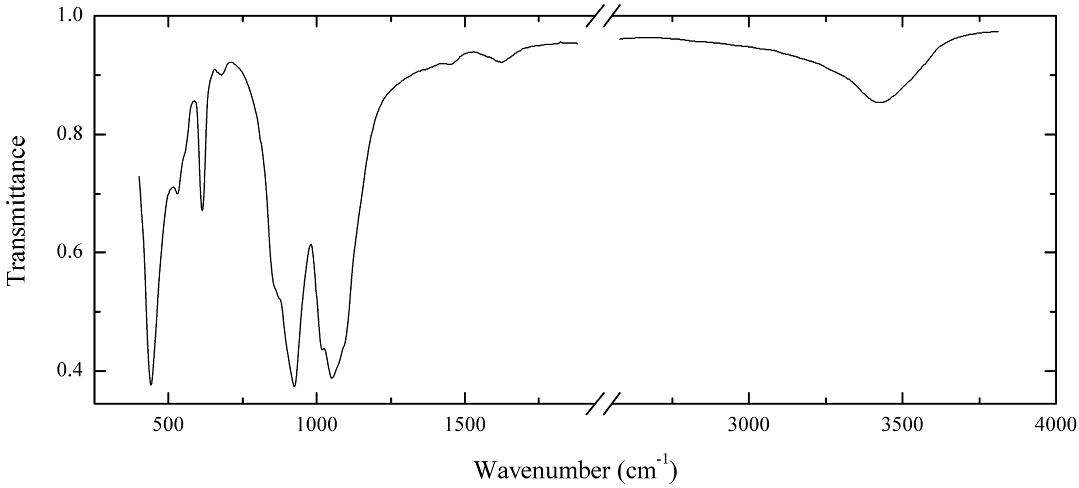
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Yellow crystals from peralkaline pegmatite. The empirical formula is (electron microprobe) $(Na_{5.7}K_{0.2})(Mn_{0.4}Fe_{0.3}Ca_{0.2})(Ti_{0.7}Zr_{0.2}Nb_{0.1})(Si_{6.0}O_{18})$.
Wavenumbers (cm^{-1}): 1063, 1027sh, 930s, 859, 623, 566, 537, 449s, 410sh.

TiSi66 Kazakovite $Na_6MnTi(Si_6O_{18})$



Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Brown crystals from peralkaline pegmatite, from the association with raslakite, terskite, microcline and aegirine. The empirical formula is (electron microprobe) $Na_{5.1}Mn_{0.7}Fe_{0.3}Ca_{0.1}(Ti_{0.6}Zr_{0.3})(Si_{6.0}O_{18})$.
Wavenumbers (cm^{-1}): 1150sh, 1058s, 1030sh, 923s, 760sh, 619, 540sh, 447s.

TiSi67 Koashvite $Na_6(Ca,Mn)_{1+x}(Ti,Fe^{3+})(Si_6O_{18})\cdot nH_2O$

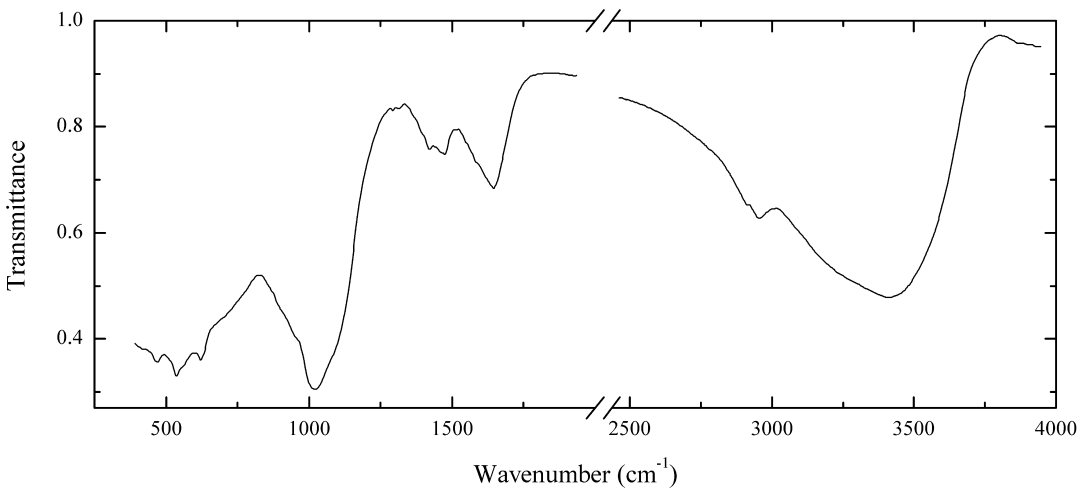


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Yellow grains from the association with lomonosovite, pectolite, villiaumite and natrophosphate. Holotype sample. Orthorhombic, space group *Pmnb*, $a = 10.179(1)$, $b = 20.899(2)$, $c = 7.335(1)$ Å, $Z = 4$. Optically biaxial (−), $\alpha = 1.637$, $\beta = 1.643$, $\gamma = 1.648$, $2V_{meas} = 83°$. $D_{meas} = 3.00(2)$ g/cm^3, $D_{calc} = 3.07$ g/cm^3. The empirical formula is $Na_{6.2}(Ca_{0.9}Mn_{0.4}Fe_{0.1}Mg_{0.1})(Ti_{0.45}Fe_{0.35})(Si_{6.0}O_{18})\cdot 0.4H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.66 (50), 3.28 (50), 2.620 (40), 2.581 (100), 1.820 (70), 1.504 (50), 1.476 (40).

Wavenumbers (cm^{-1}): 3420, 1620w, 1445w, 1100sh, 1080sh, 1058s, 1028s, 930s, 875sh, 860sh, 683w, 616, 555sh, 530, 442s.

TiSi68 Karnasurtite-(Ce) $(Ce,La,Th)(Ti,Nb)(Al,Fe^{3+})(Si,P)_2O_7(OH)_4\cdot 3H_2O$ (?)

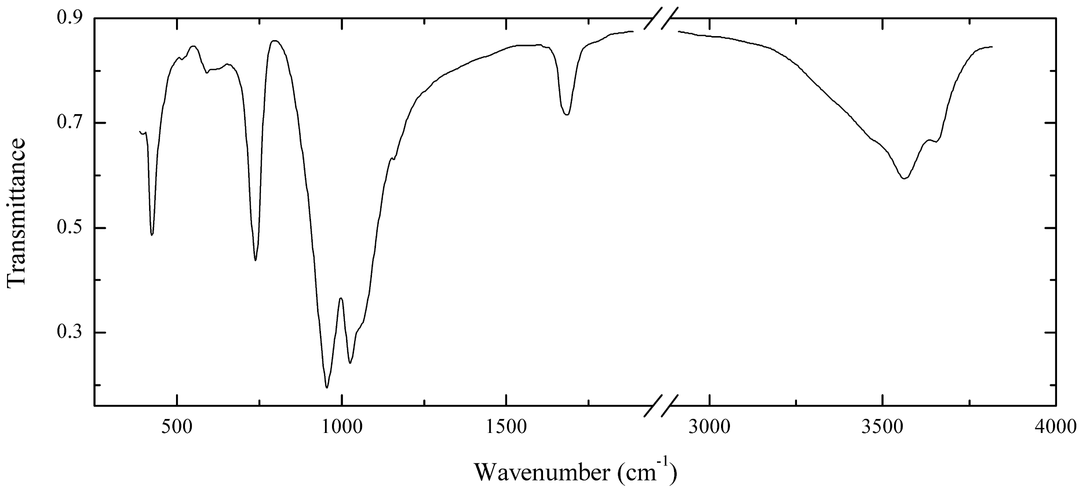


Locality: Pegmatite No. 62, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange-yellow hexagonal plates from the association with natrolite, sodalite, polylithionite and Mn^{4+}-oxides. Identified by IR spectrum and semiquantitative electron microprobe analysis. The bands at 1,310, 14,010, 1,460, 1,580, 2,855and 2,924 cm^{-1} correspond to inclusions of bituminous substance.

Wavenumbers (cm^{-1}): 3370, 3250sh, 2924, 2850sh, 1670sh, 1635, 1580sh, 1460, 1410, 1310w, 1080sh, 1019s, 960sh, 675sh, 620, 535s, 464, 435sh.

TiSi69 Catapleiite $Na_2Zr(Si_3O_9)\cdot 2H_2O$

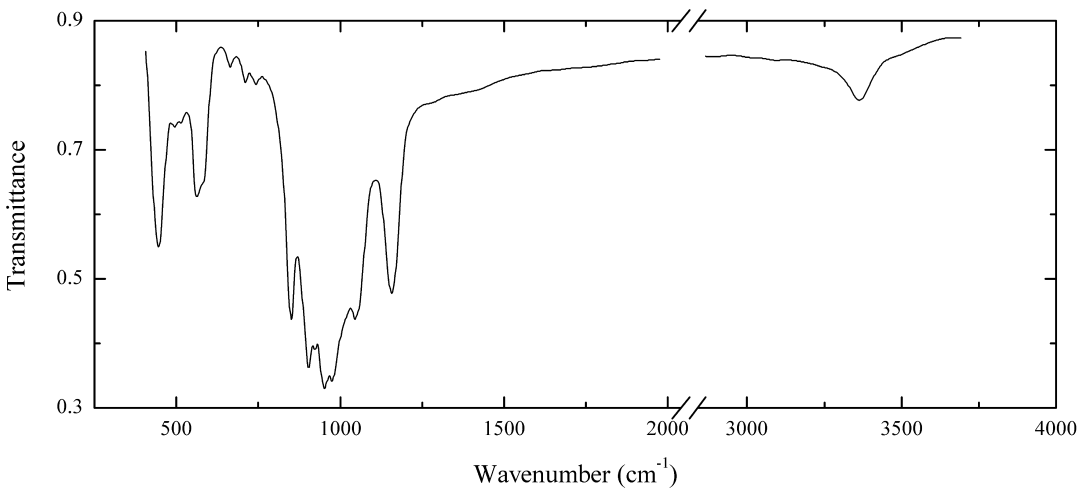


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless tabular crystal from the association with natrolite, albite, aegirine, trioctahedral Fe-rich mica, taeniolite, microcline, lorenzenite and sphalerite. Investigated by I.V. Pekov. Confirmed by IR spectrum.

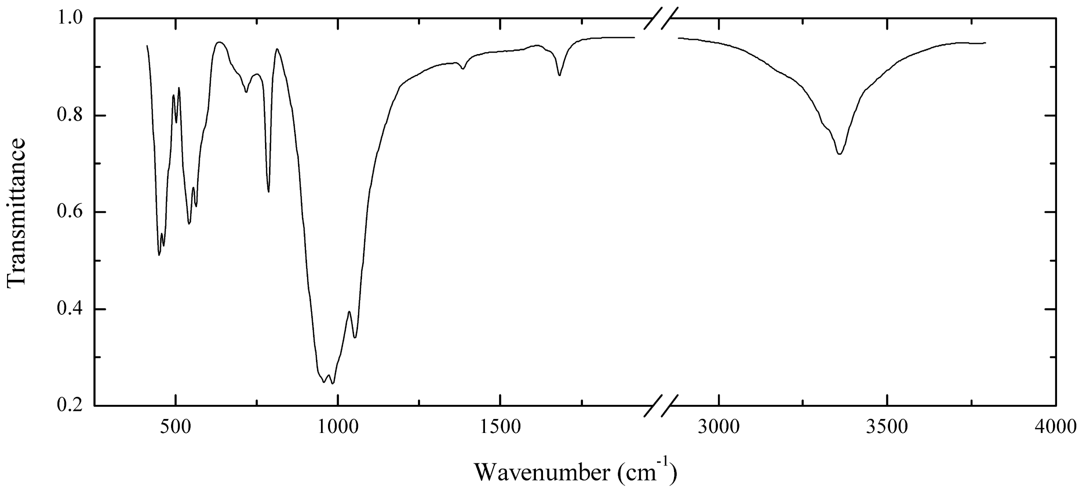
Wavenumbers (cm^{-1}): 3577, 3489, 3410sh, 1660, 1146, 1050sh, 1019s, 949s, 737, 610sh, 586, 523w, 425, 395w.

TiSi70 Keldyshite $NaZr[Si_2O_6(OH)]$



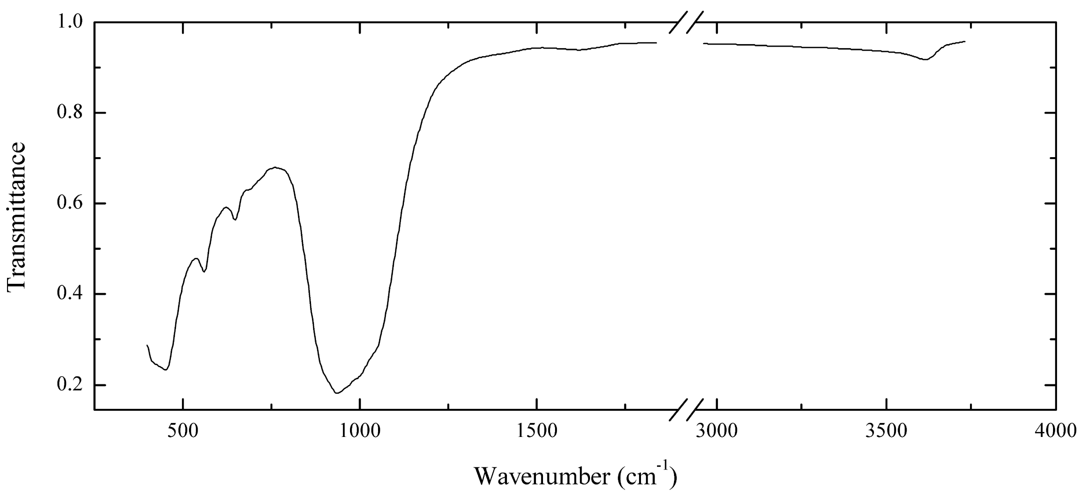
Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: White massive, pseudomorph after parakeldyshite. Associated minerals are microcline, sodalite, aegirine, eudialyte, catapleiite and loparite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3330, 1152s, 1044s, 972s, 947s, 919s, 901s, 847s, 740w, 705w, 661w, 575sh, 560, 513w, 496w, 443.

TiSi72 Kostylevite $K_2Zr(Si_3O_9)\cdot H_2O$



Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Prismatic crystals from the association with umbite. Investigated by A.P. Khomyakov.
Wavenumbers (cm^{-1}): 3355, 3310sh, 1675, 1380w, 1045s, 1000sh, 976s, 948s, 935sh, 786, 716, 685sh, 590sh, 562, 541, 530sh, 502, 480sh, 463, 450.

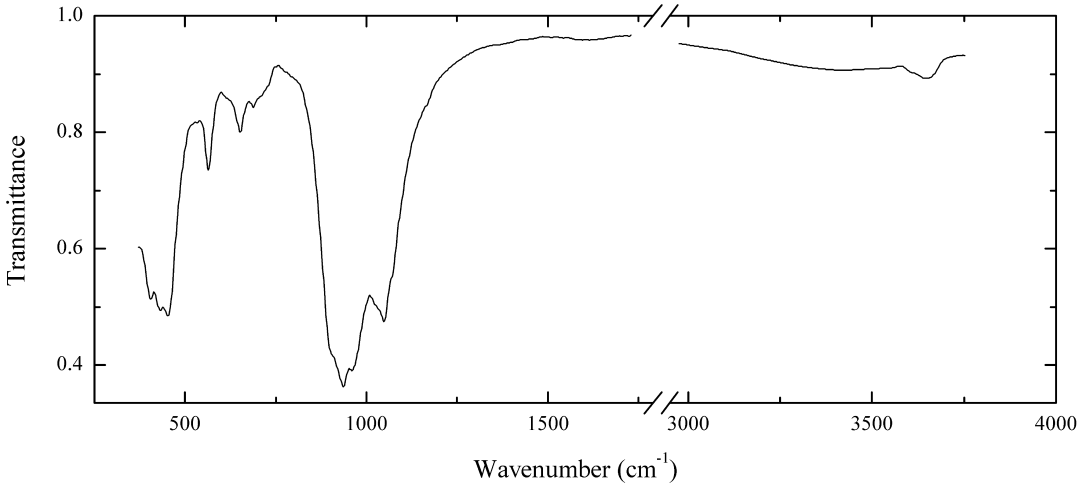
TiSi73 Kupletskite $K_2Na(Mn,Fe^{2+})_7(Ti,Nb)_2Si_8O_{24}(OH,O,F)_7$



Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

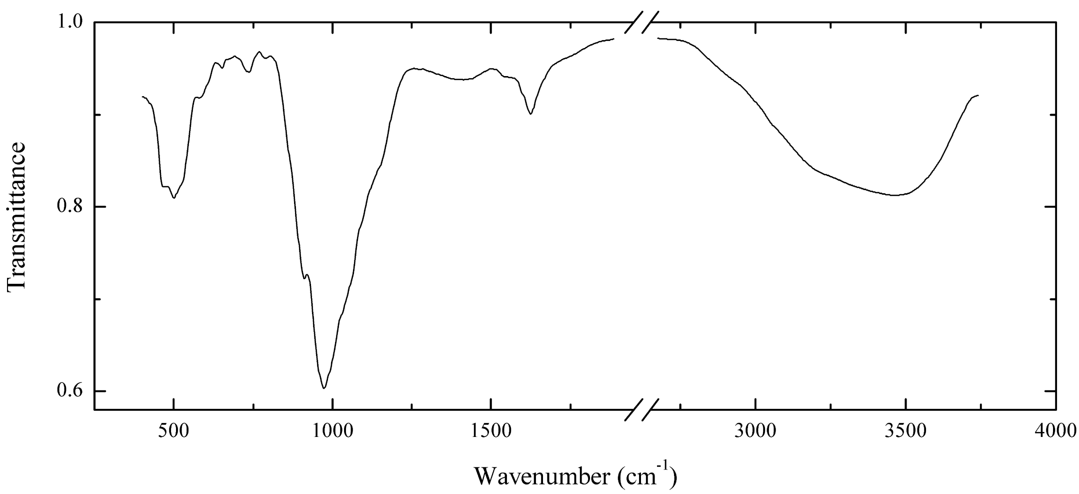
Description: Dark brown crystal from the association with natrolite. The empirical formula is (electron microprobe) $K_{1.7}Na_{0.8}Ca_{0.2}(Mn_{3.9}Fe_{2.4}Mg_{0.3}Al_{0.2})(Ti_{1.9}Nb_{0.2})Si_{8.0}O_{24}(OH,O,F)_7$.
Wavenumbers (cm^{-1}): 3610w, 1045sh, 990sh, 941s, 905sh, 680sh, 647, 559, 449s, 430sh.

TiSi74 Kupletskite $K_2Na(Mn,Fe^{2+})_7(Ti,Nb)_2Si_8O_{24}(OH,O,F)_7$



Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Dark brown single-crystal plate from the association with natrolite, fluorapatite and tsepinite-Na. Identified by IR spectrum and semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3625, 1065sh, 1047s, 1025sh, 959s, 935s, 905sh, 710sh, 689w, 649, 563, 453s, 430s, 411s.

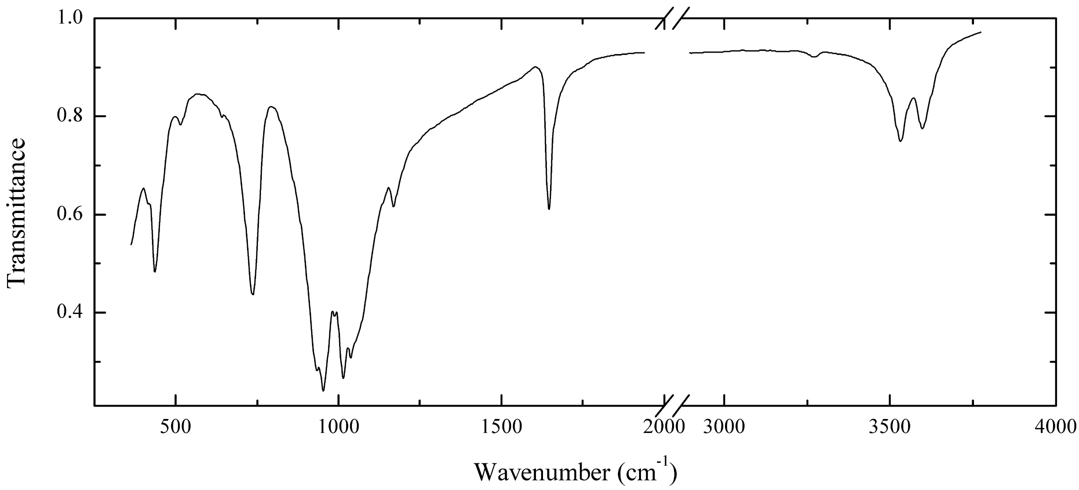
TiSi75 Calciohilairite $CaZrSi_3O_9 \cdot 3H_2O$



Locality: Flora Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brownish crystals from the association with natrolite, aegirine, lorenzenite, epididymite, fluorapatite, pyrite, kuzmenkoite-Mn, labuntsovite-Mn, organovaite-Mn and vuoriyarvite-K. Identified by IR spectrum and electron microprobe analysis. The empirical

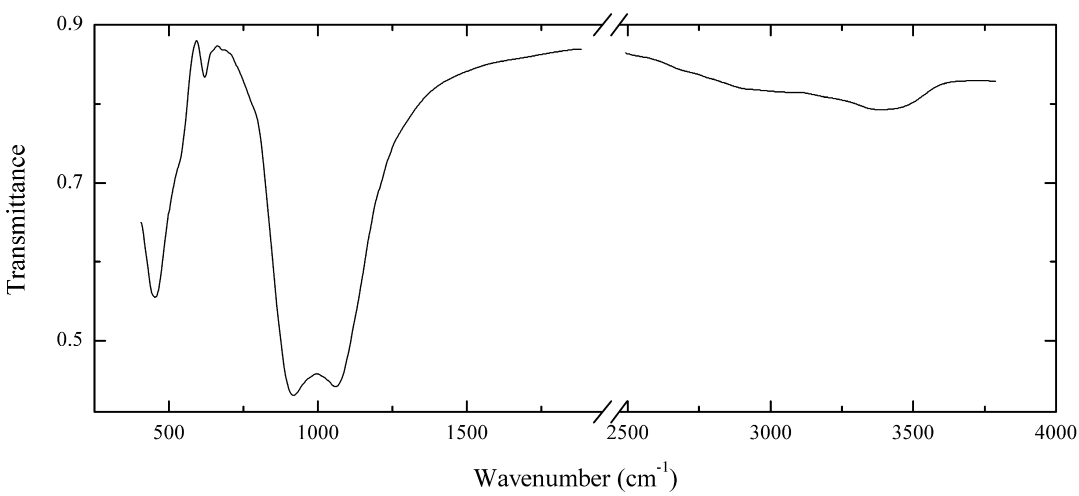
formula is $H_{0.05}Ca_{0.65}K_{0.2}Zr_{1.0}Ti_{0.05}Nb_{0.05}Si_{3.0}O_9 \cdot nH_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 6.02 (90), 5.20 (90), 3.15 (100), 3.01 (100), 2.60 (40), 1.99 (50).
Wavenumbers (cm^{-1}): 3460, 3360sh, 3230sh, 1632, 1450w, 1160sh, 1090sh, 1035sh, 976s, 915, 788w, 740w, 648w, 585w, 525sh, 496, 475.

TiSi76 Calciocatapleiite $CaZrSi_3O_9 \cdot 2H_2O$



Locality: Burpala (Burpalinskii) alkaline massif, Transbaikal territory, Siberia, Russia (type locality).
Description: Beige massive from the association with pyrophanite, pyrochlore, titanian låvenite, loparite-(Ce), kupletskite, fluorapatite, hiortdahlite, seidozerite, leucophane and microcline. Identified by IR spectrum and electron microprobe analysis. Close to the endmember $CaZrSi_3O_9 \cdot 2H_2O$. The crystal structure is solved. Orthorhombic, space group *Pbnn*, $a = 7.378(1)$, $b = 12.779(1)$, $c = 10.096(1)$ Å, $Z = 2$.
Wavenumbers (cm^{-1}): 3575, 3510, 3250w, 1645, 1168, 1055sh, 1035s, 1012s, 986, 952s, 936s, 737, 640w, 516w, 445sh, 433.

TiSi77 Kapustinite $Na_{5.5}Mn_{0.25}ZrSi_6O_{16}(OH)_2$

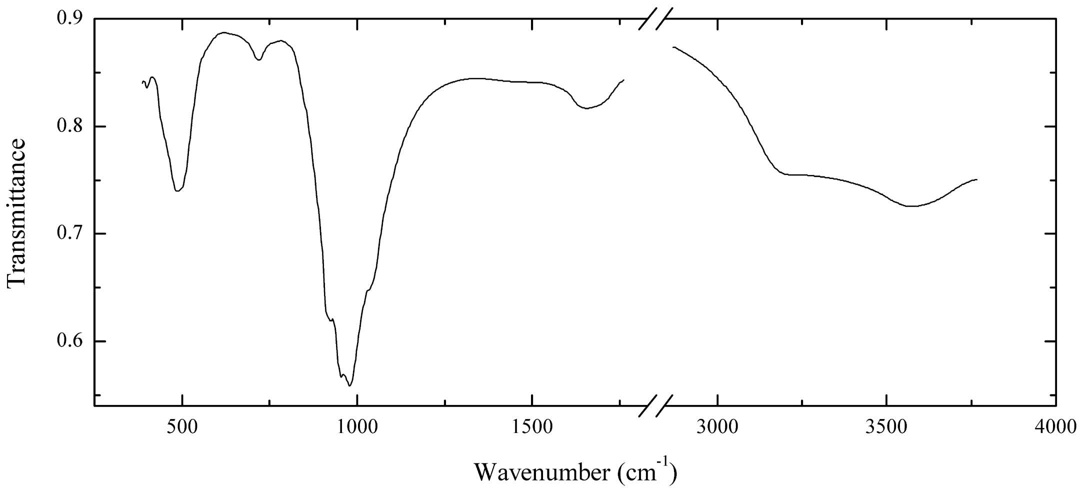


Locality: Palitra ("Palette") pegmatite, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Cherry-coloured grains from the association with microcline, aegirine, eudialyte, lorenzenite, arfvedsonite, nepheline, sodalite, analcime, ussingite, natrolite, natrosilite, manaksite, serandite, villiaumite, lomonosovite, vuonnemite, kazakovite, sphalerite, steenstrupine-(Ce), vitusite-(Ce), nordite-(Ce), ferronordite-(Ce), phosinaite-(Ce), barytolamprophyllite, manganneptunite, chkalovite, nalipoite, revdite, loellingite, *etc*. Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/m$, $a = 10.693(4)$, $b = 10.299(4)$, $c = 7.373(4)$ Å, $\beta = 91.91(5)°$, $Z = 2$. Optically biaxial (−), $\alpha = 1.585(2)$, $\beta \approx \gamma = 1.589(2)$. $D_{meas} = 2.78(1)$ g/cm^3, $D_{calc} = 2.815$ g/cm^3. The empirical formula is $Na_{5.38}Y_{0.01}Ce_{0.01}Nd_{0.01}U_{0.01}Ca_{0.02}Mn_{0.23}Fe_{0.03}Ti_{0.05}Zr_{0.91}Si_6O_{15.91}(OH)_{2.12}$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.66 (50), 3.28 (50), 2.620 (40), 2.581 (100), 1.820 (70), 1.504 (50), 1.476 (40).

Wavenumbers (cm^{-1}): 3400, 3050sh, 1056s, 915s, 613, 540sh, 446.

TiSi78 Hilairite $Na_2ZrSi_3O_9 \cdot 3H_2O$

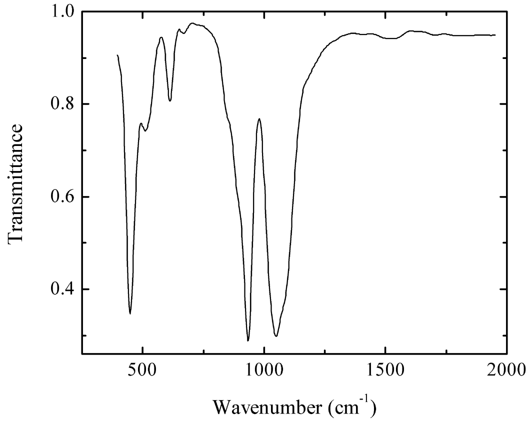


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Beige crystals from the association with neighborite. Investigated by A.P. Khomyakov. Optically uniaxial (−), $\varepsilon = 1.595$, $\omega = 1.609$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3175, 1670, 1045sh, 982s, 956s, 923s, 728, 493s, 455sh.

TiSi79 Imandrite $Na_{12-x}Ca_3(Fe^{3+},Ti)_2(Si_6O_{18})_2$

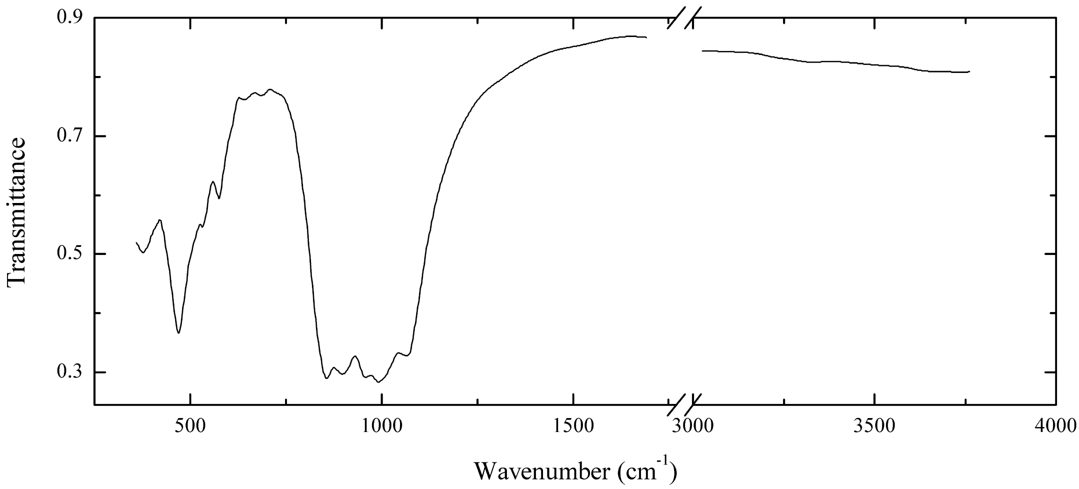


Locality: Vuonnemiok River area, Khibiny alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Honey-yellow grains from the association with eudialyte, aegirine, orthoclase, alkalic amphibole and pectolite. Holotype sample. Orthorhombic, space group *Pmnn*, $a = 10.331(4)$, $b = 10.546(1)$, $c = 7.426(4)$ Å, $Z = 1$. Optically biaxial (+), $\alpha = 1.605$, $\beta = 1.608$, $\gamma = 1.612$, $2V_{meas} = 75°$. $D_{meas} = 2.93$ g/cm^3, $D_{calc} = 2.92$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.73 (50), 3.33 (60), 2.63 (100), 1.853 (70), 1.520 (50).

Wavenumbers (cm^{-1}): 1080sh, 1051s, 937s, 895sh, 850sh, 675w, 614, 520sh, 511, 452s.

TiSi80 Hiortdahlite I $(Na,Ca)_2Ca_4Zr(Y,Zr,Mn,Fe)(Si_2O_7)_2(F,O)_4$

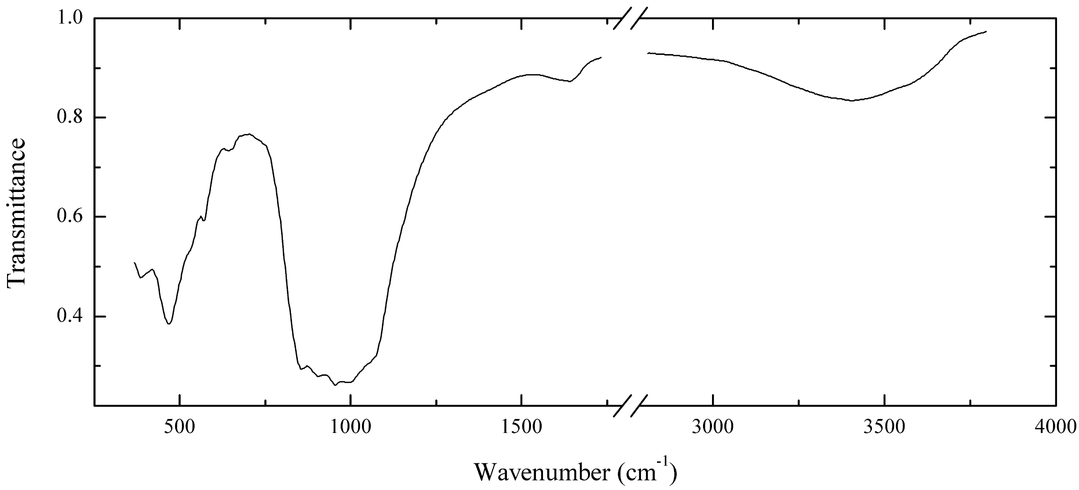


Locality: Langesundsfjord, Norway (type locality).

Description: Honey-yellow grains from the association with feldspar, biotite, meliphanite and titanite. Identified by IR spectrum and electron microprobe analysis.

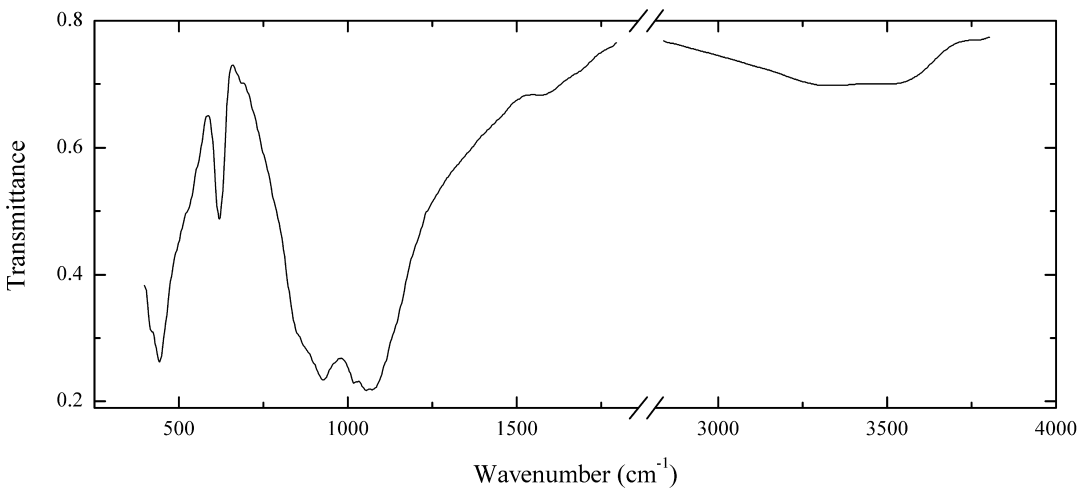
Wavenumbers (cm^{-1}): 1070s, 996s, 961s, 904s, 861s, 696w, 654w, 576, 530, 510sh, 471, 399.

TiSi81 Hiortdahlite I $(Na,Ca)_2Ca_4Zr(Y,Zr,Mn,Fe)(Si_2O_7)_2(F,O)_4$



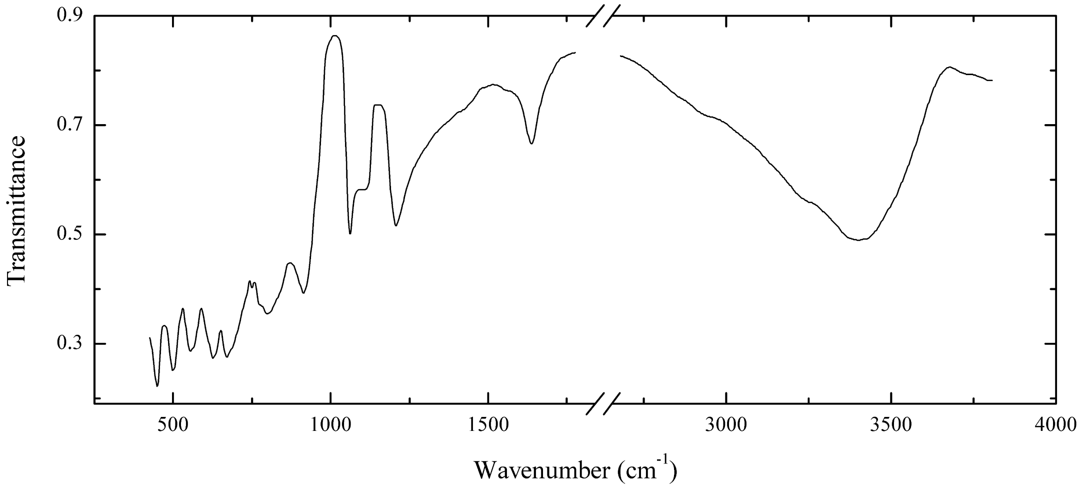
Locality: Korgeredaba, Tuva, Russia.
Description: Yellowish-brown grains. Investigated by V.I. Stepanov. A hydrated Na-deficient variety. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3400, 1640w, 1065sh, 994s, 964s, 907s, 862s, 652w, 575, 530sh, 471, 401.

TiSi82 Koashvite $Na_6(Ca,Mn)_{1+x}(Ti,Fe^{3+})(Si_6O_{18})\cdot nH_2O$



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Brownish-yellow grains from peralkaline pegmatite. Investigated by I.V. Pekov.
Wavenumbers (cm^{-1}): 3500, 3320, 1590w, 1067s, 1023s, 931s, 850sh, 620, 525sh, 445, 420sh.

TiSi83 "Kovalenkoite" $(K,Sr,Ba)_2Ca_5Nb_{12}Si_8O_{52}(O,OH)\cdot 15H_2O$ (?)

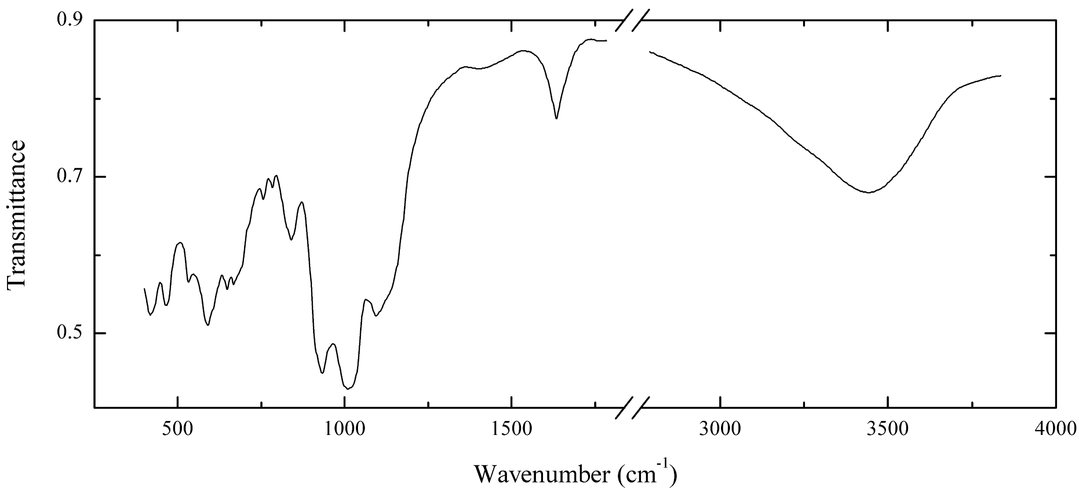


Locality: Khan Bogdo massif, Gobi desert, Mongolia (type locality).

Description: Brownish-lilac granular aggregate from alkaline granite pegmatite. Oxosilicate with pyrochlore-type module. Tetragonal, $a = 3.684$, $c = 6.012$ Å. Needs further investigation.

Wavenumbers (cm^{-1}): 3415, 3250sh, 2970sh, 1642, 1208, 1100sh, 1060, 913, 800, 775sh, 670s, 625s, 555s, 502s, 448s.

TiSi84 "Komarovite-Sr" $(Sr,Ca,Na)_x(Nb,Ti)_6Si_4O_{26}(OH,F)_2\cdot nH_2O$ (?)

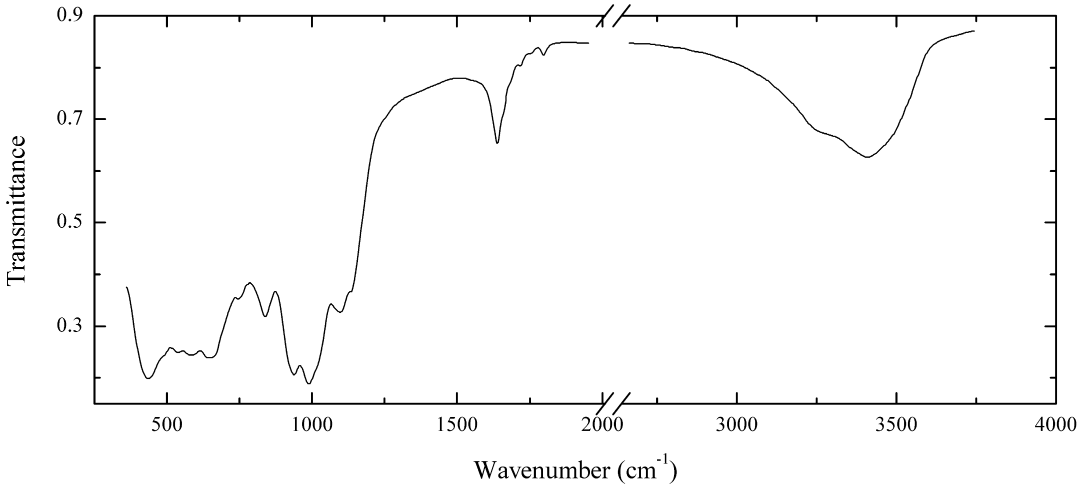


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pink scaly aggregate granular aggregate forming pseudomorph after vuonnemite crystal, from the association with natrolite, albite, yofortierite, leifite, *etc*. The empirical formula is (electron microprobe) $H_xSr_{0.75}Ca_{0.5}Na_{0.3}K_{0.25}Zn_{0.2}(Nb_{4.25}Ti_{0.75}Al_{1.0})Si_{4.0}O_{26}(OH,F)_2\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3425, 3250sh, 1638, 1130sh, 1100, 1030sh, 1013s, 935s, 843, 787w, 760w, 690sh, 671, 647, 590, 531, 466, 421.

TiSi85 **Komarovite** (□,Na,K)(□,Ca,Na)$_6$Li$_x$(Nb,Ti)$_6$Si$_4$O$_{26}$(OH,F)$_2$·nH$_2$O (?)

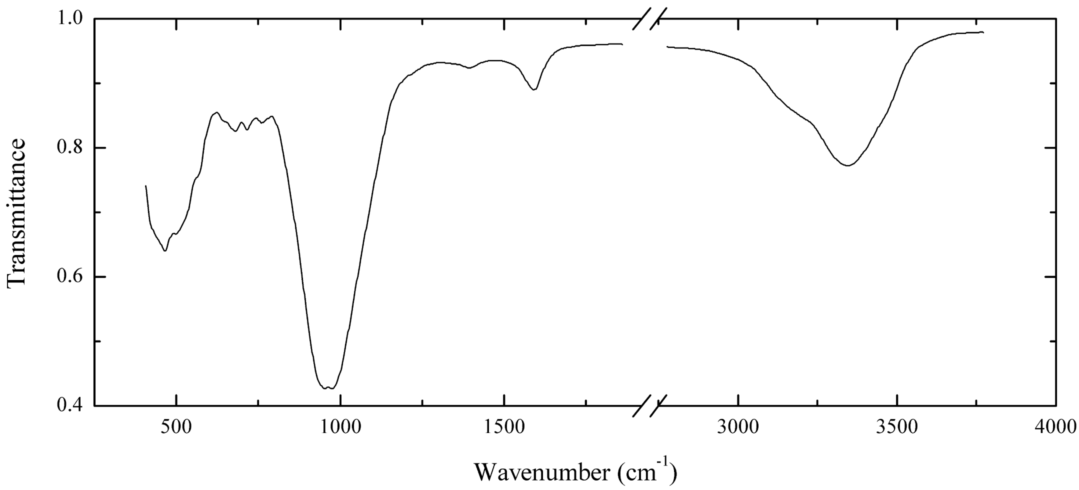


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pink pseudomorph after platy crystal of vuonnemite from the association with natrolite, albite, yofortierite, leifite, *etc*. The empirical formula is (electron microprobe) H$_x$Ca$_{1.2}$Na$_{0.5}$Sr$_{0.3}$Ba$_{0.2}$K$_{0.2}$(Nb$_{4.4}$Ti$_{0.6}$Al$_{0.4}$Fe$_{0.1}$)Si$_{4.4}$O$_{26}$(OH,F)$_2$·nH$_2$O.

Wavenumbers (cm^{-1}): 3380, 3240sh, 1795w, 1637, 1136, 1099, 1020sh, 992s, 939s, 842, 750, 638, 585, 543, 439s.

TiSi86 **Diversilite-(Ce)** (Ba,K,Na,Ca)$_{11–12}$(Ce,Fe,Th)$_4$(Ti,Nb)$_6$(Si$_6$O$_{18}$)$_4$(OH,O)$_{12}$·nH$_2$O

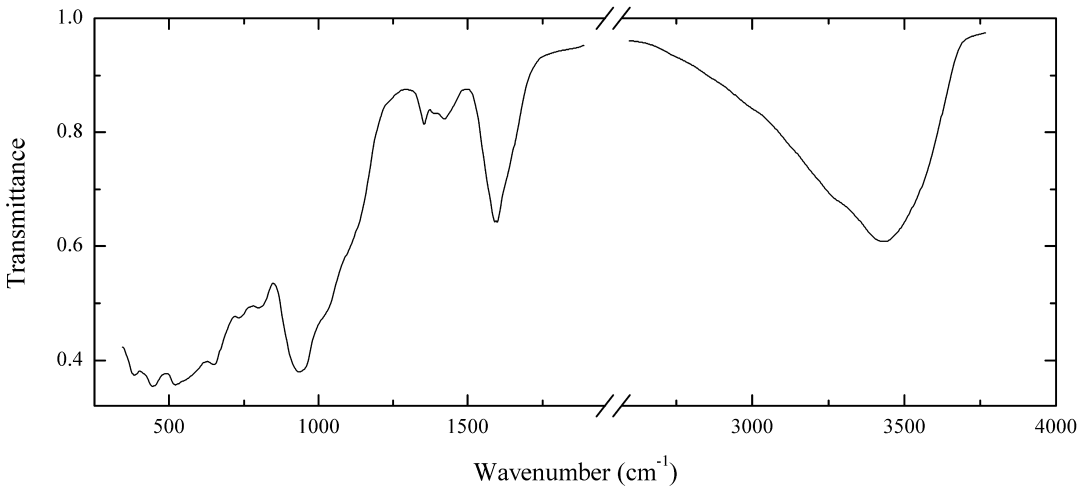


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Radial aggregate of yellow crystals from the association with nepheline, sodalite, microcline, natrolite, pectolite and aegirine. The empirical formula is (electron microprobe) (Ba$_{4.6}$K$_{3.9}$Na$_{2.1}$Ca$_{1.4}$)(Ce$_{1.5}$La$_{0.3}$Th$_{0.5}$Fe$_{1.7}$)(Ti$_{4.1}$Nb$_{1.3}$Fe$_{0.6}$)(Si$_{23.2}$Al$_{0.8}$)O$_{72}$(OH,O)$_{12}$·nH$_2$O.

Wavenumbers (cm^{-1}): 3530sh, 3420, 3250sh, 1625, 1420w, 986s, 966s, 768w, 722w, 687w, 560sh, 495sh, 452, 425sh.

TiSi87 Natrokomarovite $(Na,K)(Na,Ca)_{6-x}Li_x(Nb,Ti)_6Si_4O_{26}(OH,F)_2{\cdot}4H_2O$

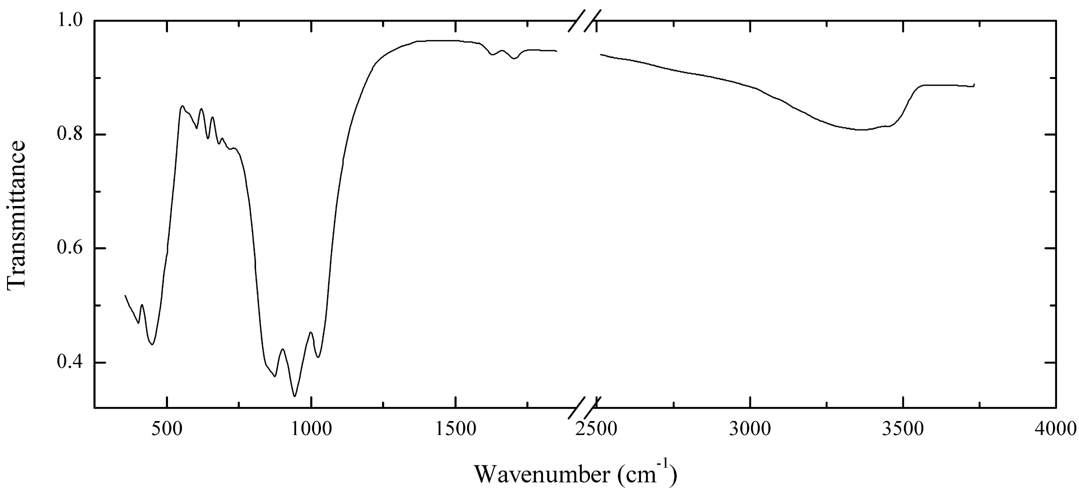


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pseudomorph after platy crystal of a heterophyllosilicate. Investigated by I.V. Pekov. The bands at 1,353, 1,420 and 1,593 cm^{-1} correspond to inclusions of a bituminous substance.

Wavenumbers (cm^{-1}): 3400, 3265sh, 1620sh, 1593s, 1420, 1353, 1130sh, 1090sh, 1020sh, 940s, 810, 740, 650s, 520s, 445s, 385s.

TiSi88 Delindeite $(Na,K)_3Ba_4(Ti,Fe)_6Si_8O_{26}(OH)_{14}$

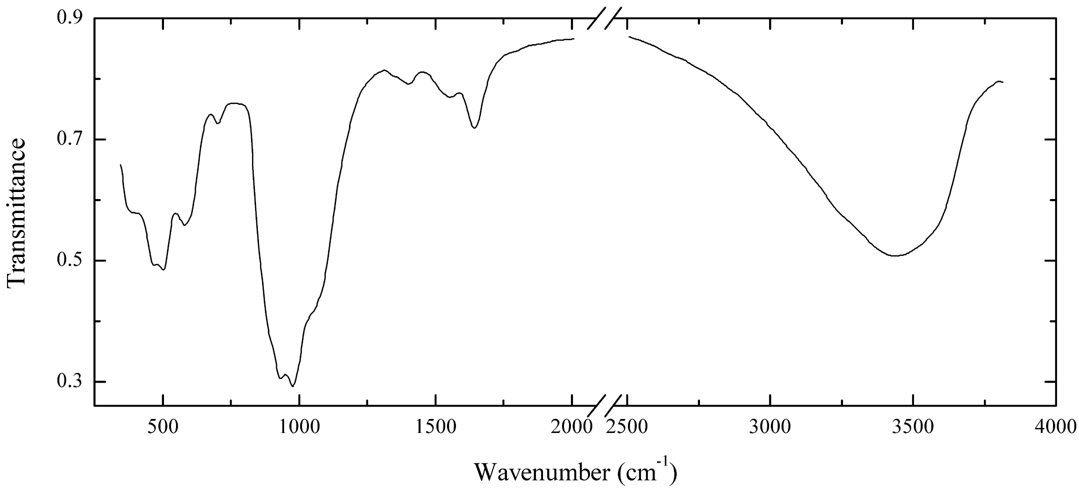


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Grey crystals from peralkaline pegmatite. Investigated by A.P. Khomyakov.

Wavenumbers (cm^{-1}): 3450sh, 3355, 1700w, 1628w, 1023s, 944s, 872s, 850sh, 719w, 678w, 643w, 605w, 575sh, 500sh, 446s. 401.

TiSi89 Ilmajokite $(Na,Ce,Ba)_2TiSi_3O_5(OH)_{10}\cdot nH_2O$

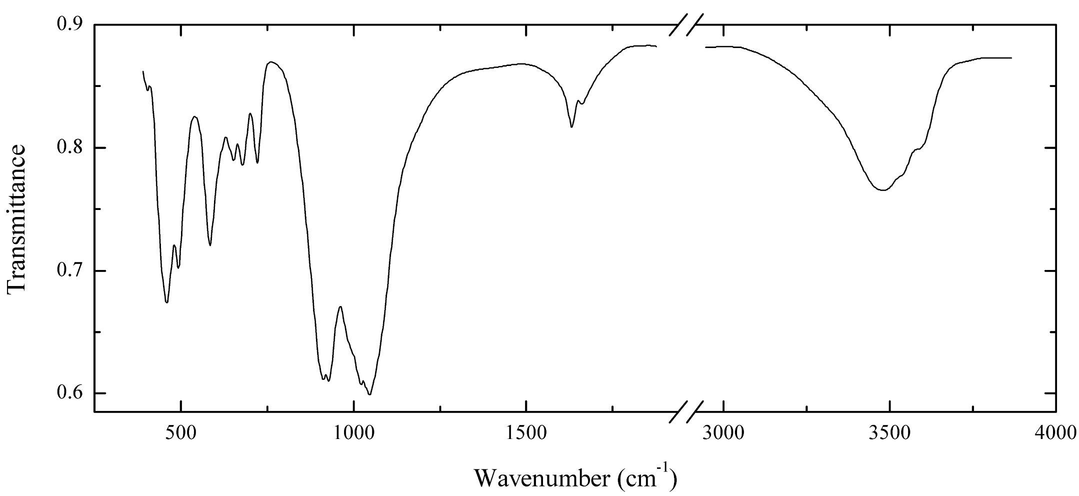


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow massive from the association with natrolite, raite, zorite, sphalerite, mountainite, aegirine, *etc*. Confirmed by IR spectrum

Wavenumbers (cm^{-1}): 3550sh, 3430, 3260sh, 1640, 1560w, 1410w, 1050sh, 980s, 936s, 900sh, 711w, 605sh, 582, 498, 472, 410sh.

TiSi90 Joaquinite-(Ce) $Ba_2NaCe_2Fe^{2+}Ti_2Si_8O_{26}(OH)\cdot H_2O$

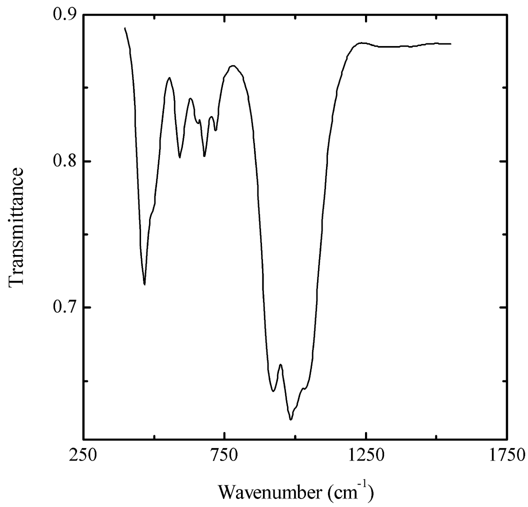


Locality: Benitoite Gem mine, Joaquin Ridge, Diablo Range, San Benito Co. California, USA (type locality).

Description: Brown crystal from the association with neptunite and benitoite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3564, 3490sh, 3410, 1656w, 1616, 1044s, 1017s, 990sh, 924s, 907s, 720, 679, 651, 585, 494, 460s.

TiSi91 Joaquinite-(Ce) $Ba_2NaCe_2Fe^{2+}Ti_2Si_8O_{26}(OH){\cdot}H_2O$

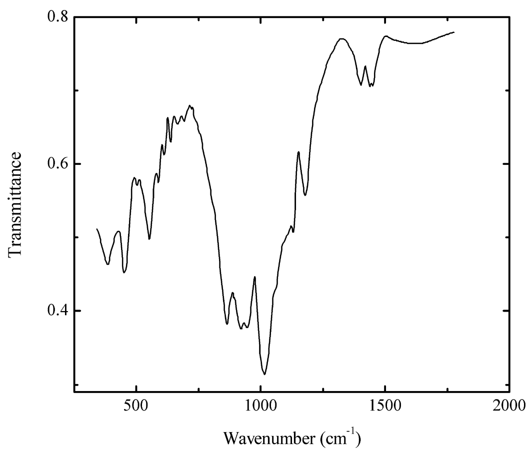


Locality: Kringlerne, Kangerdluarssuk plateau, Ilimaussaq intrusion, South Greenland.

Description: Grey crystal from the association with microcline, arfvedsonite and tundrite. Identified by powder X-ray diffraction pattern and electron microprobe analysis. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1035sh, 1005sh, 985s, 919s, 718, 682, 660, 588, 490sh, 460s.

TiSi92 Phosphoinnelite $Ba_4Na_3Ti_3Si_4O_{14}(PO_4,SO_4)_2(O,F)_3$

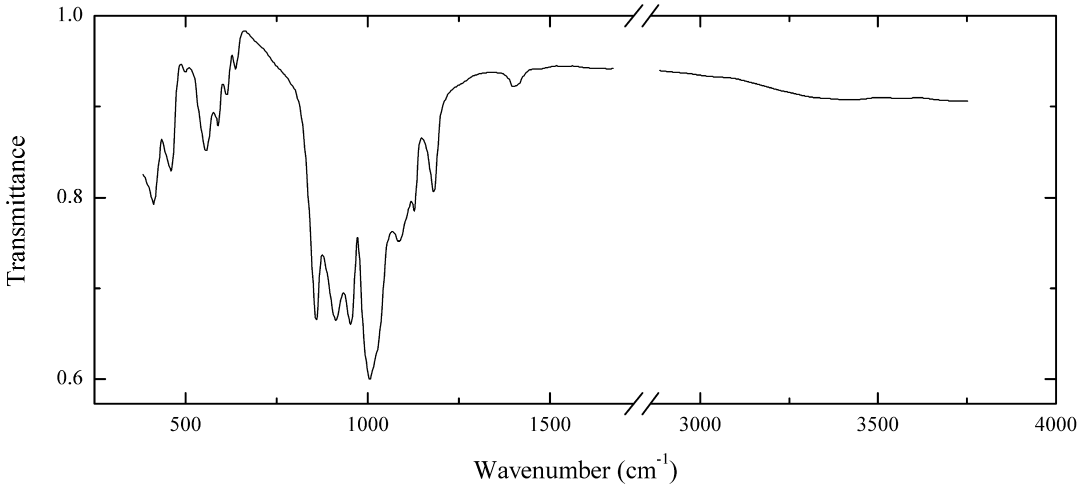


Locality: Mica mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Yellow-brown lath-like crystals from the association with cancrinite (partially altered to thomsonite-Ca), orthoclase, aegirine-augite, pectolite, magnesio-arfvedsonite, golyshevite, fluorapatite, *etc*. Holotype sample. Triclinic, space group P-1 or $P1$, $a = 5.38$, $b = 7.10$, $c = 14.76$ Å, $\alpha = 99.00°$, $\beta = 94.94°$, $\gamma = 90.14°$, $Z = 1$. Optically biaxial (+), $\alpha = 1.730$, $\beta = 1.745$, $\gamma = 1.764$. $D_{meas} = 3.82$ g/cm^3, $D_{calc} = 3.92$ g/cm^3. The empirical formula is $(Ba_{3.59}Sr_{0.13}K_{0.01})$ $(Na_{2.59}Mg_{0.21}Mn_{0.20}Ca_{0.04})(Ti_{2.80}Fe^{3+}{}_{0.26}Nb_{0.07})(Si_{3.93}Al_{0.07})O_{14}(P_{1.11}S_{0.87}O_{7.96})$ $[(O,CO_3)_{2.975}F_{0.10}]$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)]

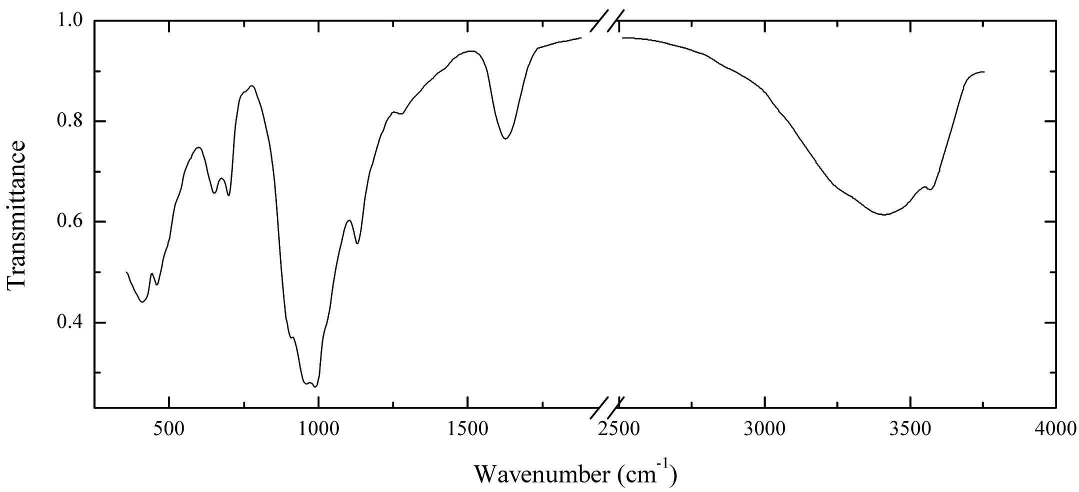
are 14.5 (100) (001), 3.455 (40) (103), 3.382 (35) (0-22), 2.921 (35) (005), 2.810 (40) (1-14), 2.683 (90) (200, -201), 2.133 (80) (-2-22), 2.059 (40) (204, 1-33, 221), 1.772 (30) (0-41, 1-27, 2-32, -2-33).
Wavenumbers (cm^{-1}): 1442, 1400, 1184, 1132, 1105sh, 1055sh, 1015s, 946s, 921s, 866s, 692w, 665w, 638, 614, 591, 553, 503, 453, 392.

TiSi93 Innelite $(Ba,K)_4(Na,Fe,Mn,Ca)_3Ti_3(Si_2O_7)_2(SO_4)_2O_3(OH,F)$



Locality: Inagli alkaline-ulthabasic massif, Sakha (Yakutia) Republic, Siberia, Russia (type locality).
Description: Brown grains from the association with natrolite, albite, lorenzenite and batisite. PO_4-rich variety. The empirical formula is (electron microprobe; CO_3 and OH calculated) $Ba_{3.35}Na_{2.29}Ca_{0.15}Mn_{0.02}Sr_{0.01}Mg_{0.29}Ti_{2.62}Fe_{0.03}Nb_{0.03}Si_{3.98}Al_{0.02}(SO_4)_{1.08}(PO_4)_{0.78}(CO_3)_{0.14}O_{1.79}F_{0.11}(OH)_{0.10}$.
Wavenumbers (cm^{-1}): 1405w, 1184, 1134, 1092, 1030sh, 1007s, 955s, 913s, 861s, 638w, 613, 590, 557, 505w, 460, 410.

TiSi94 Zorite $Na_6Ti(Ti,Nb)_4[(Si,Al)_2Si_4O_{17}]_2(O,OH)_5{\cdot}11H_2O$

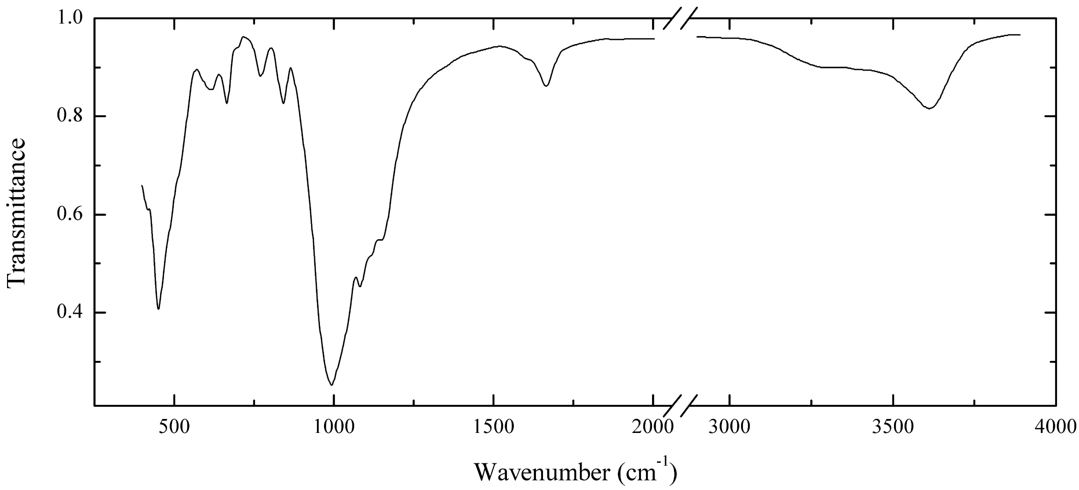


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Rose-coloured split prismatic crystals from the association with natrolite, raite, mountainite, aegirine, *etc*. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3570, 3420, 3260sh, 1638, 1385w, 1136, 1045sh, 993s, 962s, 913, 702, 653, 535sh, 490sh, 462, 421.

TiSi95 Intersilite $Na_6Mn^{2+}Ti[Si_{10}O_{24}(OH)](OH)_3·4H_2O$

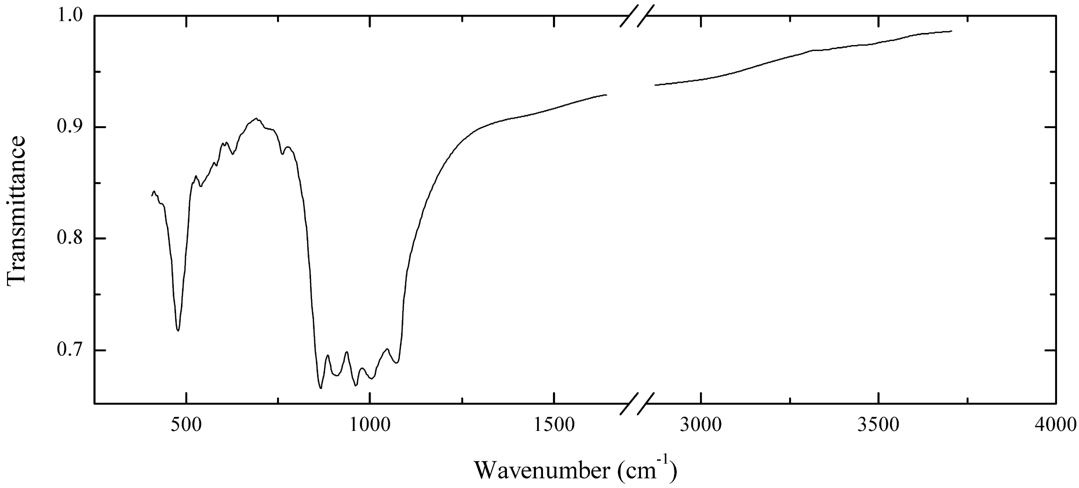


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Yellow grains from the association with makatite, villiaumite, aegirine, lomonosovite, serandite, steenstrupine, manganoneptunite and a zakharovite-like mineral. Holotype sample. The crystal structure is solved. Monoclinic, space group space group *I*2/*m*, $a = 13.033(6)$, $b = 18.717(9)$, $c = 12.264(6)$ Å, $\beta = 99.62(4)°$, $Z = 1$. Optically biaxial (−), $\alpha = 1.536(2)$, $\beta = 1.545(2)$, $\gamma = 1.553(2)$, $2V_{meas} = -87(1)°$. $D_{meas} = 2.42$ g/cm^3, $D_{calc} = 2.42$ g/cm^3. The empirical formula is $(Na_{5.84}K_{0.42})(Mn_{0.94}Fe_{0.04}Ca_{0.02})(Ti_{0.75}Nb_{0.24})Si_{10.00}(OH)_{3.3}·4.5H_2O$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 10.56 (100) (110), 6.38 (50) (200), 5.55 (45) (-112), 4.78 (40) (-202), 4.253 (40) (-222), 3.196 (80) (400, 321, -251), 2.608 (50) (-262).

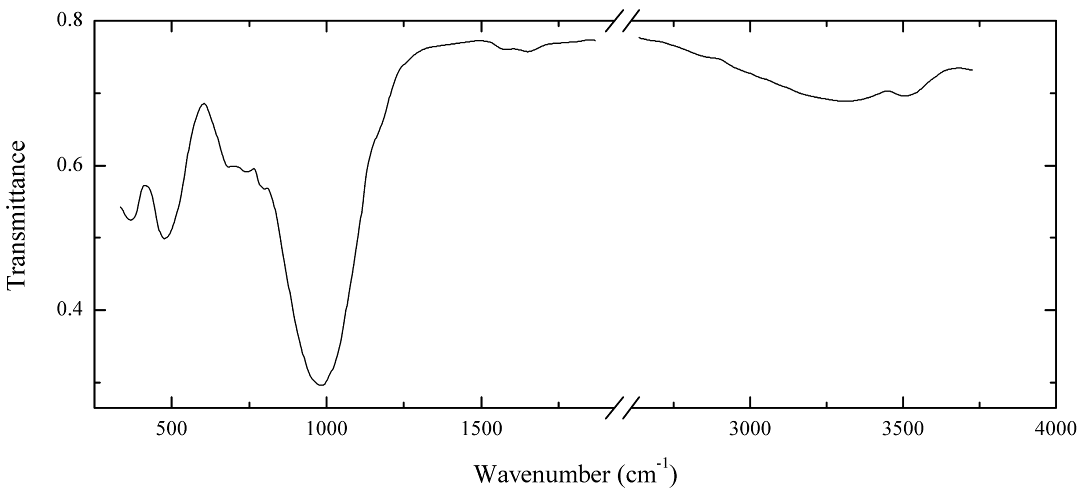
Wavenumbers (cm^{-1}): 3600, 3270w, 1658, 1605w, 1148, 1110sh, 1080s, 1030sh, 990s, 838, 765, 695sh, 661, 613, 505sh, 445s, 406.

TiSi96 Hiortdahlite I $(Na,Ca)_2Ca_4Zr(Y,Zr,Mn,Fe)(Si_2O_7)_2(F,O)_4$



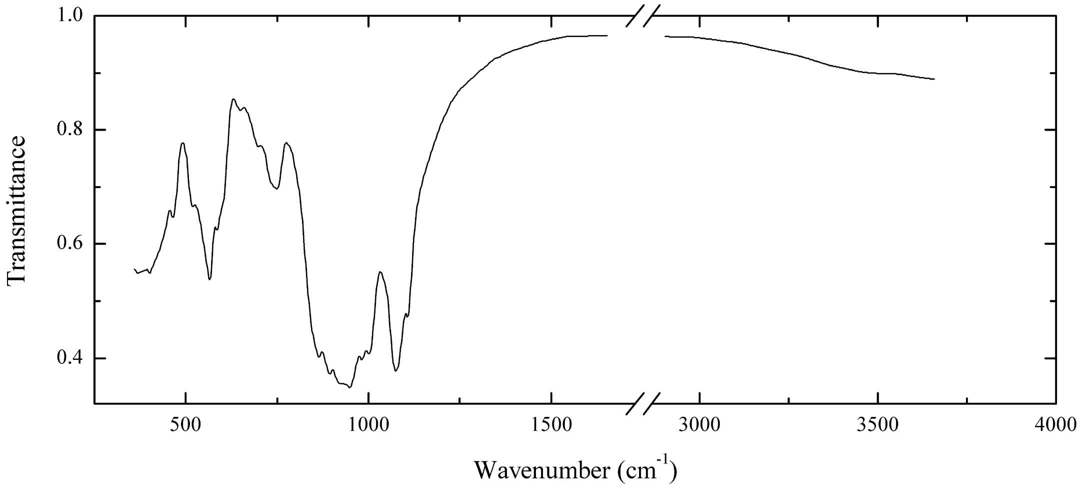
Locality: San Vito quarry, Monte Somma-Vesuvius volcanic complex, Campania, Italy.
Description: Yellow crystal from the association with sanidine. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1073s, 1001s, 957s, 902s, 860s, 755, 616, 574, 539, 470s.

TiSi98 Ilímaussite-(Ce) $Ba_2Na_4CeFe^{3+}Nb_2Si_8O_{28}\cdot 5H_2O$



Locality: Nâkâlâq, Ilímaussaq alkaline complex, South Greenland (type locality).
Description: Brown grains from the association with ussingite and analcime. The empirical formula is (electron microprobe) $Ba_{1.99}Na_{1.06}K_{0.76}(Ce_{0.70}La_{0.36}Pr_{0.06}Nd_{0.05})(Nb_{1.29}Ti_{0.54}Fe_{0.37})(Si_{7.85}Al_{0.15})O_{28}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3510, 3320, 1650w, 1575w, 988s, 970sh, 805, 750, 685, 490sh, 471, 365.

TiSi99 Lomonosovite $Na_8(Na,Ti)_4Ti_2(Si_2O_7)_2(PO_4)_2O_2(O,OH,F)_2$

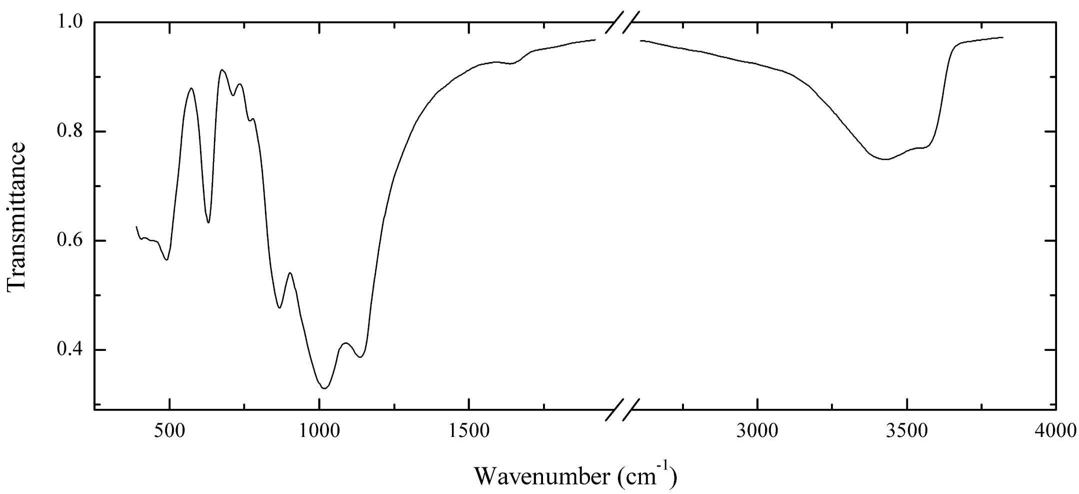


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark brown platy crystals from the association with aegirine and raslakite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1104, 1073s, 1000s, 980s, 944s, 925sh, 891s, 865s, 648, 701w, 740w, 595sh, 583, 563, 520, 465, 420sh, 401, 372.

TiSi100 Lovozerite $Na_3CaZrSi_6O_{15}(OH)_3$

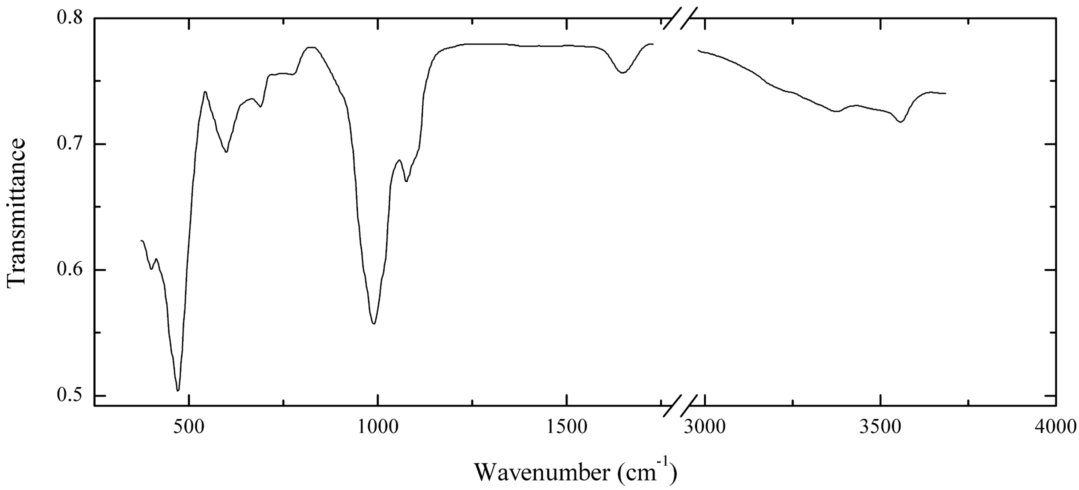


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Light brown pseudomorph after zirsinalite forming rim around a grain of eudialyte. Associated minerals are villiaumite, aegirine and lorenzenite. Identified by IR spectrum and electron microprobe analysis.

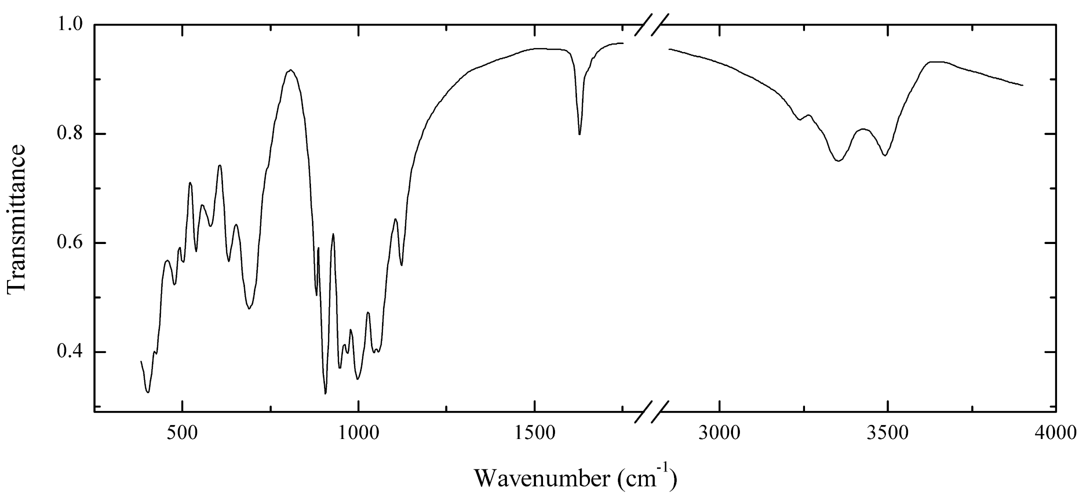
Wavenumbers (cm^{-1}): 3550, 3400, 1645w, 1136s, 1022s, 868s, 769, 713w, 627, 488, 445, 406.

TiSi101 Lourenswalsite $(K,Ba)_2Ti_4(Si,Al)_6O_{14}(OH)_{12}$



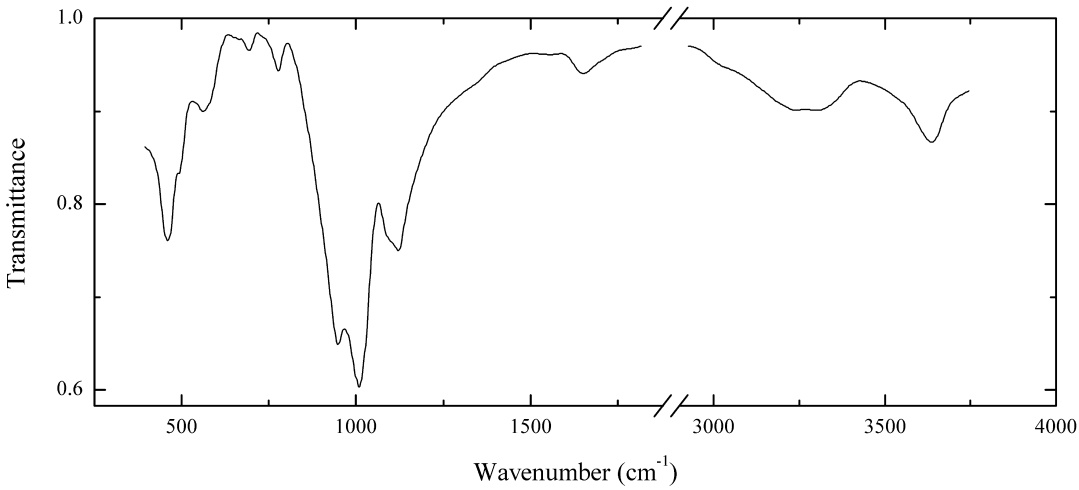
Locality: Diamond Jo quarry, Magnet Cove complex, Hot Spring Co., Arkansas, USA (type locality).
Description: Brownish-grey platy crystals. Investigated by A.V. Voloshin.
Wavenumbers (cm^{-1}): 3537w, 3350w, 1100sh, 1077, 1020sh, 989s, 960sh, 780w, 687, 596, 470s, 415.

TiSi102 Lintisite $Na_3LiTi_2Si_4O_{14}\cdot 2H_2O$



Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Colourless crystals from the association with lorenzenite, nepheline, sodalite, potassic feldspar, arfvedsonite, aegirine, eudialyte and ussingite. Investigated by I.V. Pekov. Confirmed by semiquantitative electron microprobe analysis and IR spectrum.
Wavenumbers (cm^{-1}): 3480, 3345, 3235, 1650sh, 1630, 1128, 1063s, 1049s, 1003s, 970, 951s, 910s, 881, 692, 632, 581, 538, 499, 477, 424, 403s.

TiSi103 Lemoynite $(Na,K)_2CaZr_2Si_{10}O_{26}\cdot5–6H_2O$

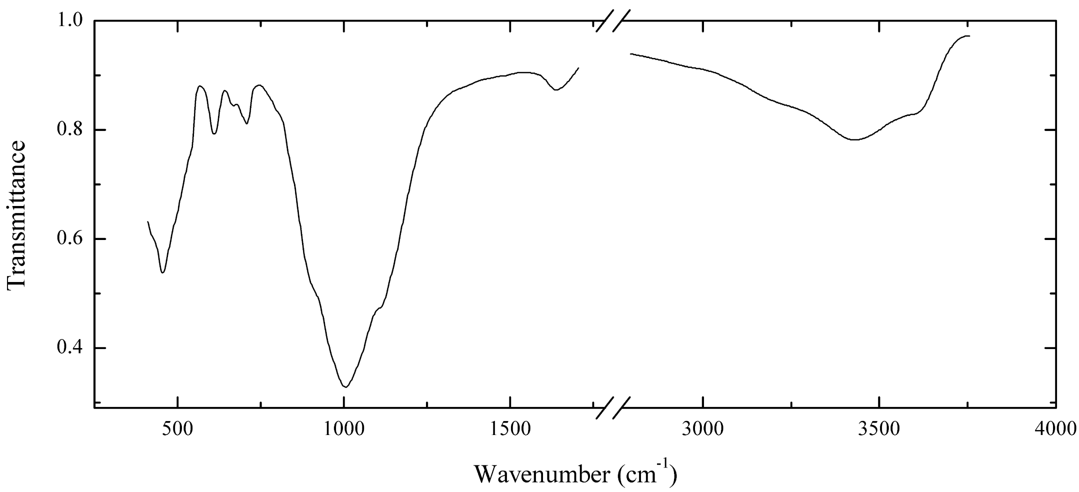


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Radial aggregate of yellowish bladed prismatic crystals from peralkaline pegmatite. The empirical formula is (electron microprobe) $Na_{1.3}K_{0.9}Ca_{0.8}Zr_{1.7}Ti_{0.2}Nb_{0.1}Si_{9.8}Al_{0.2}O_{26}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3625, 3300, 3230, 1650, 1125, 1010s, 931s, 779, 696, 566, 490sh, 460.

TiSi104 Zirconosilicate TiSi104 $Na_3MnZr[Si_6O_{15}(OH)_3]\cdot nH_2O$

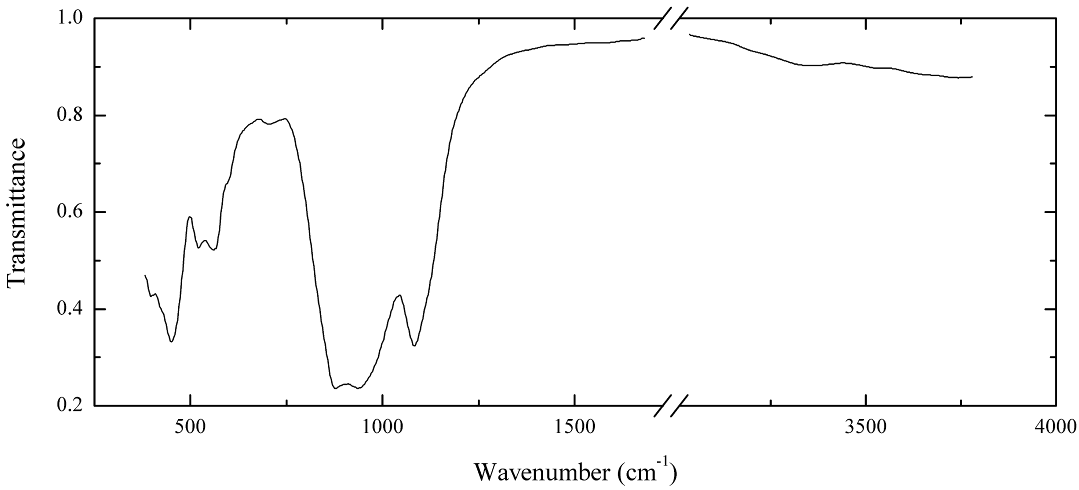


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Mn-analogue of lovozerite. Brown grains from the association with eudialyte, litvinskite, gaidonnayite, terskite, raite, zakharovite, Mn-rich pectolite, apophyllite-(F) and vitusite-(Ce). Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $(Na_{2.6}K_{0.1})(Mn_{0.8}Ca_{0.1})(Zr_{0.4}Ti_{0.3}Fe_{0.3})[Si_{6.0}O_{15}(OH)_3]\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3570, 3405, 3210sh, 1632, 1100sh, 1004s, 910sh, 795sh, 709, 669w, 612, 540sh, 490sh, 461, 420sh.

TiSi105 Låvenite $(Na,Ca)_2(Mn,Fe)(Zr,Ti,Nb)(Si_2O_7)(O,F)_2$

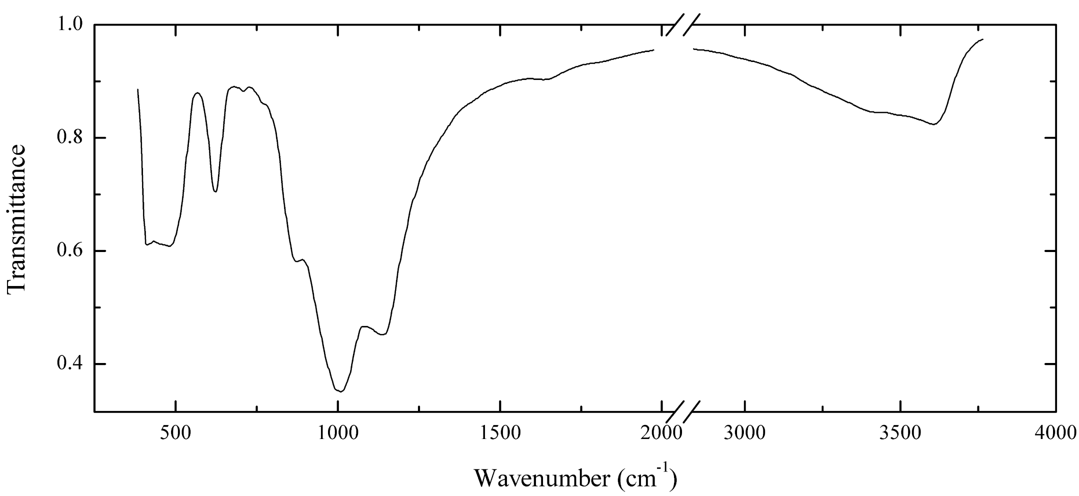


Locality: Railway station Khibiny, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown prismatic crystals from alkaline pegmatite. The empirical formula is (electron microprobe) $(Na_{1.7}Ca_{0.3})(Mn_{0.4}Ca_{0.3}Fe_{0.2}Zr_{0.1})(Zr_{0.6}Ti_{0.3}Nb_{0.1})(Si_{2.0}O_7)[(O,OH)_{1.3}F_{0.7}]$.

Wavenumbers (cm^{-1}): 3320w, 1082s, 965sh, 935s, 876s, 707w, 595sh, 563, 521, 453s, 420sh, 405.

TiSi106 Litvinskite $(Na,H_2O)_2(\square,Na,Mn)Zr[Si_6O_{12}(OH,O)_6]$



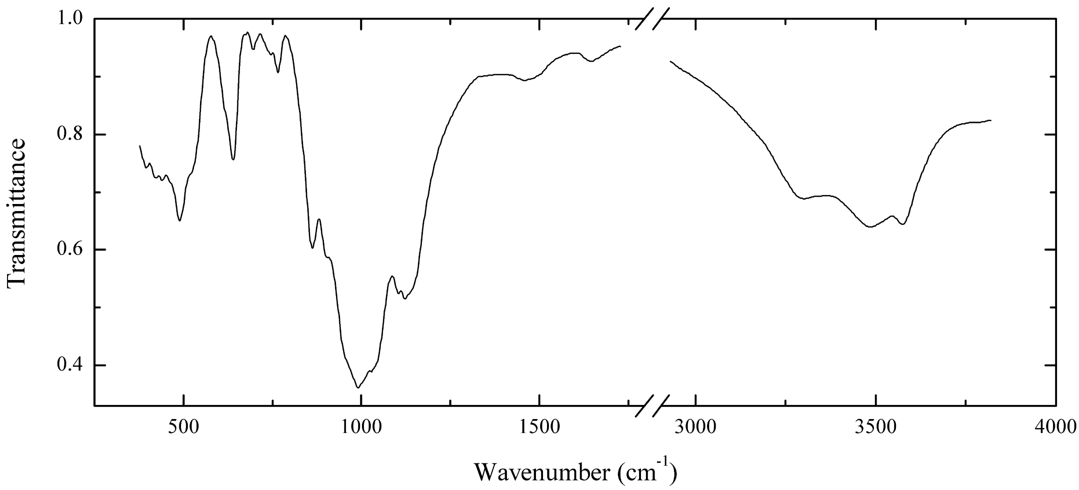
Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Reddish-brown grains from the association with microcline, nepheline, sodalite, eudialyte, lomonosovite, ussingite and mangan-neptunite, replaced by terskite and gaidonnayite. Holotype sample. The crystal structure is solved. Monoclinic, space group space group Cm, $a = 10.589(7)$, $b = 10.217(8)$, $c = 7.355(5)$ Å, $\beta = 92.91(5)°$. Optically biaxial (–), $\alpha = 1.546(1)$, $\beta = 1.574(1)$, $\gamma = 1.575(1)$. $D_{meas} = 2.61$ g/cm^3, $D_{calc} = 2.63$ g/cm^3. The empirical formula is $[Na_{1.54}K_{0.01}(H_2O)_{0.47}]Na_{0.78}(Na_{0.19}Mn^{2+}{}_{0.14}Ca_{0.01}Fe_{0.01})(Zr_{0.96}Ti_{0.01}Hf_{0.01})$

$Si_6O_{12}(OH)_3[(OH)_{2.24}O_{0.76}]$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 7.37 (44) (110, 001), 5.29 (100) (11-1, 200), 3.329 (74) (22-1, 11-2, 310), 3.238 (100) (130, 221, 112), 2.981 (39) (13-1, 022, 311), 2.553 (37) (040, 222).

Wavenumbers (cm^{-1}): 3575, 3470sh, 3400sh, 1637w, 1137s, 1009s, 877, 770sh, 707w, 621, 485, 465sh, 407.

TiSi107 Litvinskite $(Na,H_2O)_2(\square,Na,Mn)Zr[Si_6O_{12}(OH,O)_6]$

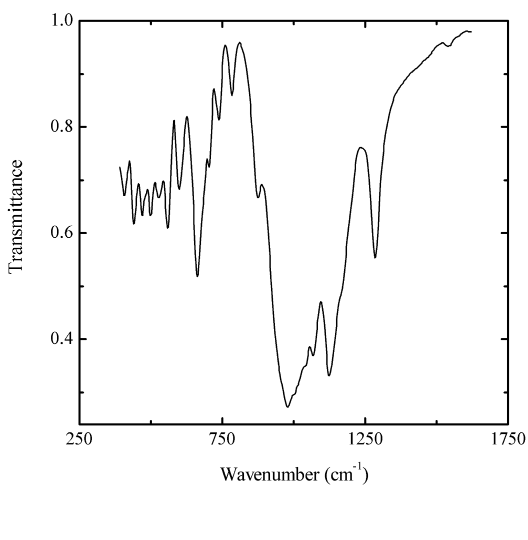


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Rims around grains of wadeite from the association with aegirine, delhayelite, lamprophyllite, fenaksite and lomonosovite. Investigated by I.V. Pekov. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $Na_{2.47}K_{0.10}Ca_{0.11}Mg_{0.01}Mn_{0.04}Fe_{0.02}Ti_{0.03}Zr_{0.95}[Si_6O_{12}(OH,O)_6]$.

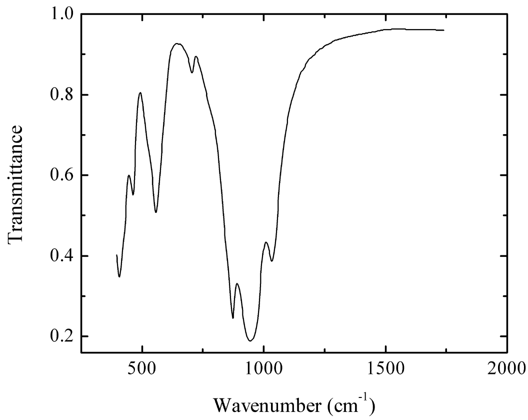
Wavenumbers (cm^{-1}): 3575, 3490, 3305, 1640w, 1460w, 1140sh, 1128s, 1109s, 1045sh, 1030sh, 994s, 965sh, 900sh, 863, 766, 745w, 697w, 638, 615sh, 525sh, 488, 435, 420, 395.

TiSi108 Leucosphenite $BaNa_4Ti_2B_2Si_{10}O_{30}$



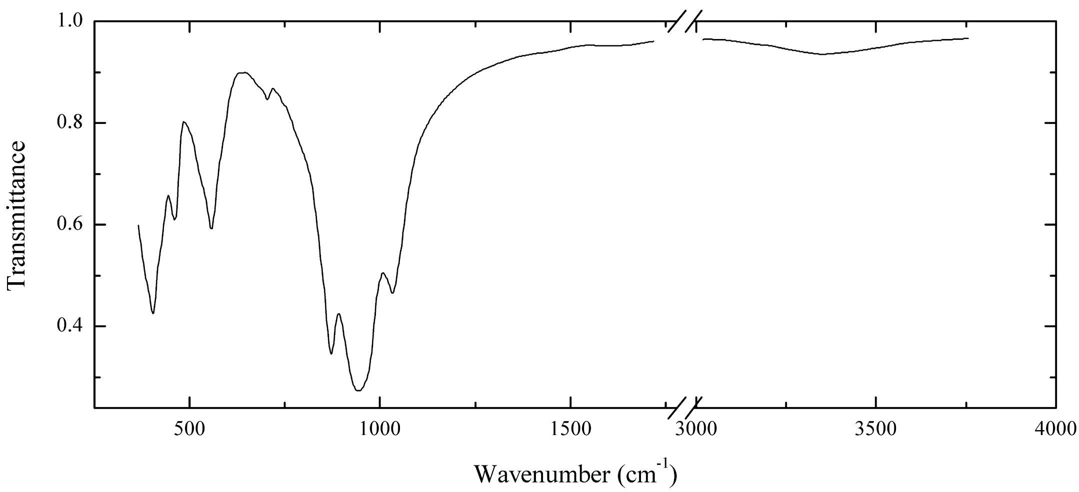
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Light green grain from the association with reedmergnerite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1278, 1140sh, 1119s, 1064, 1035sh, 1010sh, 1000sh, 975s, 871, 780w, 736w, 703w, 660, 596, 557, 526, 495, 480, 467, 437, 405.

TiSi109 Lamprophyllite $(Sr,Ba,K)_2Na(Na,Fe^{2+},Mn^{2+})_2(Ti,Fe^{3+},Mg)Ti_2(Si_2O_7)_2O_2(OH,O,F)_2$



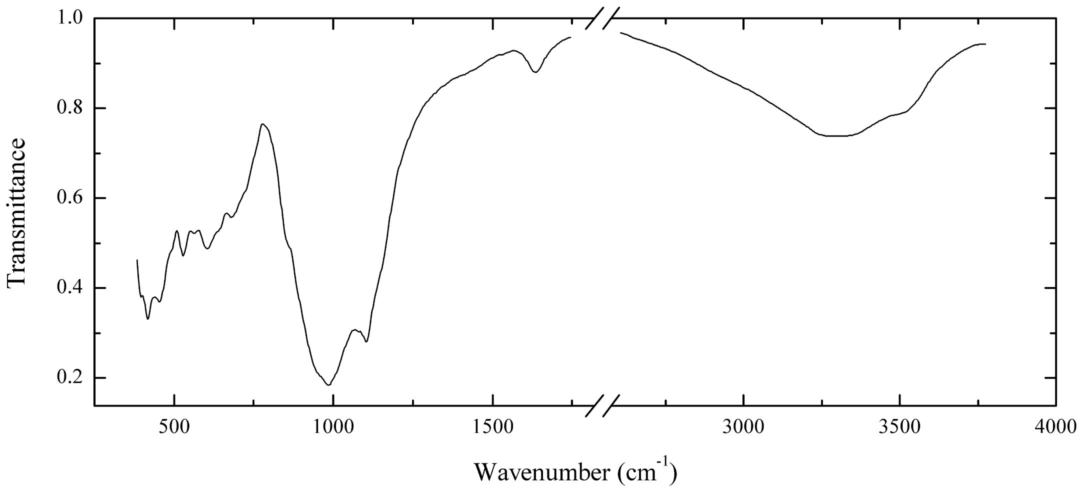
Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Reddish-brown radial aggregate from the association with parakeldyshite, sodalite, microcline, eudialyte and loparite-(Ce). The empirical formula is (electron microprobe) $(Sr_{0.92}Ba_{0.45}K_{0.11})Na_{3.11}Ca_{0.04}Mn_{0.53}Fe_{0.11}Mg_{0.04}Ti_{2.74}Nb_{0.03}(Si_{2.00}O_7)\ _2O_2(OH,O,F)_2$.
Wavenumbers (cm^{-1}): 1036, 943s, 873s, 705w, 580sh, 556, 530sh, 459, 402.

TiSi110 Lamprophyllite $(Sr,Ba,K)_2Na(Na,Fe^{2+},Mn^{2+})_2(Ti,Fe^{3+},Mg)Ti_2(Si_2O_7)_2O_2(OH,O,F)_2$



Locality: Flora Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown long-prismatic crystal from the association with eudialyte, albite, lorenzenite and murmanite. The empirical formula is (electron microprobe) $(Sr_{1.10}Na_{0.75}Ba_{0.08}K_{0.07})Na_{2.17}Fe_{0.44}Mn_{0.38}Ca_{0.11}Mg_{0.07}Ti_{2.95}(Si_{1.98}Al_{0.02}O_7)\ _2O_2(OH,O,F)_2$.
Wavenumbers (cm^{-1}): 1036, 944s, 873s, 705w, 580sh, 556, 530sh, 461, 402.

TiSi111 Paravinogradovite $Na_2Ti_3Fe^{3+}(Si_2O_6)_2(Si_3AlO_{10})(OH)_4·H_2O$

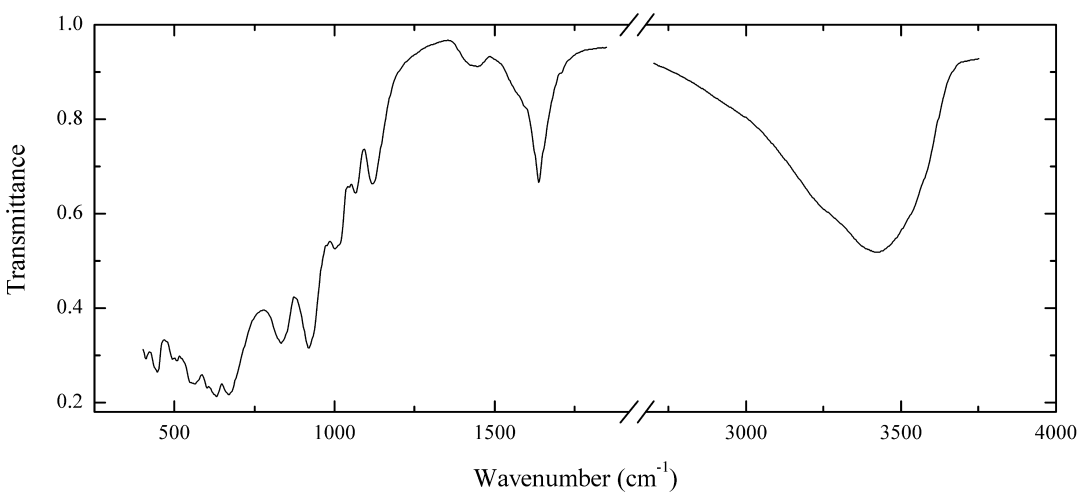


Locality: Saami Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless crystals. The empirical formula is (electron microprobe) $(Na_{1.38}K_{0.09}Sr_{0.03}Ba_{0.02})(Ti_{1.77}Fe_{0.26})(Si_{3.50}Al_{0.50})O_{22}(OH)·nH_2O$.

Wavenumbers (cm^{-1}): 3480sh, 3310, 2935sh, 1635, 1540w, 1105s, 987s, 950sh, 860sh, 720sh, 689, 645sh, 607, 530, 490sh, 458, 415, 395.

TiSi112 Mongolite $Ca_4Nb_6Si_5O_{24}(OH)_{10}·5–6H_2O$



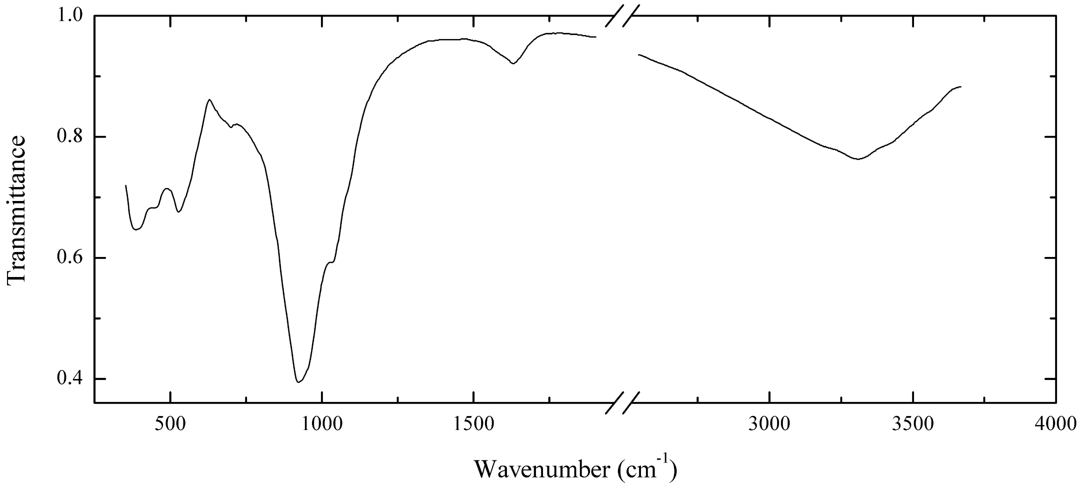
Locality: Khan Bogdo massif, Gobi desert, Mongolia (type locality).

Description: Brownish scaly aggregate from alkaline granite pegmatite, from the association with polylithionite, montmorillonite and Nb- and *REE*-silicates. Holotype sample. Tetragonal, $a = 7.00(5)$, $c = 29.0(1)$ Å, $Z = 2$. Optically uniaxial (−), $\omega = 1.80$, $\varepsilon = 1.74$. $D_{meas} = 3.147$ g/cm^3. The empirical formula is $(Ca_{3.01}Na_{0.31}Sr_{0.28}K_{0.14}Ba_{0.06})(Nb_{5.45}Al_{0.22}Mn_{0.22}Zn_{0.07}Mg_{0.03})Si_{5.00}O_{27.84}·5.07H_2O$.

Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 9.67 (45), 5.82 (45), 3.163 (100), 3.087 (65), 2.974 (70), 2.901 (35), 2.664 (40).

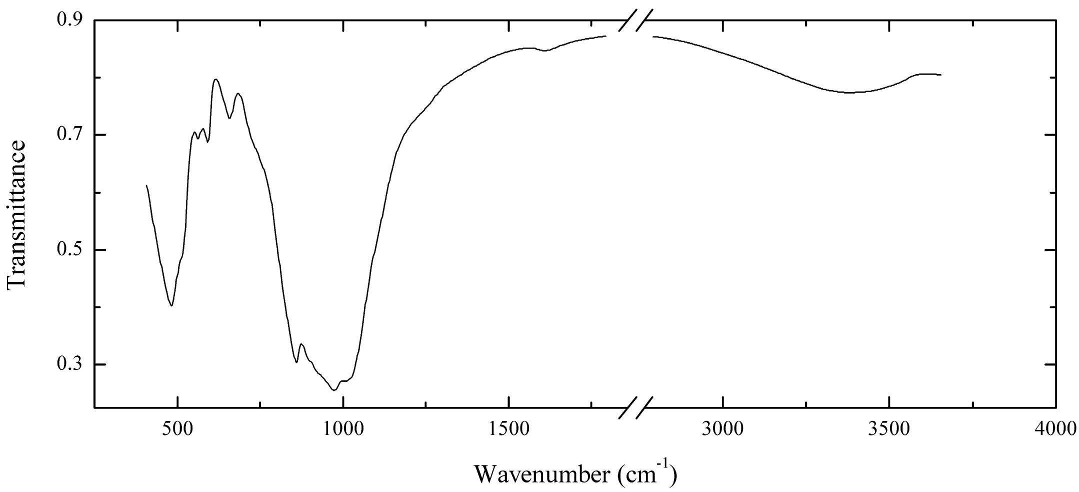
Wavenumbers (cm^{-1}): 3415, 3270sh, 1637, 1600sh, 1440w, 1117, 1064, 1003, 918, 833, 670s, 640s, 615sh, 557s, 502, 443, 410.

TiSi113 Murmanite $(Na,Ca,\square)_2(Ti,Nb,Fe)_2(Si_2O_7)(O,OH)_2 \cdot 2H_2O$



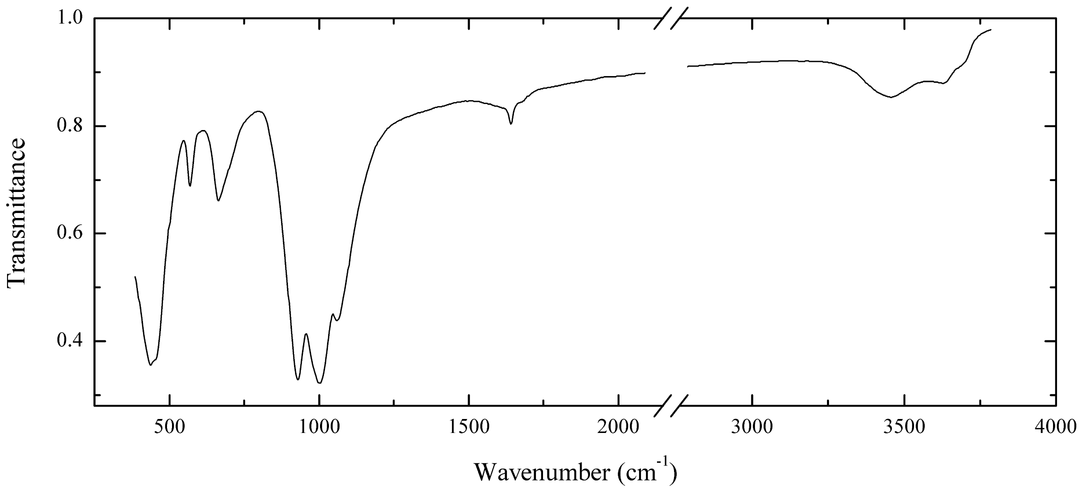
Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Violet single-crystal plates with mica-like cleavage from peralkaline pegmatite, from the association with ussingite, sodalite, microcline, nepheline, aegirine, arfvedsonite, manganoneptunite, eudialyte and ilmenite. The empirical formula is (electron microprobe) $(Na_{1.19}Ca_{0.30}Mn_{0.08}K_{0.04}Ba_{0.02})(Ti_{1.55}Nb_{0.20}Mn_{0.08}Fe_{0.07}Zr_{0.05}Mg_{0.05})(Si_{2.00}O_7)(O,OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3560sh, 3400sh, 3315, 3220sh, 1637, 1600sh, 1105sh, 1039, 940sh, 926s, 699, 680sh, 560sh, 526, 455sh, 390.

TiSi115 Nacareniobsite-(Ce) $Na_3Ca_3(Ce,La)(Nb,Ti)(Si_2O_7)_2OF_3$



Locality: Kvanefjeld tunnel, Ilímaussaq alkaline complex, South Greenland (type locality).
Description: Yellow platelets from the association with ussingite. The empirical formula is (electron microprobe) $Na_{2.98}Ca_{2.62}(Ce_{0.55}Nd_{0.29}La_{0.17}Pr_{0.07}Sm_{0.04}Y_{0.04})Si_{4.22}Al_{0.01}O_{15.29}F_{2.86}$.
Wavenumbers (cm^{-1}): 3435, 1635w, 1030s, 983s, 945sh, 915sh, 866s, 760sh, 662, 592, 561, 505sh, 476.

TiSi116 Nafertisite $Na_3(Fe^{2+},Fe^{3+})_6Ti_2Si_{12}O_{34}(O,OH)_7\cdot 2H_2O$

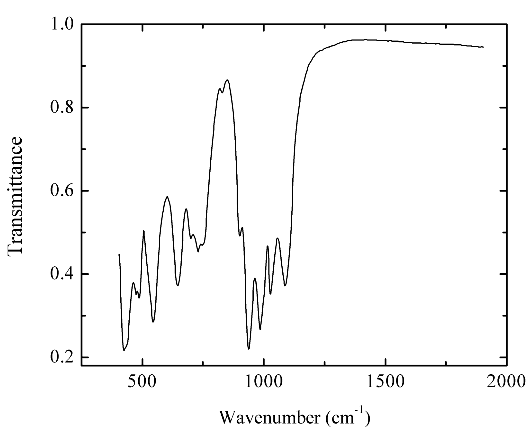


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Dark green fibrous aggregate from the association with amphibole, aegirine, nepheline, sodalite, cancrinite, pectolite, eudialyte, mosandrite, calcite, burbankite, ewaldite, villiaumite and molybdenite. Holotype sample. The crystal structure is solved. Monoclinic, space group *A*2/*m*, $a = 5.353(4)$, $b = 16.176(12)$, $c = 21.95(2)$ Å, $\beta = 94.6(2)°$. Optically biaxial (−), $\alpha = 1.627(2)$, $\beta = 1.667(2)$, $\gamma = 1.693(2)$, $2V_{meas} = 75(2)°$. $D_{meas} = 2.7(1)$ g/cm^3, $D_{calc} = 2.74$ g/cm^3. The empirical formula is $(Na_{2.47}K_{0.56})(Fe^{2+}{}_{4.68}Fe^{3+}{}_{1.27}Mg_{0.51}Mn_{0.18})(Ti_{1.67}Al_{0.41}Nb_{0.04})(Si_{10.36}Fe^{3+}{}_{1.64})O_{35.02}(OH)_2\cdot 5.97H_2O$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 13.00 (30) (001), 10.94 (100) (002), 4.44 (15) (120), 2.728 (25) (008, 151, 144), 2.641 (20) (-202), 2.547 (15) (153), 2.80 (15) (-137, -202, -146).

Wavenumbers (cm^{-1}): 3640sh, 3585, 3370, 1660sh, 1629, 1057, 998s, 924s, 690sh, 659, 564, 445sh, 431s.

TiSi117 Lorenzenite $Na_2Ti_2Si_2O_9$

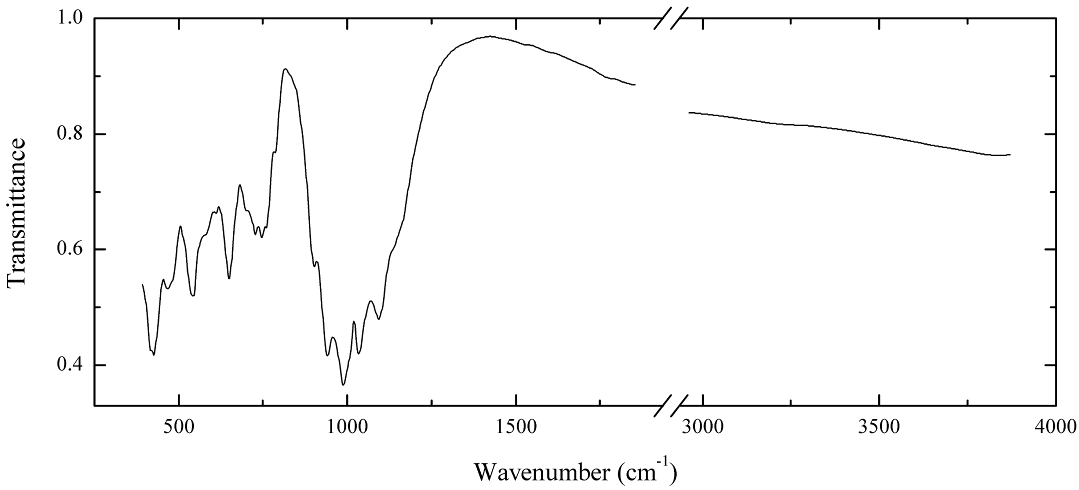


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown crystal from the association with nepheline, aegirine and albite. The empirical formula is (electron microprobe) $Na_{1.96}Ti_{1.98}Nb_{0.02}Si_{2.00}O_{8.99}$.

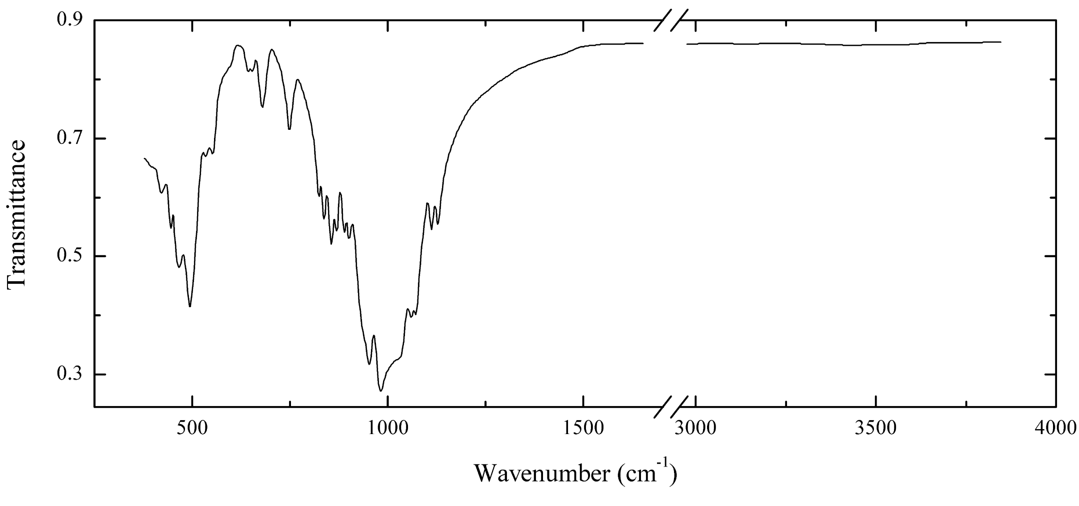
Wavenumbers (cm^{-1}): 1100, 1031, 991s, 940s, 902, 826w, 747, 730, 697, 642, 541s, 484, 467, 423s.

TiSi118 Lorenzenite $Na_2Ti_2Si_2O_9$



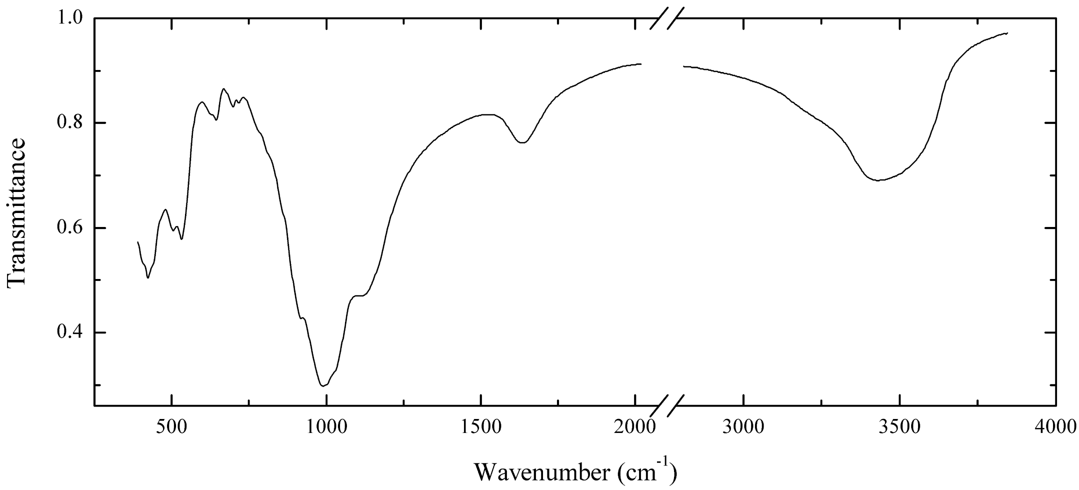
Locality: Flora Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown crystal from the association with nepheline, albite, aegirine, murmanite and eudialyte. The empirical formula is (electron microprobe) $Na_{2.0}Ti_{1.8}Nb_{0.1}Fe_{0.1}Si_{2.0}O_{9.0}$.
Wavenumbers (cm^{-1}): 1140sh, 1096, 1033s, 989s, 942s, 902, 785, 759, 746, 727, 700sh, 645, 575sh, 543, 485sh, 468, 423s.

TiSi119 Manganoneptunite $KNa_2Li(Mn^{2+},Fe^{2+})_2Ti_2Si_8O_{24}$



Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Deep red crystal from the association with natrolite, aegirine, lamprophyllite, murmanite, lomonosovite, eudialyte, *etc*. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1130, 1113, 1071s, 1060s, 1020sh, 1010sh, 984s, 955s, 940sh, 903, 890, 870, 857, 838, 825, 750, 682, 655w, 643w, 585sh, 557, 538, 496s, 469, 447, 427, 400sh.

TiSi120 Seidite-(Ce) $Na_4SrCeTiSi_8O_{22}F{\cdot}5H_2O$

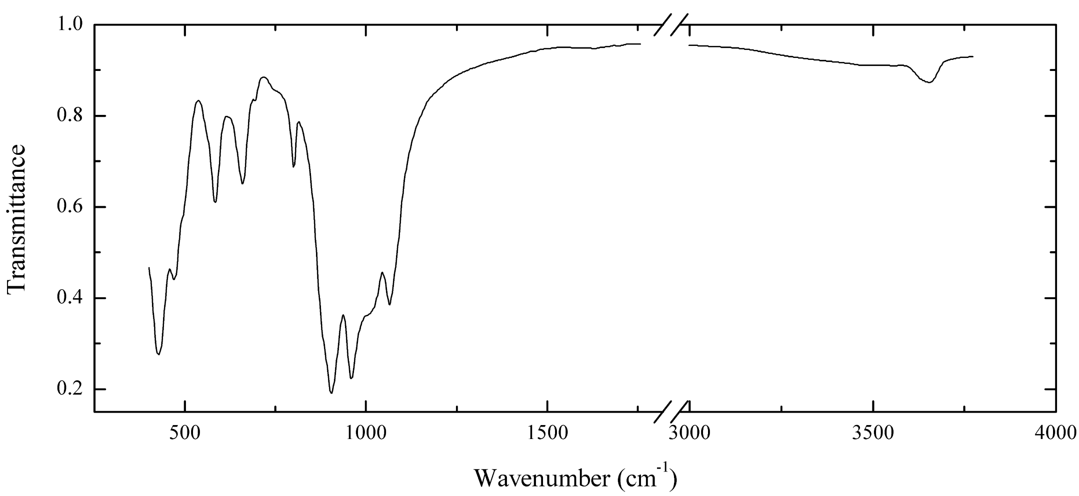


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Yellowish radial aggregate from the association with belovite-(Ce), vitusite-(Ce), vitusite-(La), sazhinite-(Ce), steenstrupine-(Ce), manganoneptunite, serandite, leucosphenite and sphalerite. Holotype sample. Monoclinic, space group $C2/c$, $a = 24.71(1)$, $b = 7.186(3)$, $c = 14.47(2)$ Å, $\beta = 95.25(10)°$. Optically biaxial (−), $\alpha = 1.542(2)$, $\beta = 1.569(2)$, $\gamma = 1.571(2)$, $2V_{meas} = 28(1)°$. $D_{meas} = 2.76$ g/cm^3, $D_{calc} = 2.75$ g/cm^3. The empirical formula is $[Na_{3.19}Ca_{0.19}(H_3O)_{0.62}][Sr_{0.53}K_{0.27}Ba_{0.11}(H_3O)_{0.09}](Ce_{0.42}La_{0.30}Nd_{0.10}Pr_{0.04}Sm_{0.02}Th_{0.01})(Ti_{0.86}Nb_{0.06}Mn_{0.05}Fe_{0.02})Si_{8.00}O_{21.90}[F_{0.84}(OH)_{0.16}]{\cdot}5.26H_2O$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 12.32 (100) (200), 3.104 (24) (420), 3.081 (16) (800), 3.058 (12) (-421), 2.705 (10) (620).

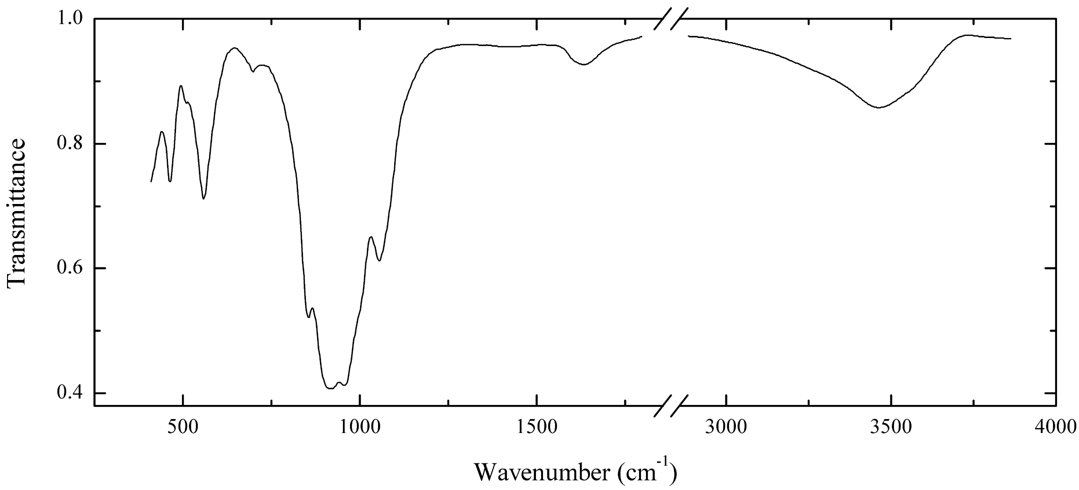
Wavenumbers (cm^{-1}): 3525sh, 3430, 3280sh, 1637, 1115s, 1020sh, 992s, 916s, 860sh, 815sh, 785sh, 712w, 692w, 640, 620sh, 522, 500, 430sh, 416s, 395sh.

TiSi122 Magnesiumastrophyllite $Na_2K_2(Fe,Mn)_5Mg_2Ti_2Si_8O_{24}(O,OH,F)_7$



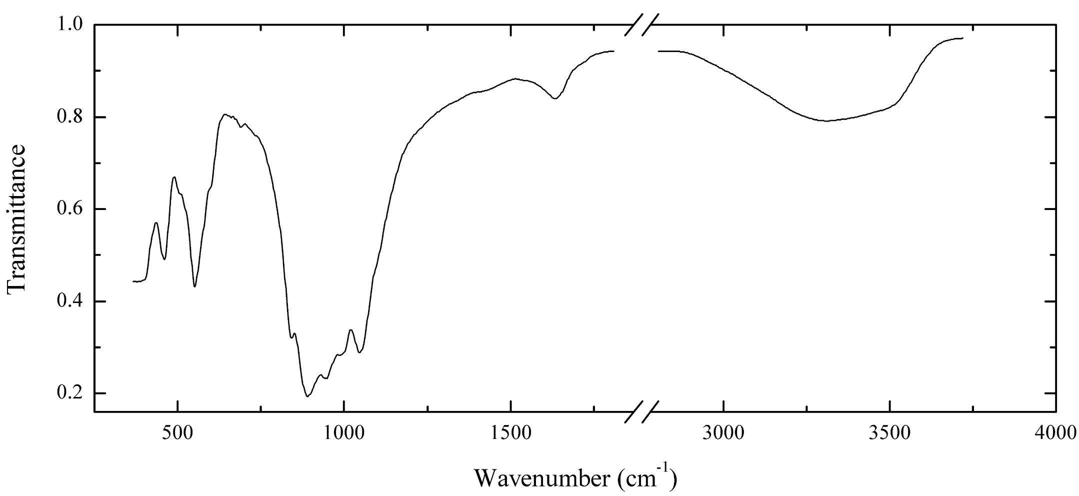
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown scaly aggregate from peralkaline pegmatite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3640, 1064, 1010sh, 958s, 904s, 799, 755sh, 693w, 659, 580, 490sh, 468, 429s.

TiSi123 Nechelyustovite $(Ba,Sr,K,\square)_2(Na,Ti,Mn)_4(Ti,Nb)_2(Si_2O_7)_2O_2(O,H_2O,F)_2\cdot 4.5H_2O$



Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).
Description: Yellowish-grey platy crystals from the association with natrolite, belovite-(La), belovite-(Ce), gaidonnayite, nenadkevichite, epididymite, fluorapophyllite, sphalerite and barytolamprophyllite. Holotype sample. Intergrowth of two polytypes: 1*M* (space group *P*2/*m*, $a = 5.37$, $b = 7.00$, $c = 24.05$ Å, $\beta = 91.1°$) and 2*M* (space group *A*2/*m*, $a = 5.38$, $b = 7.04$, $c = 48.10$ Å, $\beta = 91.1°$). Optically biaxial (+), $\alpha = 1.700(3)$, $\beta = 1.710(3)$, $\gamma = 1.734(3)$. $D_{meas} =$ 3.32-3.42 g/cm^3, $D_{calc} = 3.22$ g/cm^3. The empirical formula is $(Ba_{0.75}Sr_{0.25}K_{0.17}Ce_{0.02}Ca_{0.01})(Na_{2.20}Ti_{0.94}Mn_{0.62}Ca_{0.20}Fe_{0.04})(Ti_{1.33}Nb_{0.67})(Si_{2.00}O_7)_2O_{3.30}\cdot 4.325H_2O$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 24.06 (100), 7.05 (13), 5.95 (36), 3.95 (25), 2.828 (42), 2.712 (19), 2.155 (13).
Wavenumbers (cm^{-1}): 3530sh, 3410, 1615, 1046, 985sh, 946s, 907s, 843, 685w, 548, 500w, 454.

TiSi124 Bykovaite $BaNa(Na,Ti)_4(Ti,Nb)_2(Si_2O_7)_2(OH,O)_3(OH,F)_2\cdot 3H_2O$

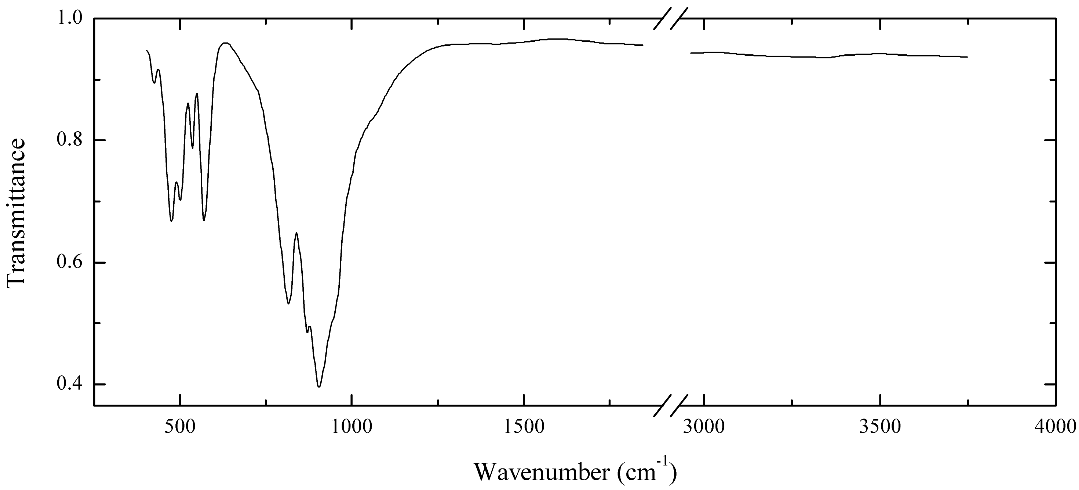


Locality: Shkatulka pegmatite, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pale yellow spherulites from the association with ussingite. The empirical formula is (electron microprobe) $(Ba_{0.88}K_{0.11}Sr_{0.01})Na_{2.40}Ca_{0.10}Ti_{1.99}Nb_{0.77}Mn_{0.26}Si_{4.00}(O,OH,F)_{19}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3475sh, 3340, 1637, 1045s, 985sh, 941s, 889s, 840s, 689w, 595sh, 548, 500sh, 455, 400.

TiSi125 Malayaite $CaSn(SiO_4)O$

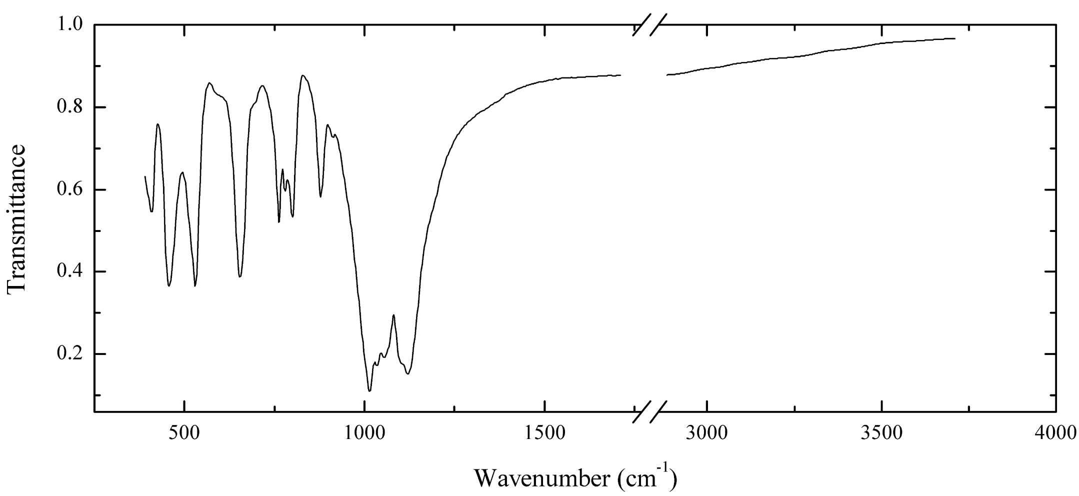


Locality: Deputatskoe Sn deposit, Deputatskiy ore knot, Sakha Republic (Yakutia), Eastern Siberia, Russia.

Description: Grey granular aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.

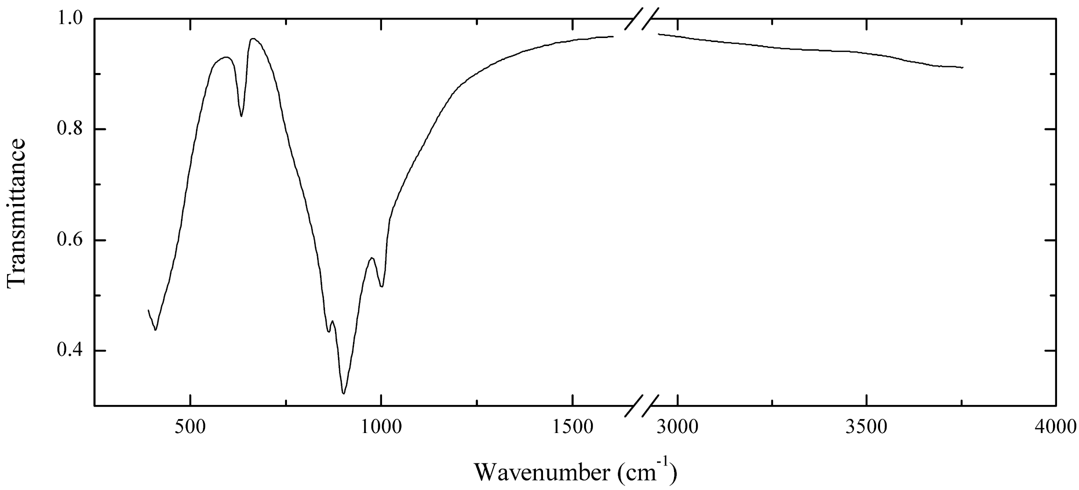
Wavenumbers (cm^{-1}): 945sh, 906s, 871s, 815s, 565, 532, 497, 473, 421w.

TiSi126 Narsarsukite $Na_2(Ti,Fe^{3+})(Si_4O_{10})(O,F)$



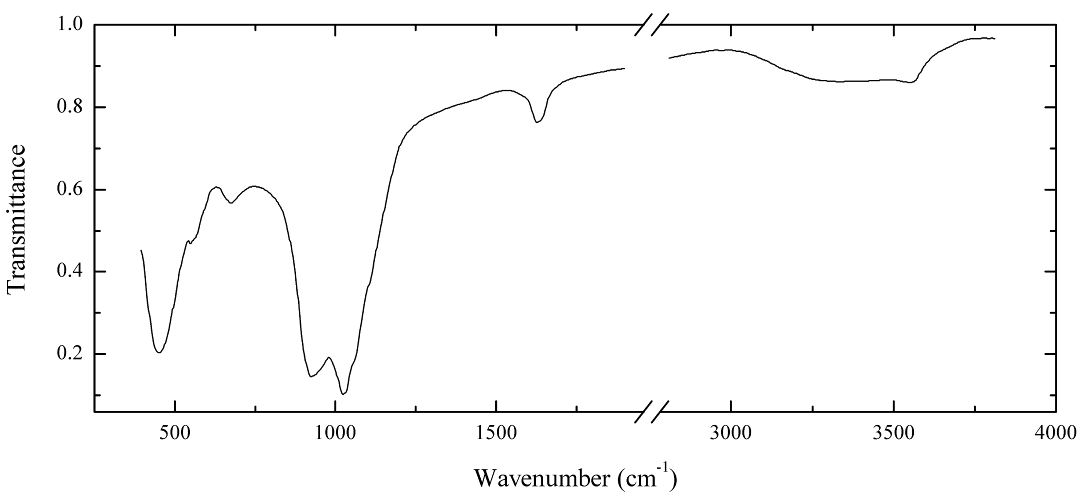
Locality: Flora Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Yellow transparent crystal from the association with quartz, aegirine, elpidite and albite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1118s, 1100sh, 1065sh, 1053s, 1034s, 1012s, 910w, 874, 797, 778w, 760, 690sh, 649, 526, 455, 400.

TiSi127 Natisite $Na_2Ti(SiO_4)O$



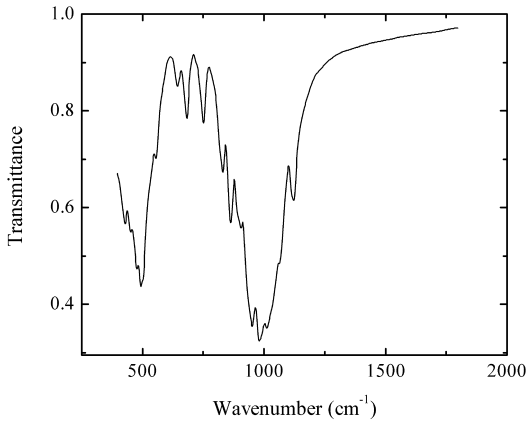
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Light grey granular aggregate with bright blue fluorescence under UV radiation from peralkaline pegmatite. Investigated by A.P. Khomyakov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1060sh, 1000, 898s, 859s, 810sh, 627, 435sh, 398s.

TiSi128 Niobophyllite $K_2Na(Fe,Mn)_7(Nb,Ti)_2Si_8O_{24}(O,OH,F)_7$



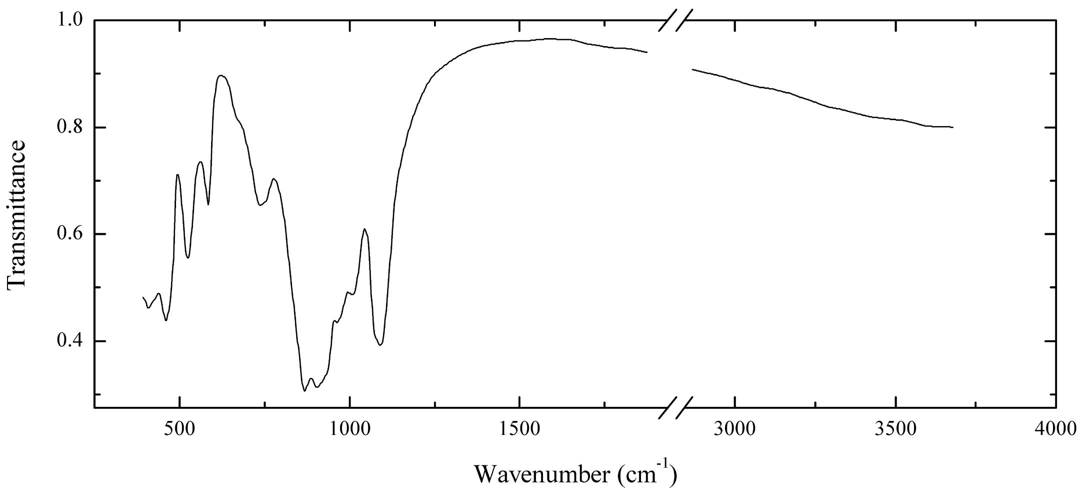
Locality: Seal Lake area, Labrador, Canada (type locality).
Description: Dark brown scaly aggregate. Altered, hydrated variety.
Wavenumbers (cm^{-1}): 3560, 3320, 1630, 1110sh, 1055sh, 1022s, 926s, 668, 547, 442s.

TiSi129 Neptunite $KNa_2Li(Fe^{2+},Mn^{2+})_2Ti_2Si_8O_{24}$



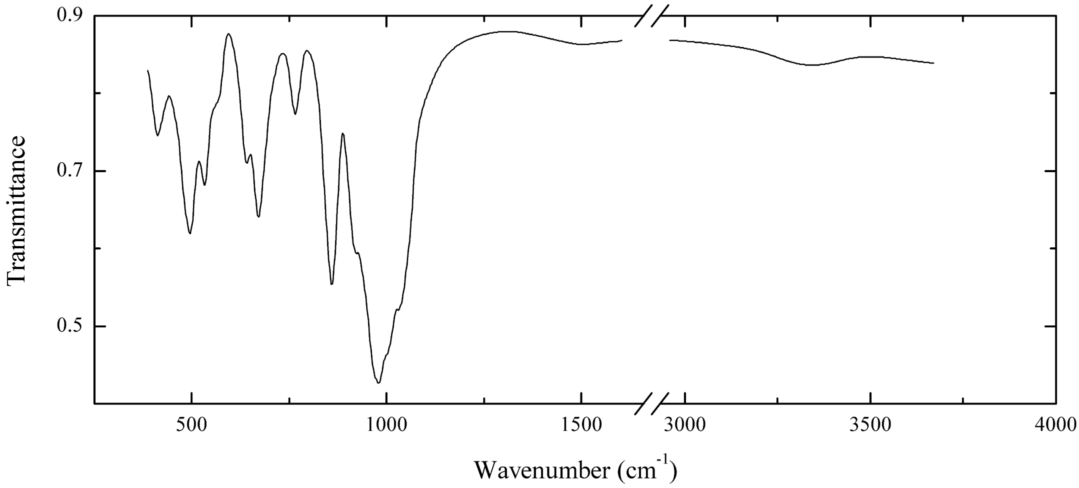
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Brown platelets from the association with titanite, zektzerite, aegirine and quartz. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $K_{0.90}Na_{1.96}Cs_{0.02}Li_x(Fe_{1.20}Mn_{0.70}Mg_{0.10})Al_{0.18}Ti_{1.92}Si_{8.00}O_{24}$.
Wavenumbers (cm^{-1}): 1123, 1110sh, 1072, 1013s, 990sh, 983s, 954s, 908, 863, 834, 825sh, 751, 684, 648w, 585sh, 557, 505sh, 496s, 479, 446, 427.

TiSi130 Normandite $NaCa(Fe^{2+},Mn^{2+})(Ti,Nb,Zr)(Si_2O_7)OF$



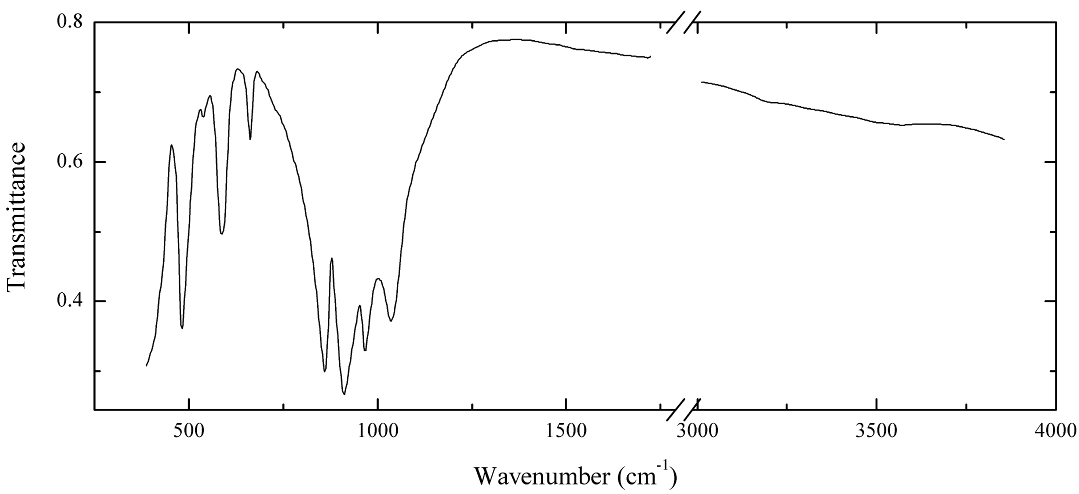
Locality: Rischorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Red radial aggregate of long-prismatic crystals. Investigated by Yu.P. Menshikov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1083s, 1070sh, 1001, 955, 915sh, 900s, 863s, 736, 670sh, 579, 516, 454s, 405.

TiSi131 **Niocalite** $Ca_7Nb(Si_2O_7)_2O_3F$



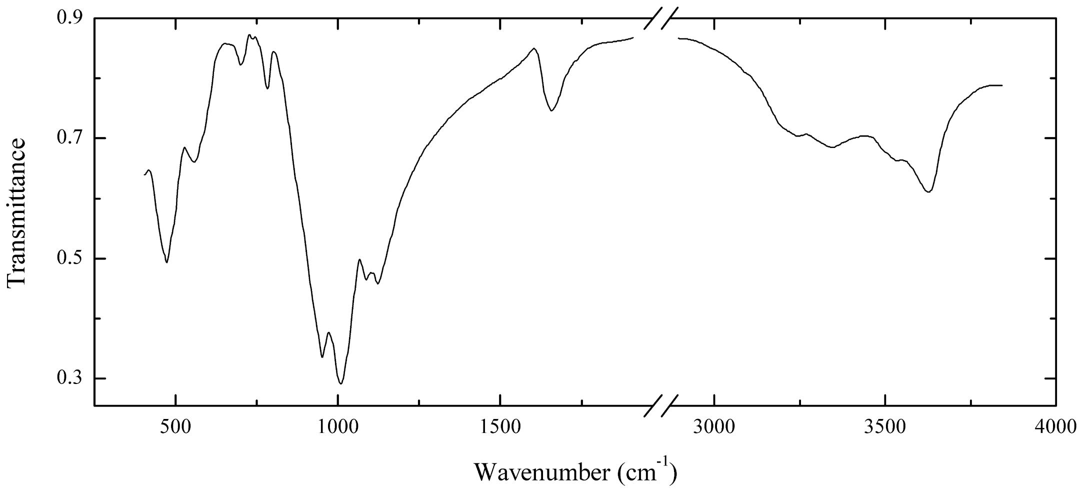
Locality: Oka complex, Oka district, Québec, Canada (type locality).
Description: Yellow grains from the association with calcite, magnetite, diopside, biotite and perovskite.
Wavenumbers (cm^{-1}): 3330w, 1500w, 1035sh, 1000sh, 980s, 920, 859, 764, 690, 639, 560sh, 531, 494, 407.

TiSi132 **Fresnoite** $Ba_2Ti(Si_2O_7)O$



Locality: Junnila mine, Clear Creek area, New Idria district, Diablo range, San Benito Co., California, USA.
Description: Yellow grains from the association with analcime. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $Ba_{2.00}Ti_{1.01}Si_{1.99}O_8$.
Wavenumbers (cm^{-1}): 1039, 968s, 912s, 861s, 664, 588, 538w, 483, 430sh.

TiSi133 Natrolemoynite $Na_4Zr_2Si_{10}O_{26}{\cdot}9H_2O$

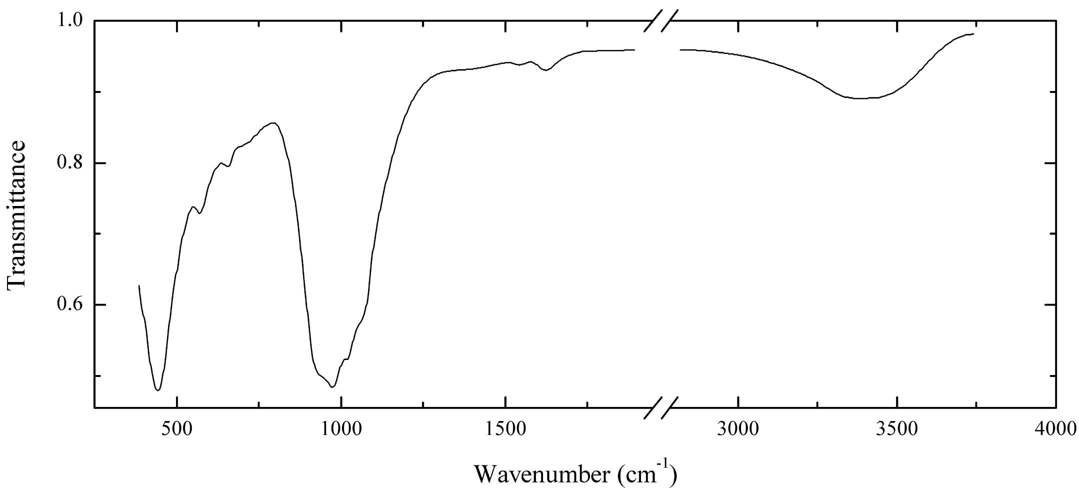


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Radial aggregate of brownish acicular crystals from the association with albite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3625, 3540, 3350, 3250, 1657, 1126s, 1092s, 1011s, 952s, 780, 700w, 580sh, 549, 490sh, 468.

TiSi134 Caryochroite $(Na,Sr)_3(Fe^{3+},Mg)_{10}Ti_2Si_{12}O_{37}(H_2O,O,OH)_{17}$

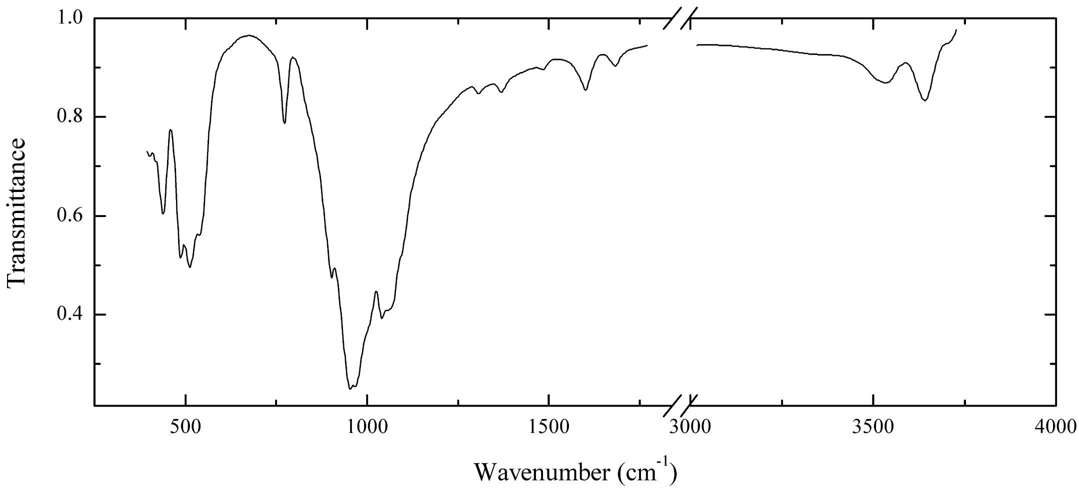


Locality: Nanna pegmatite, Igaliko, Kitaa (West Greenland) province, Greenland.

Description: Brown fibrous aggregate. Identified by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3400, 1617w, 1547w, 1060sh, 1022s, 976s, 940sh, 725w, 661w, 576, 450, 405sh.

TiSi135 Petarasite $Na_5Zr_2Si_6O_{18}(Cl,OH)\cdot 2H_2O$

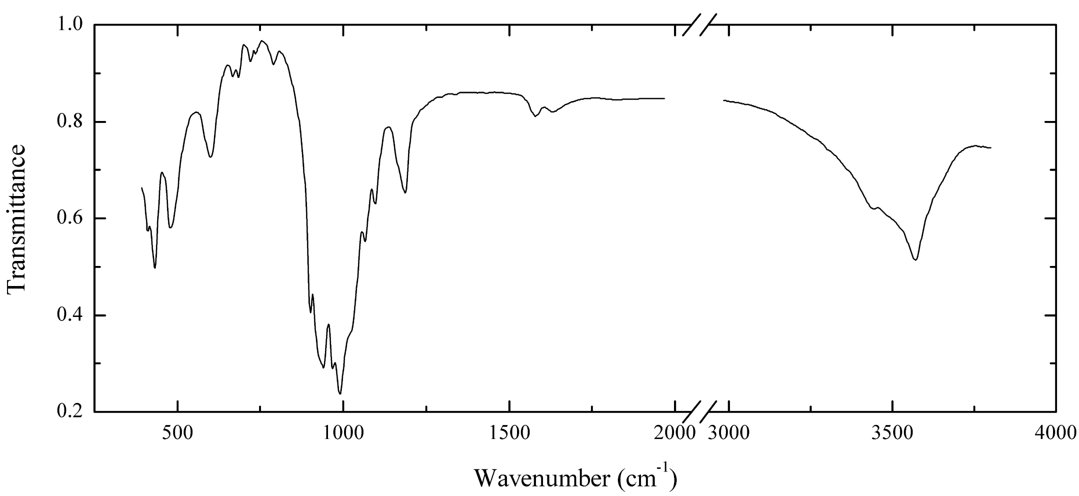


Locality: Poudrette (Demix) quarry, Mont Saint-Hilaire, Rouville RCM (Rouville Co.), Montérégie, Québec, Canada (type locality).

Description: Light brown crystal from the association with microcline, catapleiite, natrolite, nepheline, eudialyte, aegirine, and albite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3625, 3510, 1685w, 1610, 1490w, 1370w, 1307w, 1110sh, 1070sh, 1044s, 1010sh, 968s, 955s, 906, 775, 540sh, 514, 491, 441, 410w.

TiSi137 Penkvilksite-2*O* $Na_4Ti_2Si_8O_{22}\cdot 4H_2O$



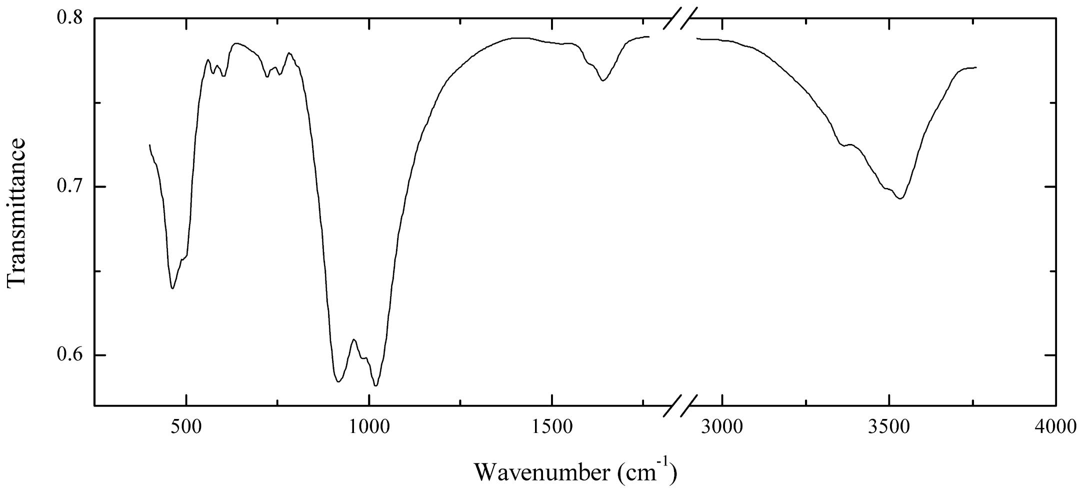
Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: White massive from the association with aegirine, natrolite, mountainite, raite, zorite, leucosphenite and sphalerite. Holotype sample. Orthorhombic, space group *Pnca*, $a = 16.3721$, $b = 8.7492$, $c = 7.4029$ Å. Optically biaxial (+), $\alpha = 1.637(2)$, $\beta = 1.640(2)$, $\gamma = 1.662(2)$. $D_{meas} = 2.58(2)$ g/cm^3. The empirical formula is $(Na_{3.7}Ca_{0.3})(Ti_{1.7}Zr_{0.2}Nb_{0.1})Si_{7.9}Al_{0.1}O_{22}\cdot nH_2O$.

Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 8.2 (100), 3.37 (90), 3.32 (70), 3.10 (70), 3.07 (70), 2.84 (80), 1.713 (70).

Wavenumbers (cm^{-1}): 3538, 3410, 1633w, 1578w, 1183, 1170sh, 1093, 1064, 1015sh, 987s, 965s, 937s, 925sh, 901, 787w, 734w, 716w, 680w, 661w, 596, 477, 427, 410sh.

TiSi138 Pyatenkoite-(Y) $Na_5(Y,REE)TiSi_6O_{18}{\cdot}6H_2O$

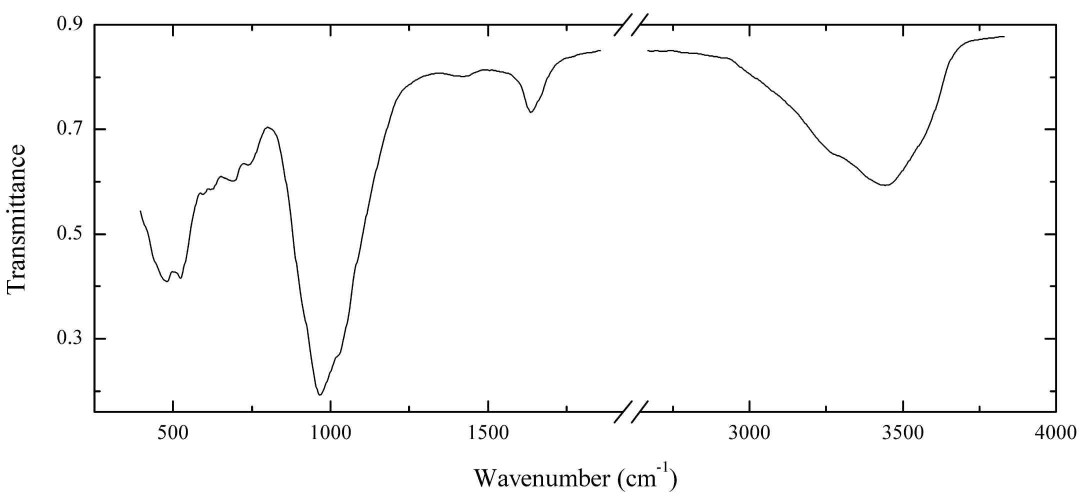


Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Light grey crystals from the association with microcline, aegirine, nepheline and rinkite. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3510, 3460, 3340w, 1637w, 1610sh, 1021s, 982s, 821s, 760w, 722w, 593w, 577w, 495sh, 465s, 430sh.

TiSi139 Paraumbite $HK_3Zr_2(Si_3O_9)_2{\cdot}nH_2O$

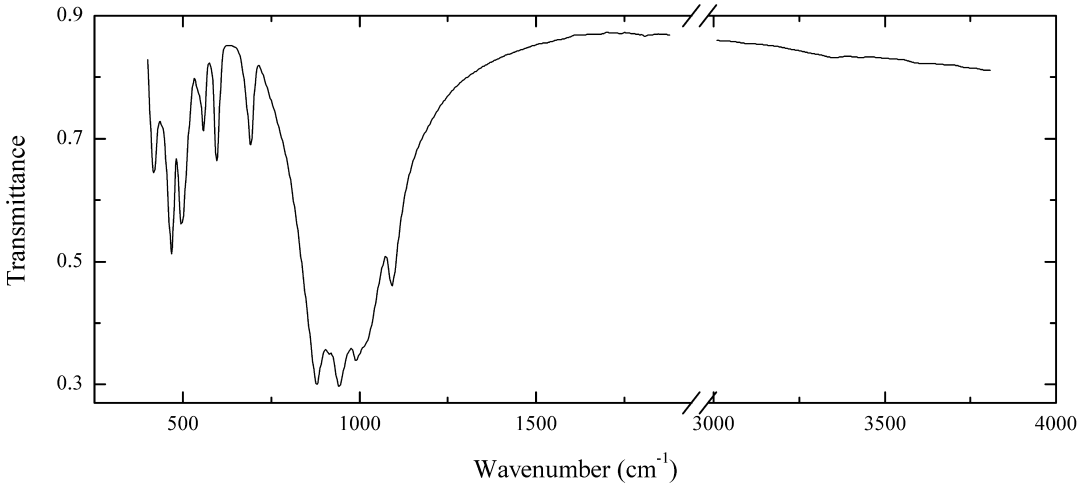


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pseudomorph after eudialyte. Ca-bearing variety. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3425, 3260sh, 1635, 1100sh, 1030sh, 970s, 920sh, 735w, 697, 625, 610, 526, 484, 450sh.

TiSi140 Parakeldyshite $Na_2Zr(Si_2O_7)$

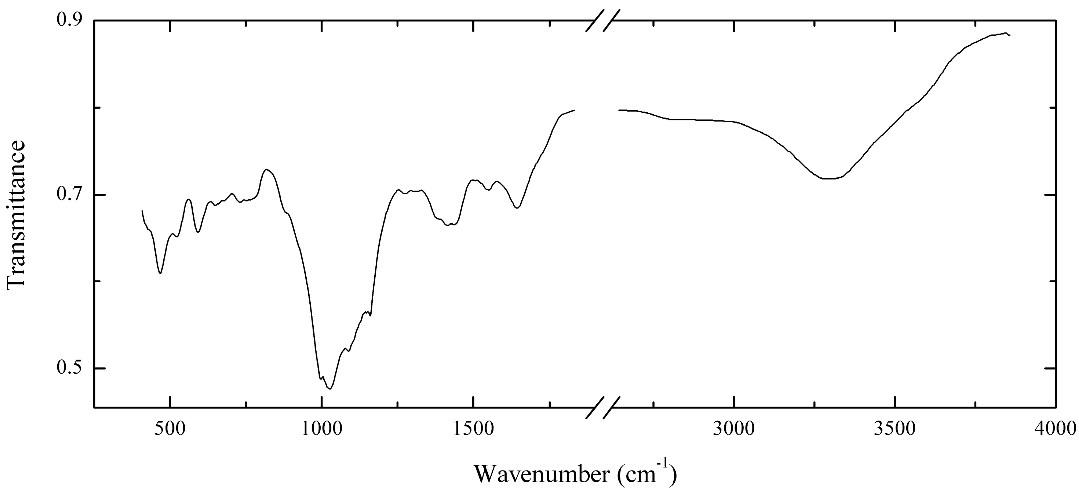


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (cotype locality).

Description: Light grey grain from the association with microcline, aegirine, eudialyte, sodalite, seidozerite and loparite-(Ce). Confirmed by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 1093, 1015sh, 989s, 942s, 905, 879s, 692, 596, 559, 545sh, 497, 469, 415.

TiSi141 Karnasurtite-(Y) $(Y,\mathit{REE})(Ti,Nb)(Al,Fe^{3+})(Si,P)_2O_7(OH)_4 \cdot 3H_2O$ (?)

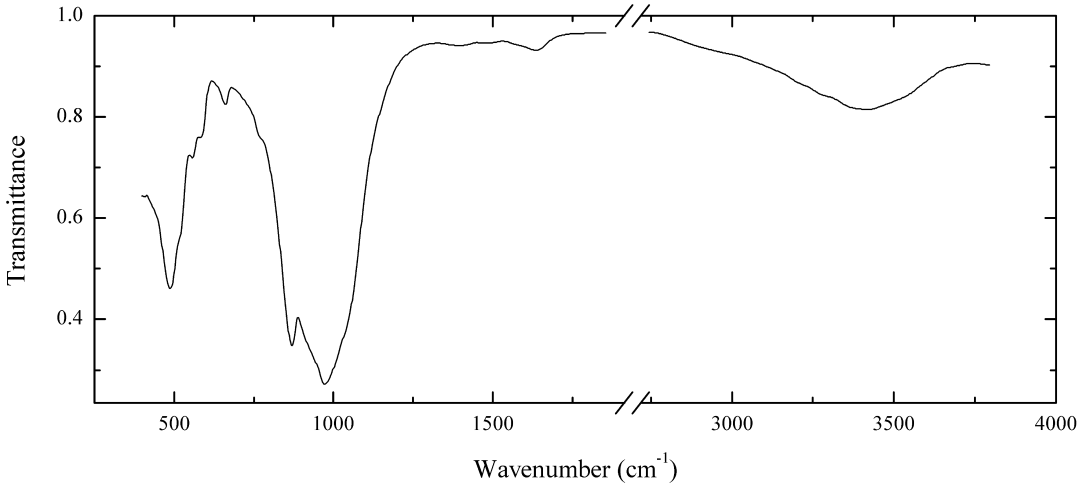


Locality: Norra Kärr, Gränna, Jönköping, Småland, Sweden.

Description: Orange grained from peralkaline pegmatite. The empirical formula is (electron microprobe) $(Y_{0.5}Ce_{0.2}Nd_{0.1}Sm_{0.1}Dy_{0.1})Sr_{0.1}(Ti_{1.2}Nb_{0.2}Zr_{0.1})Al_{1.1}Si_{1.4}P_{0.1}O_7(OH)_4 \cdot nH_2O$. The bands in the range1,200–1,600 cm^{-1} correspond to inclusions of bituminous substance.

Wavenumbers (cm^{-1}): 3320, 1700sh, 1650, 1555w, 1447, 1430, 1385, 1312w, 1275w, 1160sh, 1090sh, 1030s, 770, 730, 645, 590, 525, 465.

TiSi142 Mosandrite $(H_3O^+,Na,Ca)_3Ca_3REETi(Si_2O_7)_2(O,OH,F)_4$ (?)

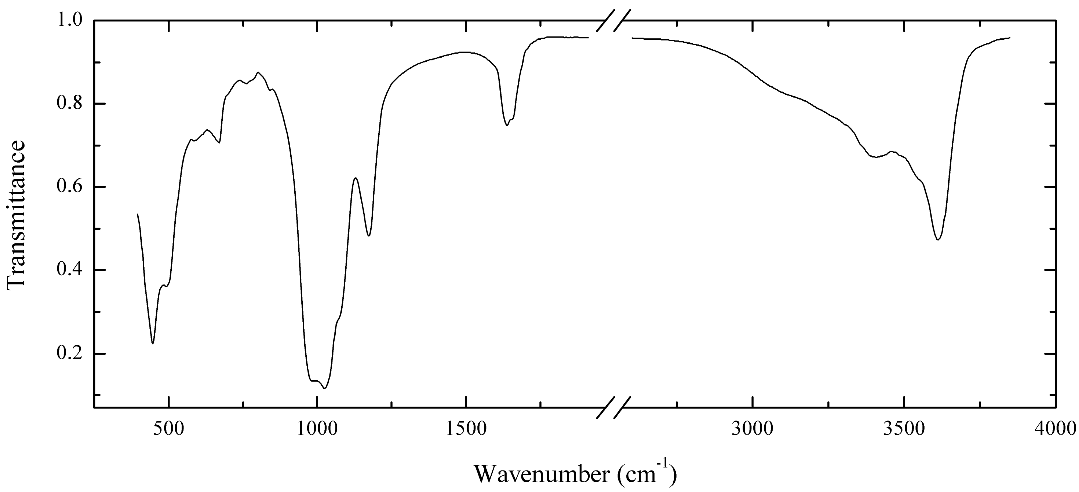


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow platy crystals from the association with albite. The empirical formula is (electron microprobe) $Na_{0.4}Ca_{3.0}Ce_{0.6}La_{0.3}Y_{0.2}Sr_{0.1}(Ti_{1.0}Nb_{1.1})(Si_{2.00}O_7)_2(O,OH.F)_4 \cdot nH_2O$.

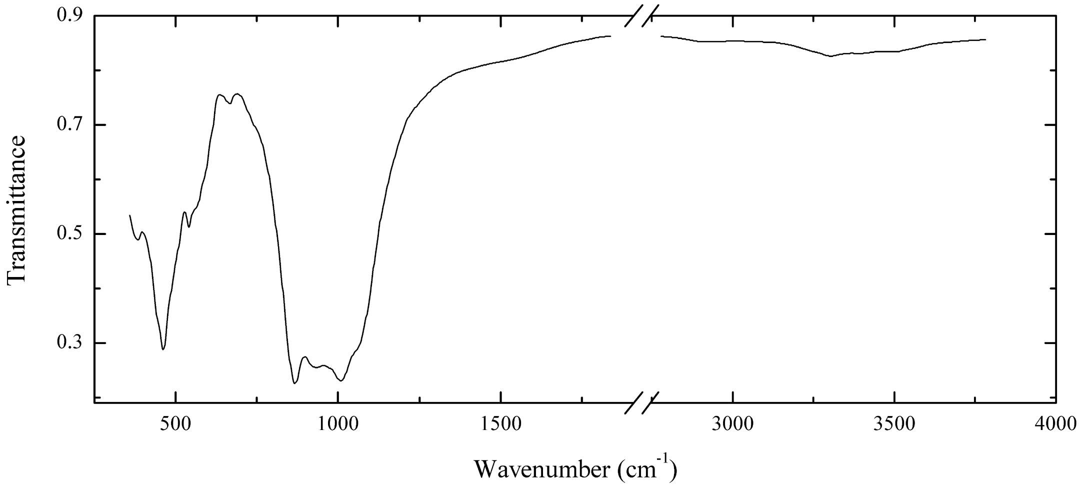
Wavenumbers (cm^{-1}): 3400, 1640w, 1400w, 1025sh, 973s, 925sh, 868s, 765sh, 661w, 584, 553, 515sh, 484s.

TiSi143 Raite $Na_3Mn_3Ti_x(Si_2O_5)_4(OH,O)_2 \cdot 10H_2O$ ($x < 0.5$)



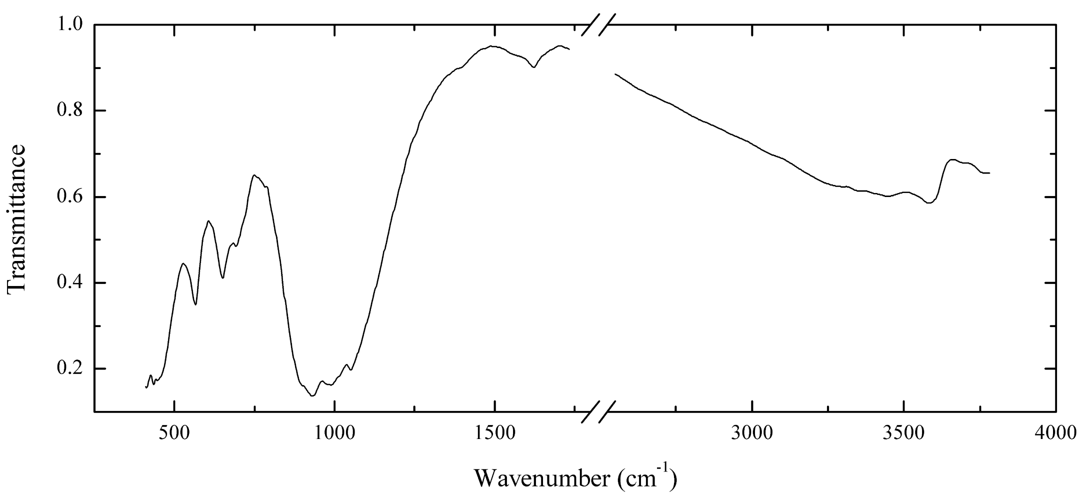
Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown acicular crystals. Na-deficient variety. The empirical formula is (electron microprobe) $H_xNa_{0.75}K_{0.13}Ca_{0.25}Mn_{1.70}Fe_{0.52}Mg_{0.06}Ti_{0.40}Zr_{0.04}Nb_{0.01}Si_{7.99}Al_{0.01}O_{20}(OH,O)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3603, 3400, 3125sh, 1660, 1643, 1177, 1070sh, 1026s, 987s, 837w, 760w, 664, 590w, 490, 442s.

TiSi144 Rosenbuschite $(Ca,Na)_6(Zr,Ti)_2(Si_2O_7)_2(F,O)_4$



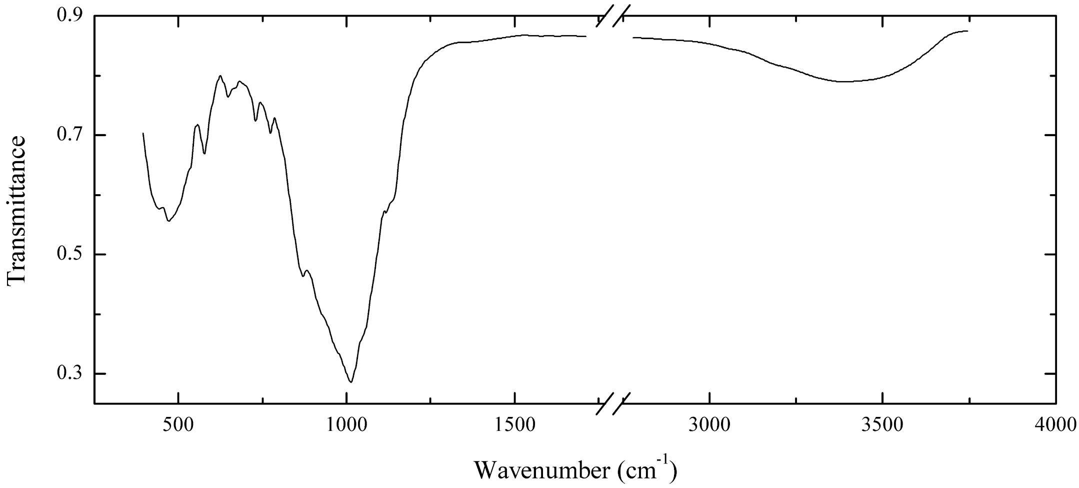
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown radial aggregate from the association with låvenite, astrophyllite, amphibole and pyrrhotite. Investigated by Yu.P. Menshikov. Identified by electron microprobe analysis, powder X-ray diffraction pattern and IR spectrum.
Wavenumbers (cm^{-1}): 3500w, 3275w, 1050sh, 1003s, 928s, 864s, 730sh, 665w, 580sh, 560sh, 538, 460s, 385.

TiSi145 Hydroastrophyllite $(H_3O,H_2O,K,Ca)_3(Fe^{3+},Mn,\square)_7(Ti,Nb)_2(Si,\square)_8(O,OH,F)_{31}$



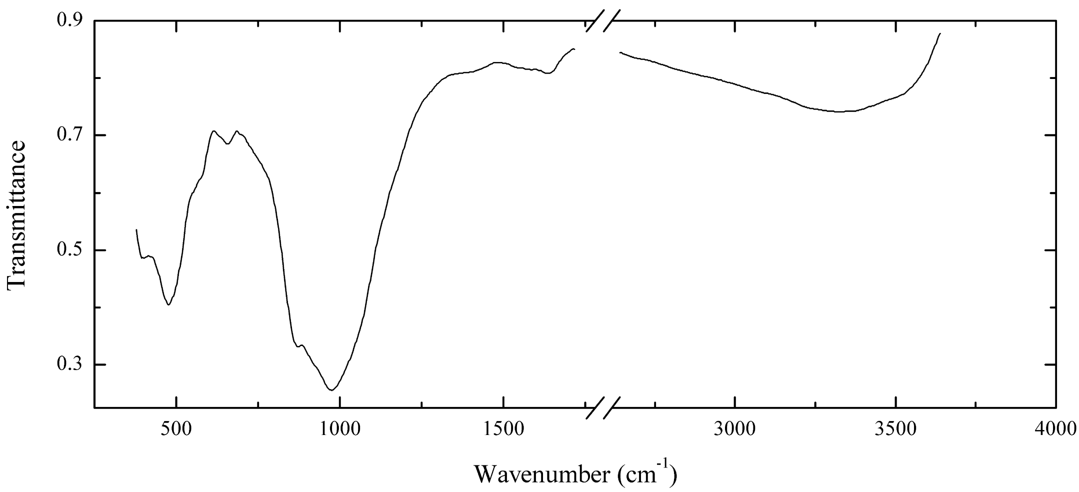
Locality: Rovozero lake, Western Keivy massif, Kola peninsula, Murmansk region, Russia.
Description: Brown platy crystals from alkaline granite, from the association with fluorite. Identified by semiquantitative electron microprobe analysis and IR spectrum.
Wavenumbers (cm^{-1}): 3590, 3440, 1625w, 1070sh, 1051s, 987s, 932s, 900sh, 694, 650, 564, 432s.

TiSi146 Rinkite $Na(Na,Ca)_2(Ca,Ce)_4Ti(Si_2O_7)_2F_2(O,F)_2$



Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Beige platy crystal from the association with microcline, sodalite, keldyshite, parakeldyshite, eudialyte and lamprophyllite. The empirical formula is (electron microprobe) $H_xNa_{0.98}(Na_{1.39}Ca_{0.61})(Ca_{2.99}REE_{1.09}Sr_{0.12})(Ti_{0.88}Nb_{0.12})(Si_{2.00}O_7)_2F_2(O,F)_2{\cdot}nH_2O$ ($x \ll 1$).
Wavenumbers (cm^{-1}): 3390, 1135sh, 1119, 1050sh, 1010s, 975sh, 920sh, 868, 773, 728, 660sh, 648w, 578, 530sh, 475, 425.

TiSi147 Mosandrite-(Y) $(H_3O^+,Na,Ca)_3Ca_3(Y,\mathit{REE})Ti(Si_2O_7)_2(O,OH,F)_4$ (?)

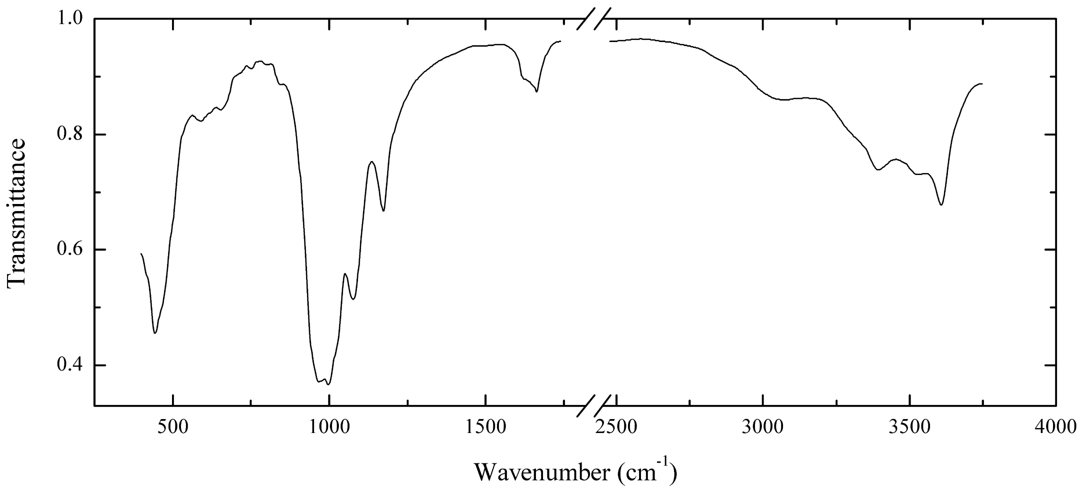


Locality: Kipawa alkaline complex, Les Lacs-du-Témiscamingue, Québec, Canada.

Description: Brown platelets from the association with microcline and hiortdahlite II. The empirical formula is (electron microprobe) $Na_{1.0}Ca_{3.5}(Y_{0.5}Ce_{0.2}Nd_{0.15}La_{0.1}Pr_{0.05})(Ti_{0.75}Zr_{0.2}Nb_{0.05})(Si_{2.00}O_7)_2(O,OH.F)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3340, 1635w, 1570sh, 1040sh, 976s, 930sh, 872s, 657w, 570sh, 476, 398.

TiSi148 Raite $Na_3Mn_3Ti_x(Si_2O_5)_4(OH,O)_2 \cdot 10H_2O$ ($x < 0.5$)

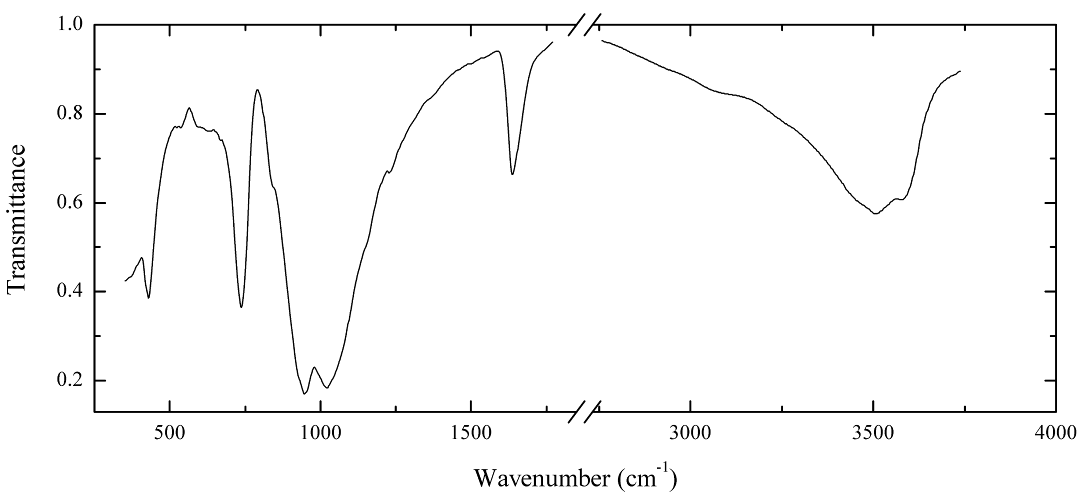


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Clusters of brown acicular crystals from the association with aegirine, natrolite, microcline, polylithionite, mountainite, zorite and sphalerite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3595, 3503, 3380, 3280sh, 3050, 1663, 1625sh, 1174, 1077, 997s, 969s, 848w, 803w, 754w, 654, 615sh, 589, 460sh, 443s.

TiSi149 Catapleiite $Na_2Zr(Si_3O_9) \cdot 2H_2O$

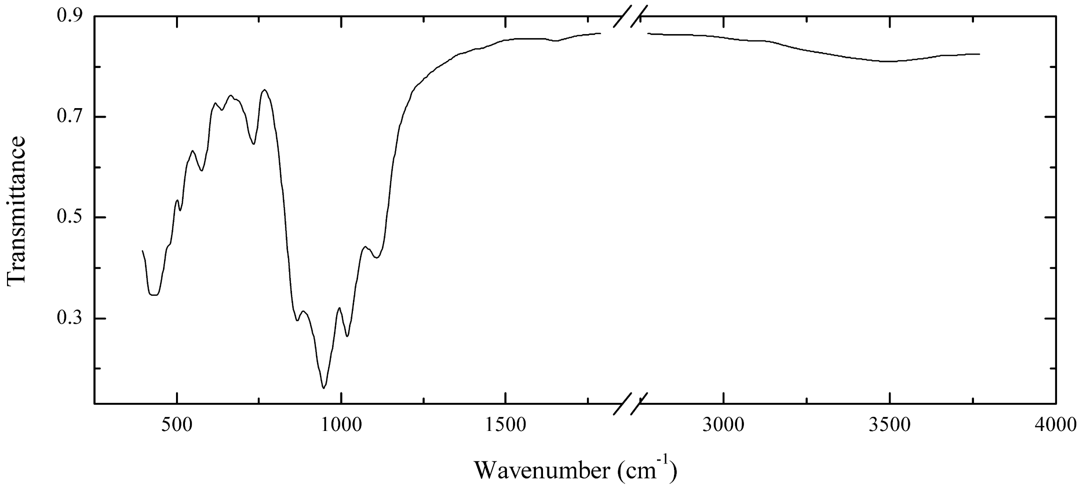


Locality: Suoluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish platy crystals. The empirical formula is (electron microprobe) $Na_{1.4}Ca_{0.3}Zr_{0.95}Ti_{0.05}Si_{3.00}O_9 \cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3575, 3500, 3100sh, 1645, 1230, 1023s, 952s, 845sh, 737, 630w, 600w, 525sh, 427.

TiSi150 Seidozerite $(Na,Ca)_4(Zr,Ti,Mn)_4(Si_2O_7)_2(O,F)_4$

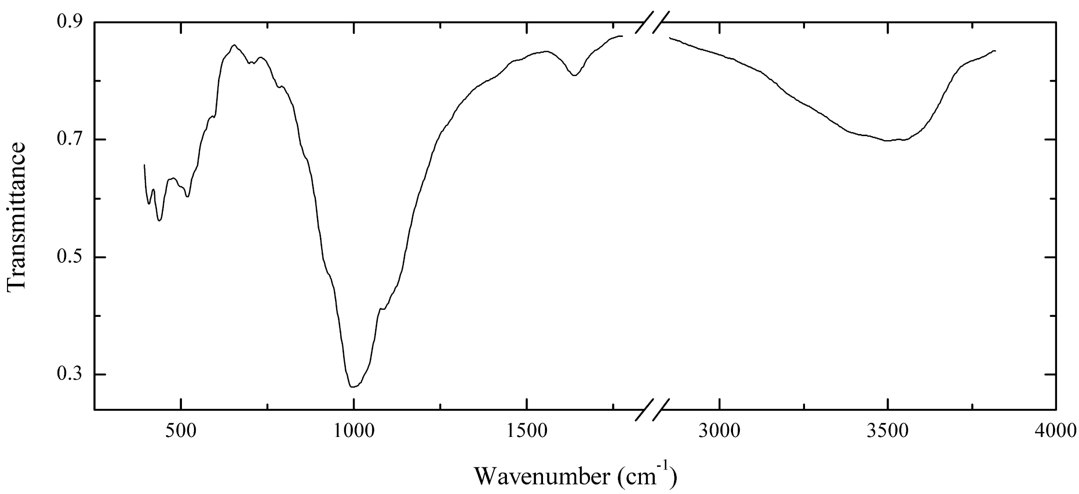


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown columnar aggregate from the association with microcline, aegirine, eudialyte, sodalite, parakeldyshite and loparite-(Ce). The empirical formula is (electron microprobe) $Na_{3.8}Ca_{0.2}Zr_{1.65}Ti_{1.4}Mn_{0.6}Fe_{0.3}Mg_{0.2}Nb_{0.05}(Si_{2.0}O_7)_2(O,F)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3480w, 1650w, 1110, 1017s, 948s, 869s, 735, 646w, 577, 511, 480sh, 430.

TiSi151 Seidite-(Ce) $Na_4SrCeTiSi_8O_{22}F \cdot 5H_2O$

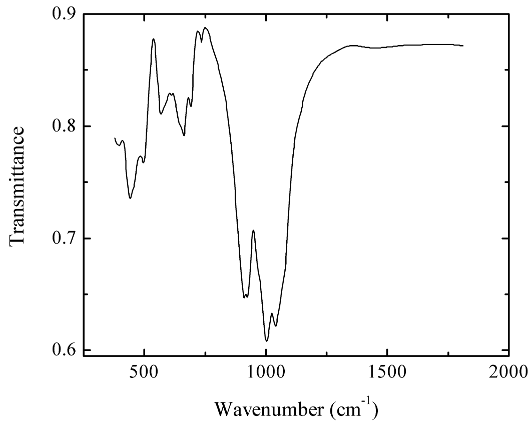


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Grey radial aggregate of flattened prismatic crystals from the association with natrolite, belovite-(Ce) and steenstrupine-(Ce). Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3480, 3400sh, 1638, 1125sh, 1090, 1035sh, 996s, 920sh, 860sh, 790sh, 704w, 574, 545sh, 518, 495sh, 436, 410.

TiSi152 Strontiojoaquinite $Sr_2Ba_2(Na,Fe^{2+})_2Ti_2Si_8O_{24}(O,OH)_2 \cdot H_2O$

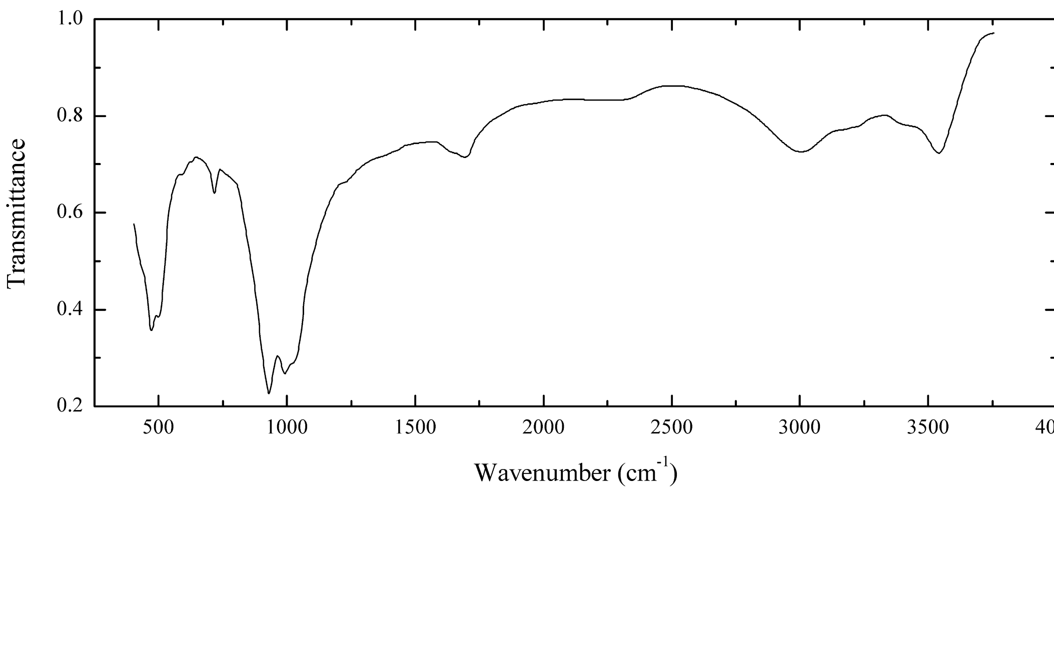


Locality: Junnila mine, New Idria district, Diablo Range, San Benito Co. California, USA.

Description: Yellow crystal from the association with joaquinite-(Ce), neptunite, benitoite and analcime. The empirical formula is (electron microprobe) $Sr_{1.7}Ba_{2.2}Ca_{0.1}Na_{1.5}Fe_{0.8}Ti_{1.7}Ca_{0.1}Si_{8,0}O_{24}(O,OH)_2 \cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1075sh, 1040s, 1001s, 970sh, 923s, 909s, 734w, 693, 665, 640sh, 572, 502, 465sh, 445.

TiSi153 Sazykinaite-(Y) $Na_5YZr(Si_6O_{18}) \cdot 6H_2O$

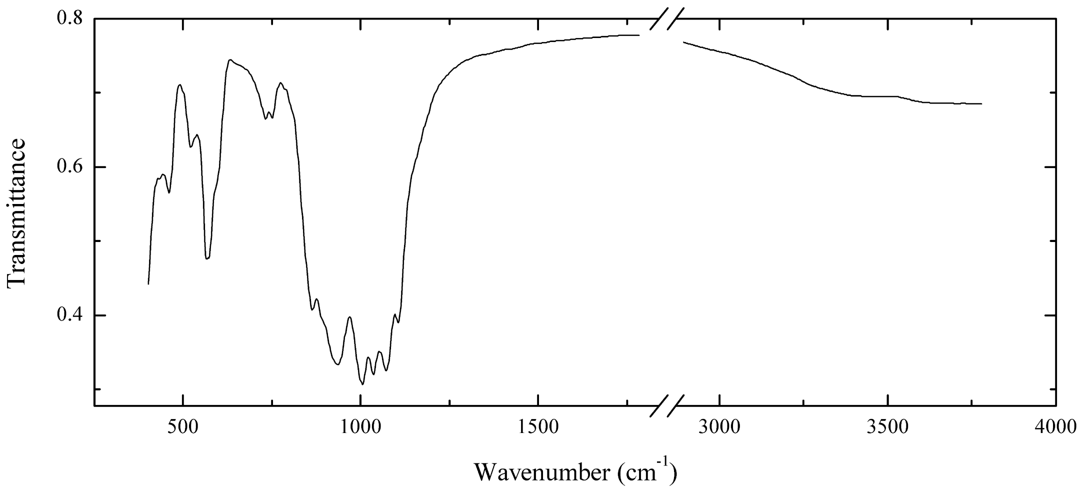


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Greenish-brown grains from the association with a labuntsovite-group mineral, aegirine, natrolite, alkaline feldspars, pectolite, alkaline amphibole, astrophyllite, lomonosovite and sphalerite. Holotype sample. Trigonal, space group *R*32, $a = 10.825(5)$, $c = 15.809(4)$ Å. Optically uniaxial (−), $\varepsilon = 1.578(2)$, $\omega = 1.585(2)$. $D_{meas} = 2.67(5)$ g/cm^3, $D_{calc} = 2.74$ g/cm^3. The empirical formula is $(Na_{4.38}K_{0.58})(Y_{0.69}Dy_{0.06}Gd_{0.05}Er_{0.04}Yb_{0.03}Th_{0.025}Sm_{0.02}Nd_{0.01}Eu_{0.01}Tb_{0.01}Ce_{0.01}Tm_{0.01})(Zr_{0.74}Ti_{0.15}Nb_{0.09})Si_{6.03}O_{18}\cdot 6.25H_2O$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.03 (32) (012), 5.40 (63) (110), 3.236 (84) (122), 3.127 (88) (300), 3.030(100) (024), 2.708 (19) (220), 2.018 (18) (404), 1.805 (21) (330).

Wavenumbers (cm^{-1}): 3510, 3400sh, 3200sh, 3150sh, 2990, 2300w, 1680, 1645sh, 1020sh, 993s, 927s, 780sh, 715, 589w, 498, 467, 430sh.

TiSi154 Sobolevite $Na_{13}Ca_2Mn_2Ti_3(Si_2O_7)_2(PO_4)_4O_3F_3$

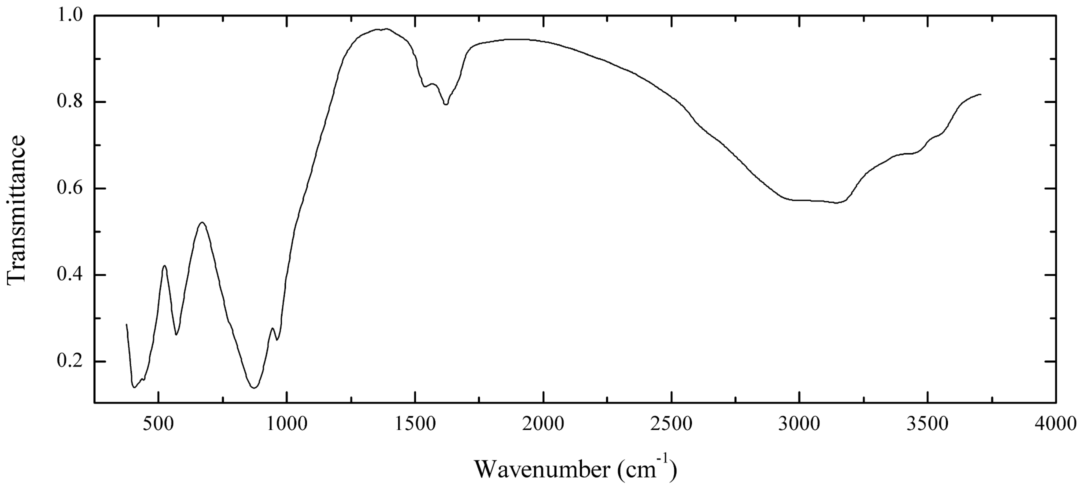


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Brown platelets from the association with polyphite, lamprophyllite and lomonosovite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): (3380w), 1110, 1074s, 1037s, 1007s, 938s, 895sh, 865, 751, 740, 595sh, 577, 569, 523, 467, 390s.

TiSi155 Sitinakite $KNa_2Ti_4Si_2O_{13}(OH){\cdot}4H_2O$

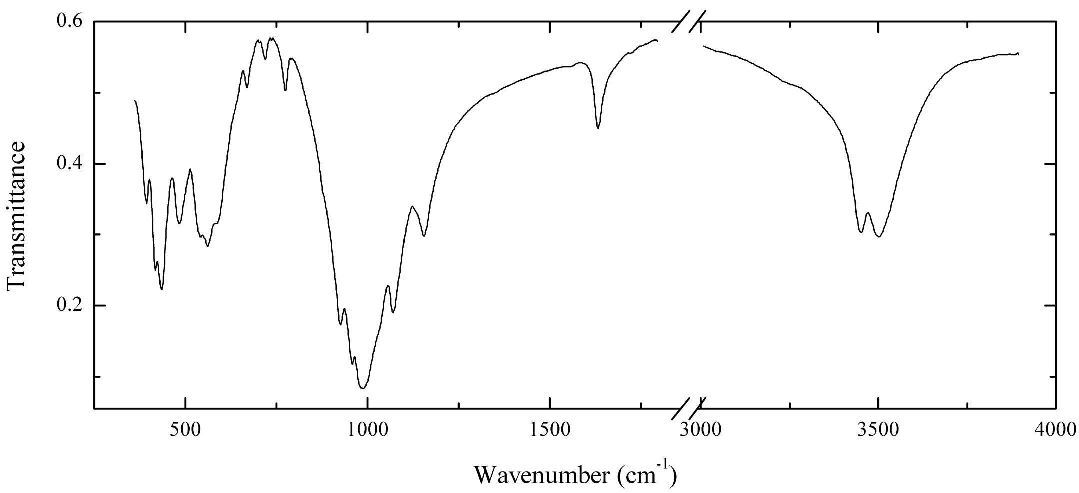


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown crystals from the association with aegirine, lamprophyllite and lomonosovite. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540sh, 3430sh, 3135, 3000sh, 1612, 1543w, 966, 874s, 572, 440sh, 396s.

TiSi156 Tumchaite $Na_2(Zr,Sn)Si_4O_{11}{\cdot}2H_2O$

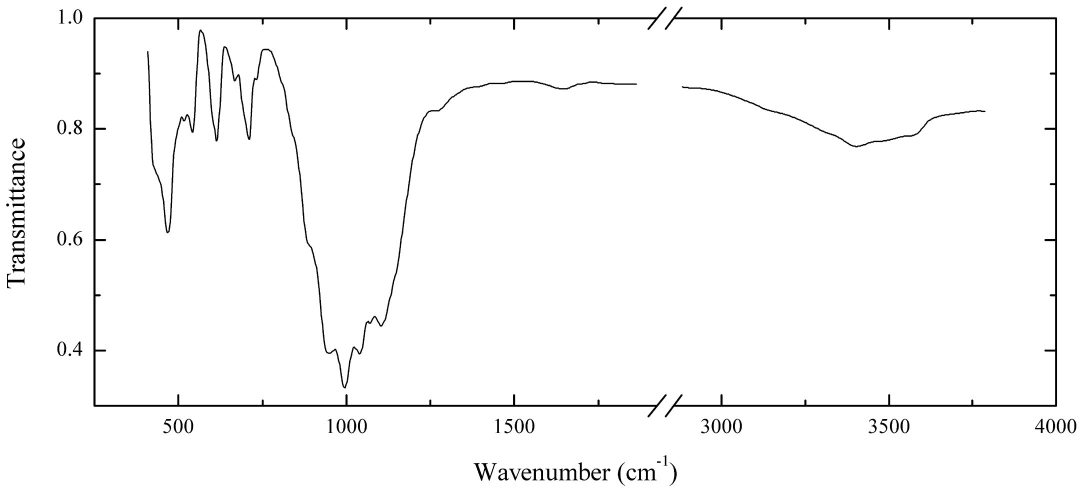


Locality: Vuoriyarvi alkaline–ultrabasic massif, northern Karelia, Russia (type locality).

Description: White granular aggregate from the association with calcite, dolomite, a serpentine-group mineral and pyrite. Holotype sample. Monoclinic, space group $P2_1/c$, $a = 9.144$, $b = 8.818$, $c = 7.537$ Å, $\beta = 113.22°$, $Z = 2$. Optically biaxial (–), $\alpha = 1.570$, $\beta = 1.588$, $\gamma = 1.594$, $2V_{meas} = 60°$. $D_{meas} = 2.78$ g/cm^3, $D_{calc} = 2.77$ g/cm^3. The empirical formula is $(Na_{2.03}Ca_{0.01})(Zr_{0.76}Sn_{0.17}Ti_{0.02}Hf_{0.01})Si_{4.02}O_{11}{\cdot}2.00H_2O$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 8.40 (100) (100), 5.38 (90) (11-1), 4.00 (80) (111), 3.401 (90) (20-2), 2.902 (90) (211), 2.772 (70) (30–2), 2.691 (90) (13-1), 2.190 (70) (31-3, 41-1).

Wavenumbers (cm^{-1}): 3500, 3450, 1634, 1158, 1072s, 992s, 958s, 926s, 776, 720w, 668, 585, 560, 540, 484, 438, 428, 400.

TiSi157 Terskite $Na_4Zr(H_4Si_6O_{18})$

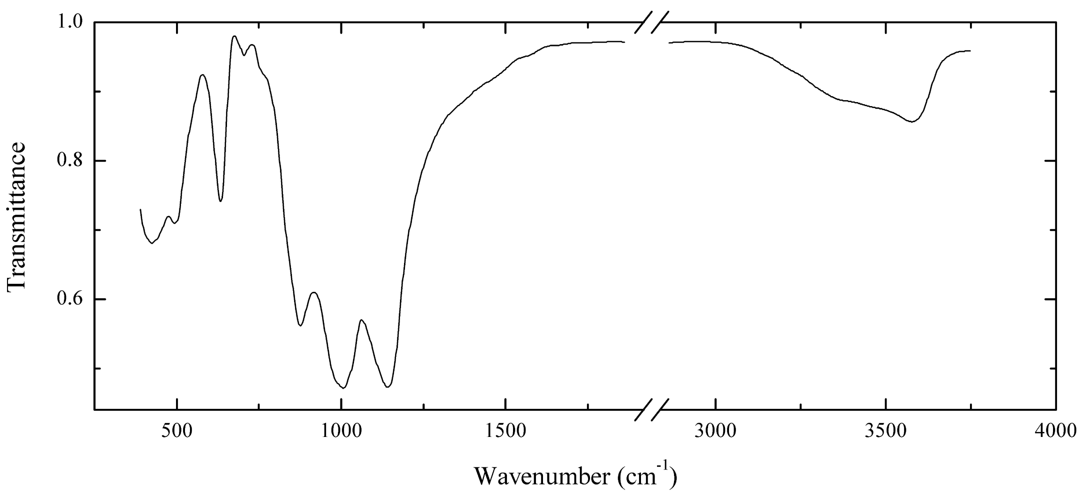


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: White rims around raslakite crystals from the association with microcline, nepheline, lamprophyllite, arfvedsonite, kazakovite and fluorcaphite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3550sh, 3390, 3180sh, 1650w, 1280w, 1130sh, 1109, 1075, 1044s, 996s, 950s, 885sh, 732w, 709, 667w, 611, 600sh, 540, 513, 467, 435sh.

TiSi158 Tisinalite $Na_3Mn^{2+}TiSi_6O_{15}(OH)_3$

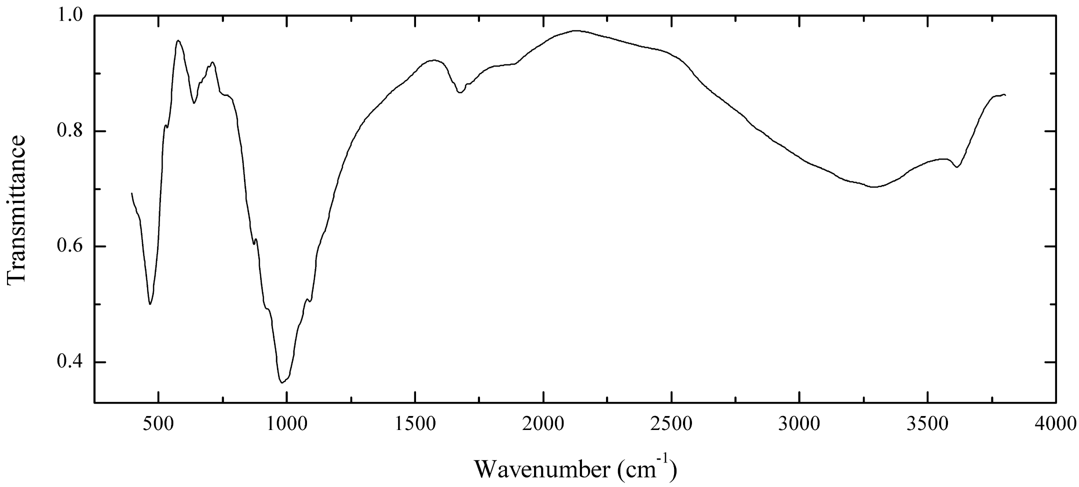


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-yellow crystals from the association with microcline, nepheline, lamprophyllite, aegirine and raslakite. Confirmed by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3560, 3360, 1144s, 1007s, 877s, 765sh, 707w, 631, 495, 417.

TiSi159 Tiettaite $(Na,K)_{17}Fe^{3+}TiSi_{16}O_{29}(OH)_{30}·2H_2O$

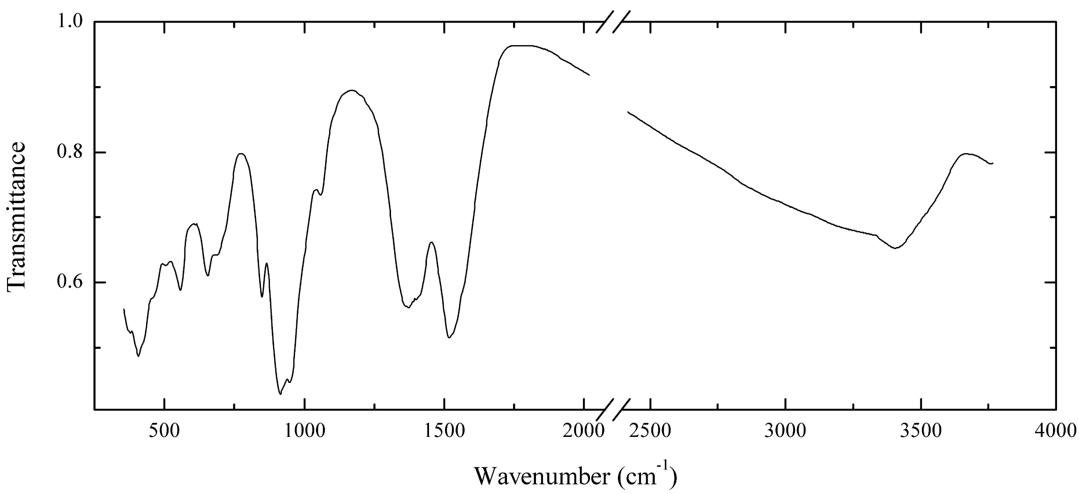


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Grey grains from the association with nepheline, orthoclase, sodalite, aegirine, rasvumite, natrite, *etc*. Holotype sample. Orthorhombic, space group *Cmcm*, *Cmc*2_1 or *C*2*cm*, $a = 29.77(1)$, $b = 11.03(2)$, $c = 17.111(5)$, $Z = 4$. Optically biaxial (–), $\alpha = 1.532(2)$, $\beta = 1.548(2)$, $\gamma = 1.559(2)$, $2V_{meas} = -79(1)°$. $D_{meas} = 2.42(2)$ g/cm^3, $D_{calc} = 2.39$ g/cm^3. The empirical formula is $(Na_{12.51}K_{4.25}Ca_{0.11})Fe_{1.02}Ti_{0.99}Si_{16.00}O_{29.10}O_{29.80}·1.84H_2O$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 10.38 (100), 4.516 (75), 3.702 (60), 3.220 (65), 3.097 (80), 2.972 (65), 2.773 (90).

Wavenumbers (cm^{-1}): 3597, 3280, 1850w, 1710sh, 1675, 1165sh, 1090, 1070sh, 1005sh, 984s, 920sh, 872, 759w, 660sh, 636, 533, 467s, 425sh.

TiSi160 Tundrite-(Ce) $Na_3(Ce,La)_4(Ti,Nb)_2(SiO_4)_2(CO_3)_3O_4(OH)·2H2O$

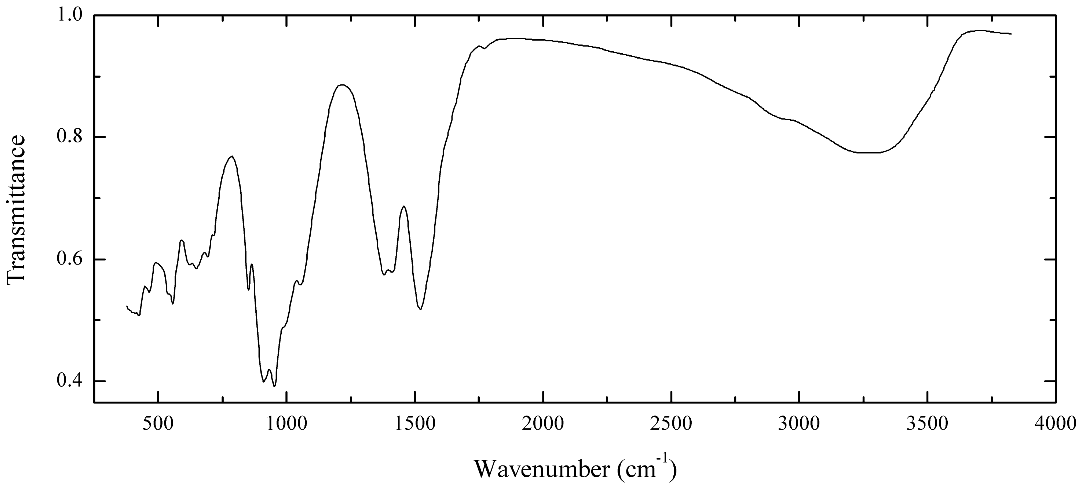


Locality: Railway station Khibiny, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Greenish-brown acicular crystals from alkaline pegmatite. Investigated by Z.V. Shlyukova.

Wavenumbers (cm^{-1}): 3390, 3290sh, 2920sh, 1570sh, 1519s, 1405sh, 1370, 1056, 947s, 913s, 847, 692, 650, 555, 502, 460sh, 430sh, 400s, 380sh.

TiSi161 Tundrite-(Ce) $Na_3(Ce,La)_4(Ti,Nb)_2(SiO_4)_2(CO_3)_3O_4(OH)\cdot 2H2O$

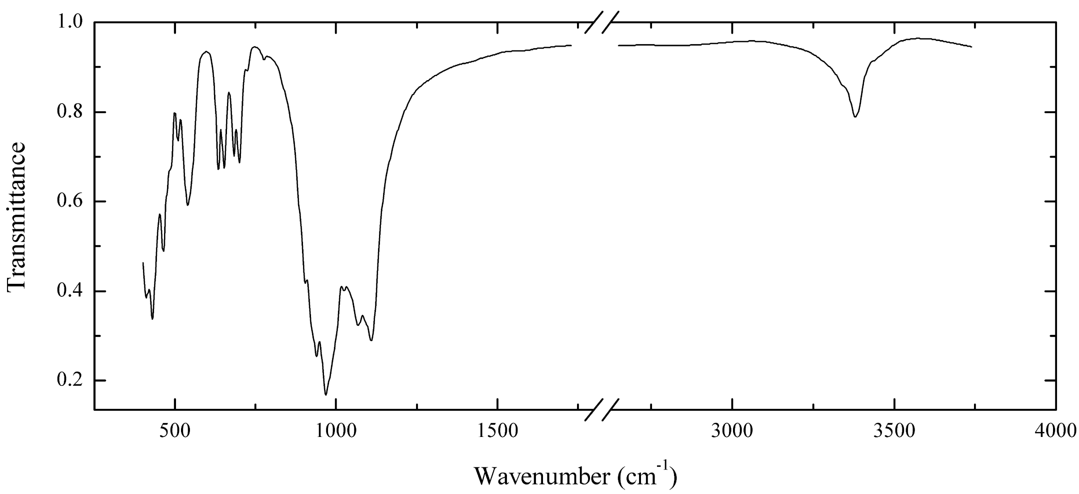


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Clusters of greenish-brown acicular crystals from alkaline pegmatite, from the association with Mn-rich eudialyte, aegirine, microcline and fluorapatite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3450sh, 3250, 2940sh, 1765w, 1524s, 1408, 1379, 1062, 995sh, 952s, 911s, 850, 714, 691, 648, 619, 555, 538, 460, 410s.

TiSi162 Tinaksite $K_2Na(Ca,Mn^{2+})_2Ti[Si_7O_{18}(OH)]O$

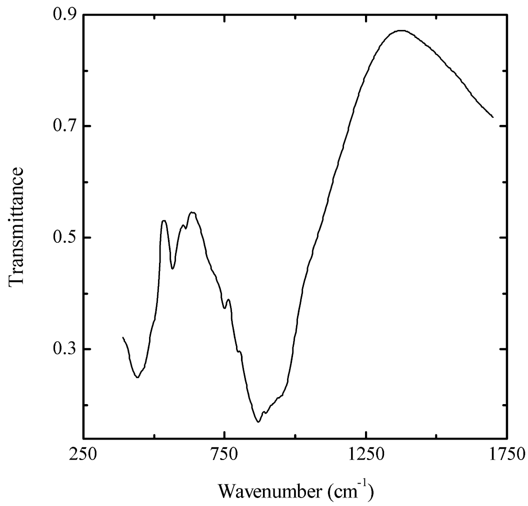


Locality: Malyi Murun (Malomurunskiy) alkaline pluton, Irkutsk region, Eastern Siberia, Russia (type locality).

Description: Yellow radial aggregate of long-prismatic crystals from the association with charoite, aegirine and microcline. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3366, 3320sh, 1108s, 1090sh, 1069s, 1023, 990sh, 966s, 938s, 925sh, 905, 780w, 723w, 700, 682, 652, 633, 541, 509, 485sh, 475sh, 465, 431s, 409s.

TiSi163 **Titanite** $CaTi(SiO_4)O$

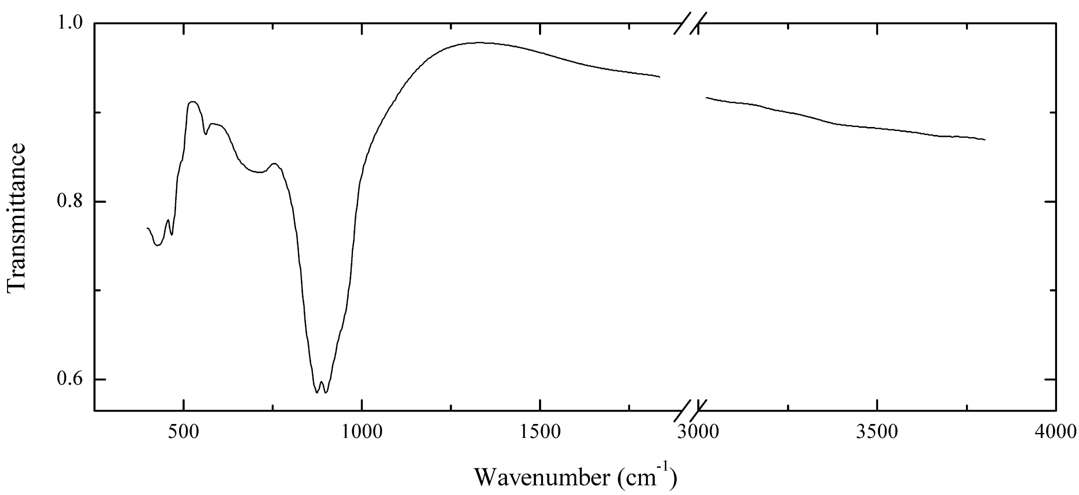


Locality: Cheremshanskoe (Malyshevskoe) Be deposit, Tokovaya river, Middle Urals, Russia.

Description: Brown lens-like crystal from the association with phlogopite, quartz and phenakite. Al- and Be-bearing variety. The empirical formula is (electron microprobe) $Ca_{0.98}Na_{0.02}Ti_{0.75}Al_{0.18}$-$Fe_{0.01}Be_xSi_{0.98}O_4(O,F)$.

Wavenumbers (cm^{-1}): 945sh, 915sh, 895s, 870s, 802, 750, 720sh, 613w, 565, 500sh, 435s.

TiSi164 **Titanite** $CaTi(SiO_4)O$

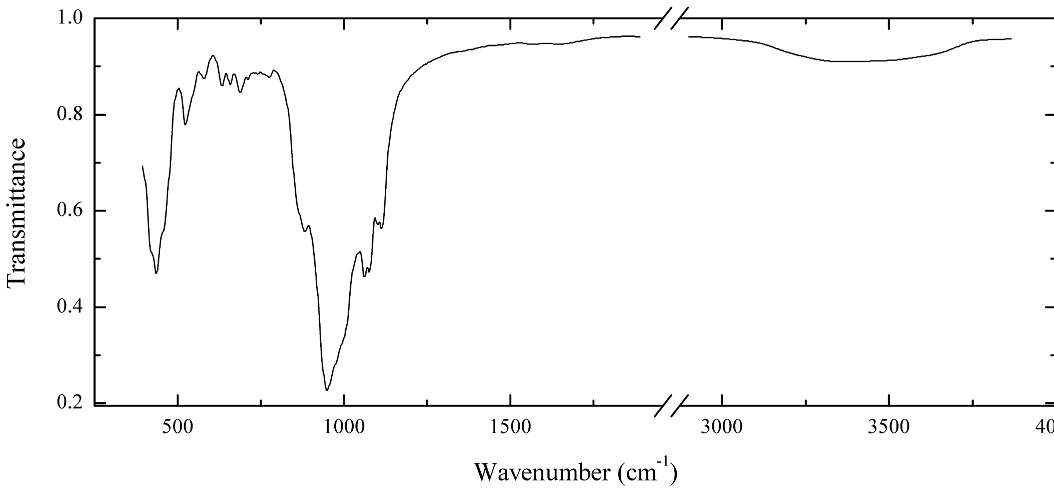


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-yellow prismatic crystal. The empirical formula is (electron microprobe) $Ca_{0.93}Ce_{0.02}Y_{0.02}Ti_{0.97}Fe_{0.03}Al_{0.02}Si_{1.00}O_5$.

Wavenumbers (cm^{-1}): 940sh, 899s, 871s, 855sh, 715, 690sh, 561, 490sh, 465, 420.

TiSi165 Eveslogite $(Ca,K,Na,Sr,Ba)_{48}[(Ti,Nb,Fe,Mn)_{12}(OH)_{12}Si_{48}O_{144}](F,OH,Cl)_{14}$

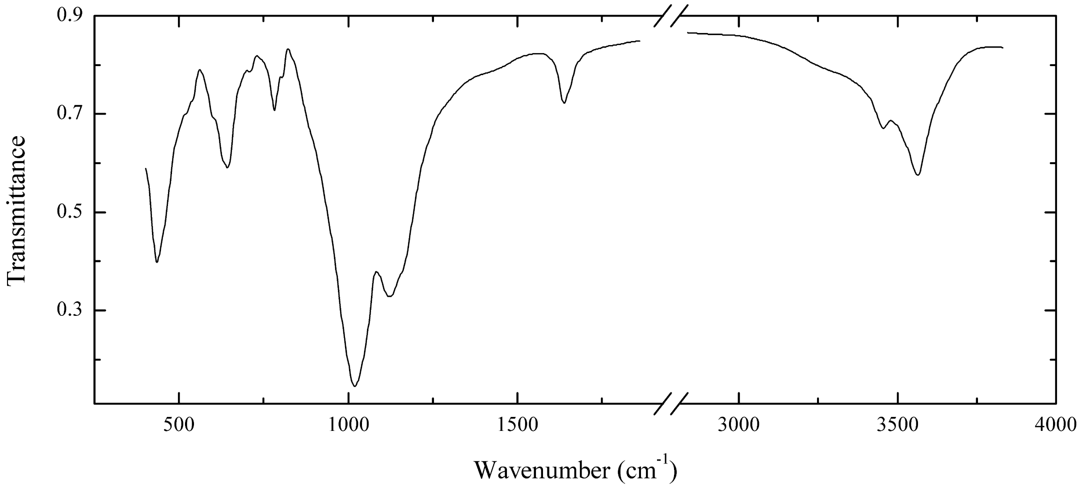


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Brownish parallel-fibrous aggregate from the association with nepheline, potassium feldspar, biotite, shcherbakovite, astrophyllite and fluorapatite. Holotype sample. Monoclinic, space group *P*2/*m* (?), $a = 14.069$, $b = 24.937$, $c = 44.31$ Å, $\gamma = 95.02°$, $Z = 4$. Optically biaxial (−), $\alpha = 1.631, \beta = 1.641, \gamma = 1.647, 2V_{meas} = -82°$. $D_{meas} = 2.85$ g/cm^3, $D_{calc} = 2.91$ g/cm^3. The empirical formula is $(Ca_{22.60}K_{12.32}Na_{10.08}Sr_{1.80}Ba_{1.28}Rb_{0.16})(Ti_{5.56}Nb_{3.36}Mn_{0.96}Fe^{2+}{}_{0.84}Fe^{3+}{}_{0.20}Zr_{0.20}Ta_{0.08})(Si_{47.56}Al_{0.44})[O_{139.36}(OH)_{20.64}F_{9.76}Cl_{0.80}]$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 12.33 (51) (020), 6.199 (42) (040), 3.127 (65) (-426), 3.110 (52) (-364), 2.990 (59) (2.3.12), 2.940 (45) (-2.4.12), 2.835 (100) (428). Related to eveslogite. Differs from eveslogite by the splitting of some IR bands (in particular, by the doublets 1,062 + 1,075 and 1,102 + 1,115 cm^{-1}).

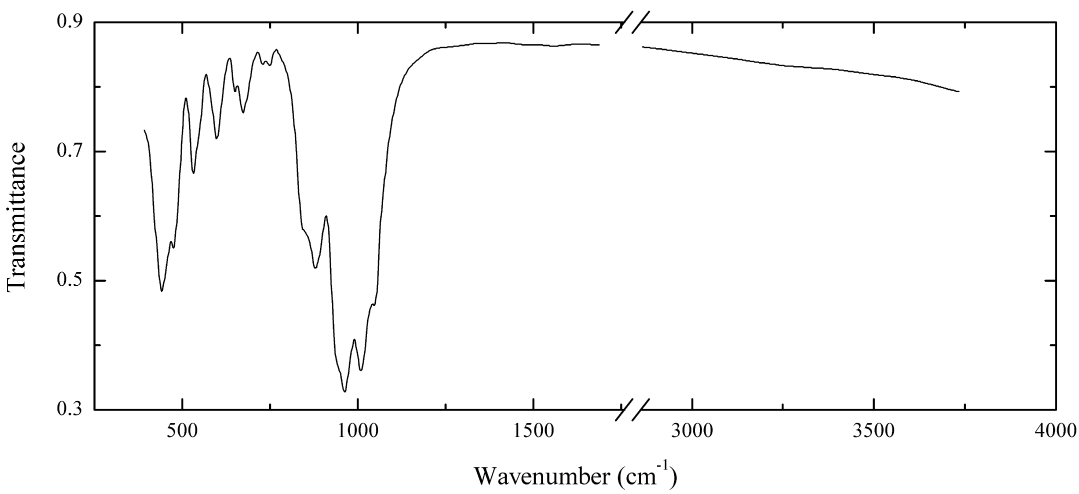
Wavenumbers (cm^{-1}): 3400, 1115, 1102, 1075s, 1062s, 1005sh, 975sh, 951s, 882, 860sh, 775w, 712w, 687, 658, 632, 576, 550sh, 522, 455sh, 437s, 425sh.

TiSi166 Elpidite $Na_2Zr(Si_6O_{15}){\cdot}3H_2O$



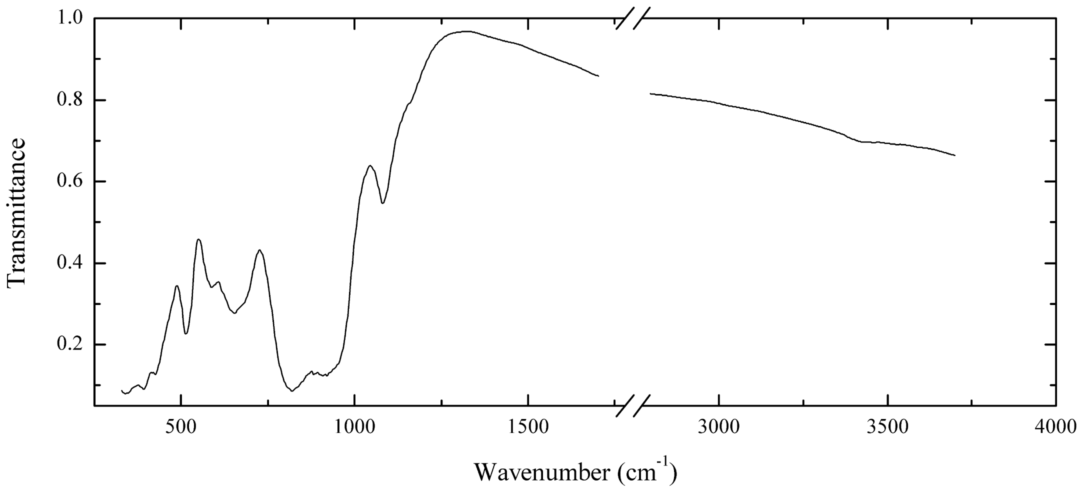
Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Colourless prismatic crystal with bright yellow fluorescence under UV radiation. Na-deficient Ti-bearing variety. Investigated by I.V. Pekov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3555, 3445, 3260sh, 1655sh, 1637, 1165sh, 1124s, 1018s, 802w, 780, 706w, 642, 630sh, 600sh, 535sh, 510sh, 450sh, 431s.

TiSi168 Aenigmatite $Na_2(Fe^{2+}{}_5Ti)Si_6O_{20}$



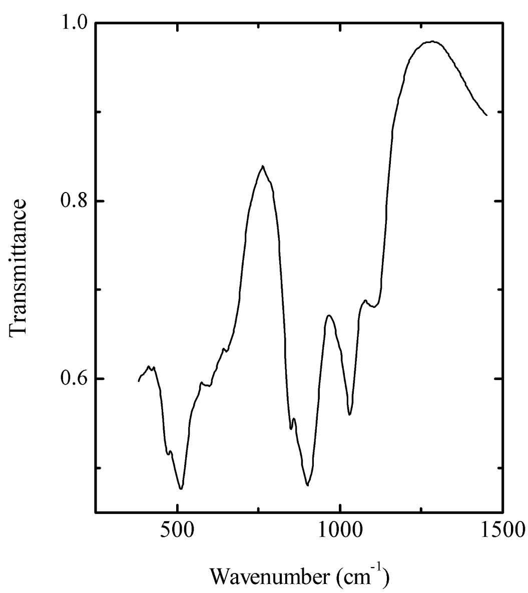
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Black crystal from the association with albite, aegirine, astrophyllite and loparite.
Wavenumbers (cm^{-1}): 1048, 1010s, 962s, 940sh, 877, 845sh, 747w, 725w, 672, 647, 596, 530, 473, 440.

TiSi169 Schorlomite $Ca_3(Ti,Fe^{3+})_2[(Si,Al,Fe^{3+})O_4]_3$



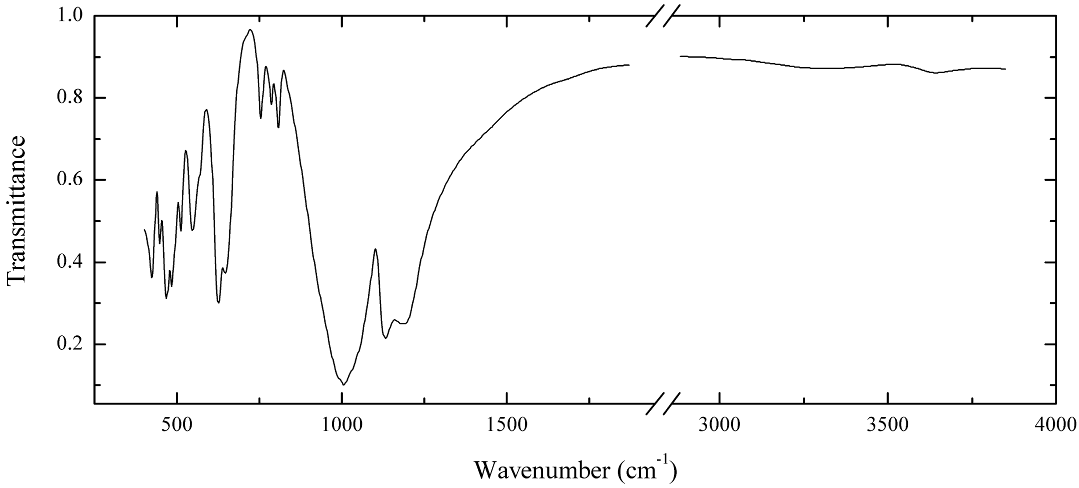
Locality: Afrikanda massif, Afrikanda, Kola peninsula, Murmansk region, Russia.
Description: Black grains from the association with magnesiohastingsite, magnetite, perovskite, titanite and calcite. The empirical formula is (electron microprobe) $(Ca_{2.9}Mg_{0.1})(Ti_{0.9}Fe_{0.7}Al_{0.3}Zr_{0.1})(Si_{2.5}Al_{0.5})O_{12}$.
Wavenumbers (cm^{-1}): 3400w, 1087, 912s, 825s, 680sh, 653, 584, 513, 424, 377s.

TiSi170 Chevkinite-(Ce) $(Ce,La,Ca)_4Fe^{2+}{}_2(Ti,Fe^{3+})_3(Si_2O_7)_2O_8$



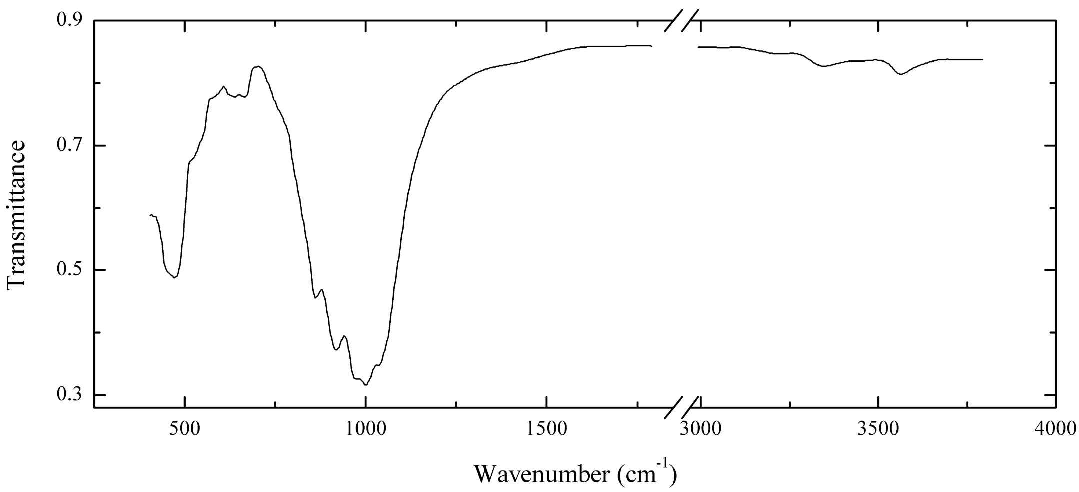
Locality: Il'meny (Il'menskie) Mts., South Urals, Russia (type locality).
Description: Black grains from the association with zircon, ilmenite and titanite. The empirical formula is (electron microprobe) $(Ce_{1.87}La_{0.90}Nd_{0.60}Pr_{0.15}Sm_{0.06}Ca_{1.23}Ba_{0.14}Th_{0.06})(Fe_{1.91}Mn_{0.04}Al_{0.11}Mg_{0.03})(Ti_{2.02}Nb_{0.58}Fe_{0.40})Si_{4.00}O_{22}$.
Wavenumbers (cm^{-1}): 1108, 1031, 903s, 853, 655sh, 600sh, 511s, 471.

TiSi171 Zektzerite $NaLiZrSi_6O_{15}$



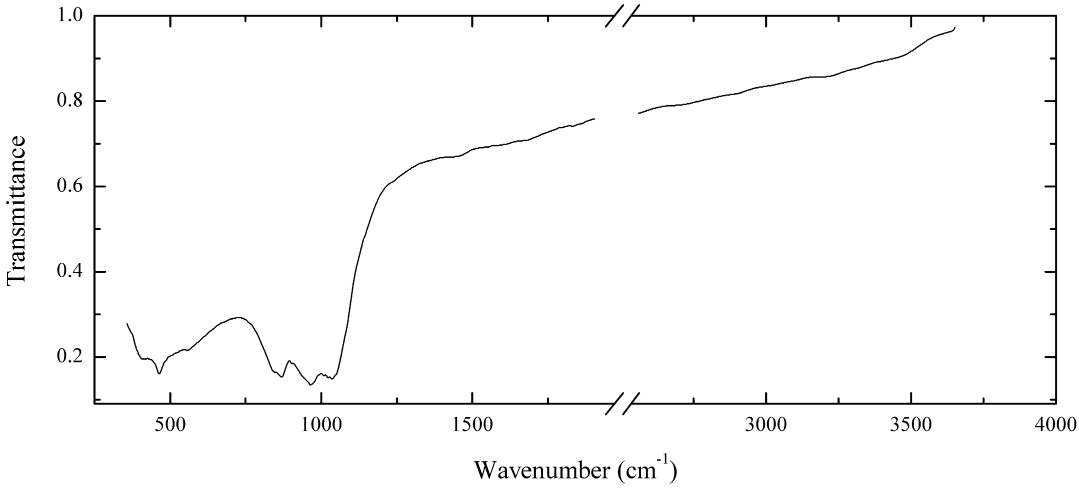
Locality: Golden Horn batholith, Washington Pass, Okanogan Co., Washington, USA (type locality).
Description: Pinkish-grey grains from the association with quartz, microcline, aegirine and zircon.
Wavenumbers (cm^{-1}): 3630w, 1185s, 1130s, 1005s, 807, 785w, 752, 646, 625s, 570sh, 546, 511, 484, 467s, 447, 425.

TiSi172 Hainite $Na_2Ca_5(Ti,Zr)_2(Si_2O_7)_2(F,OH)_4$



Locality: Bortolan quarry, Poços de Caldas plateau, Minas Gerais, Brazil.
Description: Yellow platelets from the association with aegirine and albite. The empirical formula is (electron microprobe) $Na_{1.9}Ca_{4.7}Sr_{0.2}Mn_{0.05}(Ti_{1.85}Zr_{0.1}Nb_{0.05})(Si_{2.0}O_7)_2(F,OH)_4$.
Wavenumbers (cm^{-1}): 3530w, 3315, 1039s, 999s, 970sh, 923s, 862, 671, 649, 580sh, 530sh, 474, 450sh.

TiSi173 "Niobofersmanite" $(Na,Ca)_4(Nb,Ti)_2[Si_2O_7](O,F)_5$ (?)

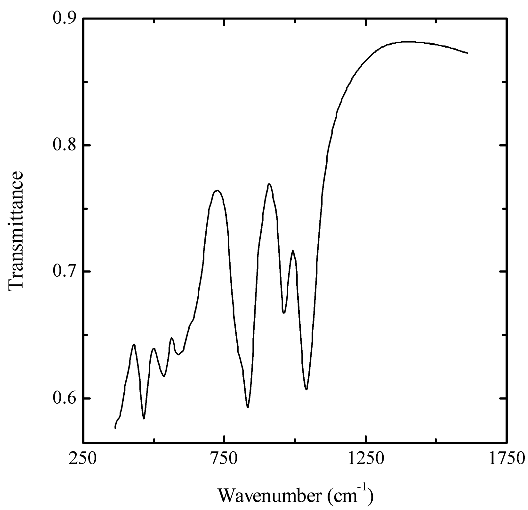


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown grains from the association with microcline, nepheline, sodalite, aegirine, pectolite, eudialyte, biotite and natrolite. Nb-dominant analogue of fersmanite. Needs further investigation.

Wavenumbers (cm^{-1}): 1034s, 966s, 867s, 840sh, 579, 500sh, 461s, 397.

TiSi174 Fersmanite $(Na,Ca)_2(Ca,Na)_2(Ti,Nb)_2[Si_2O_7]O_4F$

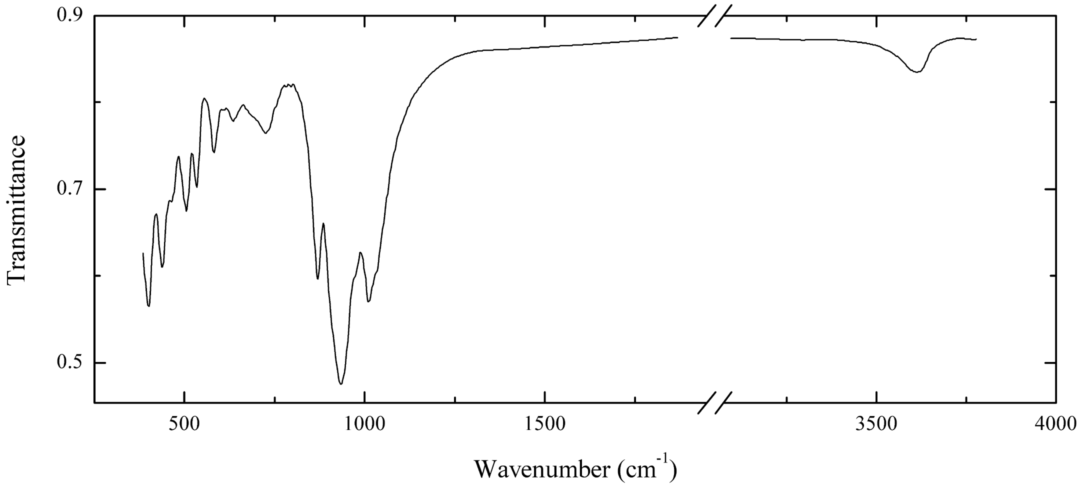


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless rectangular platelets. Investigated by I.V. Pekov.

Wavenumbers (cm^{-1}): 1044s, 961, 832s, 795sh, 645sh, 610sh, 586, 533, 460s, 380sh.

TiSi175 Jinshajiangite $(Na,Ca)(Ba,K)(Fe^{2+},Mn)_4Ti_2(Si_4O_{14})O_3(F,O,OH)_2$

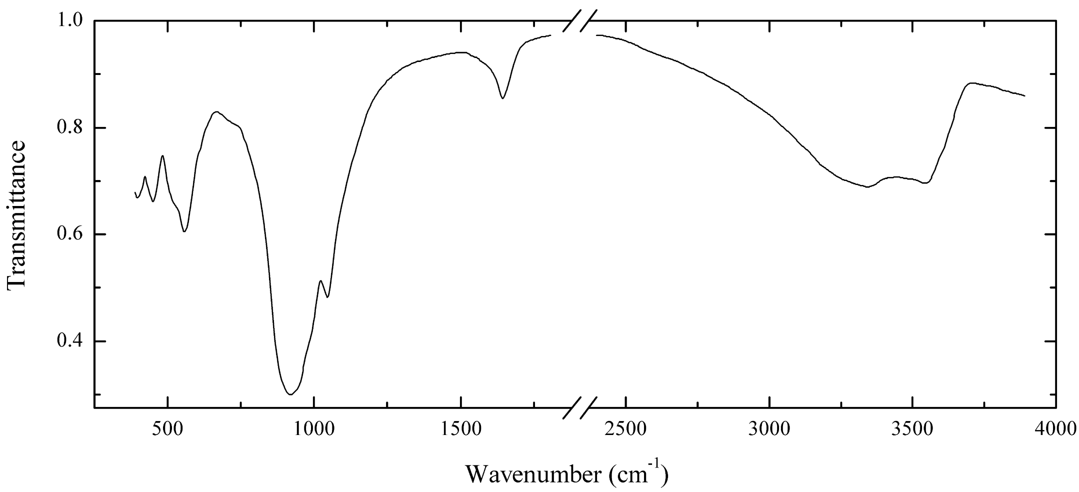


Locality: Norra Kärr, Gränna, Jönköping, Småland, Sweden.

Description: Dark ted prismatic crystals from the association with aegirine, microcline and albite. The crystal structure is solved. Monoclinic, space group *P*2/*m*, $a = 5.350(2)$, $b = 6.909(6)$, $c = 20.96(1)$ Å, $\beta = 99.83(4)°$, $Z = 4$. The empirical formula is (electron microprobe) $Na_{0.6}Ca_{0.4}Ba_{0.6}K_{0.4}(Fe_{3.0}Mn_{0.7}Mg_{0.3})(Ti_{1.6}Nb_{0.2}Zr_{0.2})(Si_{3.9}Al_{0.1})O_{17}F(OH,O)$.

Wavenumbers (cm^{-1}): 3560w, 1035sh, 1014s, 975sh, 938s, 871s, 730, 640w, 585, 535, 506, 465sh, 440, 391s.

TiSi176 Epistolite $Na_4Nb_2Ti(Si_2O_7)_2O_2(OH,F)_2{\cdot}4H_2O$

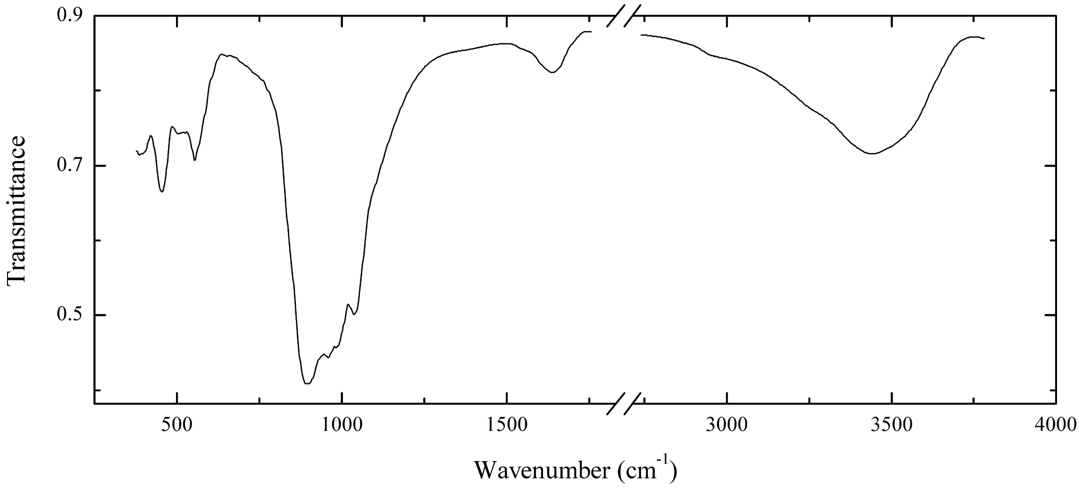


Locality: Pegmatite No. 60, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless, pseudomorph after vuonnemite, from the association with ussingite, altered rhabdophane, manganonordite-(Ce), umbozerite, aegirine, microcline, chkalovite and natrolite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3545, 3350, 1644, 1048, 983sh, 940sh, 917s, 890sh, 580sh, 554, 525sh, 449, 390.

TiSi177 Shkatulkalite $Na_{10}Mn^{2+}Ti_3Nb_3(Si_2O_7)_6(OH)_2F \cdot 12H_2O$

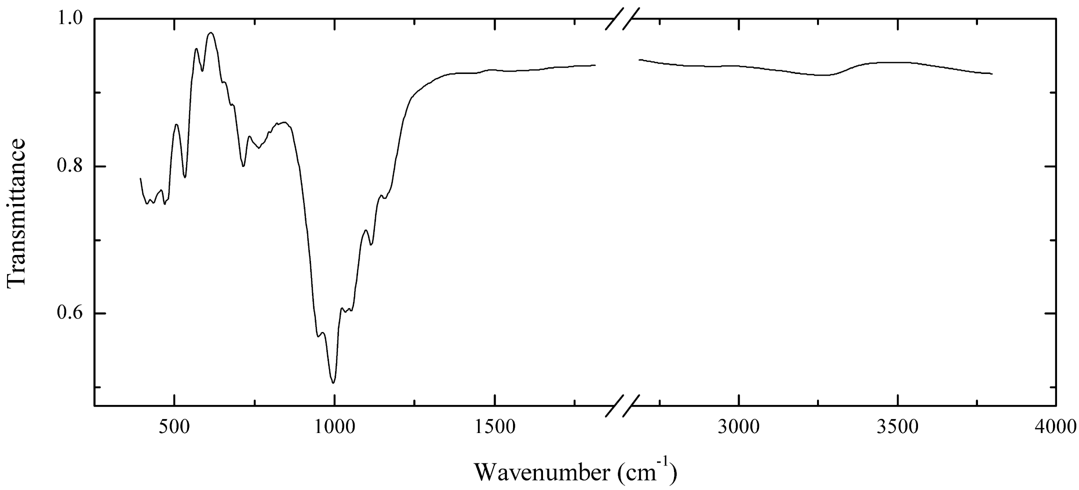


Locality: Shkatulka pegmatite, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: White semitransparent aggregate forming pseudomorph after platy crystal of vuonnemite, from peralkaline pegmatite. Confirmed by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500sh, 3415, 3300sh, 2980sh, 1630, 1100sh, 1036s, 985s, 960s, 896s, 550, 496, 453, 400.

TiSi178 Shcherbakovite $NaK(K,Ba)(Ti,Nb,Fe)_2(Si_4O_{12})O_2$

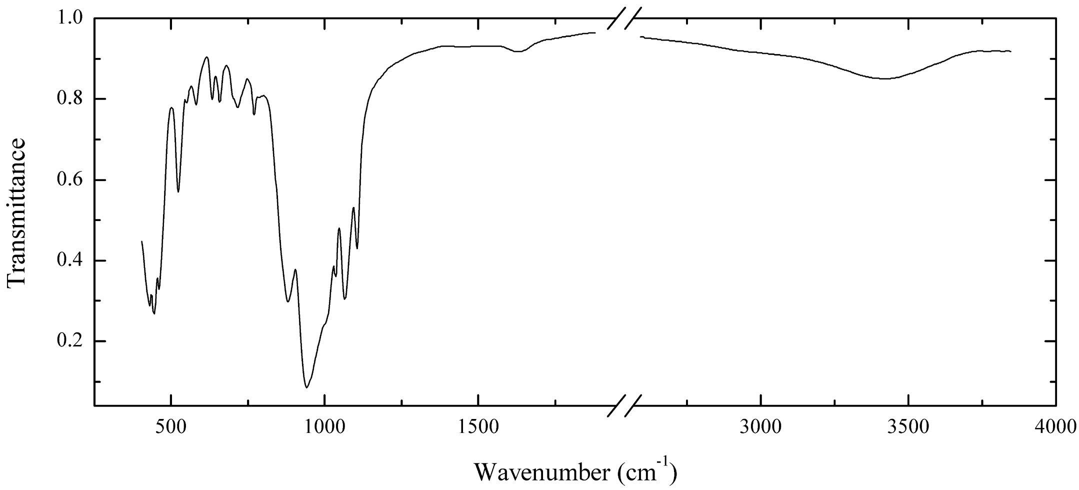


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish-yellow crystals from peralkaline pegmatite. Investigated by I.V. Pekov.

Wavenumbers (cm^{-1}): 3430w, 1153, 1109, 1048s, 1032s, 991s, 949s, 757, 708, 670, 640w, 578w, 527, 475sh, 466, 428, 413.

TiSi179 **Yuksporite** $K_4(Ca,Na)_{14}Sr_2Mn(Ti,Nb)_4(Si_6O_{17})_2(Si_2O_7)_3(H_2O,OH)_3$

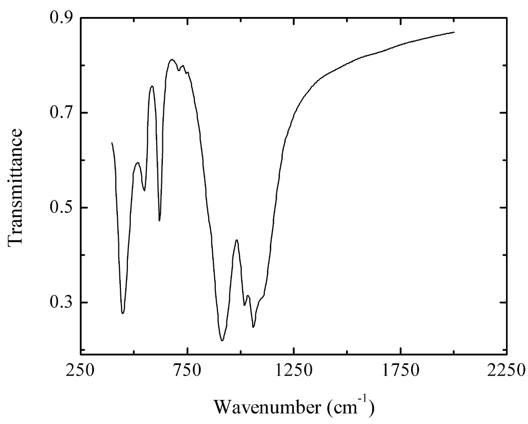


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Reddish-brown parallel-fibrous aggregate from the association with titanite, pectolite, astrophyllite, biotite and aegirine. Investigated by Yu.P. Menshikov.

Wavenumbers (cm^{-1}): 3400, 1635w, 1107, 1068s, 1035, 1005sh, 944s, 884s, 770, 715, 700sh, 657, 632, 580, 550w, 520, 458, 443s, 430.

TiSi180 **Zirsinalite** $Na_6CaZrSi_6O_{18}$

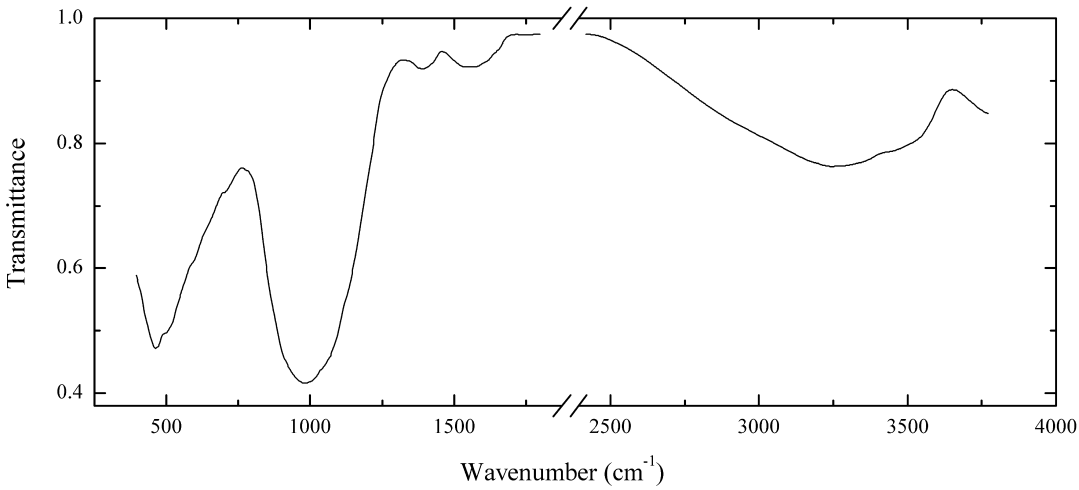


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brownish pseudomorph after eudialyte from peralkaline pegmatite, from the association with aegirine, microcline, nepheline, lomonosovite and lamprophyllite. Investigated by I.V. Pekov.

Wavenumbers (cm^{-1}): 1095sh, 1059s, 1020s, 911s, 739w, 706w, 617, 547, 440s.

TiSi181 Zircon $Zr(SiO_4)$

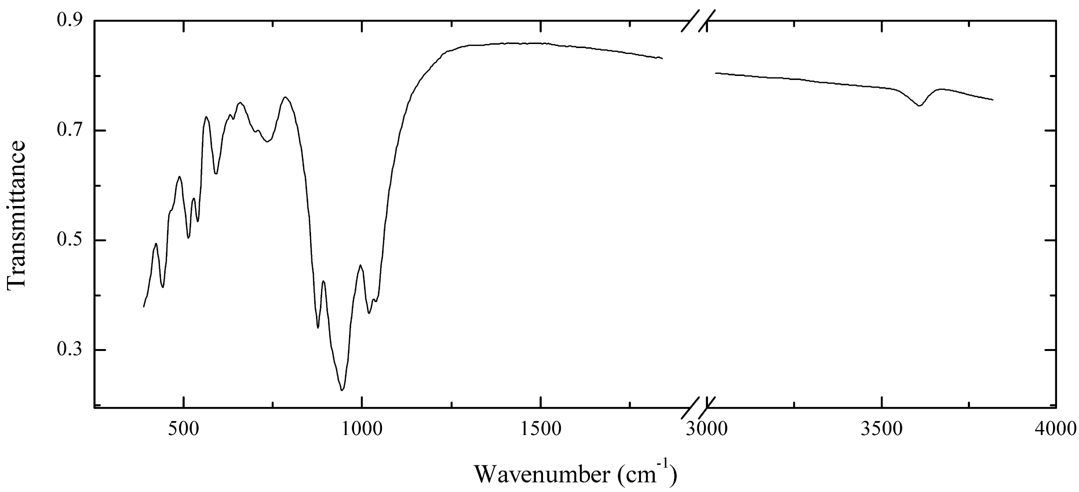


Locality: Kalba range, Kazakhstan.

Description: Brown grain from granite pegmatite. Metamict, amorphous. Hf-rich variety. The empirical formula is (electron microprobe) $(Zr_{0.65}Hf_{0.30}Ta_{0.04})(SiO_4)_{1.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3500sh, 3230, 2950sh, 1560, 1407, 985s, 700sh, 590sh, 510sh, 461s.

TiSi182 Perraultite $BaKNa_2(Mn^{2+},Fe^{2+})_8(Ti,Nb)_4(Si_2O_7)_4O_4(OH,F,O)_6$

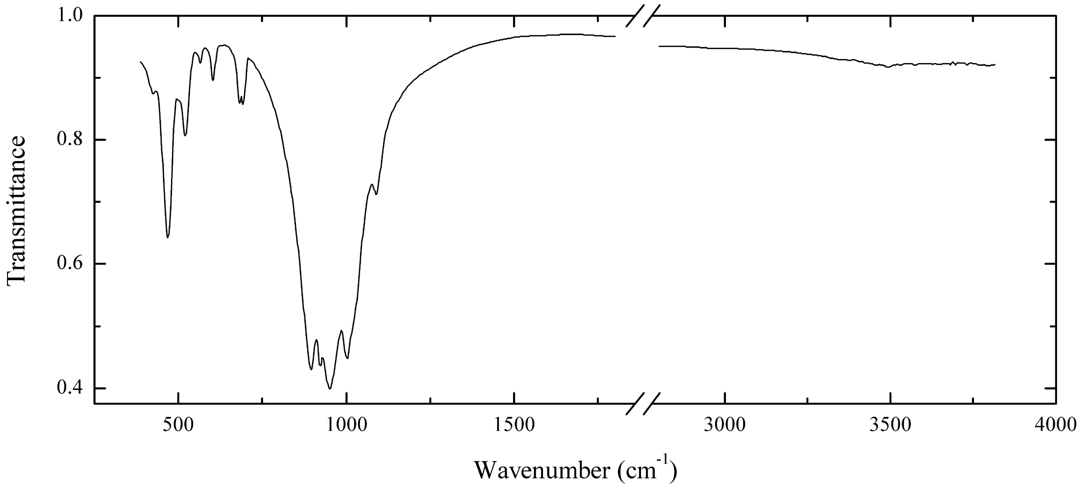


Locality: Mariupol nepheline syenite massif, Eastern Azov Sea region, Ukraine.

Description: Orange flattened prismatic crystals from the association with microcline, albite, astrophyllite, zircon, arfvedsonite and biotite. The crystal structure is solved. Monoclinic, space group $C2$, $a = 10.371(2)$, $b = 13.841(4)$, $c = 24.272(6)$ Å, $\beta = 121.19(2)°$.The empirical formula is (electron microprobe) $Na_{1.54}K_{0.61}Ca_{0.46}Sr_{0.01}Ba_{1.20}Mg_{0.02}Mn_{4.70}Fe^{2+}{}_{2.91}Fe^{3+}{}_{0.16}Al_{0.01}Ti_{3.86}Zr_{0.15}Nb_{0.17}Ta_{0.01}Si_{8.00}O_{32.38}(OH)_{3.44}O_{1.99}$.

Wavenumbers (cm^{-1}): 3585w, 1033, 1011s, 937s, 736, 688w, 634w, 581, 530, 504, 458, 432s.

TiSi183 Khibinskite $K_2Zr(Si_2O_7)$

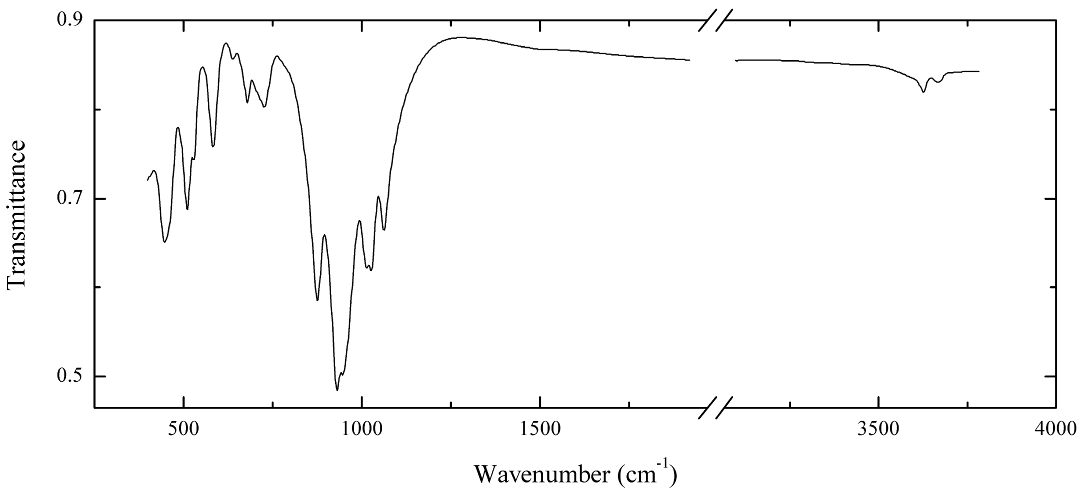


Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pale yellow grains from the association with eudialyte and zircon. Holotype sample. Monoclinic, space group *B*2/*m*, $a = 19.188$, $b = 14.072$, $c = 11.075$ Å, $\gamma = 117.07°$, $Z = 16$. Optically biaxial (–), $\alpha = 1.665$, $\beta = 1.715$, $\gamma = 1.715$, $2V_{meas} = -6$ to $-16°$. $D_{meas} = 3.40$ g/cm^3, $D_{calc} = 3.33$ g/cm^3. The empirical formula is $K_{1.98}(Zr_{1.06}Ti_{0.03})Si_{1.94}O_{7.05}$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.95 (70), 2.76 (100), 2.133 (50), 1.630 (65), 1.595 (40), 1.381 (50), 1.252 (45).

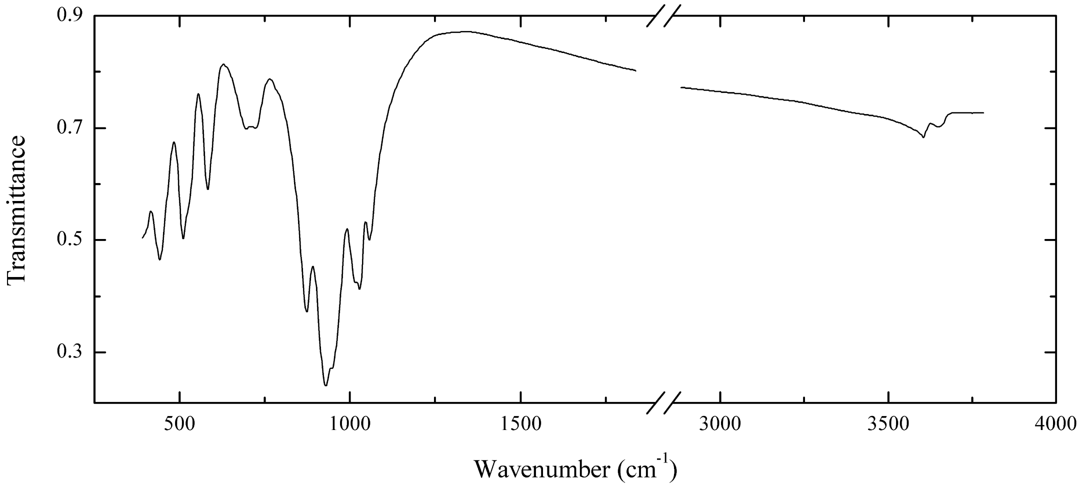
Wavenumbers (cm^{-1}): 3470w, 1089, 1015sh, 1000s, 947s, 921, 891s, 689, 682, 594, 558w, 509, 459, 415.

TiSi184 Hejtmanite-3*T* $Ba(Mn^{2+},Fe^{2+})_2Ti(Si_2O_7)O(OH,F)_2$



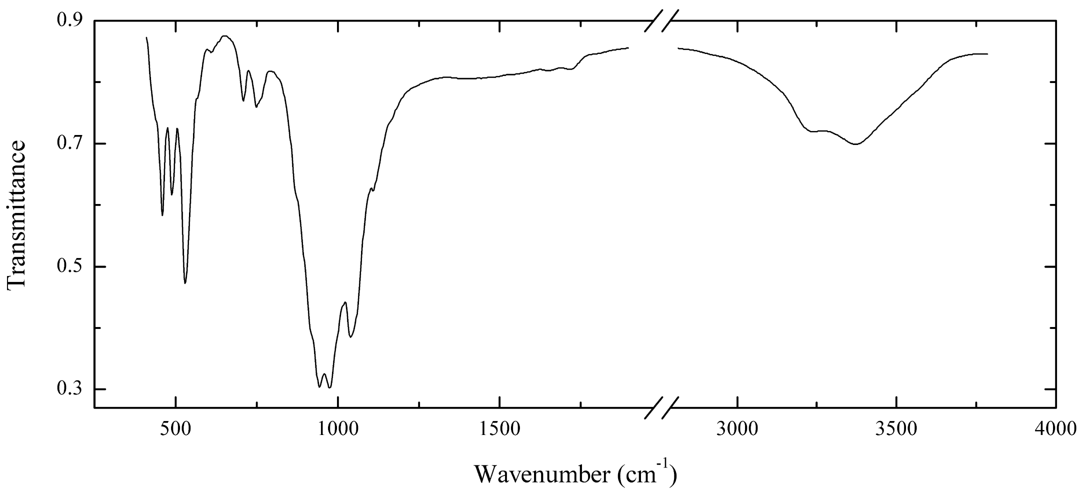
Locality: About 8 km upriver from the settlement Inylchek, Inylchek range, Tien Shan Mts., Kyrgyzstan.
Description: Red platy grains from the association with tephroite, alleghanyite, sonolite, rhodonite, spessartine, khristovite-(Ce) and alabandite. The crystal structure is solved.
Wavenumbers (cm^{-1}): 3650w, 3607w, 1056, 1023, 1008, 939s, 924s, 869s, 718, 668, 633w, 575, 520, 501, 440.

TiSi185 Hejtmanite $Ba(Mn^{2+},Fe^{2+})_2Ti(Si_2O_7)O(OH,F)_2$



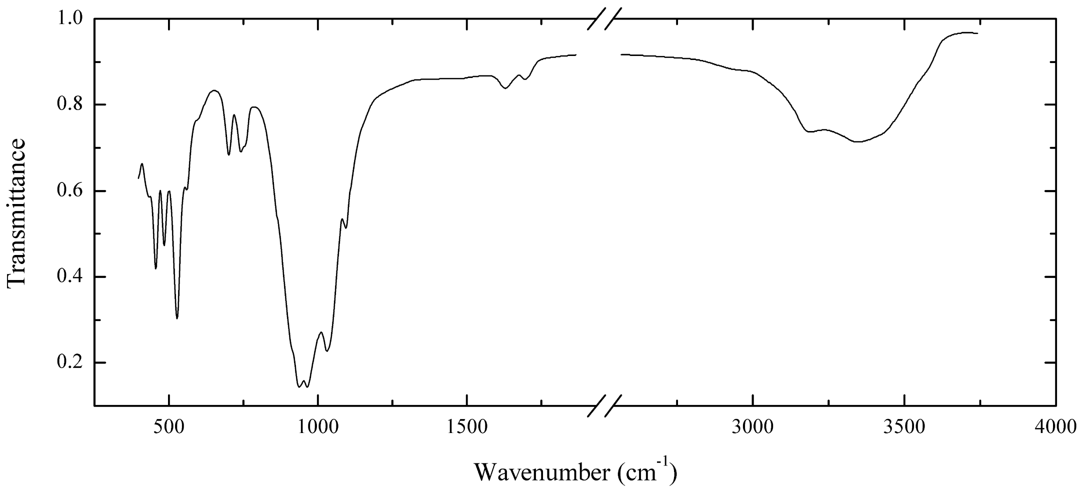
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.
Description: Red platy grains from the association with microcline, aegirine and astrophyllite. The empirical formula is (electron microprobe) $Ba_{0.95}K_{0.02}Ca_{0.02}(Mn_{1.19}Fe_{0.85})Ti_{0.99}Si_{2.00}O_8(OH,F)_2$.
Wavenumbers (cm^{-1}): 3626w, 3573w, 1056, 1027, 1012, 944s, 926s, 870s, 790sh, 722, 687, 579, 520sh, 505, 436, 425sh.

TiSi186 Umbite $K_2Zr(Si_3O_9)\cdot H_2O$



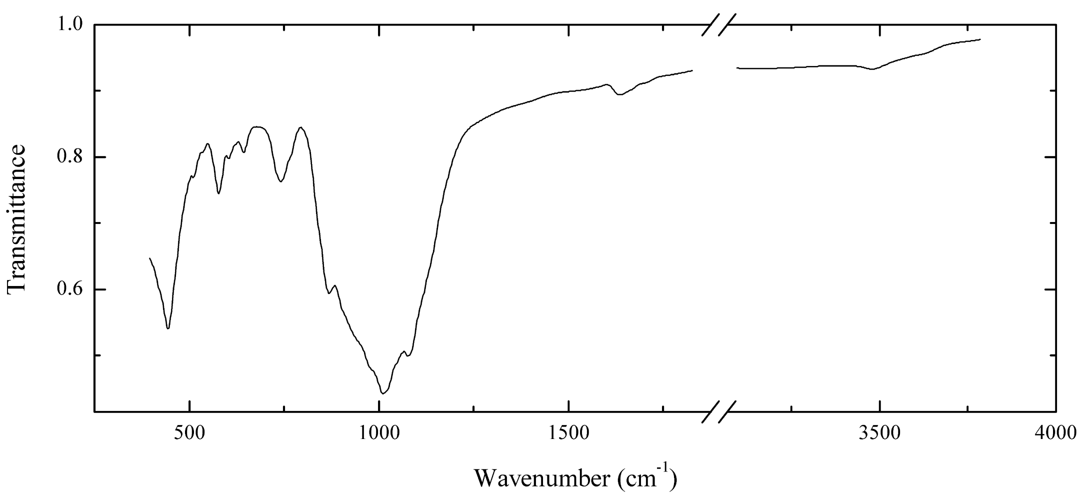
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Colourless crystal from a polymineral pseudomorph after eudialyte. Investigated by I.V. Pekov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3315, 3180, 1700w, 1630w, 1100, 1030s, 968s, 935s, 915sh, 860sh, 760sh, 741, 700, 597w, 560, 524, 481, 452, 430sh.

TiSi187 Umbite $K_2Zr(Si_3O_9)\cdot H_2O$



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Colourless crystal from the association with aegirine, microcline, nepheline and nacaphite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3550sh, 3400sh, 3315, 3175, 1700w, 1625w, 1097, 1035sh, 1028s, 965s, 937s, 915sh, 760sh, 744, 702, 600sh, 561, 528s, 485, 456, 438.

TiSi188 Låvenite $(Na,Ca)_2(Mn,Fe)(Zr,Ti,Nb)(Si_2O_7)(O,F)_2$

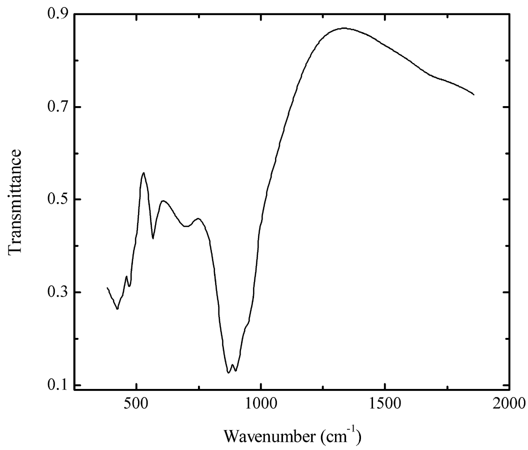


Locality: Takhtarvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Orange-red prismatic crystals from the association with eudialyte, parakeldyshite, keldyshite and zircon. Mn- and Fe-deficient variety (or analogue) of låvenite. Needs further investigation.

Wavenumbers (cm^{-1}): 3490w, 1629w, 1080s, 1015s, 885sh, 840sh, 869, 743, 645w, 605w, 590, 535w, 513w, 445s, 415sh.

TiSi189 Titanite $CaTi(SiO_4)O$

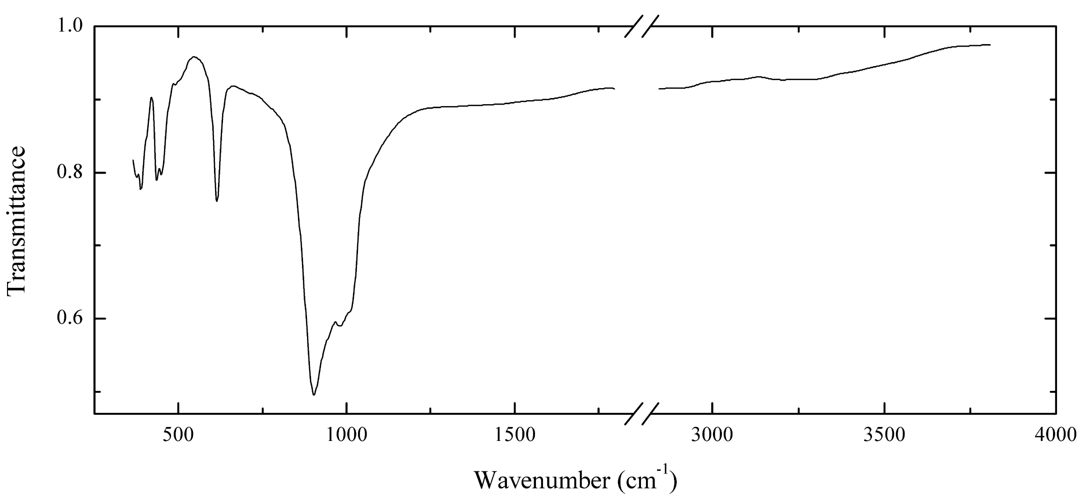


Locality: Löhley, Üdersdorf, near Daun, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany.

Description: Orange-yellow crystals from the association with nepheline, leucite, augite, magnetite, fluorapatite, perovskite and götzenite. Confirmed by IR spectrum.

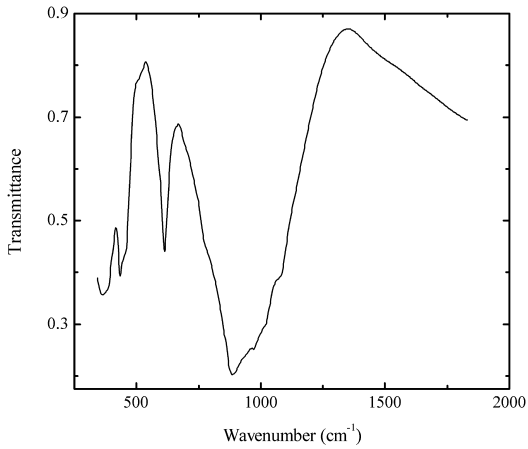
Wavenumbers (cm^{-1}): 940sh, 897s, 871s, 708, 562, 490sh, 471, 445sh, 420.

TiSi190 Zircon $Zr(SiO_4)$



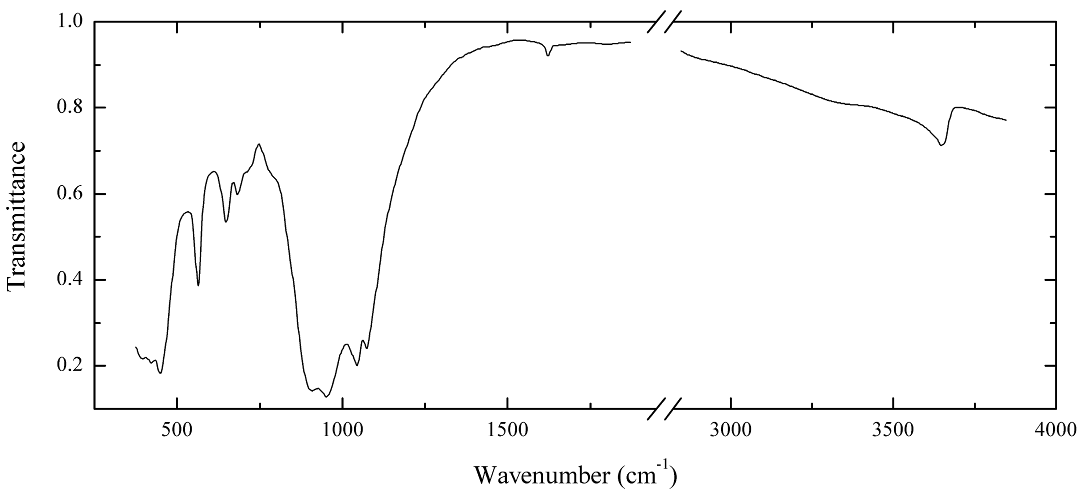
Locality: Il'meny (Il'menskie) Mts., South Urals, Russia (type locality).
Description: Yellow short-prismatic crystal from the association with microcline, nepheline, aegirine-augite and biotite. Investigated by V.V. Gordienko. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3375w, 1010sh, 983s, 905s, 613, 500sh, 450, 433, 399, 387.

TiSi191 Zircon $Zr(SiO_4)$



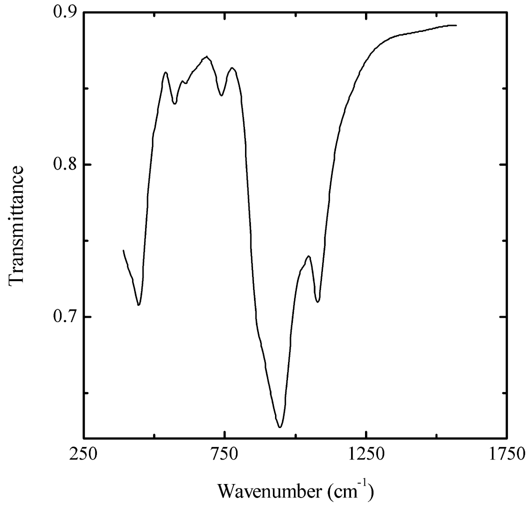
Locality: Vavnbed Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brownish dipyramidal crystal from the association with feldspar and ilmenite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1070sh, 1015s, 970, 888s, 612m 450sh, 433, 400sh, 368.

TiSi192 Kupletskite-(Cs) $(Cs,K)_2Na(Mn,Fe^{2+})_7(Ti,Nb)_2Si_8O_{24}(OH,O,F)_7$



Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).
Description: Dark brown plate with mica-like cleavage from the association with quartz, microcline, pyrochlore and hyalotekite. The empirical formula is (electron microprobe) $Cs_{1.76}K_{0.19}Na_{1.13}Ca_{0.20}Mn_{3.83}Fe_{2.31}Zn_{0.30}Mg_{0.09}Al_{0.06}Li_xTi_{1.22}Nb_{0.78}Si_{8.07}O_{24}(OH,O,F)_7$.
Wavenumbers (cm^{-1}): 3627, 3350sh, 1624w, 1073, 1041s, 952s, 909s, 795sh, 715sh, 686, 650, 563, 449s, 427, 397.

TiSi193 Låvenite $(Na,Ca)_2(Mn,Fe)(Zr,Ti,Nb)(Si_2O_7)(O,F)_2$

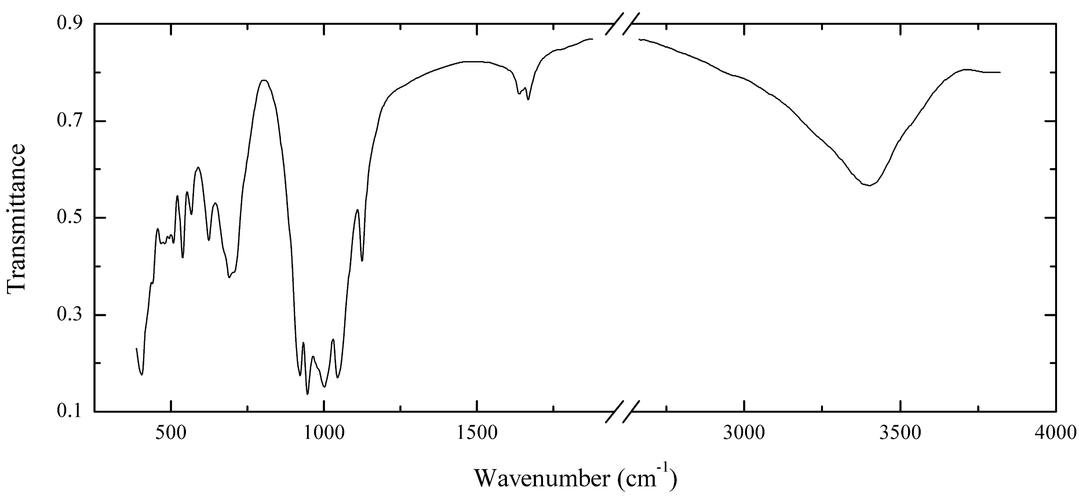


Locality: Takhtarvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Orange-red prismatic crystals from the association with eudialyte, parakeldyshite, keldyshite and zircon. Investigated by I.V. Pekov. Mn- and Fe-deficient variety (or analogue) of låvenite. Needs further investigation.

Wavenumbers (cm^{-1}): 1076s, 949s, 905sh, 875s, 737, 612w, 570, 509w, 447, 410sh.

TiSi194 Manganokukisvumite $Na_6MnTi_4Si_8O_{28}\cdot 4H_2O$

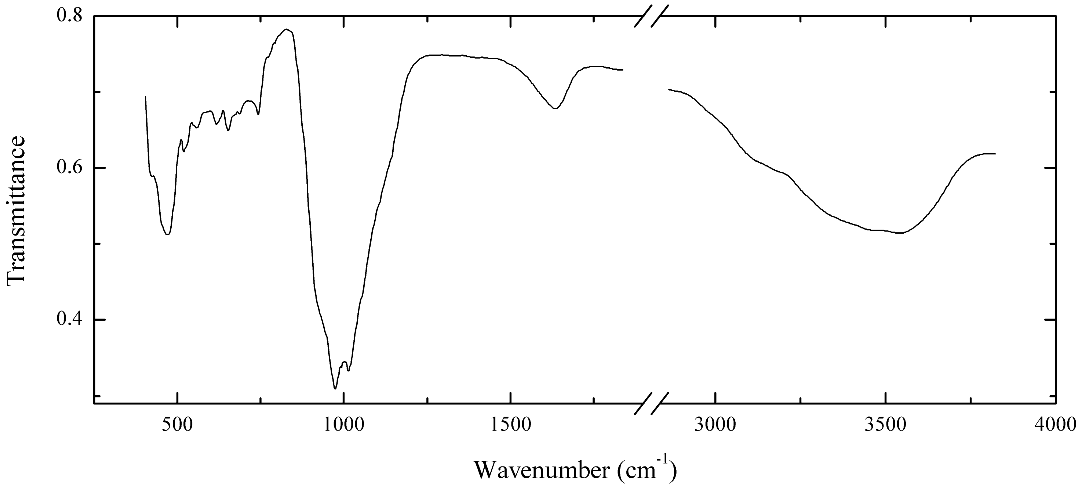


Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Colourless elongated lamellae from the association with natrolite, microcline, nenadkevichite and sphalerite. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3380, 1670w, 1640w, 1125, 1044s, 1000s, 946s, 921s, 740sh, 705sh, 692, 670sh, 624, 569, 538, 509, 489, 472, 439, 420sh, 404s.

TiSi195 Chivruaiite $Ca_4(Ti,Nb)_5(Si_6O_{17})_2(OH,O)_5 \cdot 13–14H_2O$

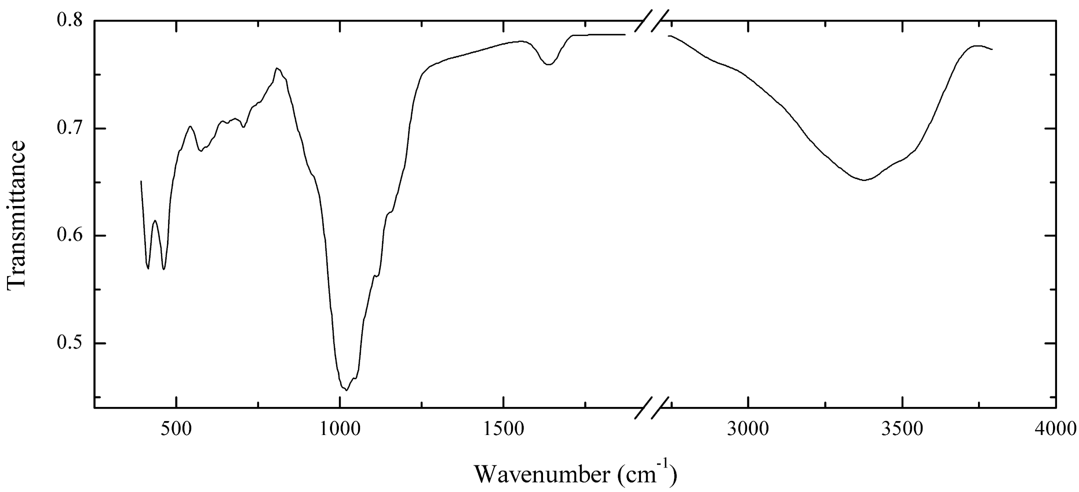


Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (cotype locality).

Description: Pink crystals from the association with astrophyllite, natrolite, catapleiite and fluorapatite. Cotype sample. The empirical formula is $(Ca_{2.79}Mn_{0.35}K_{0.10}Sr_{0.36}Mg_{0.05}Ba_{0.05}Na_{0.04}Ce_{0.02}Th_{0.01})(Ti_{3.89}Nb_{0.58}Fe^{3+}{}_{0.13}Al_{0.07})Si_{12}O_{34.9}(OH)_{4.1} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3525, 3430sh, 3170sh, 1633, 1130sh, 1015s, 974s, 915sh, 738, 670sh, 638, 612, 555, 529, 476s, 420sh.

TiSi196 Punkaruaivite $LiTi_2(HSi_4O_{12})(OH)_2 \cdot H_2O$

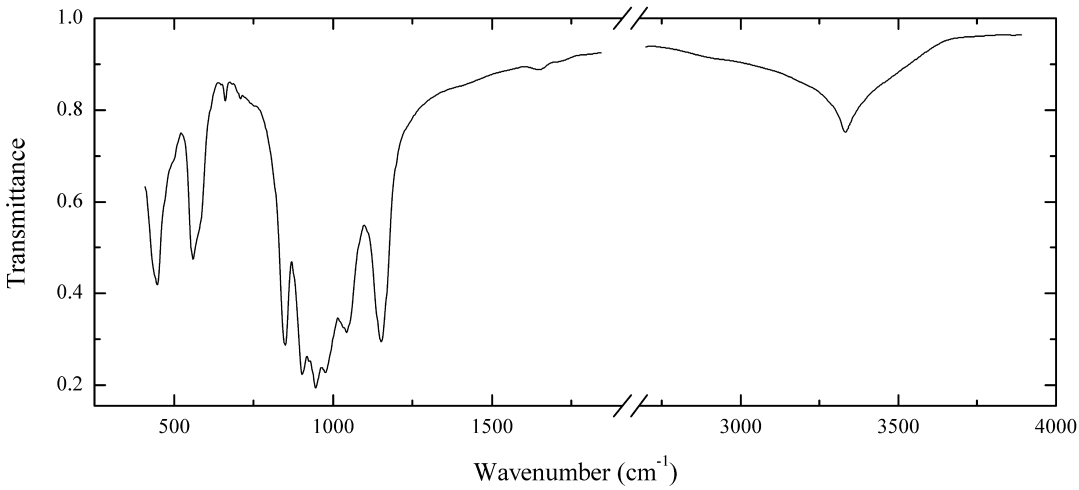


Locality: Malyi Punkaruaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Clusters of colourless crystals from the association with natrolite, rhabdophane-(Ce), gerasimovskite and lithiophorite. The crystal structure is solved. Monoclinic, space group $C2/c$, $a = 26.68$, $b = 8.77$, $c = 5.22$ Å, $\beta = 91.2°$. The empirical formula is $H_x(Ca_{0.16}Na_{0.05})Li(Ti_{1.97}Fe_{0.02}Nb_{0.01})(Si_{3.98}Al_{0.02})(O,OH)_{14} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3460sh, 3360, 2910sh, 1640, 1410w, 1180sh, 1155sh, 1115, 1047s, 1018s, 915sh, 760sh, 706, 667w, 587, 465, 412.

TiSi197 Keldyshite $Na_{2-x}H_xZr(Si_2O_7)\cdot nH_2O$

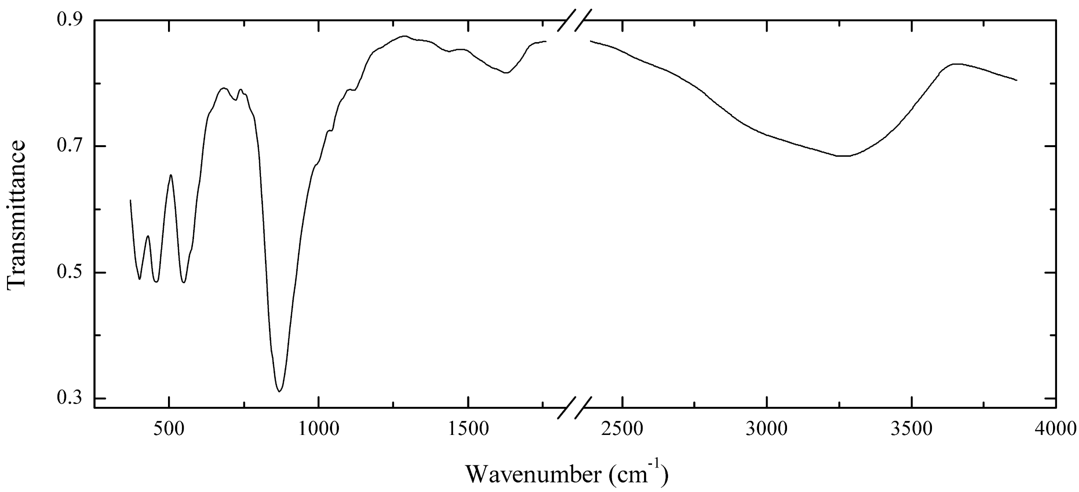


Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: White grains from the association with albite, zircon and eudialyte. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3320, 1650w, 1149s, 1044s, 1025sh, 974s, 944s, 902s, 847s, 750sh, 706w, 660w, 575sh, 557, 490sh, 447.

TiSi198 "Sitinakite-Ba" $KBaTi_4Si_2O_{13}(OH)\cdot nH_2O$

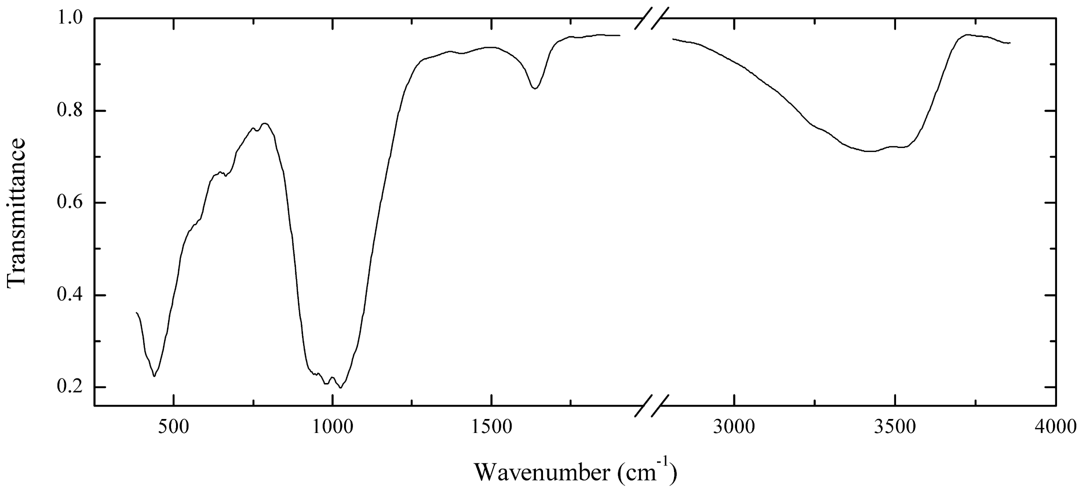


Locality: Artificial.

Description: Product of cation exchange of natural sitinakite with Ba^{2+}. Contains 35 wt.% BaO.

Wavenumbers (cm^{-1}): 3275, 3000sh, 1636, 1605sh, 1440w, 1117w, 1043w, 995sh, 868s, 719w, 640sh, 565sh, 540, 459, 400.

TiSi199 Caryochroite $(Na,Sr)_3(Fe^{3+},Mg)_{10}[Ti_2Si_{12}O_{37}](H_2O,O,OH)_{17}$

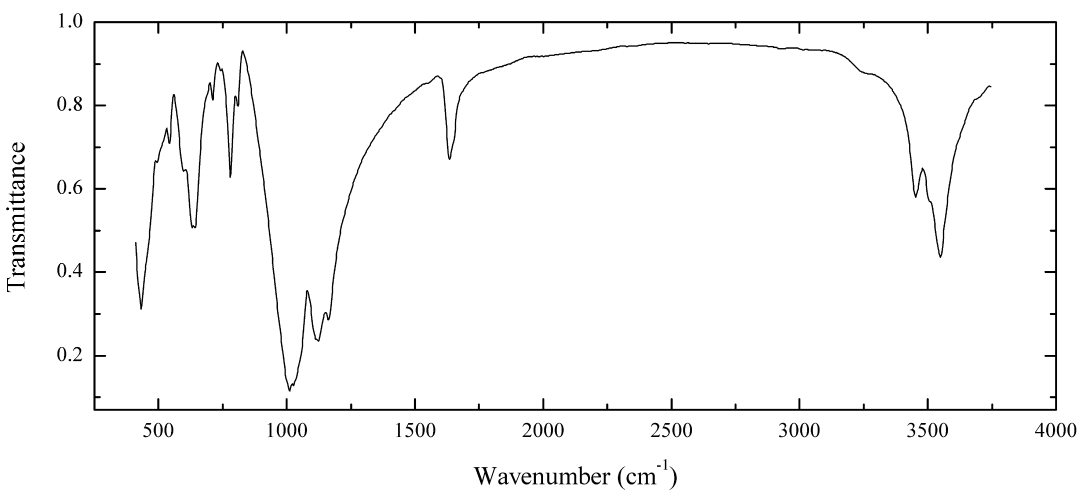


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Brown fine-grained aggregate from the association with albite, elpidite, epididymite, quartz, natrolite, pyrite, galena, sphalerite and bitumen. Cotype sample.

Wavenumbers (cm^{-1}): 3510, 3405, 3250sh, 1635, 1410w, 1023s, 981s, 940s, 765w, 667, 570sh, 443s.

TiSi200 Elpidite $Na_2Zr(Si_6O_{15})\cdot 3H_2O$

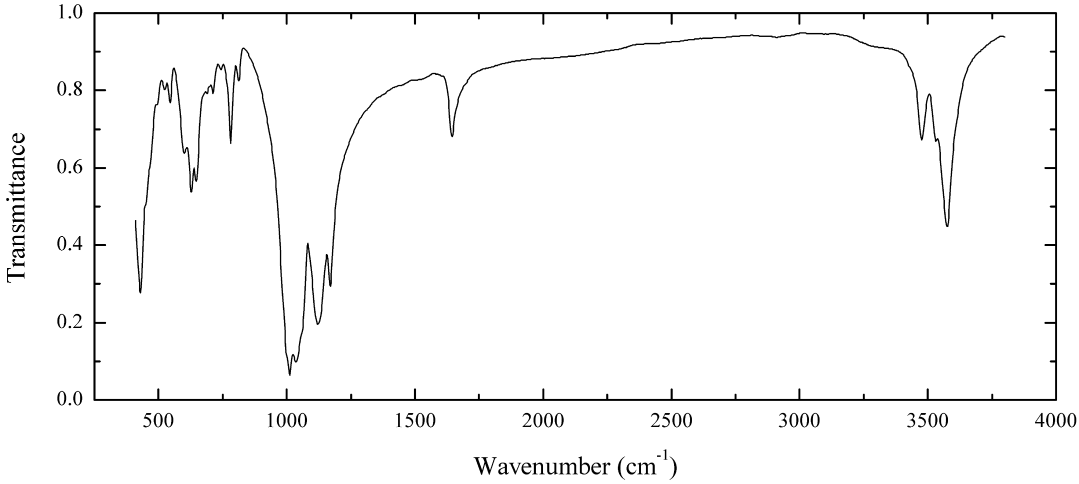


Locality: Khan Bogdo massif, Gobi desert, Mongolia.

Description: Orange grains from alkaline granite. Ca-bearing variety. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3545, 3500sh, 3445, 3250w, 1640, 1166s, 1116s, 1030sh, 1020sh, 1012s, 809w, 780, 710w, 642, 627, 596, 541, 500sh, 450sh, 432s.

TiSi201 Elpidite $Na_2Zr(Si_6O_{15}){\cdot}3H_2O$

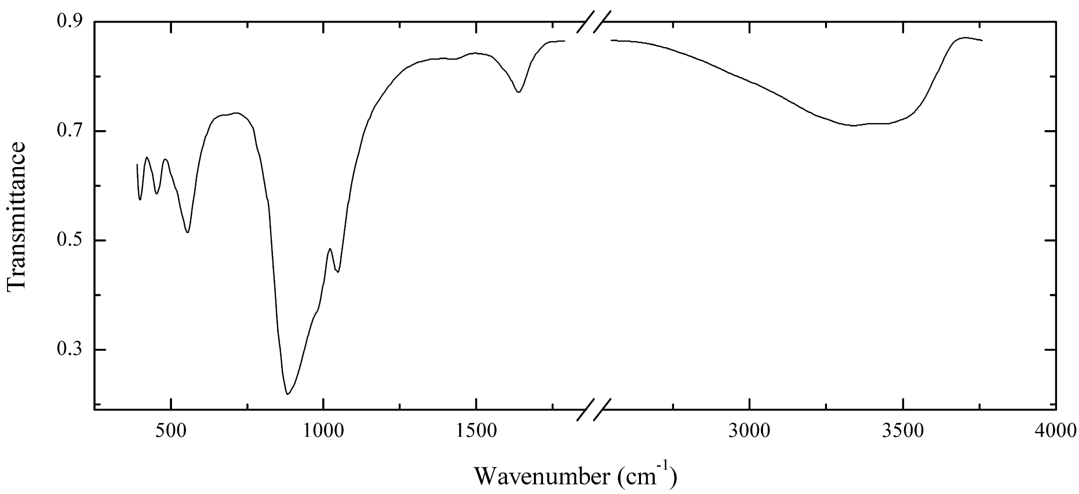


Locality: Elpiditovoe pegmatite, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia.

Description: Clusters of yellowish long-prismatic crystals from hydrothermally altered pegmatite, from the association with caryochroite, albite, natrolite, pyrite, epididymite and bitumen. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3550, 3505, 3450, 3235w, 1640, 1169s, 1117s, 1050sh, 1034s, 1010s, 808w, 778, 737w, 708w, 680sh, 646, 626, 596, 542, 520w, 491w, 465sh, 450sh, 429s.

TiSi202 Epistolite $Na_4Nb_2Ti(Si_2O_7)_2O_2(OH,F)_2{\cdot}4H_2O$

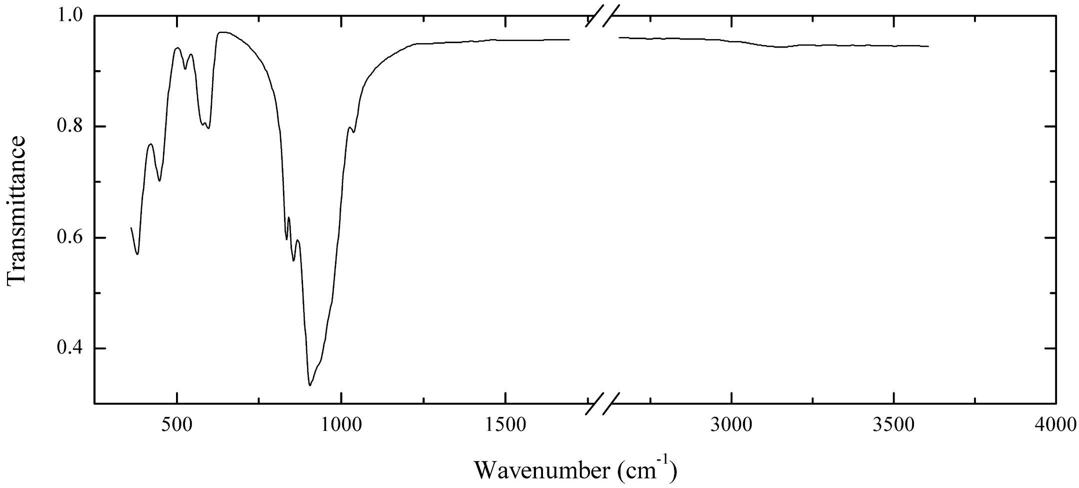


Locality: Tugtup Agtâkorfia, Ilímaussaq alkaline complex, Narssaq municipality, South Greenland (type locality).

Description: Brownish-yellow plates (pseudomorphs after vuonnemite) from the association with natrolite, and tugtupite. The empirical formula is $(Na_{2.62}Ca_{0.95}K_{0.07})(Nb_{2.08}Ti_{0.96})(Si_{3.94}Al_{0.06})O_{14}(PO_4)_{0.28}(O,F.OH)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3430, 3330, 1643, 1435w, 1048, 980sh, 888s, 553, 457, 382.

TiSi203 Paranatisite $Na_2Ti(SiO_4)O$

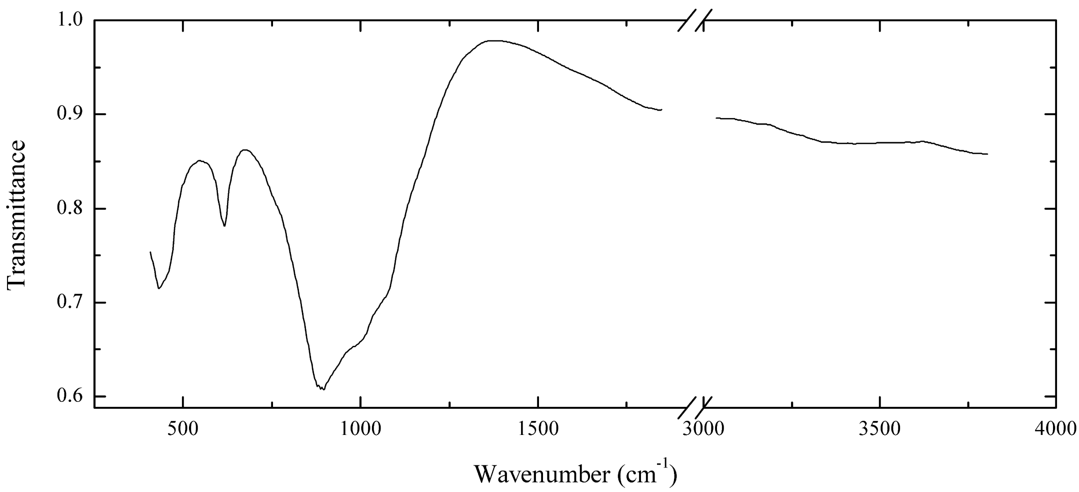


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Orange-brown grains from the association with nepheline, potassic feldspar, aegirine, aenigmatite, natisite, lamprophyllite, lorenzenite, shcherbakovite, delhayelite, villiaumite and lepidomelane. Holotype sample. Orthorhombic, space group *Pmma*, $a = 9.827(3)$, $b = 9.167(2)$, $c = 4.799(2)$ Å. Optically biaxial (+), $\alpha = 1.740(2)$, $\beta = 1.741(2)$, $\gamma = 1.765(2)$, $2V_{meas} = 20(1)°$. $D_{meas} = 3.12(5)$ g/cm^3, $D_{calc} = 3.07$ g/cm^3. The empirical formula is $Na_{1.9}Ti_{0.9}Fe_{0.1}Si_{1.05}O_5$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.748 (100), 2.257 (25), 1.720 (30), 1.680 (30), 1.660 (22), 1.475 (33), 1.443 (35).

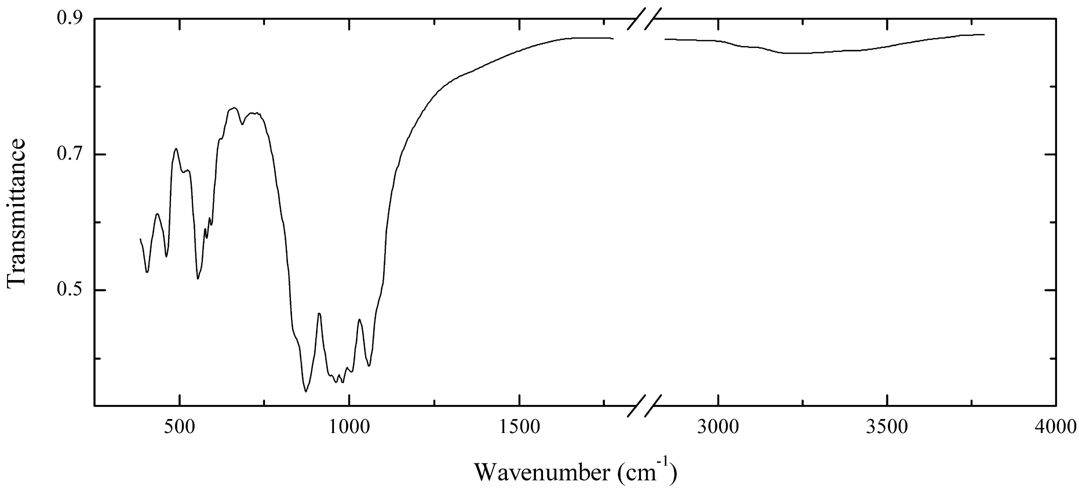
Wavenumbers (cm^{-1}): 1043, 965sh, 925sh, 908s, 854s, 833, 595, 577, 527w, 446, 382s.

TiSi204 Zircon $Zr(SiO_4)$



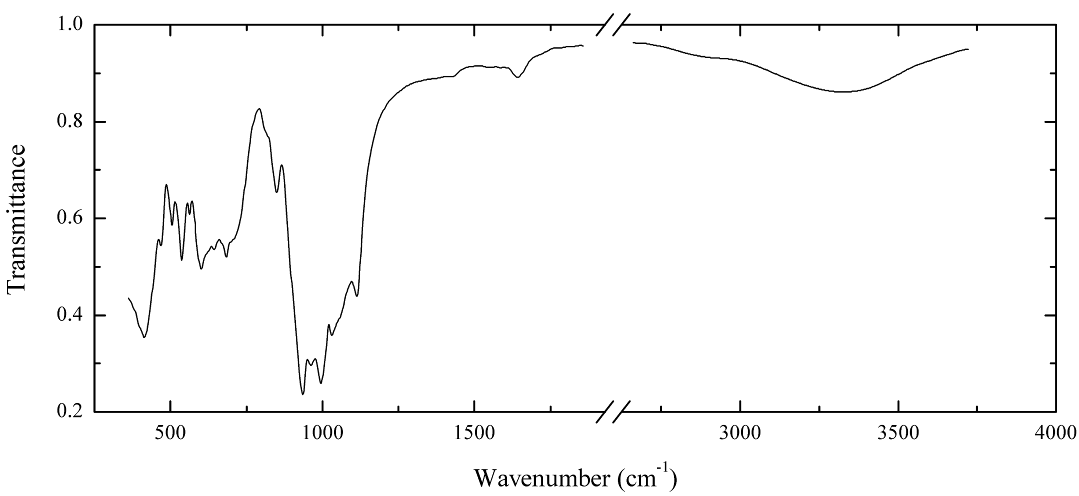
Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Brown dipyramidal crystals from the association with cancrinite, nepheline, aegirine-augite, pectolite, mogovidite, andradite, scolecite and calcite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3360w, 1070sh, 980sh, 892s, 615, 450sh, 433.

TiSi205 Vuonnemite $Na_{11}TiNb_2(Si_2O_7)_2(PO_4)_2O_3(F,OH)$



Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Grey spherulite from peralkaline pegmatite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1063s, 1005s, 981s, 962s, 944s, 872s, 840sh, 682w, 620sh, 594, 580, 560sh, 550, 511w, 457, 400.

TiSi206 Vinogradovite $(Na,Ca)_4Ti_4(Si_2O_6)_2[(Si,Al)_4O_{10}]O_4{\cdot}H_2O$

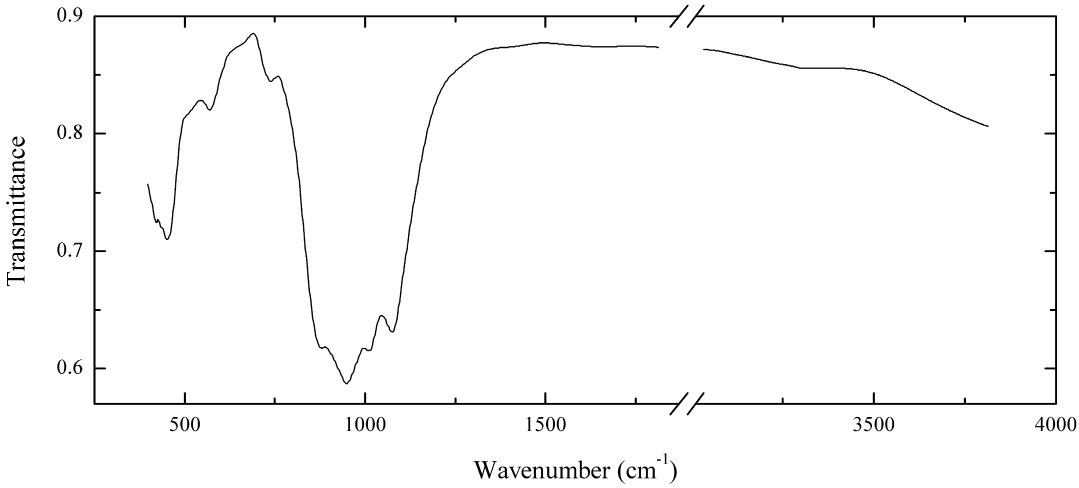


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: White fibrous aggregate with bright yellow fluorescence under short-wave UV radiation from the association with natrolite, sodalite, aegirine, pectolite, chkalovite, fluorcaphite, lemmleinite-K, ivanyukite-Na, catapleiite and fluorapatite. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3310, 1645w, 1432w, 1115, 1060sh, 1033s, 995s, 963s, 936s, 849, 705sh, 684, 638, 600, 536, 505, 468, 414s.

TiSi207 Grenmarite $(Na,Ca)_4(Mn,Na)(Zr,Ti)(Zr,Mn)_2(Si_2O_7)_2(O,F)_4$

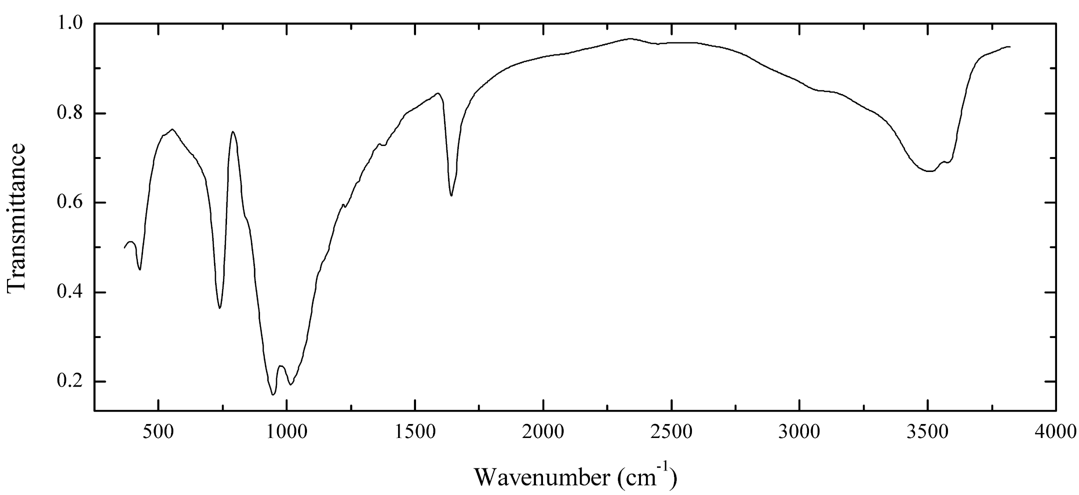


Locality: Rouma (Roume, Ruma) island, Los islands, Guinea.

Description: Light brown crystals from the association with villiaumite and kupletskite. The empirical formula is $(Na_{2.8}Ca_{1.2})(Mn_{0.7}Fe_{0.3})(Zr_{0.6}Ti_{0.4})(Zr_{1.0}Mn_{0.8}Nb_{0.2})Si_{3.95}Al_{0.05}O_{14}(O,F.OH)_4$. Confirmed by IR spectrum.

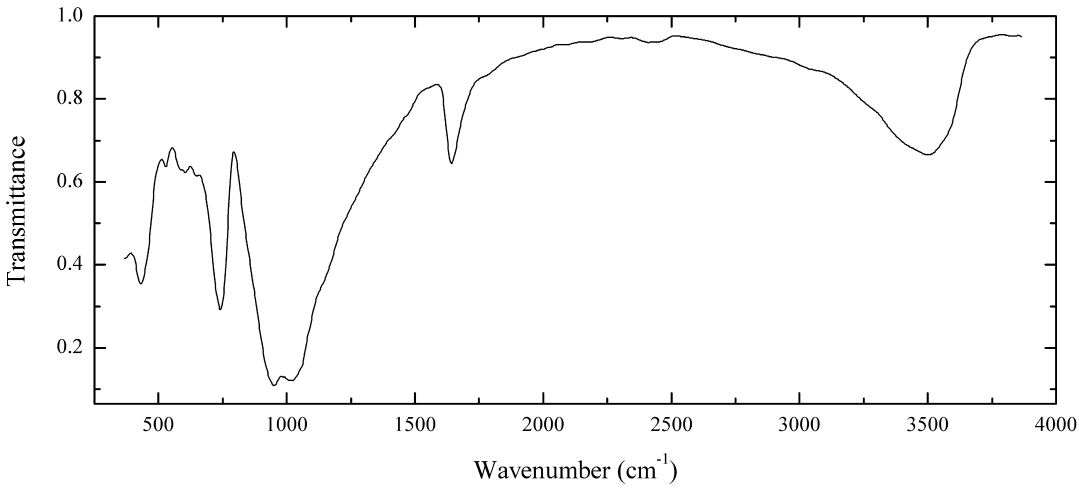
Wavenumbers (cm^{-1}): 3305w, 1075s, 1014s, 945s, 881s, 737, 571, 453, 420.

TiSi208 Catapleiite $Na_2Zr(Si_3O_9){\cdot}2H_2O$



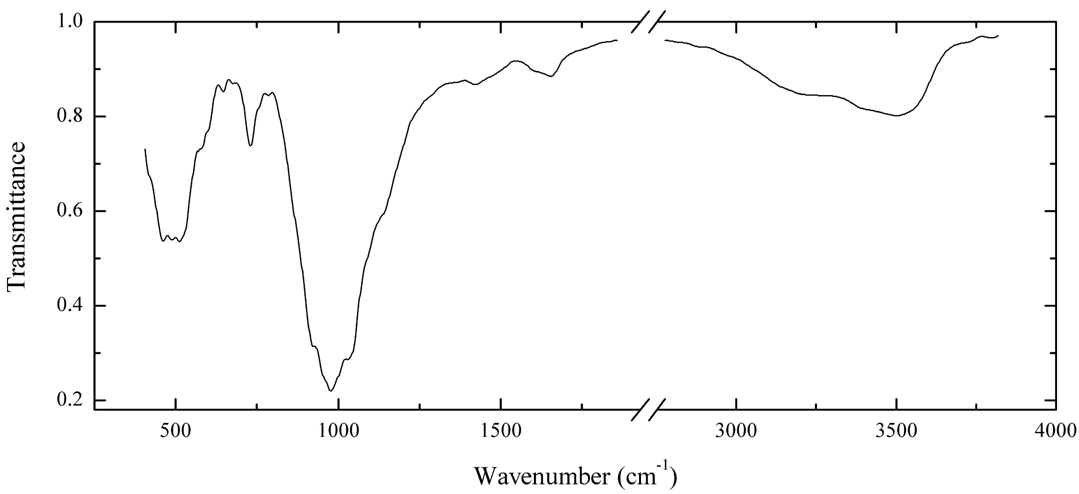
Locality: Aikuaivenchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brownish platy crystals from the association with albite, aegirine and chabazite-K. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3570, 3495, 3050sh, 2425w, 1660sh, 1645, 1380w, 1225sh, 1135sh, 1016s, 948s, 840sh, 738, 630sh, 429.

TiSi209 "Catapleiite-K" $(K,Na)_2Zr(Si_3O_9)·2H_2O$



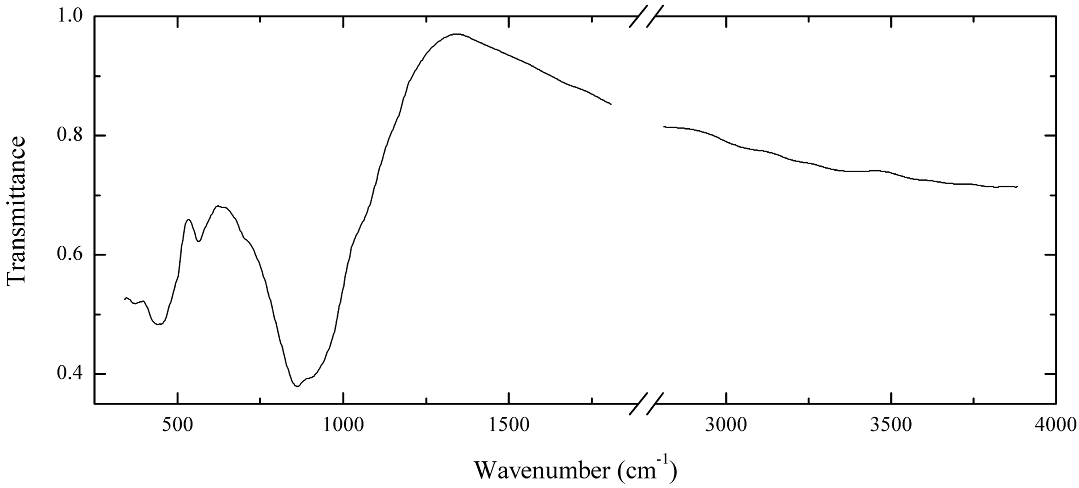
Locality: Artificial.
Description: Product of cation exchange of natural catapleiite from Aikuaivenchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia with K^+.
Wavenumbers (cm^{-1}): 3565sh, 3495, 3040sh, 2450w, 2390w, 1650, 1135sh, 1020s, 950s, 738, 648w, 605w, 588w, 528w, 427.

TiSi210 "Hilairite-K" $K_2ZrSi_3O_9·3H_2O$



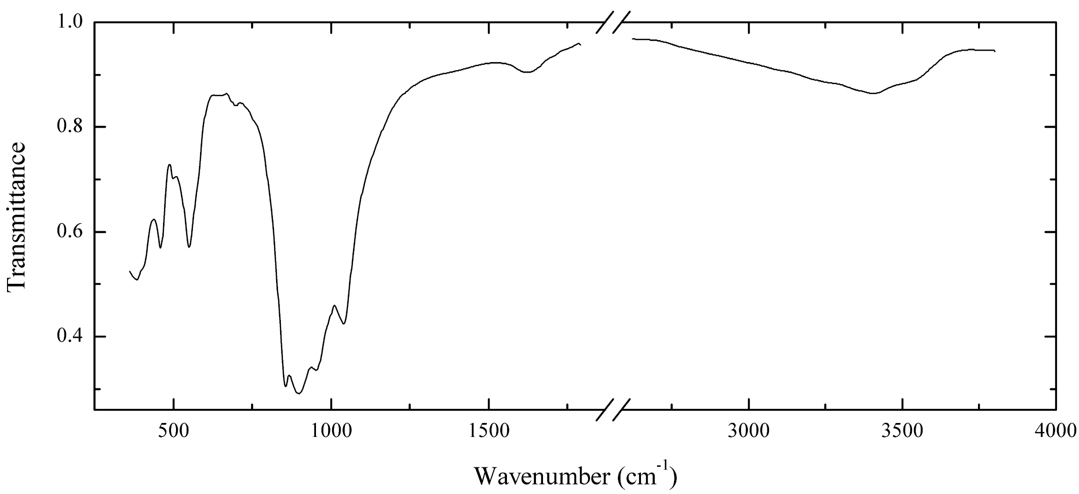
Locality: Artificial.
Description: Product of cation exchange of natural hilairite from Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia with K^+.
Wavenumbers (cm^{-1}): 3495, 3250sh, 1660w, 1610sh, 1425w, 1130sh, 1028s, 984s, 923s, 787w, 750sh, 731, 674w, 645w, 575sh, 510, 486, 458, 420sh.

TiSi211 **Titanite** $CaTi(SiO_4)O$



Locality: Alto Ligonha, Mozambique.
Description: Dark brown crystal from the association with diopside and calcite. Al-bearing variety. The empirical formula is (electron microprobe) $Ca_{0.98}Nd_{0.02}Ti_{0.74}Al_{0.20}Fe_{0.04}Cr_{0.01}Mg_{0.01}Si_{0.1.00}O_4[(O,OH)_{0.86}F_{0.14}]$.
Wavenumbers (cm^{-1}): 1060sh, 900sh, 863s, 720sh, 563, 447s, 372.

TiSi212 **Shkatulkalite** $Na_{10}Mn^{2+}Ti_3Nb_3(Si_2O_7)_6(OH)_2F{\cdot}12H_2O$

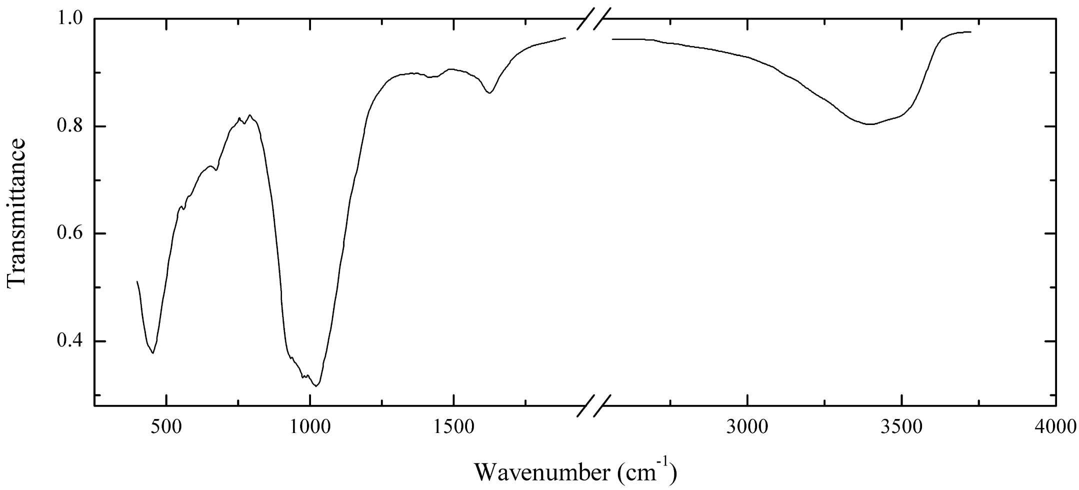


Locality: Shkatulka pegmatite, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: White scaly aggregate from the association with epistolite, aegirine and manganoneptunite. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3500sh, 3405, 1625, 1039s, 951s, 897s, 855sh, 697w, 551, 499w, 459, 390.

TiSi213 Caryochroite $(Na,Sr)_3(Fe^{3+},Mg)_{10}[Ti_2Si_{12}O_{37}](H_2O,O,OH)_{17}$

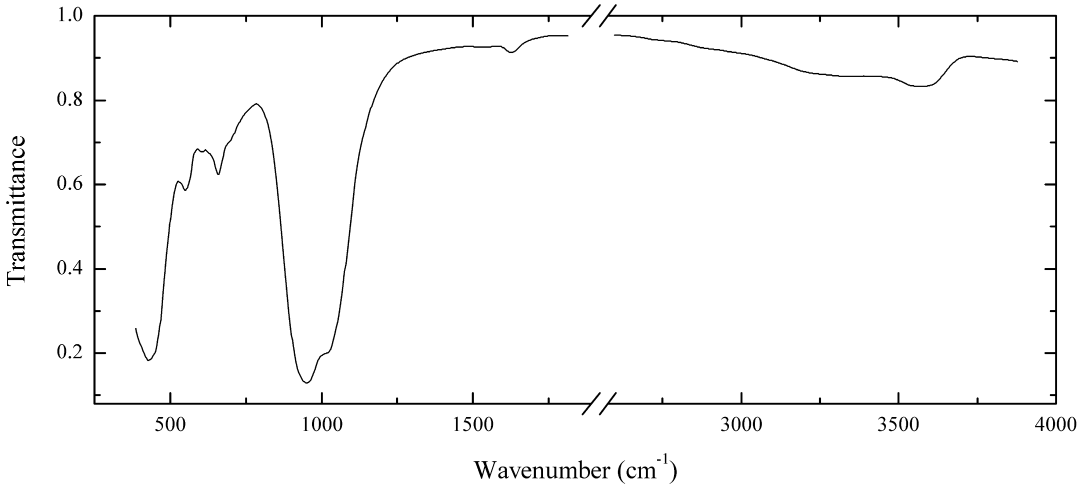


Locality: Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola Peninsula, Murmansk region, Russia (type locality).

Description: Brown fine-grained aggregate from the association with albite, elpidite, epididymite, quartz, natrolite, pyrite, galena, sphalerite and bitumen. Holotype sample. The crystal structure is solved. Monoclinic, $a = 16.47$, $b = 5.303$, $c = 24.39$ Å, $\beta = 93.5°$, $Z = 2$. Optically biaxial (−), $\alpha < 1.700$, $\beta = 1.745$, $\gamma = 1.775$, $2V_{meas} = 75°$. $D_{meas} = 2.99$ g/cm^3. The empirical formula is $(Na_{1.19}Sr_{0.62}Ca_{0.41}Mn_{0.35}K_{0.26})(Fe^{3+}{}_{7.98}Mg_{1.15}Mn_{0.49}Fe^{2+}{}_{0.38})(Ti_{1.87}Fe^{3+}{}_{0.13})(Si_{11.74}Al_{0.26})O_{54.10}H_{20.40}$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %)] are 14.1 (20), 13.3(30), 12.1(100), 4.38(10), 2.692(12), 2.631(13).

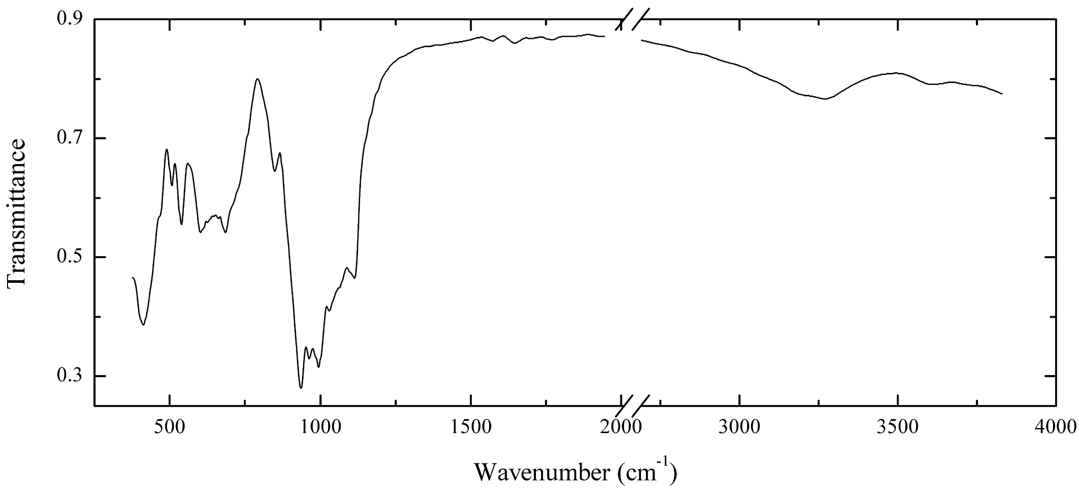
Wavenumbers (cm^{-1}): 3495sh, 3420, 1625, 1425w, 1055sh, 1021s, 981s, 950sh, 774w, 668, 580sh, 560sh, 442s.

TiSi214 Astrophyllite $K_2Na(Fe^{2+},Mn)_7Ti_2Si_8O_{24}(OH,O,F)_7$



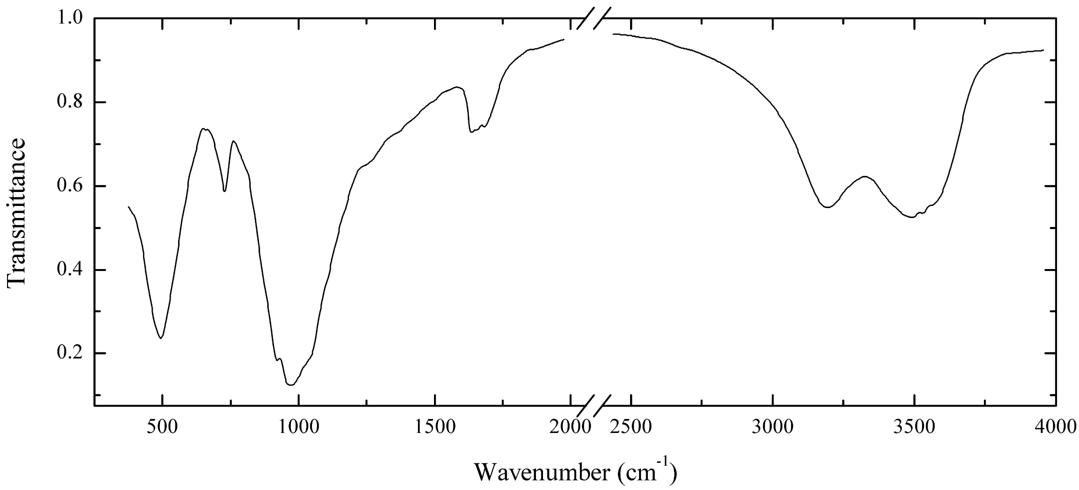
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown scales with perfect cleavage from the association with altered murmanite, natrolite, pectolite and fluorcaphite. Hydrated variety containing 1.3 apfu K and 1 apfu Na. Investigated by I.V. Pekov.
Wavenumbers (cm^{-1}): 3570, 3350, 1630w, 1010sh, 950s, 695sh, 660, 605w, 553, 428s.
Никита, привет!

TiSi215 Vinogradovite $(Na,Ca)_4Ti_4(Si_2O_6)_2[(Si,Al)_4O_{10}]O_4{\cdot}H_2O$



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Pale pink acicular crystals. Investigated by I.V. Pekov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3590w, 3260, 1765w, 1650w, 1565w, 1113, 1060sh, 1033, 995s, 965s, 937s, 850, 730sh, 705sh, 687, 640sh, 603, 536, 505, 465sh, 435sh, 413s.

TiSi216 Hilairite $Na_2ZrSi_3O_9{\cdot}3H_2O$

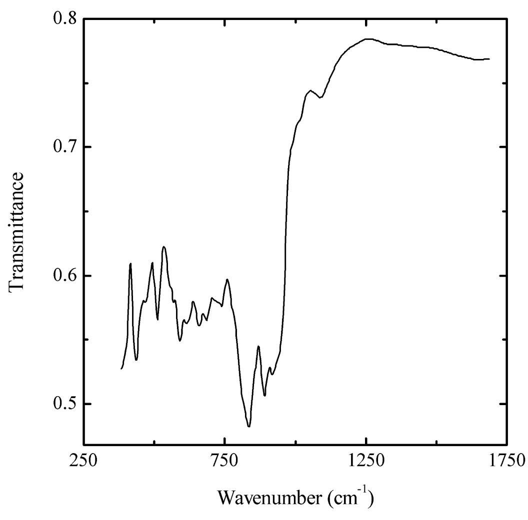


Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Brown crystals from the association with microcline, nenadkevichite, tsepinite-K, elpidite, donnayite, celadonite, strontianite, pyrite, *etc*. Investigated by I.V. Pekov. By chemical composition close to the ideal formula. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3530, 3455, 3160, 1685, 1650sh, 1630, 1350sh, 1235sh, 1035sh, 971s, 920s, 728, 494s.

TiSi217 Kimzeyite $Ca_3(Zr,Ti)_2(Si,Al,Fe^{3+})_3O_{12}$

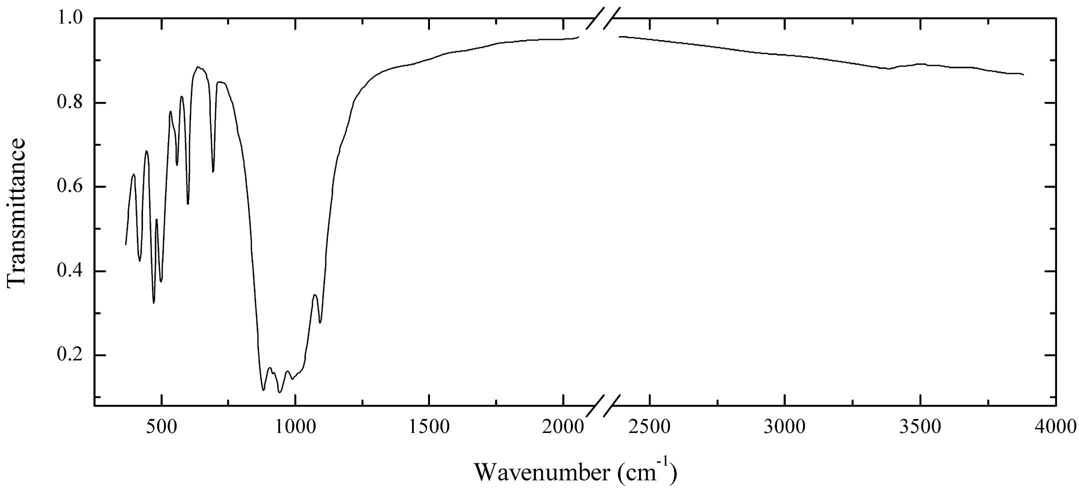


Locality: Magnet Cove igneous complex, Hot Spring Co., Arkansas, USA (type locality).

Description: Dark greenish-brown crystals from the association with magnetite. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1090w, 935sh, 915, 889s, 833s, 810sh, 740, 685, 660, 615, 590, 510, 470, 435s.

TiSi218 Parakeldyshite $Na_2Zr(Si_2O_7)$

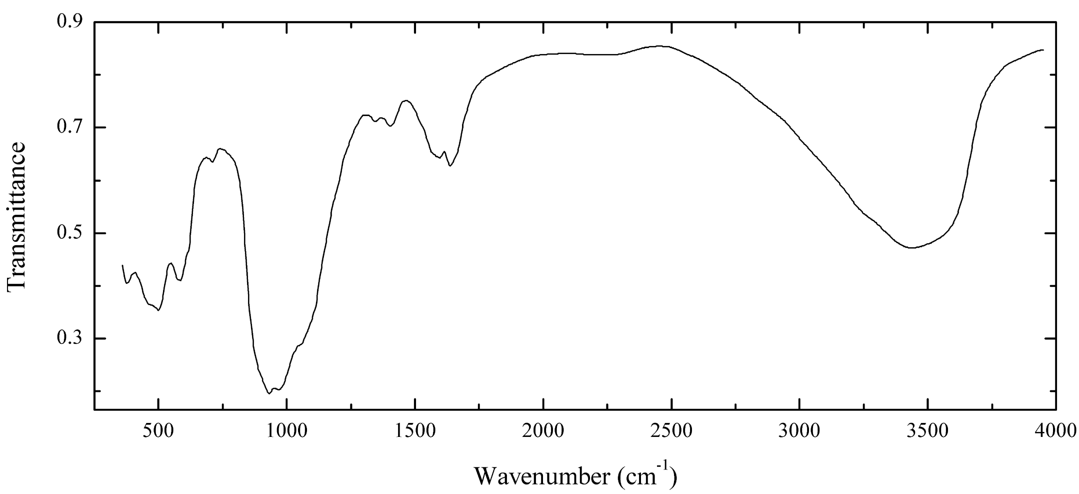


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (cotype locality).

Description: Light grey grain from the association with microcline, aegirine, eudialyte, sodalite, seidozerite and loparite-(Ce). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1092, 1015sh, 990s, 943s, 905sh, 878s, 692, 597, 560, 545sh, 497, 471, 416.

TiSi219 Ilmajokite $(Na,Ce,Ba)_2TiSi_3O_5(OH)_{10}\cdot nH_2O$

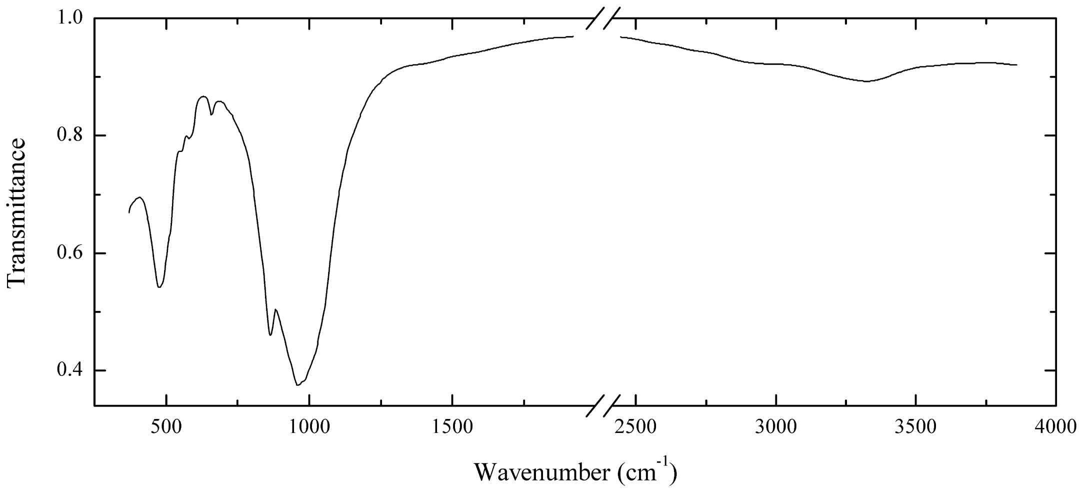


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow crust from the association with natrolite, raite and mountainite. Confirmed by IR spectrum.

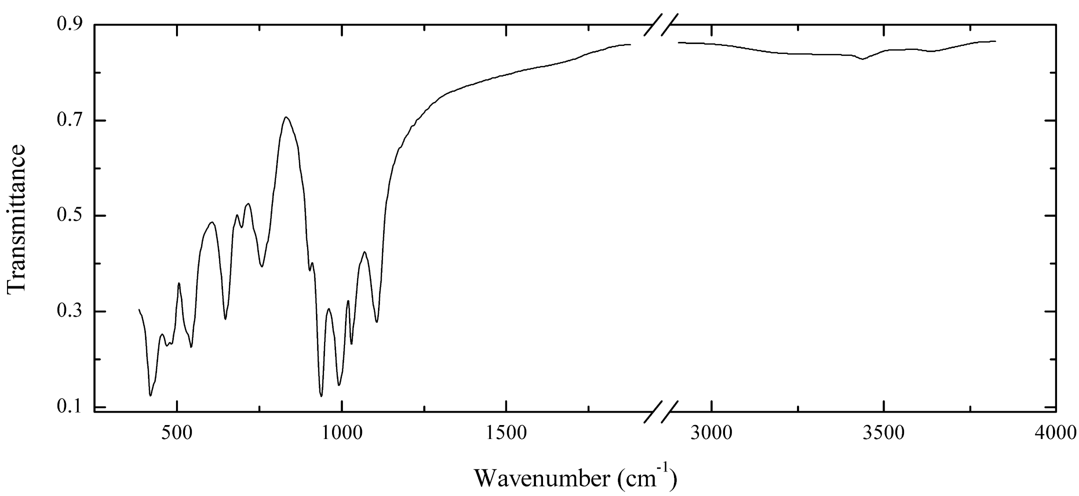
Wavenumbers (cm^{-1}): 3500sh, 3420, 3240, 1638, 1595, 1405w, 1350w, 1100sh, 1050sh, 969s, 930s, 709w, 615sh, 584, 498, 465sh, 377.

TiSi220 Mosandrite $(H_3O^+,Na,Ca)_3Ca_3REETi(Si_2O_7)_2(O,OH,F)_4$



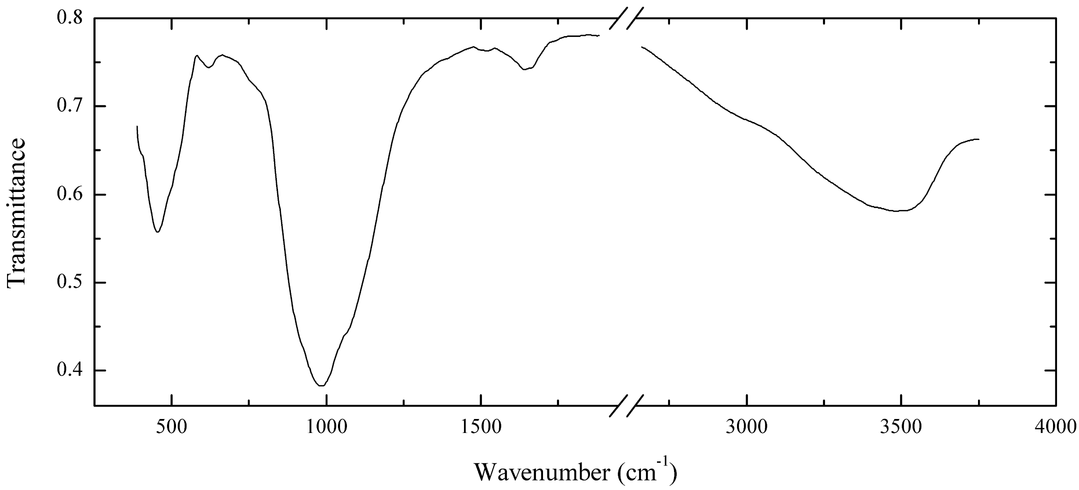
Locality: Eveslogchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Light brown elongated platelets from the association with natrolite and albite.
Wavenumbers (cm^{-1}): 3340, 2990sh, 1030sh, 962s, 862s, 657, 578, 551, 510sh, 477.

TiSi221 Lorenzenite $Na_2Ti_2Si_2O_9$



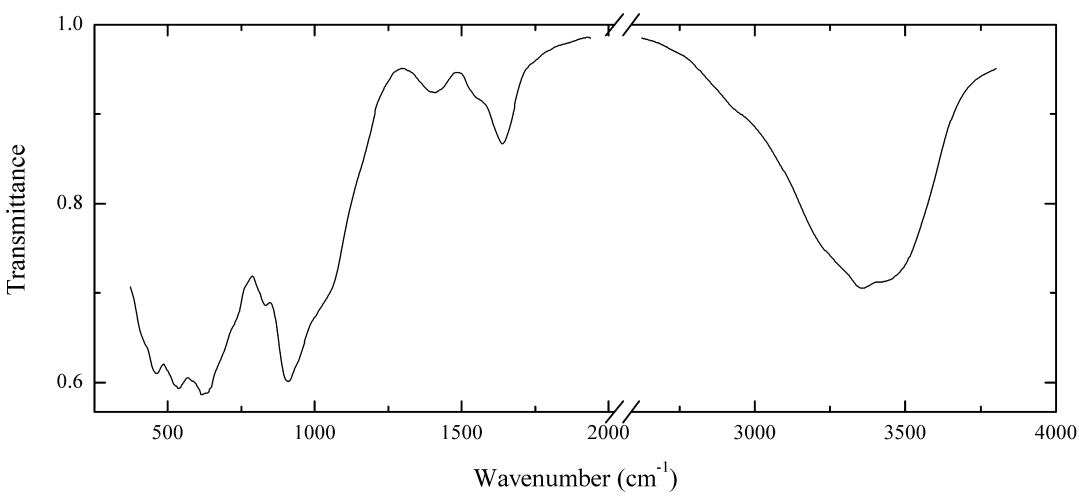
Locality: Kirovskii mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: White fibrous aggregate from the association with natrolite, biotite, ilmenite, aegirine, podlesnoite, barytocalcite, calcite, fluorite, astrophyllite, burbankite, *etc*. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3435w, 1111, 1030s, 993s, 937s, 901, 753, 735sh, 696, 643, 541s, 525sh, 485s, 469s, 421s.

TiSi222 Lovozerite $Na_3CaZrSi_6O_{15}(OH)_3$



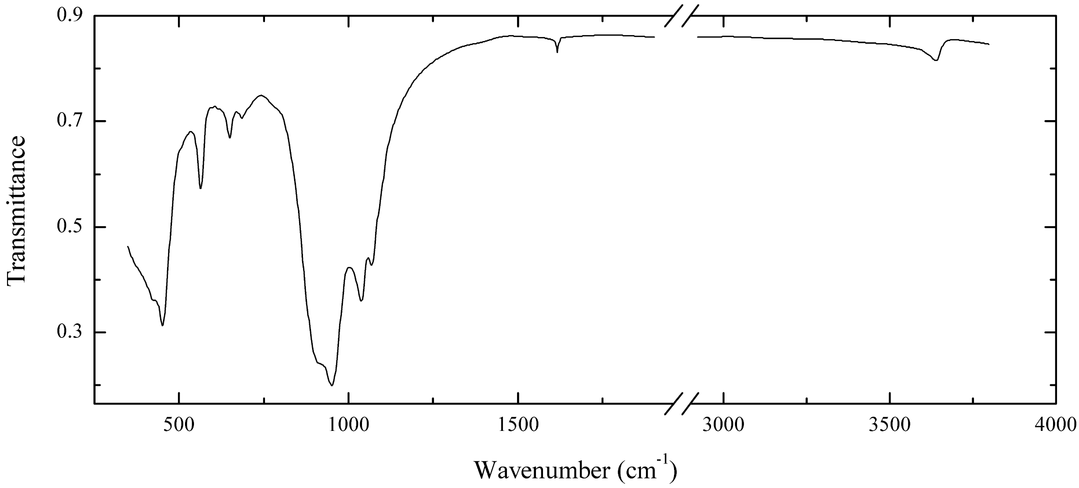
Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Light brown pseudomorph after zirsinalite forming rim around a grain of eudialyte. Associated minerals are aegirine, nepheline and rasvumite. Disordered variety. The empirical formula is (electron microprobe) $Na_{2.0}(Ca_{0.45}Na_{0.40}Mn_{0.15})(Zr_{0.65}Fe_{0.2}Ti_{0.05})Si_{6.0}(O,OH)_{18}$.
Wavenumbers (cm^{-1}): 3460, 1645, 1060sh, 985s, 920sh, 625w, 455.

TiSi223 "Niobofersmanite" $(Na,Ca)_{4-x}(Nb,Ti)_2[Si_2O_7](O,F)_5 \cdot nH_2O$ (?)



Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown grains from the association with microcline, nepheline, sodalite, aegirine, pectolite, eudialyte, biotite and natrolite. Nb-dominant analogue of fersmanite (hydrated variety). Needs further investigation.
Wavenumbers (cm^{-1}): 3450sh, 3360, 3200sh, 2950sh, 1640, 1555sh, 1410, 1070sh, 1005sh, 911s, 838, 614s, 525s, 462s.

TiSi224 Kupletskite-(Cs) $(Cs,K)_2Na(Mn,Fe^{2+})_7(Ti,Nb)_2Si_8O_{24}(OH,O,F)_7$

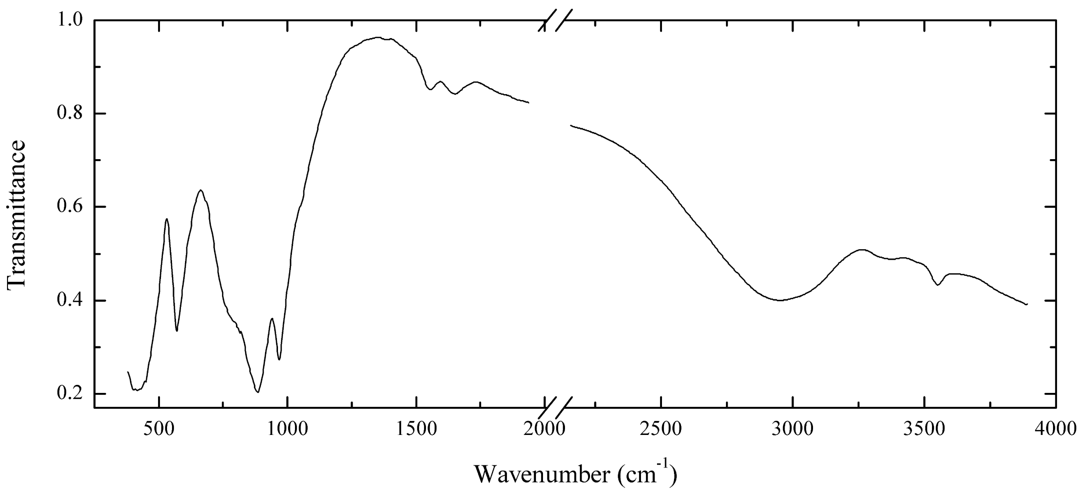


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).

Description: Dark brown plate with mica-like cleavage from the association with quartz, microcline, pyrochlore, stillwelite and sogdianite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3630w, 1618w, 1072, 1042s, 953s, 920sh, 687w, 649, 563, 450s, 425sh.

TiSi225 Sitinakite $KNa_2Ti_4Si_2O_{13}(OH)\cdot 4H_2O$

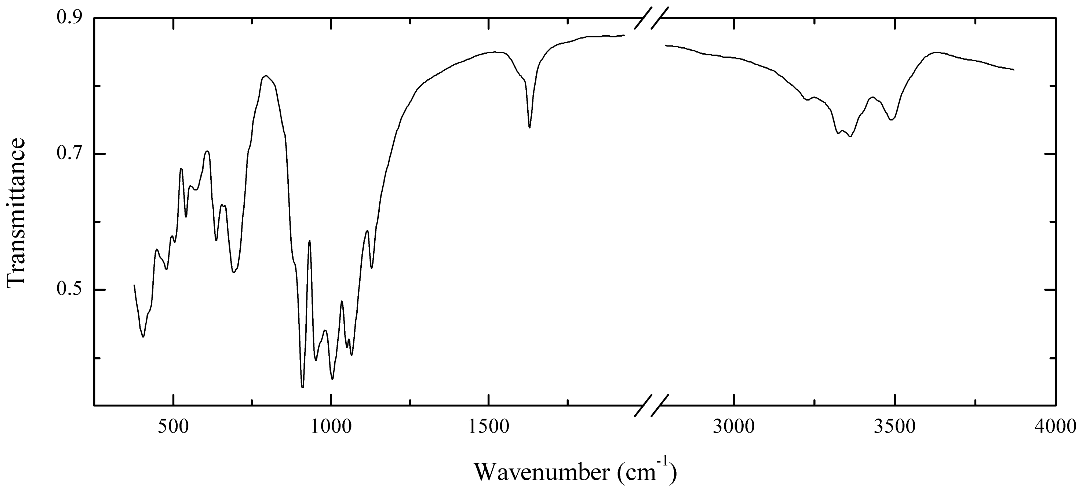


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pink platelets forming pseudomorph after lomonosovite. Investigated by I.V. Pekov. Identified by single-crystal X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3530w, 3460w, 2935, 1655w, 1557w, 968s, 884s, 790sh, 615sh, 571, 417s.

TiSi226 Lintisite $Na_3LiTi_2Si_4O_{14}{\cdot}2H_2O$

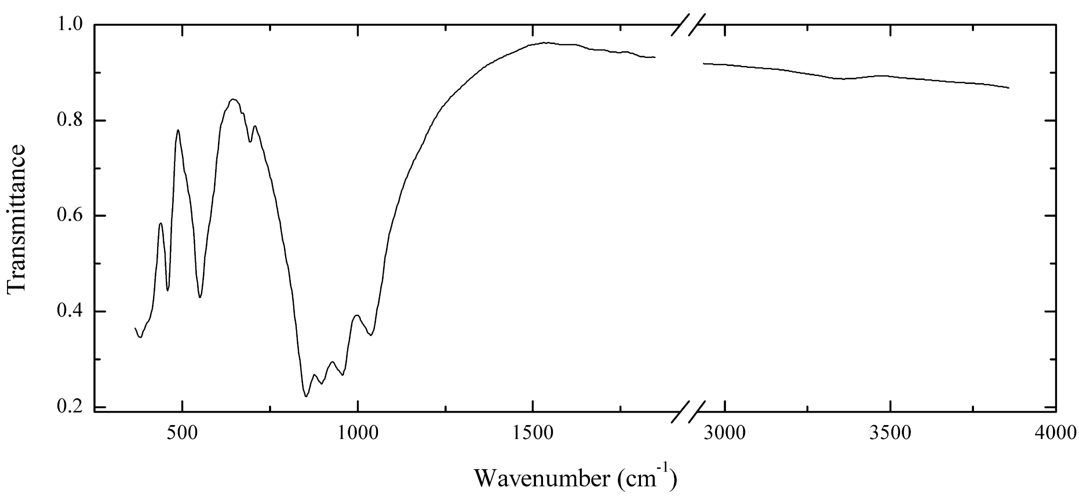


Locality: Palitra pegmatite, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: White aggregate of acicular crystals from peralkaline pegmatite, from the association with manganoneptunite, aegirine, vitusite-(Ce), phosinaite-(Ce), barytolamprophyllite, nalipoite and ussingite. Identified by IR spectrum and blue fluorescence under UV radiation.

Wavenumbers (cm^{-1}): 3485, 3360, 3325, 3225, 1633, 1610sh, 1128, 1065s, 1050s, 1003s, 965sh, 949s, 910s, 880sh, 745sh, 692, 633, 573, 539, 500, 477, 425sh, 404s.

TiSi228 Barytolamprophyllite $(Ba,Sr,K)_2Na(Na,Fe^{2+},Mn^{2+})_2(Ti,Fe^{3+},Mg)Ti_2(Si_2O_7)_2O_2(OH,O,F)_2$

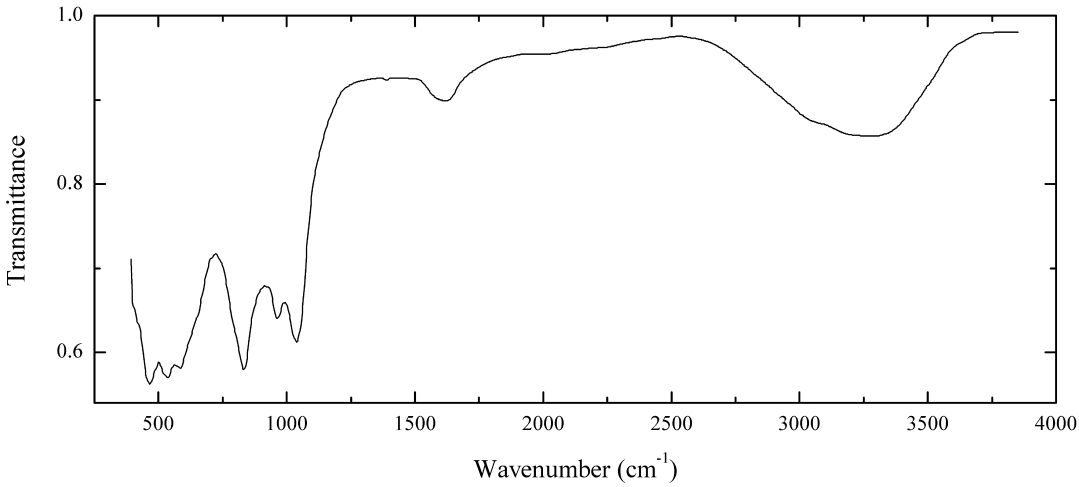


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Light brown pseudomorph after lorenzenite from the association with lomonosovite, raslakite, terskite and aegirine. The empirical formula is (electron microprobe) $(Ba_{1.44}Sr_{0.35}K_{0.19})Na(Na_{1.51}Mn_{0.32}Fe_{0.15})Ti_{3.35}Nb_{0.14}(Si_2O_7)_2O_2(O,F,OH)_2$.

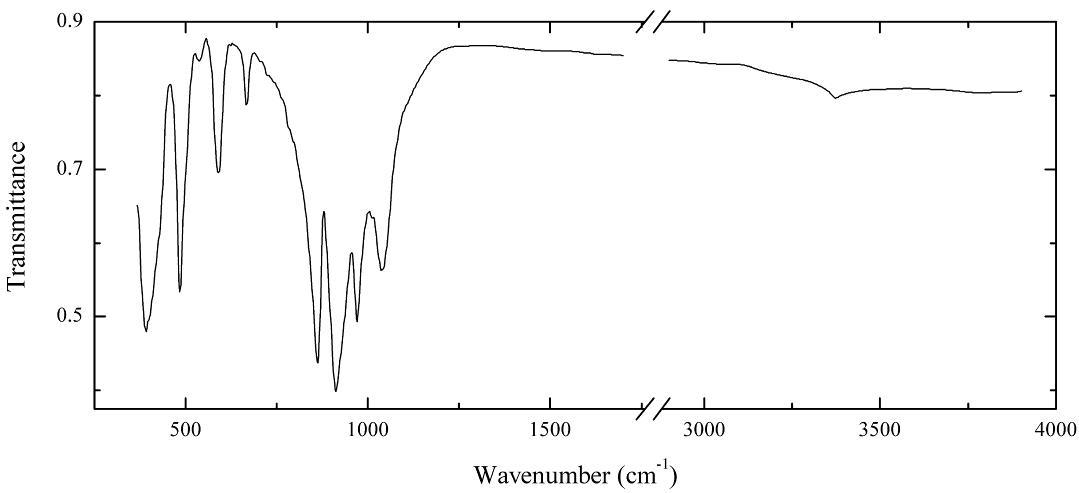
Wavenumbers (cm^{-1}): 1038, 956s, 896s, 854s, 696, 551, 459, 400sh, 380s.

TiSi229 **Fersmanite** $(Na,Ca)_2(Ca,Na)_2(Ti,Nb)_2[Si_2O_7]O_4F$



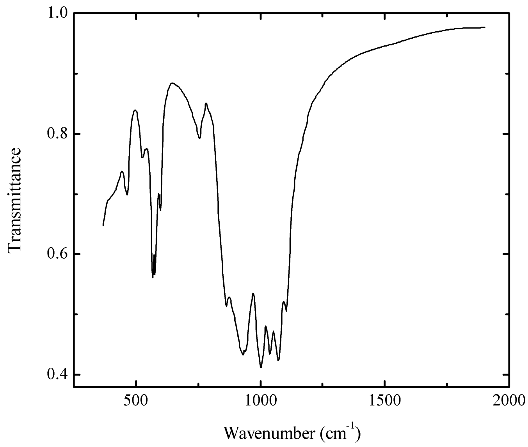
Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Reddish-brown grains from the association with phillipsite-K and gonnardite. Hydrated variety. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3270, 1620w, 1041, 968, 837s, 650sh, 585s, 529s, 467s, 400sh.

TiSi230 **Fresnoite** $Ba_2Ti(Si_2O_7)O$



Locality: Esquire #7 mine, Big Creek, Fresno Co., California, USA.
Description: Yellow crystals from the association with bario-orthojoaquinite, baotite and natrolite. Close to the endmember by composition.
Wavenumbers (cm^{-1}): 3360w, 1038, 971s, 915s, 864s, 667, 589, 538w, 483s, 394s.

TiSi231 Sobolevite $Na_{13}Ca_2Mn_2Ti_3(Si_2O_7)_2(PO_4)_4O_3F_3$

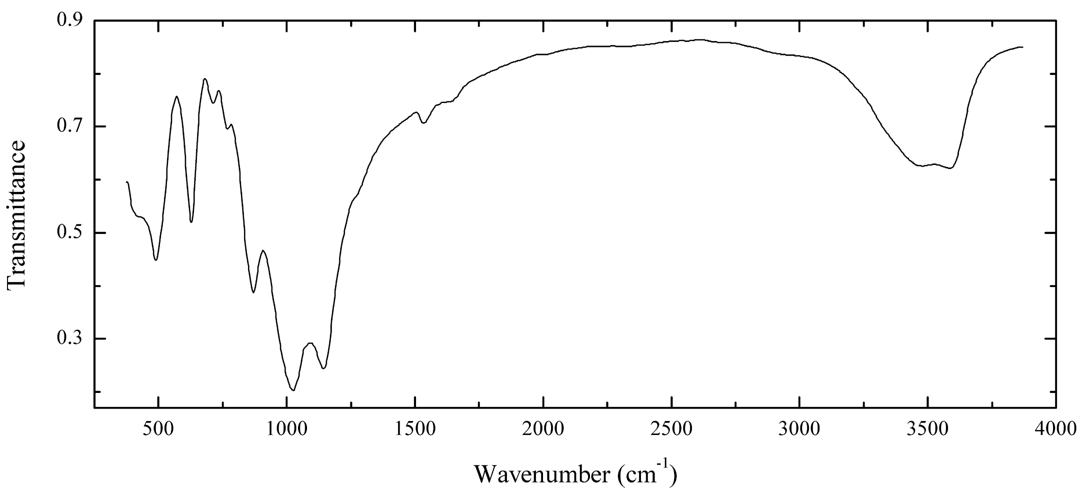


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Brown platelets from the association with sodalite, lamprophyllite, aegirine and lomonosovite. The empirical formula is (electron microprobe) $Na_{11.91}Ca_{2.05}Mn_{0.65}Mg_{0.29}Fe_{0.41}$-$Ti_{2.93}Nb_{0.18}Si_{3.91}(PO_4)_{3.08}O_{18.19}F_{1.75}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1107, 1074s, 1041s, 1003s, 931s, 864, 755, 597, 576, 567, 525, 465.

TiSi232 Litvinskite $(Na,H_2O)_2(\square,Na,Mn)Zr[Si_6O_{12}(OH,O)_6]$

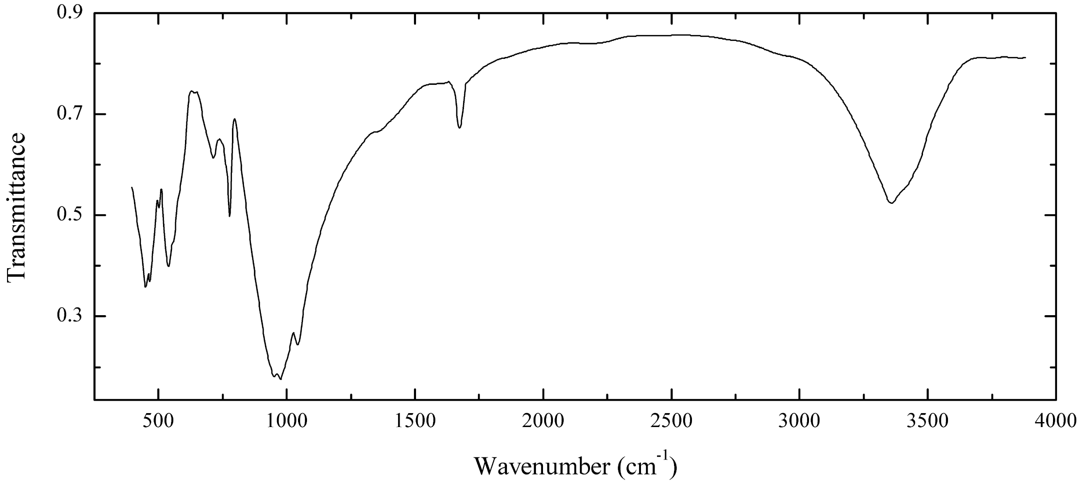


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Reddish-brown grains from the association with microcline, nepheline, lomonosovite and aegirine. The empirical formula is (electron microprobe) $Na_{1.64}Ca_{0.04}Mn_{0.22}Fe_{0.05}Zr_{0.98}$-$Ti_{0.03}Nb_{0.05}(Si_{5.97}Al_{0.03})O_{12}(OH,O)_6 \cdot nH_2O$.

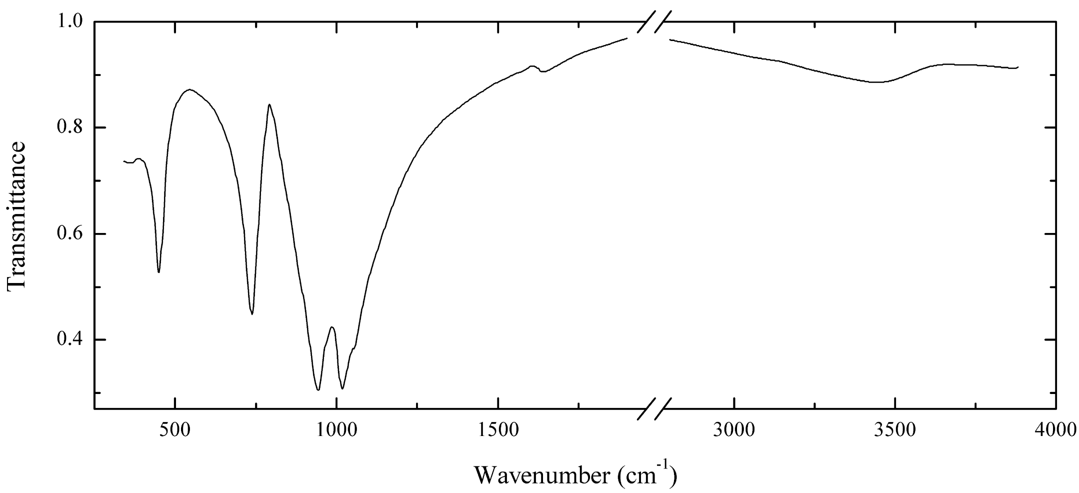
Wavenumbers (cm^{-1}): 3575, 3455, 1630w, 1535w, 1260sh, 1140s, 1022s, 870s, 747, 710, 626, 487s, 425sh.

TiSi233 Kostylevite $K_2Zr(Si_3O_9)\cdot H_2O$



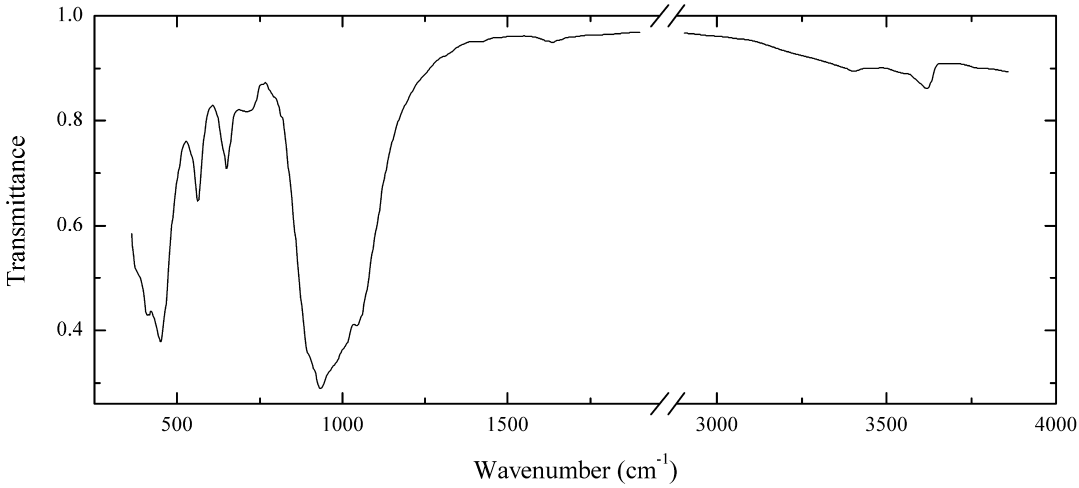
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Colourless twinned crystals from the association with sazykinaite-(Y), microcline and aegirine. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3345, 1675, 1360sh, 1045s, 976s, 948s, 785, 715, 590sh, 541, 502, 465, 450.

TiSi234 Wadeite $K_3Zr(Si_3O_9)$



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Rhombohedral crystals from peralkaline pegmatite. H_2O-bearing variety. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3410, 1640w, 1050sh, 1018s, 944s, 737, 452.

TiSi237 Astrophyllite $K_2Na(Fe^{2+},Mn)_7Ti_2Si_8O_{24}(OH,O,F)_7$

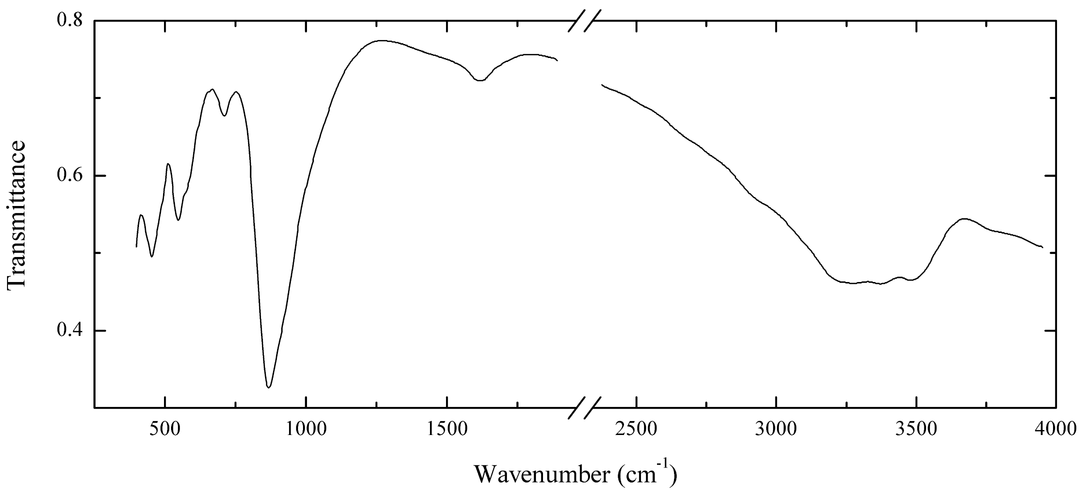


Locality: Rouma (Roume, Ruma) island, Los islands, Guinea.

Description: Brown platy grains from the association with microcline, nepheline, aegirine and ilmenite. Mn- and Zr-rich variety. The empirical formula is (electron microprobe) $K_{1.8}Na_{1.0}Ca_{0.2}(Fe_{4.0}Mn_{2.9}Mg_{0.1})(Ti_{1.25}Zr_{0.45}Nb_{0.3})(Si_{7.6}Al_{0.4})O_{24}(OH,O,F)_7$.

Wavenumbers (cm^{-1}): 3620, 3400w, 1640w, 1040, 1010sh, 980sh, 935s, 900sh, 710, 647, 563, 450s, 440sh, 410, 380sh.

TiSi239 Ivanyukite-Na-*C* $Na_2Ti_4(SiO_4)_3O_2(OH)_2{\cdot}6H_2O$

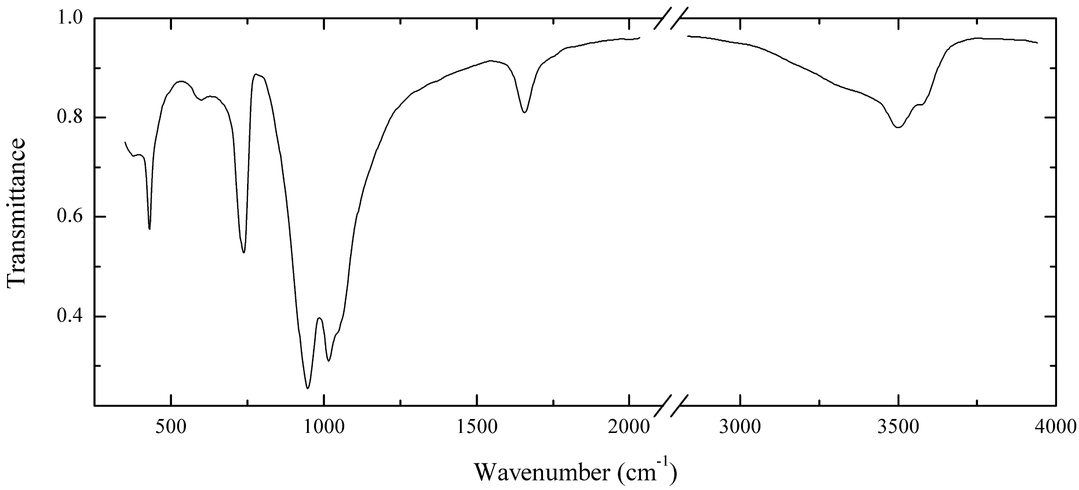


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Light orange cubic crystals from the association with microcline, vinogradovite, sazykinaite-(Y) and natrolite. Identified by qualitative electron microprobe analysis and single-crystal X-ray diffraction pattern. Isometric, $a = 7.78$ Å.

Wavenumbers (cm^{-1}): 3465, 3355, 3240, 2950sh, 1620w, 868s, 712, 580sh, 548, 445s.

TiSi240 Catapleiite $Na_2Zr(Si_3O_9)\cdot 2H_2O$

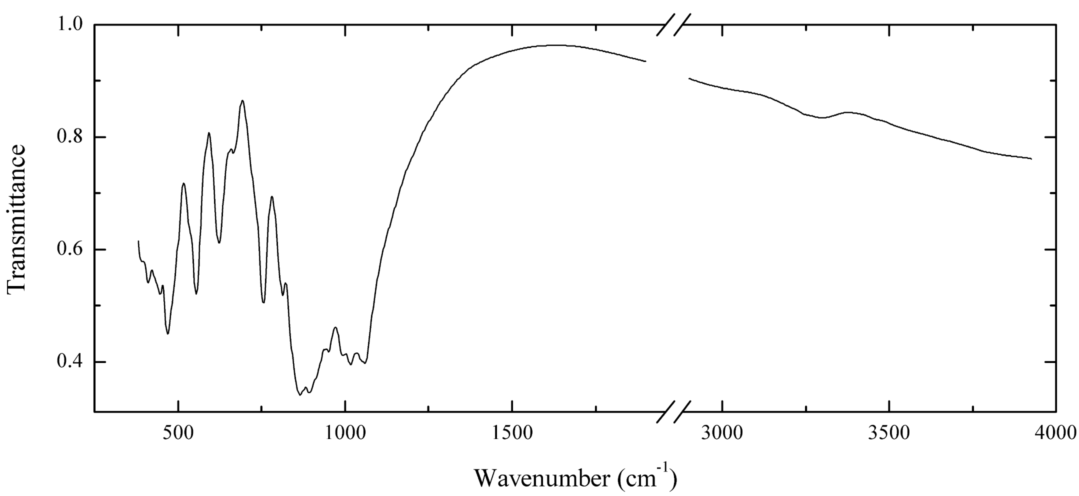


Locality: Langesundfjord, Porsgrunn, Telemark province, Norway.

Description: Brownish granular aggregate from the association with aegirine microcline. The empirical formula is (electron microprobe) $H_{0.3}Na_{1.7}Zr_{1.0}Si_{3.0}O_9\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3560, 3487, 3370sh, 1658, 1045sh, 1017s, 949s, 737, 600w, 428, 385.

TiSi241 Wöhlerite $Na_2Ca_4ZrNb(Si_2O_7)_2(O,F)_4$

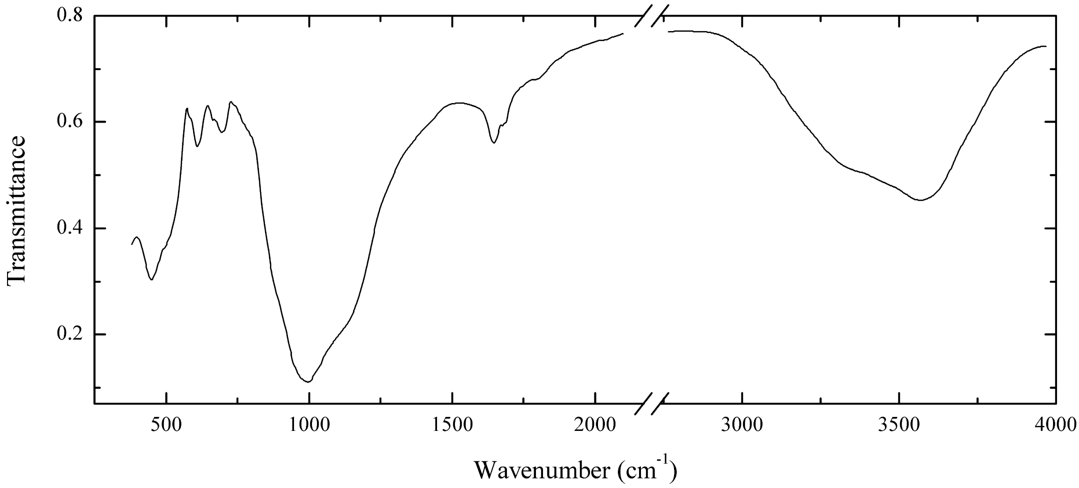


Locality: Sagåsen (Saga 3) quarry, Mørie, Porsgrunn, Telemark province, Norway.

Description: Yellow grains from the association with aegirine, ferrokentbrooksite and microcline. The empirical formula is (electron microprobe) $Na_{1.91}Ca_{4.04}(Zr_{0.90}Nb_{0.78}Mn_{0.17}Fe_{0.14}Ti_{0.06})(Si_{2.00}O_7)_2(O,OH)_{2.48}F_{1.52}$.

Wavenumbers (cm^{-1}): 3275w, 1056s, 1017s, 995, 947, 896s, 868s, 812, 755, 662w, 621, 554, 535sh, 467, 446, 410, 375sh.

TiSi242 **Terskite** $Na_4Zr(H_4Si_6O_{18})$

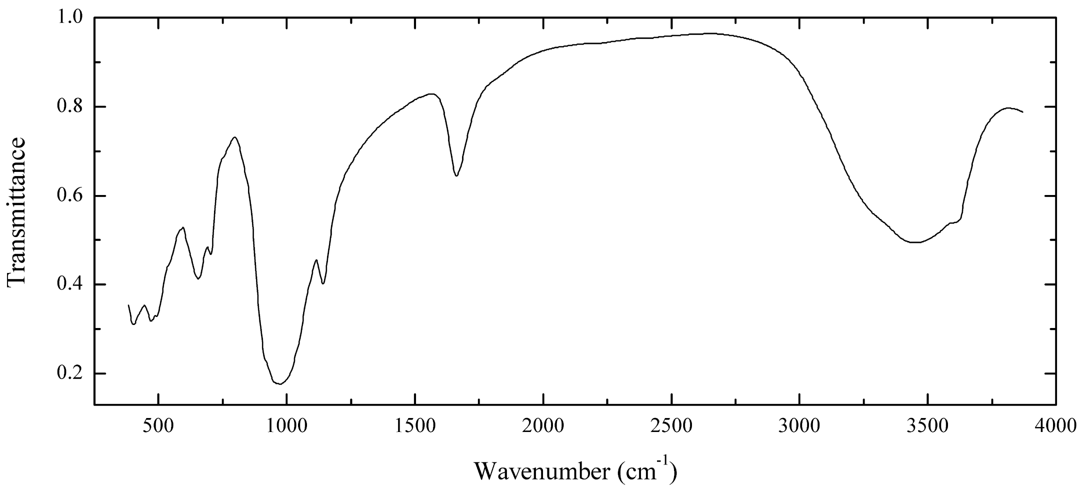


Locality: Shkatulka pegmatite, Umbozero mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: White fine-grained aggregate. Disordered and hydrated variety.

Wavenumbers (cm^{-1}): 3550, 3380sh, 1780w, 1680sh, 1650, 1140sh, 996s, 695, 664w, 610, 510sh, 452s.

TiSi243 **Zorite** $Na_6Ti(Ti,Nb)_4[(Si,Al)_2Si_4O_{17}]_2(O,OH)_5{\cdot}11H_2O$

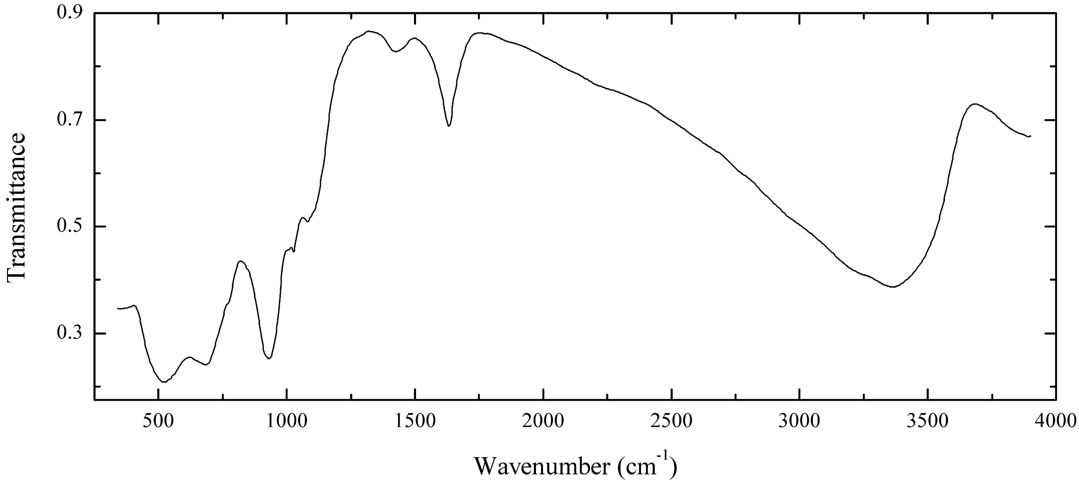


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Aggregate of colourless acicular crystals. Disordered variety. The empirical formula is (electron microprobe) $Na_7(Ti_{3.6}Nb_{0.5}Fe_{0.5})Si_{12}O_{34}(O,OH)_5{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3590sh, 3440, 3300sh, 1655, 1140, 1040sh, 978s, 955sh, 915sh, 699, 648, 535sh, 500sh, 471s, 401s.

TiSi244 Komarovite (□,Na,K)(□,Ca,Na)$_6$Li$_x$(Nb,Ti)$_6$Si$_4$O$_{26}$(OH,F)$_2$·nH$_2$O (?)

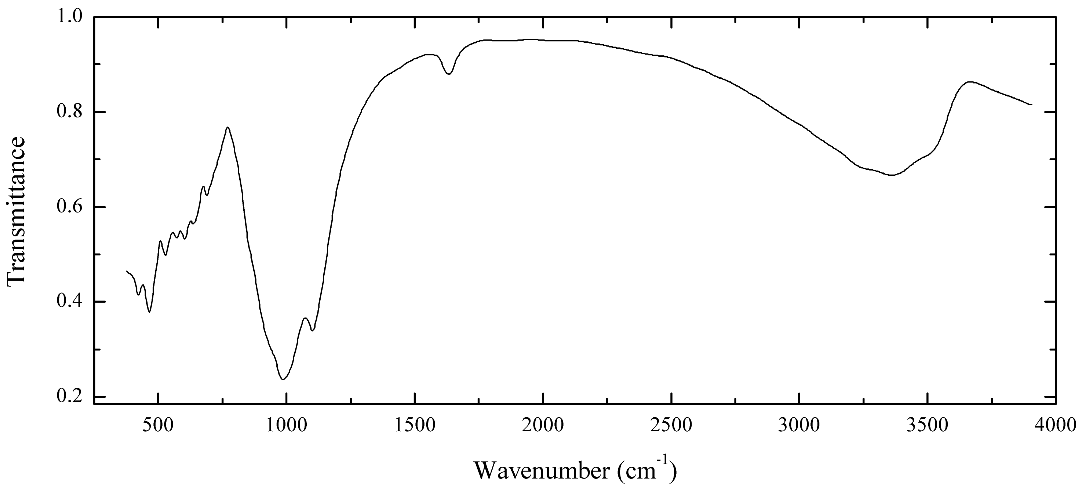


Locality: Pegmatite No. 61, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: White pseudomorph after platy crystal of vuonnemite from the association with natrolite, albite, yofortierite, leifite, *etc*. Na-free, Ca- and Si-deficient variety.

Wavenumbers (cm^{-1}): 3345, 1630, 1420w, 1080, 1026, 930s, 688s, 516.

TiSi245 Paravinogradovite $Na_2Ti_3Fe^{3+}(Si_2O_6)_2(Si_3AlO_{10})(OH)_4 \cdot H_2O$

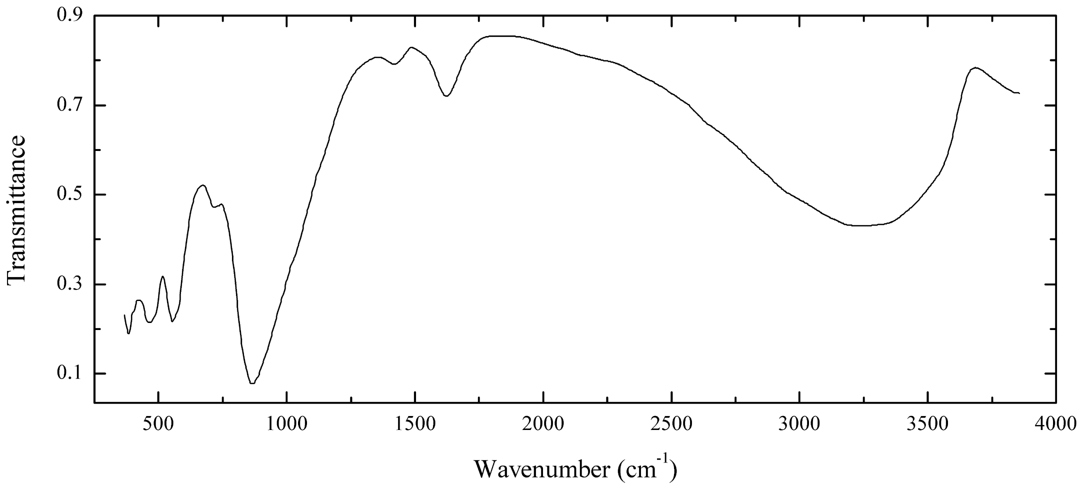


Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: White semitransparent crystals from the association with albite, carbonate-fluorapatite, ancylite-(Ce), natrolite, aegirine, a glauconite-like mineral, nordstrandite, anatase, fluorite, galena, cerussite and vinogradovite. Holotype sample. Triclinic, space group $P1$, $a = 5.246$, $b = 8.734$, $c = 12.968$ Å, $\alpha = 70.32$, $\beta = 79.01$, $\gamma = 89.90°$, $Z = 1$. Optically biaxial (–), $\alpha = 1.707$, $\beta = 1.741$, $\gamma = 1.755$, $2V_{meas} = 64°$. $D_{meas} = 2.77$ g/cm^3, $D_{calc} = 2.74$ g/cm^3. The empirical formula is $(Na_{2.28}K_{0.17})(Ti_{3.37}Fe_{0.47}Nb_{0.03}Mg_{0.03})(Si_{6.59}Al_{1.09}Be_{0.28})O_{22}(OH)_{3.74}·1.27H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.9 (58) (001), 5.98 (35) (002), 5.88 (65) (0-11, 012), 4.35 (38) (121, 102), 3.182 (100) (0-13, 014), 3.085 (29) (123), 2.735 (21) (1-22, 030).

Wavenumbers (cm^{-1}): 3520sh, 3360, 3240sh, 1633w, 1105s, 989s, 940sh, 860sh, 725sh, 691, 638, 599, 568, 523, 459s, 418.

TiSi246 Ivanyukite-K $K_2Ti_4(SiO_4)_3O_2(OH)_2·9H_2O$

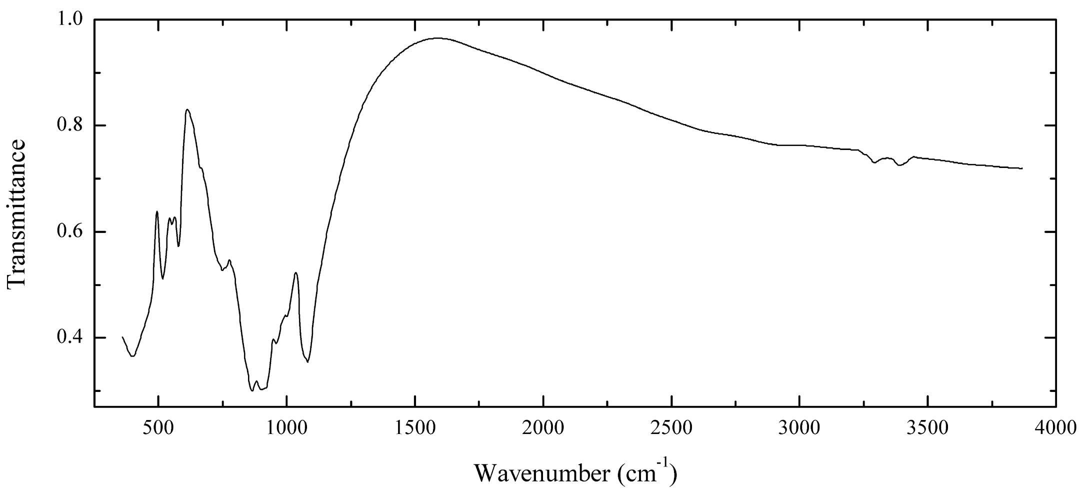


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Pale blue cubic crystals from the association with microcline, vinogradovite, sazykinaite-(Y) and natrolite. The empirical formula is (electron microprobe) $(K_{1.2}Na_{0.3}Ca_{0.2})Ti_{4.1}Nb_{0.1}Si_{2.95}O_{14}(OH)_2·nH_2O$.

Wavenumbers (cm^{-1}): 3230, 1623, 1423w, 1030sh, 865s, 717, 555s, 466s, 383s.

TiSi247 Normandite $NaCa(Fe^{2+},Mn^{2+})(Ti,Nb,Zr)(Si_2O_7)OF$

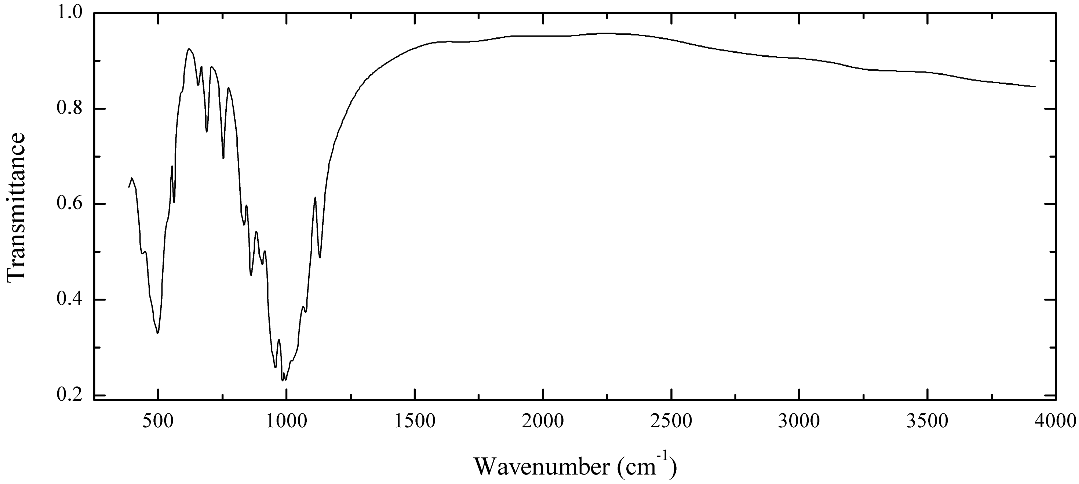


Locality: Putelichorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Red radial aggregate of long-prismatic crystals from the association with aegirine, microcline, sodalite and an intermediate member of cancrinite-kyanoxalite solid-solution series. Confirmed by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3355w, 3265w, 1081s, 1070sh, 1001, 957, 915sh, 900s, 864s, 750, 665sh, 578, 552, 516, 450sh, 400s.

TiSi248 Neptunite $KNa_2Li(Fe^{2+},Mn^{2+})_2Ti_2Si_8O_{24}$

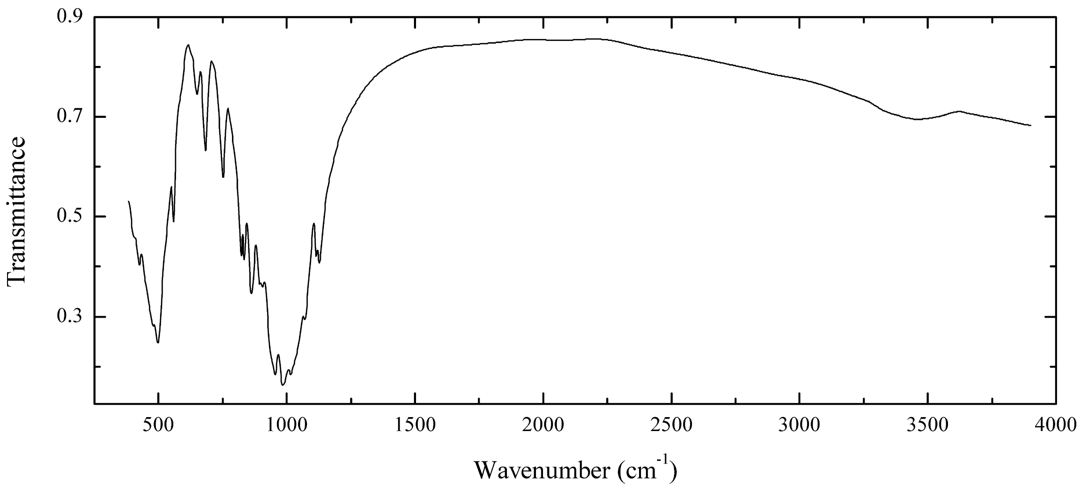


Locality: Gem mine, San Benito Co., California, USA.

Description: Deep red prismatic crystal from the association with benitoite and joaquinite-(Ce). Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1129, 1075s, 1020sh, 995s, 985s, 954s, 940sh, 906, 895sh, 863, 835, 825sh, 753, 687, 655, 595sh, 560, 535sh, 497s, 465sh, 434.

TiSi249 Neptunite $KNa_2Li(Fe^{2+},Mn^{2+})_2Ti_2Si_8O_{24}$

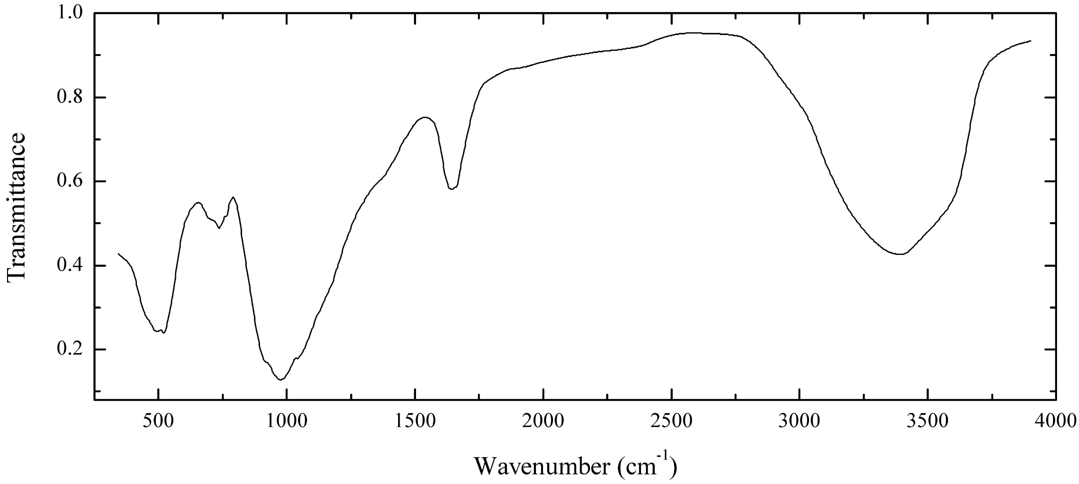


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.

Description: Brown grains from the association with microcline, aegirine, zektzerite and titanite. The empirical formula is (electron microprobe) $K_{0.9}Na_{2.0}Li_x(Fe_{1.2}Mn_{0.7}Mg_{0.1})Ti_{1.9}Al_{0.2}Si_{8.0}O_{24}$.

Wavenumbers (cm^{-1}): 3450w, 1127, 1115sh, 1072s, 1015s, 984s, 954s, 940sh, 906, 895sh, 863, 834, 823, 751, 684, 648, 558, 540sh, 496s, 477, 450sh, 427, 405sh.

TiSi250 Gaidonnayite $Na_2Zr(Si_3O_9)\cdot 2H_2O$

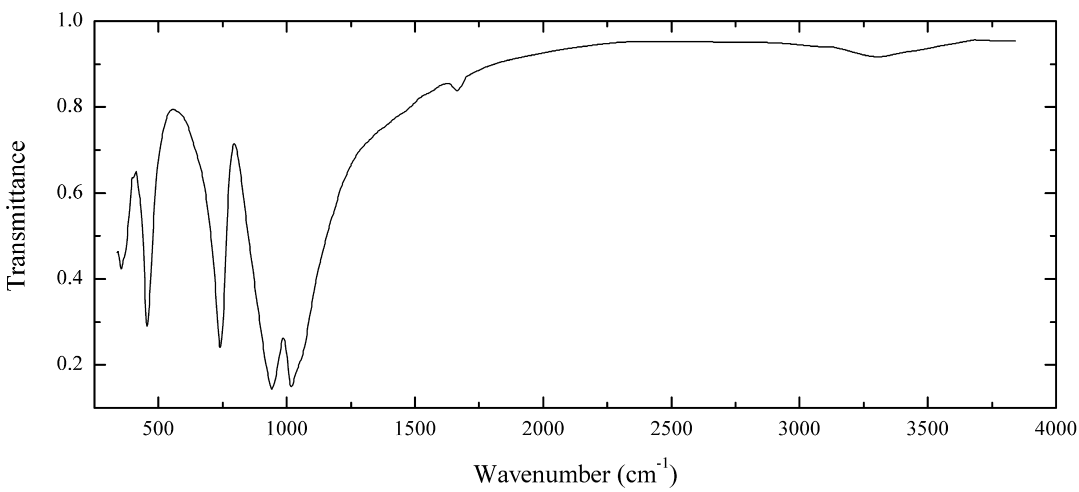


Locality: Pegmatite No. 62, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Dark brown pseudomorph after kapustinite (?) from the association with hydrated terskite, aegirine, manganoneptunite, microcline and labuntsovite-group minerals. Disordered and hydrated variety.

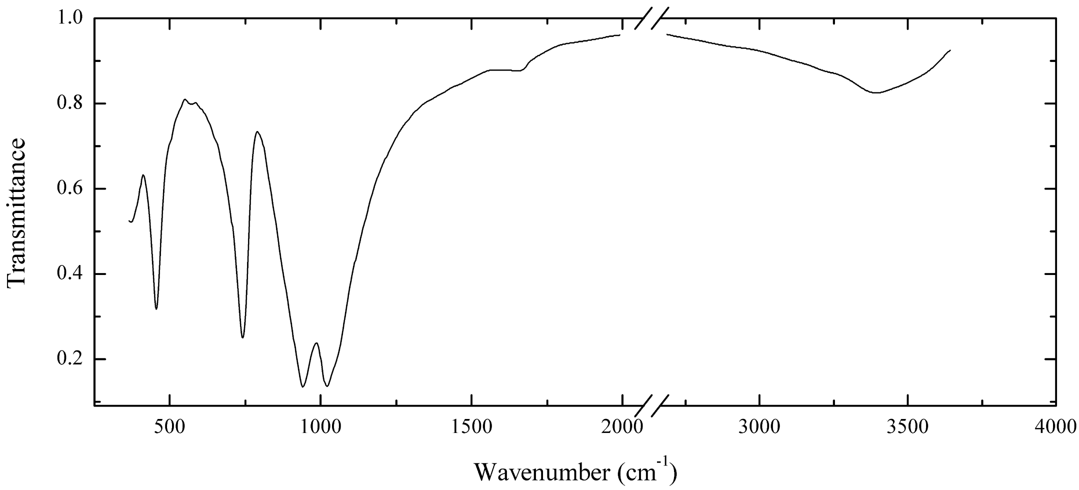
Wavenumbers (cm^{-1}): 3470sh, 3380, 1648, 1400sh, 1160sh, 1040sh, 977s, 920sh, 760sh, 737, 705sh, 517s, 490s, 450sh.

TiSi251 Wadeite $K_3Zr(Si_3O_9)\cdot nH_2O$ ($n \ll 1$)



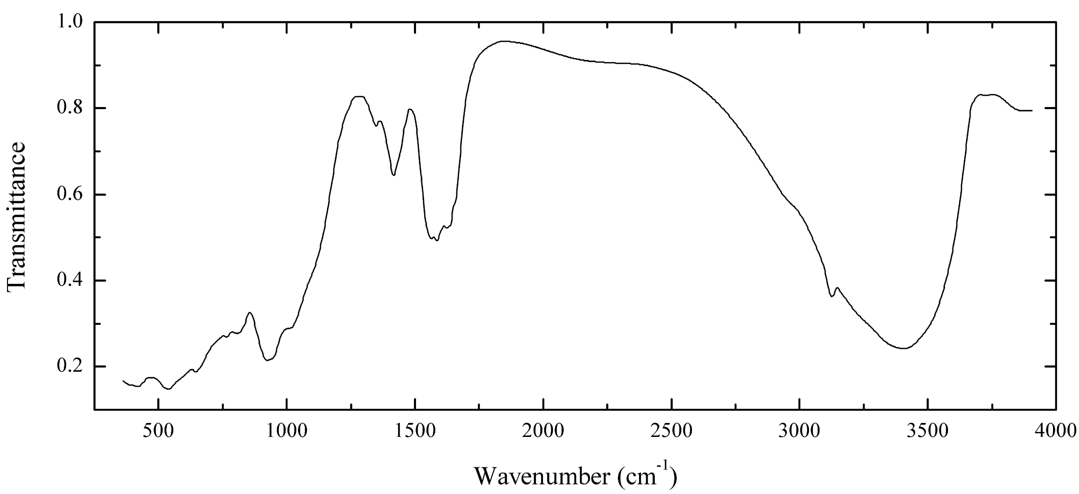
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Pink massive from peralkaline pegmatite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3280w, 1663w, 1050sh, 1016s, 940s, 740s, 453s, (365).

TiSi252 Wadeite $K_3Zr(Si_3O_9){\cdot}nH_2O$ ($n \ll 1$)



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown massive from peralkaline pegmatite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3530sh, 3380, 1650w, 1017s, 940s, 738s, 570w, 454s, (370).

TiSi253 Natrokomarovite $(Na,K)(Na,Ca)_{6-x}Li_x(Nb,Ti)_6Si_4O_{26}(OH,F)_2{\cdot}4H_2O$



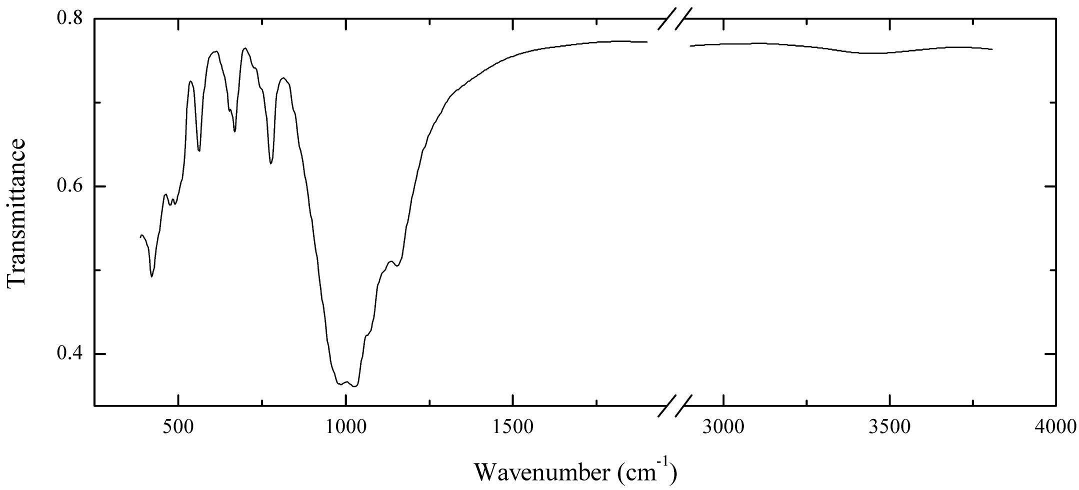
Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Pseudomorph after platy crystal of a heterophyllosilicate from the association with microcline, aegirine, lamprophyllite, gaidonnayite, nenadkevichite, belovite-(La), belovite-(Ce), ancylite-(Ce), *etc*. The empirical formula is (electron microprobe) $H_xNa_{3.23}Ca_{2.24}Ba_{0.59}Sr_{0.41}Th_{0.24}Mn_{0.19}K_{0.12}(Nb_{3.98}Ti_{1.97}Fe_{0.93})(Si_{3.96}Al_{0.04})O_{26}(OH,F)_2 \cdot nH_2O$.

The bands in the ranges from 1300 to 1600 and from 2,800 to 3,200 cm^{-1} correspond to inclusions of a bituminous substance.

Wavenumbers (cm^{-1}): 3395s, 3125, 2940sh, 1655sh, 1630, 1588, 1570, 1465sh, 1445sh, 1420, 1355w, 1110sh, 1019, 928s, 808, 765, 645s, 540s, 420s.

TiSi254 Dalyite $K_2Zr(Si_6O_{15})$

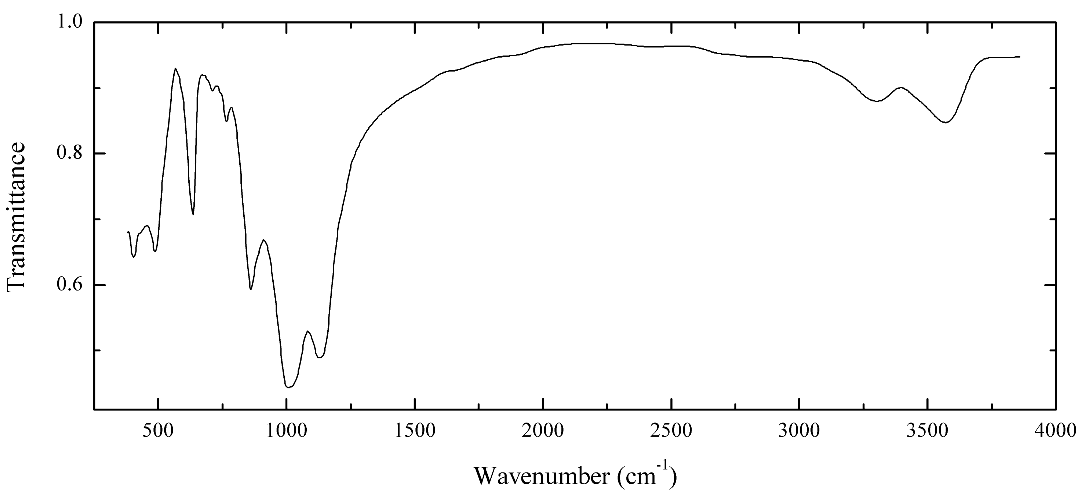


Locality: Malyi Murun (Malomurunskiy) alkaline pluton, Irkutsk region, Eastern Siberia, Russia (cotype locality).

Description: Pale violet glassy grains from the association with aegirine, microcline, quartz and tinaksite. Ti-rich variety.

Wavenumbers (cm^{-1}): 1155, 1115sh, 1065sh, 1027s, 985s, 777, 669, 655sh, 562, 492, 476, 424s.

TiSi255 Lovozerite $Na_3CaZrSi_6O_{15}(OH)_3$

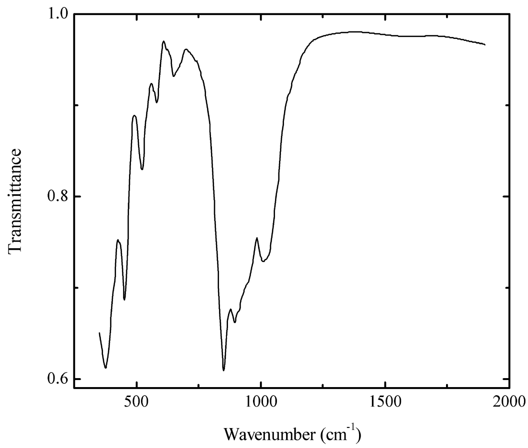


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Beige grains from peralkaline pegmatite. Associated minerals are villiaumite, aegirine and lorenzenite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Na_{2.0}K_{0.1}Ca_{0.5}Mn_{0.2}Zr_{0.7}Fe_{0.2}Ti_{0.1}Nb_{0.05}Si_{6.2}O_{15}(OH)_3$.

Wavenumbers (cm^{-1}): 3560, 3285, 1131s, 1020sh, 1005s, 861, 765, 709w, 635, 487, 420sh, 405.

TiSi256 Schüllerite $Ba_2Na(Mn,Ca)(Fe^{3+},Mg,Fe^{2+})_2Ti_2(Si_2O_7)_2(O,F)_4$

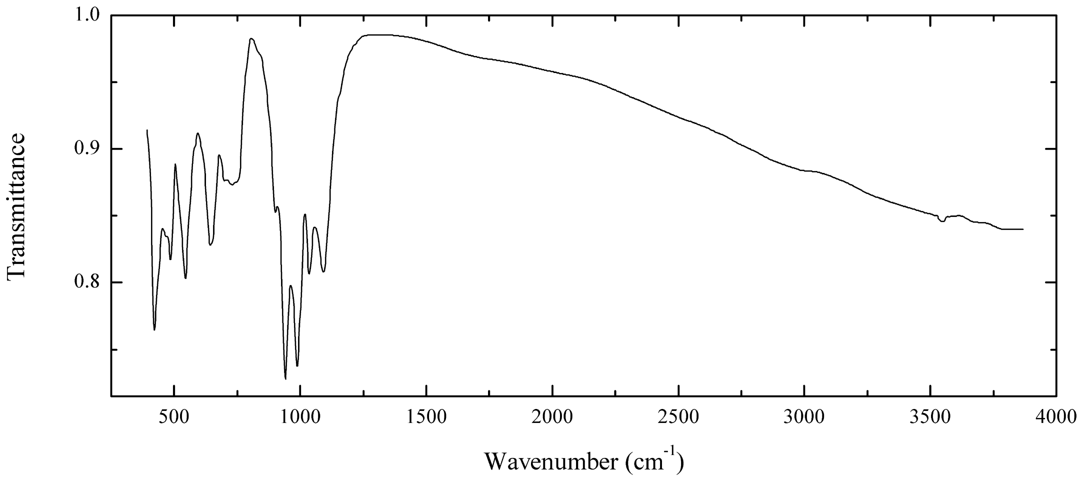


Locality: Löhley, near Üdersdorf, Eifel volcanic region, Rheinland-Pfalz (Rhineland-Palatinate), Germany (type locality).

Description: Brown flattened crystals from the association with nepheline, leucite, augite, phlogopite, magnetite, titanite, fresnoite, Fe-analogue of lileyite, fluorapatite, perovskite and pyrochlore. Holotype sample. The crystal structure is solved. Triclinic, space group $P1$, $a = 5.4027(1)$, $b = 7.066(4)$, $c = 10.2178(1)$ Å, $\alpha = 99.816(1)°$, $\beta = 99.624(1)°$, $\gamma = 90.084(1)°$, $Z = 1$. Optically biaxial (–), $\alpha = 1.756(3)$, $\beta = 1.773(4)$, $\gamma = 1.780(4)$, $2V_{meas} = 40(20)°$. $D_{calc} = 3.974$ g/cm^3. The empirical formula is $Ba_{1.68}Sr_{0.18}K_{0.11}Na_{1.05}Ca_{0.43}Mn_{0.47}Mg_{0.88}Fe^{2+}{}_{0.44}Fe^{3+}{}_{1.02}Ti_{1.28}Nb_{0.17}Al_{0.24}Si_{3.98}O_{16.98}F_{1.02}$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 9.96 (29) (001), 3.542 (28) (111), 3.490 (27) (020), 3.308 (45) (003), 3.203 (29) (013), 2.867 (29) (120, 112), 2.791 (100) (1-2-1), 2.664 (46) (200), 2.609 (36) (103, 121), 2.144 (52) (22-1).

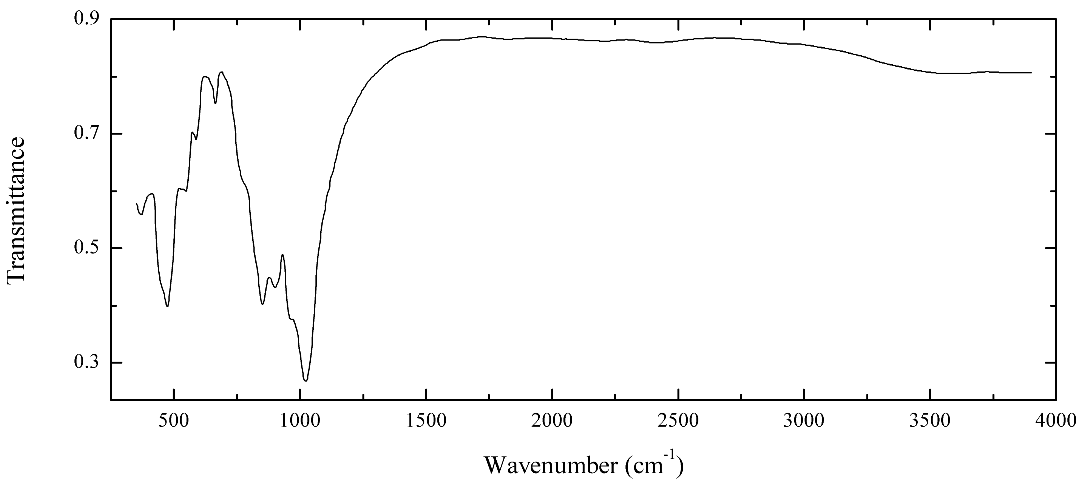
Wavenumbers (cm^{-1}): 1013, 950sh, 892s, 849s, 670sh, 654w, 570, 526, 454s, 389s.

TiSi258 Lorenzenite $Na_2Ti_2Si_2O_9$



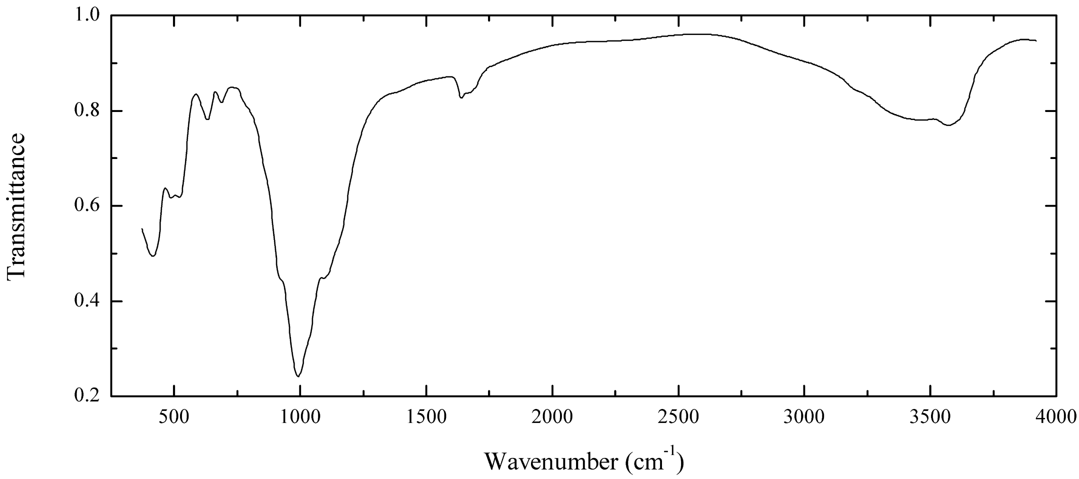
Locality: Marchenko Peak, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Brown transparent grain from the association with mosandrite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3515w, 1093, 1033, 988s, 941s, 903, 750sh, 731, 697, 647, 544, 487, 422s.

TiSi259 Götzenite $Na_2Ca_5Ti(Si_2O_7)_2(F,OH)_4$



Locality: Rother Kopf, Eifel volcanic region, Rheinland-Pfalz (Rhineland-Palatinate), Germany.
Description: Yellowish flattened long-prismatic crystals from alkaline basalt, from the association with günterblassite, nepheline, leucite, augite, phlogopite, magnetite, perovskite, lamprophyllite-group minerals, chabazite-K, chabazite-Ca, phillipsite-K and calcite. Identified by single-crystal X-ray diffraction pattern, electron microprobe analysis and IR spectrum. Triclinic, $a = 5.740(3)$, $b = 14.638(9)$, $c = 18.977(12)$ Å, $\alpha = 101.15(5)$, $\beta = 96.37(5)$, $\gamma = 90.01(5)°$. Ca-rich variety. The empirical formula is $Na_{1.3}Ca_{5.6}Ti_{0.9}Mg_{0.2}(Si_2O_7)_2F_{3.5}O_{0.5}$.
Wavenumbers (cm^{-1}): 1022s, 965sh, 903, 850s, 775sh, 661w, 587, 549, 473s, 450sh, 385.

TiSi260 Seidite-(Ce) $Na_4SrCeTiSi_8O_{22}F{\cdot}5H_2O$

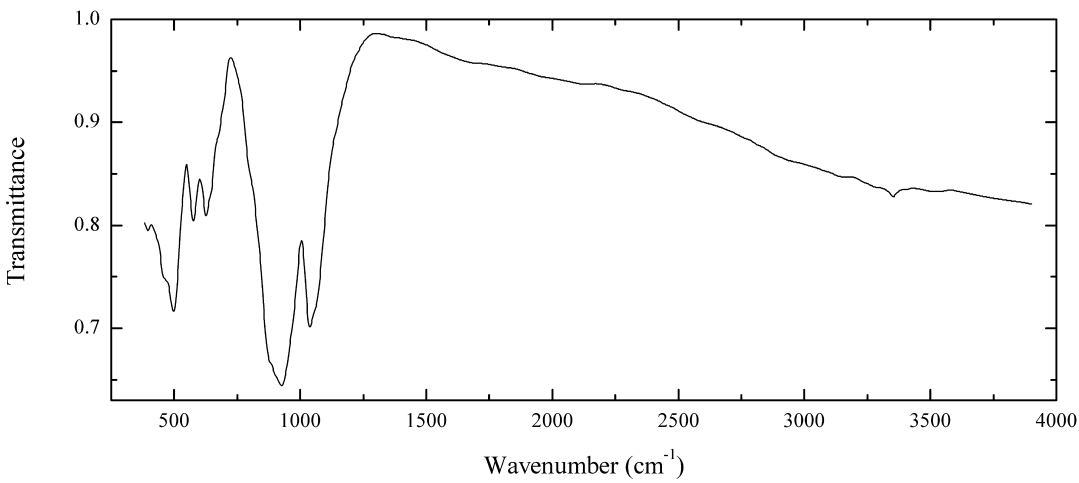


Locality: Yubileinaya pegmatite, Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Brownish curved platy crystals from the association with natrolite, raite, mountainite, *etc*. Investigated by I.V. Pekov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3430sh, 2950sh, 1665sh, 1638w, 1090s, 1035sh, 993s, 920s, 685w, 628, 525, 491, 420s.

TiSi262 Perrierite-(La) $(La,Ce,Ca)_4Fe^{2+}(Ti,Fe)_4(Si_2O_7)_2O_8$



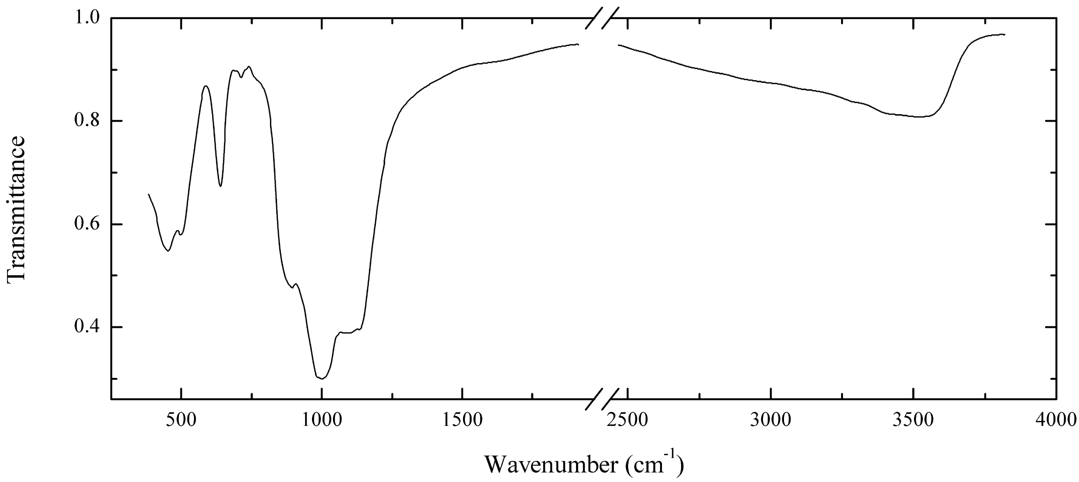
Locality: In den Dellen pumice quarry, near Mendig, Laacher See area, Eifel Mountains, Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Isolated black prismatic crystals from the association with sanidine, phlogopite, pyrophanite, zirconolite, members of the jakobsite-magnetite series, fluorocalciopyrochlore and zircon. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/a$; unit-cell parameters are $a = 13.668(1)$, $b = 5.6601(6)$, $c = 11.743(1)$ Å, $\beta = 113.64(1)°$; $V = 832.2(2)$ Å^3, $Z = 2$. Optically biaxial (–), $\alpha = 1.94(1)$, $\beta = 2.020(15)$, $\gamma = 2.040(15)$, $2V_{meas} = 50(10)°$.

D_{calc} = 4.791 g/cm^3. The empirical formula is $(La_{1.70}Ce_{1.45}Nd_{0.15}Pr_{0.06}Ca_{0.70})(Fe^{2+}_{0.53}Mn_{0.38}Mg_{0.08})$ $(Ti_{2.44}Fe^{3+}_{0.80}Al_{0.62}Nb_{0.07})Si_{4.04}O_{22}$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.19 (40) (110), 3.53 (40) (-311), 2.96 (100) (-313, 311), 2.80 (50) (020), 2.14 (50) (-422, -315, 313), 1.947 (50) 024, 223), 1.657 (40) (-407, -333, 331).

Wavenumbers (cm^{-1}): 3345w, 1045sh, 1038s, 925s, 900sh, 885sh, 800sh, 675sh, 626, 575, 499s, 465sh, 395.

TiSi263 Tisinalite $Na_{2-3}(Mn,Ca,\square)TiSi_6(O,OH)_{18}$

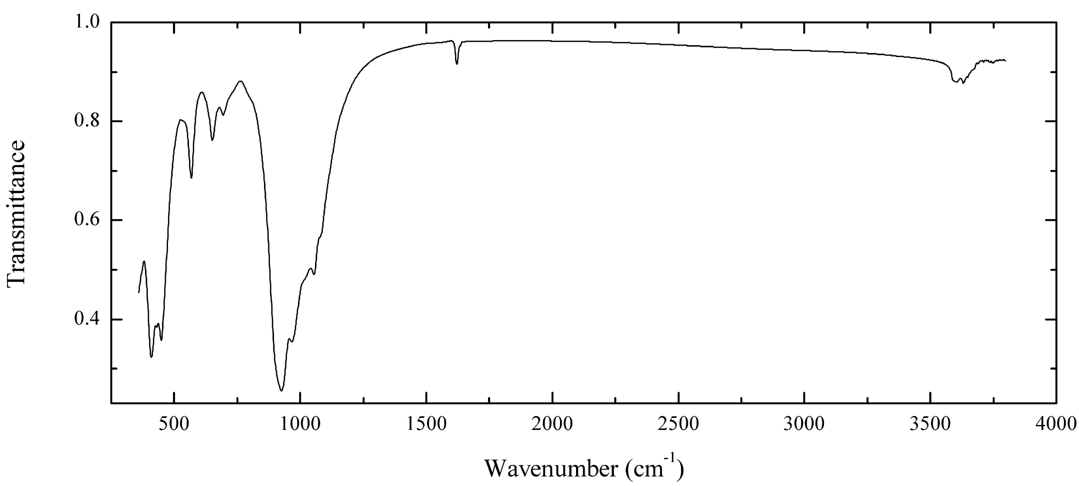


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia (type locality).

Description: Brown hexagonal platelets from the association with aegirine, sodalite, potassic feldspar, lamprophyllite, altered delhayelite, altered eudialyte, nacaphite, rasvumite, lomonosovite, villiaumite, *etc*. Investigated by I.V. Pekov. The empirical formula is (electron mictoprobe) $(Na_{3.05}K_{0.02})(Mn_{0.27}Ca_{0.25})(Ti_{0.63}Fe_{0.42})Si_6(O,OH)_{18}$.

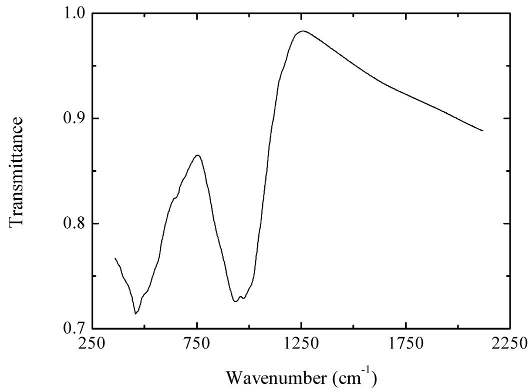
Wavenumbers (cm^{-1}): 3520, 3000sh, 1130sh, 1088s, 1000s, 885, 701w, 629, 491, 446.

TiSi264 Nalivkinite $Li_2NaFe^{2+}{}_7Ti_2Si_8O_{26}(OH)_4F$



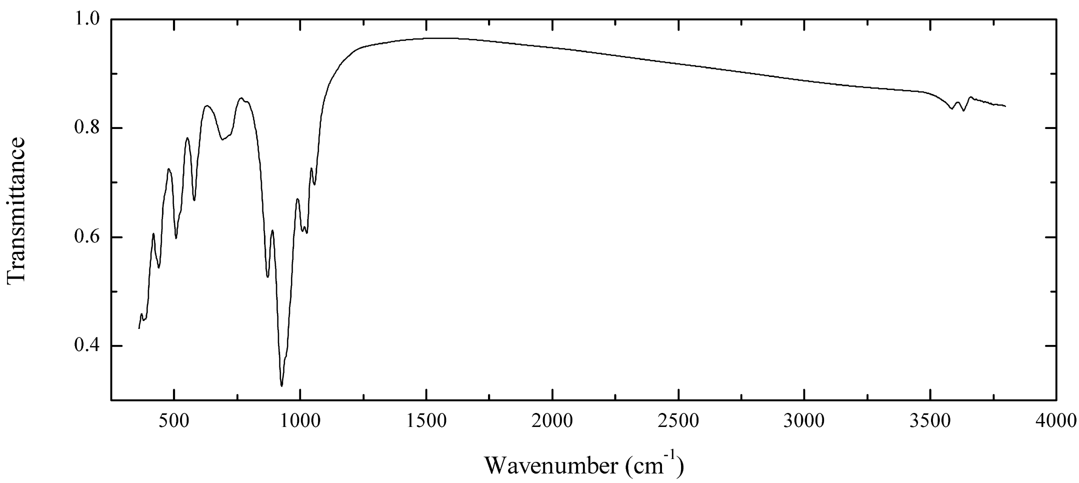
Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan (type locality).
Description: Reddish-brown platelets from the association with microcline, bafertisite and "calcibeborosilite". K-rich variety. The empirical formula is (electron mictoprobe) $(Li_xK_{0.9})(Na_{0.5}Ca_{0.4})(Fe_{4.8}Mn_{2.0}Mg_{0.1})(Ti_{1.8}Nb_{0.1}Zr_{0.1})(Si_{7.9}Al_{0.1})O_{26}(OH,F)_2{\cdot}nH_2O$ ($n \ll 1$).
Wavenumbers (cm^{-1}): 3630, 3602. 1621w, 1080sh, 1055, 1020sh, 968s, 926s, 694, 651, 568, 449s, 432, 409s.

TiSi265 Polyakovite-(Ce) $(Ce,Ca)_4(Mg,Fe^{2+})(Cr^{3+},Fe^{3+})_2(Ti,Nb)_2Si_4O_{22}$



Locality: Pit No. 97, Ilmeny (Il'menskie) Mts., Chelyabinsk region, South Urals, Russia (type locality).
Description: Black grain from the association with calcite, dolomite, fluororichterite, phlogopite, forsterite, monazite-(Ce), clinohumite, chromite and davidite-(Ce). The empirical formula is (electron mictoprobe) $(Ce_{1.9}La_{1.2}Nd_{0.4}Pr_{0.1}Ca_{0.2}Th_{0.2})(Mg_{0.7}Fe_{0.3}(Cr_{1.4}Fe_{0.6})(Ti_{1.5}Nb_{0.5})Si_4O_{22}$.
Wavenumbers (cm^{-1}): 1010sh, 974s, 935s, 650sh, 560sh, 505sh, 458s, 410sh.

TiSi266 Bafertisite $Ba(Fe^{2+},Mn^{2+})_2Ti(Si_2O_7)O(OH,F)_2$

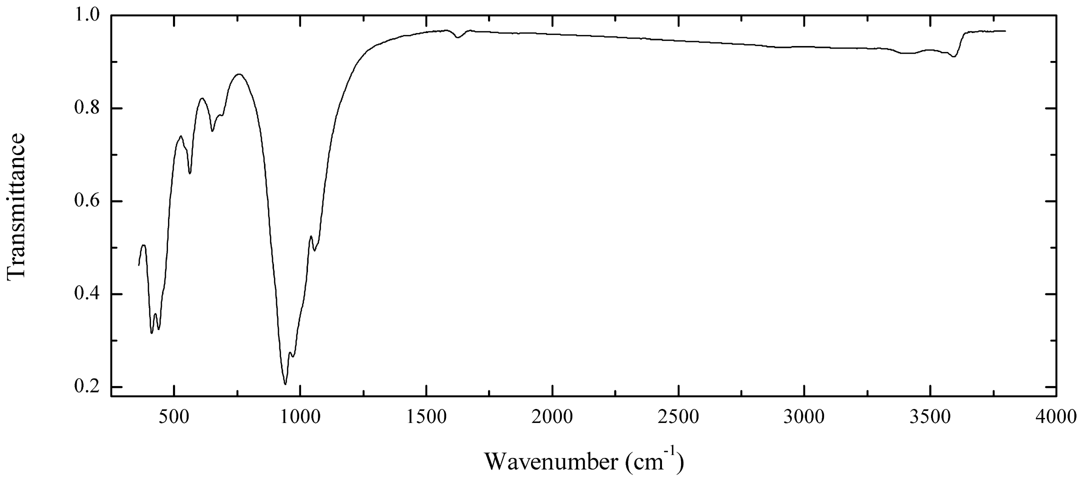


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.

Description: Brownish-red platy grains with mica-like cleavage from the association with microcline, quartz, nalivkinite and "calcibeborosilite". The empirical formula is (electron microprobe) $Ba_{0.97}K_{0.06}(Fe_{1.15}Mn_{0.81})Ti_{1.03}Si_{2.00}O_8(OH,F)_2$.

Wavenumbers (cm^{-1}): 3631, 3586, 1056, 1026, 1011, 940sh, 927s, 871s, 788w, 720sh, 692, 580, 525sh, 507, 439s, 385s.

TiSi267 Tarbagataite $(K,\square)_2(Ca,Na)(Fe^{2+},Mn^{2+})_7Ti_2Si_8O_{26}(OH)_4(OH,F)$

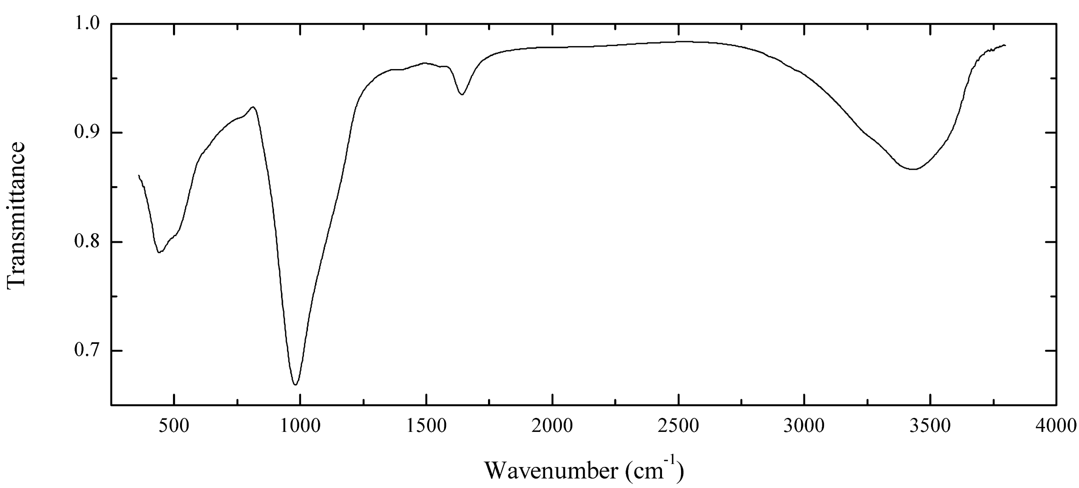


Locality: Verkhnee Espe deposit, Akzhailyautas Mts., Tarbagatai range, Eastern Kazakhstan region, Kazakhstan (type locality).

Description: Aggregate of brown platelets with zones of astrophyllite. Fragment of holotype.

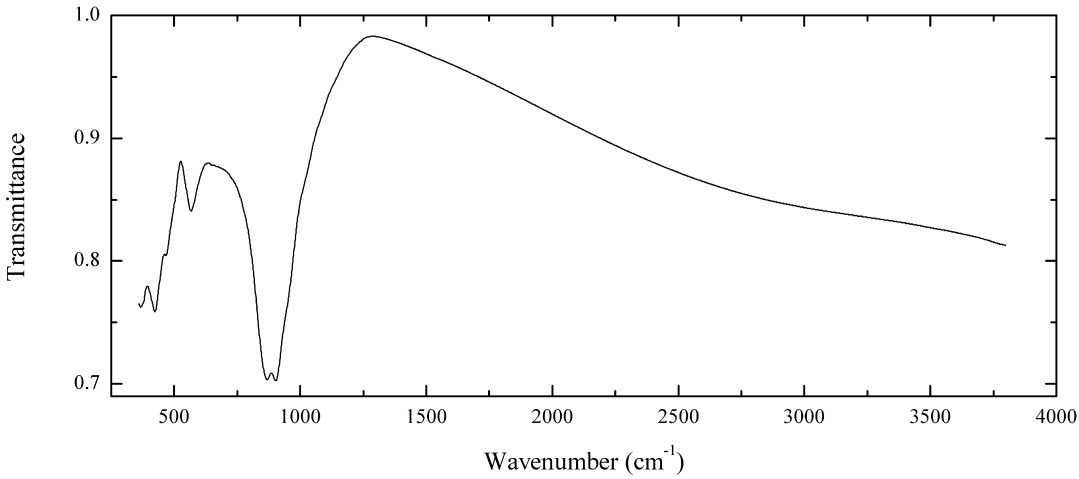
Wavenumbers (cm^{-1}): 3594, 3555sh, 3412w, 2915w, 1623w, 1070sh, 1057, 1005sh, 972s, 941s, 686, 652, 562, 545sh, 455sh, 439s, 411s.

TiSi268 Zirconosilicate TiSi268 $Na_3(Mn,Ca)ZrSi_6O_{15}(OH)_3\cdot nH_2O$



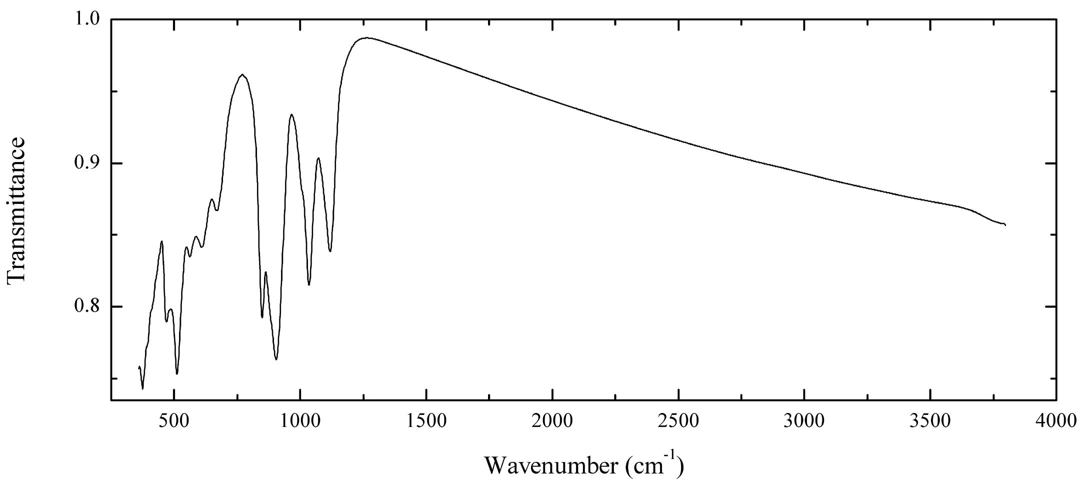
Locality: Apuaiv Mt., Lovozero alkaline complex, Kola peninsula, Murmansk region, Russia.
Description: Dark brown grains from altered peralkaline pegmatite. Investigated by I.V. Pekov. Disordered Mn-dominant analogue of lovozerite.
Wavenumbers (cm^{-1}): 3550sh, 3430, 3260, 1637, 1555w, 1400w, 1090sh, 981s, 760sh, 490sh, 441.

TiSi269 Natrotitanite $(Na_{0.5}Y_{0.5})Ti(SiO_4)O$



Locality: Verkhnee Espe deposit, Akzhailyautas Mts., Tarbagatai range, Eastern Kazakhstan region, Kazakhstan (type locality).
Description: Yellowish grains from the association with microcline, albite, quartz, riebeckite, aegirine, biotite, astrophyllite, rutile, zircon and elpidite. Holotype sample. The crystal structure is solved. Monoclinic, space group *C*2/*c*; unit-cell parameters are $a = 6.5691(2)$, $b = 8.6869(3)$, $c = 7.0924(2)$ Å, $\beta = 114.1269(4)°$. Optically biaxial, the refractive indices are $\alpha = 1.904$, $\gamma = 2.030$. $D_{calc} = 3.833$ g/cm^3. The empirical formula is $[Na_{0.39}Ca_{0.32}(Y_{0.15}Dy_{0.03}Yb_{0.03}Er_{0.03}Ce_{0.01}Ho_{0.01}Tm_{0.01}Gd_{0.01}Nd_{0.01})](Ti_{0.95}Nb_{0.02}Sn_{0.01}Fe_{0.01}Mn_{0.01}V_{0.01})Si_{1.01}O_{4.00}(O_{0.83}F_{0.17})$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %))] are 2.597 (100), 3.248 (80), 2.994 (60), 1.641 (40), 4.941 (30), 1.498 (30), 2.273 (30).
Wavenumbers (cm^{-1}): 903s, 868s, 567, 467, 423, 369.

TiSi270 Christofschäferite-(Ce) $(Ce,La,Ca)_4Mn^{2+}(Ti,Fe^{3+})_3(Fe^{3+},Fe^{2+},Ti)(Si_2O_7)_2O_8$

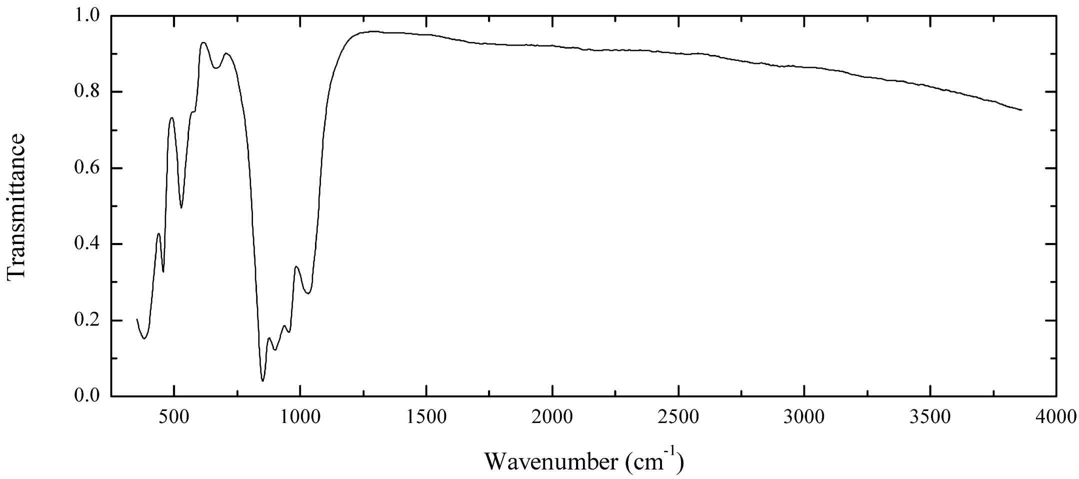


Locality: Wingertsberg, near Mendig, Laacher See area, Eifel Mountains, Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Black coarse crystals from the association with orthoclase, rhodonite, bustamite, tephroite, zircon, fluorapatite, pyrophanite and jacobsite. Holotype sample. The crystal structure is solved. Monoclinic, space group: $P2_1/m$; $a = 13.3722(4)$, $b = 5.7434(1)$, $c = 11.0862(2)$ Å, $\beta = 100.580(2)°$, $V = 836.97(4)$ Å^3, $Z = 2$. Optically biaxial (–), $\alpha = 1.945(10)$, $\beta = 2.015(10)$, $\gamma = 2.050(10)$, $2V_{meas} = 70(10)°$. $D_{calc} = 3.833$ g/cm^3. The empirical formula is $(Ce_{1.72}La_{1.48}Nd_{0.17}Pr_{0.04}Ca_{0.57})Mn^{2+}{}_{0.76}Fe^{2+}{}_{0.72}Mg_{0.02}Fe^{3+}{}_{0.48}$ $Al_{0.02}Ti_{2.935}$ $Nb_{0.09}Si_{3.98}O_{22}$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 4.90 (39) (-111); 4.64 (65) (-202); 3.480 (78) (310); 3.169 (81) (311, -312); 3.095 (43) (-113); 2.730 (100) (004); 2.169 (46) (-421, -513); 1.737 (46) (603, 504, 315, 025, -622).

Wavenumbers (cm^{-1}): 1119, 1035, 904s, 849, 671, 609, 562, 511s, 469, 375s.

TiSi271 Lileyite $Ba_2(Na,Fe,Ca)_3MgTi_2(Si_2O_7)_2O_2F_2$

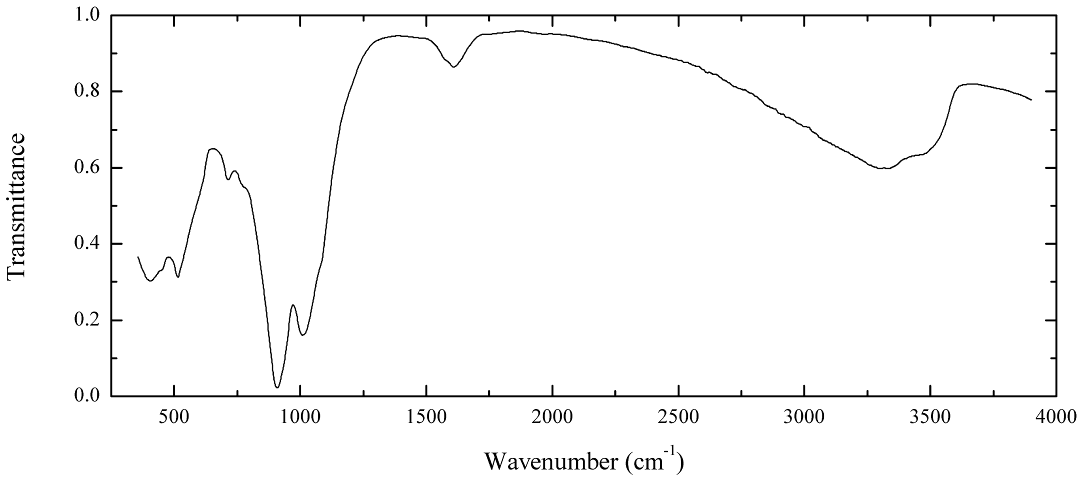


Locality: Löhley, near Üdersdorf, Eifel volcanic region, Rheinland-Pfalz (Rhineland-Palatinate), Germany (type locality).

Description: Brown flattened crystals from the association with nepheline, leucite, augite, magnetite, fluorapatite, perovskite and götzenite. Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/m$, $a = 19.905(1)$, $b = 7.098(1)$, $c = 5.405(1)$ Å, $\beta = 96.349(5)°$, $V = 758.93(6)$ Å^3, $Z = 2$. Optically biaxial (+), $\alpha = 1.718(5)$, $\beta = 1.735(5)$, $\gamma = 1.755(5)$, $2V_{meas} = 75(15)°$. $D_{calc} = 3.776$ g/cm^3. The empirical formula is $Ba_{1.50}Sr_{0.19}K_{0.26}Na_{1.89}Ca_{0.36}Mn_{0.18}Mg_{0.99}Fe_{0.54}Ti_{2.01}Nb_{0.06}Si_{4.06}O_{16.23}F_{1.77}$. The strongest reflections of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 3.749 (45) (31-1), 3.464 (76) (510, 311, 401), 3.045 (37) (51-1), 2.792 (100) (221, 511), 2.672 (54) (002, 601, 20-2), 2.624 (43) (710, 42-1).

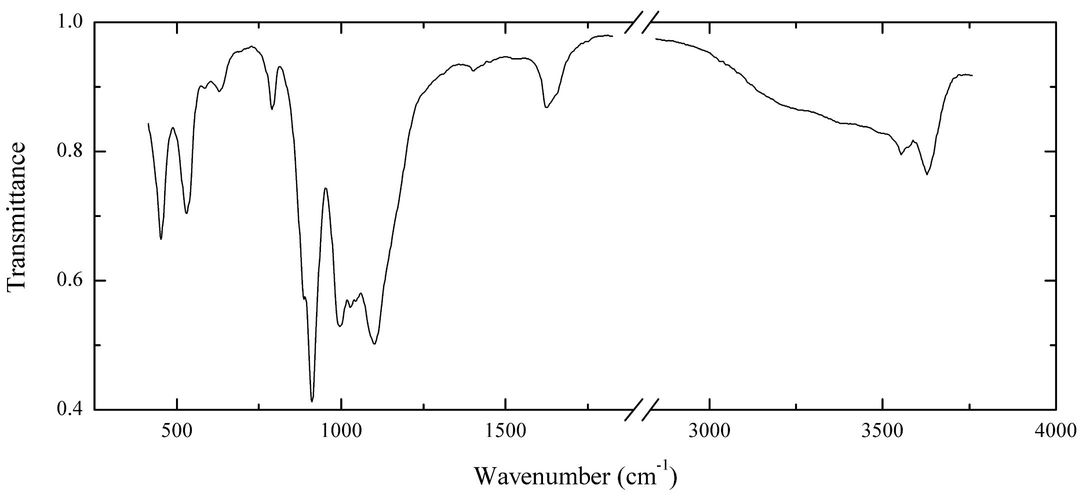
Wavenumbers (cm^{-1}): 1032, 957s, 901s, 854s, 680w, 578, 529, 458, 399s.

TiSi272 Vigrishinite $Zn_2Ti_{4-x}Si_4O_{14}(OH,H_2O,\square)_8$ ($x < 1$)



Locality: Malyi Punkaruaiv Mt., Lovozero alkaline complex, Kola Peninsula, Russia (type locality).
Description: Yellowish translucent platelets from the association with microcline, ussingite, aegirine, analcime, gmelinite-Na, chabazite-Ca, *etc*. Holotype sample. The crystal structure is solved. is triclinic, space group *P*-1, $a = 8.743(9)$, $b = 8.698(9)$, $c = 11.581(11)$ Å, $\alpha = 91.54(8)°$, $\beta = 98.29(8)°$, $\gamma = 105.65(8)°$, $V = 837.2(1.5)$ Å^3, $Z = 2$. Optically biaxial (–), $\alpha = 1.755(5)$, $\beta = 1.82(1)$, $\gamma = 1.835(8)$, $2V_{meas} = 45(10)°$. $D_{meas} = 3.03(2)$ g/cm^3, $D_{calc} = 2.97$ g/cm^3. The empirical formula is $H_{7.42}K_{0.05}Ba_{0.02}(Zn_{1.30}Na_{0.23}Mn_{0.22}Ca_{0.07}Mg_{0.07})(Ti_{2.68}Nb_{0.41}Fe_{0.18}Zr_{0.12})(Si_{3.95}Al_{0.05})O_{20.31}F_{0.18}$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.7 (67) (001); 8.27 (50) (100); 6.94 (43) (0-11, -110); 5.73 (54) (1-11, 002); 4.17 (65) (020, -1-12, 200), 2.861 (100) (3-10, 2-22, 004, 1-31).
Wavenumbers (cm^{-1}): 3450, 3330, 1620w, 1590sh, 1080sh, 1012s, 913s, 800sh, 719, 519, 440sh, 405.

USi1 Weeksite $(K,Na)_2(UO_2)_2(Si_5O_{13})\cdot3H_2O$

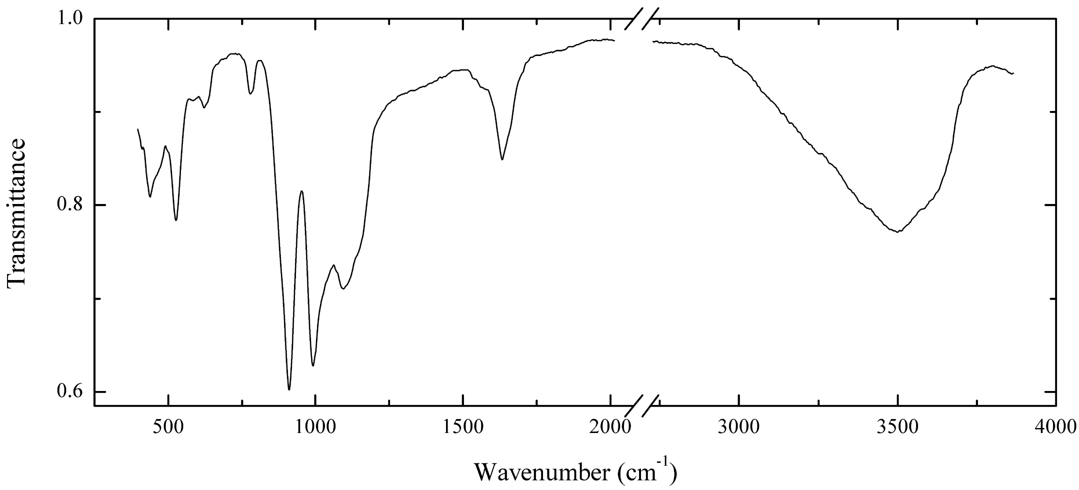


Locality: An unknown locality in Kazakhstan.

Description: Yellow prismatic crystals. Orthorhombic, $a = 14.22$, $b = 35.67$, $c = 14.11$ Å. The empirical formula is (electron microprobe) $K_{1.3}Na_{0.4}Ca_{0.1}(UO_2)_{2.1}(Si_{4.9}Al_{0.1}O_{13}){\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3607, 3540, 3380sh, 3250sh, 1655sh, 1623, 1400w, 1102s, 1050, 1027, 997s, 910s, 885, 789, 640, 588w, 528, 447.

USi2 Haiweeite $Ca(UO_2)_2(Si_5O_{12})(OH)_2{\cdot}4.5H_2O$

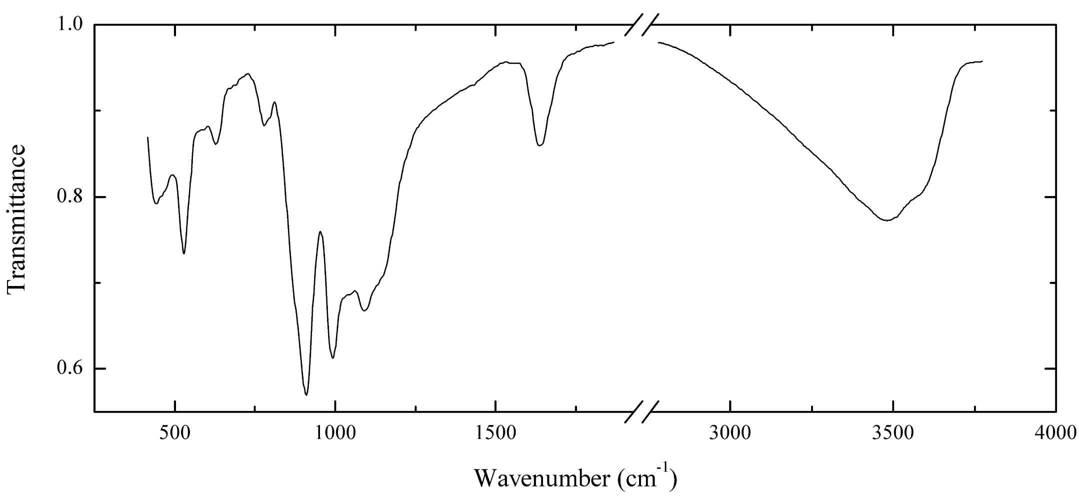


Locality: Dara-i Pioz alkaline massif, Alaiskii ridge, Tien Shan Mts., Tajikistan.

Description: Yellow crust on quartz. Investigated by L.A. Pautov and V.Yu. Karpenko.

Wavenumbers (cm^{-1}): 3570sh, 3470, 3370sh, 3220sh, 1625, 1145sh, 1105sh, 1094, 993s, 910s, 786, 685, 527, 460sh, 439.

USi3 Haiweeite $Ca(UO_2)_2(Si_5O_{12})(OH)_2{\cdot}4.5H_2O$

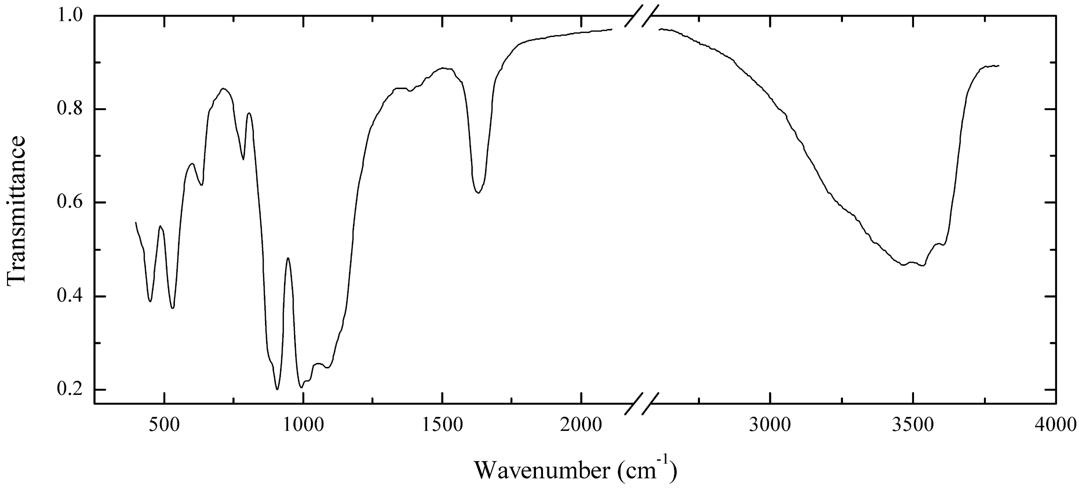


Locality: Oktyabr'skoe deposit, Karamazar Mts., Tajikistan.

Description: Yellow massive. Investigated by A.A. Chernikov.

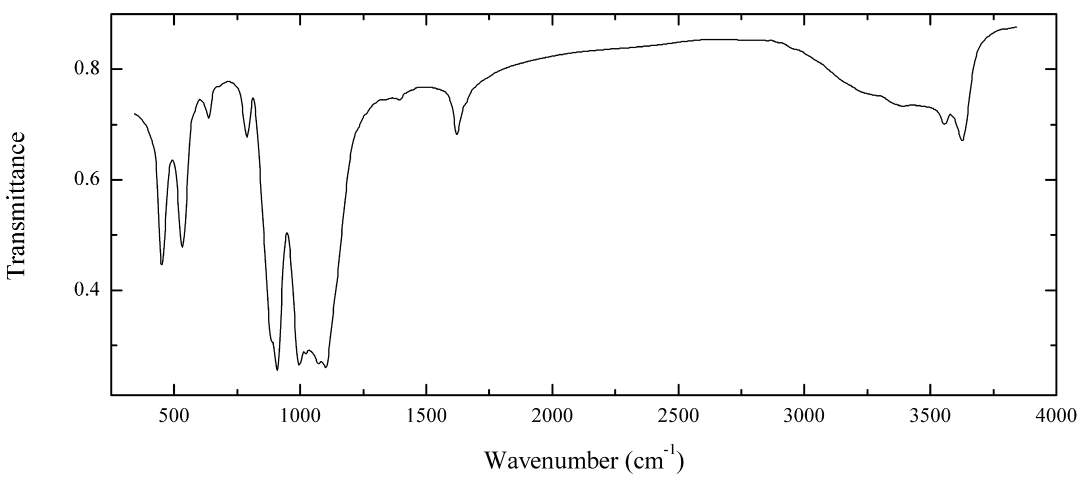
Wavenumbers (cm^{-1}): 3560sh, 3470, 1640, 1140sh, 1094, 1050sh, 991s, 910s, 890sh, 783, 623, 526, 470sh, 438.

USi4 Ursilite $(Mg,Na,K)_{2-x}(UO_2)_2[(Si,Al)_5O_{13}]\cdot nH_2O$



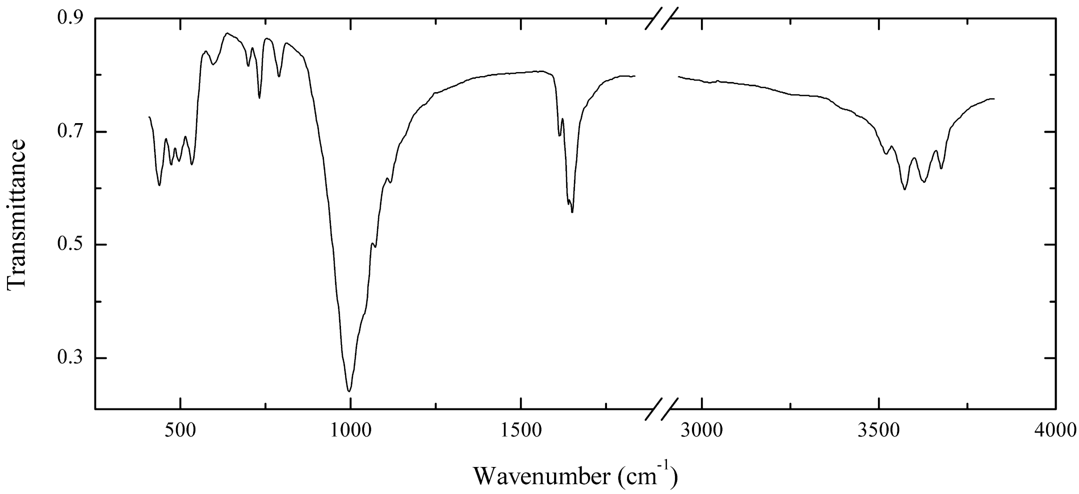
Locality: Oktyabr'skoe deposit, Karamazar Mts., Tajikistan.
Description: Yellow massive. Investigated by A.A. Chernikov. Confirmed by electron microprobe analysis. The empirical formula is $(Mg_{0.79}Na_{0.47}K_{0.26}Ca_{0.21}Cu_{0.07})(UO_2)_{1.98}(Si_{4.88}Al_{0.12}O_{13})\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3600, 3530, 3455, 3360sh, 3250sh, 1633, 1385w, 1150sh, 1102s, 1021s, 997s, 910s, 890sh, 787, 635, 530, 448.

USi5 Weeksite $(K,Na)_2(UO_2)_2(Si_5O_{13})\cdot 3H_2O$



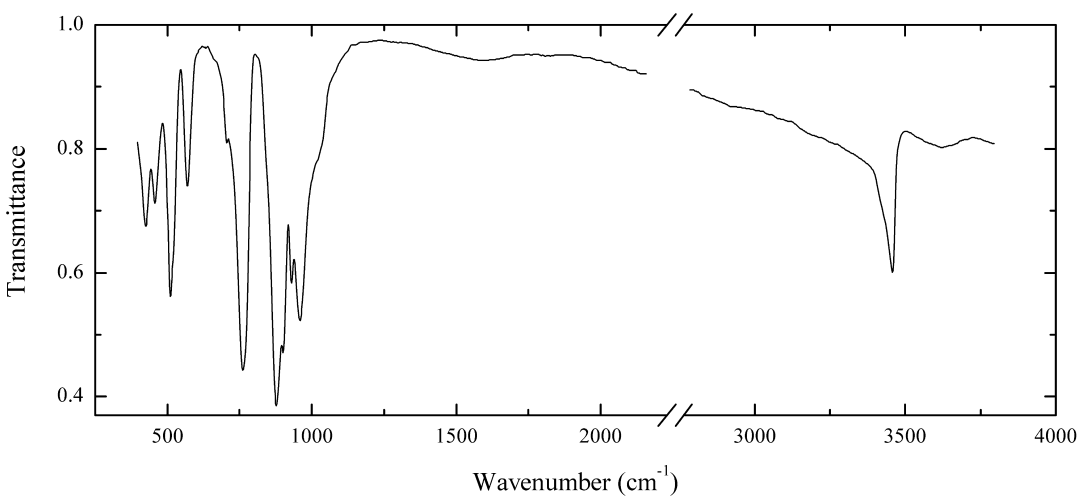
Locality: An unknown locality in Kazakhstan.
Description: Yellow radial aggregate. Investigated by G.A. Sidorenko.
Wavenumbers (cm^{-1}): 3602, 3530, 3480sh, 3425sh, 3225sh, 1622, 1103s, 1070s, 1050sh, 1024s, 1001s, 912s, 883, 789, 639, 582w, 535, 451.

VSi1 Cavansite $Ca(V^{4+}O)(Si_4O_{10})\cdot 4H_2O$



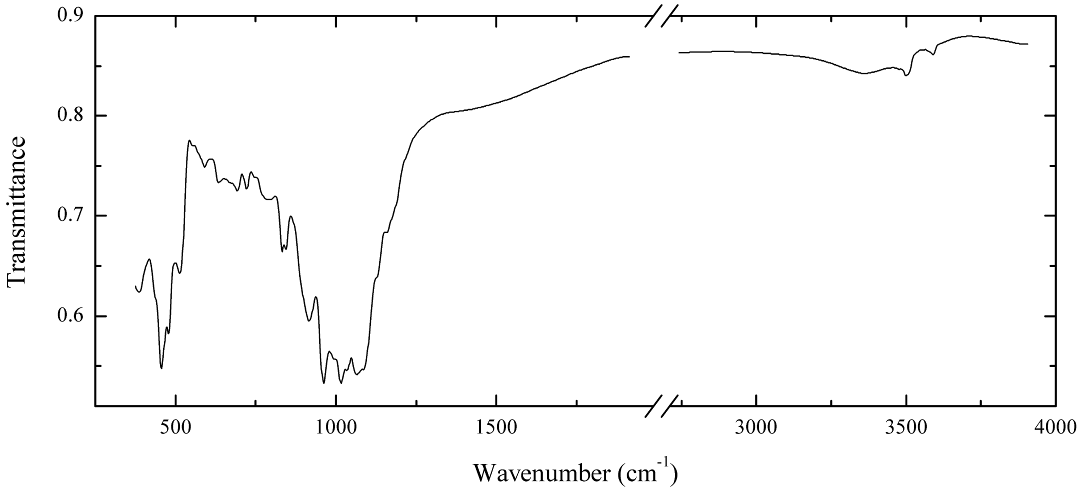
Locality: Wagholi quarry, Pune complex, Maharashtra, India.
Description: Blue radial aggregate from the association with stilbite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3660, 3610, 3555, 3500, 1650, 1635, 1610, 1117, 1072, 1035sh, 994s, 791, 733, 698, 599, 531, 495, 472, 439.

VSi2 Franciscanite $Mn^{2+}{}_3V^{5+}{}_{1-x}(SiO_4)(O,OH)_3$



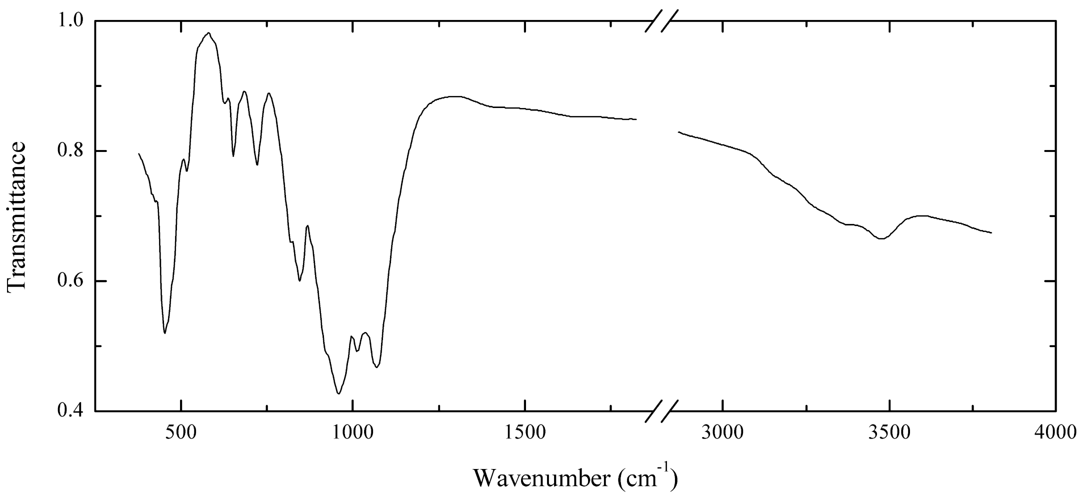
Locality: Pennsylvania mine, San Antonio valley, Santa Clara Co., California, USA (type locality).
Description: Dark reddish-brown from the association with hausmannite and braunite.
Wavenumbers (cm^{-1}): 3560w, 3426, 1635w, 1020sh, 955, 924, 897s, 874s, 758s, 704, 566, 515sh, 505, 454, 422.

VSi3 Scheuchzerite $Na(Mn,Mg)_9[VSi_9O_{28}(OH)](OH)_3$



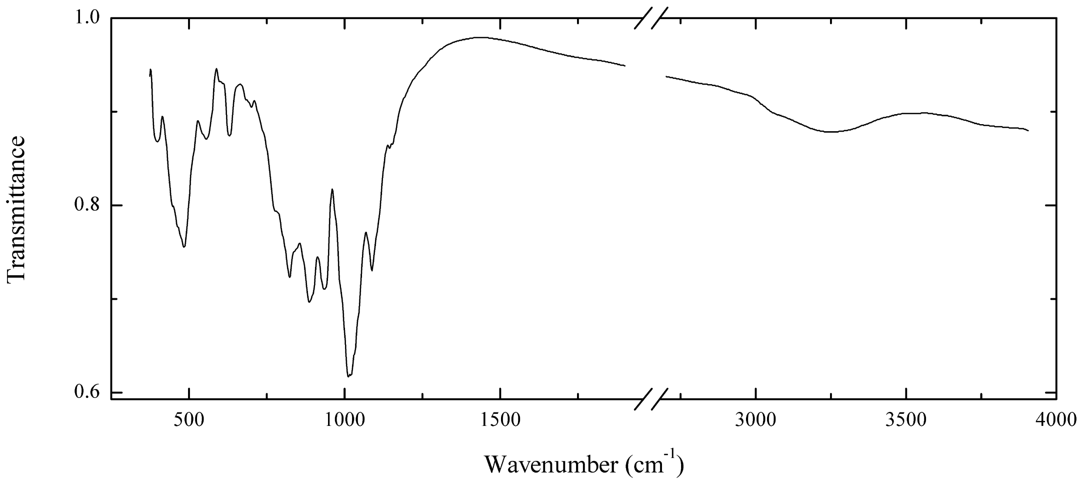
Locality: Gambatesa mine, Val Graveglia (Graveglia valley), Genova province, Liguria, Italy.
Description: Orange-brown radial aggregates in quartz. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3575w, 3490w, 3360w, 1150sh, 1125sh, 1085sh, 1063s, 1041s, 1017s, 995sh, 961s, 921, 895sh, 847, 835, 790w, 727w, 695w, 645w, 575w, 512, 480, 457s, 387.

VSi4 Saneroite $Na_2Mn^{2+}{}_{10}VSi_{11}O_{34}(OH)_4$



Locality: Molinello mine, Val Graveglia (Graveglia valley), Genova province, Liguria, Italy (type locality).
Description: Orange grains from the association with quartz, barite, caryopilite and ganophyllite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3480, 3360w, 3300sh, 3200sh, 1130sh, 1072s, 1014s, 961s, 925sh, 880sh, 855sh, 847, 823, 720, 651, 627, 516, 475sh, 450s, 425sh.

VSi5 Medaite $(Mn^{2+},Ca)_6(V^{5+},As^{5+})Si_5O_{18}(OH)$



Locality: Molinello mine, Val Graveglia (Graveglia valley), Genova province, Liguria, Italy (type locality).

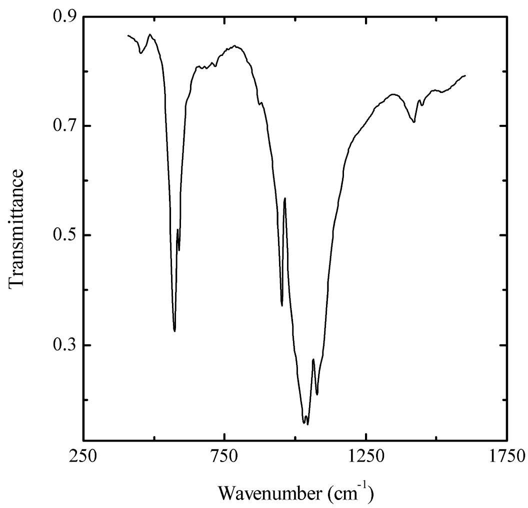
Description: Red crystals from the association with quartz, braunite, calcite and parsettensite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3210w, 3050sh, 1145w, 1085, 1014s, 935, 888s, 821, 780sh, 700w, 627, 540, 485, 460sh, 400.

2 IR Spectra of Minerals and Reference Samples Data

2.8 Phosphates

P1 Nefedovite $Na_5Ca_4(PO_4)_4F$



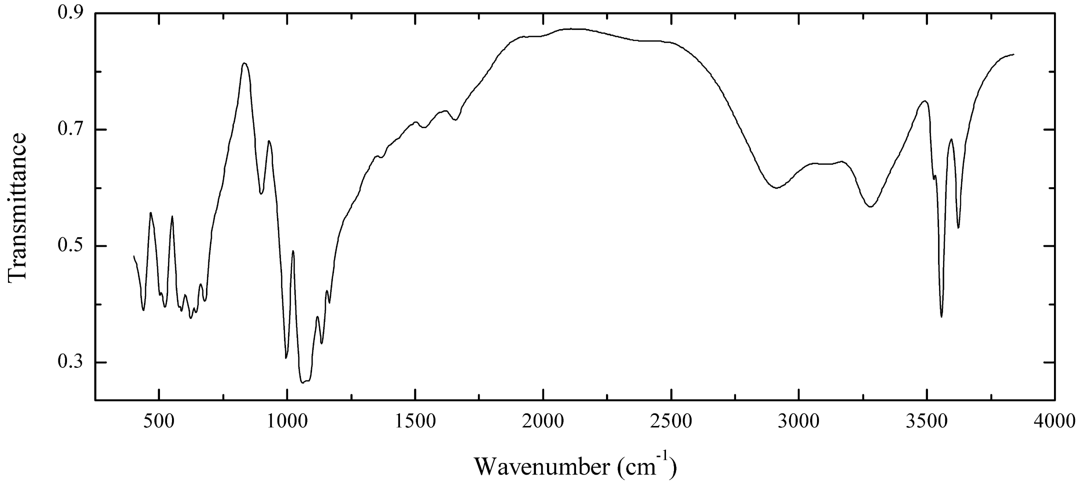
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description Graphic intergrowth with villiaumite. Identified by powder X-ray diffraction pattern. Contains CO_3^{2-} groups (weak bands at 1,450, 1,423, 874 and 716 cm^{-1}). The empirical formula is (electron microprobe) $Na_{4.63}Ca_{4.18}K_{0.09}(PO_4)_{4.00}F_{0.85}(CO_3)_x$.

Wavenumbers (cm^{-1}): 3360, 1650w, 1520w, 1450w, 1423w, 1095sh, 1078s, 1045s, 1033s, 954, 874w, 716w, 683w, 620sh, 600sh, 588, 572, 451w.

N.V. Chukanov, *Infrared spectra of mineral species: Extended library*,
Springer Geochemistry/Mineralogy, DOI 10.1007/978-94-007-7128-4_2,

P2 Wardite $NaAl_3(PO_4)_2(OH)_4 \cdot 2H_2O$

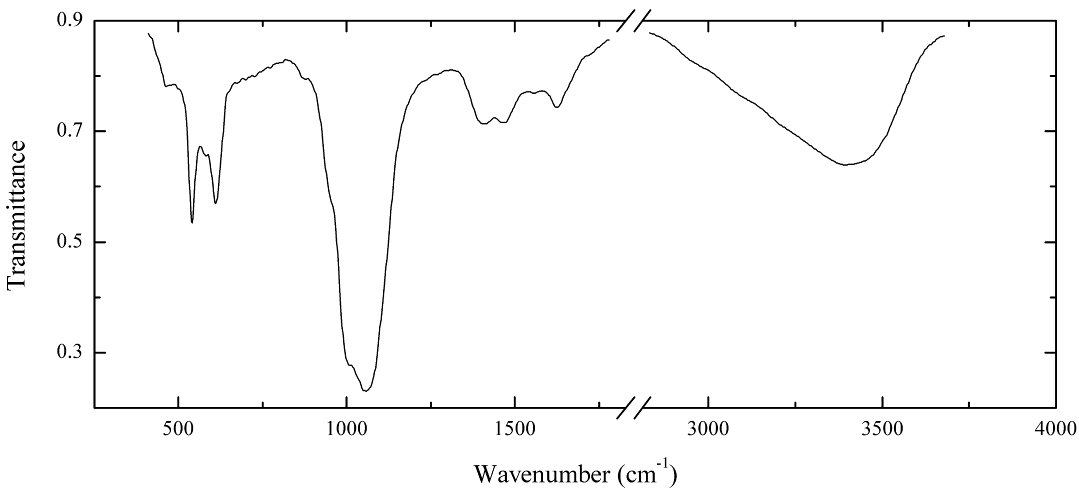


Locality: Viitaniemi pegmatite, Eräjärvi pegmatite field, Orivesi, Finland.

Description: Pale rose-coloured transparent grains from the association with microcline, elbaite, viitaniemiite, väyrenenite, fluorapatite and lepidolite. Identified by powder X-ray diffraction pattern. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 4.8 (100), 3.10 (100), 2.998 (90), 2.862 (60), 2.592 (100), 2.15 (90), 1.778 (80).

Wavenumbers (cm^{-1}): 3620, 3555s, 3523w, 3270, 3125w, 2915, 1990w, 1750sh, 1658w, 1535w, 1370w, 1260sh, 1168, 1139s, 1086s, 1062s, 996s, 898, 735sh, 676, 640, 623, 576, 520, 497, 432.

P3 Rhabdophane-(Ce) $Ce(PO_4) \cdot H_2O$

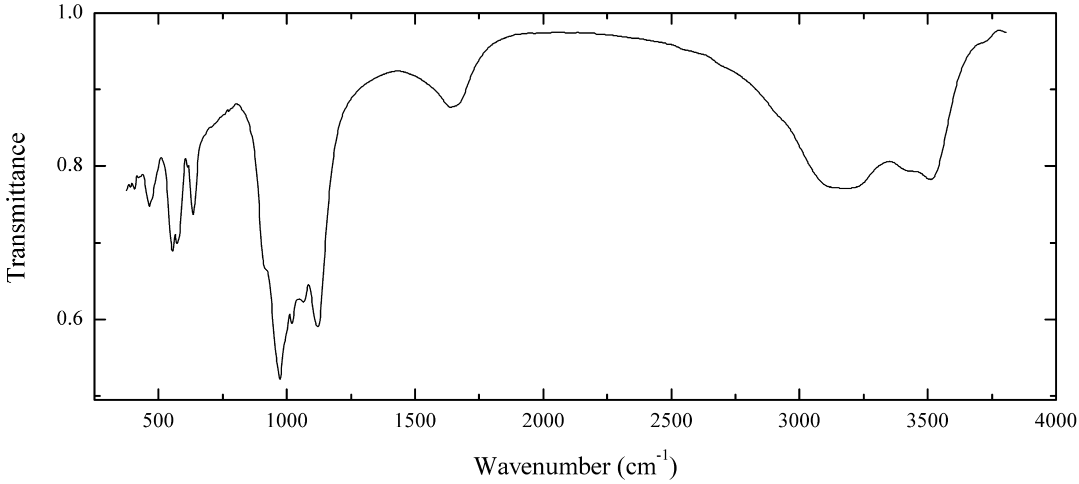


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White radial aggregates from dolomite carbonatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $H_xCe_{0.3}La_{0.15}Nd_{0.05}Ca_{0.2}Sr_{0.15}(PO_4)_{0.9}(CO_3)_y \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3410, 1632, 1470, 1415, 1058s, 1009s, 955sh, 609, 578, 537, 460.

P4 Jahnsite-(CaMnMg) $CaMn^{2+}Mg_2Fe^{3+}{}_2(PO_4)_4(OH)_2\cdot 8H_2O$

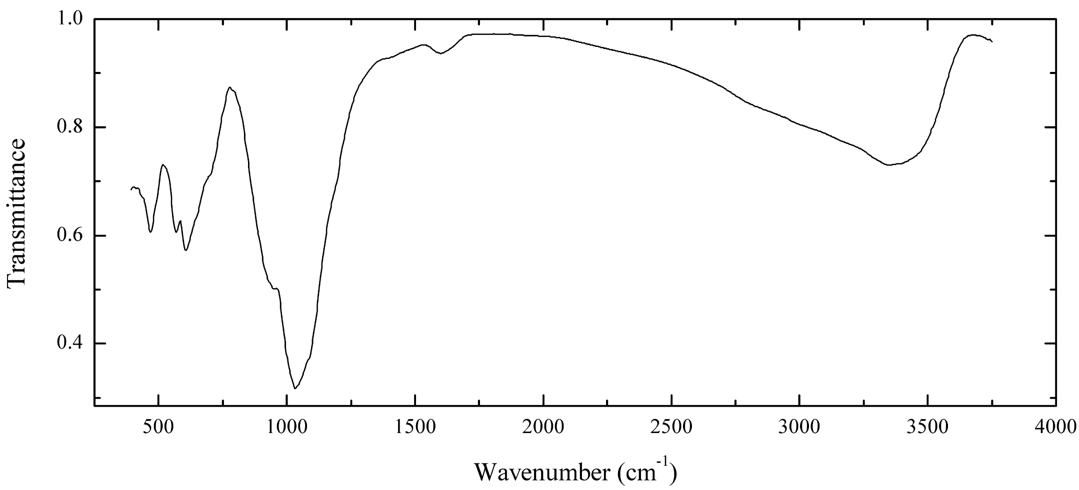


Locality: Tip Top pegmatite, Custer, Custer Co., South Dakota, USA (type locality).

Description: Yellow prismatic crystals. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $(Ca_{0.9}Mn_{0.1})Mn_{1.0}(Mg_{1.9}Mn_{0.1})(Fe^{3+}{}_{1.6}Al_{0.3}Mn^{3+}{}_{0.1})(PO_4)_{4.0}(OH)_2\cdot n H_2O$.

Wavenumbers (cm^{-1}): 3510, 3425sh, 3220sh, 3150, 1650, 1125s, 1072, 1025s, 995sh, 977s, 960sh, 920sh, 634, 580, 549, 466.

P5 Ernstite $(Mn^{2+},Fe^{3+})Al(OH,O)_2(PO_4)\cdot H_2O$

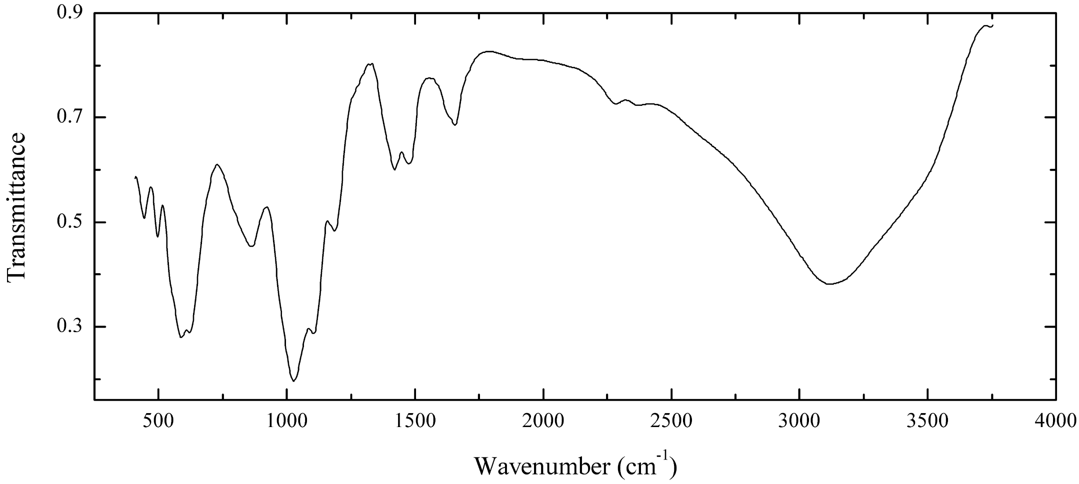


Locality: La Viquita mine, Chacabuco Dept., San Luis province, Argentina.

Description: Brown radial aggregates. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3415sh, 3350, 3000sh, 1595w, 1085sh, 1042s, 1020sh, 950s, 700sh, 640sh, 605, 568, 469, 435sh.

P6 Plumbogummite $PbAl_3(PO_4)_2(OH)_5{\cdot}H_2O$

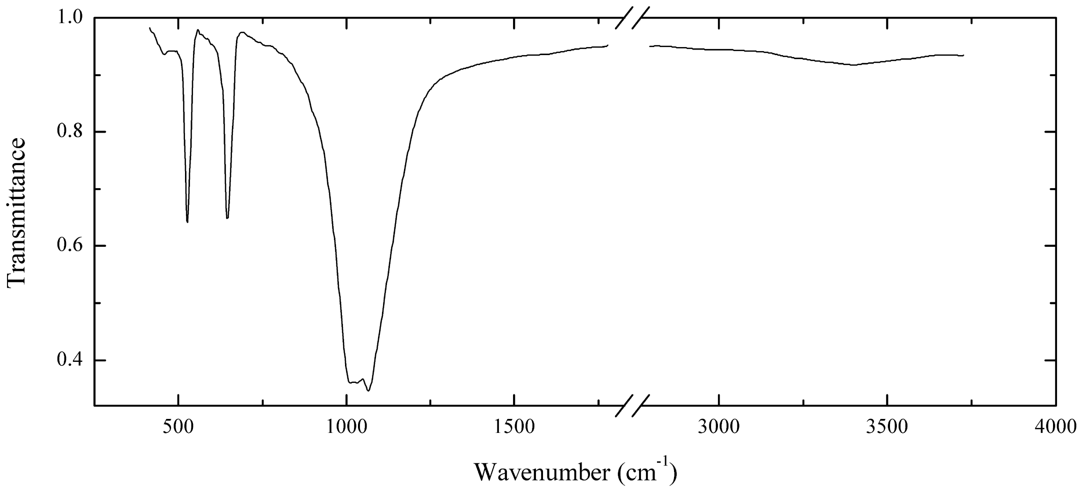


Locality: Dry Gill mine, Cumberland, England, UK.

Description: Blue veinlet in the association with phosphorous mimetite. AsO_4- and CO_3-bearing variety. The empirical formula based on $(Pb,Sr)_{1.00}$ is (electron microprobe, CO_3 calculated) $(Pb_{0.98}Sr_{0.02})Al_{0.99}[(PO_4)_{1.7}(AsO_4)_{0.2}(CO_3)_{0.1}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3475sh, 3120s, 2375w, 2275w, 1658, 1635sh, 1480, 1423, 1187, 1105s, 1027s, 862, 800sh, 618s, 588s, 550sh, 494, 440.

P7 Xenotime-(Y) $Y(PO_4)$

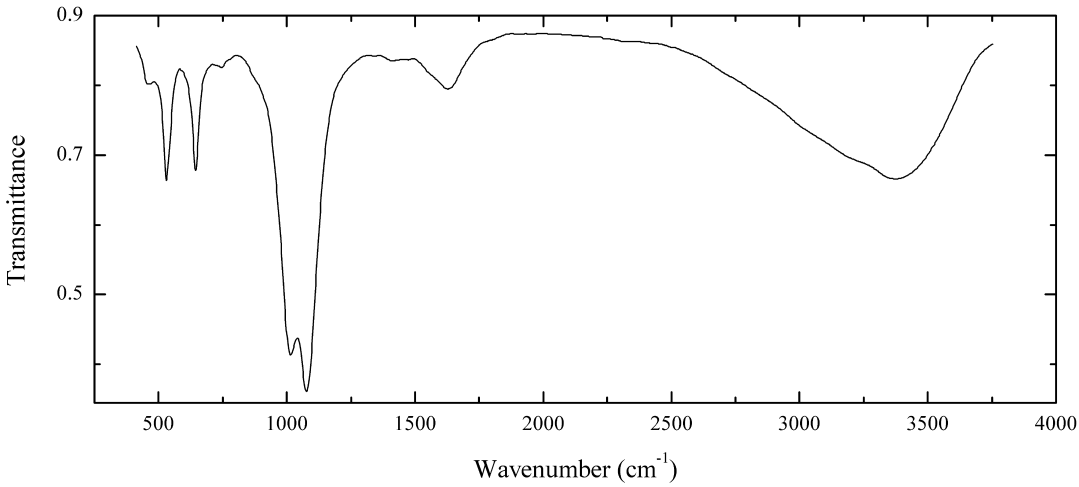


Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: Brown grain from granitic pegmatite. The empirical formula is (electron microprobe) $(Y_{0.64}Yb_{0.13}Er_{0.07}Dy_{0.05}Th_{0.04}Tm_{0.02}Gd_{0.02}Lu_{0.01}Ca_{0.01})$ (PO_4).

Wavenumbers (cm^{-1}): 1064s, 1030s, 1007s, 900sh, 642, 522, 460w.

P8 "Hydroxenotime-(Y)" $Y(PO_4)\cdot nH_2O$

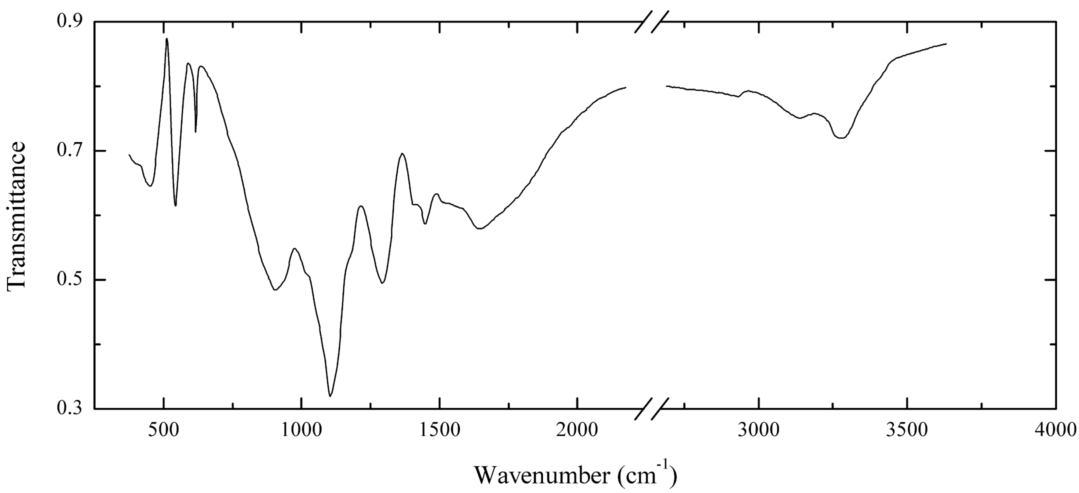


Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.

Description: Brown grains from granitic pegmatite. By the powder X-ray diffraction pattern corresponds to xenotime, but contains water. Investigated by A.V. Voloshin.

Wavenumbers (cm^{-1}): 3370, 3240sh, 1635, 1575sh, 1077s, 1012s, 750w, 642, 527, 455w.

P9 Archerite $(K,NH_4)(H_2PO_4)$

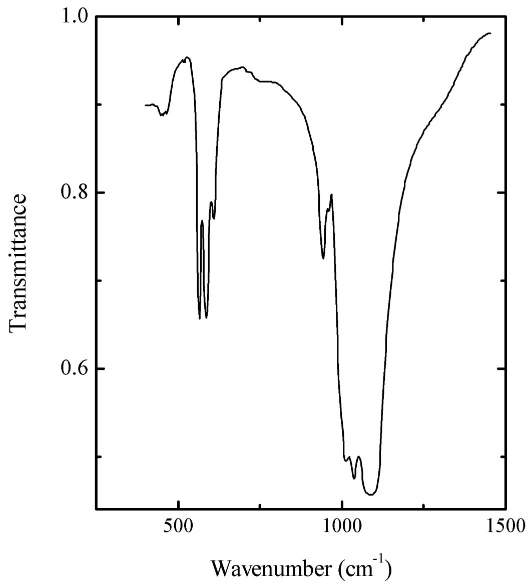


Locality: Cockelbiddy cave, Western Australia, Australia.

Description: Brownish-grey crust from the association with biphosphammite. The empirical formula is (electron microprobe) $K_{0.56}(NH_4)_{0.44}$ $(H_2PO_4)_{1.00}$.

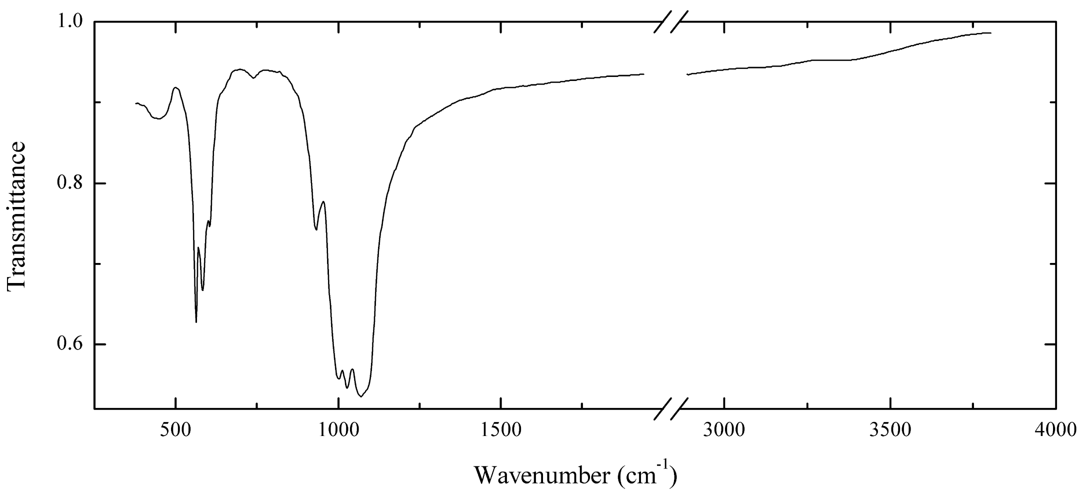
Wavenumbers (cm^{-1}): 3255, 3120, 2910w, 1800sh, 1647, 1540sh, 1449, 1407, 1291s, 1180sh, 1108s, 1025sh, 910s, 618, 540, 452, 400sh.

P10 Arctite $Na_2Ca_7Ba(PO_4)_6F_3$



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: White grains with blue fluorescence under SW and LW UV irradiation. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1095sh, 1076s, 1032s, 1007s, 954, 935, 605, 584, 561, 459w.

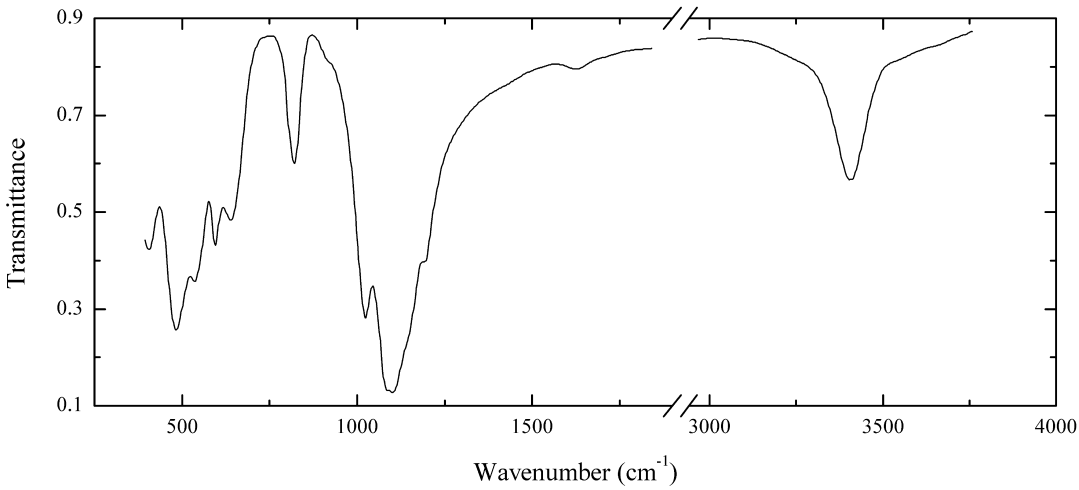
P11 Arctite $Na_2Ca_7Ba(PO_4)_6F_3$



Locality: Drill core from the Vuonnemiok River valley, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: Colourless crystal from the association with natrosilite, vuonnemite, lomonosovite, zirsinalite, natisite, rasvumite, villiaumite, aegirine, thenardite, umbite, paraumbite, kostylevite and wadeite. Holotype sample. The crystal structure is solved. Trigonal, space group *R*-3*m*,

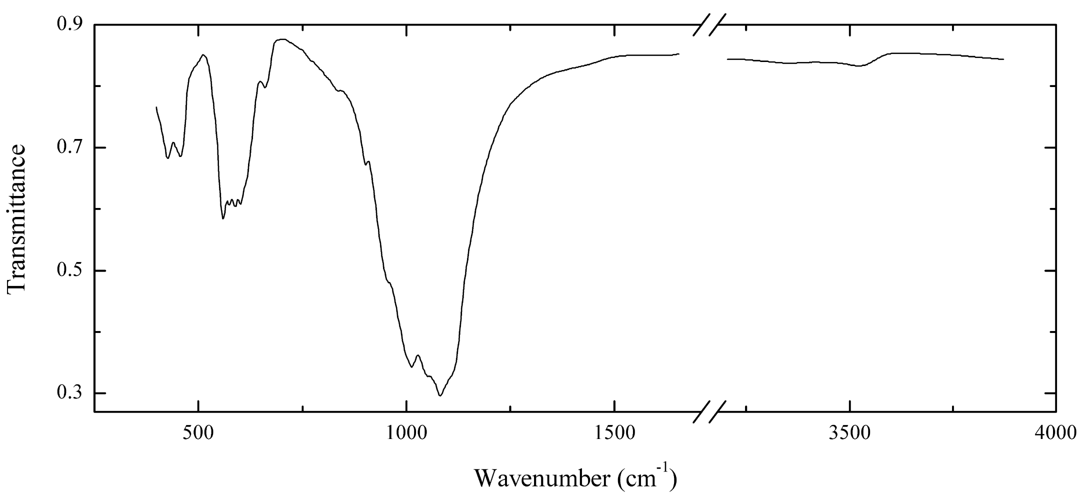
$a = 7.094$, $c = 41.320$ Å, Z = 1. $D_{meas} = 3.13$ g/cm^3, $D_{calc} = 3.19$ g/cm^3. Optically uniaxial (−), $\omega = 1.578(2)$, $\varepsilon = 1.577(2)$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.746 (100), 3.43 (32), 13.80 (25), 3.06 (25), 2.804 (25), 3.54 (21), 2.719 (21).
Wavenumbers (cm^{-1}): 1095sh, 1073s, 1032s, 1006s, 950sh, 935, 740w, 605, 584, 561, 455w.

P12 Montebrasite (Li,Na)Al(PO_4)(OH,F)



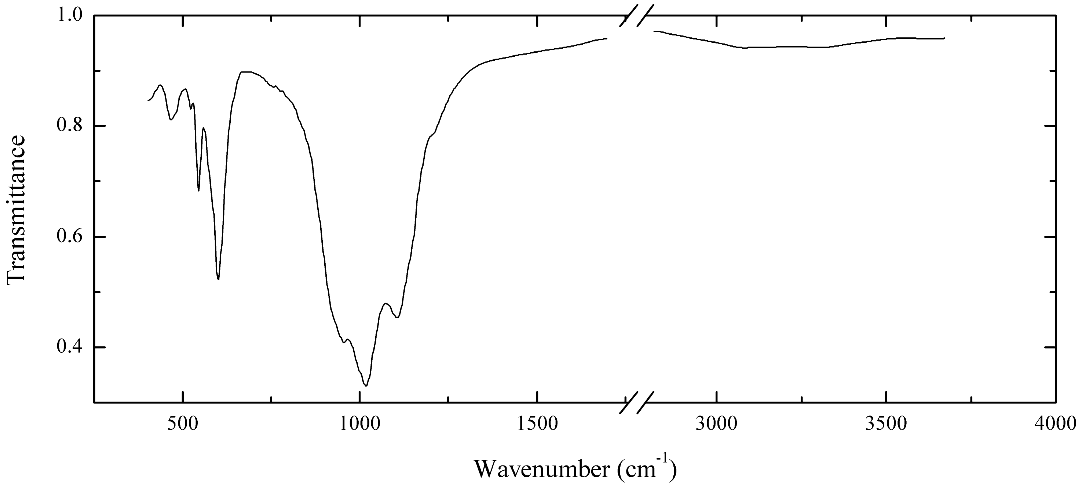
Locality: Ognyovka mine, Bakennoe deposit, Kalba range, Eastern Kazakhstan.
Description: Cream-coloured crystal from the association with lepisolite and quartz. The empirical formula is (electron microprobe) ($Li_xNa_{0.03}$)Al(PO_4)$_{1.00}$[(OH)$_{0.59}$$F_{0.41}$].
Wavenumbers (cm^{-1}): 3376, 1625w, 1187, 1135sh, 1095s, 1083s, 1019s, 818.5, 641, 597, 539, 486s, 411.

P13 Arrojadite-(KNa) (KNa)Na_2Ca(Na_2□)Fe^{2+}_{13}Al(PO_4)$_{11}$(HPO_4)$(OH)_2$



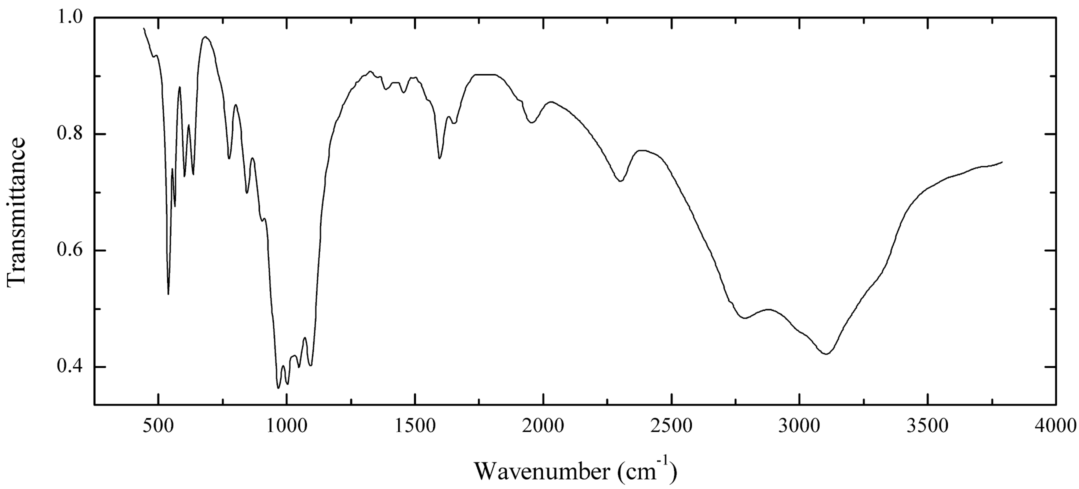
Locality: Rapid Creek, Richardson Mts., Yukon Territory, Canada (type locality).
Description: Beige crystal. The empirical formula is (electron microprobe) $K_{0.75}Na_{5.00}Ca_{1.02}$ ($Fe_{10.05}Mg_{2.63}Mn_{0.37}$)$Al_{1.13}$($PO_4$)$_{11}$($HPO_4$)$(OH)_2$.
Wavenumbers (cm^{-1}): 3505, 1100sh, 1081s, 1066s, 1013s, 1000sh, 960, 902, 659w, 600, 588, 575, 559, 457, 423.

P14 Alluaudite $(Na,Ca,\square)\square Mn^{2+}Fe^{3+}_2(PO_4)_3$



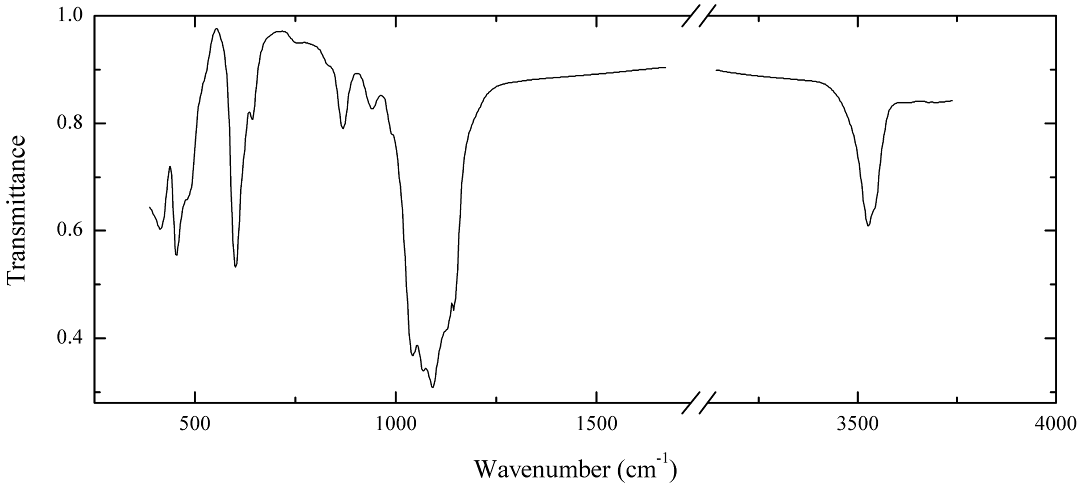
Locality: Buranga pegmatite, Gatumba district, Western Province, Rwanda.
Description: Brown massive, with good cleavage. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1200sh, 1110s, 1021s, 959s, 598, 570sh, 541, 518w, 465.

P15 Anapaite $Ca_2Fe^{2+}(PO_4)_2 \cdot 4H_2O$



Locality: Chernomorskiy mine, Eltigen-Ortel deposit, Kerch iron-ore basin, Crimea, Ukraine.
Description: Light green crystals from the association with barite and messelite. The empirical formula is (electron microprobe) $Ca_{1.88}Fe_{1.04}Mg_{0.04}(PO_4)_{2.00} \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3290sh, 3100, 3000sh, 2770, 2300, 1955, 1655, 1600, 1460w, 1390w, 1097s, 1054s, 1030, 1005s, 971s, 945, 904, 848, 777, 634, 602, 563, 539, 490w.

P16 Althausite $Mg_4(PO_4)_2(OH,O)(F,\square)$

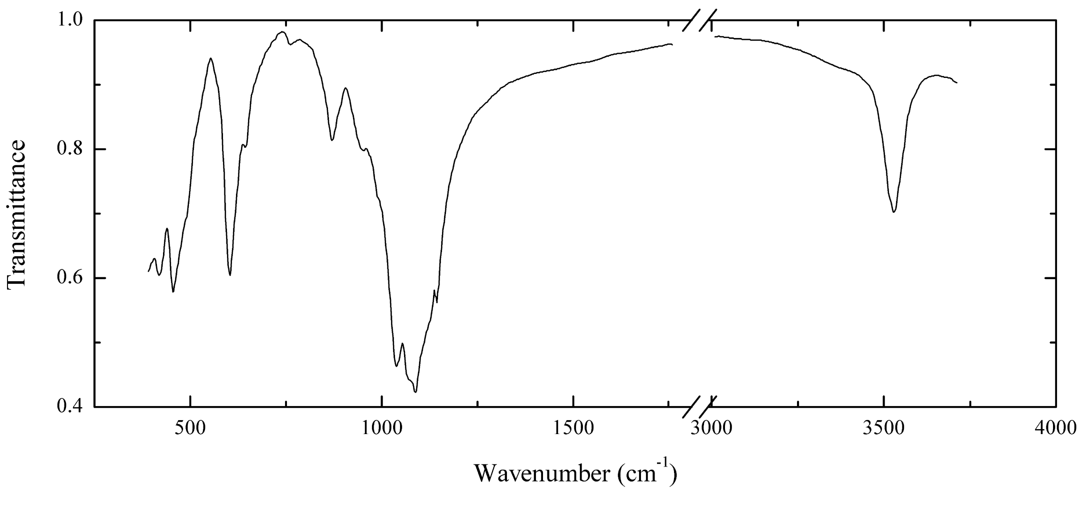


Locality: Tingelstadtjern quarry, Modum, Buskerud, Norway (type locality).

Description: Brownish platy grains from the association with serpentine, talc, holtedahlite, apatite and magnesite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3504, 1141s, 1115sh, 1087s, 1066s, 1037s, 992, 942, 867, 757w, 640, 600, 490sh, 475sh, 452, 415.

P17 Althausite $Mg_4(PO_4)_2(OH,O)(F,\square)$

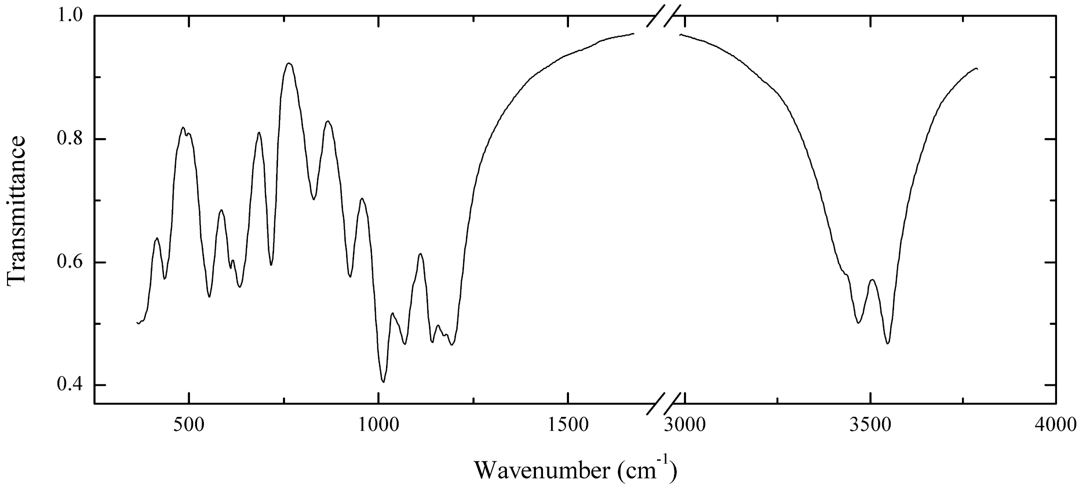


Locality: Tingelstadtjern quarry, Modum, Buskerud, Norway (type locality).

Description: Brownish platy grains from the association with serpentine, talc and holtedahlite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3510, 1144, 1120sh, 1110sh, 1088s, 1068s, 1045sh, 1038s, 990sh, 950, 868, 759w, 639, 600, 480sh, 451, 414.

P19 Augelite $Al_2(PO_4)(OH)_3$

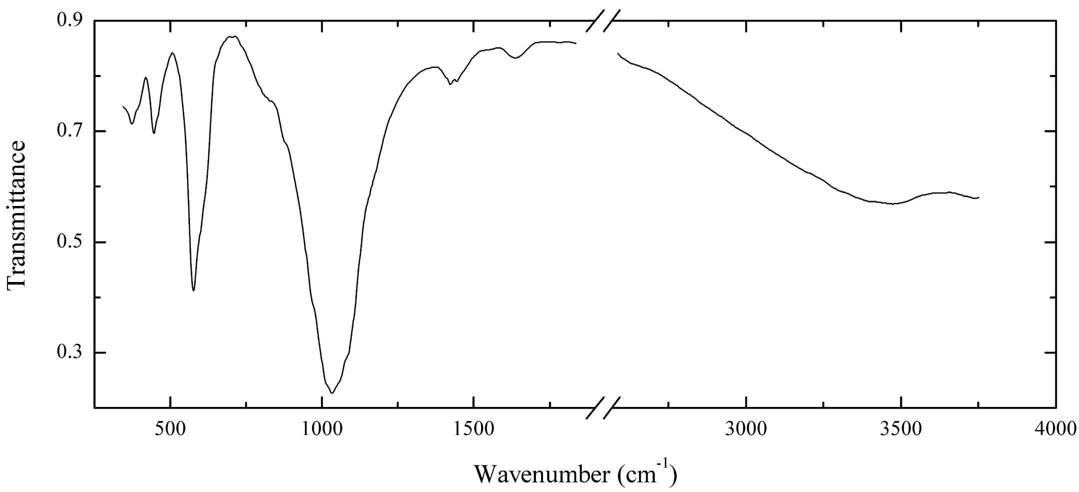


Locality: Këster deposit, Arga-Ynnakh-Khaiskaya intrusion, Yana river basin, Sakha (Yakutia) Republic, Russia.

Description: White crystals from the association with montebrasite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Al_{1.93}Fe_{0.03}P_{1.00}O_{3.94}$.

Wavenumbers (cm^{-1}): 3555s, 3475, 3440sh, 1203s, 1179s, 1148s, 1100sh, 1074s, 1018s, 928, 831, 717, 638, 609, 550, 433, ≈400s.

P20 Benyacarite $(H_2O,K)_2Ti(Mn^{2+},Fe^{2+})_2(Fe^{3+},Ti)_2(PO_4)_4(O,F)_2{\cdot}14H_2O$

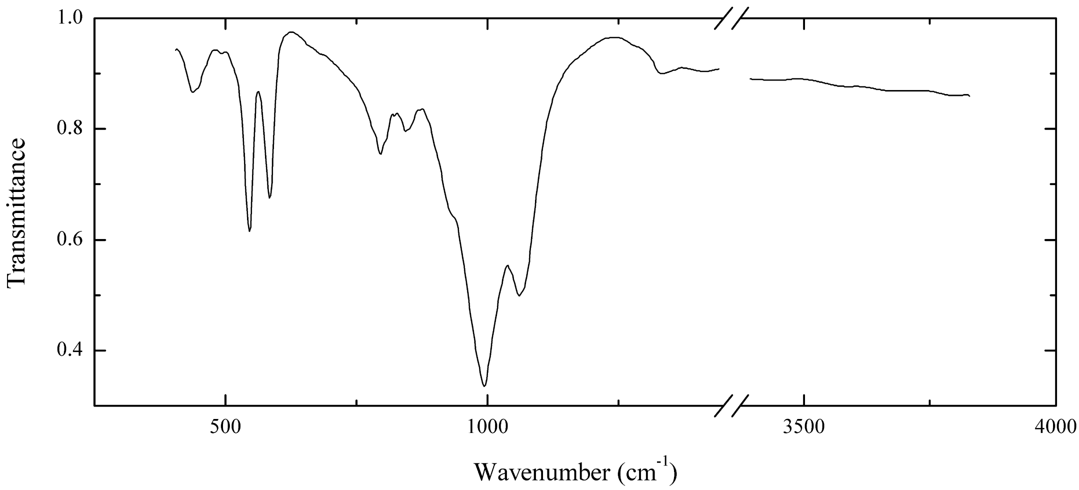


Locality: Folgosinho, Gouveia, Guarda district, Portugal.

Description: Yellow crystals from the association with phosphosiderite. The empirical formula is (electron microprobe) $[K_{0.65}(H_2O)_{1.35}]Ti_{1.00}(Mn_{1.60}Fe_{0.30}Ca_{0.10})(Fe_{1.13}Ti_{0.80}Mg_{0.07})(PO_4)_{1.00}(O,F)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3450, 1637w, 1427w, 1090sh, 1065sh, 1034s, 975sh, 830sh, 620sh, 600sh, 581s, 452, 375.

P21 Pyromorphite $Pb_5(PO_4)_3Cl$

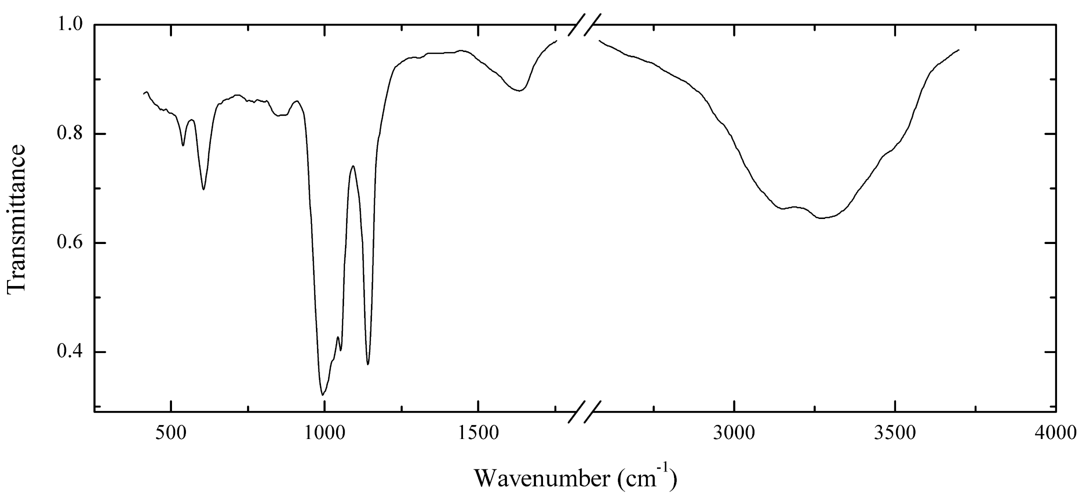


Locality: Old dumps near Freiberg, Saxony, Germany.

Description: Yellow powdery. Identified by IR spectrum. The empirical formula is (electron microprobe, CO_3 and Cl calculated) $(Pb_{4.31}Ca_{0.69})[(PO_4)_{2.56}(AsO_4)_{0.28}(CO_3)_{0.16}]Cl_{0.95}(OH)_{0.05}$.

Wavenumbers (cm^{-1}): 1420w, 1325w, 1065s, 993s, 935sh, 851, 799, 589, 550, 445.

P22 Koninckite $Fe^{3+}(PO_4)\cdot 3H_2O$

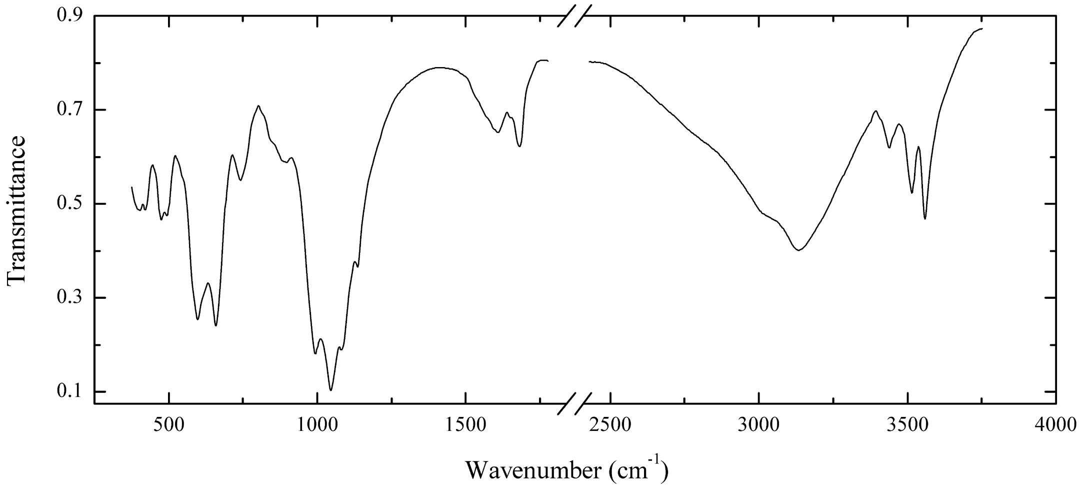


Locality: Kociha, near Rimanská Sobota, Banská Bystrica district, Slovakia.

Description: White spherulites from the association with evansite. The empirical formula is (electron microprobe) $Ca_{0.01}Fe_{0.975}Al_{0.02}(PO_4)_{1.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3480sh, 3260, 3145, 1640, 1140s, 1052s, 1025sh, 996s, 875w, 846w, 770w, 606, 540.

P23 Metavauxite $Fe^{2+}Al_2(PO_4)_2(OH)_2\cdot 8H_2O$

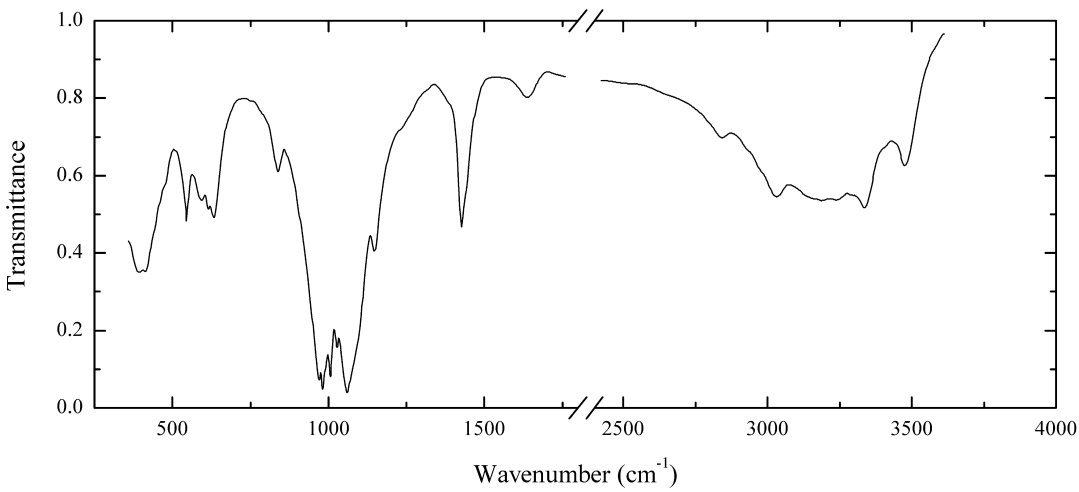


Locality: Siglo Veinte mine, Llallagua, Rafael Bustillo province, Potosí department, Bolivia (type locality).

Description: Green fibrous aggregate from the association with paravauxite and quartz. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3495, 3422, 3120s, 3010sh, 2800sh, 1685, 1610, 1141, 1085s, 1049s, 994s, 894, 850sh, 747, 665s, 603s, 497, 476, 428, 409.

P24 Spheniscidite $(NH_4,K)(Fe^{3+},Al)_2(PO_4)_2(OH)\cdot 2H_2O$

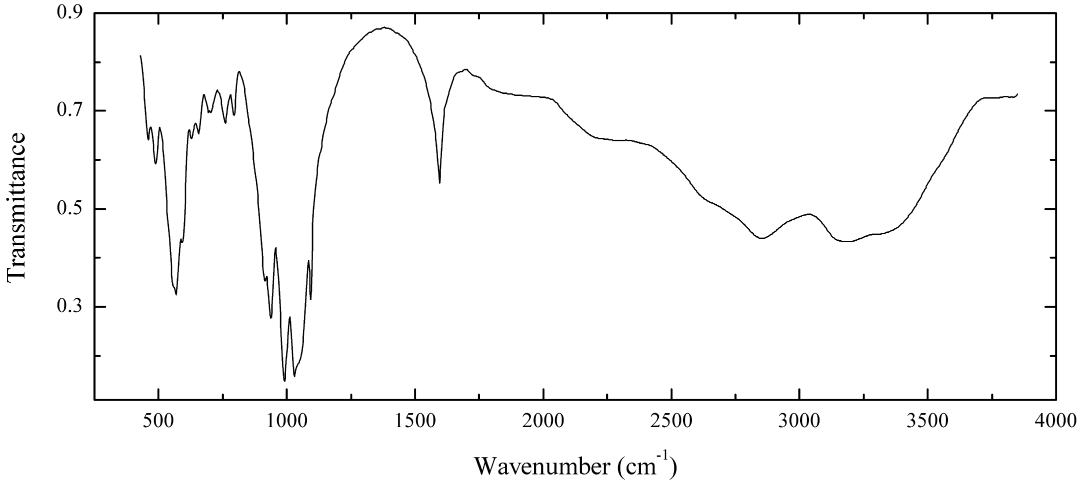


Locality: Kyz-Aul deposit, Kerch peninsula, Kerch iron-ore basin, Crimea, Ukraine.

Description: Light brown transparent crystals on mitridatite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $[(NH_4)_{0.77}K_{0.14}Ca_{0.02}Na_{0.02}Ba_{0.01}](Fe_{1.96}Al_{0.03}Mg_{0.02})(PO_4)_{2.00}(OH)\cdot H_2O$.

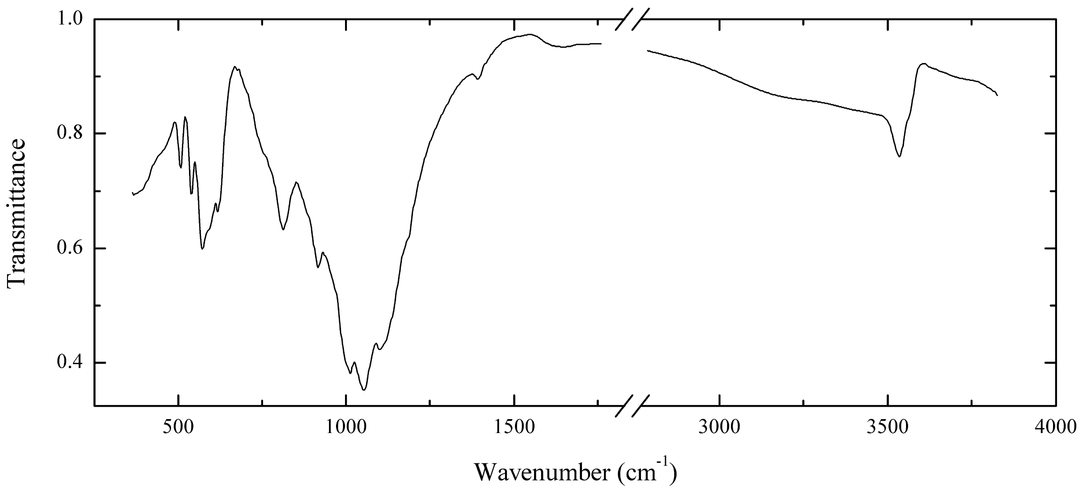
Wavenumbers (cm^{-1}): 3465, 3330, 3230, 3170, 3020, 2835, 1643w, 1428, 1152, 1095sh, 1064s, 1029s, 1007s, 985s, 972s, 840, 633, 616, 598, 529, 440sh, 424, 409.

P25 Ludlamite $Fe^{2+}{}_3(PO_4)_2 \cdot 4H_2O$



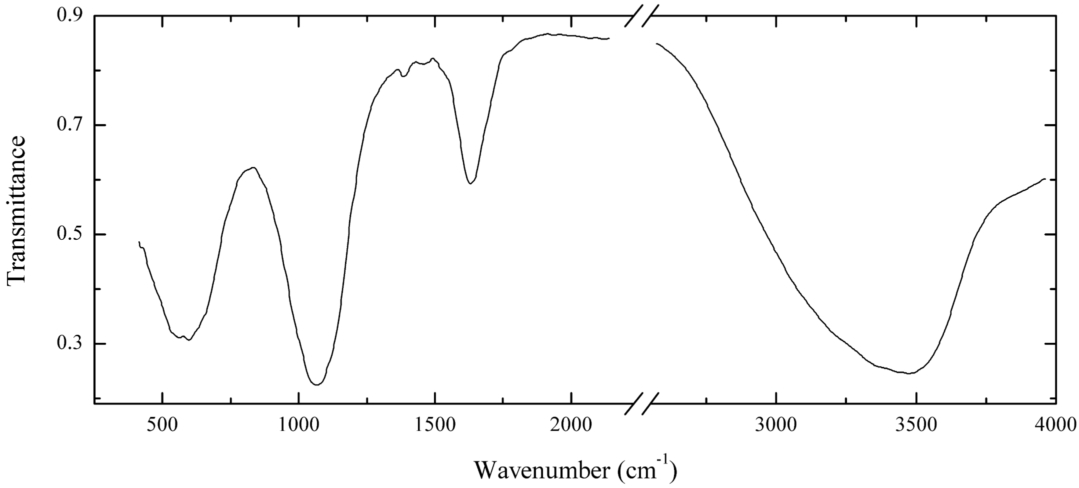
Locality: Mina Huanuni, Dalence province, Oruro department, Bolivia.
Description: Green split crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3290, 3160, 2840, 2630sh, 2270, 1597, 1093, 1046s, 1030s, 990s, 938s, 915, 796, 762, 702, 657, 631, 596, 571, 559, 490, 461.

P26 Satterlyite $(Fe^{2+},Mg)_{12}(PO_4)_5(HPO_4)(OH,O)_6$



Locality: Big Fish River, Yukon Territory, Canada (type locality).
Description: Greenish-brown grain from the association with wolfeite and quartz. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3525, 3230w, 1650w, 1400w, 1180sh, 1110s, 1054s, 1011s, 923, 815, 623, 615sh, 585sh, 573, 542, 507, 445sh.

P27 Evansite $(Fe^{2+},Mg)_{12}(PO_4)_5(HPO_4)(OH,O)_6$

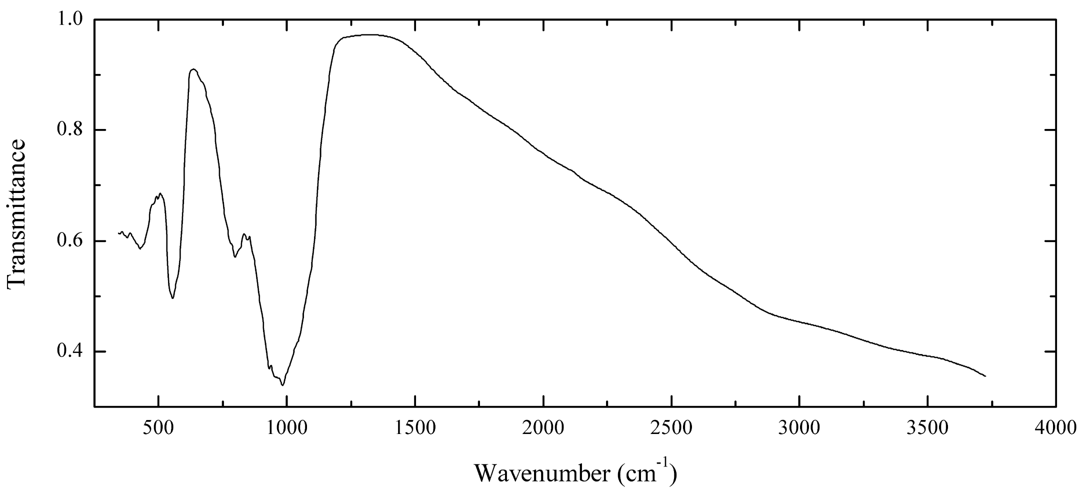


Locality: Železník, near Sirk, Slovakia (type locality).

Description: Green semitransparent crust. Isotropic. Amorphous. Identified by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3470s, 3240sh, 1645, 1400w, 1073s, 597, 567.

P28 Smrkovecite $Bi_2(PO_4)O(OH)$

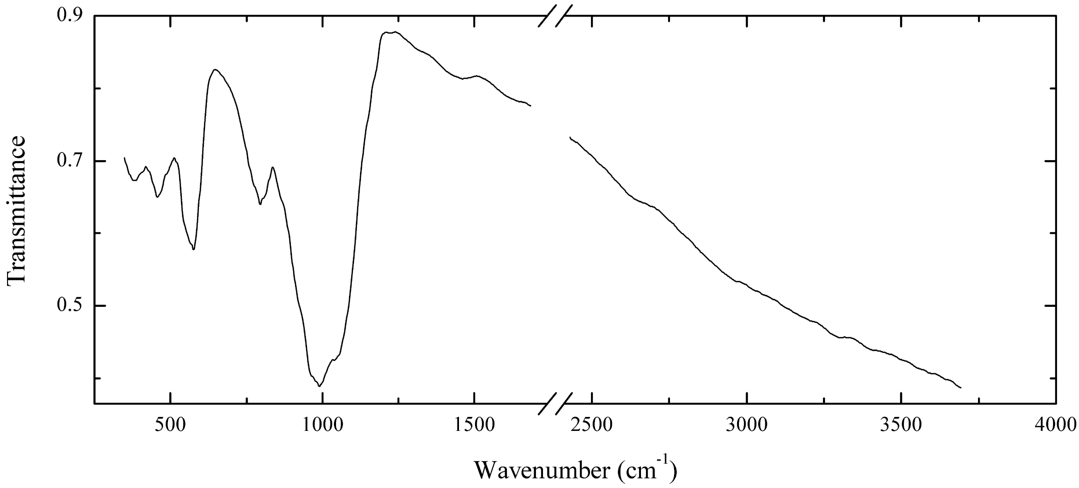


Locality: Old dumps near As–U deposit Smrkovec, Slavovsky Les Mts., near Mariánské Lázně, Czech Republic (type locality).

Description: Pale yellow spherical aggregates from the association with quartz, bismutite and petitjeanite. Identified by powder X-ray diffraction pattern, IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{0.03}Bi_{1.87}[(PO_4)_{0.74}(AsO_4)_{0.13}(SiO_4)_{0.09}(VO_4)_{0.04}](O,OH)_2$.

Wavenumbers (cm^{-1}): 2900sh, 1075sh, 1030sh, 985s, 960sh, 936s, 803, 580sh, 559, 440, 400.

P29 Smrkovecite $Bi_2(PO_4)O(OH)$

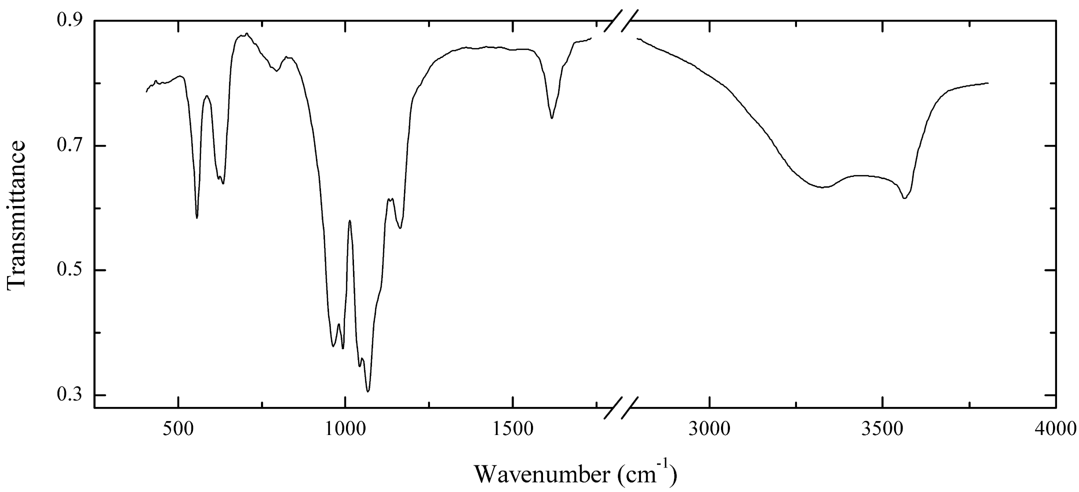


Locality: Old dumps near As–U deposit Smrkovec, Slavovsky Les Mts., near Mariánské Lázně, Czech Republic (type locality).

Description: Brown spherical aggregates from the association with quartz, bismutite, petitjeanite and preisingerite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{0.05}Bi_{2.30}[(PO_4)_{0.78}(AsO_4)_{0.09}(SiO_4)_{0.08}(VO_4)_{0.05}](O,OH)_2$.

Wavenumbers ($\mathbf{cm^{-1}}$): (3000w), 2650sh, 1450w, 1040s, 996s, 975sh, 925sh, 789, 579, 565sh, 545sh, 461, 390.

P30 Sampleite $NaCaCu_5(PO_4)_4Cl{\cdot}5H_2O$

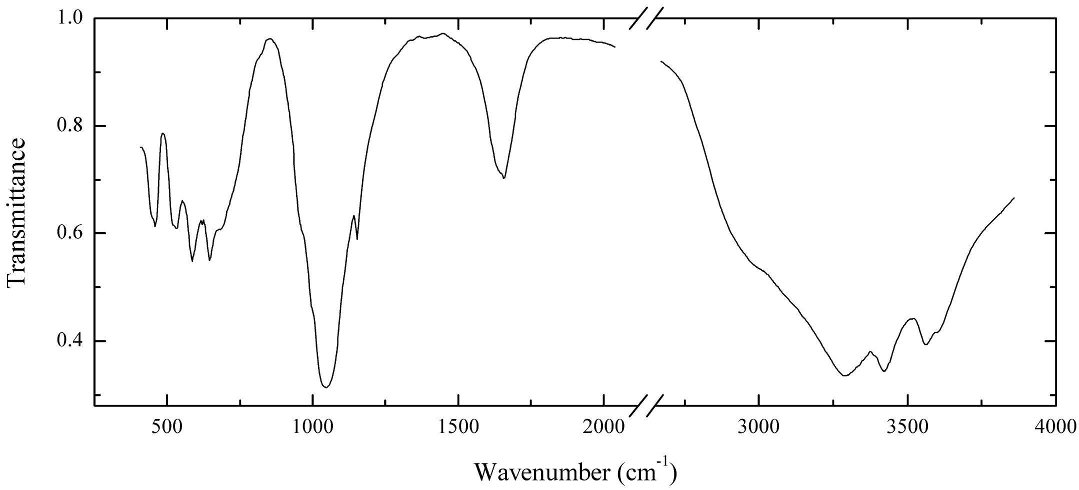


Locality: Endeavour 24 Pit, Northparkes mine, near Parkes, New South Wales, Australia.

Description: Light blue platy crystals. The empirical formula is $Na_{0.7}Ca_{1.2}Cu_{6.0}(PO_4)_{4.0}Cl_{1.1}(H_2O,OH)_5$.

Wavenumbers ($\mathbf{cm^{-1}}$): 3555, 3315, 1620, 1169, 1100sh, 1071s, 1047s, 997s, 968s, 798w, 640, 624, 561.

P31 Paravauxite $Fe^{2+}Al_2(PO_4)_2(OH)_2{\cdot}8H_2O$

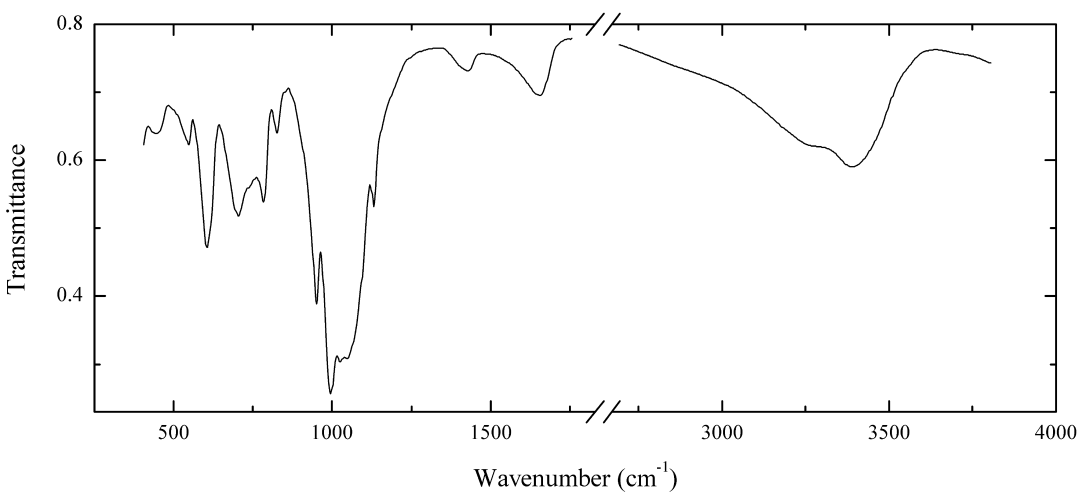


Locality: Siglo Veinte mine, Llallagua, Rafael Bustillo province, Potosí department, Bolivia (type locality).

Description: White prismatic crystals from the association with metavauxite and quartz. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3595, 3545, 3410s, 3280s, 3000sh, 1655, 1154, 1044s, 1000sh, 970sh, 720sh, 680sh, 649s, 588s, 532, 458.

P32 Olmsteadite $KFe^{2+}{}_2(Nb,Ta)(PO_4)_2O_2{\cdot}2H_2O$

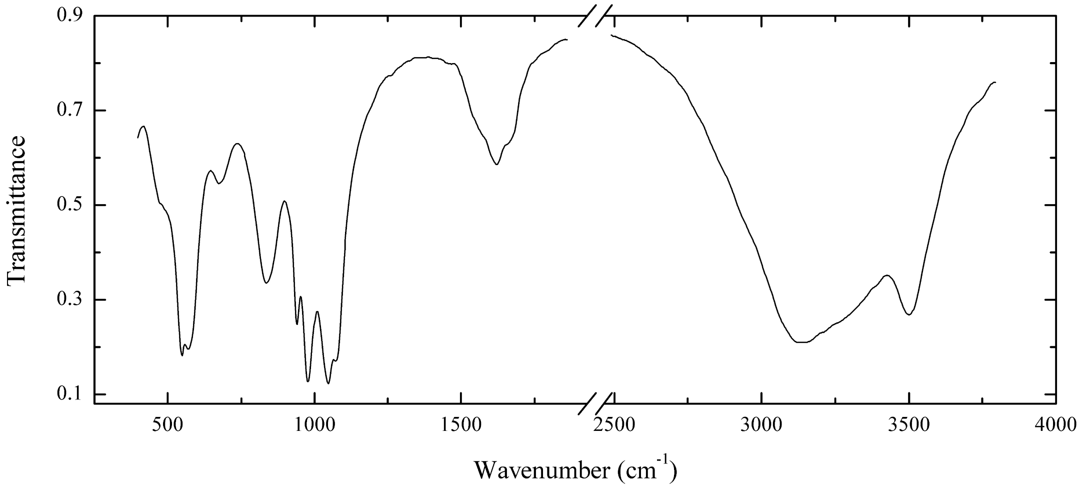


Locality: Hesnard pegmatite, Custer, Custer Co., South Dakota, USA (type locality).

Description: Dark brown semitransparent grains. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3380, 3270sh, 1660, 1435w, 1135, 1052s, 1026s, 1000s, 952s, 829, 786, 705, 620sh, 607, 550, 535sh, 445.

P33 Barićite $(Mg,Fe^{2+})_3(PO_4)_2 \cdot 8H_2O$

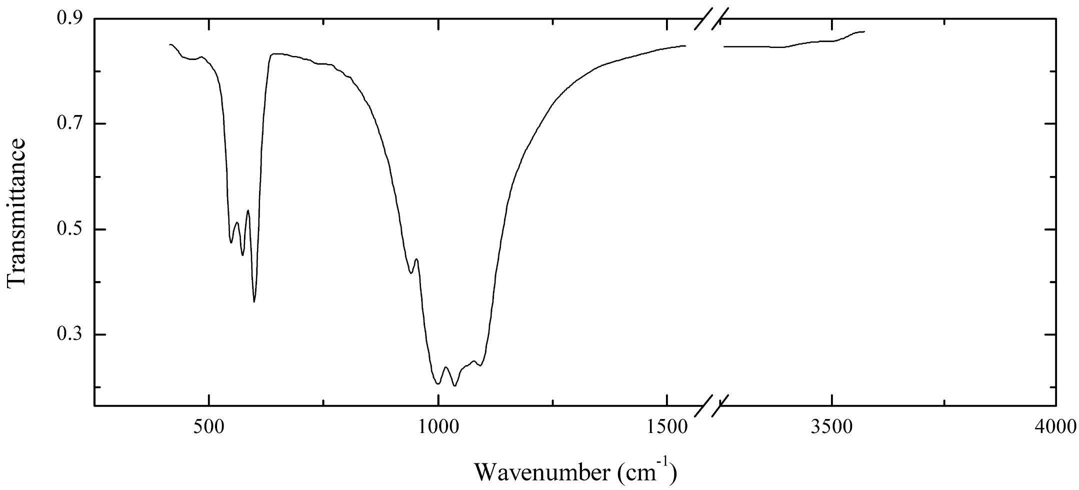


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Blue crystal from dolomite carbonatite. Identified by powder X-ray diffraction pattern, IR spectrum and electron microprobe analysis. The empirical formula is $(Mg_{1.8}Fe_{1.2})(PO_4)_{2.0} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3486s, 3250sh, 3125s, 1655sh, 1624, 1570sh, 1075s, 1047s, 979s, 943, 841, 679, 572s, 549s, 480sh.

P34 Belovite-(Ce) $Sr_3Na(Ce,La)(PO_4)_3(F,OH)$

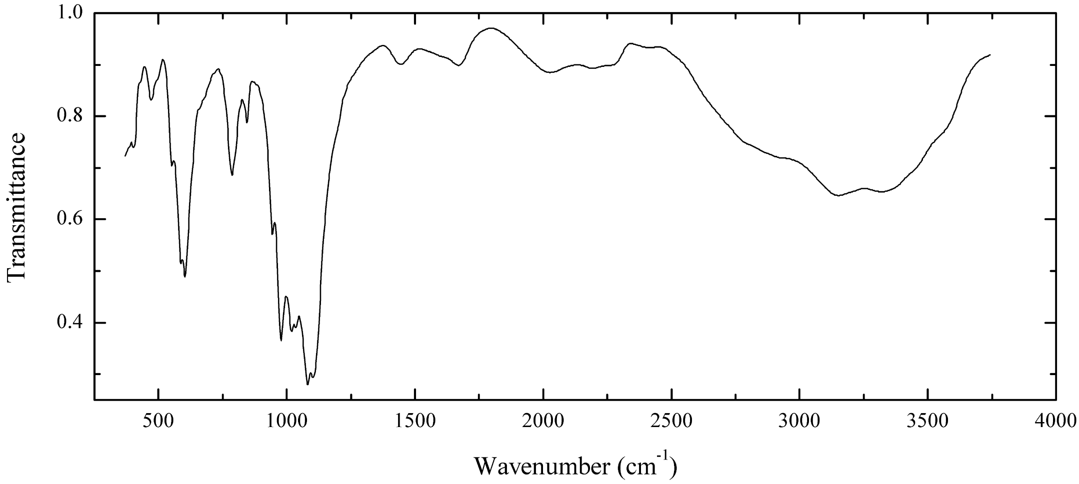


Locality: Shkatulka pegmatite, Alluaiv Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: Yellow radial aggregate of prismatic crystals from massive ussingite. The empirical formula is (electron microprobe) $Sr_{2.93}Ba_{0.08}Ca_{0.08}Na_{0.89}Ce_{0.51}La_{0.35}Nd_{0.10}Pr_{0.05}Sm_{0.02}(PO_4)_{3.00}(F,OH,O)$.

Wavenumbers (cm^{-1}): 3500w, 1095s, 1065sh, 1038s, 1004s, 945, 598, 574, 546, 457w.

P35 Bakhchisaraitsevite $Na_2Mg_5(PO_4)_4 \cdot 7H_2O$

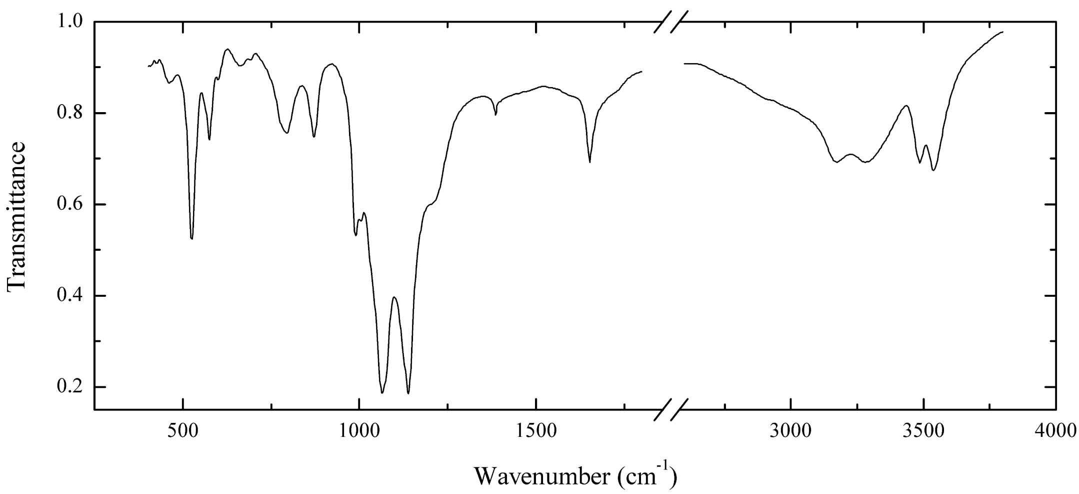


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Yellow-brown crystals from the association with bobierrite, pyrite and collinsite. The empirical formula is (electron microprobe) $(Na_{1.96}Ca_{0.04})(Mg_{4.80}Fe_{0.13})(PO_4)_{4.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3300, 3130, 2910sh, 2400w, 2255w, 2180w, 2025w, 1680w, 1610sh, 1447w, 1102s, 1080s, 1035s, 1020s, 977s, 943, 846, 787, 670sh, 603, 586, 552, 495sh, 475, 435sh, 405.

P36 Brushite $CaH(PO_4) \cdot 2H_2O$

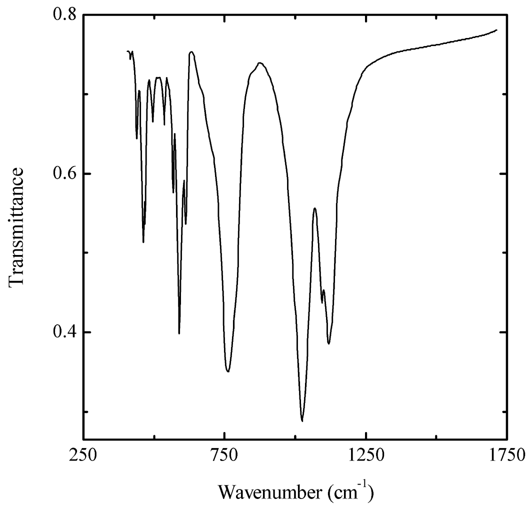


Locality: Moorba Cove, Jurien Bay, West Australia, Australia.

Description: White massive. Identified by powder X-ray diffraction pattern and IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3488, 3287, 3173, 1650, 1384, 1210sh, 1137s, 1062s, 1000, 988, 873, 796, 785sh, 663w, 577, 527, 466w.

P37 Babefphite $BaBe(PO_4)F$

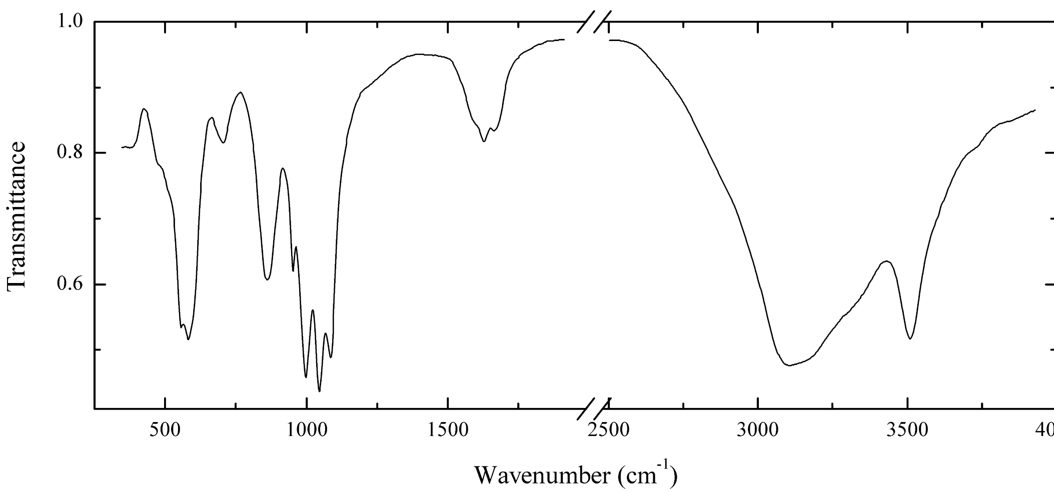


Locality: Aunik fluorite-Be-*REE* deposit, Vitim plateau, Buryatia Republic, Transbaikal area, Eastern Siberia, Russia (type locality).

Description: Colourless grains from the association with zircon, ilmenorutile, fluorite, phenakite, scheelite, bertrandite, albite, microcline and quartz. Holotype sample. Triclinic, space group $P1$, $a = 6.889(3)$, $b = 16.814(7)$, $c = 6.902(3)$ Å, $\alpha = 90.01(3)°$, $\beta = 89.99(3)$, $\gamma = 90.32(3)°$, $Z = 8$. The empirical formula is $Ba_{0.99}Be_{1.20}(PO_4)_{1.00}F_{1.02}(OH)_{0.36}$. $D_{meas} = 4.31$ g/cm^3, $D_{calc} = 4.325$ g/cm^3. Optically biaxial, pseudouniaxial (+), $\omega = 1.629(2)$, $\varepsilon = 1.632(2)$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.190 (100), 2.163 (100), 1.516 (100), 2.760 (80), 2.440 (70), 2.033 (70), 1.135 (70).

Wavenumbers (cm^{-1}): 1130sh, 1118s, 1095, 1022s, 761s, 612, 589s, 567, 537, 493, 467, 459, 437, 400w.

P39 Bobierrite $Mg_3(PO_4)_2{\cdot}8H_2O$

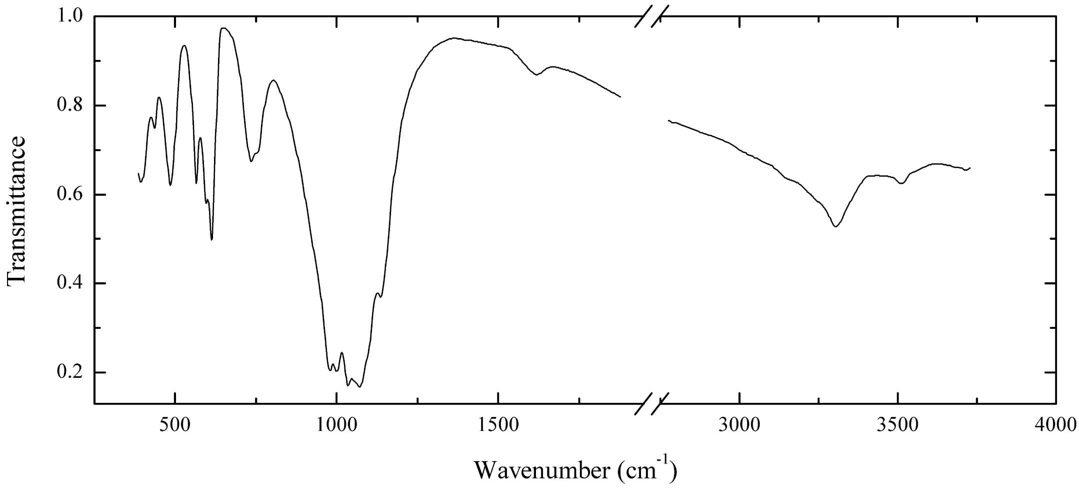


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless crystal from dolomite carbonatite. Identified by powder X-ray diffraction pattern, IR spectrum and electron microprobe analysis. The empirical formula is $(Mg_{2.90}Fe_{0.07}Mn_{0.01})(PO_4)_{2.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3497, 3340sh, 3280sh, 3160sh, 3092s, 2900sh, 1674, 1630, 1595sh, 1083s, 1043s, 995s, 951, 860, 697, 600sh, 578s, 549s, 510sh, 476w, 385.

P40 Barbosalite $Fe^{2+}Fe^{3+}{}_2(PO_4)_2(OH)_2$

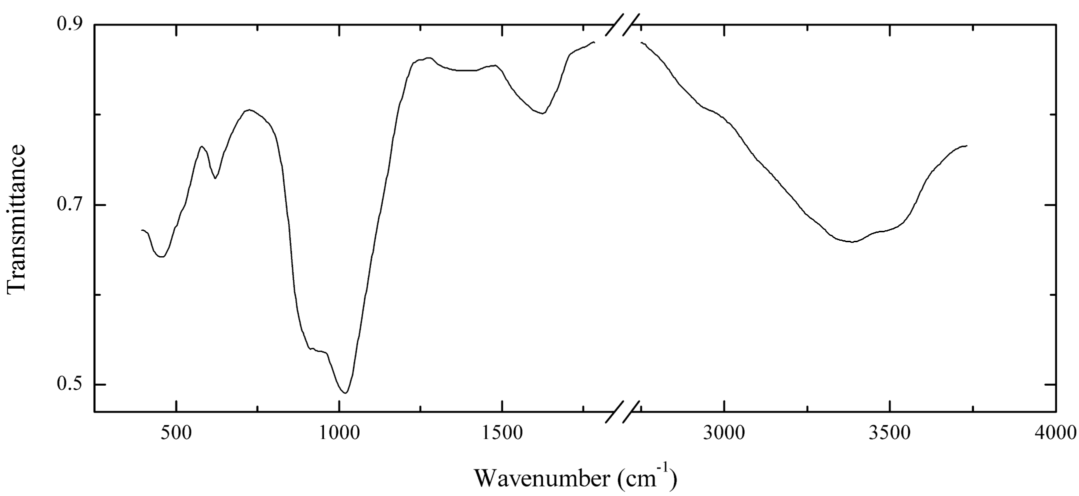


Locality: Bull Moose mine, Custer, Custer Co., South Dakota, USA.

Description: Very dark blue fine-grained aggregate from the association with pyrite. Confirmed by qualitative electron microprobe analysis and IR spectrum.

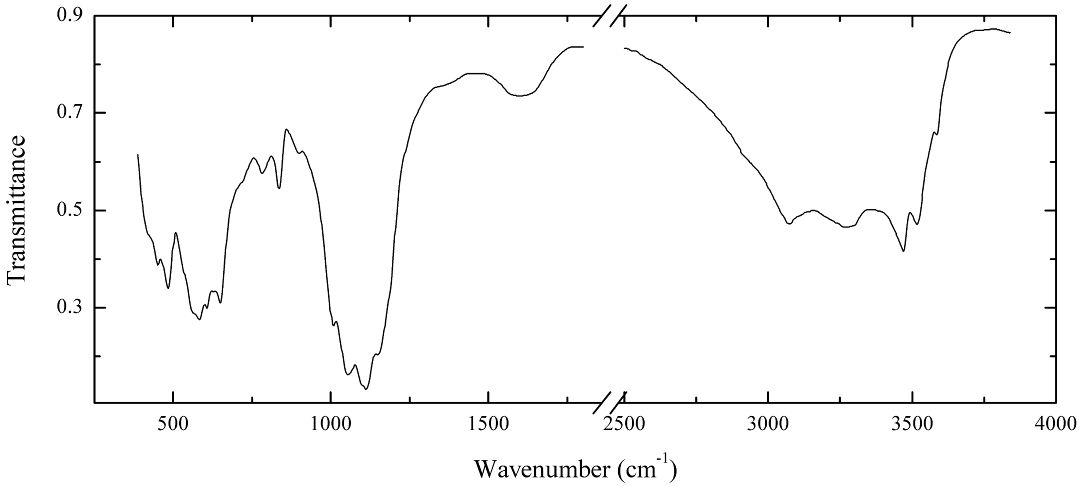
Wavenumbers (cm^{-1}): 3505w, 3293, 1629w, 1137, 1095sh, 1071s, 1060sh, 1033s, 1000s, 979s, 755sh, 736, 608, 593, 561, 480, 432, 398.

P41 Brockite $(Ca,Th,Ce)(PO_4,CO_3)\cdot H_2O$



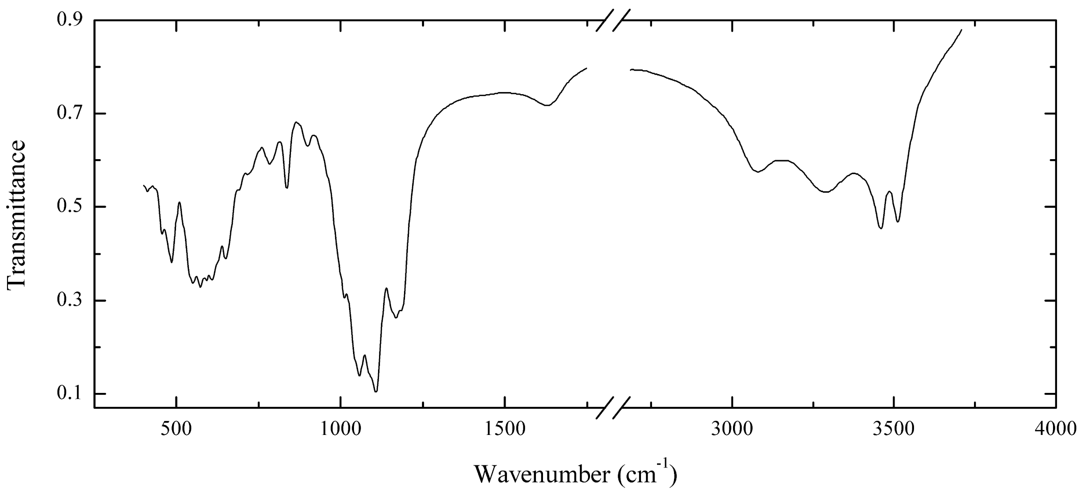
Locality: Ilmeny (Il'menskie) Mts., Chelyabinsk region, South Urals, Russia.
Description: White massive. Investigated by V.A. Popov.
Wavenumbers (cm^{-1}): 3460sh, 3380, 1620, 1400w, 1021s, 915s, 621, 454.

P42 Turquoise $Cu^{2+}Al_6(PO_4)_4(OH)_8 \cdot 4H_2O$



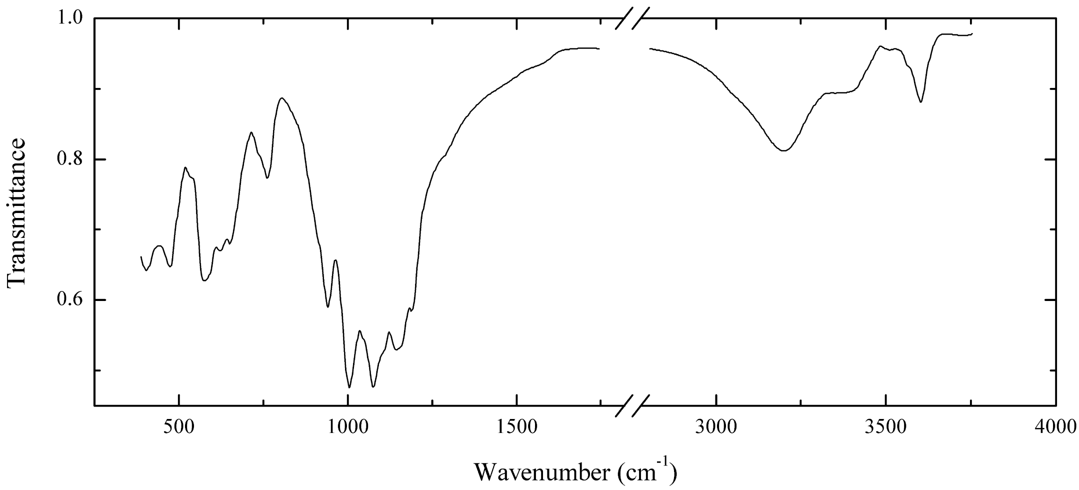
Locality: Kouroudiako iron deposit, Saraya, Falémé River basin, east Senegal.
Description: Green crust from the association with senegalite and variscite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Cu_{0.9}Ca_{0.05})(Al_{5.5}Fe_{0.7})(PO_4)_{4.0}(OH,O)_8 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3575w, 3505, 3460, 3270, 3070, 1605w, 1185sh, 1148s, 1111, 1095sh, 1058s, 1008s, 903w, 835, 786, 710sh, 648, 625, 605, 583, 570sh, 560sh, 481, 452, 420sh.

P43 Turquoise $Cu^{2+}Al_6(PO_4)_4(OH)_8 \cdot 4H_2O$



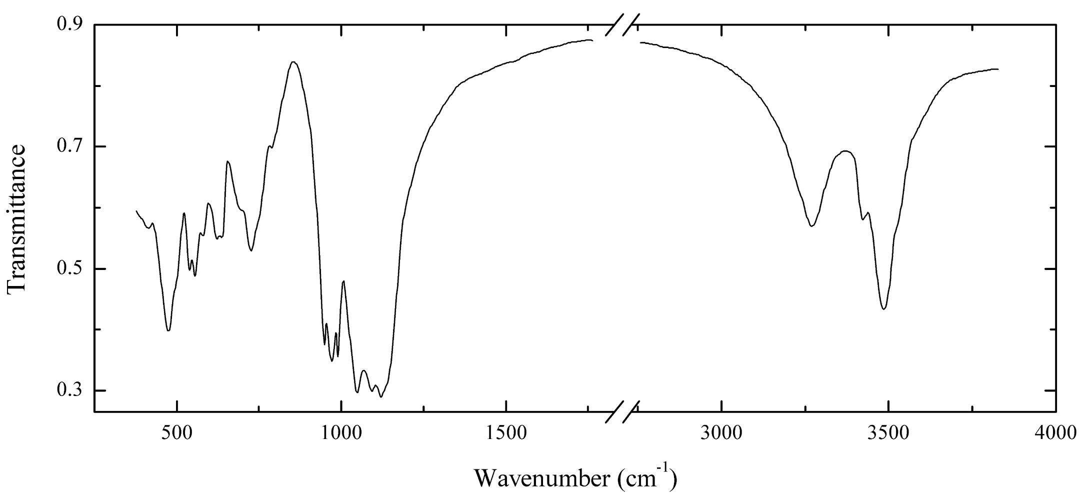
Locality: Ancient jewellery of second–third century B.C., the Republic of Kalmykia, Russia.
Description: Green fine-grained aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3510, 3460, 3290, 3080, 1640w, 1189, 1171s, 1160sh, 1109s, 1090sh, 1058s, 1045sh, 1012, 990sh, 903w, 837, 784, 715sh, 685sh, 649, 607, 589, 570, 546, 482, 454.

P44 Bertossaite $(Li,Na)_2CaAl_4(PO_4)_4(OH,F)_4$



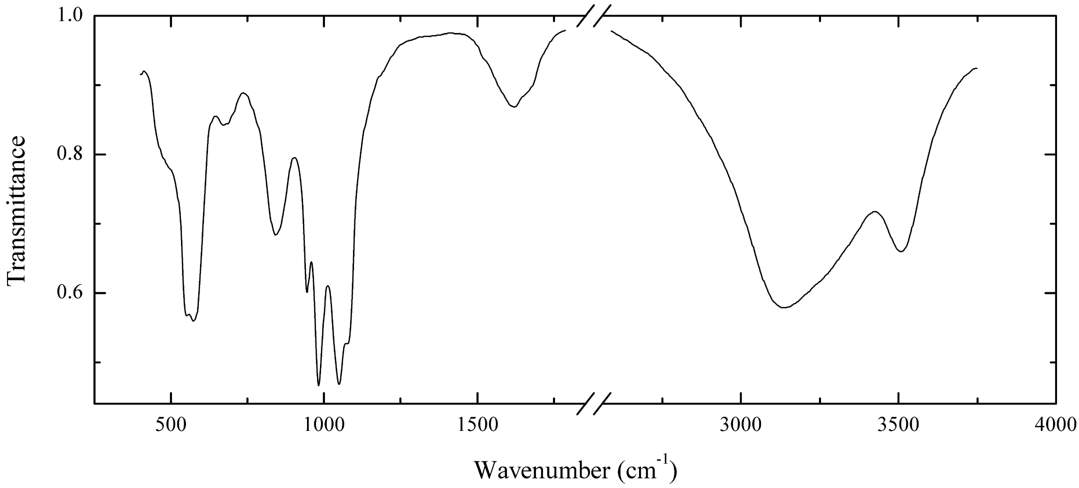
Locality: Buranga pegmatite, Gatumba district, Western Province, Rwanda (type locality).
Description: Pink massive. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3590, 3550sh, 3495w, 3360sh, 3195, 1189, 1147s, 1110sh, 1074s, 1003s, 941, 760, 735sh, 645, 615, 573, 530w, 473, 400.

P45 Brazilianite $NaAl_3(PO_4)_2(OH)_4$



Locality: Conselheira Pena, Minas Gerais, Brazil (type locality).
Description: Yellow transparent crystal from the association with montebrasite, elbaite and muscovite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3480, 3415, 3260, 1140sh, 1123s, 1092s, 1047s, 989, 971s, 948, 793w, 750sh, 725, 690sh, 632, 617, 577, 554, 538, 495sh, 473, 411.

P46 Barićite $(Mg,Fe^{2+})_3(PO_4)_2{\cdot}8H_2O$

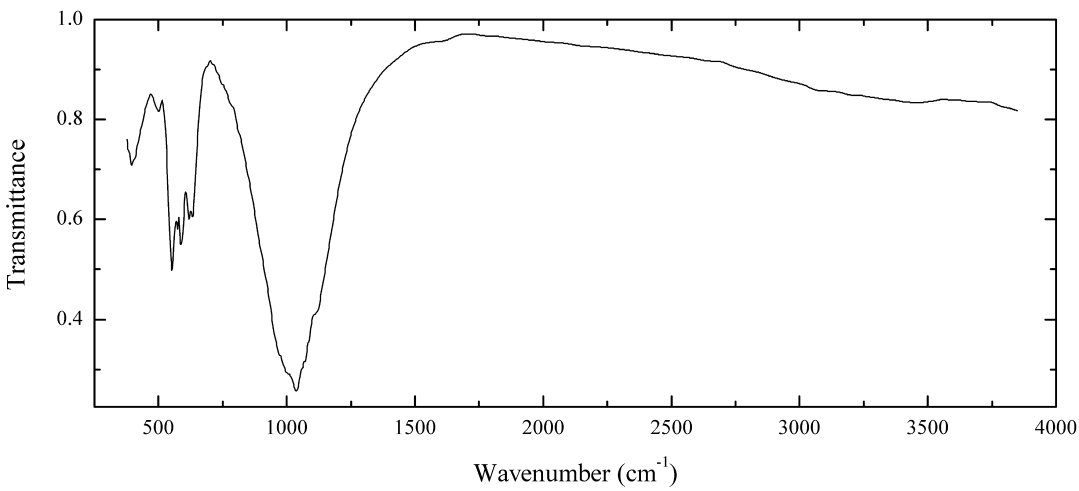


Locality: Rapid Creek, Richardson Mts., Yukon Territory, Canada.

Description: Dark blue crystal. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Mg_{1.54}Fe_{1.40}Zn_{0.03}Mn_{0.01})(PO_4)_{2.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3485, 3125s, 1655sh, 1623, 1077s, 1049s, 982s, 945, 844, 681, 570s, 545s, 495sh.

P47 Beusite $(Mn^{2+},Fe^{2+},Ca,Mg)_3(PO_4)_2$

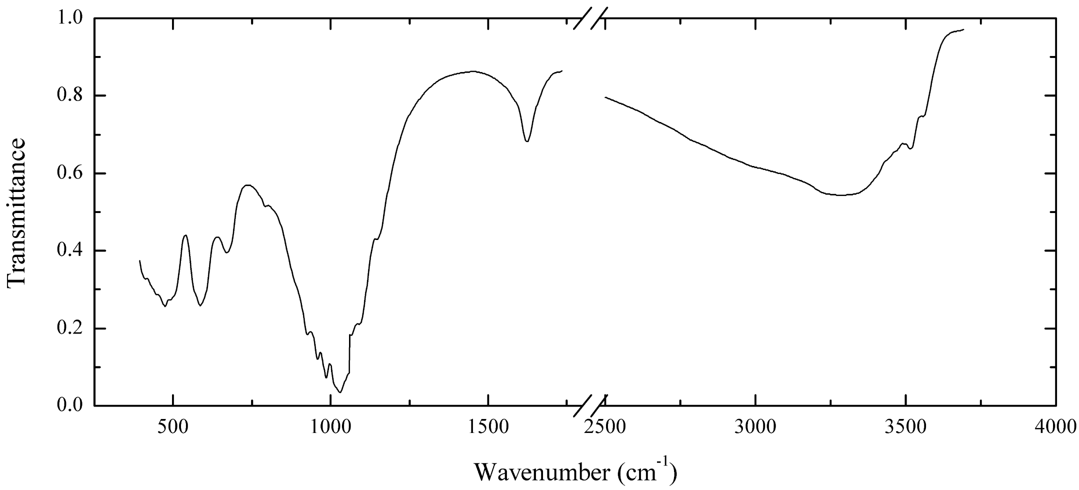


Locality: Kyrk-Bulak pegmatite, Turkestan range, Osh region, Kyrgyzstan.

Description: Reddish grains in pegmatite, in the association with vivianite and other phosphates. Identified by powder X-ray diffraction pattern, chemical analysis and IR spectrum. Investigated by V.Y. Karpenko.

Wavenumbers (cm^{-1}): 1120sh, 1040s, 1005sh, 980sh, 633, 618, 587, 551, 498w, 400.

P48 "Oxyberaunite" $(Fe^{3+},Mn)Fe^{3+}_5(PO_4)_4(OH)_6·5H_2O$ (?)

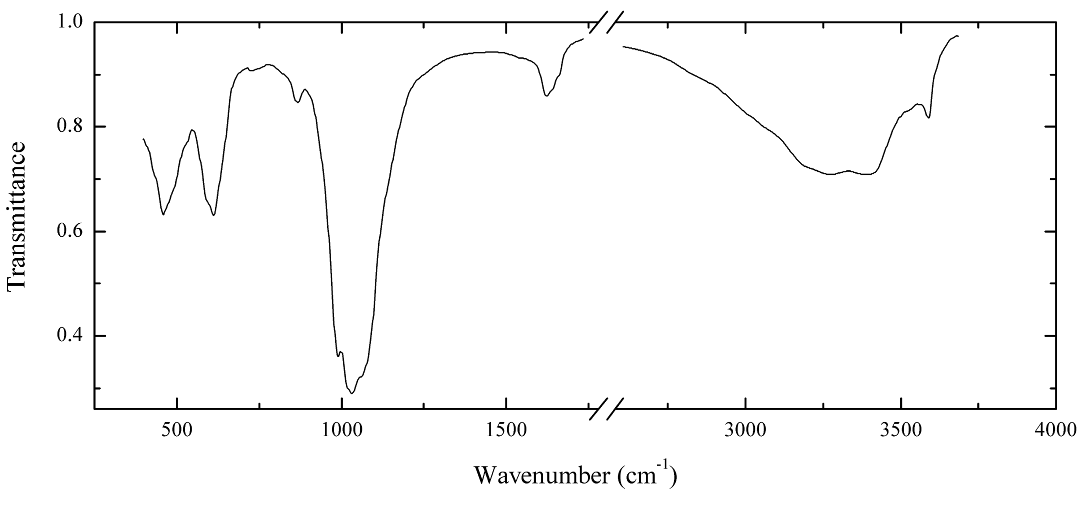


Locality: Rotläufchen mine, Waldgirmes, Germany.

Description: Brown prismatic crystals. Identified by powder X-ray diffraction pattern and IR spectrum. Related to beraunite. Needs further investigation.

Wavenumbers (cm^{-1}): 3545, 3500, 3280, 3000sh, 1625, 1150, 1094s, 1067s, 1032s, 1020sh, 988s, 960s, 919, 800w, 677, 586, 570sh, 500sh, 473, 445sh, 410sh.

P49 Beraunite $Fe^{2+}Fe^{3+}_5(PO_4)_4(OH)_5·4H_2O$

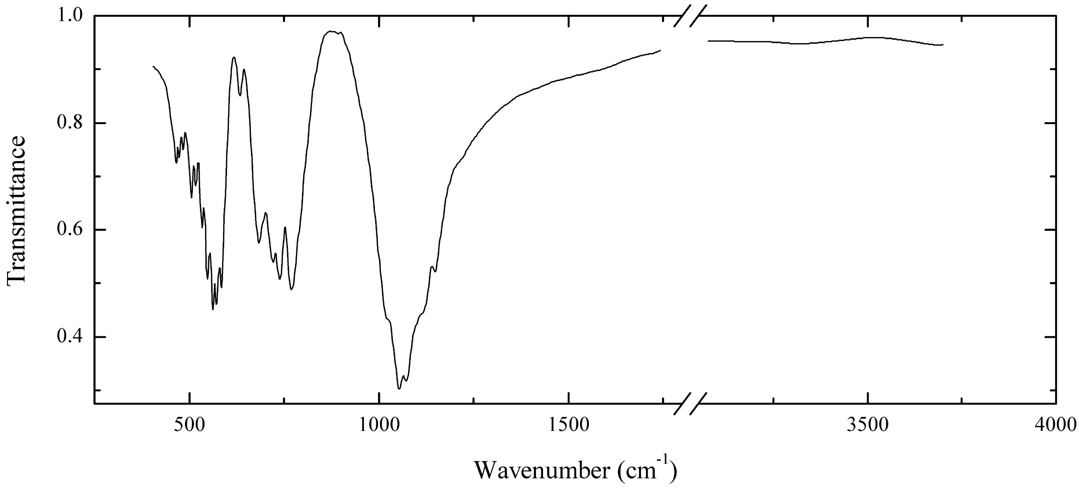


Locality: Rotläufchen mine, Waldgirmes, Germany.

Description: Bluish black prismatic crystals. Identified by IR spectrum. Al-rich variety. The empirical formula is $Fe^{2+}_{1.0}(Fe^{3+}_{3.4}Al_{1.6})(PO_4)_{4.0}(OH)_5·nH_2O$.

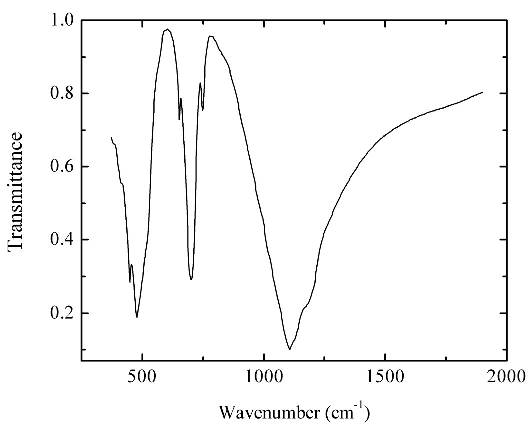
Wavenumbers (cm^{-1}): 3575, 3390, 3250, 3180, 1625, 1065sh, 1033s, 1020sh, 990s, 868w, 730w, 610, 480sh, 459.

P51 Beryllonite $NaBe(PO_4)$



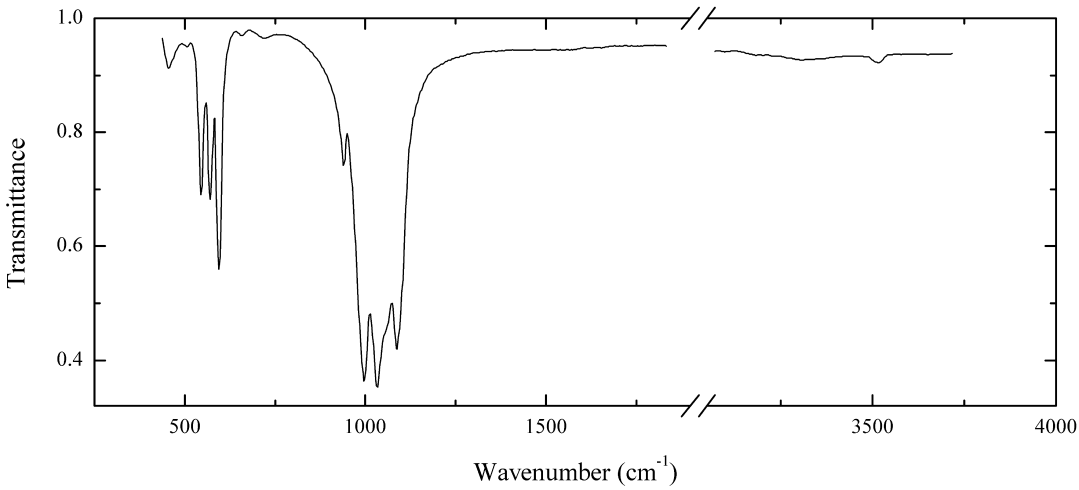
Locality: Mika pegmatite, Rangkul' Highlands, Pamir Mts., Tajikistan.
Description: Colourless crystals from the association with topaz, elbaite, quartz and albite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1148, 1115sh, 1072s, 1053s, 1020sh, 790sh, 771, 739, 722, 685, 635w, 585, 573, 562, 547, 533, 518, 507, 483w, 473w, 466.

P52 Berlinite $Al(PO_4)$



Locality: Hålsjöberget, Värmland, Sweden.
Description: Grey grains from the association with Wagnerite, scorzalite and trolleite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1180sh, 1112s, 749, 705s, 652, 515sh, 477s, 449, 415sh.

P53 Belovite-(Ce) $Sr_3Na(Ce,La)(PO_4)_3(F,OH)$

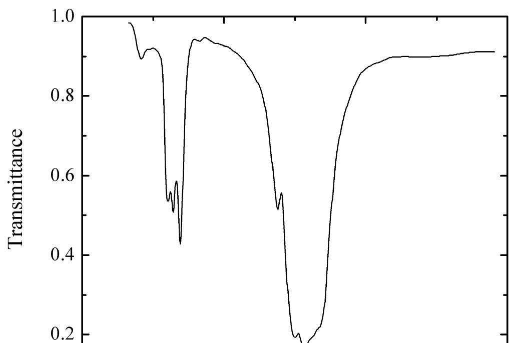


Locality: Shkatulka pegmatite, Alluaiv Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: Yellow crystal from the association with ussingite, steenstrupine, vuonnemite, chkalovite and serandite. The empirical formula is (electron microprobe) $Sr_{2.85}Ba_{0.07}Ca_{0.08}Na_{0.91}Ce_{0.53}La_{0.37}Nd_{0.09}Pr_{0.06}(PO_4)_{3.00}[F_{0.7}(OH)_{0.3}]$.

Wavenumbers (cm^{-1}): 3525w, 1095s, 1068sh, 1042s, 1007s, 951, 725w, 665w, 596, 573, 546, 490w, 457.

P54 Belovite-(La) $Sr_3Na(La,Ce)(PO_4)_3(F,OH)$

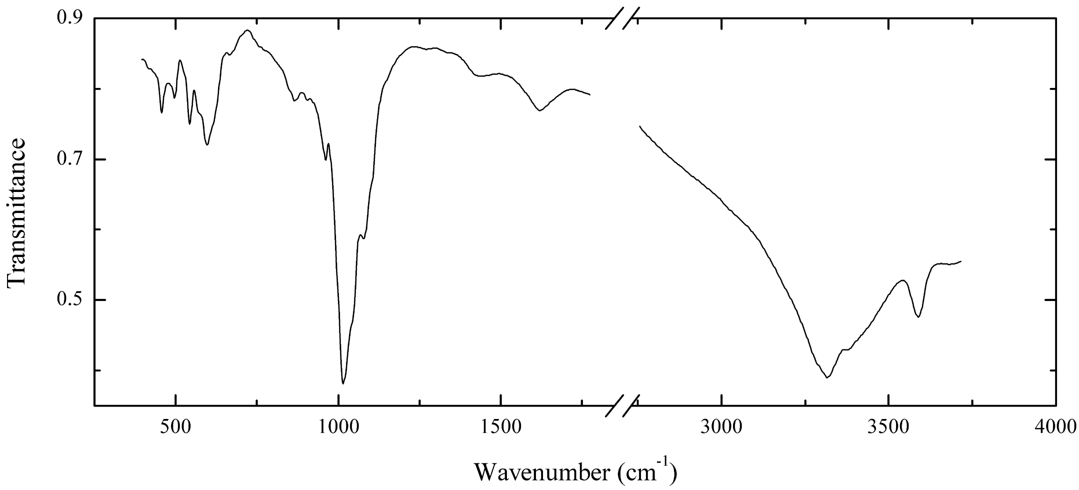


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline massif, Kola peninsula, Murmansk region, Russia (type locality).

Description: Yellow crystal from the association with microcline, aegirine, pectolite, lamprophyllite, gaidonnayite, gerasimovskite, *etc*. Holotype sample. The crystal structure is solved. Trigonal, space group *P*-3. $a = 9.647(1)$, $c = 7.170(1)$ Å, $Z = 2$. The empirical formula is $Sr_{2.91}Ba_{0.12}Ca_{0.06}Na_{1.00}$-$La_{0.59}Ce_{0.37}Nd_{0.01}Pr_{0.01}Th_{0.01}(PO_4)_{2.97}$ $(SiO_4)_{0.03}[F_{0.80}(OH)_{0.18}]$. Optically uniaxial (−), $\omega = 1.653$, $\varepsilon = 1.635$–1.636. $D_{meas} = 4.19$ g/cm^3, $D_{calc} = 4.05$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.897 (100), 2.884 (100), 3.59 (87), 3.30 (65), 2.790 (54), 1.910 (36), 1.796 (36)

Wavenumbers (cm^{-1}): 1092sh, 1080sh, 1065sh, 1041s, 1005s, 945, 668w, 595, 570, 551, 496w, 455.

P56 Veszelyite $(Cu^{2+},Zn)_3(PO_4)(OH)_3\cdot 2H_2O$

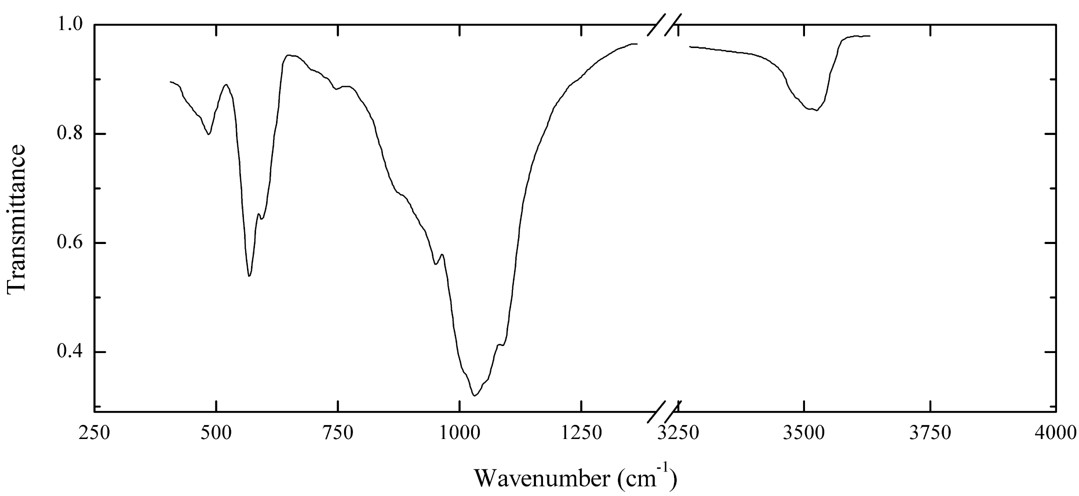


Locality: Ocna de Fier, formerly Vaskö, Banat, Romania (type locality).

Description: Bluish-green crystals. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3564, 3350sh, 3290, 1615, 1410w, 1105sh, 1081, 1045sh, 1017s, 963, 869, 669w, 625sh, 602, 575sh, 548, 501, 464.

P57 Wolfeite $Fe^{2+}{}_2(PO_4)(OH)$

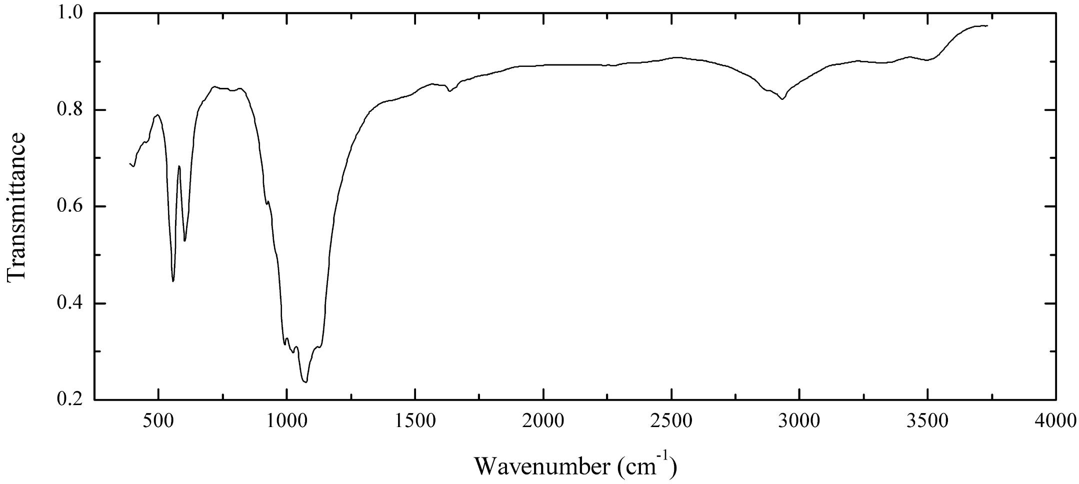


Locality: Berg, Sollefteå, Ångermanland, Sweden.

Description: Brown granular aggregate from the association with graftonite. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3495, 1090s, 1050sh, 1035s, 1010sh, 952, 880sh, 750w, 700sh, 594, 567, 487, 460sh.

P58 Whitlockite $Ca_9Mg(HPO_4)(PO_4)_6$

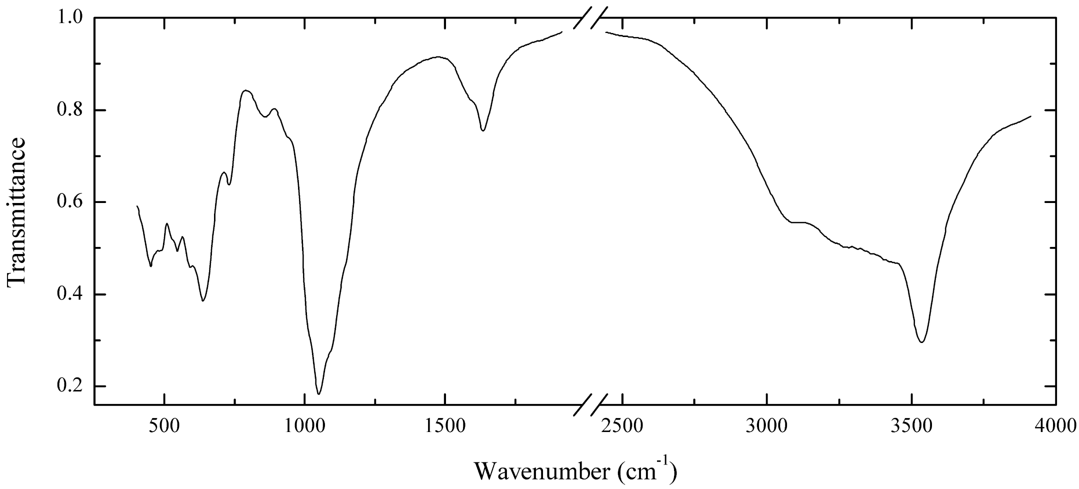


Locality: Tip Top pegmatite, Tip Top mine, Fourmile, Custer district, Custer Co., South Dakota, USA.

Description: Pink crystals from the association with englishite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3480w, 3310w, 2920, 1640w, 1134s, 1076s, 1065sh, 1026s, 1014s, 993s, 960sh, 923, 794w, 754w, 674w, 615sh, 603, 557, 460sh, 398.

P59 Wavellite $Al_3(PO_4)_2(OH,F)_3{\cdot}5H_2O$

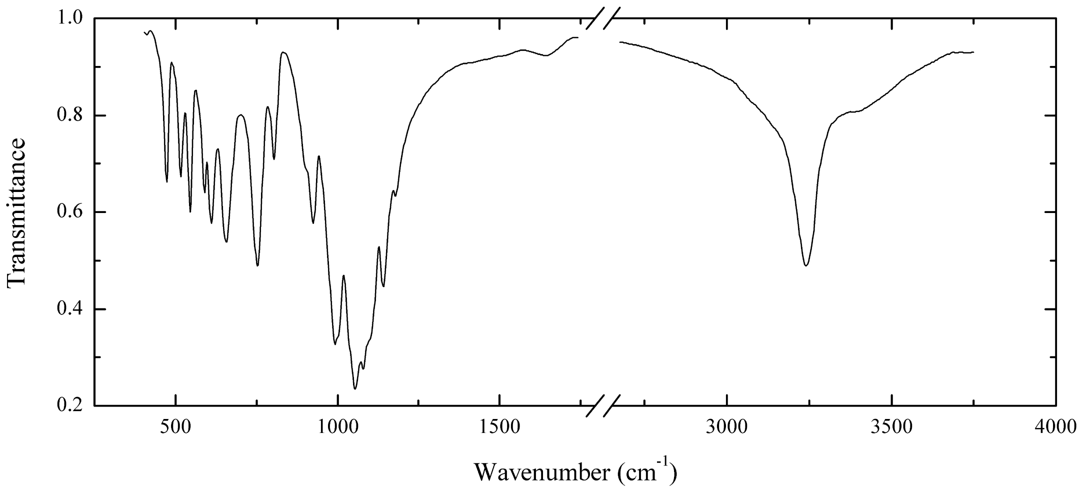


Locality: Siglo Veinte mine, Llallagua, Rafael Bustillo province, Potosí department, Bolivia.

Description: Crystalline crust from the association with paravauxite. The empirical formula is (electron microprobe) $Al_{2.4}Fe_{0.6}(PO_4)_{2.0}(OH,F)_3{\cdot}nH_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 11.0 (90), 8.55 (100), 7.15 (30), 5.69 (60), 4.35 (50), 4.04 (50), 3.44 (70), 3.22 (80), 3.08 (30), 2.563 (40).

Wavenumbers (cm^{-1}): 3520s, 3410sh, 3360sh, 3080, 1638, 1590sh, 1280sh, 1140sh, 1090sh, 1051s, 1020sh, 945sh, 863w, 733, 637s, 590, 548, 530sh, 487, 450.

P60 Väyrynenite $MnBe(PO_4)(OH)$

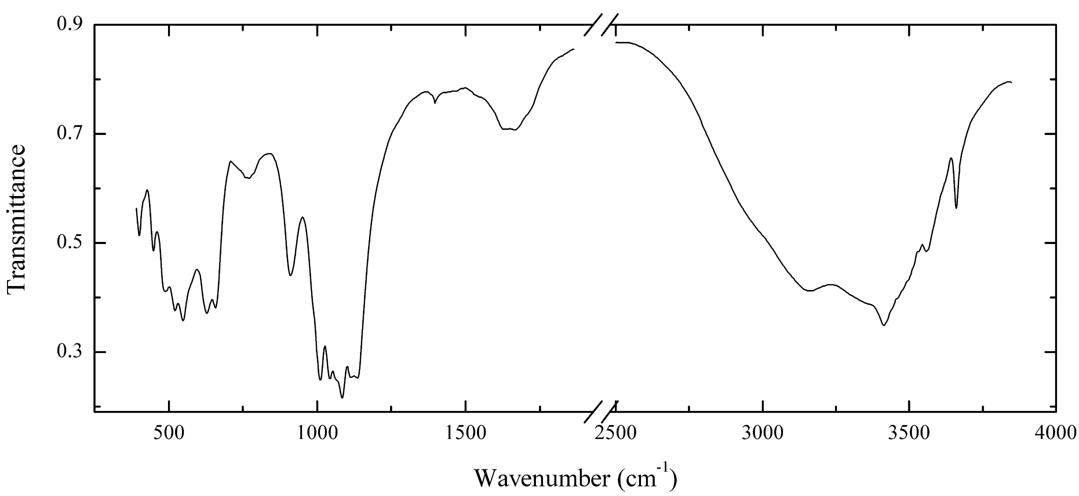


Locality: Viitaniemi pegmatite, Eräjärvi area, Orivesi, Finland.

Description: Pink grains from the association with muscovite, microcline, quartz, elbaite, topaz, beryllonite, amblygonite and fluorapatite. The empirical formula is (electron microprobe) $(Mn_{0.85}Fe_{0.1}Ca_{0.05})Be(PO_4)_{1.0}(OH)$.

Wavenumbers (cm^{-1}): 3215, 1176, 1137, 1100sh, 1078s, 1050s, 1035s, 990s, 922, 900sh, 800, 749, 650, 607, 586, 541, 513, 470.

P61 Vauxite $Fe^{2+}Al_2(PO_4)_2(OH)_2 \cdot 6H_2O$

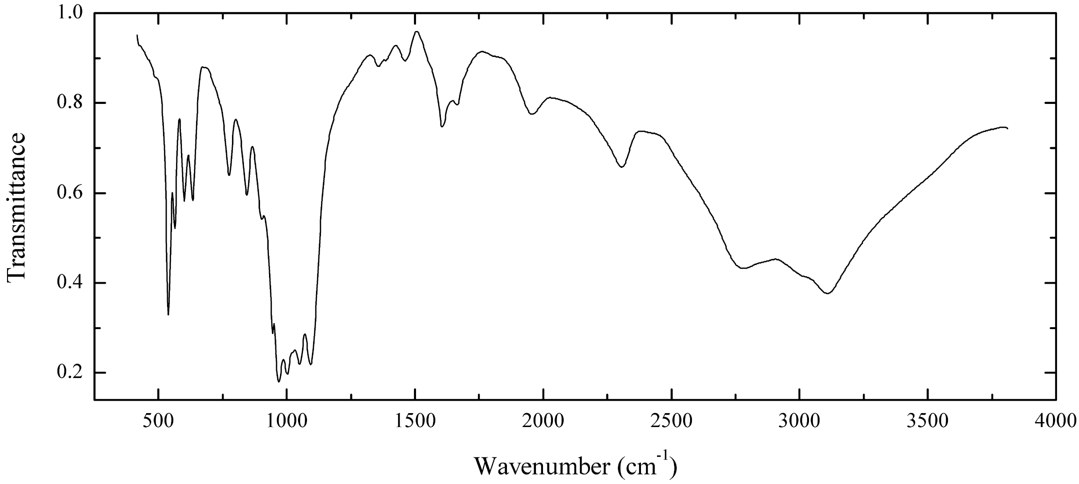


Locality: Siglo Veinte mine, Llallagua, Rafael Bustillo province, Potosí department, Bolivia (type locality).

Description: Blue crystals from the association with quartz, paravauxite and wavellite. Identified by IR spectrum. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 10.8 (100), 8.10 (80), 6.01 (80), 5.45 (90), 3.043 (80), 2.960 (50), 2.878 (90), 2.720(40).

Wavenumbers (cm^{-1}): 3645, 3555, 3490sh, 3407s, 3350sh, 3150, 2980sh, 1710sh, 1670, 1635, 1400w, 1135s, 1116s, 1080s, 1065sh, 1043s, 1009s, 985sh, 909, 763, 654, 621, 545, 520, 486, 445, 393.

P62 Anapaite $Ca_2Fe^{2+}(PO_4)_2 \cdot 4H_2O$

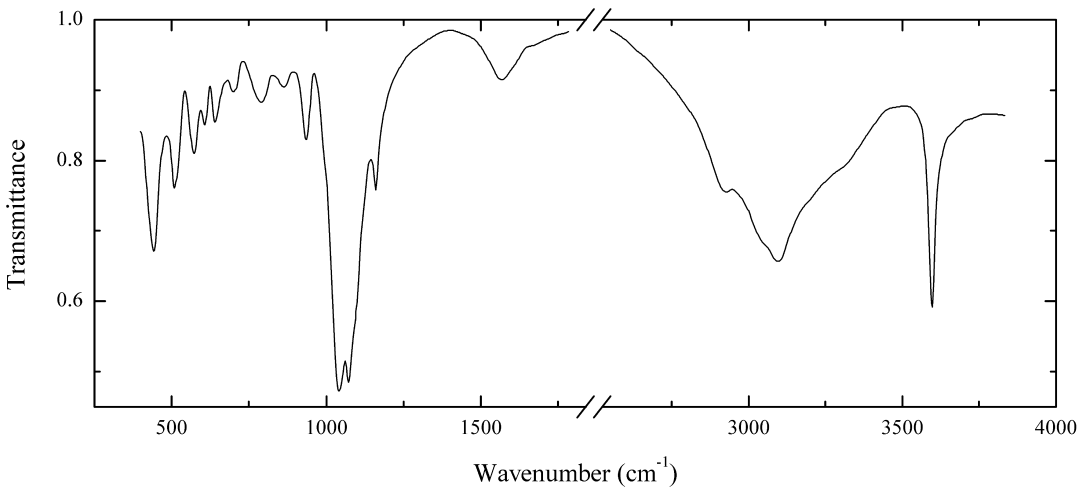


Locality: Chernomorskiy mine, Eltigen-Ortel deposit, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.

Description: Light green semitransparent crystals on iron ore. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3300sh, 3090, 3000sh, 2770, 2300, 1950, 1660, 1602, 1460w, 1390w, 1355w, 1097s, 1054s, 1030, 1005s, 970s, 945, 904, 848, 777, 634, 602, 563, 539, 490sh.

P63 Variscite $Al(PO_4) \cdot 2H_2O$

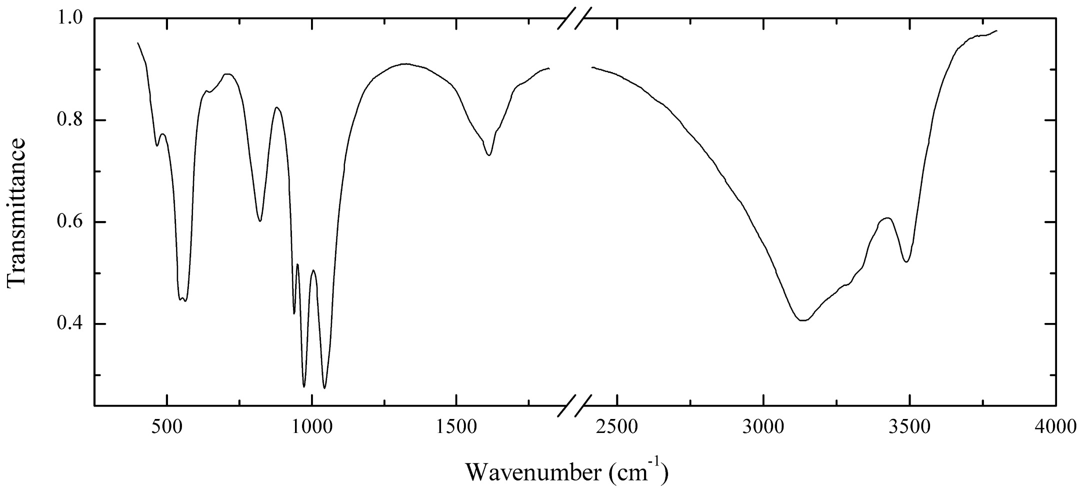


Locality: Galiléia, Minas Gerais, Brazil.

Description: Pink transparent crystals from the association with albite. Identified by IR spectrum. Fe-rich variety.

Wavenumbers (cm^{-1}): 3585s, 3300sh, 3190sh, 3095, 3060sh, 2930, 1600sh, 1570, 1156, 1068s, 1038s, 933, 866w, 790, 700w, 660sh, 640, 605, 571, 507, 444.

P65 Vivianite $Fe^{2+}_3(PO_4)_2 \cdot 8H_2O$

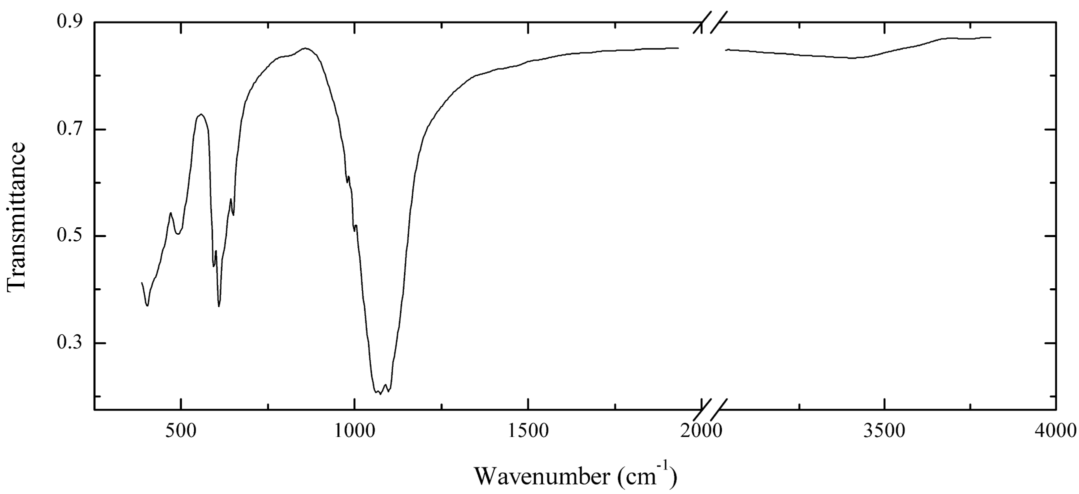


Locality: Chernomorskiy mine, Eltigen-Ortel deposit, Kerch iron-ore basin, Crimea, Ukraine.

Description: Bottle-green prismatic crystals in fossilized shell, in the association with siderite and aragonite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Fe_{2.86}Mg_{0.07}Mn_{0.02})(PO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3480, 3320sh, 3280sh, 3220sh, 3135s, 1735sh, 1660sh, 1617, 1575sh, 1540sh, 1045s, 972s, 939, 819, 660w, 563, 541, 465.

P66 Wagnerite $Mg_2(PO_4)F$

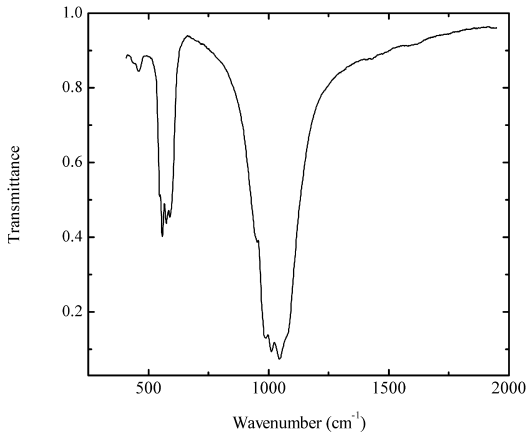


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Pale yellow platy crystals from the association with epsomite and hematite. Investigated by B.V. Chesnokov. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $(Mg_{1.88}Fe_{0.04}Mn_{0.02}Ca_{0.02}Ti_{0.01})(PO_4)_{1.00}F_{0.97}$. Optically biaxial (+), $\alpha = 1.566$, $\beta = 1.571$, $\gamma = 1.578$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 5.64 (25) (-200), 3.29 (40) (122), 3.12 (44) (040), 2.970 (100) (-401), 2.836 (66) (132), 2.752 (36) (103).

Wavenumbers (cm^{-1}): 1128sh, 1098s, 1075s, 1059s, 1020sh, 997, 977, 644, 620sh, 602, 589, 516sh, 486, 410sh, 400.

P67 Vitusite-(Ce) $Na_3(Ce,La)(PO_4)_2$

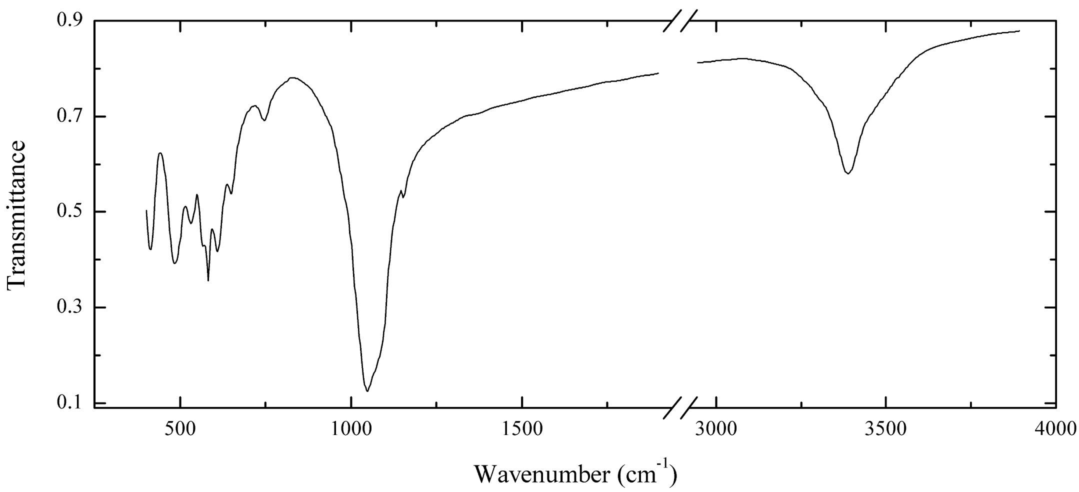


Locality: Alluaiv Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: Greenish grains with strong lilac fluorescence under UV radiation, from the association with ussingite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Na_{2.8}Ca_{0.2}Sr_{0.1})(Ce_{0.5}La_{0.3}Nd_{0.1}Pr_{0.05})(PO_4)_{2.0}$.

Wavenumbers (cm^{-1}): 1083sh, 1051s, 1016s, 991s, 957, 950sh, 597sh, 593, 575, 559, 548, 459w, 445w.

P68 Viitaniemiite $Na(Ca,Mn)Al(PO_4)(F,OH)_2(OH)$

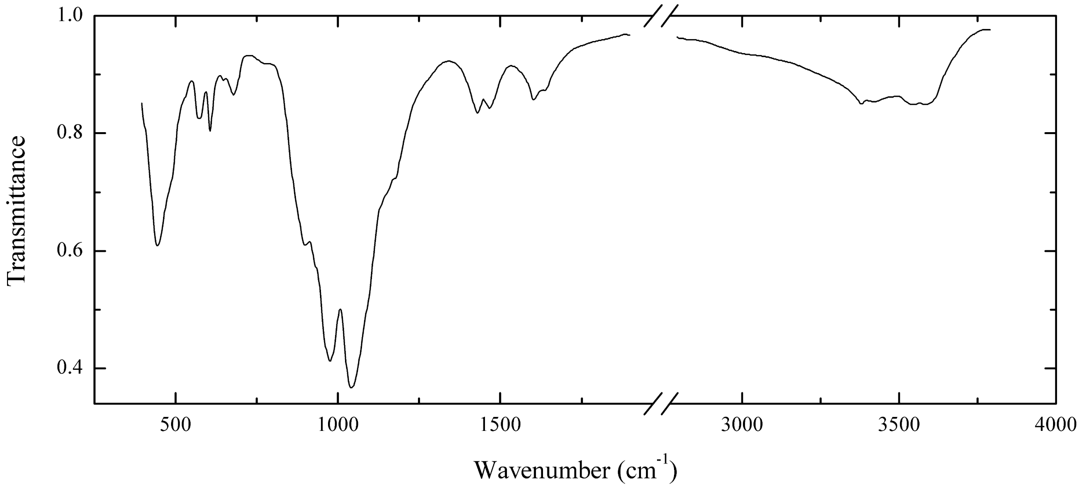


Locality: Tigrinoe Sn–W–Mo deposit, Primorskiy Kray, Sikhote-Alin range, Far East, Russia.

Description: Colourless twinned platy crystals, from the association with goyazite, gorceixite, triplite, apatite, herderite and fluorite. Investigated by V.I. Popova and V.A. Popov. Confirmed by IR spectrum. Monoclinic, $a = 6.849$, $b = 7.202$, $c = 5.492$ Å, $\beta = 108.95°$.The empirical formula is $Na_{1.00}Ca_{0.95}Mn_{0.04}Mg_{0.04}Al_{1.00}(PO_4)_{0.99}F_{2.03}(OH)_{1.00}$. $D_{meas} = 3.17$ g/cm^3, $D_{calc} = 3.13$ g/cm^3. Optically biaxial (−), $\alpha = 1.540$, $\beta = 1.550$, $\gamma = 1.557$, $2V_{meas} = -76°$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.18 (30) (001), 4.905 (40) (10-1), 3.235 (40) (200), 2.957 (50) (21-3, 140, 003), 2.902 (100) (12-1), 2.597 (60) (002), 2.179 (70) (031).

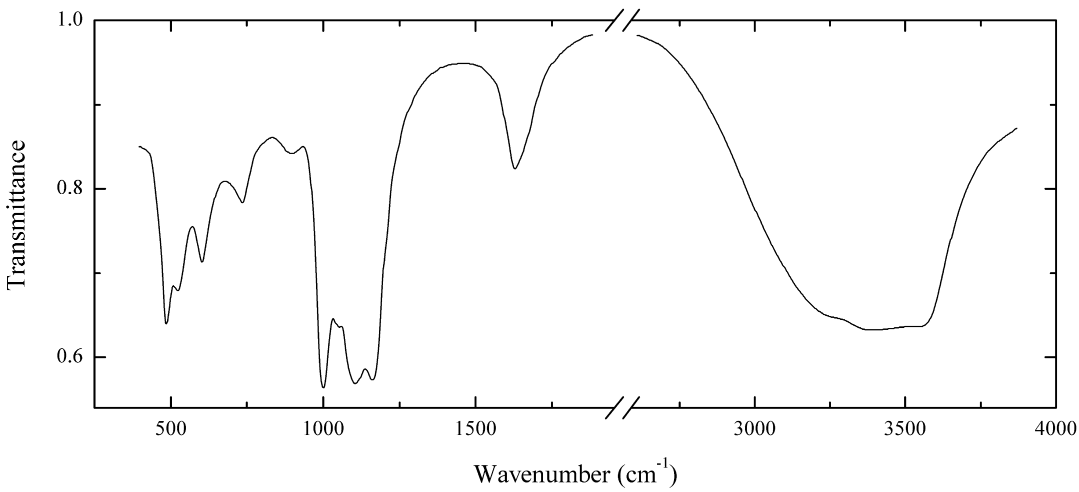
Wavenumbers (cm^{-1}): 3475sh, 3400, 1165, 1100sh, 1077sh, 1066sh, 1054s, 751w, 655, 617, 590, 573, 538, 492, 420.

P69 "Wilkeite" Fine oriented intergrowth of jennite with S,Si,C-apatite



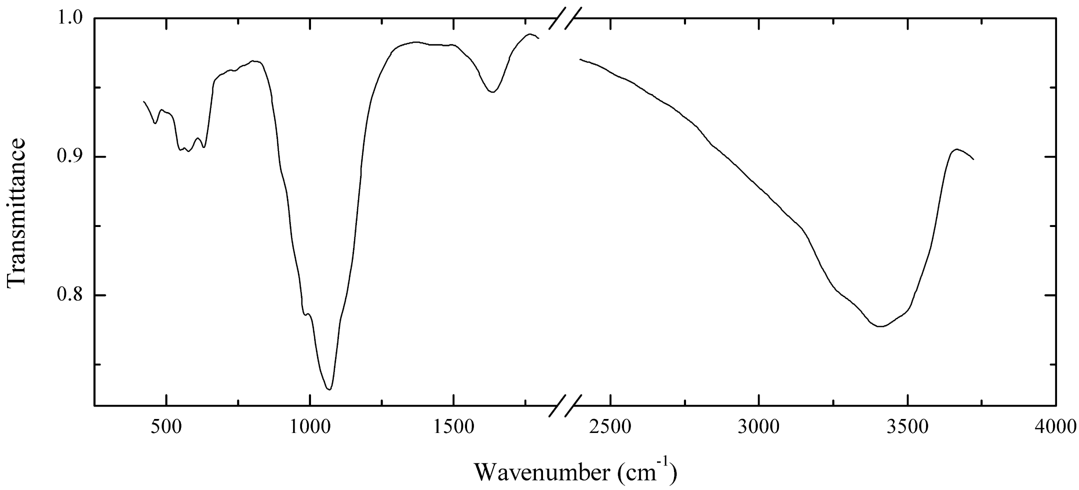
Locality: Crestmore, Riverside Co., California, USA.
Description: White fine-grained aggregate. The empirical formula of apatite is $K_{0.04}Ca_{10.00}(PO_4)_{3.00}(SiO_4)_{1.23}(SO_4)_{0.80}(CO_3)_{0.965}(OH,O)_2$.
Wavenumbers (cm^{-1}): 3532, 3497, 3335, 3320, 1635w, 1600, 1462, 1425, 1173, 1140sh, 1085sh, 1039s, 974s, 933, 898, 875sh, 773w, 679, 649w, 602, 565sh, 560, 475sh, 447.

P70 Vashegyite $Al_{11}(PO_4)_9(OH)_6 \cdot 38H_2O$



Locality: VanNavSan Claim, Eureka Co., Nevada, USA.
Description: White powdery. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3555s, 3370s, 3260sh, 1644, 1164s, 1110s, 1052, 1001s, 885w, 730, 600, 522, 482.

P71 Wilhelmvierlingite $CaMn^{2+}Fe^{3+}(PO_4)_2(OH)\cdot 2H_2O$

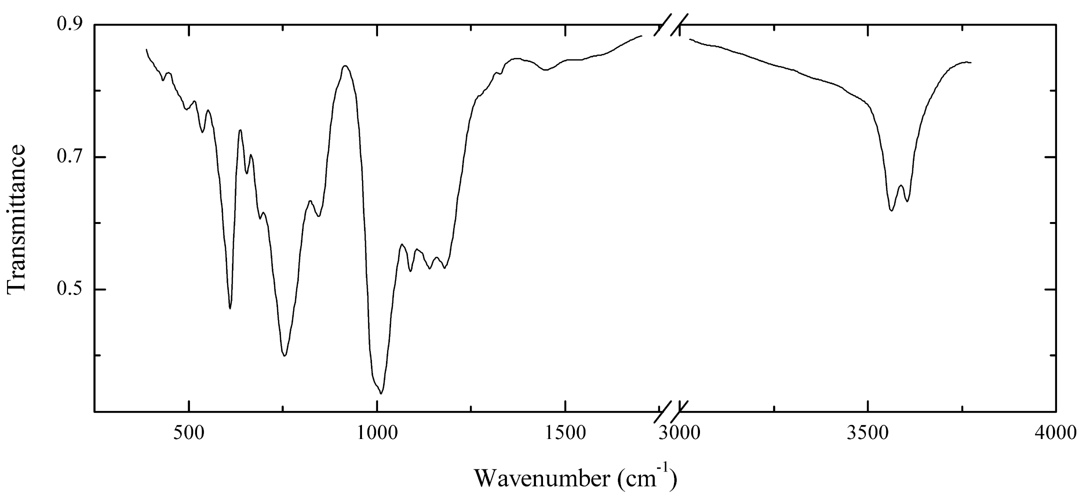


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Yellow prismatic crystals from pegmatite. Specimen No. 1984/1 from the Mining Museum, Saint-Petersburg, Russia.

Wavenumbers (cm^{-1}): 3535sh, 3470sh, 3385, 3250sh, 1632, 1110sh, 1063s, 981, 910sh, 623, 577, 547, 462w.

P72 Glucine $CaBe_4(PO_4)_2(OH)_4\cdot 0.5H_2O$

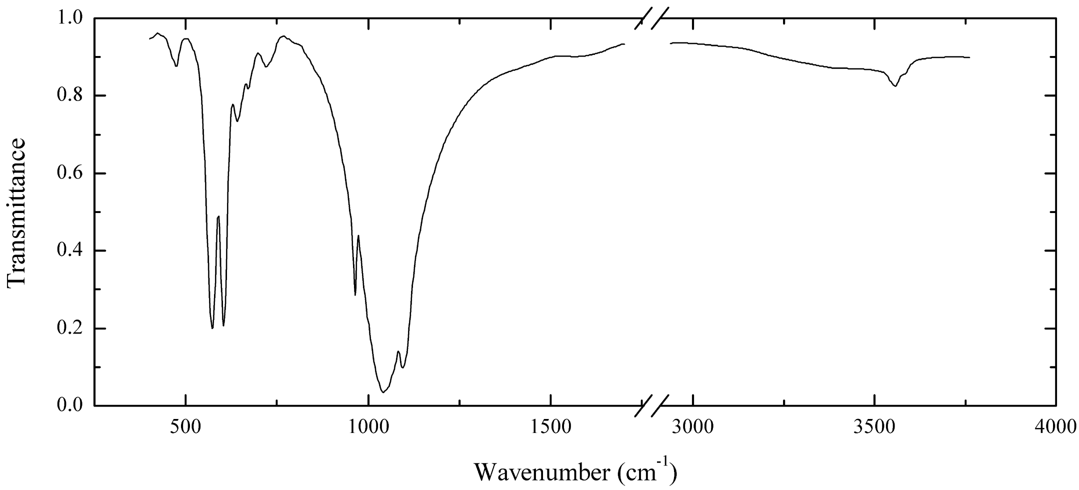


Locality: Boevskoe Be deposit, Kamensk-Ural'skii, Chelyabinsk region, South Urals, Russia (type locality).

Description: Yellowish crust from the association with crandallite and moraesite. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3575, 3530, 1570sh, 1530w, 1450w, 1182, 1143, 1090, 1012s, 995sh, 846, 755s, 690, 656, 612s, 538, 499w, 437w.

P73 Hydroxylapatite $Ca_5(PO_4)_3(OH)$

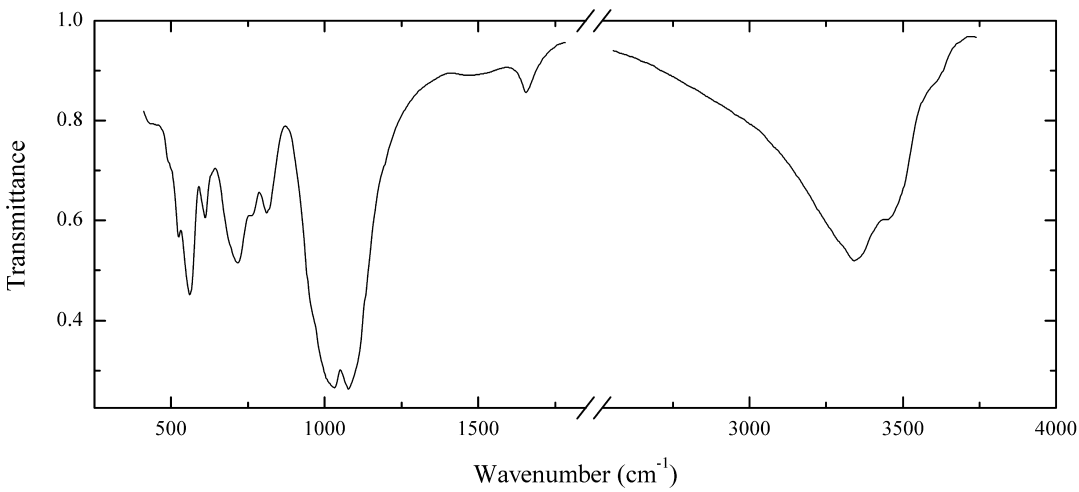


Locality: An unknown locality in Germany.

Description: Greenish-blue transparent. The empirical formula is $Ca_{4.93}Na_{0.05}Al_{0.02}Fe_{0.01}(PO_4)_{3.00}[F_{0.42}Cl_{0.03}(OH,O)_{0.55}]$.

Wavenumbers (cm^{-1}): 3555w, 3530w, 1091s, 1070sh, 1040s, 965, 718w, 670sh, 638, 601s, 570s, 472w.

P74 Greifensteinite $Ca_2Be_4(Fe^{2+},Mn)_5(PO_4)_6(OH)_4{\cdot}6H_2O$

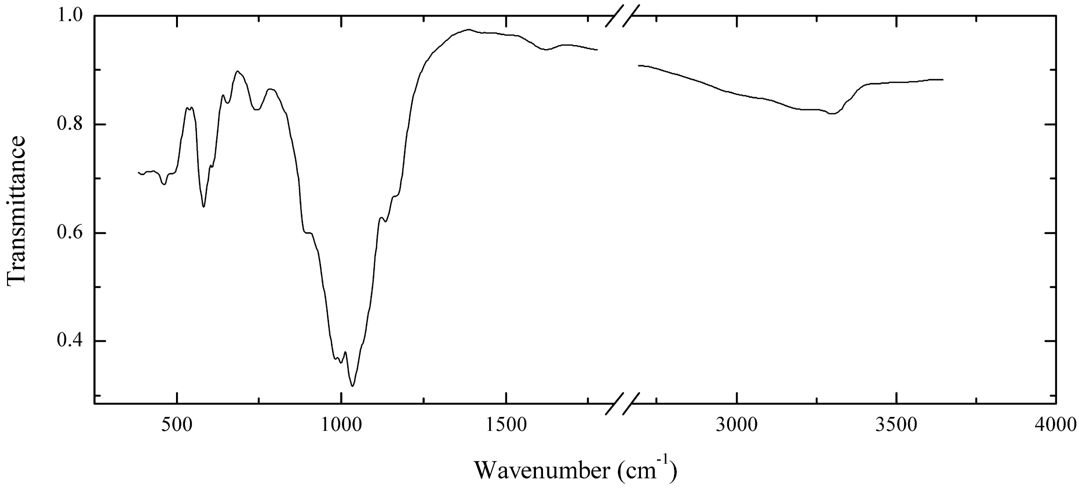


Locality: Greifenstein, near Ehrenfriedersdorf, Saxony, Germany (type locality).

Description: Green radial aggregates from the association with albite, potassic feldspar, roscherite, viitaniemiite, childrenite, quartz, apatite, herderite, elbaite and montmorillonite. Holotype sample. The crystal structure is solved. Monoclinic, space group *C*2/*c*, $a = 15.903(7)$, $b = 11.885(7)$, $c = 6.677(3)$ Å, $\beta = 94.68(4)°$. Optically biaxial (−), $\alpha = 1.624(2)$, $\beta = 1.634(2)$, $\gamma = 1.638(2)$. $D_{calc} = 2.95(2)$ g/cm^3, $D_{meas} = 2.93(2)$ g/cm^3. The empirical formula is $Ca_{0.99}Be_{2.05}(Fe^{2+}{}_{1.73}Mn^{2+}{}_{0.44}Al_{0.11}Mg_{0.05})[PO_4]_3(OH)_{1.86}{\cdot}3.26H_2O$. Strong lines of powder X-ray diffraction pattern, [*d*, Å (*I*, %) (*hkl*)] are 9.48 (100) (110), 5.94 (80) (020), 3.96 (90) (400), 2.982 (70) (202), 2.783 (80) (240), 2.638 (70) (600).

Wavenumbers (cm^{-1}): 3450, 3345s, 1658, 1110sh, 1079s, 1032s, 1020sh, 960sh, 813, 760, 720, 695sh, 610, 559, 523, 490sh, 440w.

P75 Giniite $Fe^{2+}Fe^{2+}_4(PO_4)_4(OH)_2{\cdot}2H_2O$

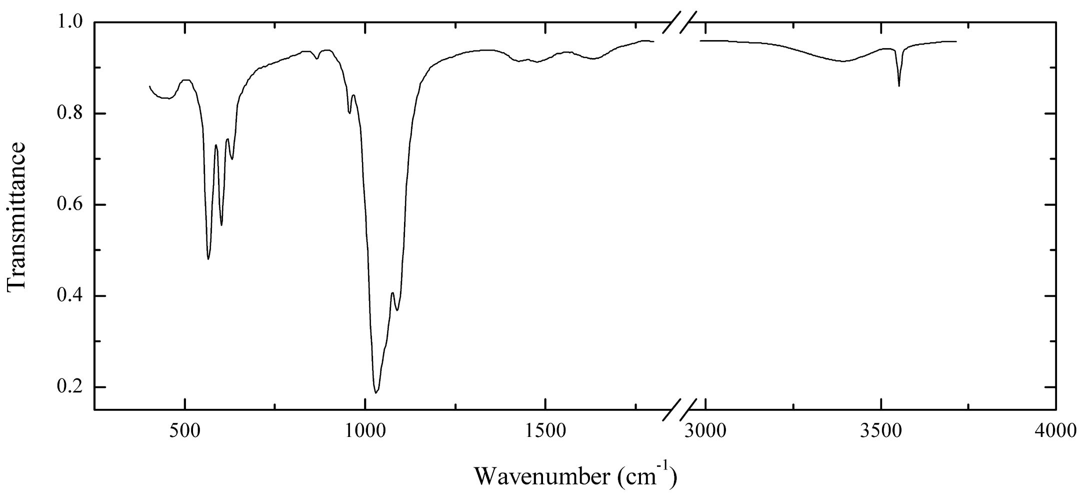


Locality: Sandamab (Sandamap), Usakos, Namibia (type locality).

Description: Dark greenish-black crystals from the association with barbosalite and phosphosiderite. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3290, 3190w, 1625w, 1170, 1135, 1033s, 1000s, 980s, 895, 740, 651w, 610, 581, 536w, 492, 463, (395).

P76 Hydroxylapatite $Ca_5(PO_4)_3(OH)$

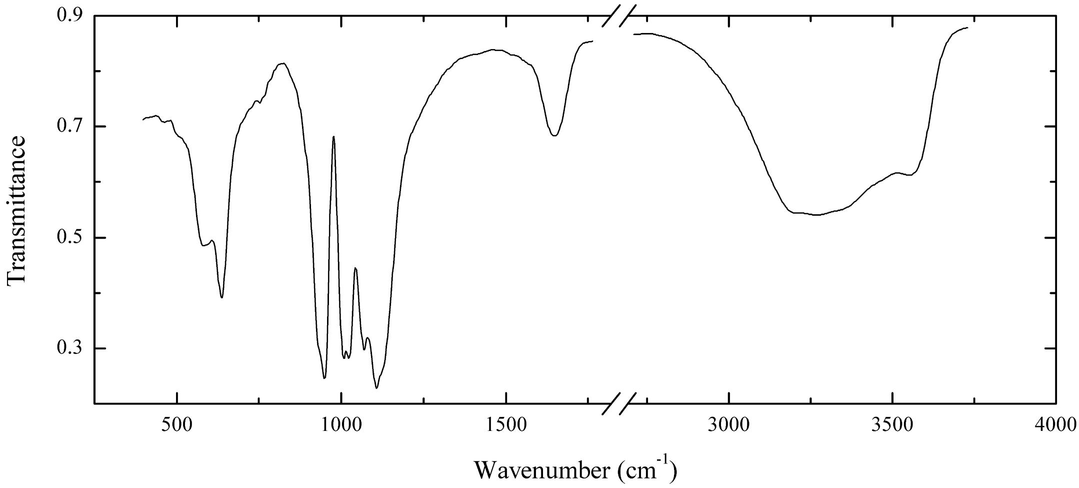


Locality: Synthetic.

Description: White powder. Confirmed by IR spectrum and powder X-ray diffraction pattern. Contains little H_2O molecules (the bands at 3,370 and 1,640 cm^{-1}) and CO_3^{2-} anions (the bands at 1,460, 1,430 and 867 cm^{-1}), probably in accordance with the substitution scheme $Ca^{2+} + 2PO_4^{3-} \rightarrow H_2O + 2CO_3^{2-}$.

Wavenumbers (cm^{-1}): 3530, 3370, 1640, 1460, 1430, 1093s, 1065sh, 1035s, 963, 867w, 633, 601, 564, 445.

P77 Hopeite $Zn_3(PO_4)_2{\cdot}4H_2O$

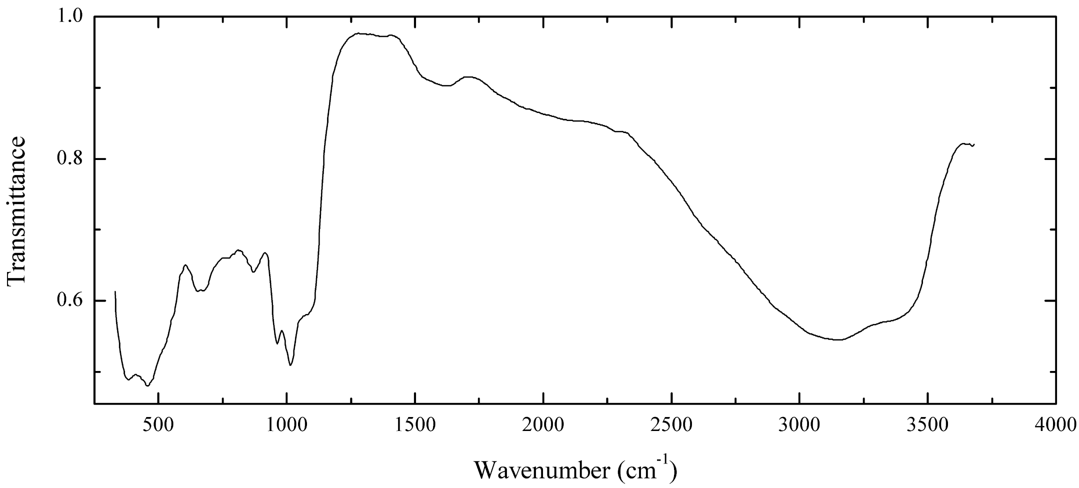


Locality: Broken Hill mines, Zimbabwe.

Description: Colourless crystal. Specimen No. 36759 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. IR spectrum coincides with that of synthetic orthorhombic $Zn_3(PO_4)_2{\cdot}4H_2O$.

Wavenumbers (cm^{-1}): 3530, 3300sh, 3250, 3160, 1640, 1125sh, 1109s, 1069s, 1024s, 1010s, 949s, 935sh, 750sh, 636, 600sh, 582.

P78 Gladiusite $Fe^{3+}_2(Fe^{2+}, Fe^{3+},Mg)_4(PO_4)(OH)_{11}{\cdot}H_2O$

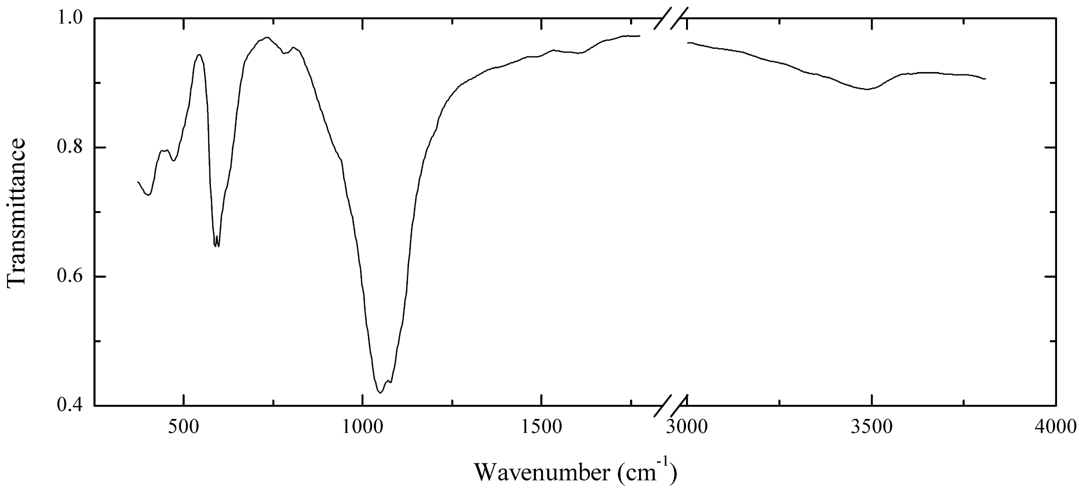


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Radial aggregate of dark green acicular crystals from dolomite carbonatite, from the association with collinsite, rimkorolgite, bobierrite, strontiowhitlockite, juonniite, a ternovite-like mineral, pyrrhotite, pyrite, rutile and catapleiite. The empirical formula is (electron microprobe) $Fe_{4.2}Mg_{1.7}Ca_{0.1}(PO_4)_{1.0}(OH)_{11}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3350, 3160s, 2150sh, 1630w, 1550sh, 1090sh, 1019s, 966, 878, 765w, 671, 550sh, 520sh, 467s, 410s.

P79 Wagnerite $Mg_2(PO_4)F$

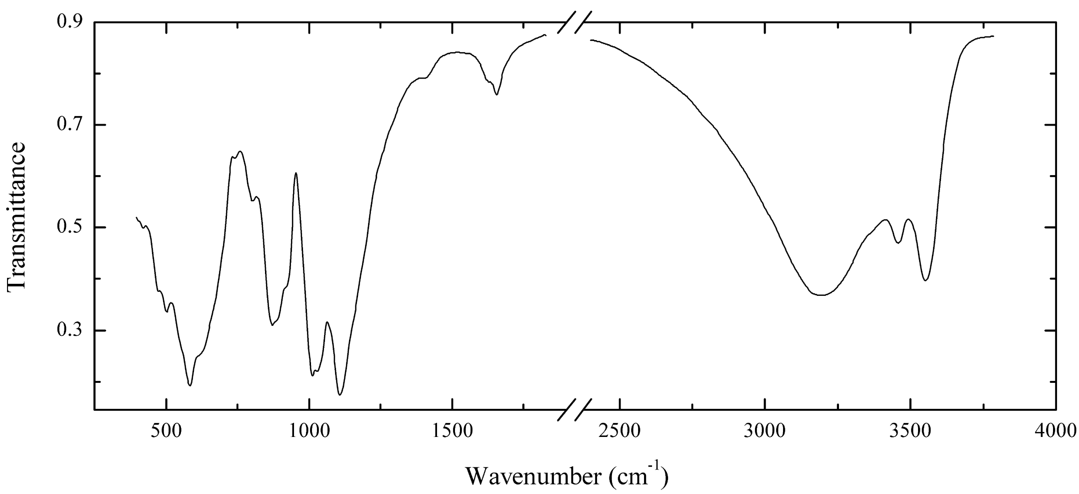


Locality: Hålsjöberget, Värmland, Sweden.

Description: Orange-brown grains from the association with kyanite, lazulite, apatite and rutile. The empirical formula is (electron microprobe) $(Mg_{1.71}Fe_{0.22}Mn_{0.06}Ca_{0.01})(PO_4)_{1.00}F_{0.8}(OH)_{0.2}$.

Wavenumbers (cm^{-1}): 3490, 1610w, 1110sh, 1079, 1052, 945sh, 796w, 620sh, 597, 587, 471, 400.

P80 Gorceixite $BaAl_3[PO_3(O,OH)]_2(OH,H_2O)_6$

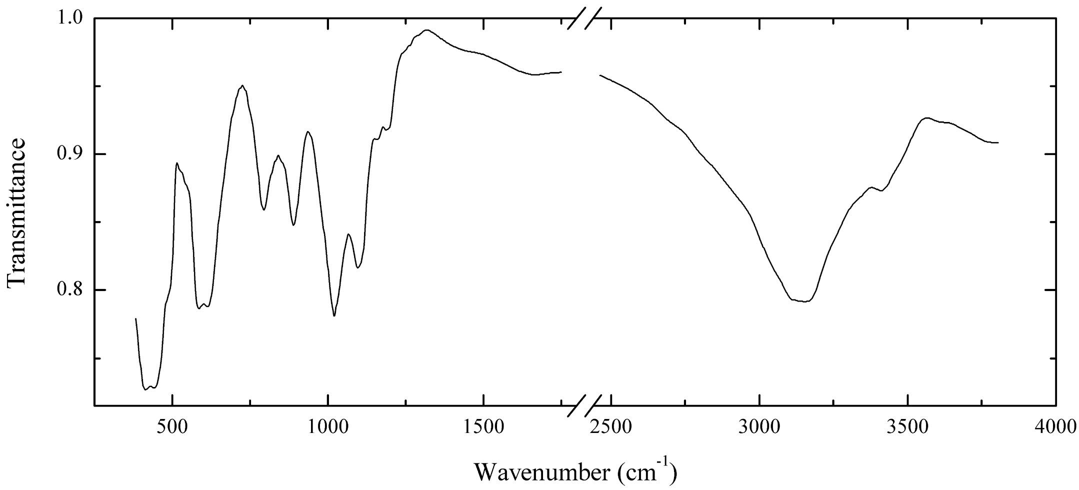


Locality: Ehrenfriedersdorf, Saxony, Germany.

Description: Yellow crystalline crust. The empirical formula is $(Ba_{0.83}Sr_{0.10}Ca_{0.04})(Al_{2.99}Fe_{0.06}Mg_{0.05})[P_{1.81}As_{0.19}O_3(O,OH)](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3537, 3455, 3180, 1655, 1625sh, 1410w, 1109s, 1031s, 1011s, 920sh, 890sh, 872, 803, 743w, 670sh, 615sh, 583s, 550sh, 501, 474, 412w.

P81 Hinsdalite $PbAl_3[(P,S)O_4]_2(OH,H_2O)_6$

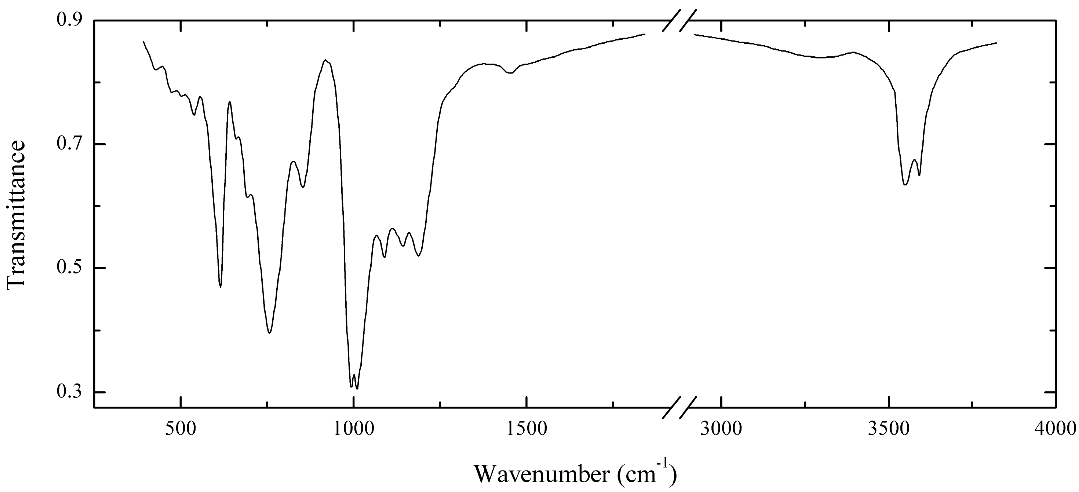


Locality: Dornbach, Carinthia, Austria.

Description: Light green crystals. The empirical formula is $Pb_{1.09}(Al_{2.54}Fe_{0.27}Zn_{0.02})(PO_4)_{1.46}(SO_4)_{0.54}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3400, 3135s, 3100sh, 1650w, 1570w, 1190, 1170, 1101, 1023s, 891, 795, 620s, 590s, 490sh, 452s, 438s.

P82 Glucine $CaBe_4(PO_4)_2(OH)_4{\cdot}0.5H_2O$

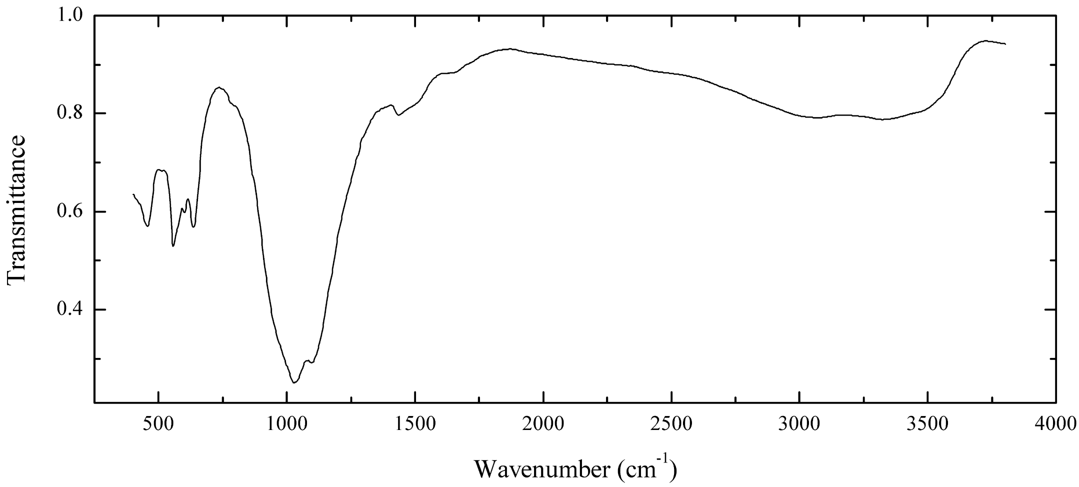


Locality: Boevskoe Be deposit, Kamensk-Ural'skii, Chelyabinsk region, South Urals, Russia (type locality).

Description: Yellowish crust from the association with crandallite and montmorillonite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3570, 3525, 3280w, 1570w, 1520w, 1455w, 1185, 1144, 1090, 1010s, 994s, 852, 780sh, 752s, 691, 658, 611s, 600sh, 580sh, 528, 499w, 474w, 435w, 405sh.

P83 Griphite $Ca_4(Mn,Na,Ca,Fe)_{22}Li_2(Fe,Al,\square)_4(Al,Fe)_8[PO_4,(OH)_4]_{24}(F,OH)_8$

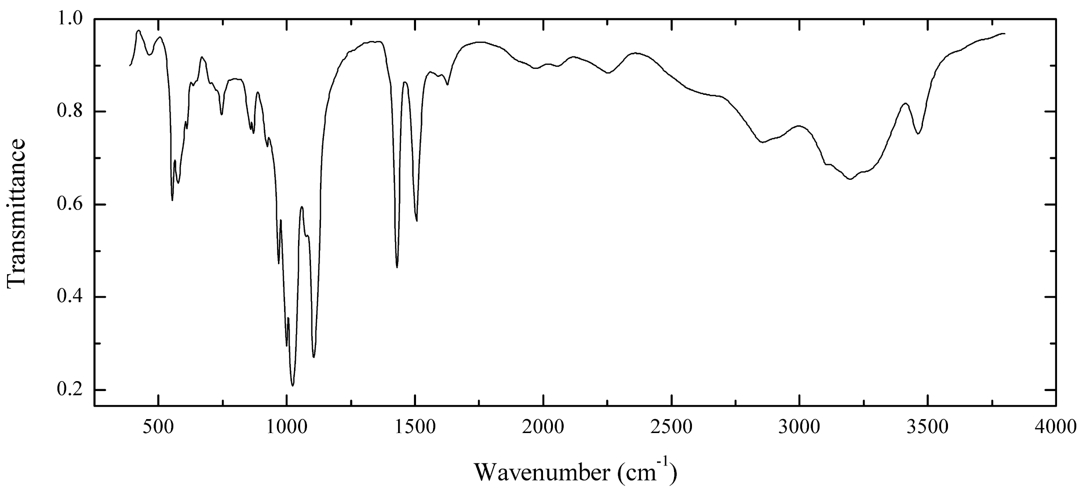


Locality: Everly pegmatite, Harney City, Pennington Co., South Dakota, USA (type locality).

Description: Greenish-grey, massive. The empirical formula calculated on the basis $Li_2(PO_4)_{24}(F,OH)_8$, taking into account charge-balance requirement, is (electron microprobe) $Na_{6.05}Ca_{5.53}Mn^{2+}{}_{14.53}Fe^{2+}{}_{2.71}Mg_{0.26}Fe^{3+}{}_{1.46}Al_{7.17}Li_2(PO_4)_{24.00}F_{4.5}(OH)_{3.5}$. The band at 1,426 cm^{-1} indicate the presence of carbonate groups or H^+ cation.

Wavenumbers (cm^{-1}): 3535sh, 3440, 3340sh, 3285, 3030, 1635w, 1490sh, 1426, 1098s, 1028s, 970sh, 860sh, 634, 602, 570sh, 556, 509w, 455, 420sh.

P84 Girvasite $NaCa_2Mg_3(PO_4)_2(H_2PO_4)(CO_3)(OH)_2{\cdot}4H_2O$

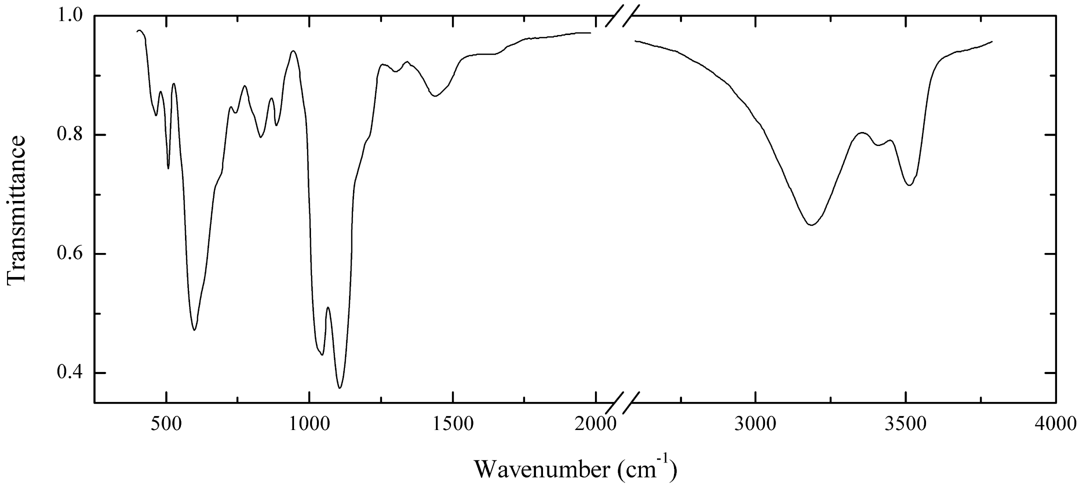


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: White granular aggregate from dolomite carbonatite, from the association with bobierrite and pyrite. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/c$, $a = 6.522(3)$, $b = 12.25(3)$, $c = 21.56(2)$ Å, $\beta = 89.48(5)°$, $Z = 4$. The empirical formula is $Na_{1.05}Ca_{1.95}(Mg_{3.00}Fe^{3+}_{0.11}Mn_{0.01})(PO_4)_2(H_2PO_4)(CO_3)_{1.10}\cdot 4.53H_2O$. $D_{meas} = 2.46$ (2) g/cm^3, $D_{calc} = 2.42$ g/cm^3. Optically biaxial (−), $\alpha = 1.541(2)$, $\beta = 1.557(2)$, $\gamma = 1.565(2)$, $2V_{meas} = -60(5)°$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 10.72 (100), 3.57 (80), 2.016 (35), 3.08 (32), 2.108 (32), 3.42 (26), 2.817 (26).

Wavenumbers (cm^{-1}): 3445, 3240, 3180, 3155sh, 3105, 2900sh, 2845, 2650sh, 2250w, 2050w, 1965w, 1900sh, 1625w, 1590w, 1507, 1431, 1104s, 1080, 1023s, 1000s, 970, 923, 871, 860, 760sh, 747, 720sh, 701w, 650sh, 639w, 612, 595sh, 577, 554, 465w.

P85 Goyazite $SrAl_3(PO_4)_2(OH,H_2O)_6$

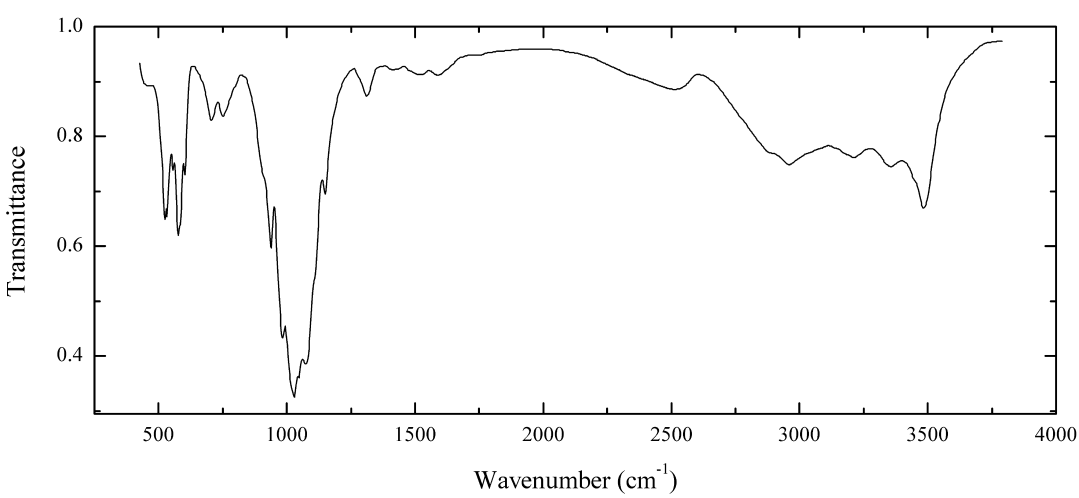


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White powdery aggregate from dolomite carbonatite, from the association with gorceixite and rhabdophane-(Ce). Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $(Sr_{0.51}Ba_{0.47}Ca_{0.04}Ce_{0.03})(Al_{2.62}Fe_{0.13}Mg_{0.05})(PO_4)_{2.00}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3482, 3380, 3160, 1635w, 1465sh, 1435, 1302w, 1200sh, 1106s, 1046s, 1030sh, 890sh, 883, 830, 739, 690sh, 630sh, 597s, 550sh, 507, 466, 450sh.

P87 Hureaulite $Mn^{2+}_5(PO_4)_2(HPO_4)_2\cdot 4H_2O$

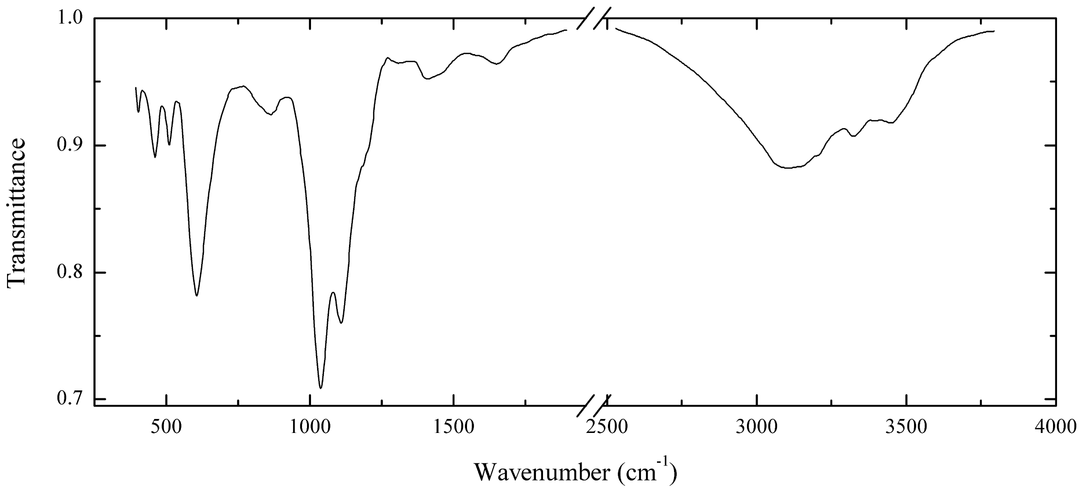


Locality: Viitaniemi pegmatite, Eräjärvi area, Orivesi, Finland.

Description: Pink cellular aggregates from the association with lithiophilite and alluaudite. The empirical formula is (electron microprobe) $(Mn_{4.3}Fe_{0.5}Ca_{0.1})(PO_4)_2(HPO_4)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3420, 3300, 3170, 2920, 2850sh, 2495w, 1620sh, 1575w, 1515w, 1400w, 1302, 1147, 1105sh, 1074s, 1043s, 1027s, 1015sh, 981s, 935, 910sh, 751, 706, 602, 580sh, 576, 556, 532, 525, 450.

P88 Goyazite $SrAl_3(PO_4)_2(OH,H_2O)_6$

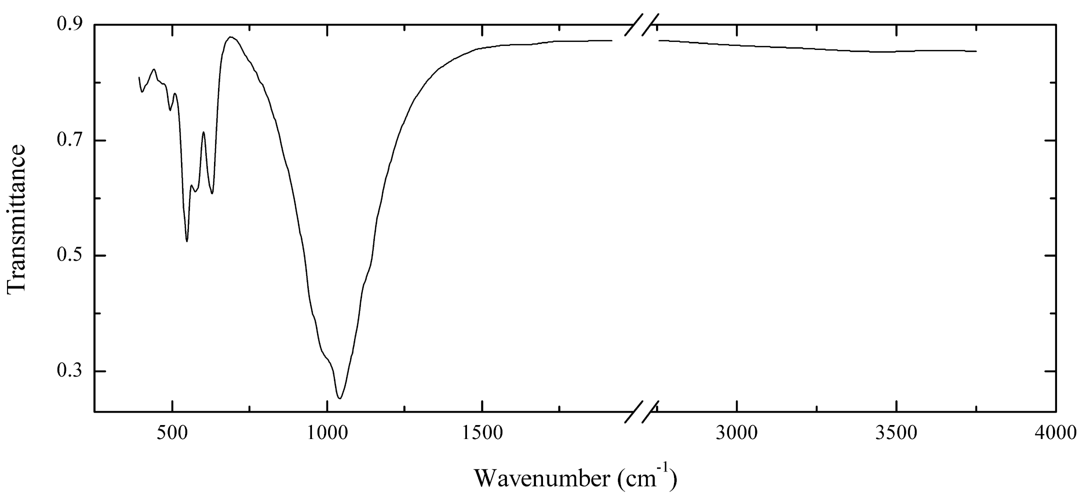


Locality: Clay Canyon, Fairfield, Utah Co., Utah, USA.

Description: Yellowish spherulites from the association with gordonite. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $(Sr_{0.92}Ca_{0.06})Al_{3.02}[(PO_4)_{1.94}(SiO_4)_{0.06}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3420w, 3300, 3100, 1652w, 1430w, 1310w, 1190sh, 1107s, 1034s, 862, 607s, 507, 462, 405w.

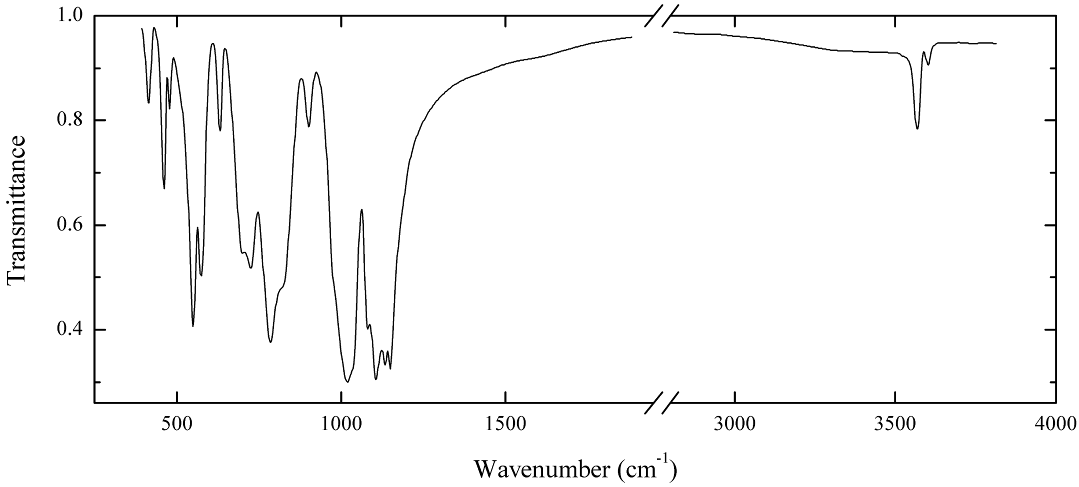
P89 Graftonite $Fe^{2+}{}_3(PO_4)_2$



Locality: Tip Top pegmatite, Custer, Custer Co., South Dakota, USA.

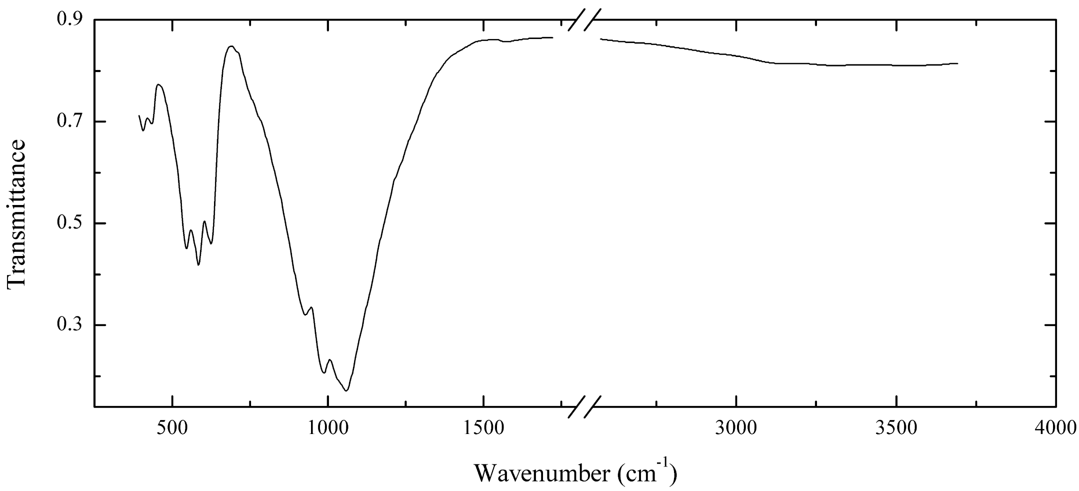
Description: Yellowish-pink platy crystals from the association with triploidite. Specimen No. 1354/1 from the Mining Museum, Saint-Petersburg, Russia.
Wavenumbers (cm^{-1}): 1138sh, 1040s, 1000sh, 930sh, 630, 580, 546, 492w, 460sh, 400w.

P90 Herderite $CaBe(PO_4)(F,OH)$



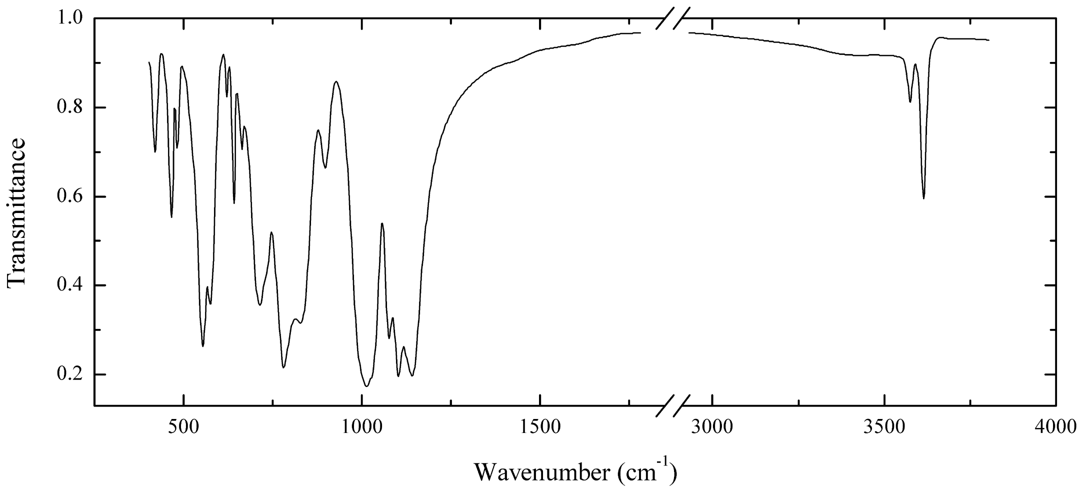
Locality: Nagornoe deposit, Pyrkakaiskiy ore knot, Chukchi peninsula, Russia.
Description: Colourless crystals from the association with quartz and topaz. Identified by IR spectrum and powder X-ray diffraction pattern. Differs from hydroxylherderite by the band at 3,565 cm^{-1} and very low intensity of the band at 3,600 cm^{-1}.
Wavenumbers (cm^{-1}): 3600w, 3565, 1147s, 1136s, 1105s, 1080, 1030sh, 1017s, 980sh, 901, 820sh, 785s, 724, 696, 632, 570, 548s, 477w, 459, 413.

P91 Graftonite $Fe^{2+}{}_3(PO_4)_2$



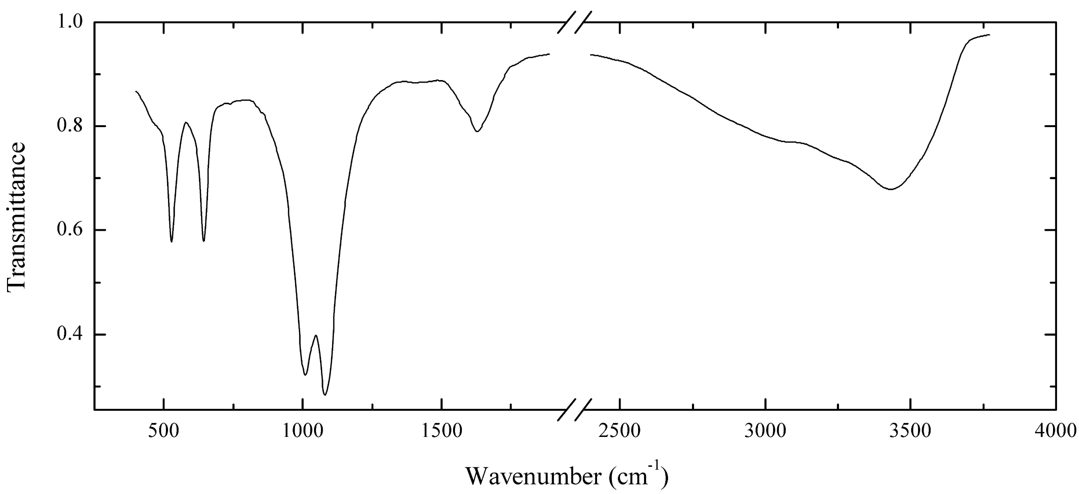
Locality: Berg, Sollefteå, Ångermanland, Sweden.
Description: Brown massive from the association with wolfeite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1575w, 1061s, 1035sh, 987s, 929s, 623, 584, 543, 429w, 395.

P92 Hydroxylherderite $CaBe(PO_4)(OH,F)$



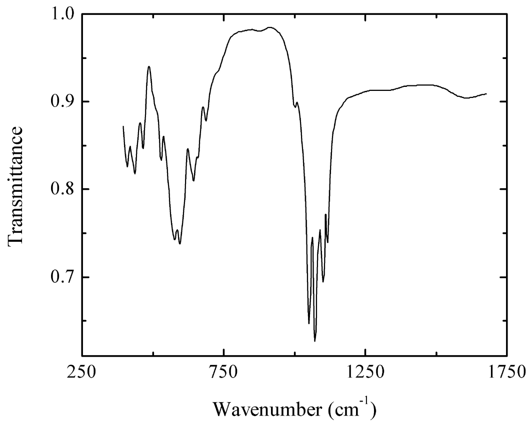
Locality: Luftenberg, St Georgen an der Gusen, Perg, Mühlviertel, Upper Austria, Austria.
Description: Colourless grain. Identified by IR spectrum. Differs from herderite by rather strong band at 3,600 cm^{-1} and relatively low intensity of the band at 3,567 cm^{-1}.
Wavenumbers (cm^{-1}): 3600, 3567, 1139s, 1102s, 1074s, 1025sh, 1011s, 898, 826, 779s, 730sh, 711, 658, 638, 618w, 569, 549s, 479, 461, 415.

P93 "Hydroxenotime-(Y)" $Y(PO_4)\cdot nH_2O$



Locality: Ploskaya Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: Brown grains from granitic pegmatite. By the powder X-ray diffraction pattern corresponds to xenotime, but contains water. Investigated by A.V. Voloshin.
Wavenumbers (cm^{-1}): 3395, 3250sh, 3060sh, 1625, 1585sh, 1077s, 1006s, 642, 525, 470sh.

P94 Bøggildite $Sr_2Na_2Al_2(PO_4)F_9$

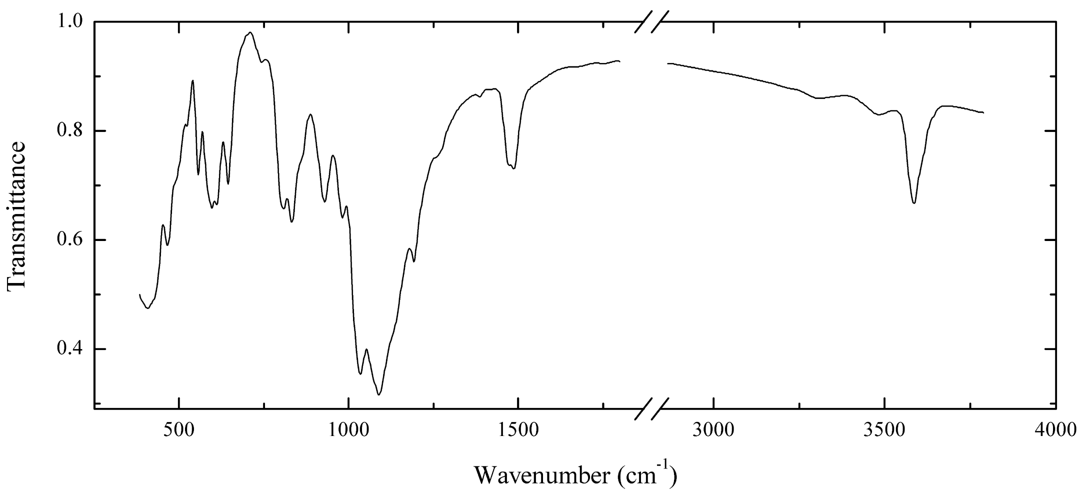


Locality: Ivigtut cryolite deposit, Ivittuut municipality, West Greenland, Greenland (type locality).

Description: Reddish semitransparent columnar aggregate from the association with fluorite, cryolite, sphalerite, pyrite, zircon, chalcopyrite, galena, molybdenite, albite, muscovite and quartz. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/c$, $a = 5.251(3)$, $b = 10.464(5)$, $c = 18.577(9)$ Å, $\beta = 107.53(3)°$, $Z = 4$. The empirical formula is $Sr_{2.04}Na_{2.03}Al_{2.01}(PO_4)_{1.00}F_{8.97}$. $D_{meas} = 3.66$ g/cm^3, $D_{calc} = 3.692$ g/cm^3. Optically biaxial (+), $\alpha = 1.462(2)$, $\beta = 1.466(2)$, $\gamma = 1.469(2)$, $2V_{meas} = -78°$to $-80°$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.162 (100), 3.893 (80), 3.96 (65), 3.127 (65), 2.627 (65), 2.878 (50), 2.865 (50).

Wavenumbers (cm^{-1}): 1120, 1102s, 1073s, 1054s, 1002, 735sh, 687, 659, 642, 596s, 577s, 528, 505sh, 467, 436, 402.

P95 Holtedahlite $Mg_{12}(PO_4)_5(HPO_4,CO_3)(OH,O)_6$

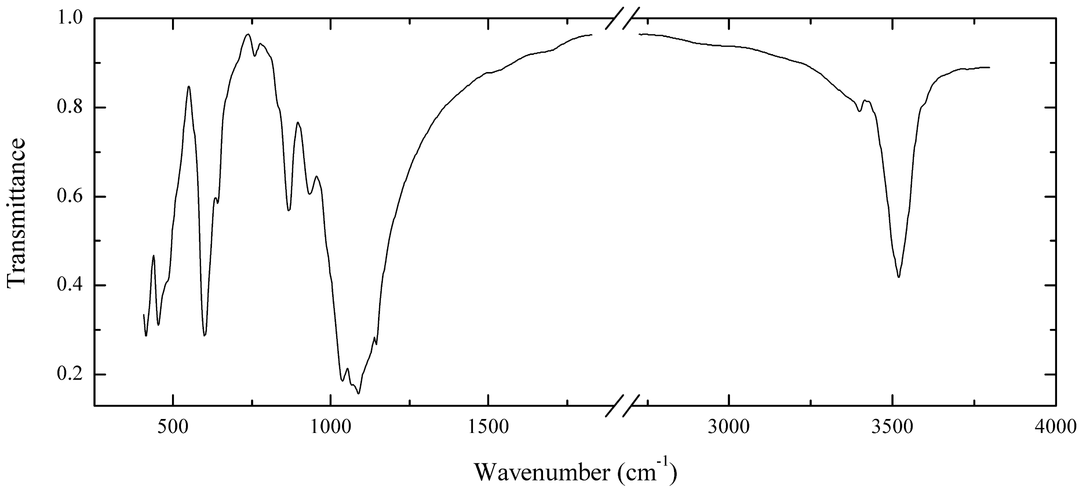


Locality: Tingelstadtjern quarry, Modum, Buskerud, Norway (type locality).

Description: Colourless grains from the association with althausite, talc, apatite and magnesite. Identified by IR spectrum.

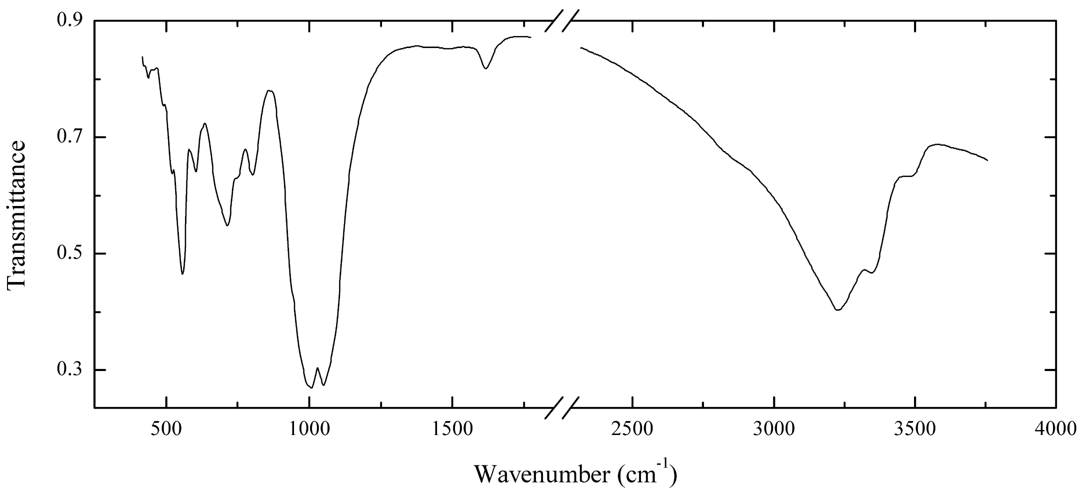
Wavenumbers (cm^{-1}): 3572, 3470w, 3285w, 1490, 1475, 1390w, 1260sh, 1193, 1135sh, 1090s, 1035s, 983, 930, 860sh, 833, 807, 741w, 643, 609, 597, 590sh, 556, 523w, 490sh, 465, 420sh, 402.

P96 Althausite $Mg_4(PO_4)_2(OH,O)(F,\square)$



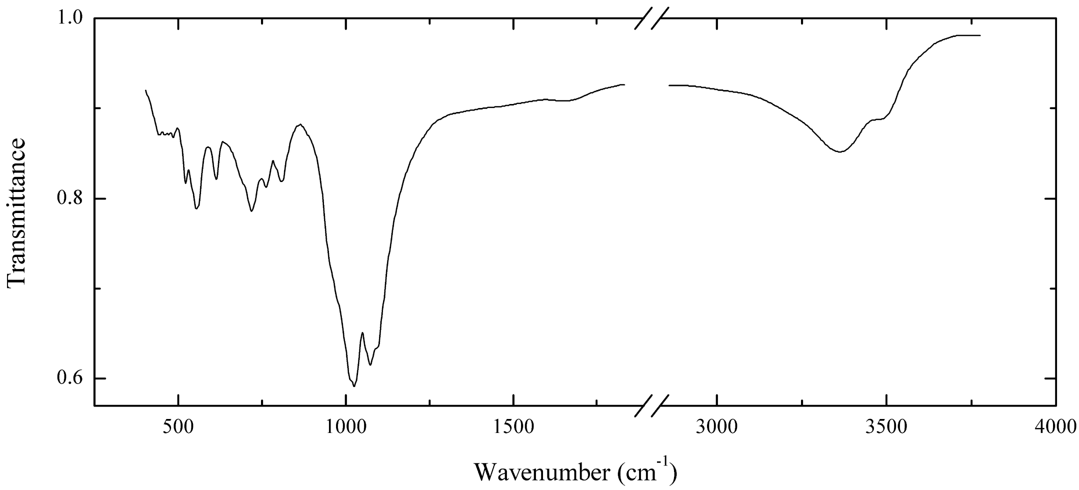
Locality: Tingelstadtjern quarry, Modum, Buskerud, Norway (type locality).
Description: Brownish grains in serpentine. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3505, 1144, 1120sh, 1110sh, 1088s, 1068s, 1045sh, 1038s, 990sh, 950, 885sh, 868, 759w, 639, 600, 480sh, 451, 414.

P97 Greifensteinite $Ca_2Be_4(Fe^{2+},Mn)_5(PO_4)_6(OH)_4{\cdot}6H_2O$



Locality: Gunnislake Clitters mine, Gunnislake, Calstock, Callington district, Cornwall, England, UK.
Description: Dark green radial aggregates from the association with fluorapatite. The empirical formula is (electron microprobe) $Ca_{2.05}Be_4(Fe^{2+}{}_{4.40}Al_{0.16}Mn^{2+}{}_{0.14}Mg_{0.07})[PO_4]_{6.00}(OH)_4{\cdot}nH_2O$. According to Mössbauer spectrum, all iron is bivalent.
Wavenumbers (cm^{-1}): 3600, 3450, 3325, 1665w, 1110sh, 1077s, 1036s, 1025sh, 960sh, 815, 762, 724, 695sh, 609, 562, 523, 490w, 437w, 425w.

P98 Footemineite $Ca_2Mn^{2+}\square Mn^{2+}_2Mn^{2+}_2Be_4(PO_4)_6(OH)_4\cdot 6H_2O$

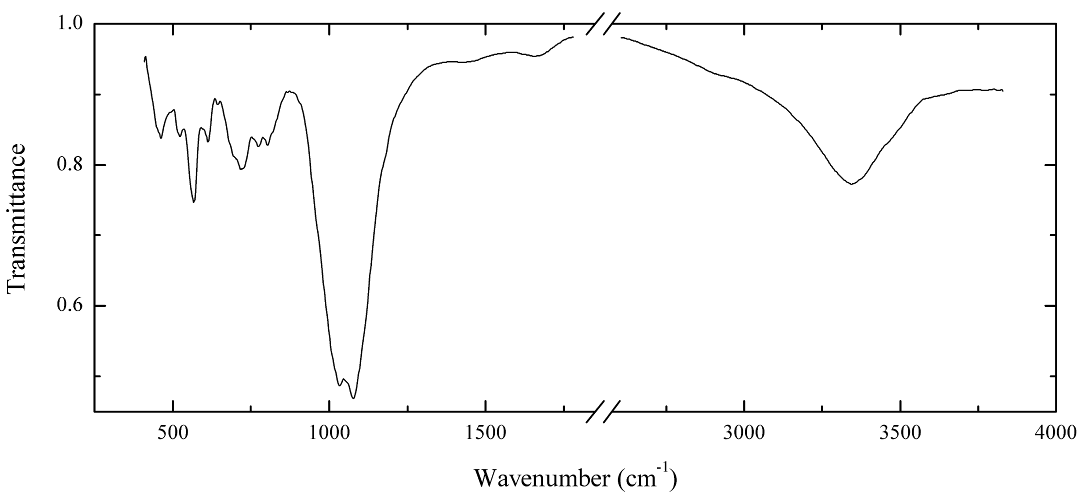


Locality: Foote Mine, Cleveland, North Carolina, USA (type locality).

Description: Yellow split prismatic crystals from the association with albite, analcime, fluorapatite, fairfieldite, eosphorite, siderite, rhodochrosite, pyrite, quartz and milarite. Holotype sample. The crystal structure is solved. The space group is $P\bar{1}$. Unit-cell parameters are $a = 6.742(3)$, $b = 9.883(8)$, $c = 9.981(6)$ Å, $\alpha = 74.12(6)°$, $\beta = 86.10(4)°$, $\gamma = 87.36(5)°$, $V = 637.9(7)$ Å^3, $Z = 1$. $D_{calc} = 2.940$ g/cm^3. Optically biaxial (–), $\alpha = 1.620(2)$, $\beta = 1.627(2)$, $\gamma = 1.634(2)$, $2V_{obs} = 80°$. The empirical formula is $(Ca_{1.93}Sr_{0.03}Ba_{0.02})_{\Sigma 1.98}Mn^{2+}_{0.79}(Mn^{2+}_{3.44}Fe^{2+}_{0.53}Al_{0.03})_{\Sigma 4.00}Be_4(P_{5.92}Si_{0.08}O_{24})$ $(OH)_{3.50}\cdot 6.60H_2O$. The strongest reflections of the powder diffraction pattern [d, Å (I, %) (hkl)] are 9.393 (53) (010), 5.922 (100) (0-11), 4.799 (26) (021), 3.173 (44) (211), 2.983 (14) (0-22), 2.787 (35) (0-31), 2.636 (29) (033), 2.413 (14) (231).

Wavenumbers (cm^{-1}): 3580sh, 3500sh, 3480, 3350, 3200sh, 1665w, 1100sh, 1075s, 1028s, 1015s, 970sh, 950sh, 810, 762, 720, 695sh, 611, 555, 522, 490w, 475w, 460w, 445w.

P99 Greifensteinite $Ca_2Be_4(Fe^{2+},Mn)_5(PO_4)_6(OH)_4\cdot 6H_2O$

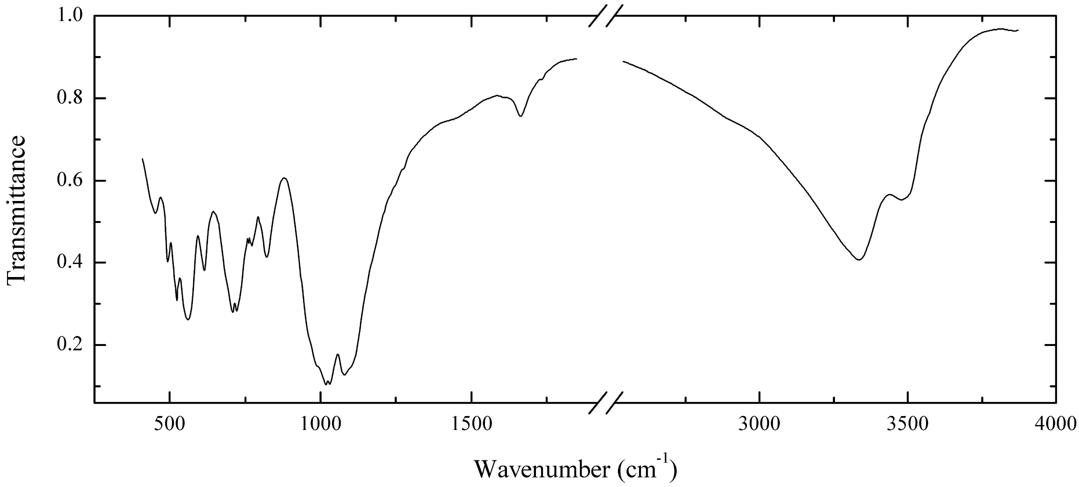


Locality: Brandrücken, Moschkogel, Weinebene area, Koralpe, Carinthia, Austria.

Description: Greenish-brown radial aggregates. The empirical formula is (electron microprobe, the ratio Fe^{2+}:Fe^{3+} by Mössbauer spectroscopy data) $(Ca_{1.92}Ba_{0.05})Be_4(Fe^{2+}{}_{2.84}Fe^{3+}{}_{0.37}Mn_{0.46}Al_{0.34}Mg_{0.13})(PO_4)_{6.00}(OH)_4 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3450sh, 3340, 1680w, 1650w, 1076s, 1033s, 1010sh, 803, 775, 720, 695sh, 610, 566, 522, 460.

P100 Atencioite $Ca_2Fe^{2+}\square Mg_2Fe^{2+}{}_2Be_4(PO_4)_6(OH)_4 \cdot 6H_2O$

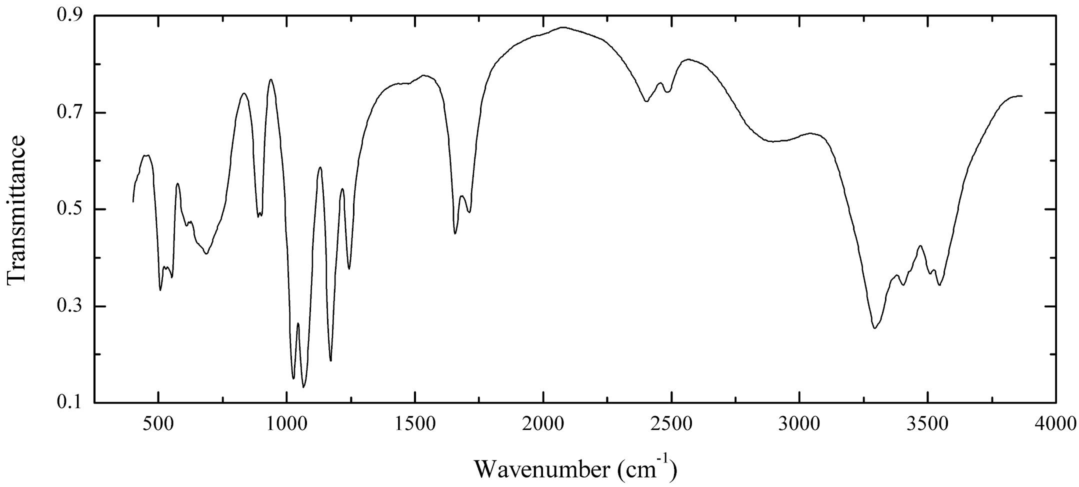


Locality: Linópolis, Divino das Laranjeiras, Minas Gerais State, Brazil (type locality).

Description: Greenish-brown spherulites from the association with albite, quartz, lepidolite, beryllonite, moraesite and ushkovite. Holotype sample. The crystal structure is solved. Triclinic, P-1; $a = 6.668(1)$, $b = 9.879(2)$, $c = 9.883(1)$ Å; $\alpha = 73.53(1)$, $\beta = 85.60(1)$, $\gamma = 86.93(1)°$; $V = 622.8(4)$ Å^3; $Z = 1$. The empirical formula is (the ratio Fe^{2+}:Fe^{3+} by Mössbauer spectroscopy data) $Ca_{1.87}Mg_{2.24}Mn_{0.19}Fe^{2+}{}_{1.98}Fe^{3+}{}_{0.52}Al_{0.08}Be_{3.93}(PO_4)_6(OH)_{4.22} \cdot 5.63H_2O$. $D_{meas} = 2.84$ (1) g/cm^3, $D_{calc} = 2.832$ g/cm^3. Optically biaxial, negative; $\alpha = 1.613(2)$, $\beta = 1.620(2)$, $\gamma = 1.626(2)$, $2V_{meas} = 60(10)°$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %), hkl], are 9.47 (41) (010), 5.92 (100) (0-11), 3.31 (34) (-1-21, 1-21), 3.17 (53) (210), 2.784 (86) (-103), 2.639(30) (-202), 2.202 (32) (-1-32, -124).

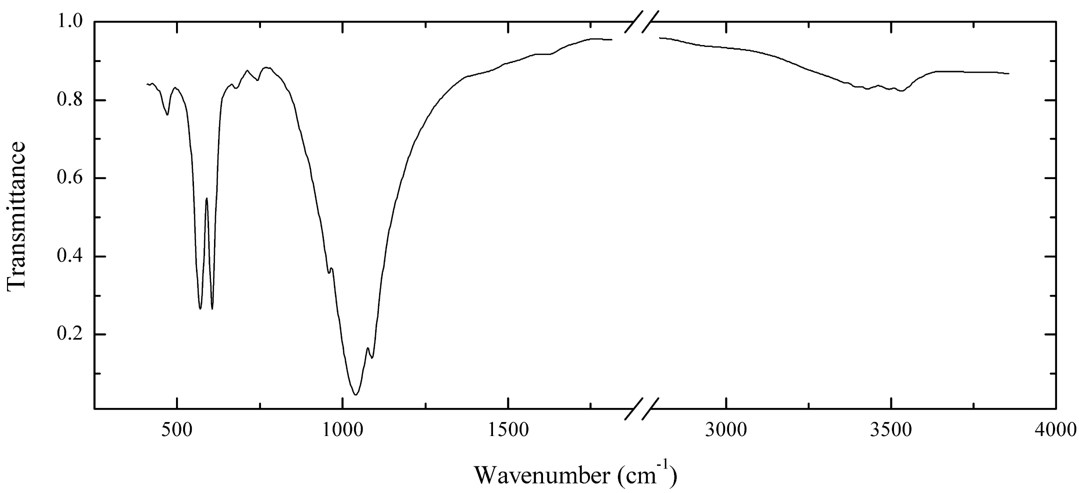
Wavenumbers (cm^{-1}): 3620sh, 3480, 3340, 3290sh, 2930sh, 1735w, 1670w, 1595w, 1110sh, 1084s, 1031s, 1019s, 990sh, 960sh, 822, 775, 721, 709, 695sh, 614, 565sh, 556, 550sh, 522, 491, 449, 440sh.

P101 Newberyite $Mg(HPO_4)\cdot3H_2O$



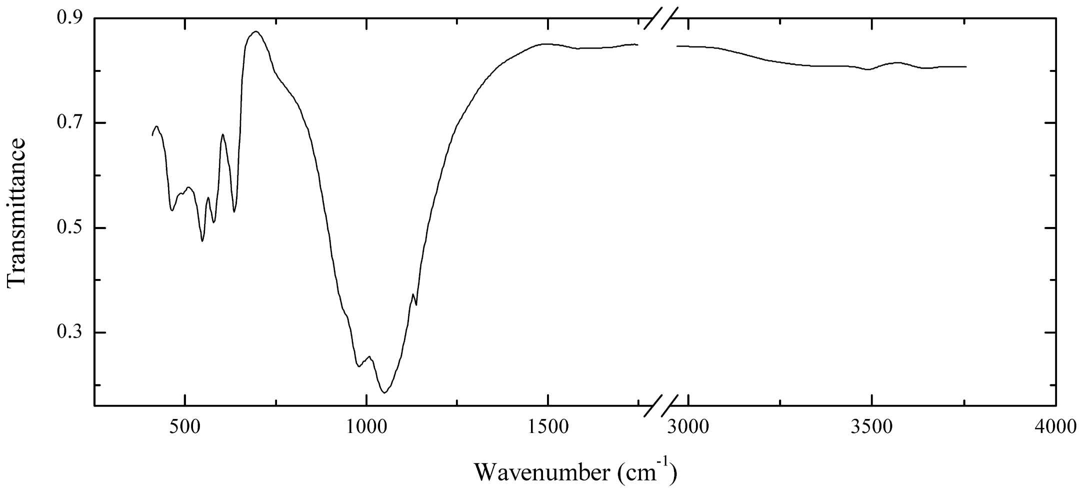
Locality: Skipton cave, Widderin Mt., Skipton, Victoria, Australia (type locality).
Description: Brownish crystals from the association with hannayite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3515, 3480, 3375, 3275s, 2900, 2470, 2395, 1708, 1652, 1237, 1167s, 1063s, 1022s, 900, 889, 740sh, 688, 650sh, 605, 550, 529, 505.

P102 Chlorapatite $Ca_5(PO_4)_3Cl$



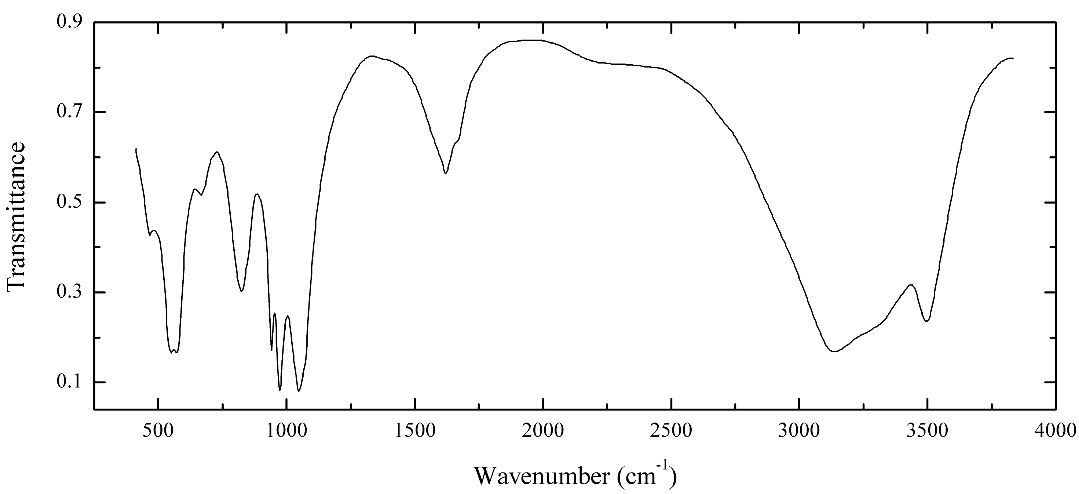
Locality: Maglovec quarry, Vyšná Šebastová, Prešov region, Slovakia.
Description: Outer zone of fluotapatite crystal. The empirical formula is (electron microprobe) $Ca_{4.97}REE_{0.02}(PO_4)_{3.00}Cl_{0.58}(OH)_{0.30}F_{0.12}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3535w, 3495w, 3430, 1625w, 1455w, 1410w, 1091s, 1042s, 1020sh, 959, 741w, 667w, 603, 568, 472.

P103 Graftonite $Fe^{2+}{}_3(PO_4)_2$



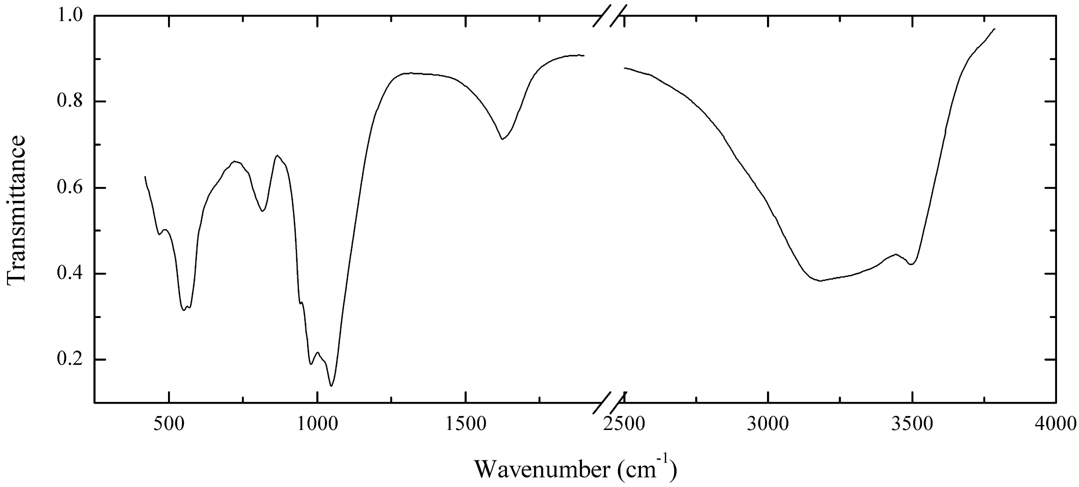
Locality: Přibyslavice, near Kutná Hora, Czech Republic.
Description: Brown massive from the association with heterosite and quartz. The empirical formula is (electron microprobe) $(Fe_{1.54}Mn_{1.13}Ca_{1.27}Zn_{0.03}Mg_{0.02})(PO_4)_{2.00}$.
Wavenumbers (cm^{-1}): 3625w, 3470w, 1135, 1056s, 985s, 940sh, 634, 577, 547, 495, 465.

P104 Vivianite $Fe^{2+}{}_3(PO_4)_2 \cdot 8H_2O$



Locality: Chernomorskiy mine, Eltigen-Ortel deposit, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.
Description: Blue curved prismatic crystals from the association with anapaite. Mg-rich variety. The empirical formula is (electron microprobe) $(Fe_{2.55}Mg_{0.45})(PO_4)_{2.00} \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3485, 3370sh, 3290sh, 3115s, 2300w, 1660sh, 1620, 1590sh, 1060sh, 1045s, 972s, 939, 822, 661, 565, 544, 467.

P105 Vivianite $Fe^{2+}_3(PO_4)_2{\cdot}8H_2O$

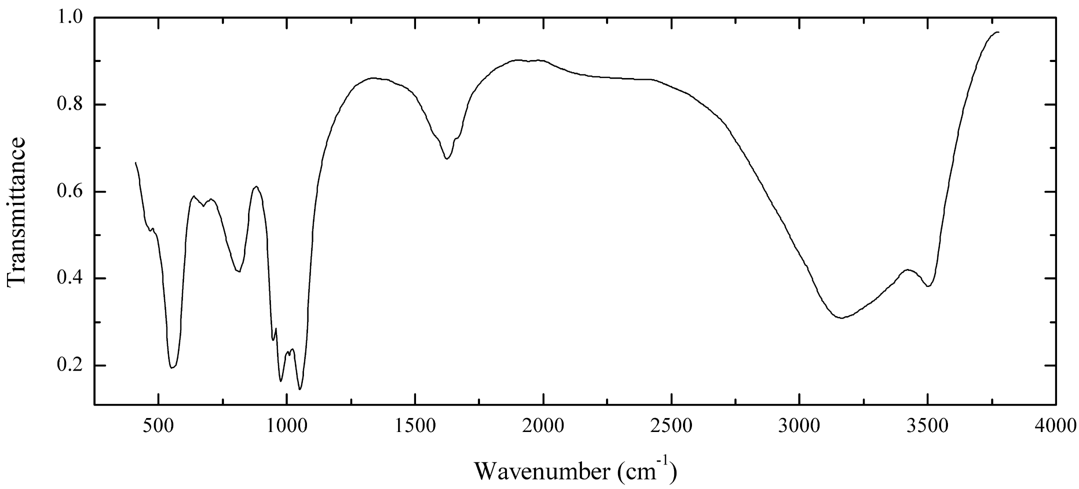


Locality: The mine E, Kamysh-Burun deposit, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.

Description: Greenish-blue powdery aggregate. Partly oxidized variety, $(Fe^{2+},Fe^{3+})_3(PO_4)_2(H_2O,OH)_8$.

Wavenumbers (cm^{-1}): 3470, 3280, 3150, 1623, 1045s, 1005sh, 971s, 941, 818, 563, 544, 469.

P106 "Kerchenite" $(Fe^{2+},Fe^{3+})_3(PO_4)_2(H_2O,OH)_8$

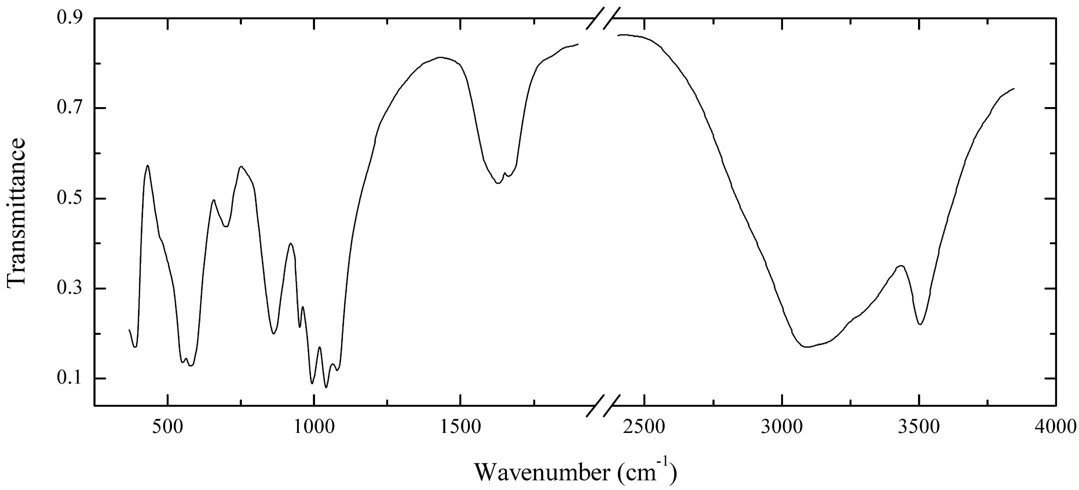


Locality: Chernomorskiy mine, Eltigen-Ortel deposit, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.

Description: Blue fine-grained crust on iron ore. Fine intergrowth of vivianite and metavivianite. Identified by IR spectrum and powder X-ray diffraction pattern. The ratio Fe^{2+}:Fe^{3+} is 55:45 (by Mössbauer spectroscopy data).

Wavenumbers (cm^{-1}): 3470, 3140s, 1665sh, 1625, 1575sh, 1051s, 1005s, 977s, 947, 811, 675w, 553s, 470.

P107 Bobierrite $Mg_3(PO_4)_2 \cdot 8H_2O$

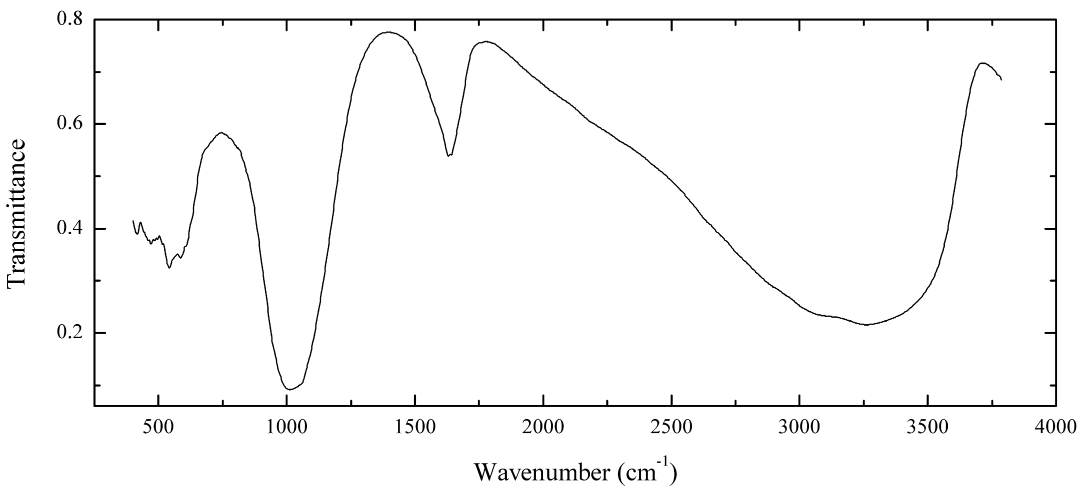


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless crystal from dolomite carbonatite, from the association with CO_3,OH-rich fluorapatite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Mg_{3.06}Fe_{0.02})(PO_4)_{2.00} \cdot n(H_2O,OH)$.

Wavenumbers (cm^{-1}): 3496, 3375sh, 3275sh, 3150sh, 3088s, 1670, 1630, 1600sh, 1090sh, 1083s, 1043s, 994s, 952, 861, 698, 577s, 550s, 475sh, 390.

P108 Santabarbaraite $Fe^{3+}{}_3(PO_4)_2(OH)_3 \cdot 5H_2O$

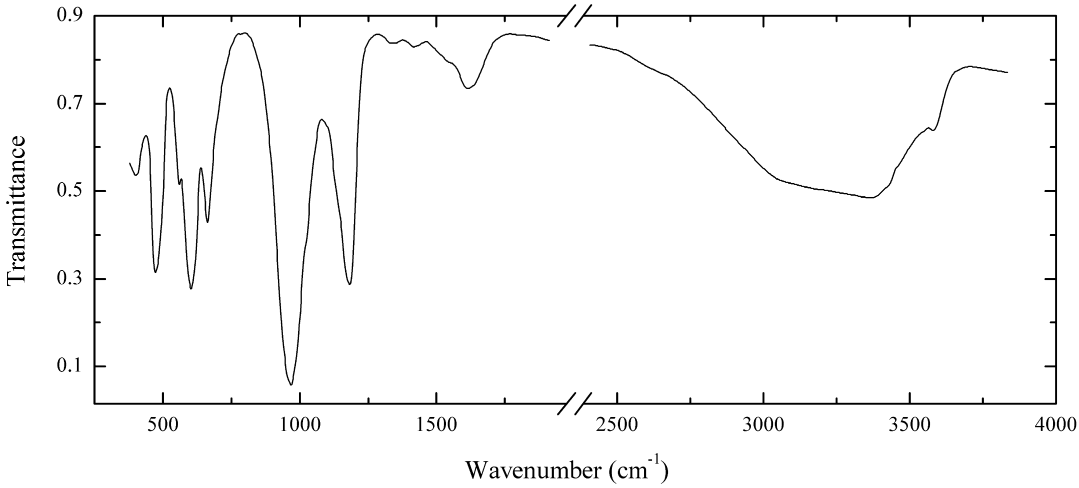


Locality: Novokarantinnyi mine, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.

Description: Brown pseudomorphs after vivianite crystals in the association with mitridatite. Identified by IR spectrum. Amorphous.

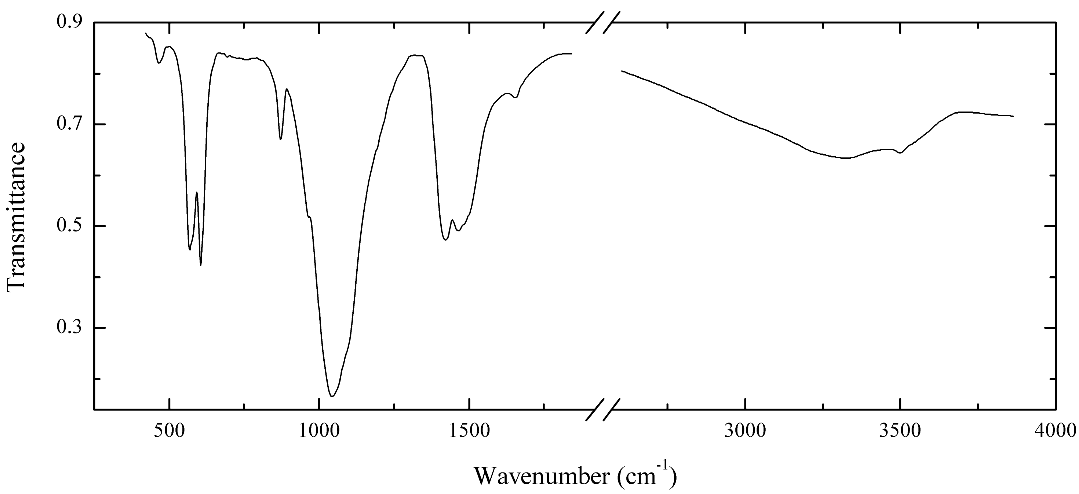
Wavenumbers (cm^{-1}): 3250s, 3100s, 1634, 1040sh, 1018s, 600sh, 585, 541, 470, 418.

P109 Mitridatite $Ca_2Fe^{3+}{}_3(PO_4)_3O_2{\cdot}3H_2O$



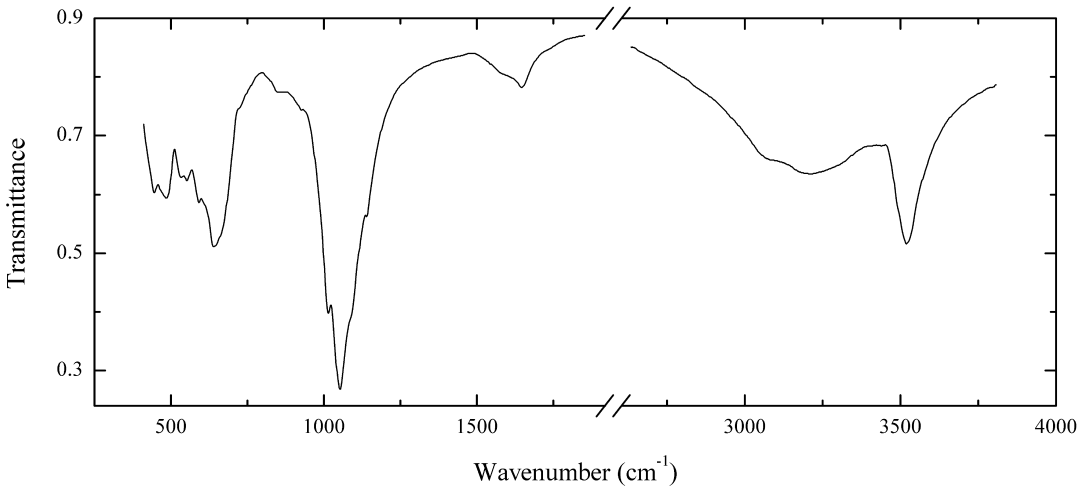
Locality: Novokarantinnyi mine, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.
Description: Greenish-yellow fine-grained aggregate from the association with santabarbaraite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3580, 3360, 3150sh, 1623, 1560sh, 1425w, 1350w, 1186s, 967s, 663, 602, 561, 472, 408.

P110 Fluorapatite CO$_3$-rich $(Ca,H_2O,\square)_5(PO_4,CO_3)_3(F,OH,H_2O)$



Locality: Flux quarry, Partizanski, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.
Description: Brown pseudomorph after the bone of otter. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3485w, 3305, 3230w, 1655w, 1490sh, 1467, 1424, 1090sh, 1043s, 963, 872. 605, 575sh, 567, 467w.

P111 Wavellite $Al_3(PO_4)_2(OH,F)_3{\cdot}5H_2O$

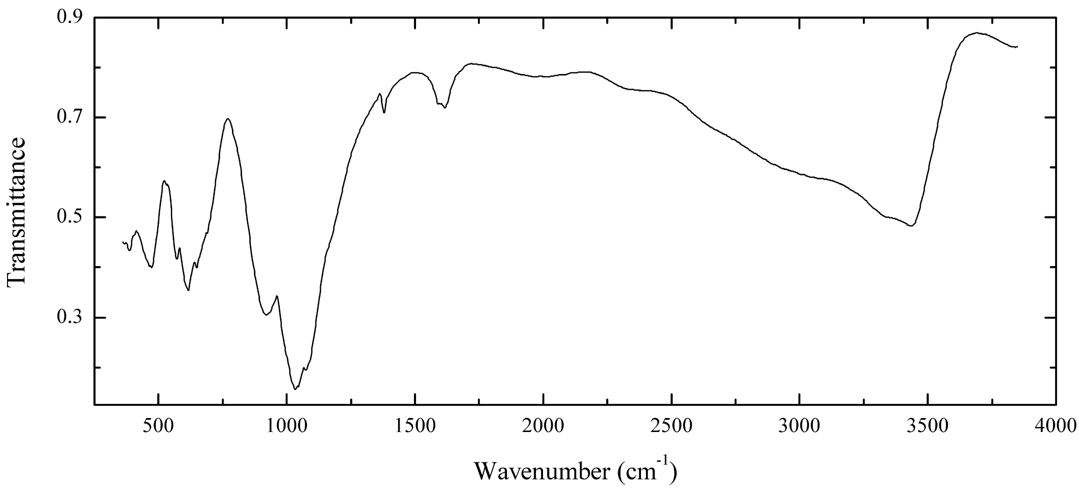


Locality: An unknown locality in Arkansas, USA.

Description: Light green radial aggregate. Identified by IR spectrum. The empirical formula is (electron microprobe, OH calculated) $(Al_{2.84}Fe_{0.21}Mg_{0.03})(PO_4)_{2.00}[(OH)_{2.47}F_{0.53}]{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3515, 3200, 3075, 1645, 1600sh, 1145, 1090sh, 1055s, 1020s, 925w, 863w, 665sh, 646, 597, 550, 535, 484, 447.

P112 Childrenite $Fe^{2+}Al(PO_4)(OH)_2{\cdot}H_2O$

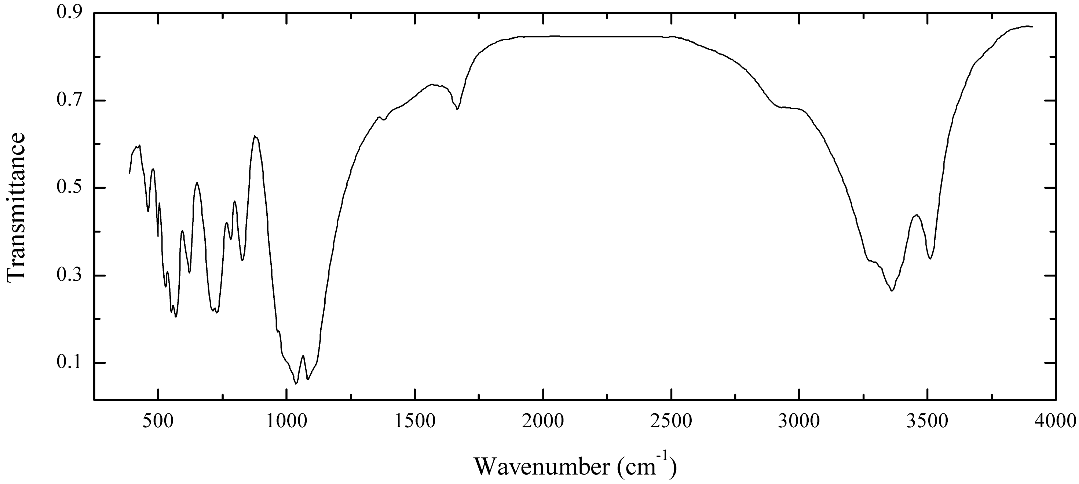


Locality: Córrego Frio mine, Linópolis, Divino das Laranjeiras, Doce valley, Minas Gerais state, Brazil.

Description: Brown crystal from the association with quartz, feldspar and roscherite-group minerals. Identified by IR spectrum. Mn-rich variety. The empirical formula is (electron microprobe) $(Fe_{0.45}Mn_{0.41}Mg_{0.11}Ca_{0.04})(Al_{0.95}Fe_{0.05})(PO_4)_{1.00}(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3430, 3320sh, 3080sh, 2800sh, 2360w, 2020w, 1630w, 1605sh, 1377w, 1075s, 1037s, 927, 680sh, 614, 574, 472, 375.

P113 Zanazziite $Ca_2(Mg,Fe^{2+})(Mg,Fe^{2+},Al)_4Be_4(PO_4)_6(OH)_4{\cdot}6H_2O$

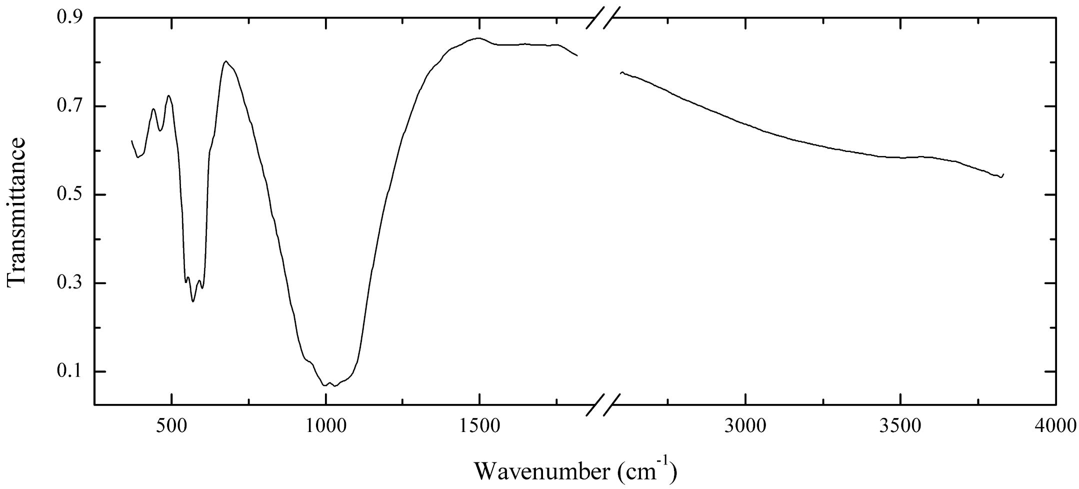


Locality: Linópolis, Divino das Laranjeiras, Minas Gerais State, Brazil.

Description: Cream-coloured spherulites on feldspar. The empirical formula is (electron microprobe) $(Ca_{1.84}Mn_{0.14}Sr_{0.02})(Mg_{4.87}Mn_{0.06}Al_{0.06}Fe_{0.05})Be_4(PO_4)_{6.00}(OH)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3497, 3345s, 3265sh, 2940w, 1665w, 1386w, 1110sh, 1084s, 1035s, 990sh, 968, 826, 782, 727, 713, 621, 567, 549, 526, 496, 458.

P114 Phosphate P114 $Na(Na,\square)Mm(Fe^{3+},Fe^{2+})_2(PO_4)_3$

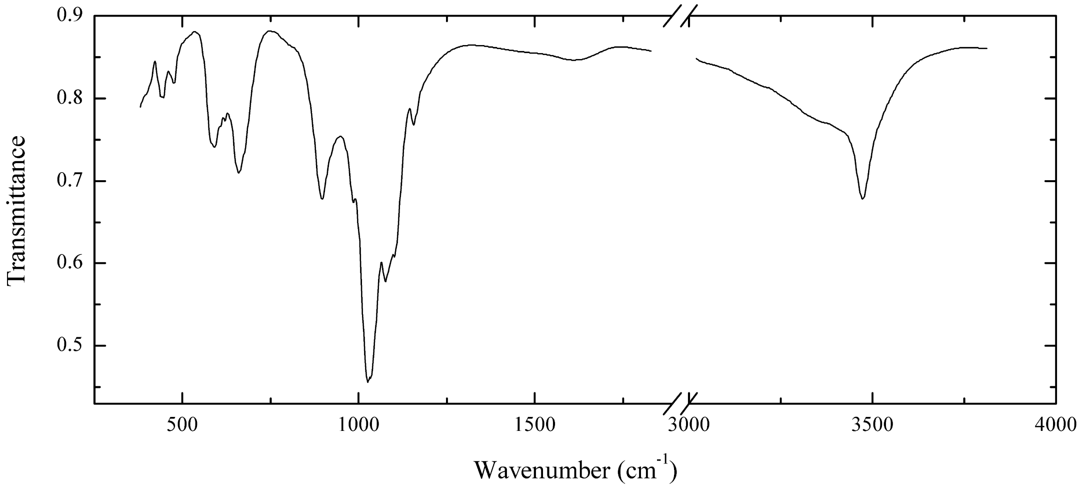


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Brownish-green coarse-grained aggregate. The empirical formula is (electron microprobe) $Na_{1.0}(Na_{0.5}Ca_{0.1}\square_{0.4})Mn_{1.0}Fe_{2.0}(PO_4)_{3.0}$. Probably related to alluaudite. Needs further investigation.

Wavenumbers (cm^{-1}): 1090sh, 1065sh, 1033s, 997s, 945sh, 630sh, 599, 571, 547, 463w, 420sh, 404.

P115 Eosphorite $Mn^{2+}Al(PO_4)(OH)_2{\cdot}H_2O$

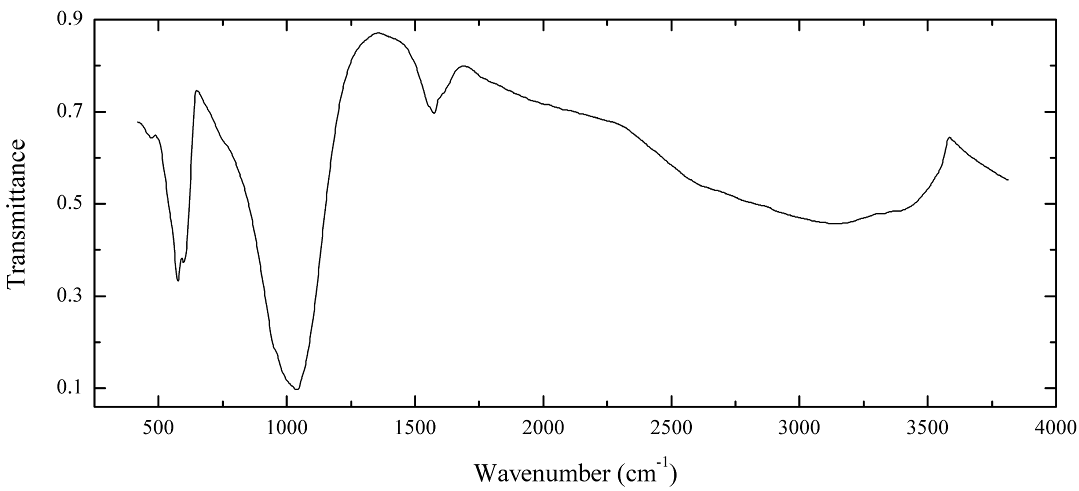


Locality: Foote Mine, Kings Mountain district, Cleveland Co., North Carolina, USA.

Description: Light cream-coloured spherulites. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Mn_{0.74}Ca_{0.15}Fe_{0.11})Al_{1.00}(PO_4)_{1.00}[(OH)_{1.87}F_{0.13}]{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3450, 3340sh, 1630w, 1158, 1099, 1078, 1032s, 987, 896, 661, 595, 473, 443.

P116 Phosphoferrite $Fe^{2+}Fe^{2+}{}_2(PO_4)_2{\cdot}3H_2O$

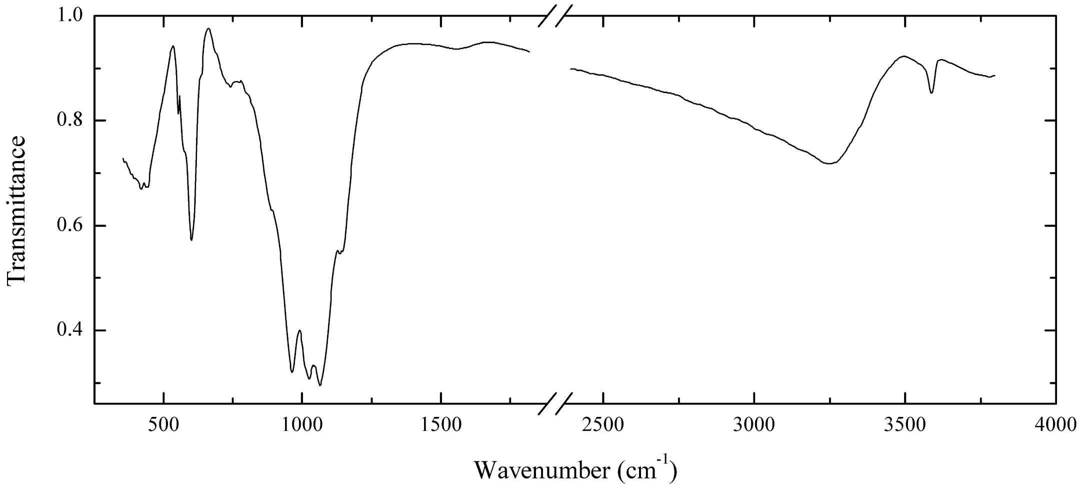


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Dark greenish-brown, semitransparent, massive. Partly oxidized variety (transitional to kryzhanovskite).

Wavenumbers (cm^{-1}): 3375sh, 3150, 2670sh, 1620sh, 1590, 1037s, 1010sh, 955sh, 597, 510, 465w.

P117 Rockbridgeite $Fe^{2+}Fe^{3+}{}_4(PO_4)_3(OH)_5$

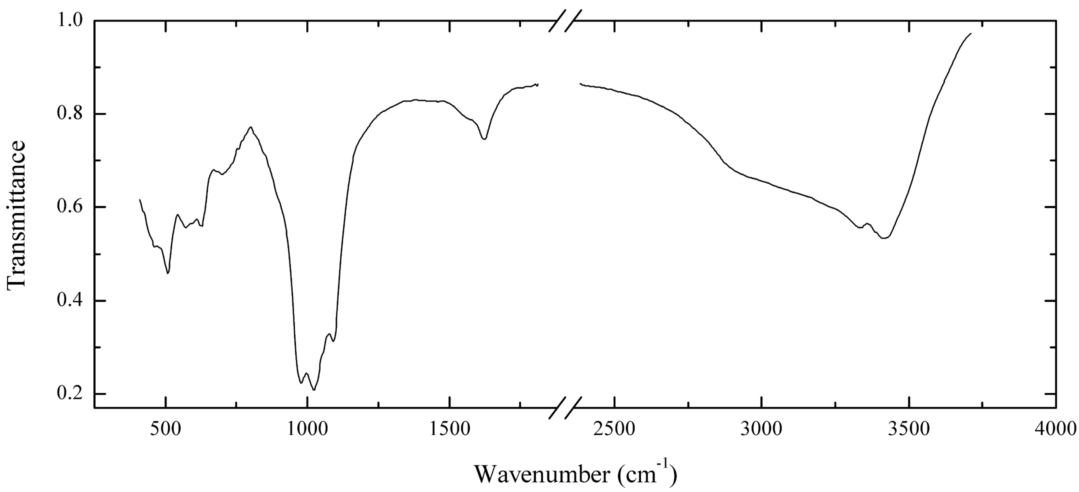


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Black radial aggregate. Streak is dark green. The empirical formula is (electron microprobe) $(Fe_{0.78}Mn_{0.17}Mg_{0.02})(Fe_{3.95}Al_{0.05})(PO_4)_{3.00}(OH)_5$.

Wavenumbers (cm^{-1}): 3570, 3240, 1580w, 1142, 1066s, 1026s, 966s, 890sh, 745, 635sh, 605sh, 600, 575sh, 553sh, 435, 415, 390sh.

P118 Strunzite $Mn^{2+}Fe^{3+}{}_2(PO_4)_2(OH)_2{\cdot}6H_2O$

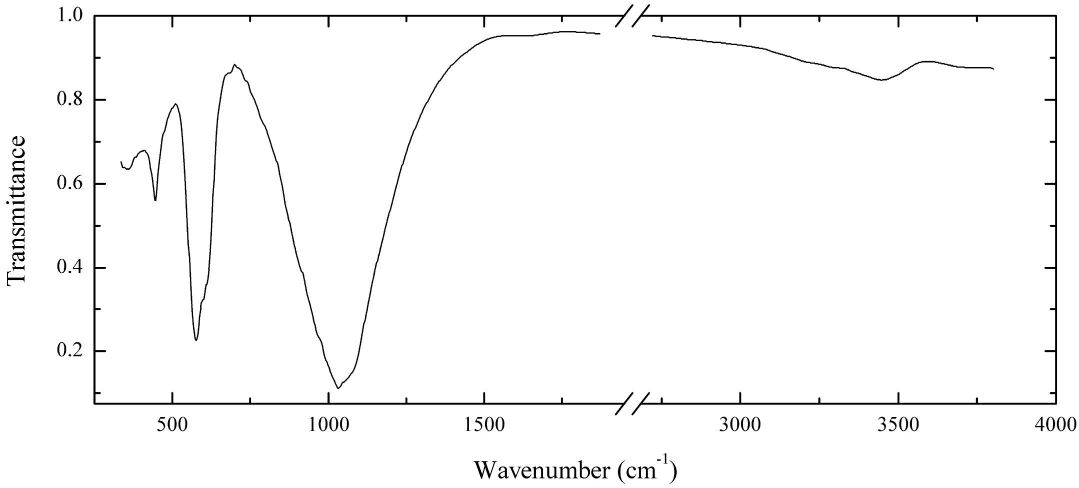


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Yellow fibrous aggregate from the association with rockbridgeite. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Mn_{0.59}Fe_{2.35}Al_{0.04})(PO_4)_{2.00}(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3400, 3325, 3000sh, 1623, 1560sh, 1090, 1022s, 976s, 699, 626, 580, 507, 475, 435sh.

P119 Zwieselite $(Fe^{2+},Mn)_2(PO_4)F$

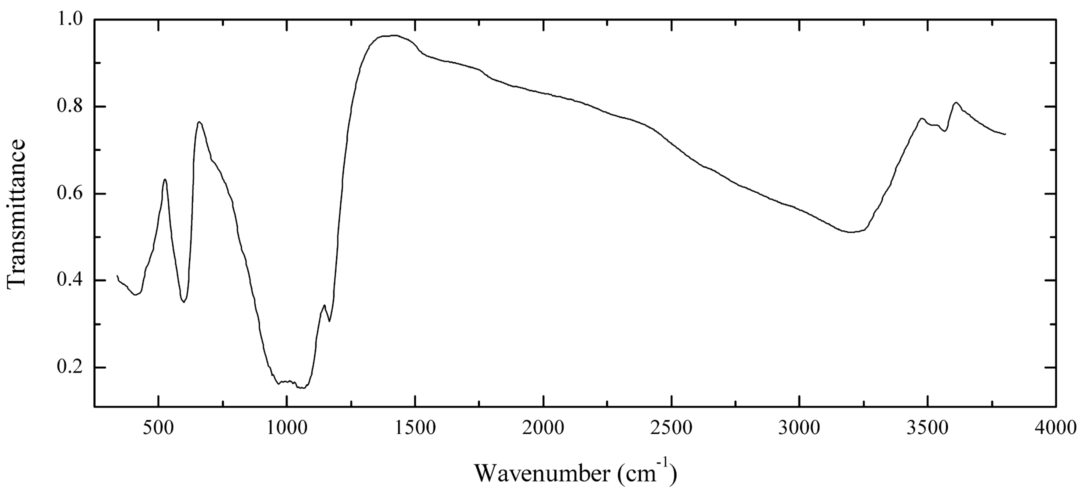


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Light brown grain. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Fe_{1.2}Mn_{0.6}Mg_{0.2})(PO_4)_{1.0}[F_{0.7}(OH)_{0.3}]$.

Wavenumbers (cm^{-1}): 3445w, 1085sh, 1037s, 975sh, 920sh, 610sh, 600sh, 578, 446, 355.

P120 Frondelite $Mn^{2+}Fe^{3+}{}_4(PO_4)_3(OH)_5$

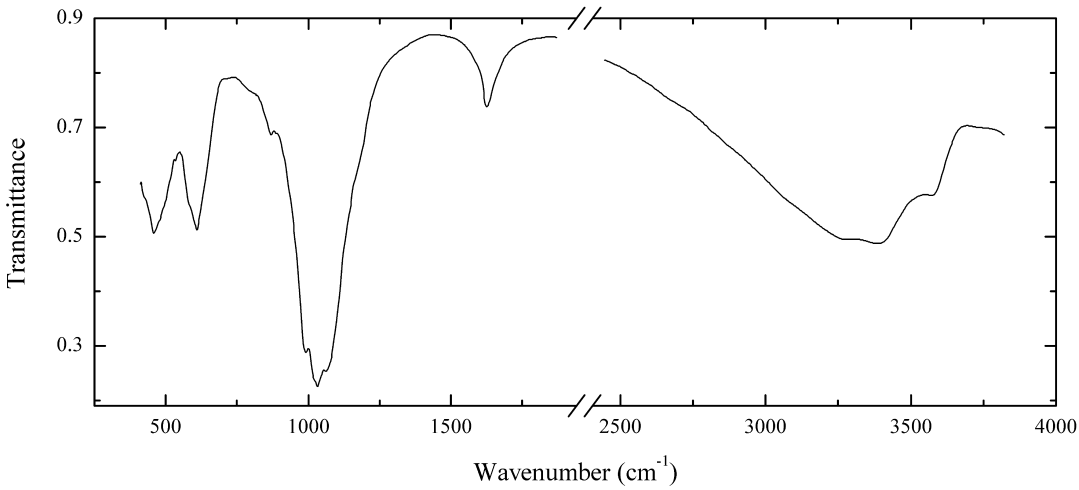


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Black radial aggregate. Streak is dark green. The empirical formula is (electron microprobe) $(Mn_{0.54}Fe_{0.43})(Fe_{3.96}Al_{0.04})(PO_4)_{3.00}(OH)_5$.

Wavenumbers (cm^{-1}): 3555w, 3510w, 3190, 1550sh, 1161, 1080sh, 1062s, 974s, 598, 460sh, 415.

P121 Beraunite $Fe^{2+}Fe^{3+}_5(PO_4)_4(OH)_5 \cdot 4H_2O$

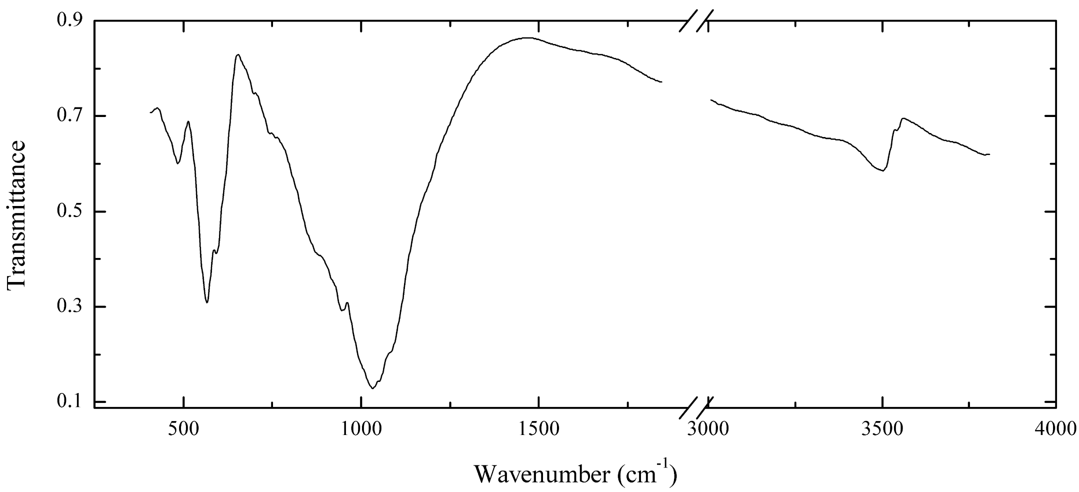


Locality: Levaäniemi mine, Svappavaara, Kiruna district, Lappland, Sweden.

Description: Radial aggregate of bluish black prismatic crystals from the association with cacoxenite and kidwellite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3570, 3375, 3260, 1630, 1065s, 1035sh, 1027s, 990s, 867, 609, 480sh, 460.

P122 Wolfeite $Fe^{2+}_2(PO_4)(OH)$

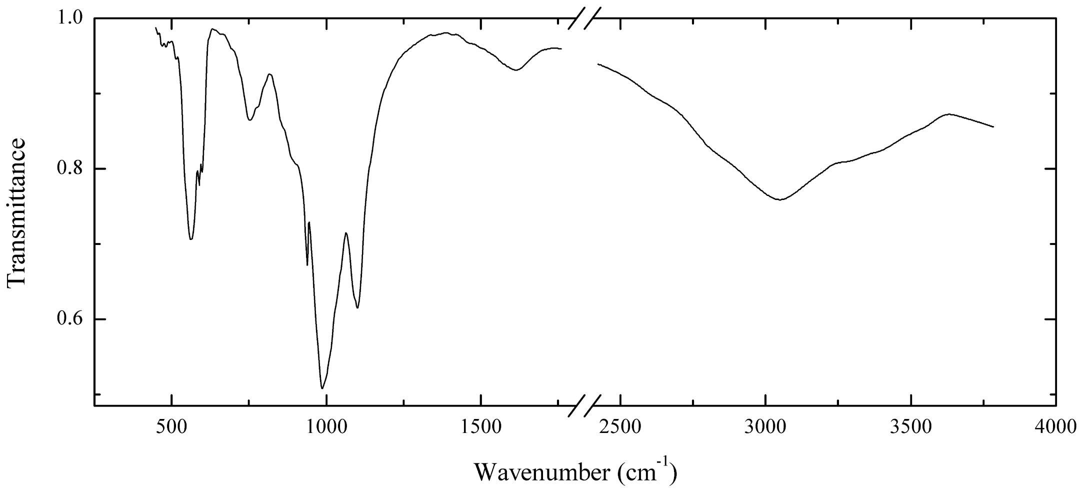


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Pinkish brown granular aggregate. Identified by IR spectrum and electron microprobe analysis. The empirical formula is (OH calculated) $Fe_{1.52}Mn_{0.40}Mg_{0.03}Al_{0.02}(PO_4)_{1.00}[(OH)_{0.8}F_{0.2}]$.

Wavenumbers (cm^{-1}): 3490, 1086s, 1050sh, 1034s, 1005sh, 952s, 885sh, 760sh, 700sh, 595, 566, 487.

P123 Fairfieldite $Ca_2(Mn^{2+},Fe^{2+})(PO_4)_2 \cdot 2H_2O$

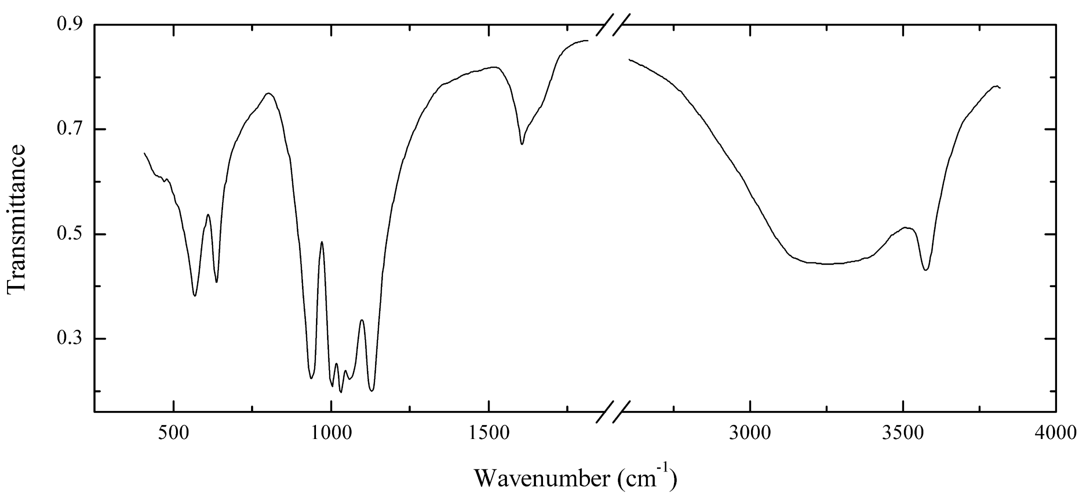


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Pale yellow crystals. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{1.87}Sr_{0.04}Mn_{0.69}Fe_{0.37}(PO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3300sh, 3025, 1615w, 1101s, 1030sh, 1010sh, 990s, 939, 910sh, 785sh, 763, 598, 589, 566, 558, 470w.

P124 Phosphophyllite $Zn_2(Fe^{2+},Mn^{2+})(PO_4)_2 \cdot 4H_2O$

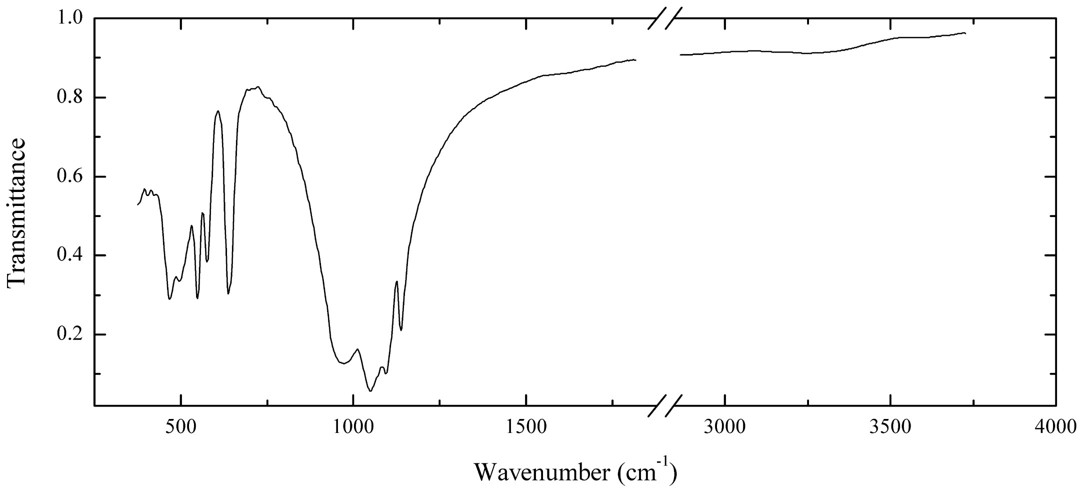


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Pale green crystals from the association with triplite, apatite, rockbridgeite and phosphosiderite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Zn_{1.96}(Fe_{0.86}Mn_{0.13})(PO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3565, 3350sh, 3240, 1660sh, 1610, 1130s, 1063s, 1033s, 1003s, 945sh, 938s, 635, 569, 510sh, 470sh.

P125 Triphylite $LiFe^{2+}(PO_4)$

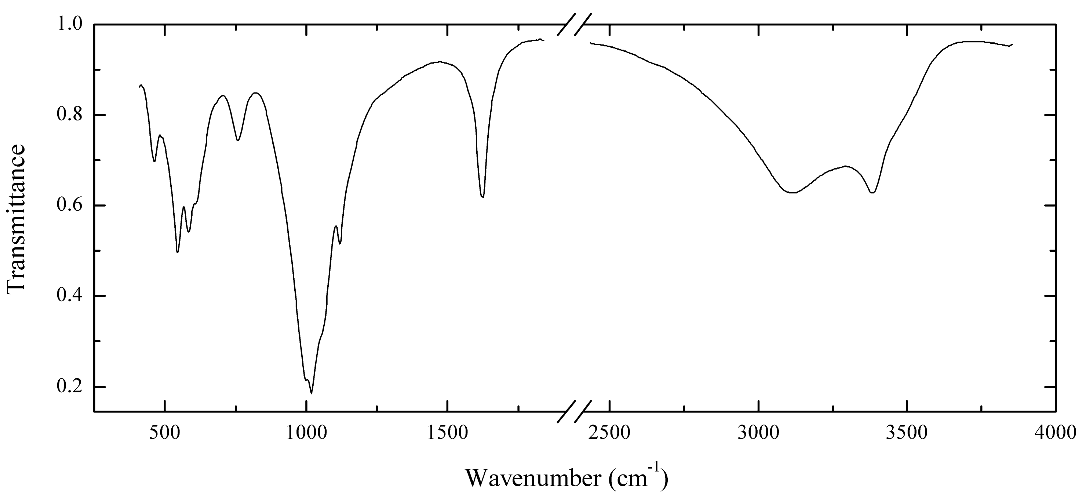


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Greenish-grey massive from the association with vivianite and fluorapatite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Li_x(Fe_{0.65}Mn_{0.37})(PO_4)_{1.00}$.

Wavenumbers (cm^{-1}): 1138, 1094s, 1051s, 970s, 645sh, 636, 577, 548, 496, 467.

P126 Phosphosiderite $Fe^{3+}(PO_4)\cdot 2H_2O$

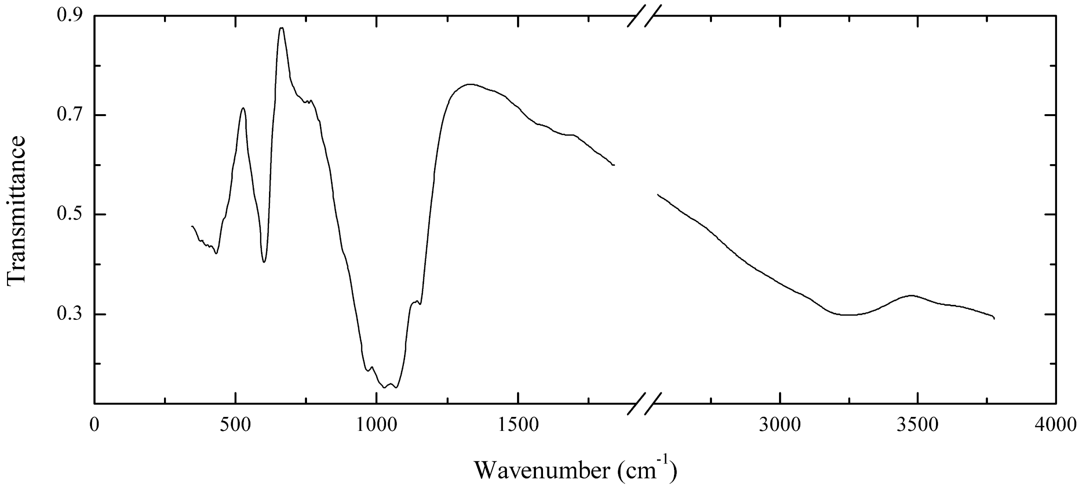


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Pink crystals from the association with strengite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3370, 3105, 1625, 1118, 1055sh, 1017s, 999s, 759, 605sh, 574, 539, 460.

P127 Rockbridgeite $Fe^{2+}Fe^{3+}_4(PO_4)_3(OH)_5$

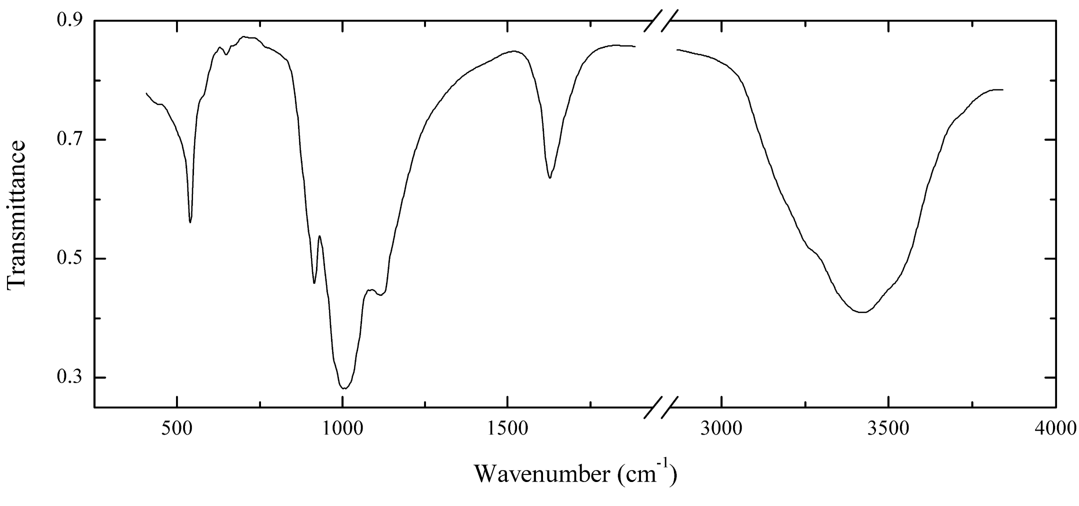


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Black radial aggregate from the association with phosphophyllite and triplite. Streak is dark green. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3240, 1655w, 1570w, 1147, 1064s, 1027s, 971s, 750w, 600, 565sh, 500sh, 450sh, 421, 400sh, 380sh.

P128 Meta-autunite $Ca(UO_2)_2(PO_4)_2{\cdot}2–6H_2O$

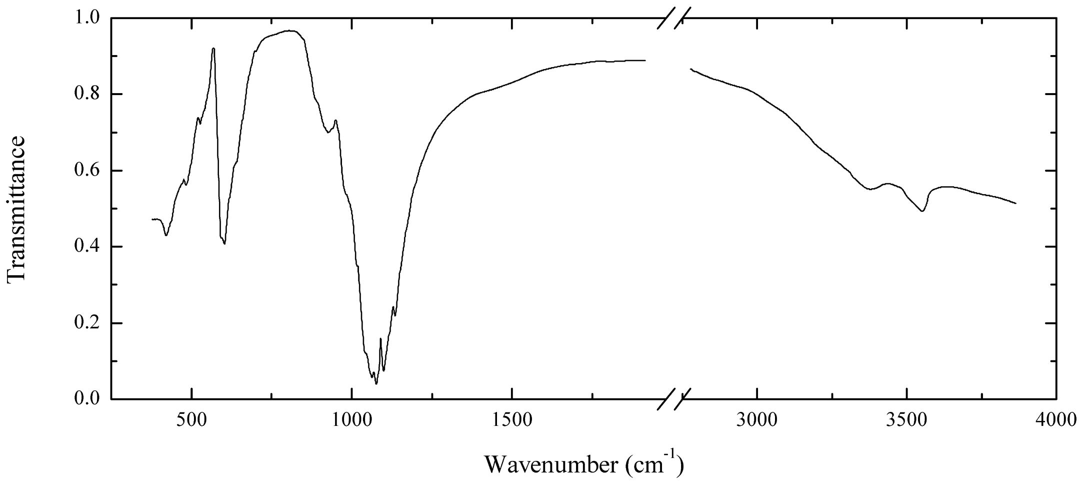


Locality: Koscheka U deposit, Auminzatau Mts., Central Kazakhstan region, Kyzylkum desert, Uzbekistan.

Description: Yellow platy crystals from the association with saléeite and halloysite. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500sh, 3415s, 3260sh, 1635, 1120s, 1007s, 920s, 645w, 575sh, 540.

P129 Hydroxylwagnerite $Mg_2(PO_4)(OH)$

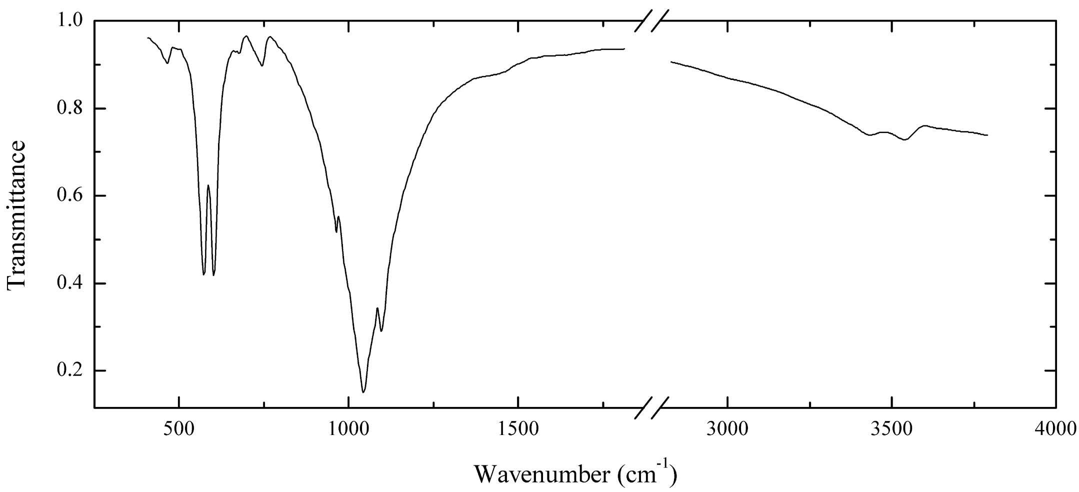


Locality: Dora-Maira massif, Western Alps, Cuneo province, Piedmont, Italy (type locality).

Description: Pale yellow grains in pyrope, in the association with magnesiostaurolite and ellenbergerite. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.64 (30), 3.32 (100), 3.15 (100), 2.996 (100), 2.859 (100), 2.765 (70), 2.727 (50), 2.088 (50), 1.904 (60).

Wavenumbers (cm^{-1}): 3550, 3380, 1120, 1093s, 1073s, 1057s, 1035sh, 1010sh, 980sh, 924, 640sh, 606, 595sh, 525, 495, 422.

P130 Fluorapatite $Ca_5(PO_4)_3F$

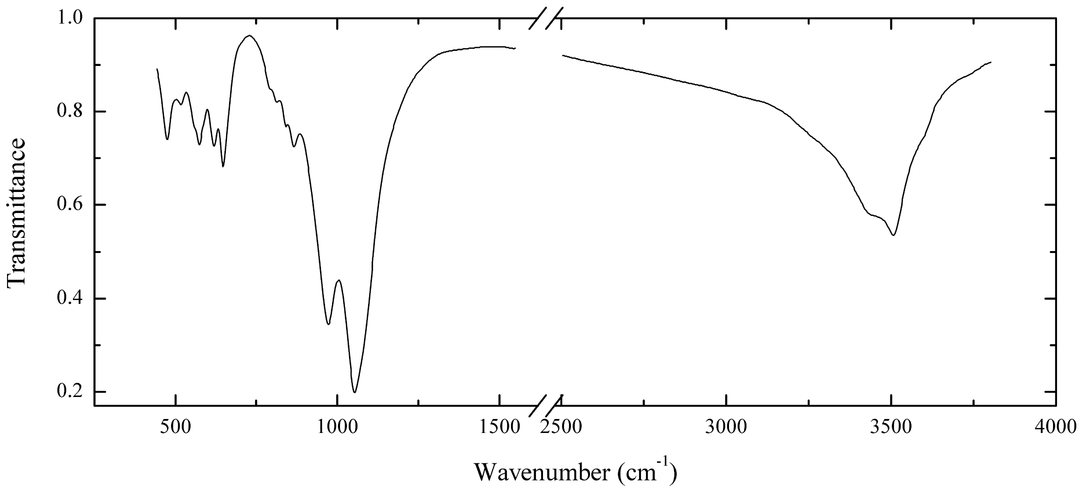


Locality: Pestsovye Keivy, Keivy Mts., Kola peninsula, Murnansk region, Russia.

Description: Green transparent from metamorphic rock. OH-rich variety. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3525, 3415, 1094s, 1065sh, 1040s, 964, 744w, 673w, 601, 573, 565sh, 462w.

P131 Zincolibethenite $CuZn(PO_4)(OH)$

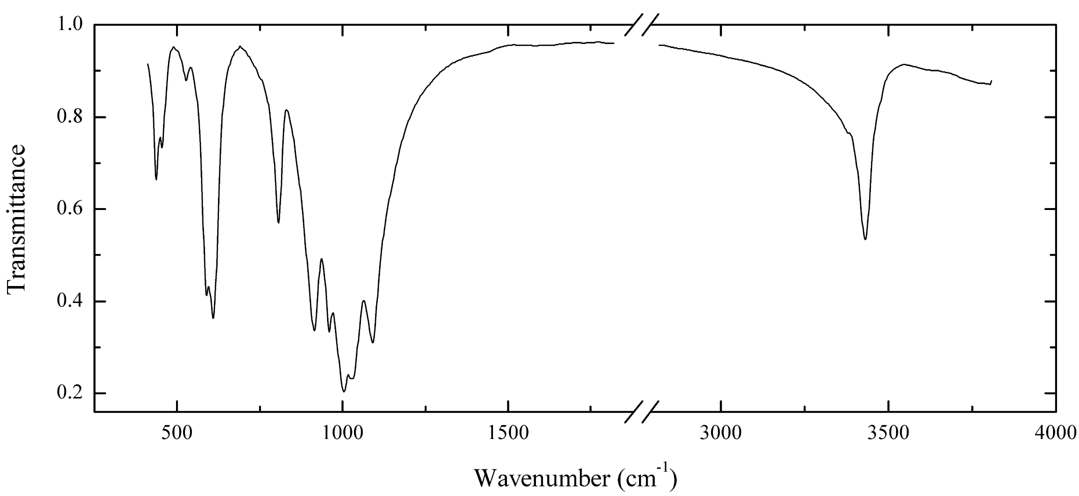


Locality: Chuquicamata mine, Chuquicamata district, Calama, El Loa province, Antofagasta Region, Chile.

Description: Green prismatic crystals. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $Pb_{0.03}Cu_{1.04}Zn_{0.91}(PO_4)_{2.00}(OH,H_2O)$.

Wavenumbers (cm^{-1}): 3509, 3433, 1054s, 970s, 856, 828, 800w, 633, 606, 560, 500w, 458.

P132 Tarbuttite $Zn_2(PO_4)(OH)$

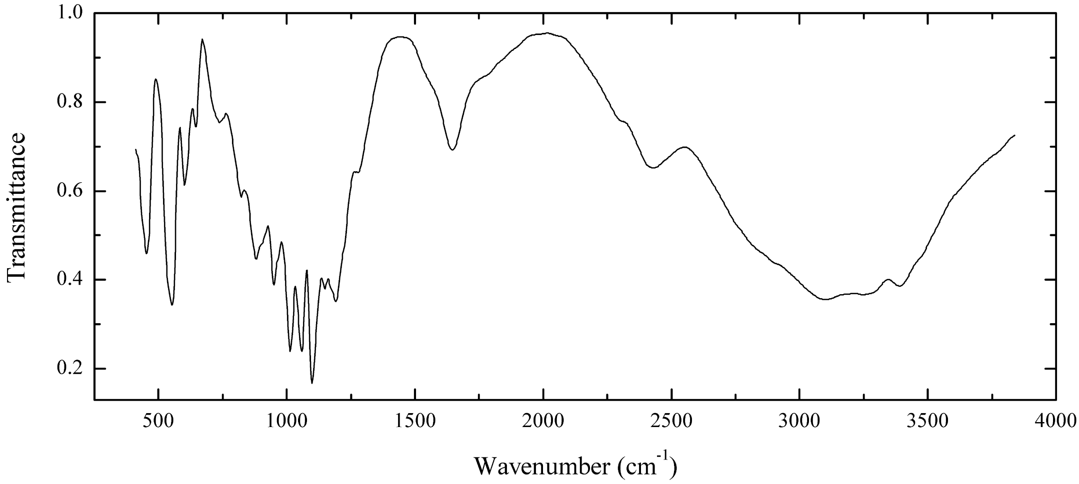


Locality: Kabwe (Broken Hill) mine, Central Province, Zambia (type locality).

Description: Colourless crystals from the association with hemimorphite and goethite. Identified by IR spectrum and qualitative electron microprobe analysis.

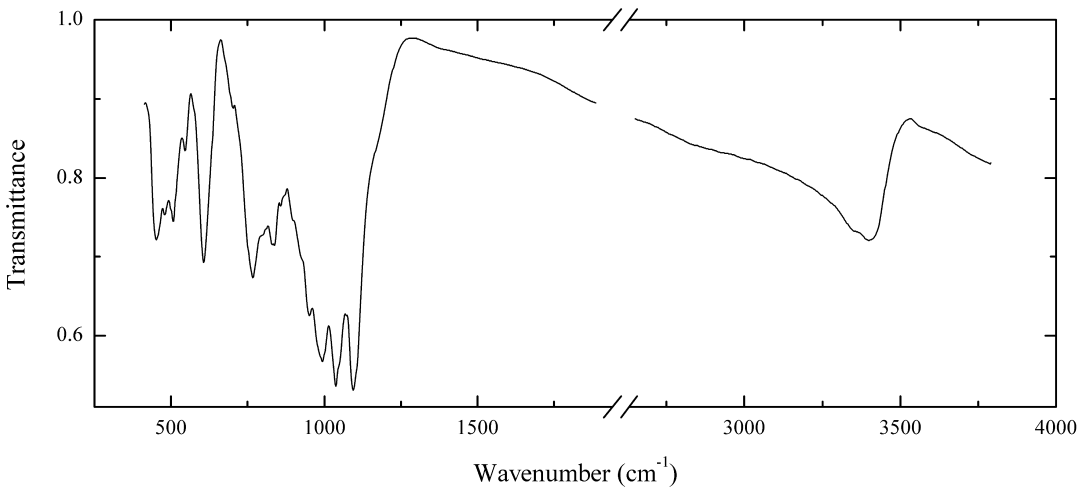
Wavenumbers (cm^{-1}): 3430, 1595w, 1092s, 1031s, 1003s, 959s, 914s, 805, 608s, 587, 524w, 452, 434.

P133 Taranakite $K_3Al_5(HPO_4)_6(PO_4)_2{\cdot}18H_2O$



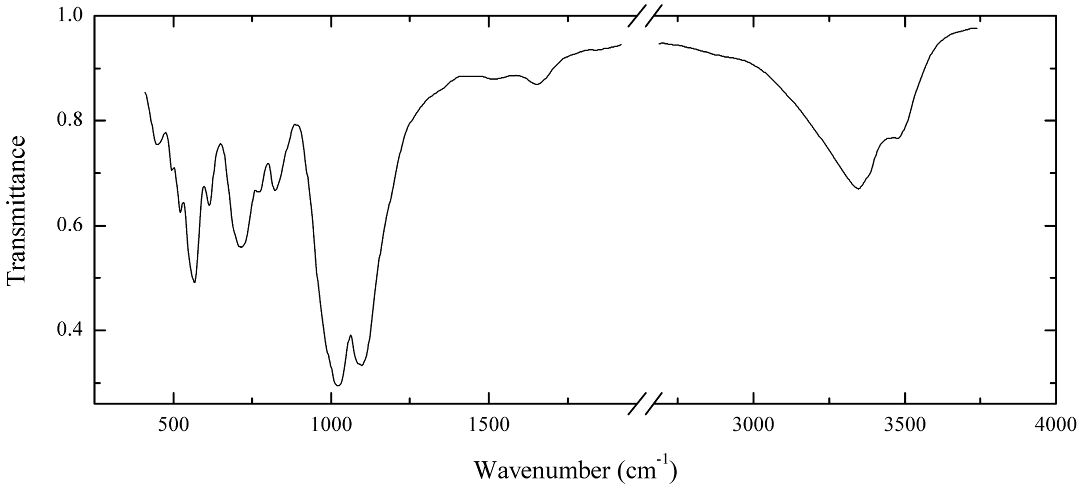
Locality: Sasyk-Unkur cave, near Aravan mine, Osh region, Kyrgyzstan.
Description: White concretion. Identified by powder X-ray diffraction pattern and IR spectrum.
Wavenumbers (cm^{-1}): 3375, 3240, 3095s, 2900sh, 2425, 2300w, 1770sh, 1648, 1570sh, 1280, 1220sh, 1180sh, 1194, 1150, 1100s, 1060s, 1015s, 965sh, 950, 905sh, 878, 825, 740w, 645w, 602, 548, 450.

P134 Reichenbachite $Cu^{2+}{}_2(PO_4)_2(OH)_4$



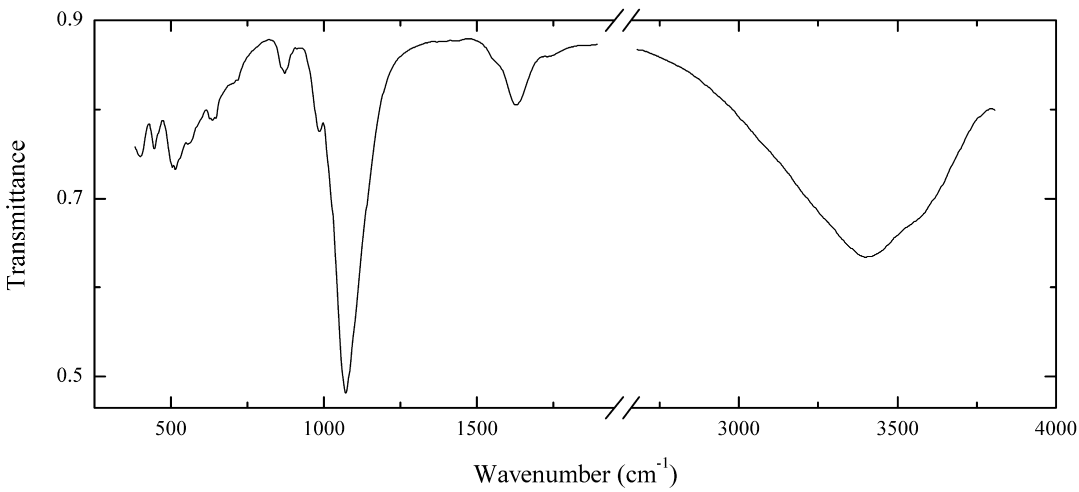
Locality: Borstein near Reichenbach, Odenwald, Germany (type locality).
Description: Green crystalline crust from the association with pseudomalachite and malachite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3390, 1095s, 1039s, 991s, 953, 925sh, 900sh, 837, 767, 605, 545w, 506, 468, 450.

P135 Greifensteinite $Ca_2Be_4(Fe^{2+},Mn)_5(PO_4)_6(OH)_4{\cdot}6H_2O$



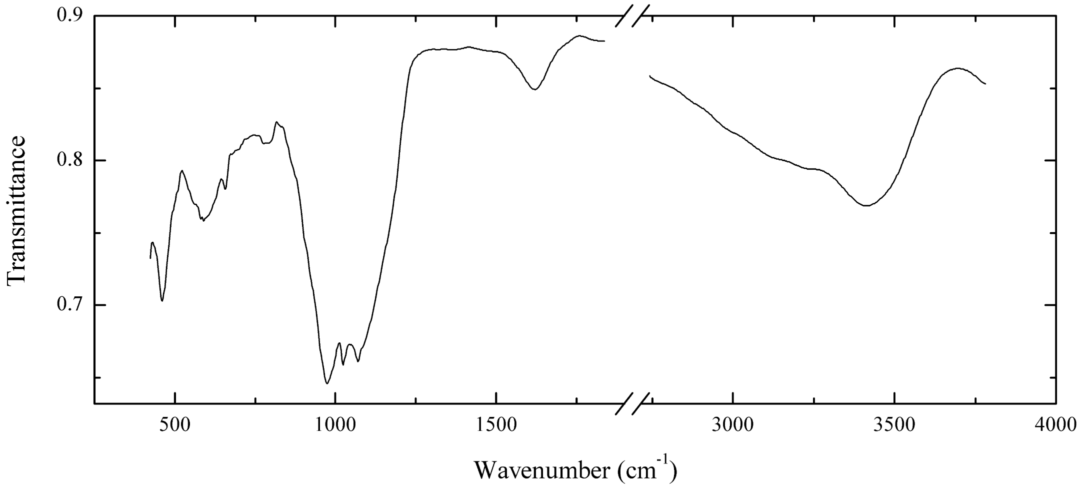
Locality: Linópolis, Divino das Laranjeiras, Minas Gerais State, Brazil.
Description: Brown spherulites from the association with gormanite. The empirical formula is (electron microprobe) $Ca_{2.0}(Fe_{3.0}Mg_{2.0}Mn_{0.2})Be_4(PO_4)_{6.00}(OH)_4{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3460, 3335, 1655w, 1090s, 1025s, 980sh, 822, 470, 715, 615, 562, 522, 491, 447w.

P136 Nevadaite $(Cu^{2+},\square,Al,V^{3+})_6Al_8(PO_4)_8F_8(OH)_2{\cdot}22H_2O$



Locality: Gold Quarry mine, Carlin, Eureka Co., Nevada, USA (type locality).
Description: Blue radial aggregates. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3390, 1735w, 1625, 1560sh, 1105sh, 1073s, 983, 873, 700sh, 633, 560sh, 511, 445, 390.

P137 Jahnsite-(CaMnFe) $CaMn^{2+}Fe^{2+}{}_2Fe^{3+}{}_2(PO_4)_4(OH)_2 \cdot 8H_2O$

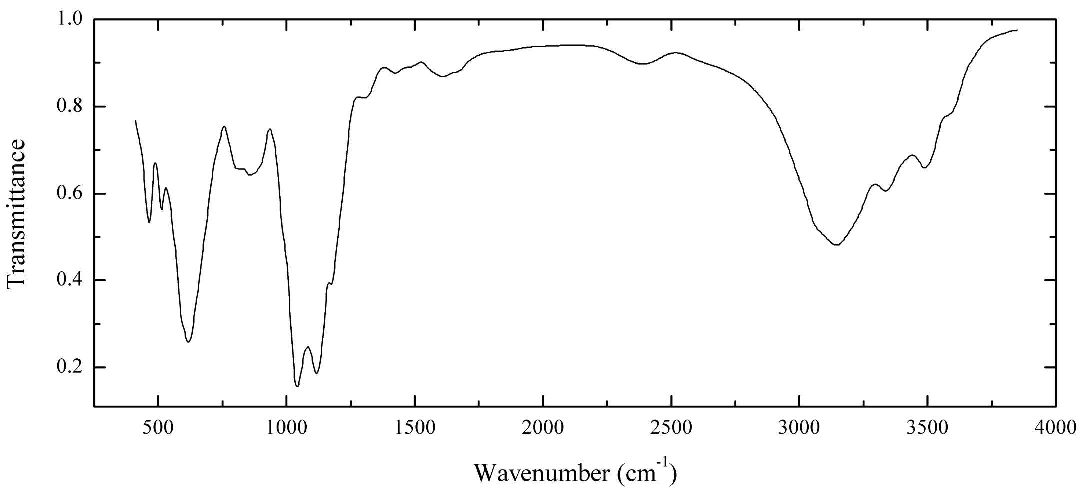


Locality: White Elephant mine, Cicero Peak, Pringle, Custer district, South Dakota, USA.

Description: Beige crystals. The empirical formula is (electron microprobe) $Ca_{1.0}Mn_{1.0}(Fe_{0.9}Mn_{0.8}Mg_{0.3})Fe_{2.0}(PO_4)_{4.0}(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3480sh, 3400, 3320, 3125sh, 1630, 1160sh, 1072s, 1025s, 975s, 780w, 660, 590, 560sh, 465.

P138 Crandallite $CaAl_3(PO_4)_2(OH)_6 \cdot H_2O$

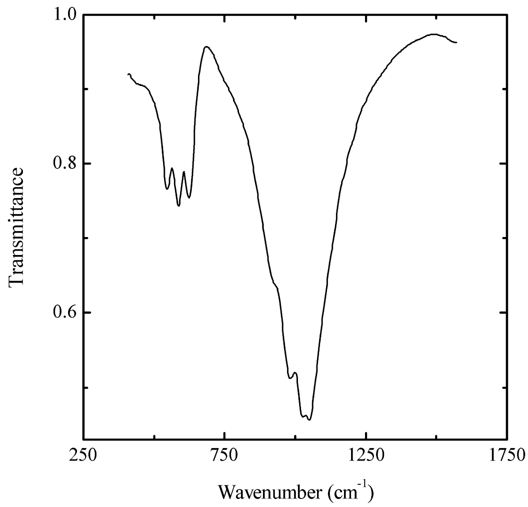


Locality: Taiba mine, Keur Mor Fall deposit, Taiba, Thiès region, Senegal.

Description: Beige powdery from the association with augelite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3550w, 3490sh, 3465, 3310, 3125, 2375w, 1655sh, 1605w, 1500w, 1605w, 1423w, 1310w, 1220sh, 1171, 1117s, 1041s, 865, 817, 616s, 600sh, 515, 467.

P139 Graftonite $Fe^{2+}_3(PO_4)_2$

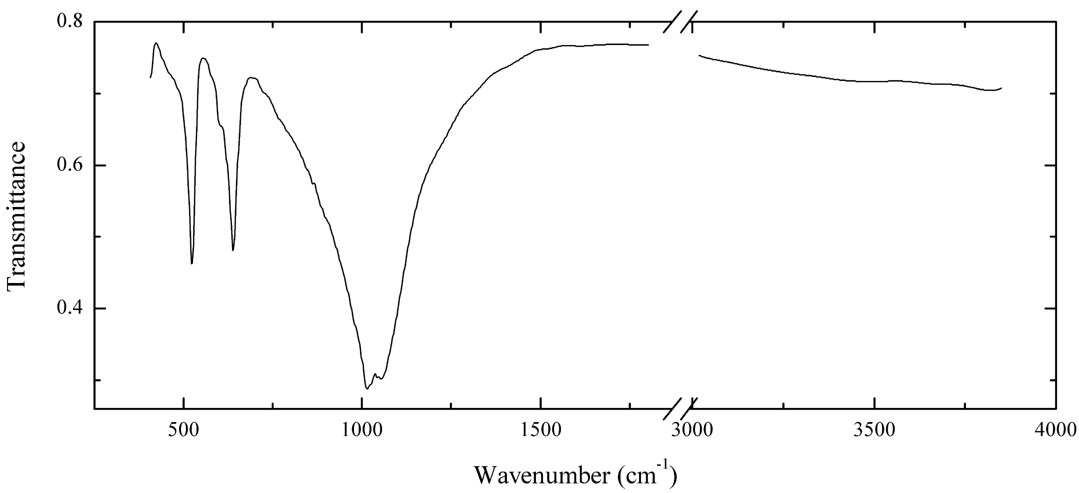


Locality: Berg, Sollefteå, Ångermanland, Sweden.

Description: Brown massive from the association with wolfeite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1061s, 1042s, 989s, 935shs, 626, 586, 545, 430w.

P140 Xenotime-(Y) $Y(PO_4)$

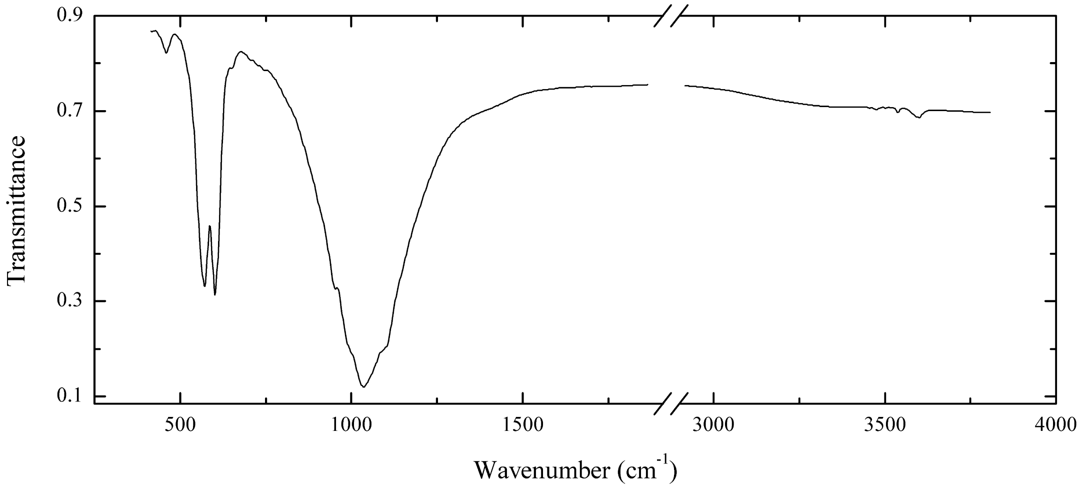


Locality: Crosetto talc mine, Prali, Germanasca valley, Torino province, Piedmont, Italy.

Description: Colourless crystal. The empirical formula is (electron microprobe) $(Y_{0.71}Dy_{0.07}Gd_{0.06}Mn_{0.04}Er_{0.03}Yb_{0.03}Ca_{0.03}Th_{0.02}Sm_{0.01})[(PO_4)_{0.98}(SiO_4)_{0.02}]$.

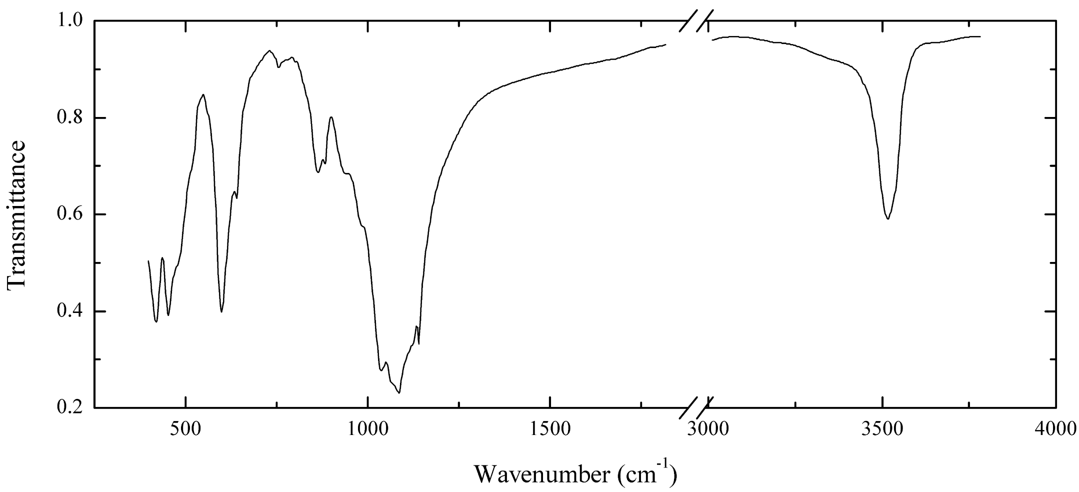
Wavenumbers (cm^{-1}): 1100sh, 1060s, 1019s, 955sh, 640, 620sh, 605sh, 524.

P141 Fluorapatite $Ca_5(PO_4)_3F$



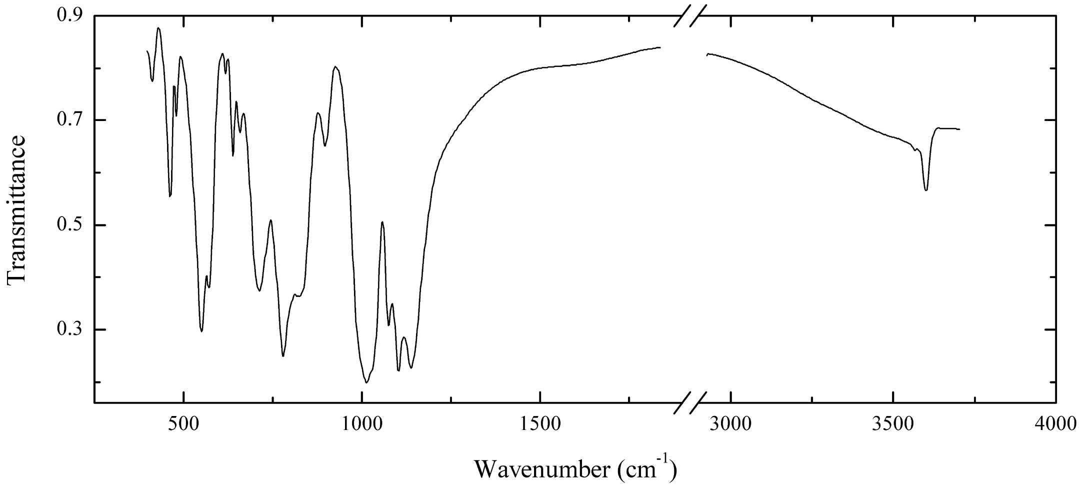
Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Yellow transparent crystal. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Ca_{4.3}Sr_{0.3}Na_{0.2}Ce_{0.1}La_{0.1})(PO_4)_{3.0}[F_{0.55}(OH)_{0.45}]$.
Wavenumbers (cm^{-1}): 3585w, 3530w, 1090sh, 1036s, 1000sh, 958, 650w, 602, 573, 463w.

P142 Althausite $Mg_4(PO_4)_2(OH,O)(F,\square)$



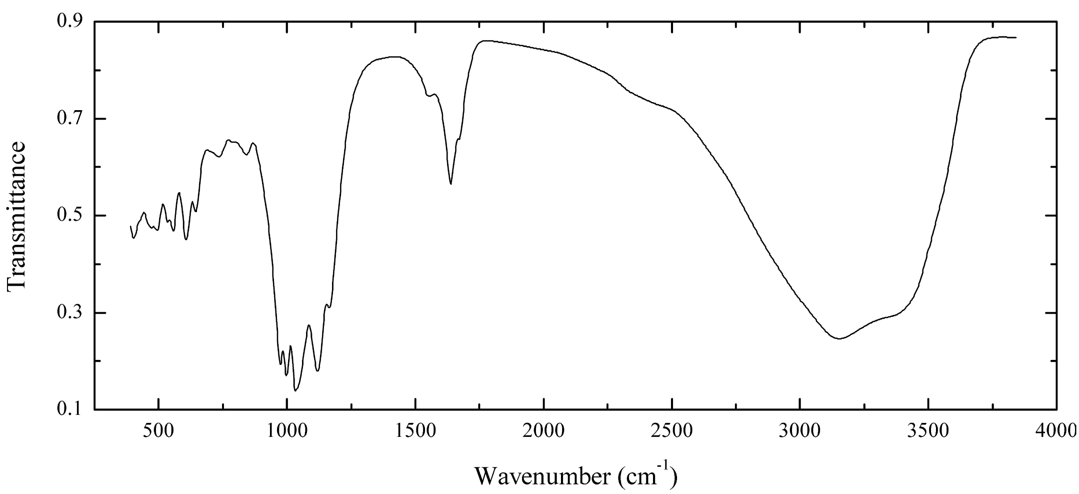
Locality: Tingelstadtjern quarry, Modum, Buskerud, Norway (type locality).
Description: Brownish grains from the association with holtedahlite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3500, 1140, 1115sh, 1070sh, 1085s, 1037s, 990sh, 949, 884, 866, 758w, 640, 601, 520sh, 480sh, 453, 416.

P143 Hydroxylherderite $CaBe(PO_4)(OH,F)$



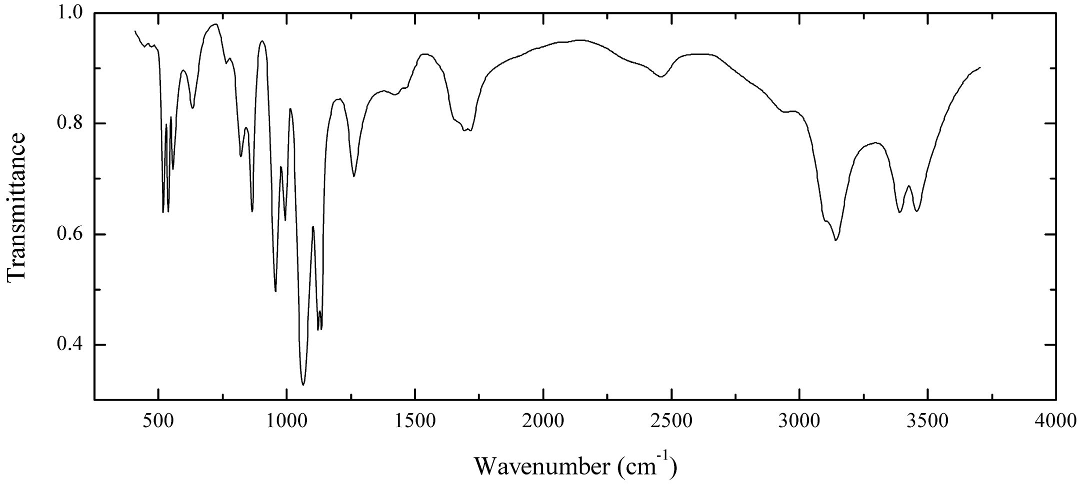
Locality: Bakennoe Ta deposit, Kalba range, Eastern Kazakhstan region, Kazakhstan.
Description: Yellowish split crystals from the association with albite and microlite. Identified by IR spectrum. Differs from herderite by rather strong band at 3,600 cm^{-1} and very low intensity of the band at 3,565 cm^{-1}.
Wavenumbers (cm^{-1}): 3600, 3565w, 1139s, 1102s, 1074, 1025sh, 1010s, 897, 824, 779s, 730sh, 712, 658, 639, 618w, 569, 550s, 480, 463, 415w.

P144 Destinezite $Fe^{2+}{}_2(PO_4)(SO_4)(OH)\cdot 6H_2O$



Locality: Hloubětín, Prague district, Bohemia, Czech Republic.
Description: Yellowish earthy concretion. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3355sh, 3145s, 2400sh, 1680, 1645, 1560w, 1167, 1122s, 1050sh, 1033s, 1000s, 976s, 844w, 738w, 643, 604, 557, 534, 492, 473, 399.

P146 Dorfmanite $Na_2(HPO_4)\cdot 2H_2O$

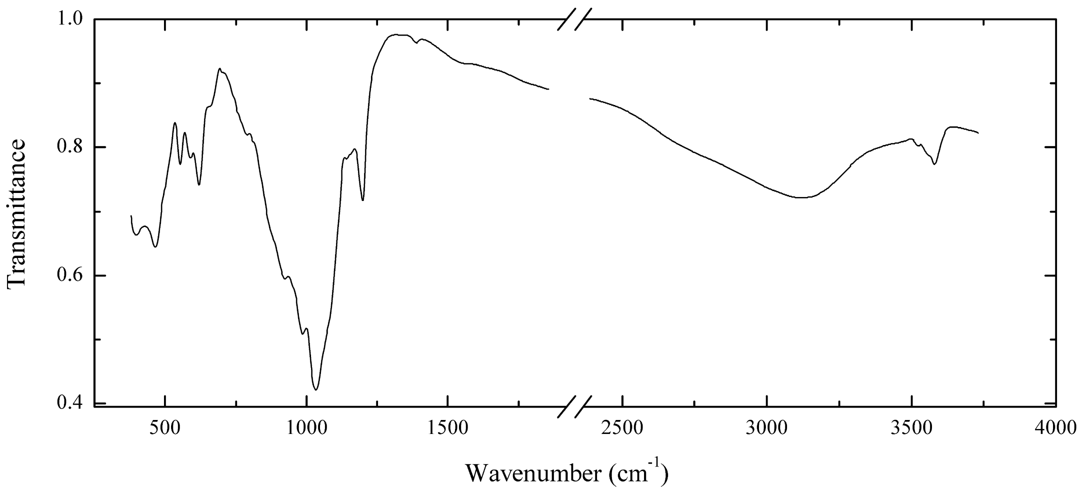


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: White powdery, pseudomorph after an earlier Na phosphate, from the association with ussingite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3445, 3380, 3135, 3095sh, 2955w, 2455w, 2350sh, 1715, 1693, 1655sh, 1465w, 1430w, 1265, 1135s, 1123s, 1072s, 996, 957s, 865, 824, 770w, 637, 559, 537, 517, 470w, 440w.

P147 Dufrénite $Ca_{0.5}Fe^{2+}Fe^{3+}{}_5(PO_4)_4(OH)_6\cdot 2H_2O$

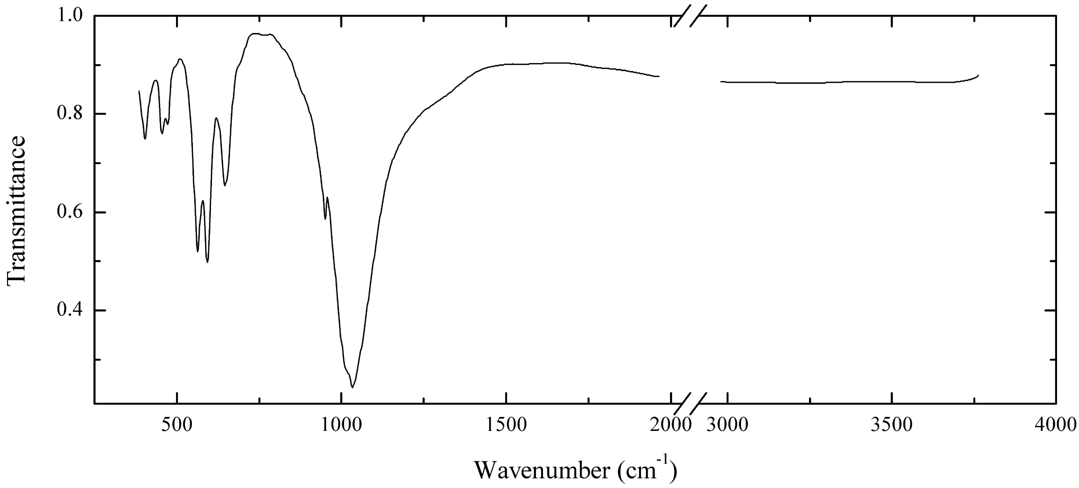


Locality: Poniklá, Jilemnice, Liberec region, Bohemia, Czech Republic.

Description: Brown radial aggregates. The empirical formula is (electron microprobe) $(Ca_{0.18}Na_{0.15})(Fe_{5.77}Al_{0.18}Mg_{0.03})[(PO_4)_{0.97}(SiO_4)_{0.03}](OH,H_2O)_x$.

Wavenumbers (cm^{-1}): 3565w, 3520sh, 3110, 2800sh, 1550w, 1388w, 1200, 1145w, 1065sh, 1034s, 985s, 930, 792w, 660sh, 621, 589, 554, 467, 397.

P148 Isokite $CaMg(PO_4)F$

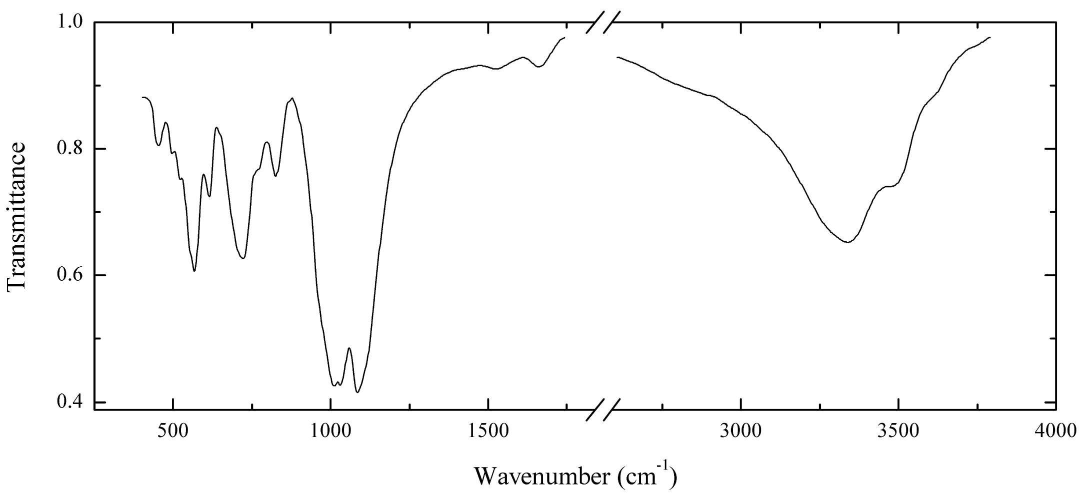


Locality: Nkumbwa Hill, near Isoka, Zambia (type locality).

Description: Specimen No. 70115 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1070sh, 1036s, 1015sh, 952, 649, 594, 566, 477, 458, 385.

P149 Zanazziite $Ca_2(Mg,Fe^{2+})(Mg,Fe^{2+},Al)_4Be_4(PO_4)_6(OH)_4{\cdot}6H_2O$

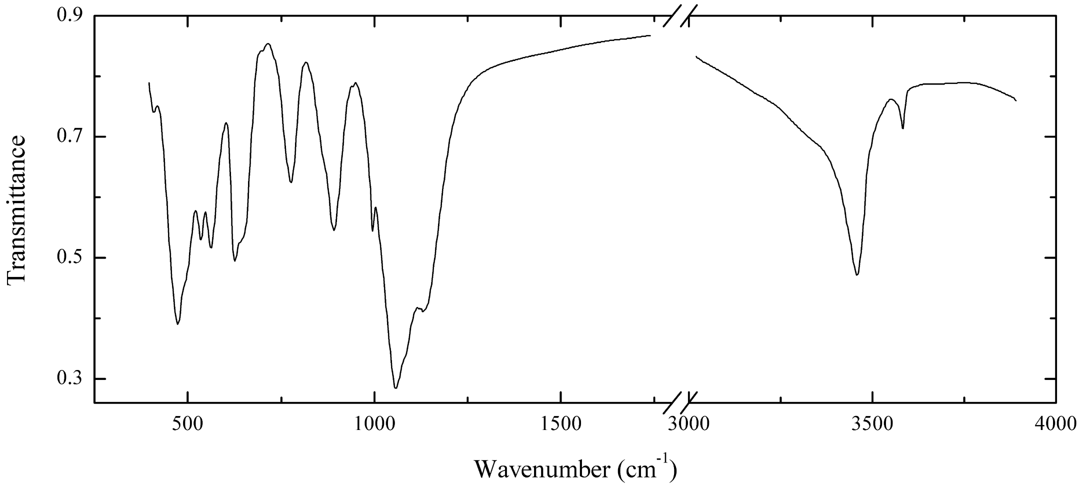


Locality: Minas Gerais State, Brazil.

Description: Green spherulite. Specimen No. 89539 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. The empirical formula is (electron microprobe) $(Ca_{1.95}Na_{0.03})(Mg_{2.66}Fe_{1.39}Al_{0.43}Mn_{0.24}Zn_{0.03})Be_4(PO_4)_{6.00}(OH)_4{\cdot}nH_2O$. Splitting of the bands of Si–O and Be–O stretching vibrations (the doublets at 1,013 + 1,034 and 710 + 724 cm^{-1}) indicates that it can be a triclinic analogue of zanazziite (by analogy with atencioite and footemineite).

Wavenumbers (cm^{-1}): 3620sh, 3490, 3340, 1660w, 1540w, 1115sh, 1087s, 1034s, 1013s, 827, 775sh, 724, 710sh, 614, 569, 550sh, 522, 497w, 458w.

P150 Jagowerite $BaAl_2(PO_4)_2(OH)_2$

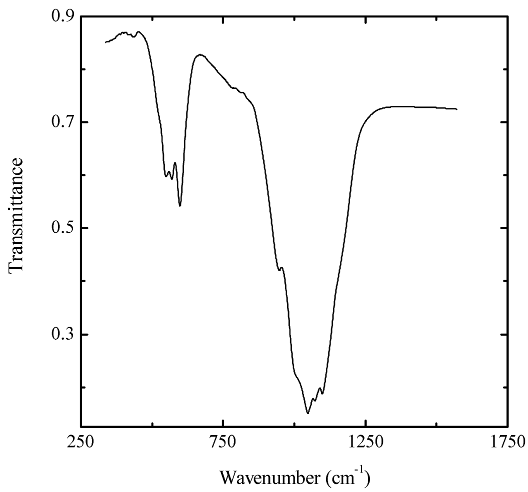


Locality: 26 km north of the Hess River, Yukon territory, Canada (type locality).

Description: Greenish grain from the association with quartz. Specimen No. 79611 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 3560w, 3437, 1132s, 1058s, 996, 893, 778, 640sh, 624, 562, 539, 490sh, 473, 406w.

P151 Deloneite-(Ce) $NaCa_2SrCe(PO_3)_3F$

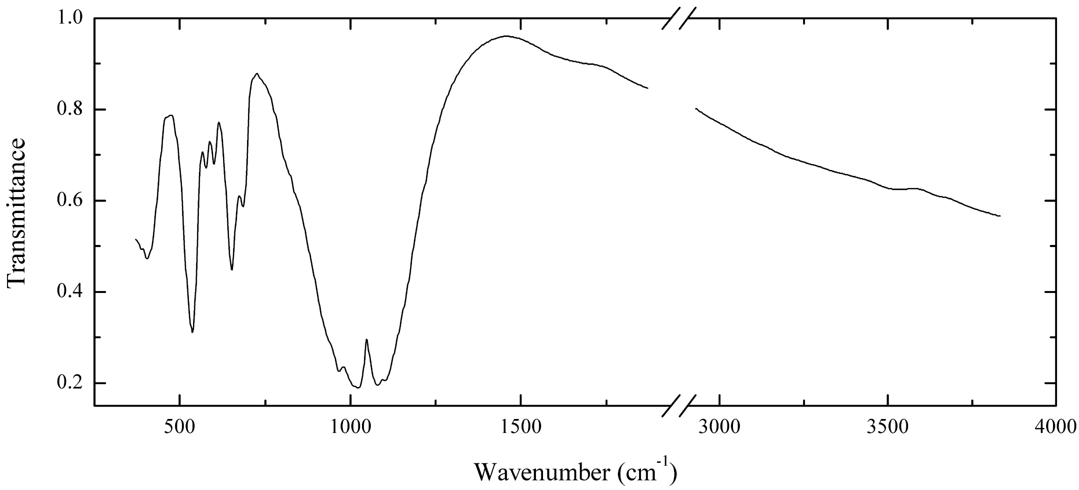


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Yellow grains from the association with fluorcaphite, belovite-(Ce), lomonosovite, sitinakite and fluorite. Holotype sample. The crystal structure is solved. Trigonal, space group $P3$, $a = 9.51(1)$, $c = 7.01(1)$ Å, $Z = 2$. The empirical formula is $(Na_{0.96}K_{0.01})Ca_{1.77}Sr_{1.18}(Ce_{0.54}La_{0.34}Nd_{0.15}Pr_{0.04}Sm_{0.02})[(PO_4)_{0.97}(SiO_4)_{0.03}][F_{0.72}(OH)_{0.28}]$. $D_{meas} = 3.92(5)$ g/cm^3, $D_{calc} = 3.95$ g/cm^3. Optically biaxial (−), $\omega = 1.682(2)$, $\varepsilon = 1.660(2)$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.84 (100), 3.12 (40), 2.753 (40), 3.51 (30), 1.967 (30), 1.870 (30), 2.288 (20).

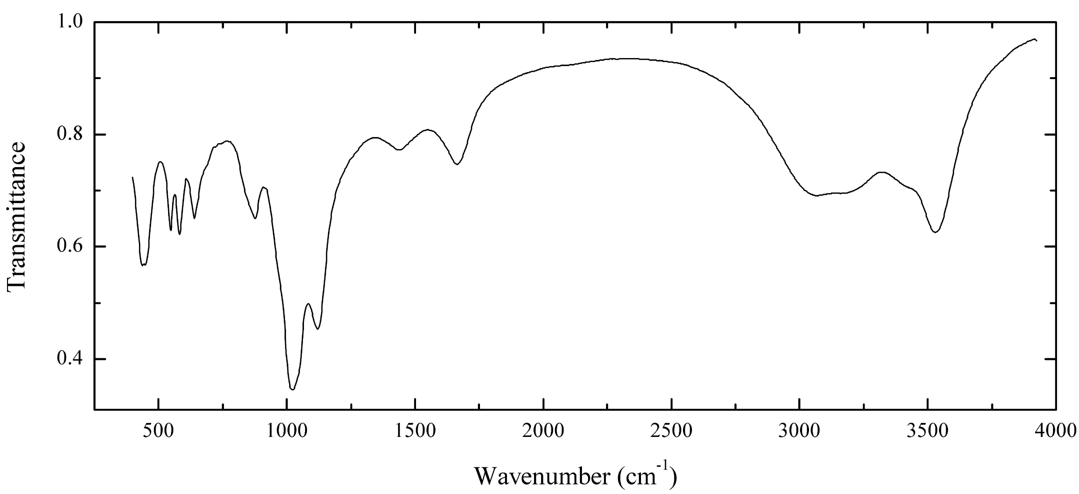
Wavenumbers (cm^{-1}): 1160sh, 1101s, 1068s, 1045s, 1005sh, 947, 602, 575, 554, 467w.

P152 Purpurite $Mn^{3+}(PO_4)$



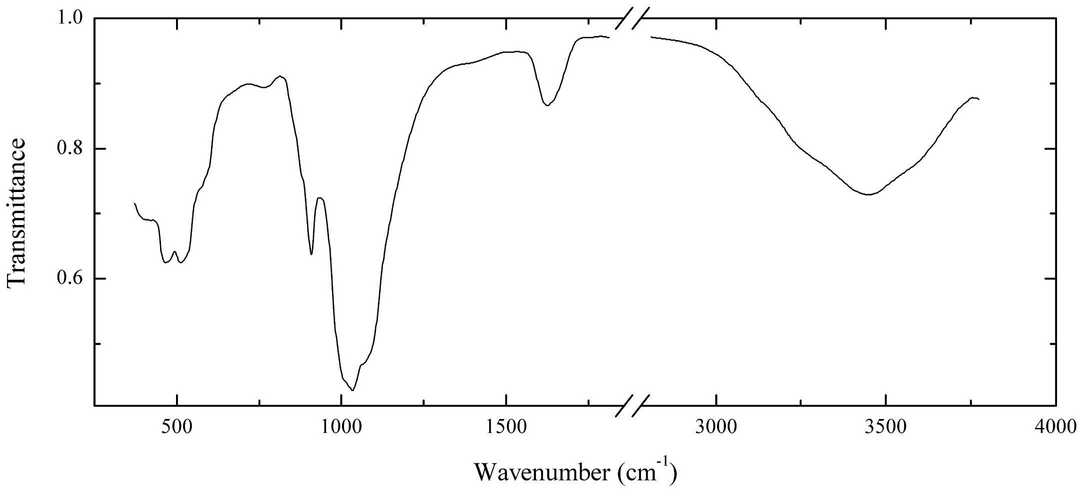
Locality: Mangualde, Viseu district, Portugal.
Description: Reddish purple, massive. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3500w, 1105s, 1085s, 1022s, 1005sh, 966s, 683, 650, 599w, 576w, 534, 403.

P153 Juonniite $CaMgSc(PO_4)_2(OH){\cdot}4H_2O$



Locality: Iron mine, Kovdor, Kovdor ultramafic alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: Grey spherulites from the association with dolomite, magnesite, bobierrite, kovdorskite, manasseite, hydrotalcite, apatite, strontiowhitlockite, pyrite, strontian collinsite, rimkorolgite, talc, baddeleyite, zircon and gypsum. Investigated by the discoverer, R.P. Liferovich.
Wavenumbers (cm^{-1}): 3500, 3410sh, 3130, 3025, 1663, 1435w, 1120s, 1050sh, 1022s, 878, 690sh, 641, 582, 546, 447, 435.

P154 Yingjiangite $K_2Ca(UO_2)_7(PO_4)_4(OH)_6{\cdot}6H_2O$

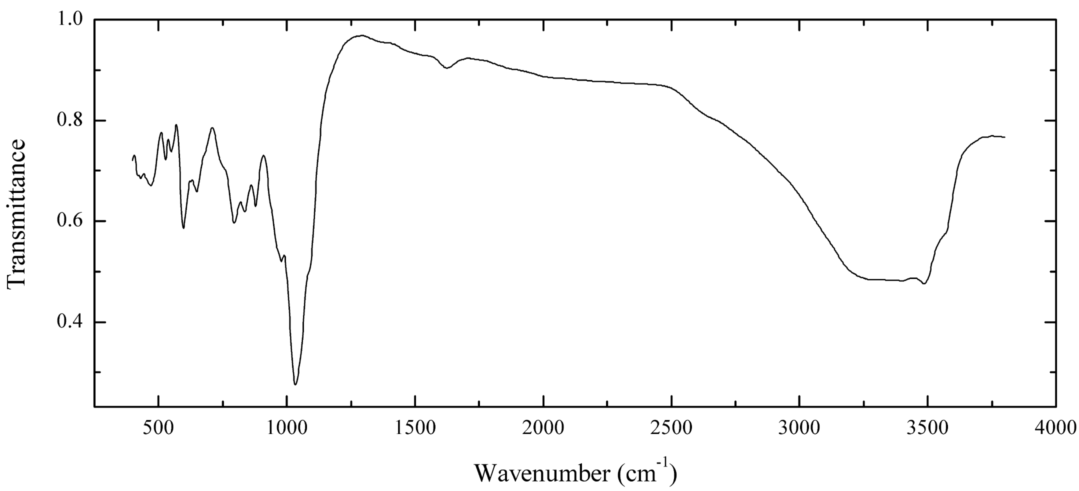


Locality: Johanngeorgenstadt, Erzgebirge, Saxony, Germany.

Description: Yellow massive from the association with quartz. Confirmed by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3550sh, 3440, 3250sh, 1630, 1080sh, 1034, 1010sh, 912, 880sh, 860sh, 800w, 590sh, 565sh, 513, 465, 400.

P155 Kipushite $(Cu,Zn)_6(PO_4)_2(OH)_6{\cdot}H_2O$

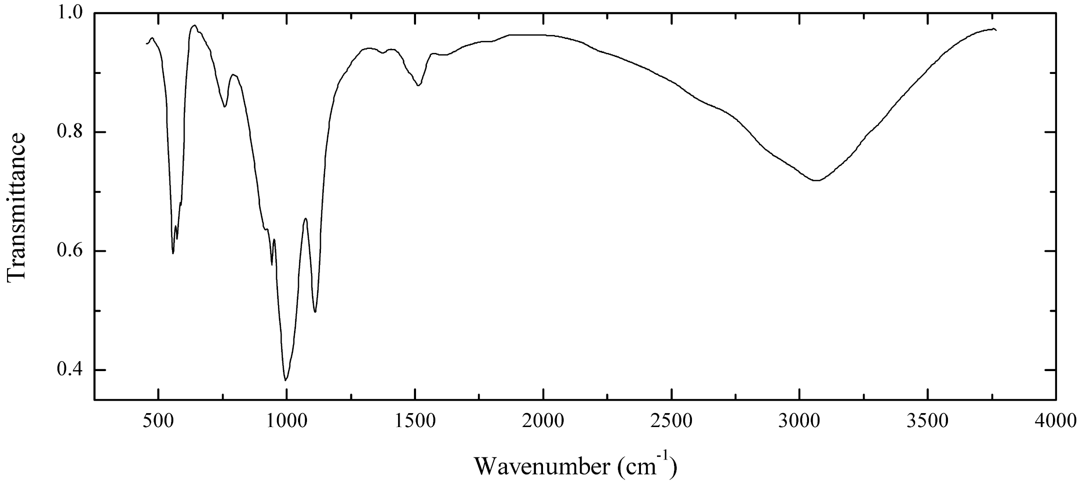


Locality: Black Pine mine, Philipsburg, Montana, USA.

Description: Bluish-green spherulites. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Cu_{4.1}Zn_{1.8}Mg_{0.1})[(PO_4)_{1.55}(AsO_4)_{0.45}](OH)_6{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3540sh, 3470, 3370, 3270, 2650sh, 1627w, 1085sh, 1034s, 980s, 965sh, 940sh, 880, 837, 797, 755sh, 670sh, 650, 596, 548, 526, 475, 430.

P156 Collinsite $Ca_2Mg(PO_4)_2 \cdot 2H_2O$

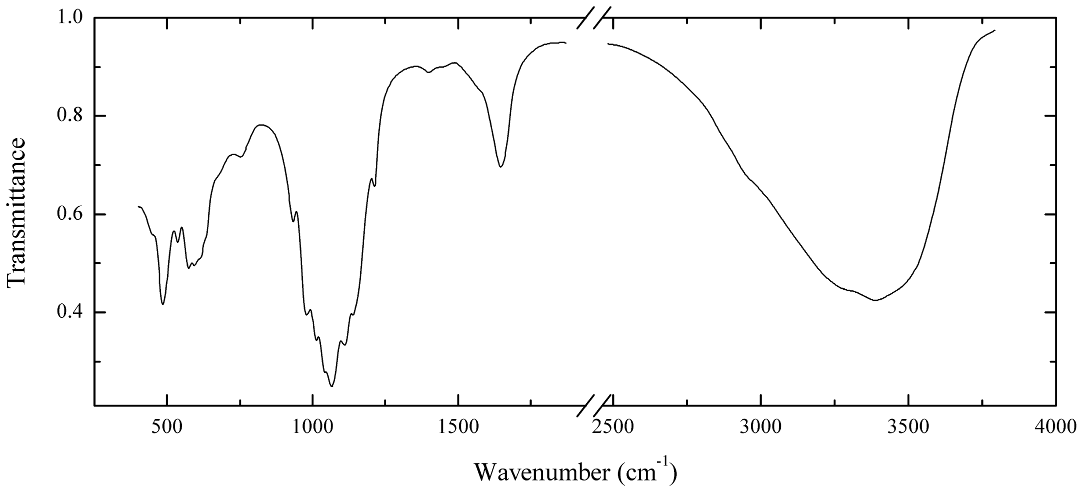


Locality: Iron mine, Kovdor, Kovdor ultramafic alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Grey spherulites on bobierrite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Ca_{1.72}Sr_{0.21}Ba_{0.02})(Mg_{0.97}Fe_{0.06})(PO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3275sh, 3050, 2870sh, 1805w, 1617w, 1515, 1480sh, 1378w, 1111s, 1020sh, 996s, 943, 918, 758, 587, 573, 555.

P157 Cacoxenite $AlFe^{2+}{}_{24}(PO_4)_{17}O_6(OH)_{12} \cdot nH_2O$ ($n \approx 75$)

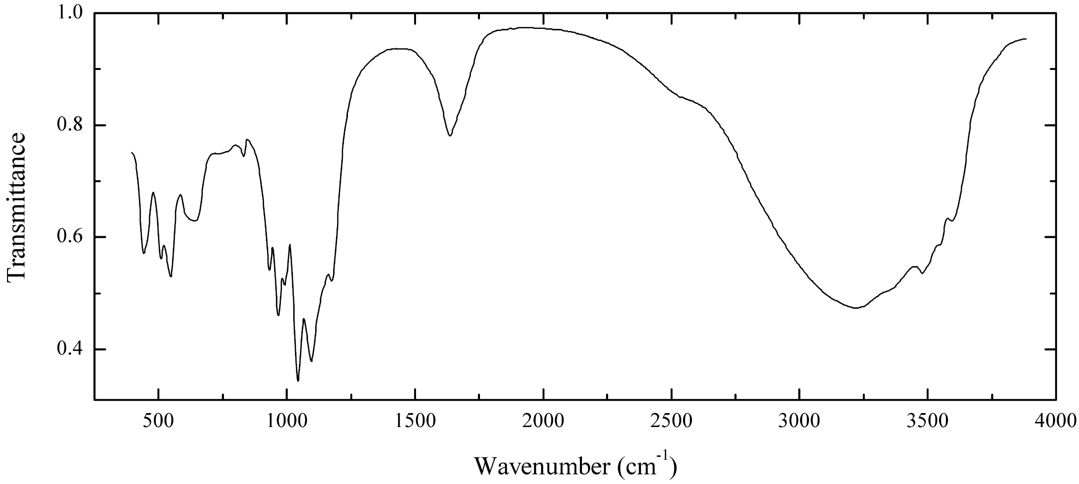


Locality: Leveäniemi mine, Svappavaara, Kiruna district, Lappland, Sweden.

Description: Yellow acicular crystals. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3450sh, 3375s, 3290sh, 2950sh, 1645, 1570sh, 1455sh, 1401w, 1212, 1132s, 1107s, 1061s, 1036s, 1009s, 978s, 930, 749, 670sh, 620sh, 605sh, 588, 567, 529, 478, 440sh.

P158 Coconinoite $Fe^{3+}{}_2Al_2(UO_2)_2(PO_4)_4(SO_4)(OH)_2{\cdot}20H_2O$

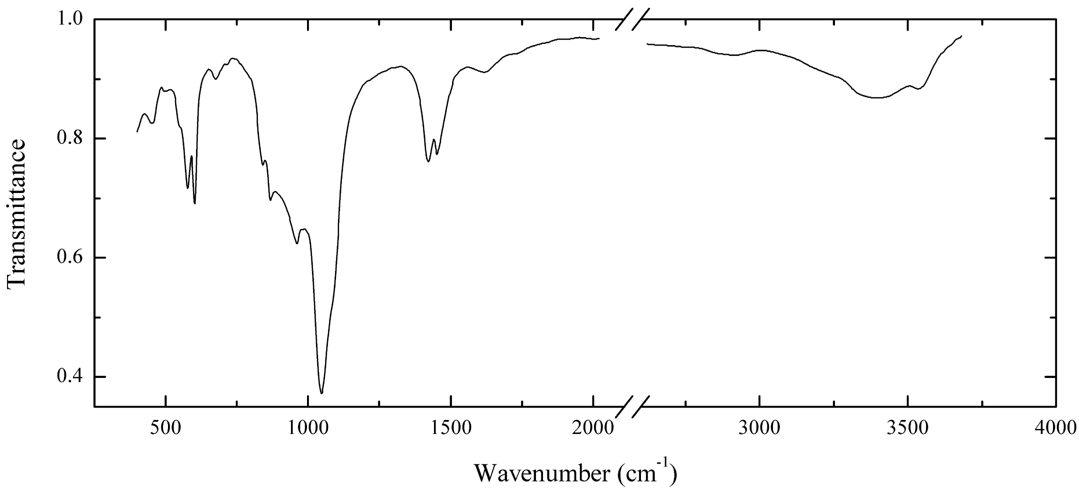


Locality: Koscheka U deposit, Auminzatau Mts., Central Kazakhstan region, Kyzylkum desert, Uzbekistan.

Description: Yellow massive. Fe-poor variety. The empirical formula is (electron microprobe)s $(Al_{3.41}Fe_{0.38})(UO_2)_{2.12}(PO_4)_{4.17}(SO_4)_{0.83}(OH)_x{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3580, 3530, 3465, 3340sh, 3210s, 2540sh, 1670sh, 1635, 1173, 1140sh, 1094s, 1042s, 989, 965s, 931, 833w, 730w, 640, 610sh, 544, 505, 436.

P159 Hydroxylapatite $Ca_5(PO_3)_3(OH)$

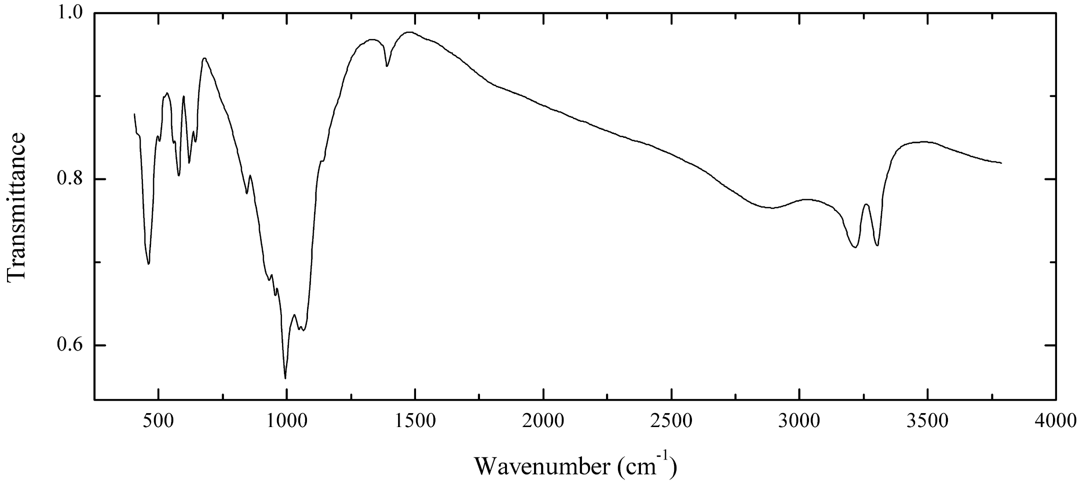


Locality: Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Brownish pseudomorph after platy crystals of an unknown mineral. CO_3- and H_2O-bearing variety, $(Ca,\square,H_2O)_5(PO_4,CO_3)_3(OH,F,H_2O)$.

Wavenumbers (cm^{-1}): 3540, 3400, 2900w, 1725w, 1625w, 1457, 1427, 1090sh, 1050s, 964, 866, 844, 678w, 602, 577, 550sh, 457.

P160 Cornetite $Cu^{2+}{}_3(PO_4)(OH)_3$

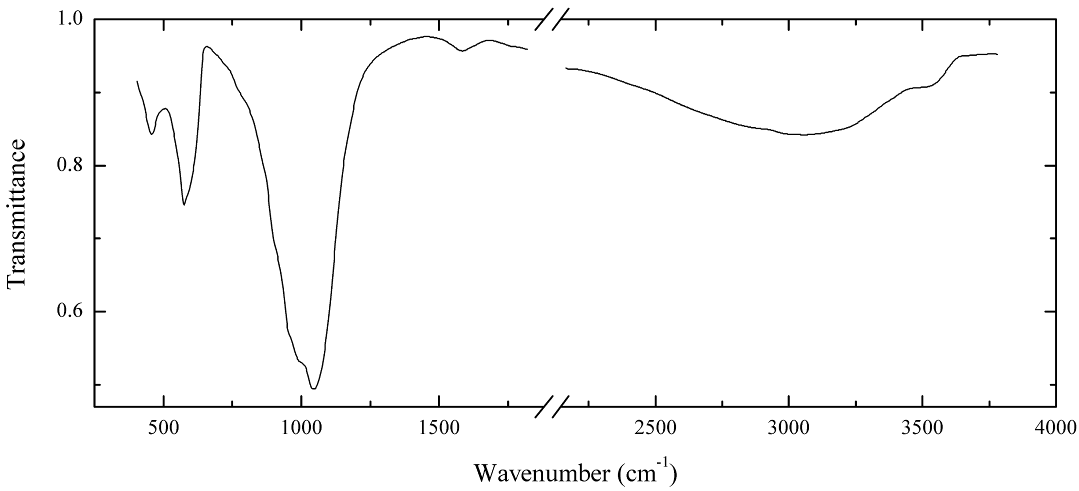


Locality: L'Étoile du Congo mine, Lubumbashi, Katanga, Democratic Republic of Congo (type locality).

Description: Blue crystals from the association with chrysocolla. Confirmed by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3290, 3200, 2890, 1390w, 1142, 1069s, 1047s, 1010sh, 991s, 955, 932, 924, 847, 643, 620, 577, 555, 505, 457, 405w.

P161 Kryzhanovskite $(Fe^{3+},Mn)Fe^{3+}{}_2(PO_4)_2(OH,H_2O)_3$

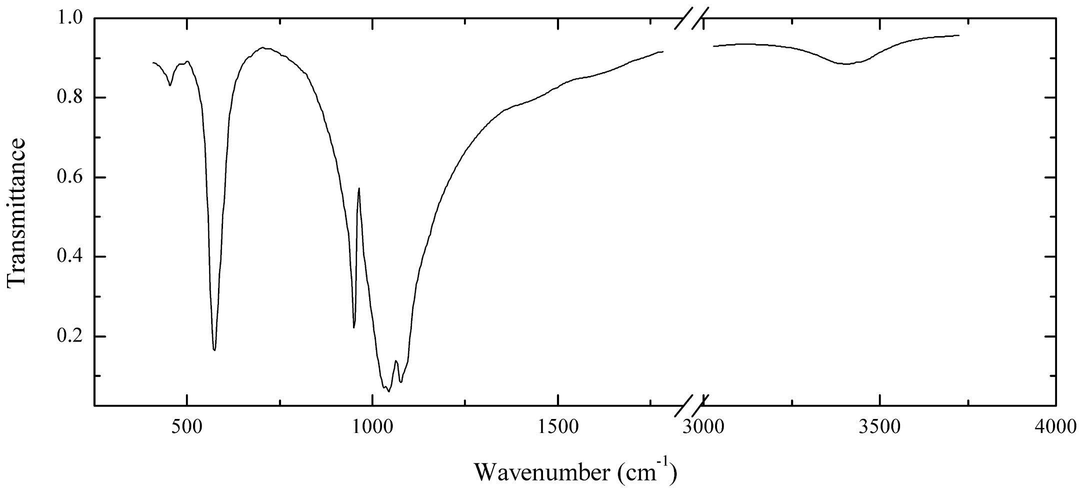


Locality: Kyrk-Bulak pegmatite, Turkestan range, Osh region, Kyrgyzstan.

Description: Dark brown massive. Investigated by L.A. Pautov.

Wavenumbers (cm^{-1}): 3500w, 3050, 1585w, 1053s, 990sh, 960sh, 920sh, 895sh, 870sh, 590sh, 572, 457.

P162 Nefedovite $Na_5Ca_4(PO_4)_4F$

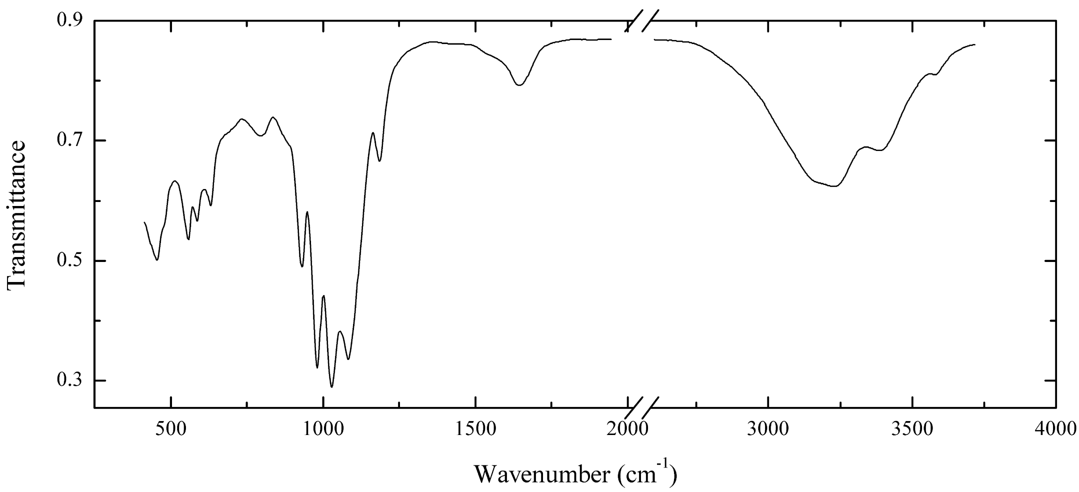


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description Graphic intergrowth with villiaumite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3370, 1450sh, 1095sh, 1077s, 1043s, 1031s, 954, 590sh, 572, 450w.

P163 Natrodufrénite $NaFe^{2+}Fe^{3+}{}_5(PO_4)_4(OH)_6 \cdot 2H_2O$

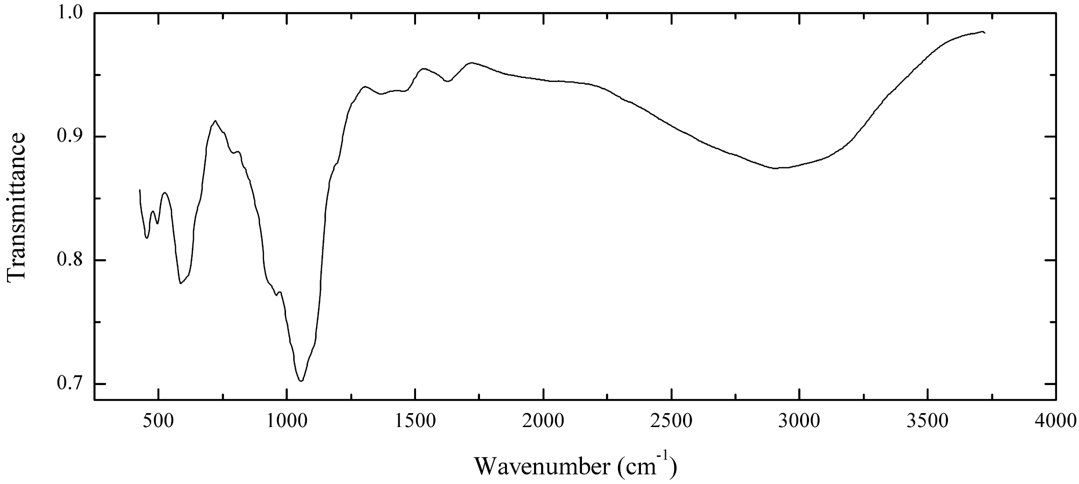


Locality: Teškov quarry, Holoubkov, Czech Republic.

Description: Green spherulites from the association with leucophosphite and strengite. Identified by IR spectrum and qualitative electron microprobe analysis.

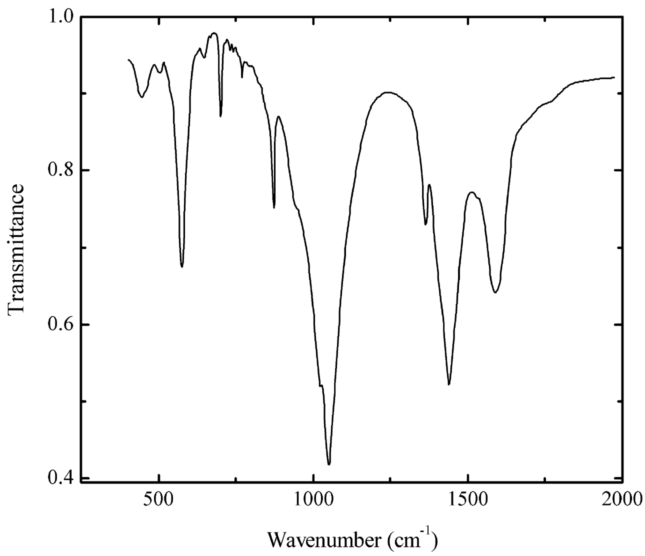
Wavenumbers (cm^{-1}): 3580w, 3370, 3220, 3260sh, 1640, 1184, 1079s, 1024s, 978s, 925, 795w, 624, 582, 550, 460sh, 430.

P164 Zaïrite $BiFe^{3+}_3(PO_4)_2(OH,H_2O)_6$



Locality: Eta-Etu, Kivu, Congo (type locality).
Description: Greenish-brown massive from the association with bismutite and quartz.
Wavenumbers (cm^{-1}): 3060sh, 2920, 1640w, 1460w, 1370w, 1195sh, 1100sh, 1060s, 1025sh, 963, 940sh, 800w, 660sh, 610sh, 589, 494, 459.

P165 Crawfordite $Na_3Sr(PO_4)(CO_3)$

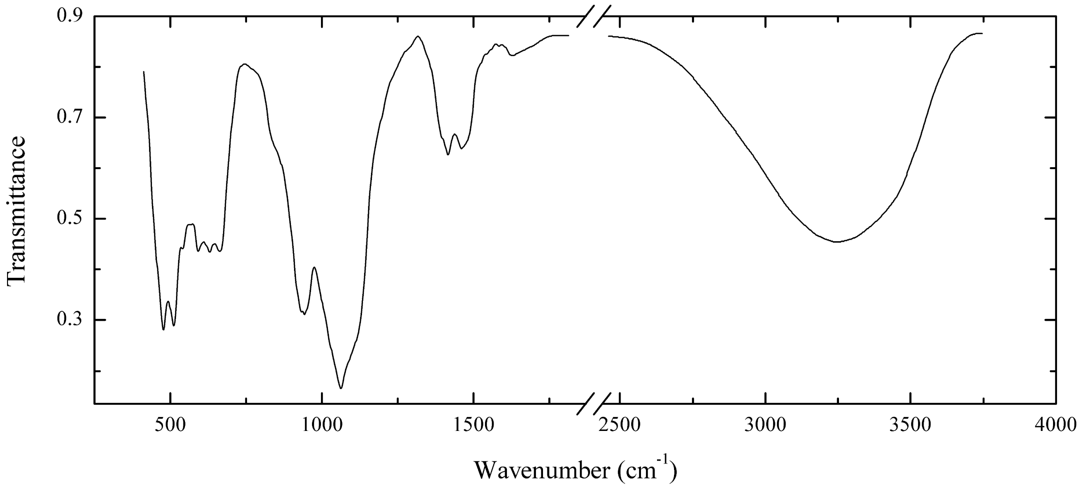


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless grains from the association with Pectolite, astrophyllite, barytolamprophyllite, shcherbakovite, vuonnemite, kazakovite, ershovite, chkalovite, natrite, villiaumite, rasvumite, potassian feldspar, nepheline, sodalite and aegirine. Holotype sample. Monoclinic, space group $P2_1$, $a = 9.187(3)$, $b = 6.707(2)$, $c = 5.279(1)$ Å, $\beta = 89.98(3)°$, $Z = 2$. The empirical formula is $Na_{3.13}Sr_{0.81}Ca_{0.08}K_{0.01}P_{1.01}C_{1.00}O_7$. $D_{meas} = 3.05$ g/cm^3, $D_{calc} = 3.08$ g/cm^3. Optically biaxial (−), $\alpha = 1.520(2)$, $\beta = 1.564(2)$, $\gamma = 1.565(2)$, $2V_{meas} = -20(1)°$. The

strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.708 (100), 2.172 (100), 2.648 (90), 1.891 (80), 1.415 (70), 1.129 (60), 1.106 (60).

Wavenumbers (cm^{-1}): 1596, 1442s, 1367, 1053s, 1027s, 950sh, 874, 774w, 702, 649w, 577, 505w, 452.

P166 Krasnovite Ba(Al,Mg)(PO_4,CO_3)$(OH)_2$·H_2O

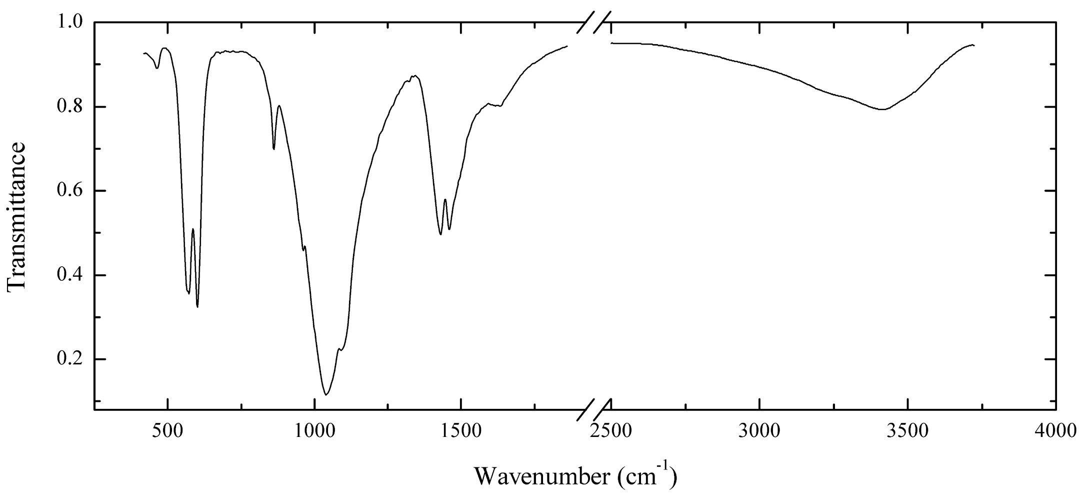


Locality: Cerro Sapo, Cochabamba, Bolivia.

Description Blue radial aggregate from carbonatite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3250, 1630w, 1475, 1420, 1105sh, 1065s, 1040sh, 1005sh, 943s, 845sh, 663, 630, 594, 540, 511s, 479s.

P167 Fluorapatite CO$_3$-rich (Ca,H_2O,□)$_5$(PO_4,CO_3)$_3$(F,OH,H_2O)

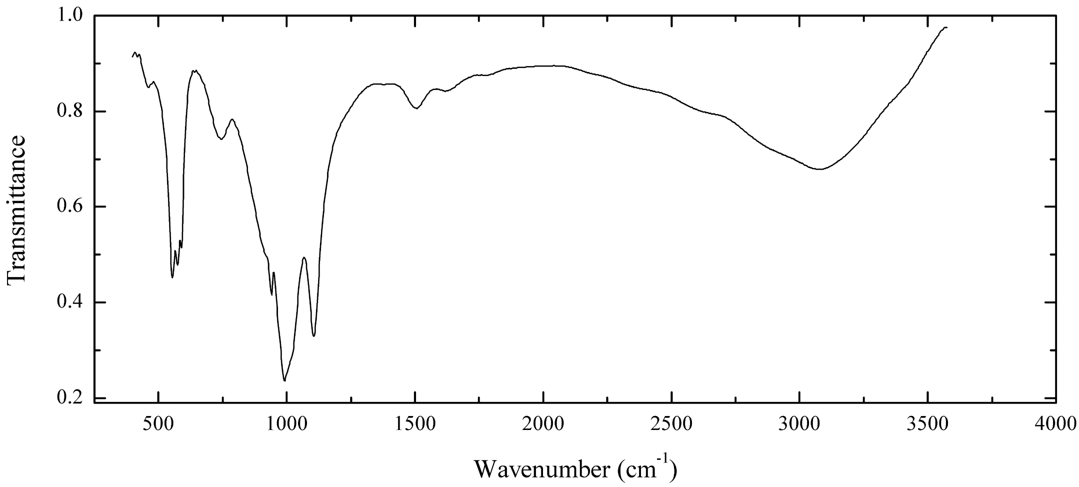


Locality: François Lake, British Columbia, Canada.

Description: Brown spherulites from the association with collinsite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3400, 1625w, 1458, 1427, 1094s, 1042s, 964, 870sh, 865, 605s, 578, 572, 471w.

P168 Collinsite $Ca_2Mg(PO_4)_2 \cdot 2H_2O$

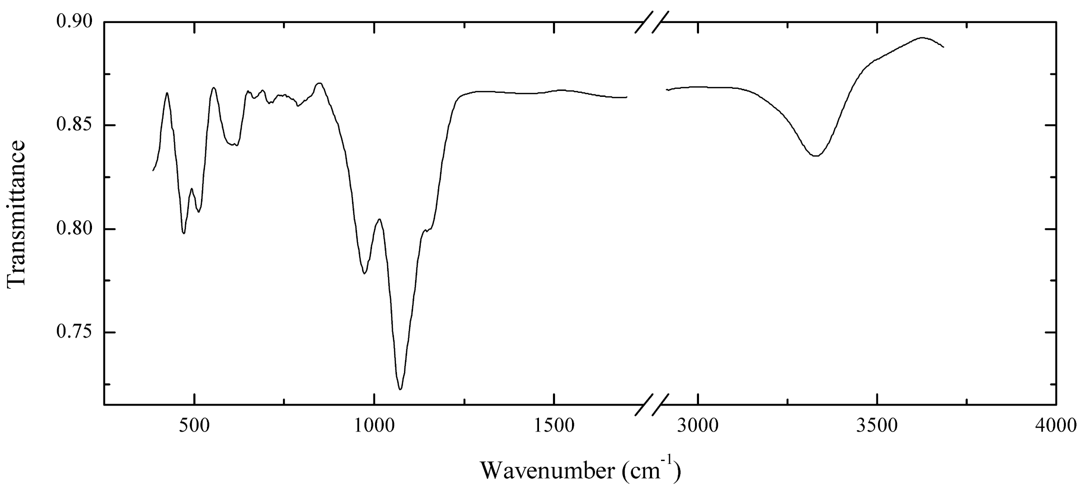


Locality: Iron mine, Kovdor, Kovdor ultramafic alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Grey spherulites from dolomite carbonatite. Identified by IR spectrum and electron microprobe analysis. Sr-rich variety. The empirical formula is $(Ca_{1.24}Sr_{0.72}Ba_{0.03})(Mg_{0.92}Fe_{0.05}Mn_{0.05})(PO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3390sh, 3070, 2930sh, 2650sh, 1775w, 1630w, 1510, 1109s, 1020sh, 994s, 941, 920sh, 746, 589, 576, 554, 461w.

P169 Kintoreite $PbFe^{3+}{}_3(PO_4)_2(OH,H_2O)_6$

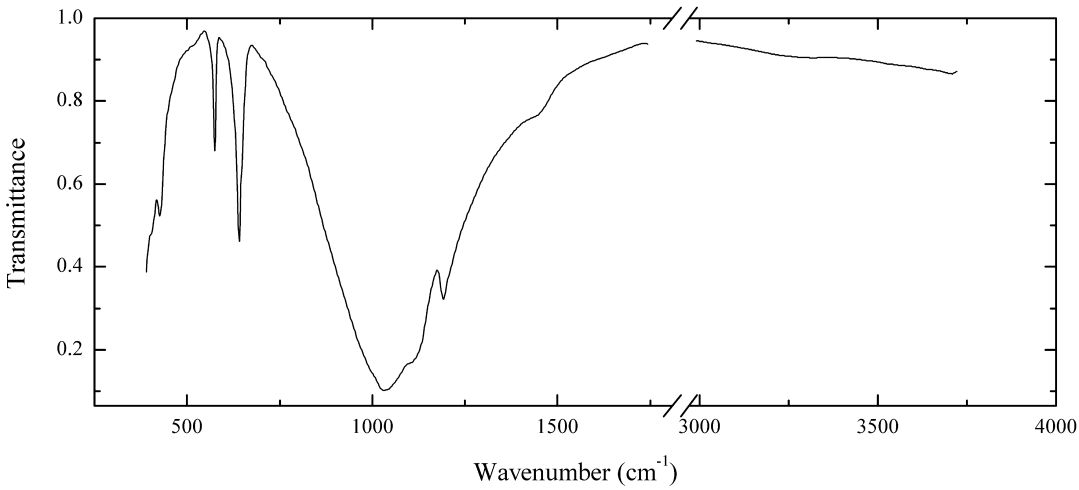


Locality: Clara mine, Rankach valley, Oberwolfach, Wolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Brown crystals. The empirical formula is $(Pb_{0.8}Ba_{0.1})(Fe_{2.5}Al_{0.4})[(PO_4)_{1.7}(SO_4)_{0.3}](OH,H_2O)_3$.

Wavenumbers (cm^{-1}): 3330, 1160, 1074s, 975, 800w, 720w, 675w, 624, 610, 512, 468.

P170 Kosnarite $KZr_2(PO_4)_3$

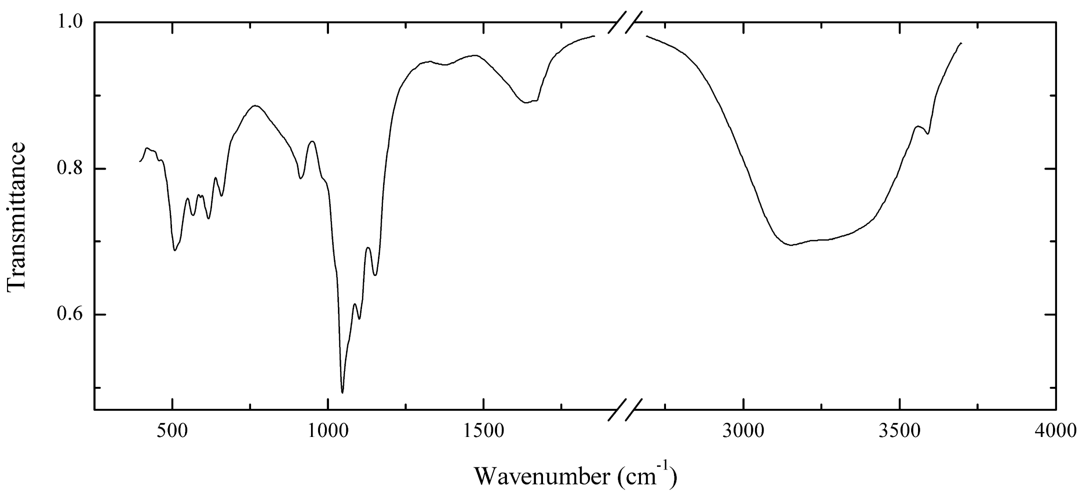


Locality: Limoeiro mine, Campo Formoso, Bahia, Brazil.

Description: Brown crystals from the association with tourmaline. Identified by powder X-ray diffraction pattern. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 6.37 (14), 4.35 (20), 3.817 (19), 3.194 (20), 2.937 (100), 2.513 (10), 2.129 (10), 1.912 (14). The empirical formula is $(K_{0.85}Na_{0.14}Ca_{0.02})(Zr_{0.91}Hf_{0.08})(PO_4)_{3.00}$.

Wavenumbers (cm^{-1}): 1440sh, 1200, 1115sh, 1039s, 650sh, 640, 574, 423, 400sh.

P171 Kingite $Al_3(PO_4)_2(OH,F)_3{\cdot}9H_2O$

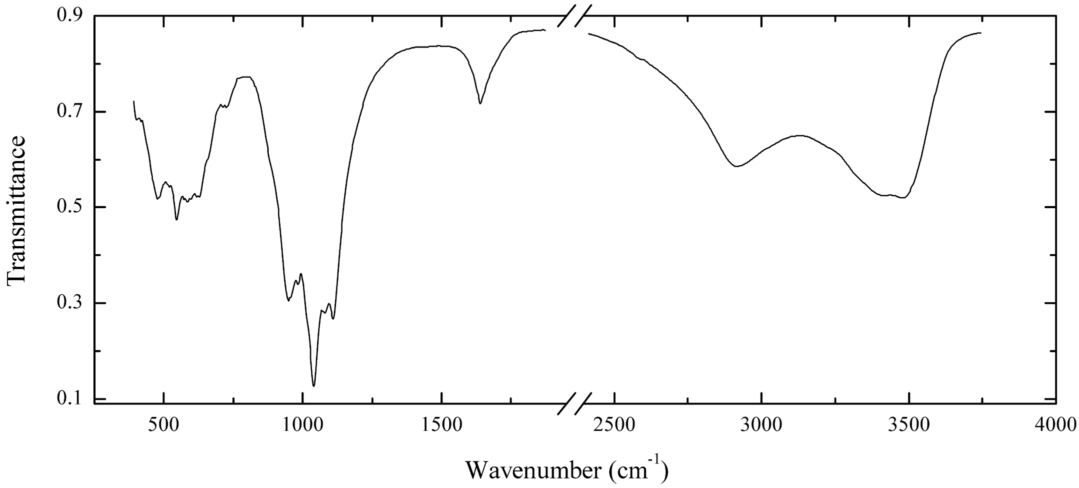


Locality: Clinton mine, near Robertstown, South Australia, Australia (type locality).

Description: White fine-grained aggregate from the association with talc and quartz.

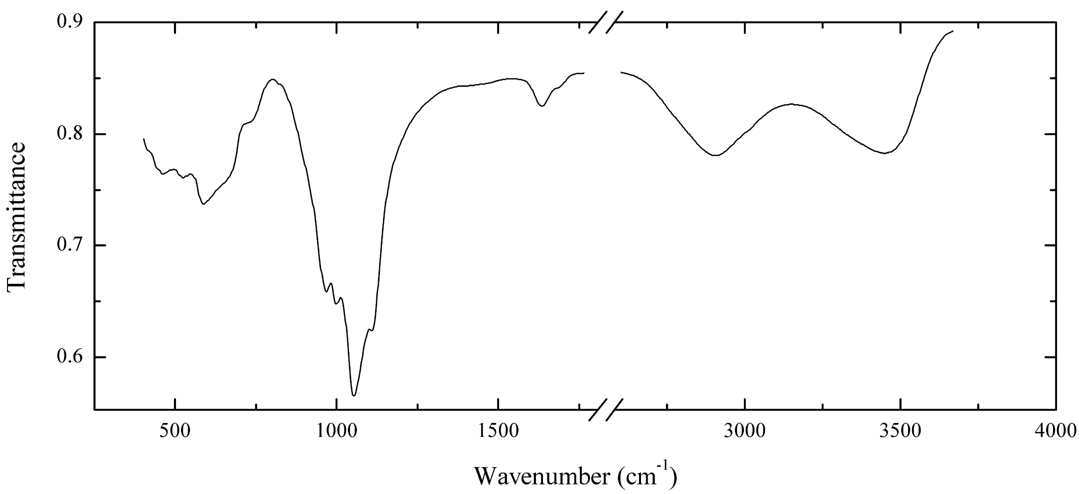
Wavenumbers (cm^{-1}): 3575w, 3350sh, 3275, 3120, 1675, 1640, 1380w, 1153, 1103s, 1070sh, 1048s, 990sh, 917, 656, 612, 593w, 562, 510.

P172 Calcioferrite $Ca_4Mg(Fe^{3+},Al)_4(PO_4)_6(OH)_4·12H_2O$



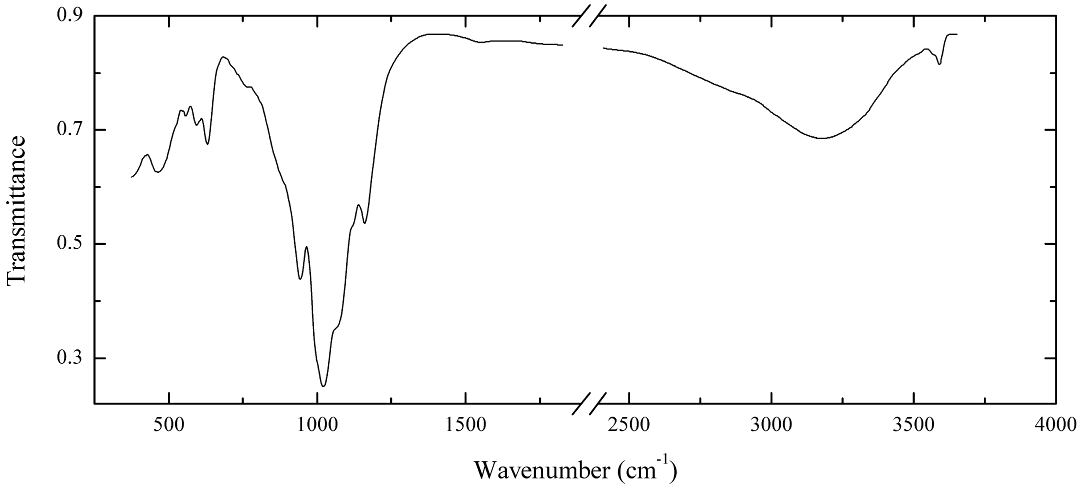
Locality: Bruguers, Gavá, Baix Llobregat, Barcelona, Catalonia, Spain.
Description: Light olive green crystals. The empirical formula is $Ca_{4.0}(Mg_{0.9}Fe_{0.1})Fe_{4.0}(PO_4)_{6.0}(OH)_4·nH_2O$.
Wavenumbers (cm^{-1}): 3460, 3410, 2905, 1640, 1112s, 1080s, 1040s, 984, 949s, 723w, 623, 586, 546, 478, 410w.

P173 Calcioferrite $Ca_4Mg(Fe^{3+},Al)_4(PO_4)_6(OH)_4·12H_2O$



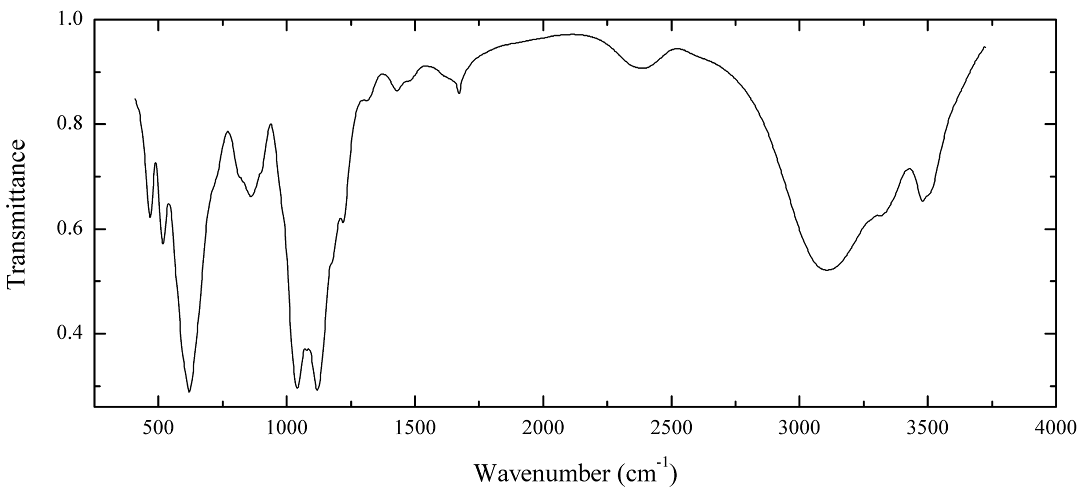
Locality: Moculta phosphate quarry, Angaston, Barossa valley, Lofty Ranges Mt., South Australia, Australia.
Description: Light green crystals.
Wavenumbers (cm^{-1}): 3455, 2910, 1640, 1114, 1057s, 1002, 972, 730sh, 650sh, 587, 530w, 463w.

P174 Kidwellite $NaFe^{3+}_9(PO_4)_6(OH)_{10}{\cdot}5H_2O$



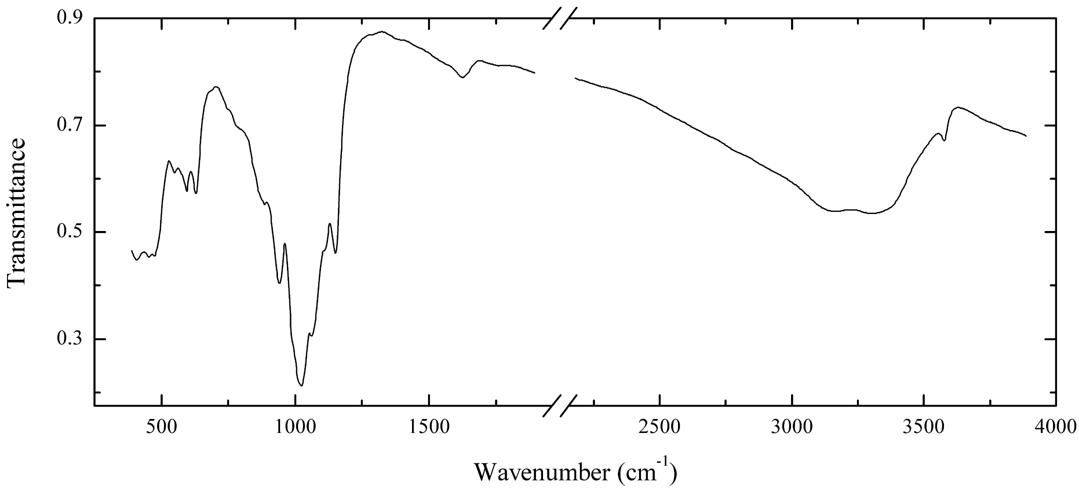
Locality: Three Oak Gap, Polk Co., Arkansas, USA.
Description: Grey-green crust. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3575w, 3165, 1560w, 1160, 1120sh, 1065sh, 1021s, 100sh, 944s, 870sh, 629, 596, 554w, 466.

P175 Crandallite $CaAl_3(PO_4)_2(OH,H_2O)_6$



Locality: Boevskoe Be deposit, Kamensk-Ural'skii, Chelyabinsk region, South Urals, Russia.
Description: Beige crust from the association with kaolinite, beryl, muscovite and fluorite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3490sh, 3470, 3305sh, 3100, 2380, 1675w, 1630sh, 1470w, 1435w, 1315w, 1222, 1175sh, 1120s, 1041s, 970sh, 900sh, 867, 840sh, 825sh, 715sh, 617s, 600sh, 515, 466.

P176 "Oxydufrénite" $Ca_{0.5}Fe^{3+}Fe^{3+}{}_5(PO_4)_4(OH)_7 \cdot nH_2O$

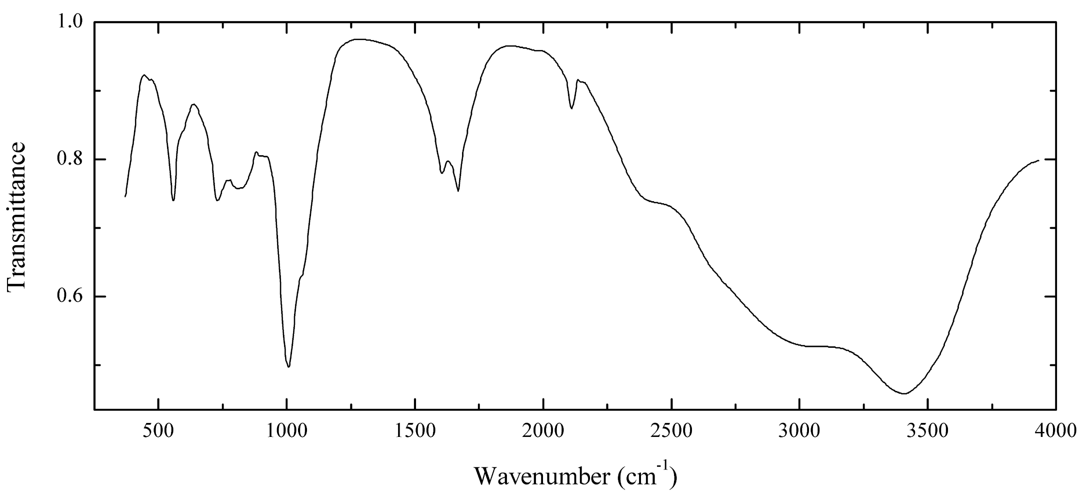


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Brown radial aggregates. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3565w, 3290, 3160, 1635w, 1154, 1110sh, 1080sh, 1064s, 1023s, 990sh, 942, 884, 770sh, 631, 594, 551, 477, 460, 405.

P177 Cattiite $Mg_3(PO_4)_2 \cdot 22H_2O$



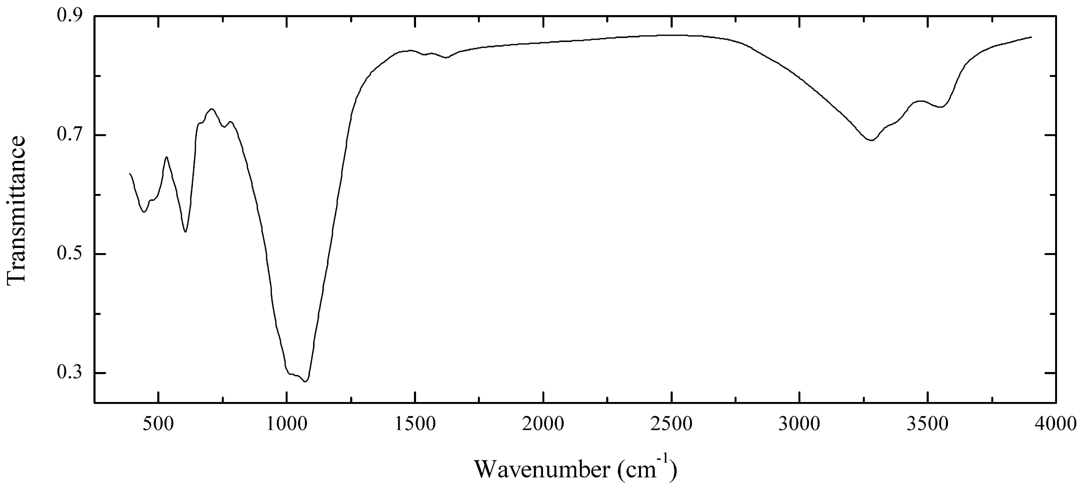
Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Crystalline aggregate filling up cavity of dolomite carbonatite. Associated minerals are dolomite, bakhchisaraitsevite, nastrophite, magnetite, sjogrenite and CO_3-bearing fluorapatite. Holotype sample. Triclinic, space group $P\overline{1}$, $a = 6.932(2)$, $b = 6.925(3)$, $c = 16.154(5)$ Å, $\alpha = 82.21(4)°$, $\beta = 89.70(4)°$, $\gamma = 119.51(3)°$, V 666.3(3) Å^3, $Z = 1$. The empirical formula is $(Mg_{2.92}Fe^{2+}{}_{0.01})_{\Sigma 2.93}P_{2.01}O_{7.955} \cdot 22.055H_2O$. $D_{meas} = 1.65(2)$ g/cm^3, $D_{calc} = 1.640(1)$ g/cm^3.

Optically biaxial (−), $\alpha = 1.459(1)$, $\beta = 1.470(1)$, $\gamma = 1.470(1)$, $2V_{meas} = -25(5)°$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 7.98 (100) (002), 5.32 (63) (003), 3.190 (45) (005), 2.896 (33) (202), 2.867 (30) (-222), 2.728 (32) (1-15), 2.658 (37) (006). The infrared absorption spectrum was obtained with the sample dispersed in mineral oil (nuyol). The absorption bands of nuyol were subtracted from the overall spectrum.

Wavenumbers (cm^{-1}): 3490sh, 3390s, 3050s, 2410, 2102w, 1665, 1602, 1055sh, 1006s, 900w, 805, 727, 557.

P178 Zinclipscombite $ZnFe^{3+}{}_2(PO_4)_2(OH)_2$

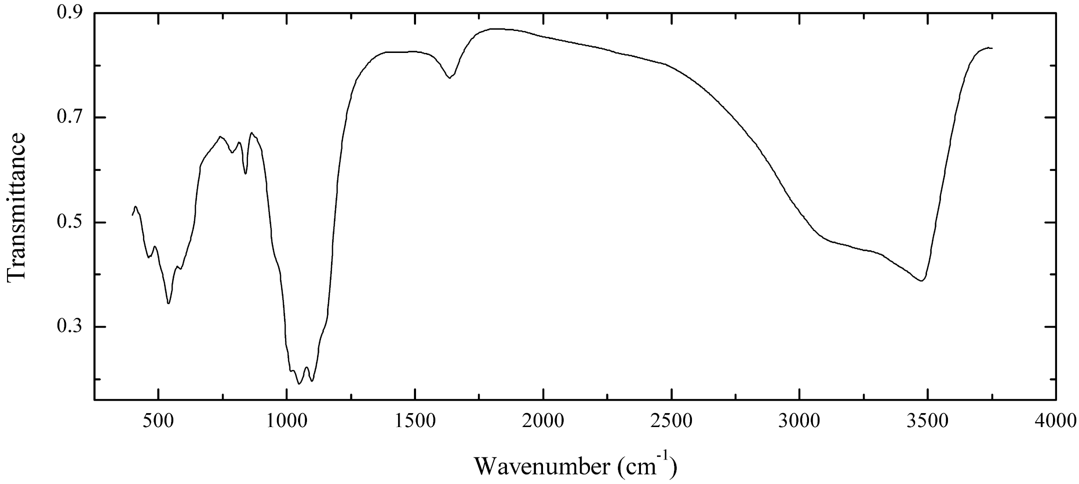


Locality: Silver Coin mine, Valmy, Edna Mountains, Humboldt Co., Nevada, USA (type locality).

Description: Brownish-green spheroidal, radial-fibrous aggregate from the association with apophyllite, quartz, baryte, jarosite, plumbojarosite, turquoise and calcite. Holotype sample. Tetragonal, space group $P4_32_12$ or $P4_12_12$; $a = 7.242(2)$ Å, $c = 13.125(5)$ Å, $V = 688.4(5)$ Å^3, $Z = 4$. The empirical formula is $(Zn_{0.76}Ca_{0.02})_{\Sigma 0.78}(Fe^{3+}{}_{1.72}Al_{0.36})_{\Sigma 2.08}[(PO_4)_{1.86}(AsO_4)_{0.14}]_{\Sigma 2.00}(OH)_{1.80}\cdot 0.17H_2O$. $D_{meas} = 3.65(4)$ g/cm^3, $D_{calc} = 3.727$ g/cm^3. Optically biaxial (+), $\omega = 1.755(5)$, $\varepsilon = 1.795(5)$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.79 (80) (111), 3.32 (100) (113), 3.21 (60) (210), 2.602 (45) (213), 2.299 (40) (214), 2.049 (40) (106), 1.663 (45) (226), 1.605 (50) (421, 108).

Wavenumbers (cm^{-1}): 3535, 3330sh, 3260, 1625w, 1530w, 1068s, 1047s, 1022s, 970sh, 768w, 684 w, 609s, 502, 460.

P179 Chalcosiderite $Cu^{2+}Fe^{3+}{}_6(PO_4)_4(OH)_8{\cdot}4H_2O$

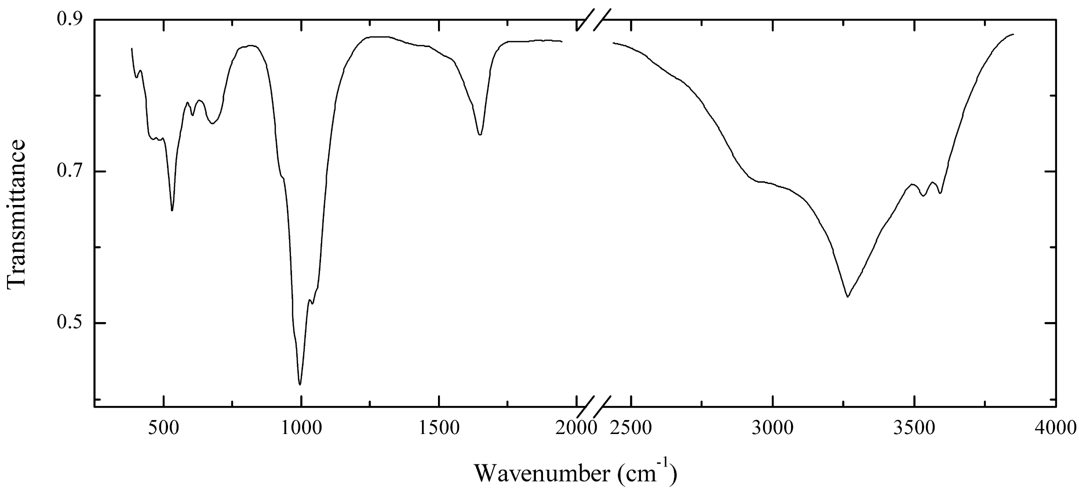


Locality: South Australia, Australia.

Description: Green crystalline crust. Al-rich variety. The empirical formula is $(Cu_{0.80}Zn_{0.09}Ca_{0.02})(Fe_{3.18}Al_{2.90})(PO_4)_{4.00}(OH)_8{\cdot}4H_2O$.

Wavenumbers (cm^{-1}): 3440s, 3240sh, 3115sh, 1630w, 1155sh, 1096s, 1048s, 1015s, 955sh, 831, 793w, 630sh, 586, 535, 463.

P180 Laueite $Mn^{2+}Fe^{3+}{}_2(PO_4)_2(OH)_2{\cdot}8H_2O$

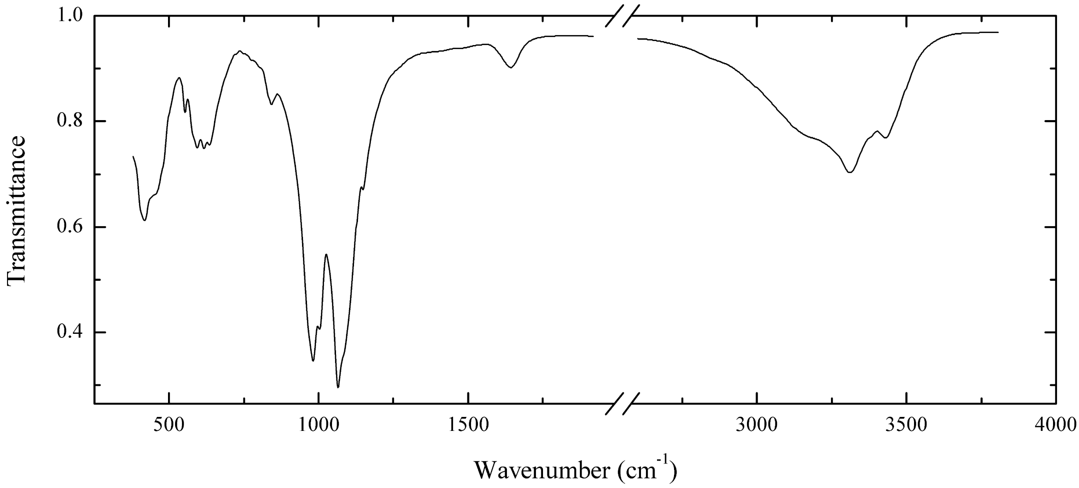


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Honey-yellow crystals from the association with rockbridgeite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3585, 3525, 3260s, 2960sh, 1650, 1610sh, 1060sh, 1042s, 993s, 975sh, 930sh, 690sh, 672, 609w, 529, 482, 454, 390w.

P181 Leucophosphite $KFe^{3+}{}_2(PO_4)_2(OH)\cdot 2H_2O$

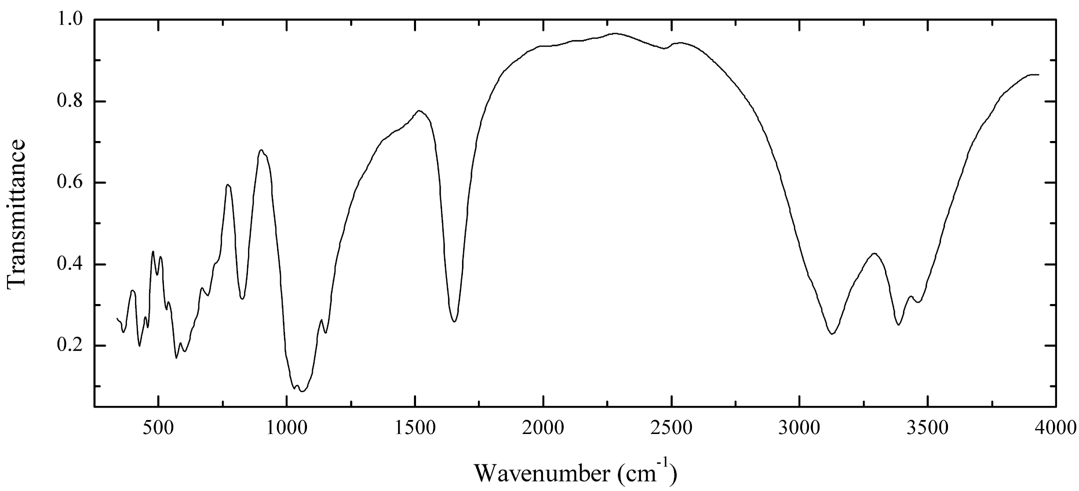


Locality: Teškov quarry, Holoubkov, Bohemia, Czech Republic.

Description: Light greenish-brown crystalline crust from the association with natrodufrenite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3433, 3315, 3170sh, 1655, 1152, 1085sh, 1069s, 1009, 986s, 845w, 639, 618, 596, 580sh, 552w, 480sh, 465w, 421.

P182 Metavariscite $Al(PO_4)\cdot 2H_2O$

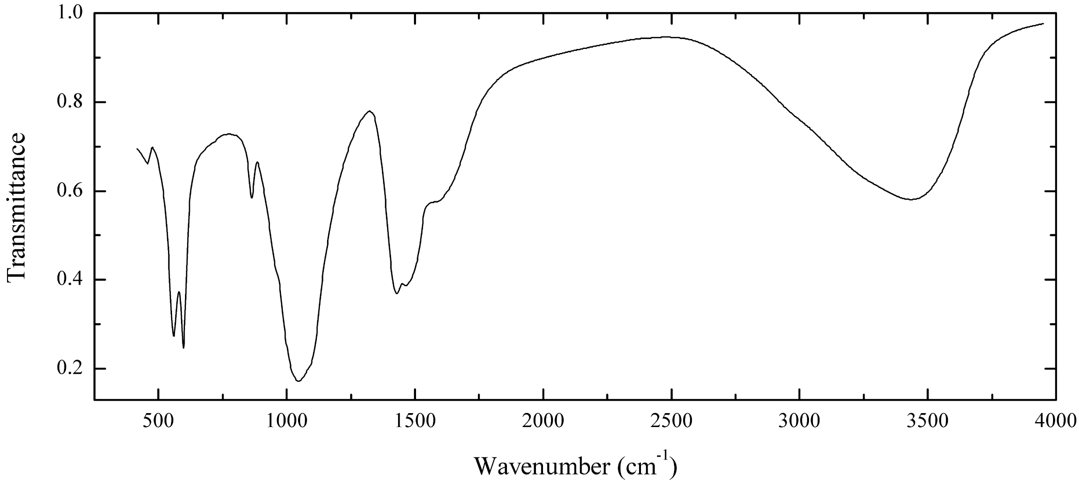


Locality: Edison Bird claim, Utahlite Hill, Lucin, Box Elder Co., Utah, USA (type locality).

Description: Green crystals from the association with variscite, fluorapatite and hydroxylapatite. Confirmed by IR spectrum.

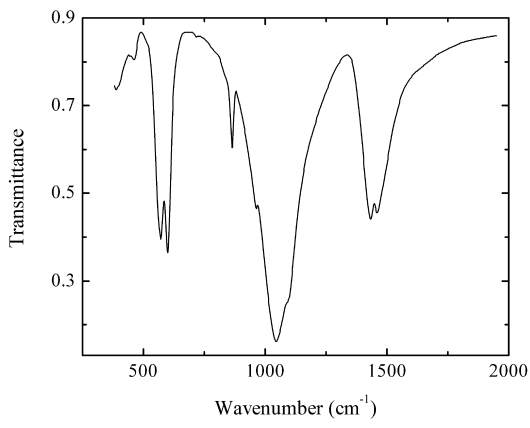
Wavenumbers (cm^{-1}): 3440, 3365s, 3110s, 3030sh, 2460w, 1657, 1154, 1065s, 1030s, 829, 725, 694, 640sh, 606, 572s, 533, 495, 457, 428, 367.

P183 Fluorapatite CO$_3$-rich (Ca,H$_2$O,□)$_5$(PO$_4$,CO$_3$)$_3$(F,OH,H$_2$O)



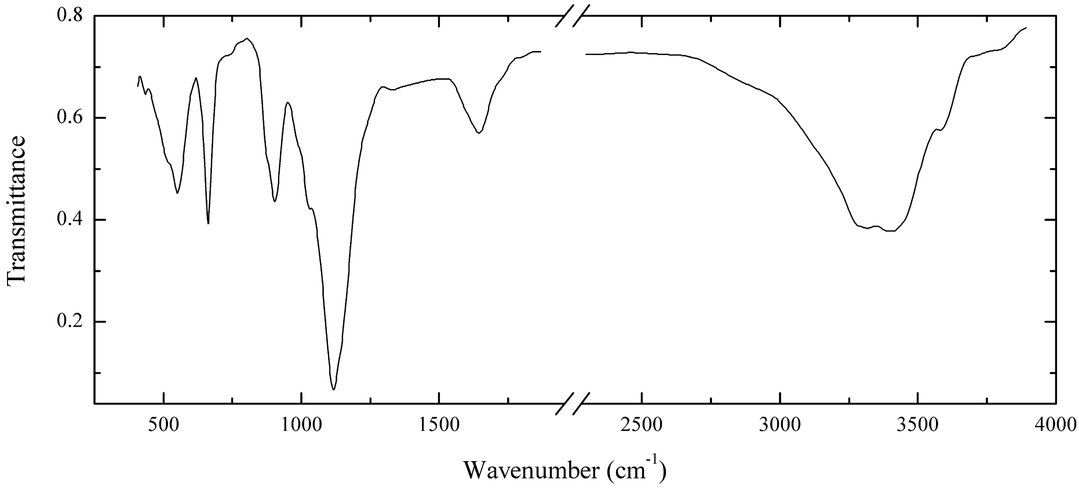
Locality: Mikhailovskiy mine, Kursk Magnetic Anomaly, Zheleznogorsk, Kursk region, Russia.
Description: Brown colloform ("collophane") from the association with siderite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3400, 3200sh, 2950sh, 1640sh, 1575, 1458, 1425, 1085sh, 1047s, 960sh, 865, 596, 565, 466w.

P184 Fluorapatite CO$_3$-rich (Ca,H$_2$O,□)$_5$(PO$_4$,CO$_3$)$_3$(F,OH,H$_2$O)



Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Brownish skeletal crystals from a late association of peralkaline pegmatite. The empirical formula is Ca$_{4.6}$[(PO$_4$)$_{2.1}$(CO$_3$)$_{0.9}$]F$_{0.7}$(OH,H$_2$O)$_x$.
Wavenumbers (cm^{-1}): 1458, 1427, 1090sh, 1045s, 963, 865, 600, 574, 565sh, 460w, 394w.

P185 Kanonerovite $MnNa_3P_3O_{10}\cdot 12H_2O$

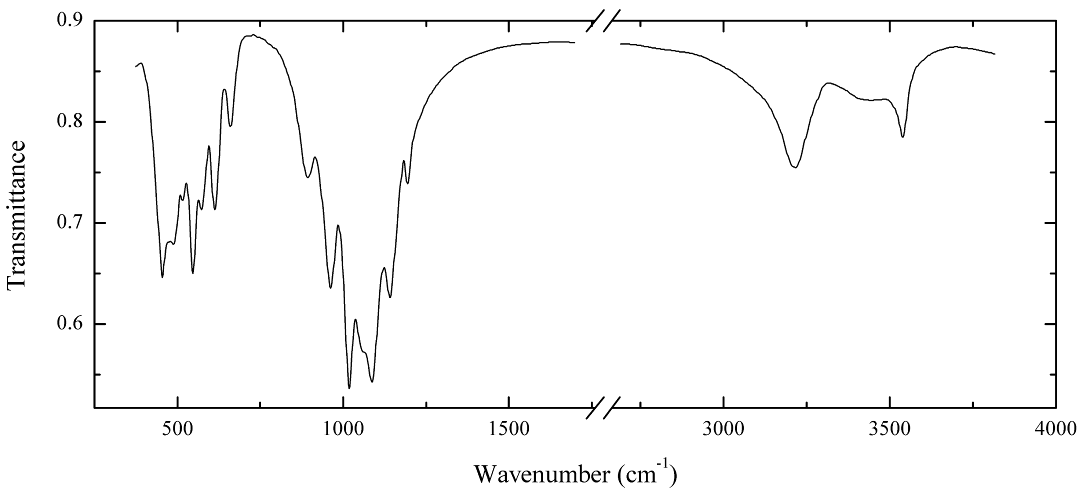


Locality: Kazennitsa pegmatite vein, the Alabashka pegmatite field, Middle Urals, Russia (type locality).

Description: Tiny, snow-white radial-platy aggregates from the association with are quartz, albite, microcline, muscovite, topaz, beryl, cassiterite and milarite. Holotype sample. Monoclinic, space group $P2_1/n$, $a = 14.71(1)$, $b = 9.33(1)$, $c = 15.13(2)$ Å, $\beta = 89.8(1)°$, $V = 2075(3)$ Å^3, $Z = 4$. The empirical formula is $(Mn_{0.95}Mg_{0.02}Fe_{0.01})_{\Sigma 0.98}(Na_{2.86}Ca_{0.02}K_{0.01})_{\Sigma 2.89}P_{2.98}O_{9.87}\cdot 12.13H_2O$. $D_{meas} = 1.91(2)$ g/cm^3, $D_{calc} = 1.90$ g/cm^3. Optically biaxial (−), $\alpha = 1.453(2)$, $\gamma = 1.459(2)$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 10.50 (75) (101), 7.36 (100) (200), 6.95 (90) (111, -111), 3.316 (60) (411, -411, -123, 321, -321, 313), 3.162 (50) (214, -214), 2.889 (60) (420, 124, 032, 421).

Wavenumbers (cm^{-1}): 3586, 3397, 3314, 1650, 1590sh, 1327w, 1155sh, 1118s, 1034, 990sh, 908, 875sh, 668, 559, 520sh, 448w.

P186 Kulanite $BaFe^{2+}{}_2Al_2(PO_4)_3(OH)_3$

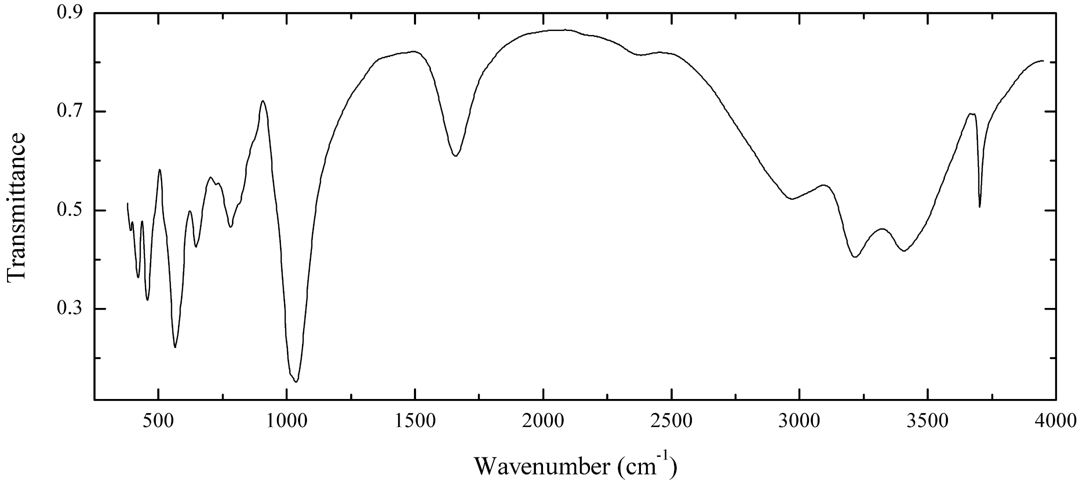


Locality: Rapid Creek, Dawson mining district, Yukon territory, Canada (type locality).

Description: Dark blue crystals. The empirical formula is $Ba_{0.94}Ca_{0.18}Fe_{1.12}Mg_{0.75}Mn_{0.03}Al_{1.93}(PO_4)_{3.00}(OH)_3$.

Wavenumbers (cm^{-1}): 3517, 3425w, 3200, 1197, 1142, 1089s, 1060sh, 1018s, 963, 894, 659, 612, 570, 546, 513, 498, 475sh, 452.

P188 Kovdorskite $Mg_2(PO_4)(OH)\cdot 3H_2O$

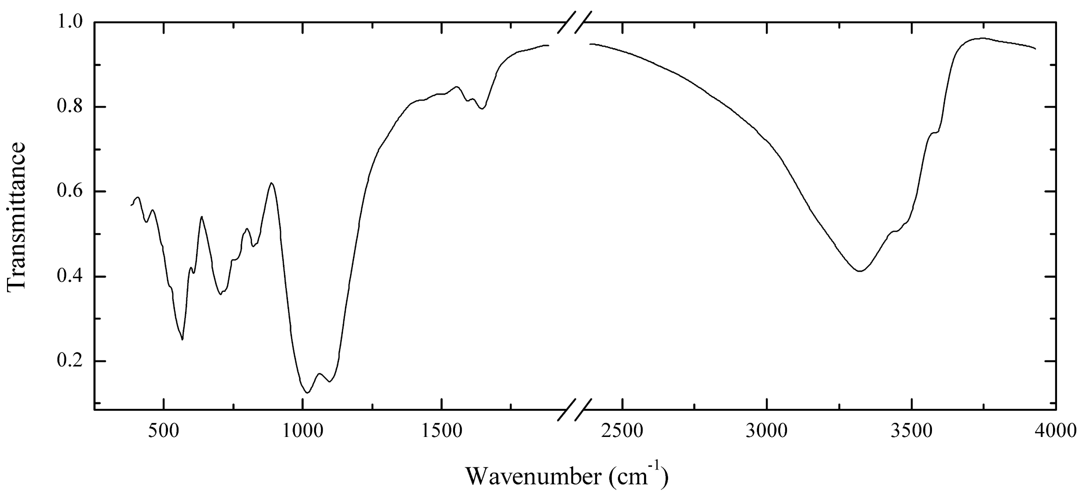


Locality: Iron mine, Kovdor, Kovdor ultramafic alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Blue crystals from dolomite carboinatite, from the association with collinsite. The empirical formula is $Mg_{1.93}Fe_{0.06}(PO_4)_{1.00}(OH)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3690, 3395, 3200, 2960, 2380w, 1655, 1036s, 1020sh, 870sh, 815sh, 779, 723w, 650, 585sh, 562s, 485sh, 450, 415, 385.

P189 Ruifrancoite $Ca_2(\square,Mn^{2+})_2(Fe^{3+},Mg,Mn^{2+},Fe^{2+},Al)_4Be_4(PO_4)_6(OH)_6\cdot 4H_2O$

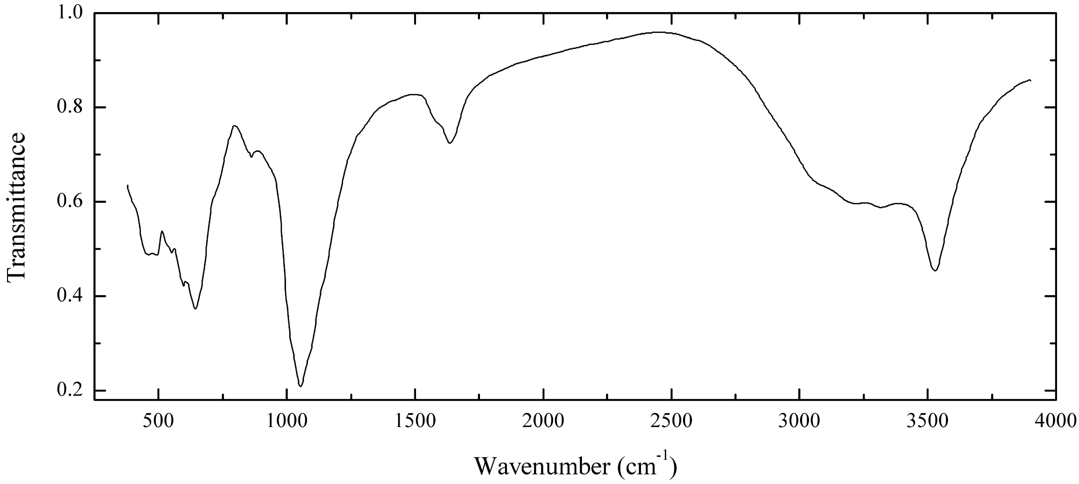


Locality: Sapucaia mine, Sapucaia do Norte, Galiléia Co., Minas Gerais, Brazil (type locality).

Description: Brown fibrous aggregate. Identified by IR and Mössbauer spectra and electron microprobe analysis. The empirical formula is $(Ca_{1.9}Na_{0.1})(Fe^{3+}{}_{1.9}Mg_{1.4}Fe^{2+}{}_{0.7}Al_{0.3}Mn_{0.2})Be_4(PO_4)_{6.00}(OH,H_2O)_{10}$.

Wavenumbers (cm^{-1}): 3585, 3455sh, 3355, 1654w, 1602w, 1515w, 1440w, 1095s, 1015s, 820, 760sh, 720sh, 705, 610, 562s, 520, 495sh, 438.

P190 Wavellite $Al_3(PO_4)_2(OH,F)_3 \cdot 5H_2O$

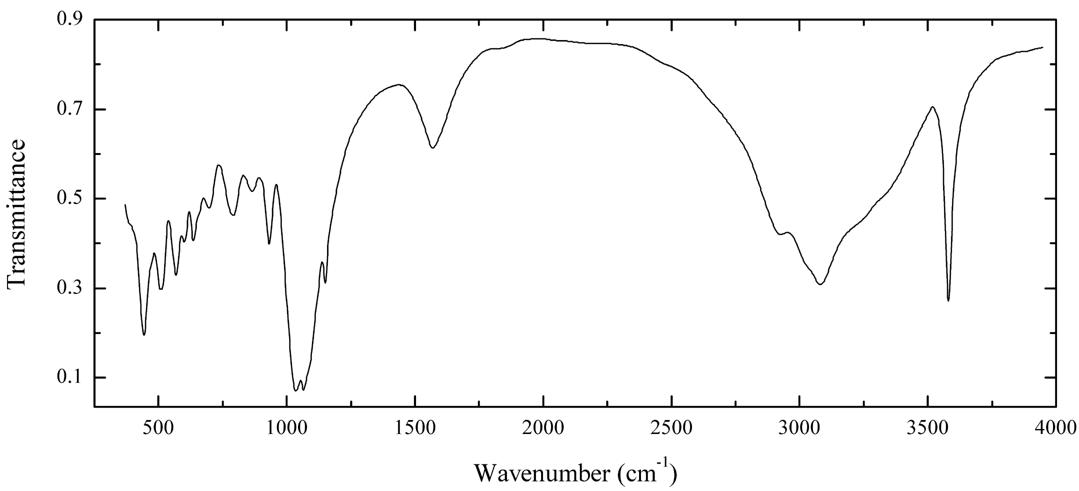


Locality: Edison Bird claim, Utahlite Hill, Lucin, Box Elder Co., Utah, USA.

Description: Pale green spherulite from the association with variscite, metavariscite, fluorapatite and hudroxylapatite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3515s, 3305, 3200, 3060sh, 1638, 1600sh, 1145sh, 1053s, 1020sh, 864w, 850sh, 725sh, 665sh, 642s, 603, 590sh, 551, 540sh, 483, 455, 400sh.

P191 Variscite $Al(PO_4) \cdot 2H_2O$

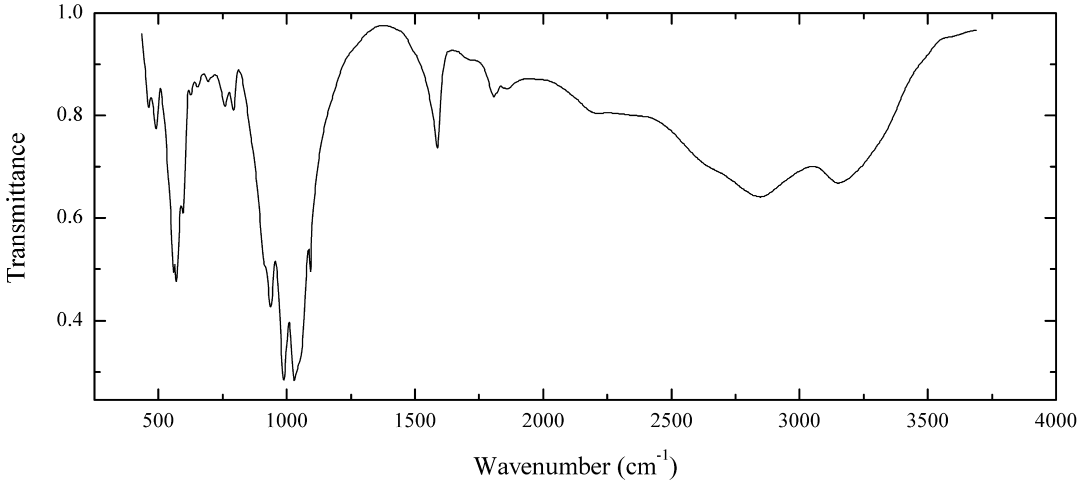


Locality: Edison Bird claim, Utahlite Hill, Lucin, Box Elder Co., Utah, USA.

Description: Green massive from the association with metavariscite, wavellite, fluorapatite and hudroxylapatite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3585s, 3260sh, 3098, 3040sh, 2930, 1573, 1157, 1069s, 1037s, 933, 865, 783, 701, 638, 605, 568, 503, 440s, 385sh.

P192 Ludlamite $Fe^{2+}{}_3(PO_4)_2 \cdot 4H_2O$

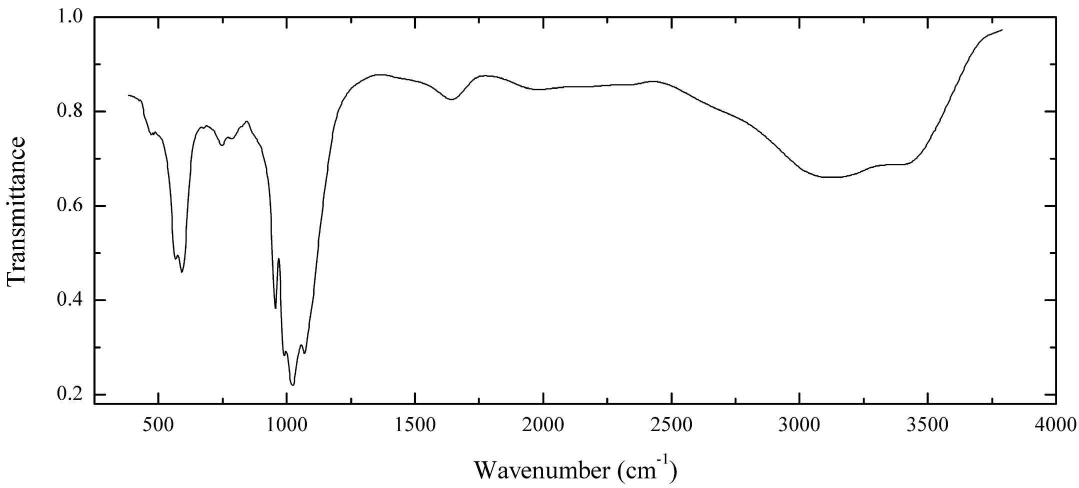


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Light green crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3340sh, 3150, 2850, 2680sh, 2200w, 1865w, 1815, 1593, 1094, 1050sh, 1030s, 989s, 938s, 915sh, 796, 761, 700w, 658w, 628w, 595, 569, 558, 489, 460.

P193 Metaswitzerite $(Mn,Fe)_3(PO_4)_2 \cdot 4H_2O$

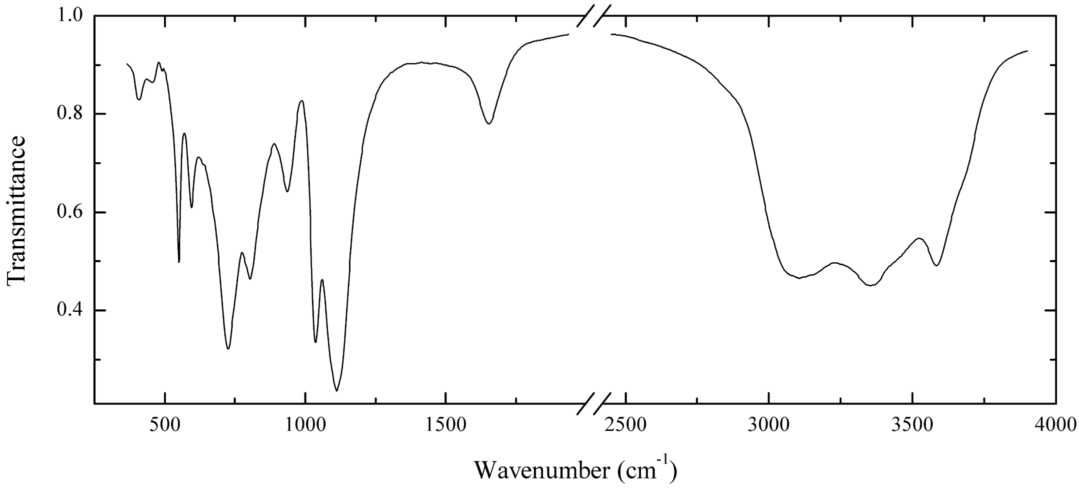


Locality: Iron Monarch open cut, Iron Knob, Middleback range, Eyre peninsula, South Australia, Australia.

Description: Beige scaly aggregate.

Wavenumbers (cm^{-1}): 3380, 3100, 2300sh, 2100sh, 1940w, 1643, 1115sh, 1068s, 1022s, 987s, 953s, 788w, 743w, 592, 566, 463w.

P194 Moraesite $Be_2(PO_4)(OH \cdot 4H_2O)$

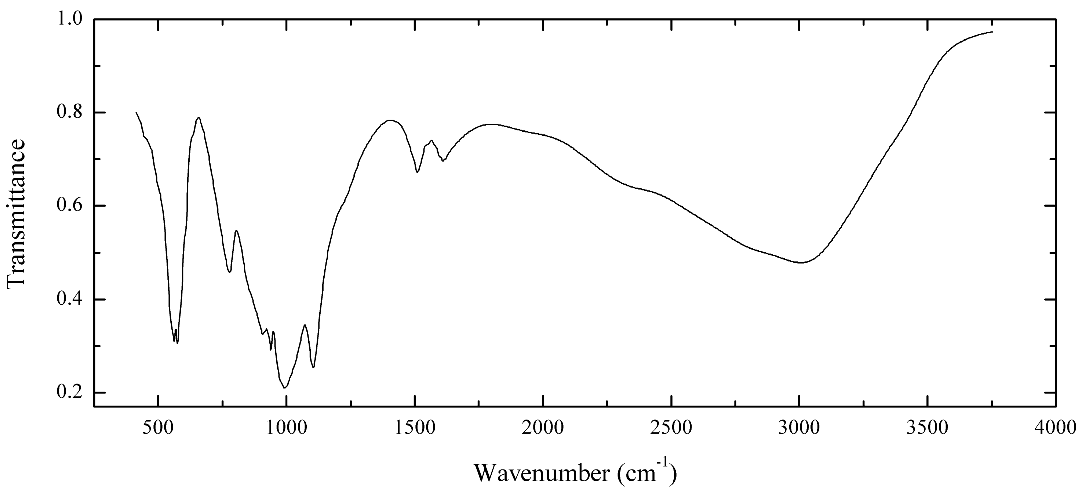


Locality: Boevskoe Be deposit, Kamensk-Ural'skii, Chelyabinsk region, South Urals, Russia.

Description: White concretion from the association with glucine and crandallite. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3570, 3340, 3100, 1655, 1115s, 1035s, 937, 805, 725s, 595, 546, 490w, 460w, 410w.

P195 Messelite $Ca_2Fe^{2+}(PO_4)_2 \cdot 2H_2O$

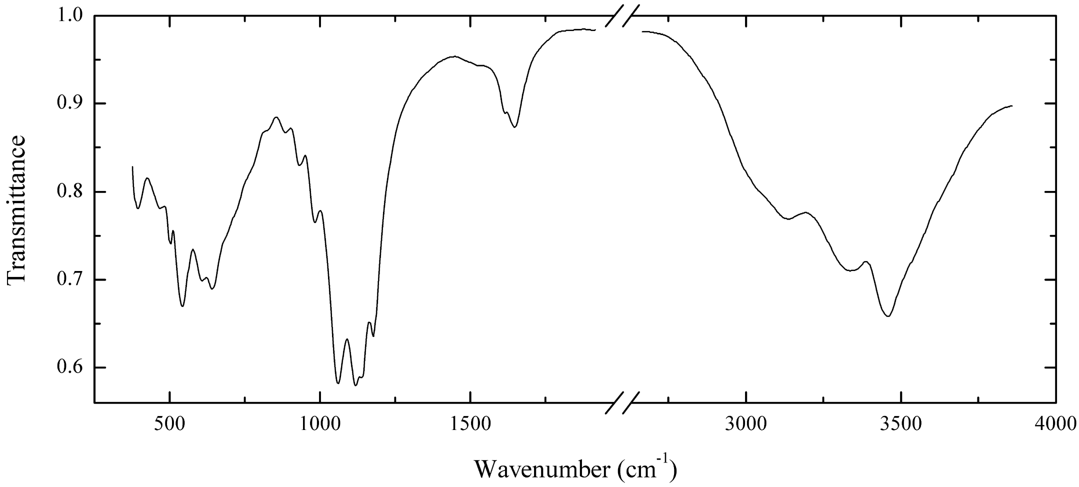


Locality: Messel mine, Messel, Darmstadt, Hesse, Germany (type locality).

Description: Brown radial aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.

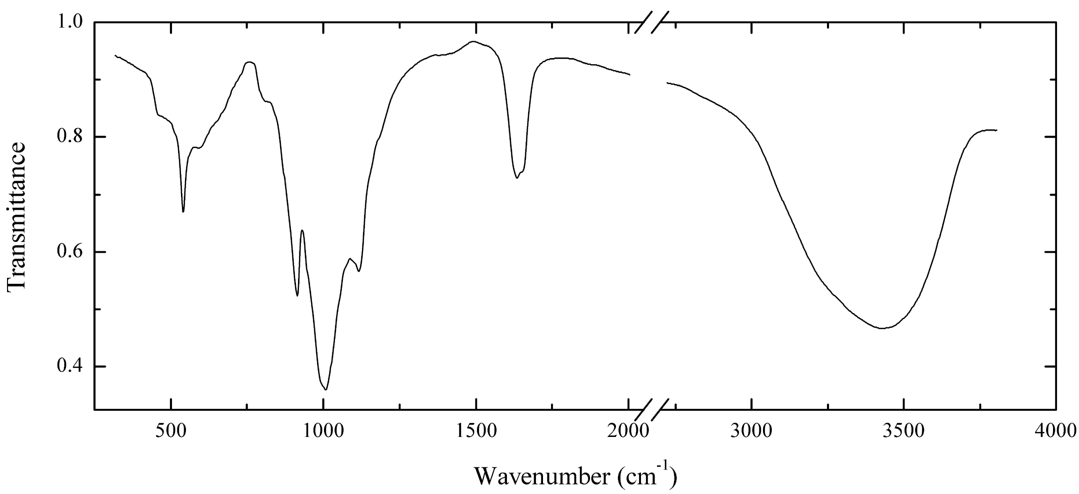
Wavenumbers (cm^{-1}): 3380sh, 3310sh, 3010, 2850sh, 2380sh, 1610, 1510, 1200sh, 1103s, 992s, 939s, 908, 779, 740sh, 635sh, 605sh, 574, 562, 550sh, 500sh.

P196 Matulaite $CaAl_{18}(PO_4)_{12}(OH)_{20}\cdot 28H_2O$



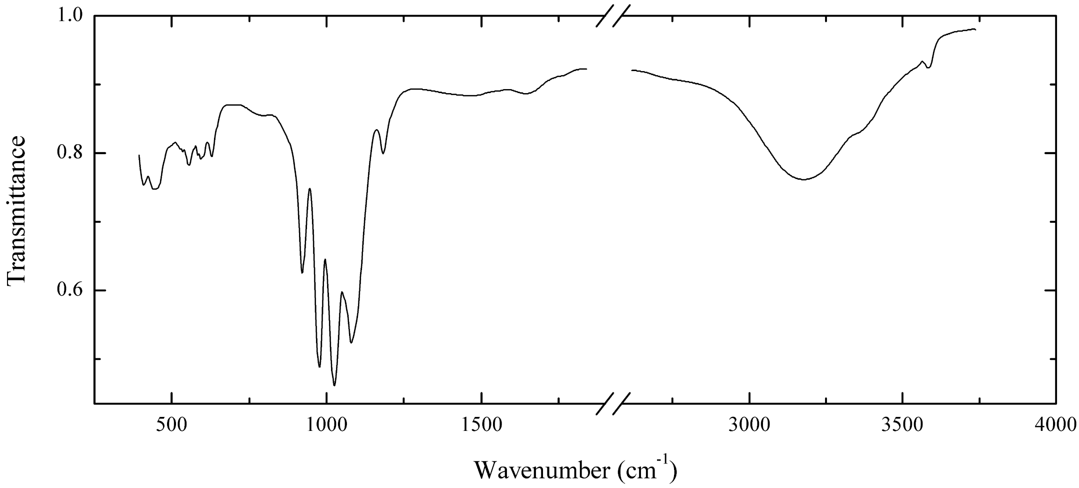
Locality: Bachman iron mine, Hellertown, Lower Saucon township, Northampton Co., Pennsylvania, USA (type locality).
Description: Snow-white aggregates of small platy crystals.
Wavenumbers (cm^{-1}): 3455, 3340, 3130, 3160sh, 1650, 1615sh, 1178, 1140s, 1118s, 1059s, 983, 935, 890w, 720sh, 690sh, 643, 608, 542, 504, 470, 398.

P197 Meta-autunite $Ca(UO_2)_2(PO_4)_2\cdot 2–6H_2O$



Locality: Djedeli deposit, Central Kazakhstan region, Kazakhstan.
Description: Yellow platy crystals. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3440s, 3255sh, 1660sh, 1645, 1119s, 1009s, 916s, 818w, 680sh, 600, 542, 470sh.

P198 Meurigite-K $KFe^{3+}_7(PO_4)_5(OH)_7 \cdot 8H_2O$

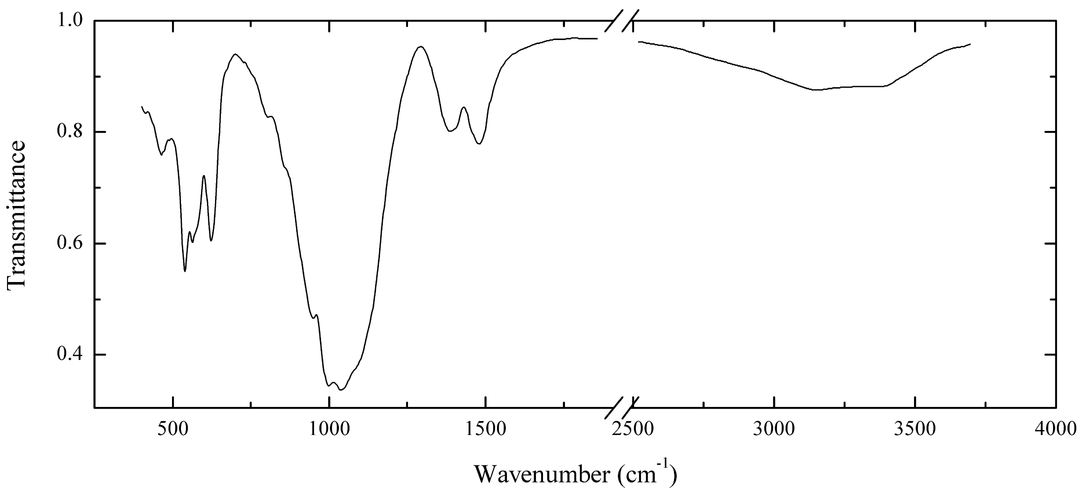


Locality: Teškov quarry, Holoubkov, Bohemia, Czech Republic.

Description: Yellow spherulite from the association with leucophosphite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $(K_{0.80}Na_{0.16}Ca_{0.01})(Fe_{6.67}Al_{0.37})(PO_4)_{5.00}(OH)_7 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3570w, 3350sh, 3175, 1655w, 1188, 1100sh, 1081s, 1025s, 976s, 923, 800w, 630, 591, 557, 445, 407.

P199 Monazite-(Ce) $(Ce,La,Nd)(PO_4)_2$

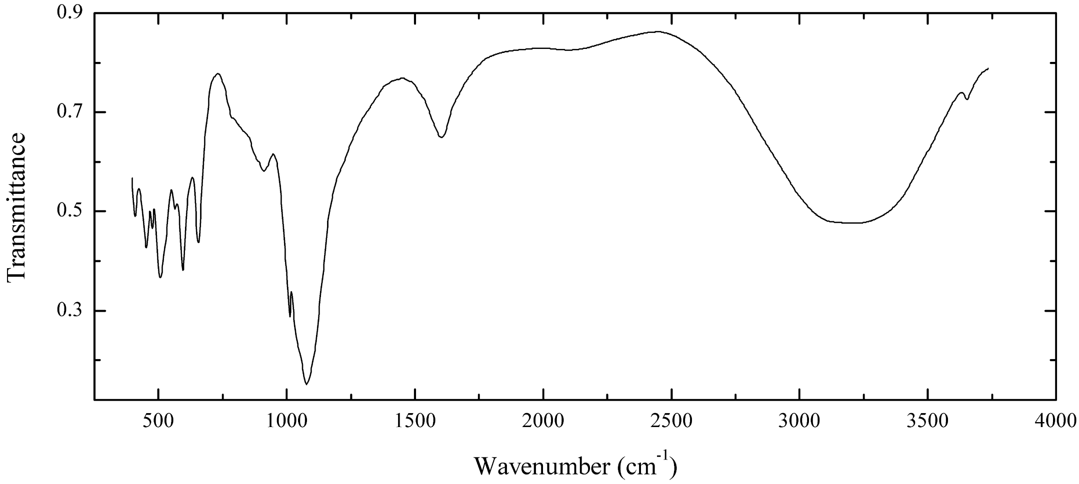


Locality: Vuoriyarvi alkaline-ultramafic massif, Northern Karelia, Russia.

Description: SO_4- and CO_3-bearing variety. Investigated by A.G. Bulakh.

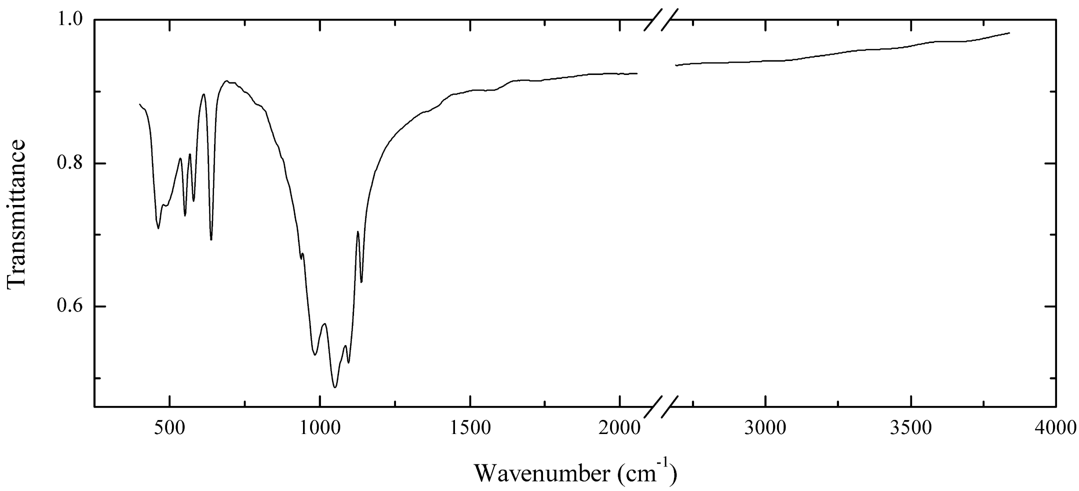
Wavenumbers (cm^{-1}): 3380w, 3140w, 1480, 1389, 1090sh, 1041s, 997s, 950, 860sh, 803w, 623, 575sh, 563, 534, 460.

P200 Minyulite $KAl_2(PO_4)_2(F,OH)\cdot 4H_2O$



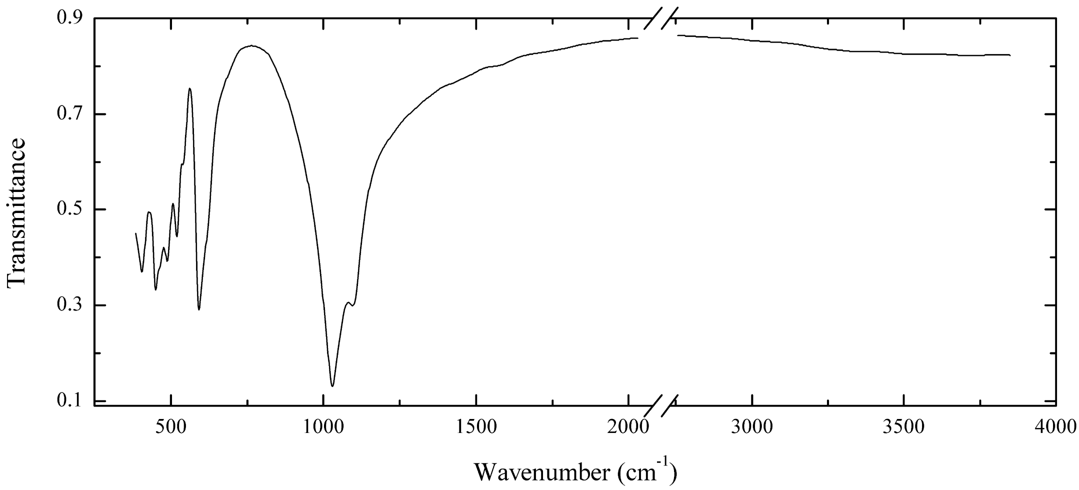
Locality: La Floquerie quarry, Pannecé, Loire-Atlantique, Pays de Loire, France.
Description: Greenish-yellow fibrous aggregate. The empirical formula is (electron microprobe) $(K_{0.91}Na_{0.07})(Al_{1.93}Fe_{0.03}Mn_{0.02})(PO_4)_{2.00}[F_{0.6}Cl_{0.15}(OH)_x]\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3653w, 3200, 2120w, 1615, 1145sh, 1110sh, 1081s, 1045sh, 1012, 916w, 810sh, 657, 596, 563w, 505, 475w, 450, 405.

P201 Lithiophilite $LiMn^{2+}(PO_4)$



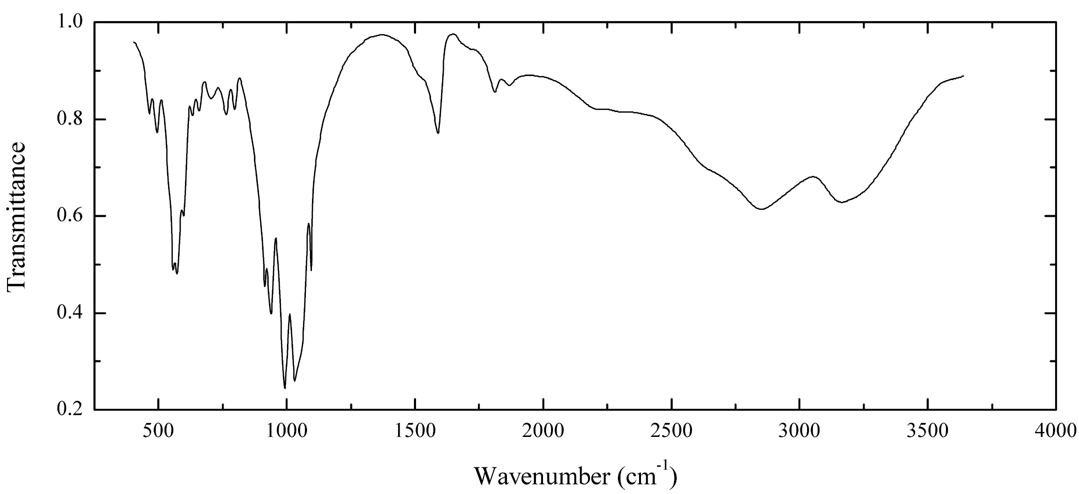
Locality: Vishnyakovskoe rare-metal pegmatite deposit, East Sayan Mts., Siberia, Russia.
Description: Orange-pink massive. The empirical formula is (electron microprobe) $Li_xMn_{0.86}Fe_{0.13}Ca_{0.02}(PO_4)_{1.00}$.
Wavenumbers (cm^{-1}): 1136, 1092s, 1084s, 981s, 944, 637, 577, 550, 505sh, 490, 459.

P202 Lithiophosphate $Li_3(PO_4)$



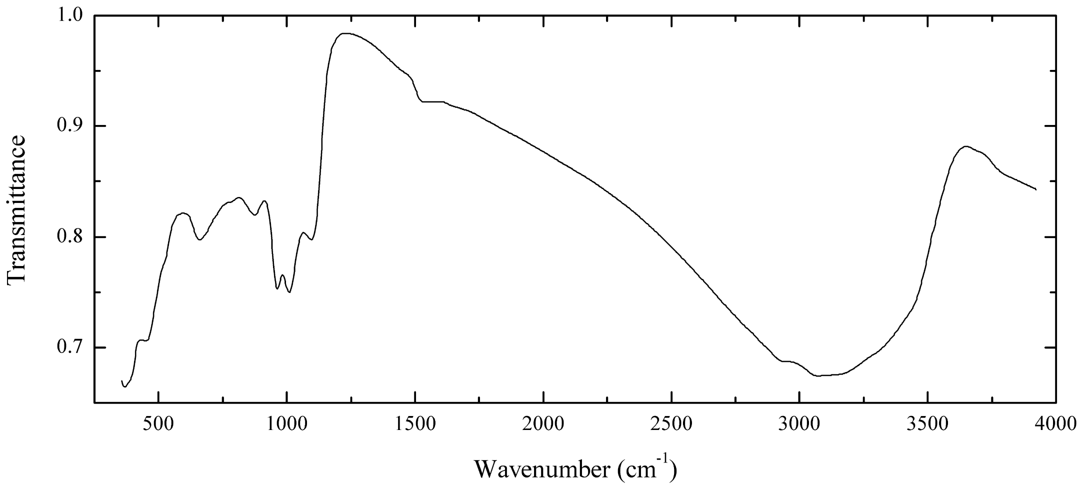
Locality: Okh-Myl'k Mt., Voron'i Tundras, Kola peninsula, Murnansk region, Russia.
Description: Colourless grains from a lithium-rich pegmatite. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1094s, 1026s, 610sh, 588s, 537, 516, 484, 460sh, 446s, 400.

P203 Ludlamite $Fe^{2+}{}_3(PO_4)_2{\cdot}4H_2O$



Locality: Salsigne mine, Salsigne, Mas-Cabardès, Carcassonne, Aude, Languedoc-Roussillon, France.
Description: Green crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3220sh, 3140, 2840, 2650sh, 2290w, 2200w, 1870w, 1815, 1593, 1520sh, 1094, 1050sh, 1030s, 990s, 938s, 914, 795w, 761w, 704w, 656w, 629w, 595, 569, 556, 540sh, 488, 460.

P204 "Oxygladiusite" $Fe^{3+}{}_2(Fe^{3+},Mg)_4(PO_4)(OH)_{11}\cdot H_2O$

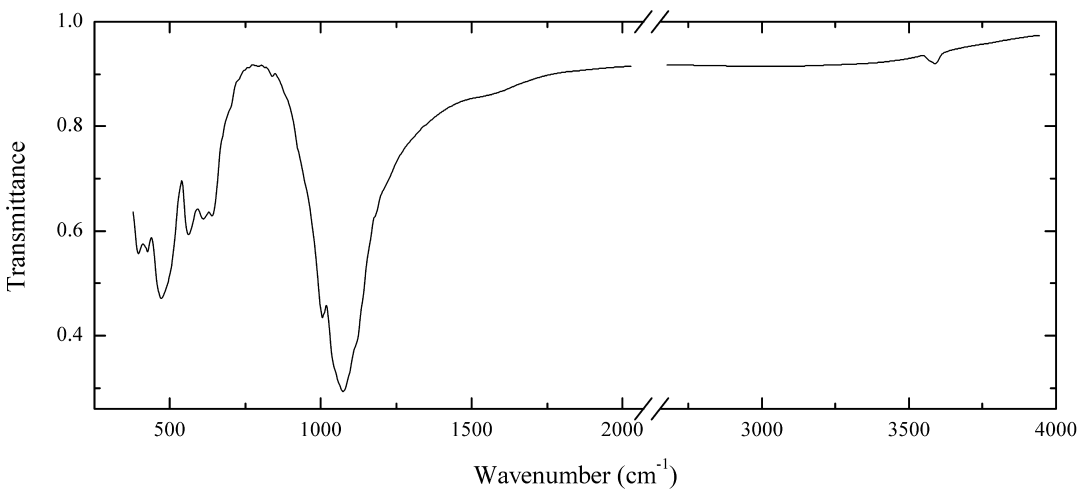


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Radial aggregate of dark red acicular crystals from dolomite carbonatite. Fe^{3+}-dominant (in all structural positions) analogue of gladiusite. Mössbauer spectrum shows that all iron is trivalent. The empirical formula is $(Fe^{3+}{}_{4.27}Mg_{1.06}Mn_{0.08})(PO_4)(OH)_{9.91}O_{1.09}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3400sh, 3070s, 2920, 1550w, 1102, 1016s, 967s, 880, 667, 530sh, 465, 380s.

P205 Lacroixite $NaAl(PO_4)F$

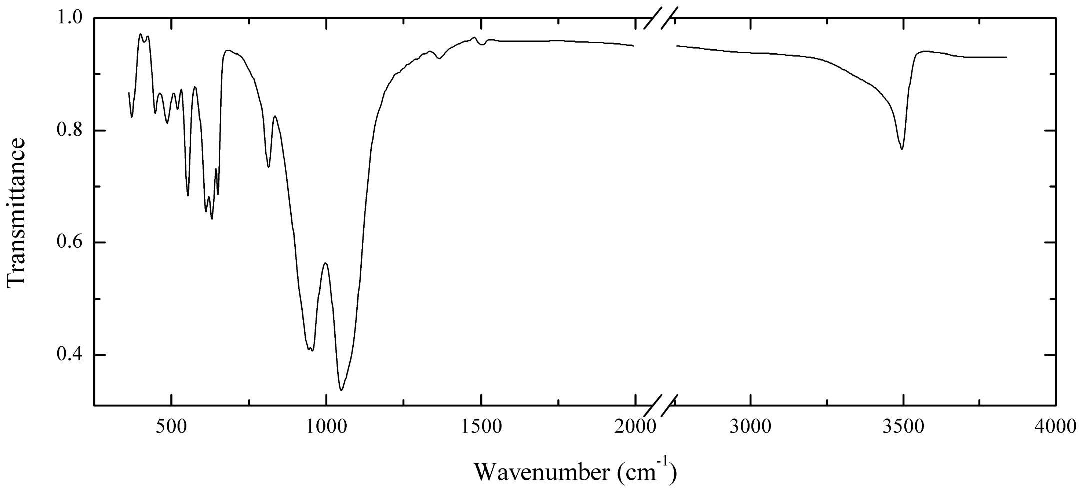


Locality: Buranga pegmatite, Gatumba district, Western Province, Rwanda.

Description: Pale blue to white, massive, from the association with burangaite. Specimen No. 79726 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

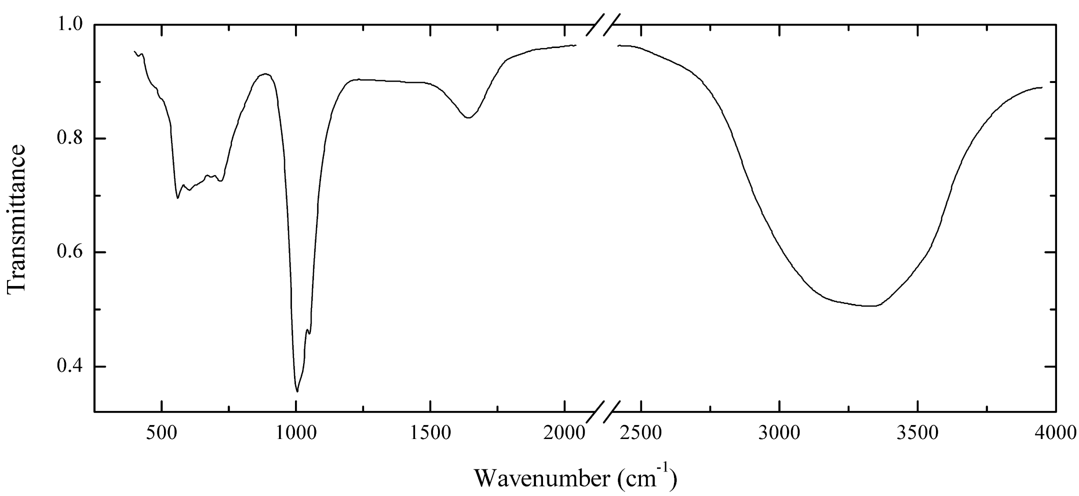
Wavenumbers (cm^{-1}): 3560w, 1115sh, 1077s, 1060sh, 1007s, 637, 616, 560, 475, 427, 407.

P206 Libethenite $Cu^{2+}_2(PO_4)(OH)$



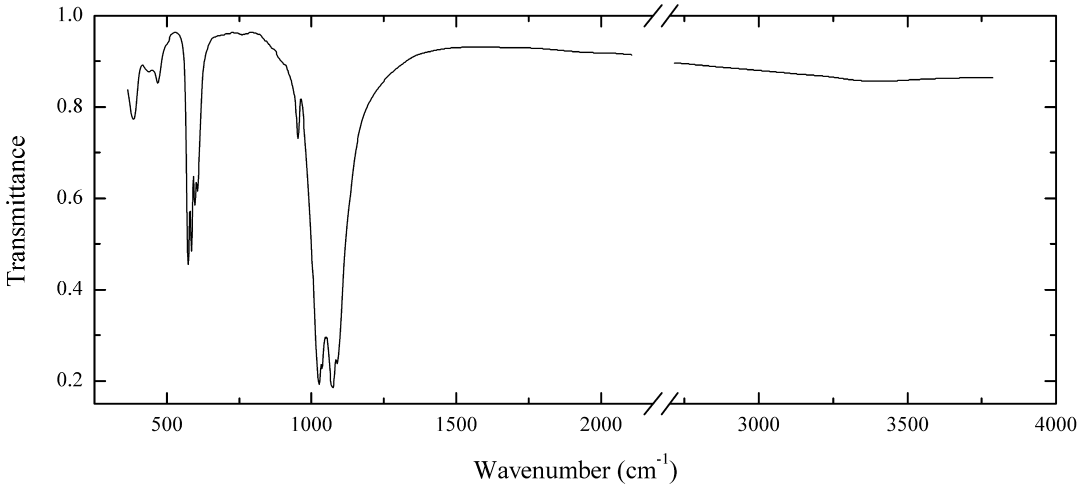
Locality: Mednorudyanskoe Cu deposit, Nizhniy Tagil, Middle Urals, Russia.
Description: Green crystals from the association with malachite and pseudomalachite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3475, 1500w, 1364w, 1080sh, 1047s, 954s, 943s, 814, 648, 633, 613, 552, 518w, 485, 446, 415w, 380.

P207 Nastrophite $NaSr(PO_4)\cdot 9H_2O$



Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless grains from the association with dolomite, bakhchisaraitsevite and cattiite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3300s, 3200sh, 1653, 1053s, 1020sh, 1008s, 720, 655sh, 615, 564, 500sh, 475sh, 390w.

P208 Nacaphite $Na_2Ca(PO_4)F$

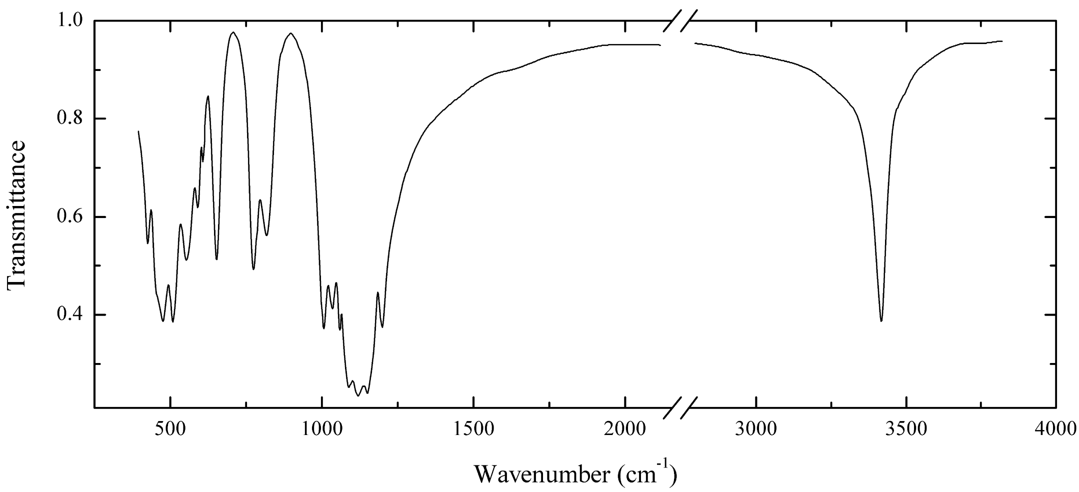


Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless grains from the association with thermonatrite, villiaumite, aegirine, apatite and barytolamprophyllite. Holotype sample. The crystal structure is solved. Triclinic, space group $P1$, $a = 13.387(3)$, $b = 13.383(5)$, $c = 7.072(3)$ Å, $\alpha = 90.25(3)°$, $\beta = 89.73(4)°$, $\gamma = 133.12°$, $Z = 8$. The empirical formula is $Na_{1.99}(Ca_{0.94}Sr_{0.01}Mn_{0.01})P_{1.00}O_{3.97}F_{0.97}$. $D_{meas} = 2.85$ g/cm^3, $D_{calc} = 2.88$ g/cm^3. Optically biaxial (−), $\alpha = 1.508(2)$, $\beta = 1.515(2)$, $\gamma = 1.520(2)$, $2V_{meas} = -80°$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.649 (100), 3.054 (45), 3.049 (40), 2.005 (40), 1.762 (33), 3.51 (24), 1.470 (21).

Wavenumbers (cm^{-1}): 1125sh, 1090s, 1077s, 1065s, 1043, 1037, 1030s, 1019s, 950, 945sh, 601, 594, 588, 576, 565, 460w, 432w, 384.

P209 Lazulite $MgAl_2(PO_4)_2(OH)_2$

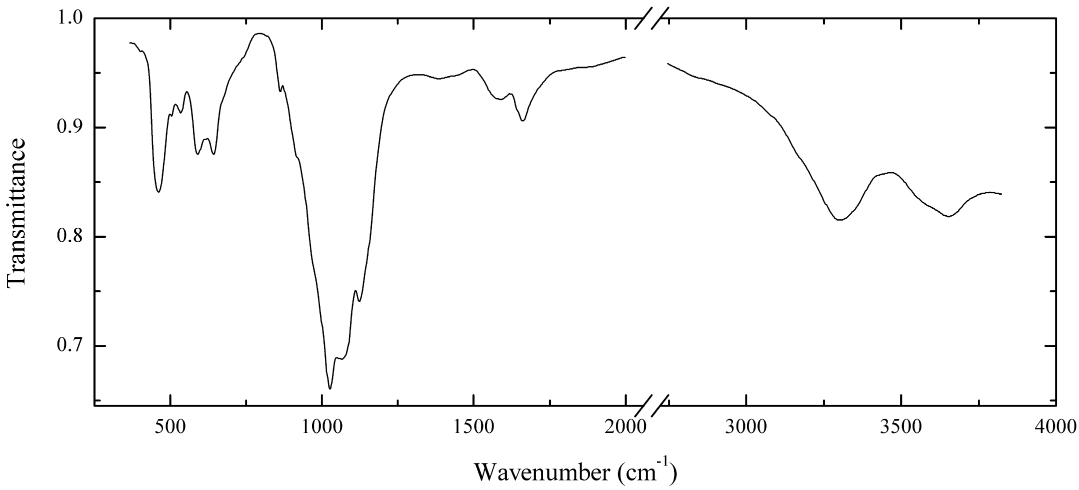


Locality: Starukha Mt., Balban'yu River basin, Subpolar Urals, Russia.

Description: Light blue granular aggregate from the association with quartz, muscovite, hematite. The empirical formula is $Mg_{0.96}Fe_{0.07}Al_{1.98}(PO_4)_{2.00}(OH)_2$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.16 (20) (100), 4.73 (40) (011), 3.256 (100) (112), 3.215 (80), (111), 3.148 (50) (120), 3.083 (90), (200), 2.555 (70) (121), 2.348 (40) (102), 2.004 (50) (131), 1.981 (40) (123), 1.571 (60) (042).

Wavenumbers (cm^{-1}): 3430, 1201, 1050s, 1122s, 1090s, 1060, 1035, 1006, 814, 773, 649, 607w, 590, 548, 506, 470, 455sh, 421.

P210 Lun'okite $(Mn^{2+},Ca)(Mg,Fe^{2+},Mn^{2+})Al(PO_4)_2(OH)\cdot 4H_2O$

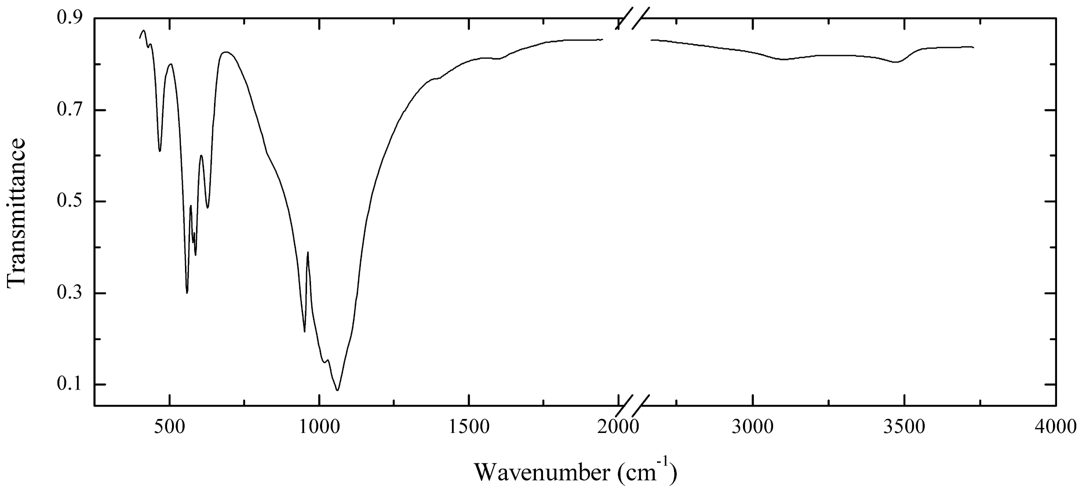


Locality: Vasin-Myl'k Mt., Voron'i Tundras, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless prismatic crystals from the association with eosphorite, laueite, kingsmountite, fairfieldite and mitridatite. Holotype sample. Orthorhombic, space group *Pbca*, $a = 14.95(5)$, $b = 18.71(2)$, $c = 6.96(3)$ Å, $Z = 8$. The empirical formula is $(Mn_{0.77}Ca_{0.23})(Mg_{0.35}Fe_{0.31}Mn_{0.30})Al_{1.05}(PO_4)_{1.99}(OH)_{1.10}\cdot 3.78H_2O$. $D_{meas} = 2.66$ g/cm^3, $D_{calc} = 2.69$ g/cm^3. Optically biaxial (+), $\alpha = 1.603$, $\beta = 1.608$, $\gamma = 1.616$, $2V_{meas} = 70°$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.809 (100), 9.39 (90), 2.92 (70), 3.48 (60), 5.15 (50), 1.877 (50), 1.568 (50).

Wavenumbers (cm^{-1}): 3620, 3530sh, 3260, 1660, 1585w, 1145sh, 1118, 1069s, 1022s, 975sh, 920sh, 863w, 740sh, 636, 592, 536w, 507w, 463.

P211 Marićite $NaFe^{2+}(PO_4)$

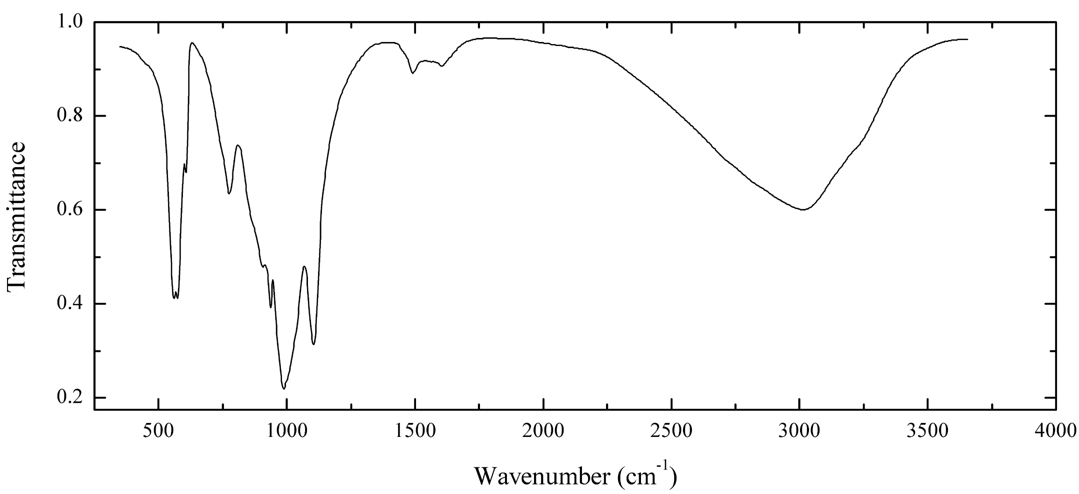


Locality: Big Fish River, Yukon Territory, Canada (type locality).

Description: Light grey massive from the association with vivianite, quartz, wolfeite and apatite. The empirical formula is (electron microprobe) $Na_{0.95}(Fe_{0.82}Mn_{0.13}Mg_{0.07})(PO_4)$.

Wavenumbers (cm^{-1}): 3485w, 3080w, 1620w, 1110sh, 1058s, 1025sh, 1010s, 952s, 940sh, 860sh, 625, 584, 575, 553s, 462, 422w.

P212 Messelite $Ca_2Fe^{2+}(PO_4)_2 \cdot 2H_2O$

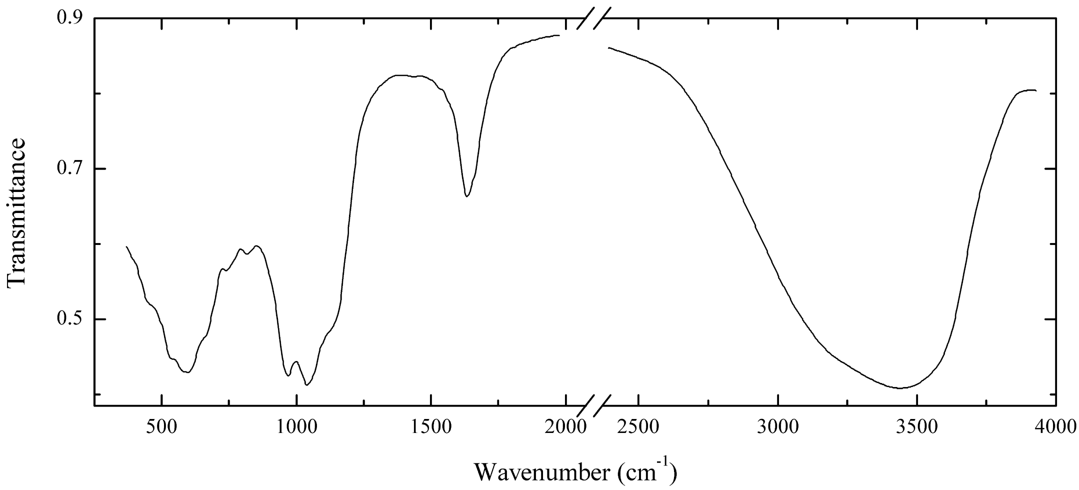


Locality: Palermo No. 1 mine, Groton, Grafton Co., New Hampshire, USA.

Description: Radial aggregate of cream-coloured platy crystals from the association with siderite and quartz. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $Ca_{2.00}(Fe_{0.79}Mn_{0.17}Mg_{0.03})(PO_4)_{2.00} \cdot nH_2O$.

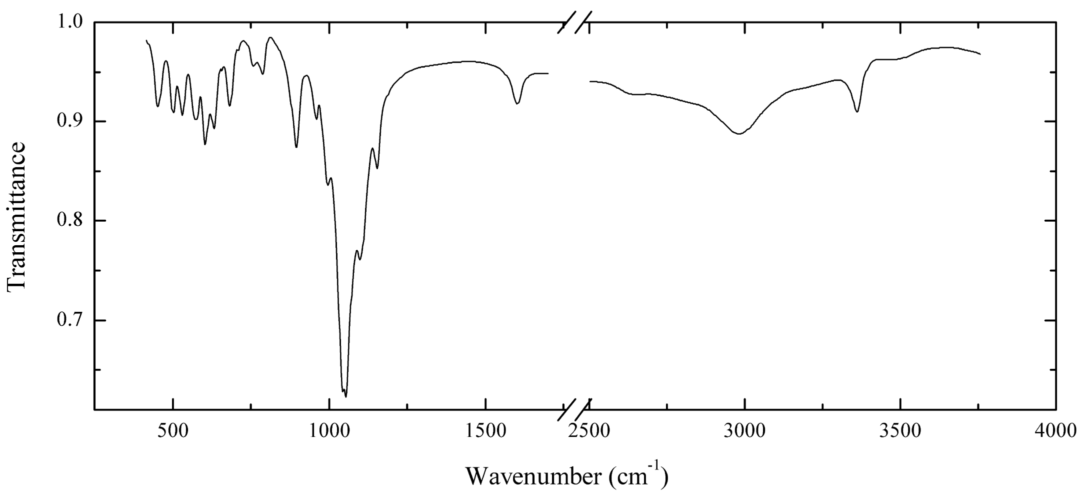
Wavenumbers (cm^{-1}): 3370sh, 3310sh, 3010, 1607w, 1490w, 1103s, 1030sh, 1010sh, 989s, 939s, 910, 870sh, 778, 603, 569, 558.

P214 Metaschoderite $Al_2(PO_4)(VO_4)\cdot 6H_2O$



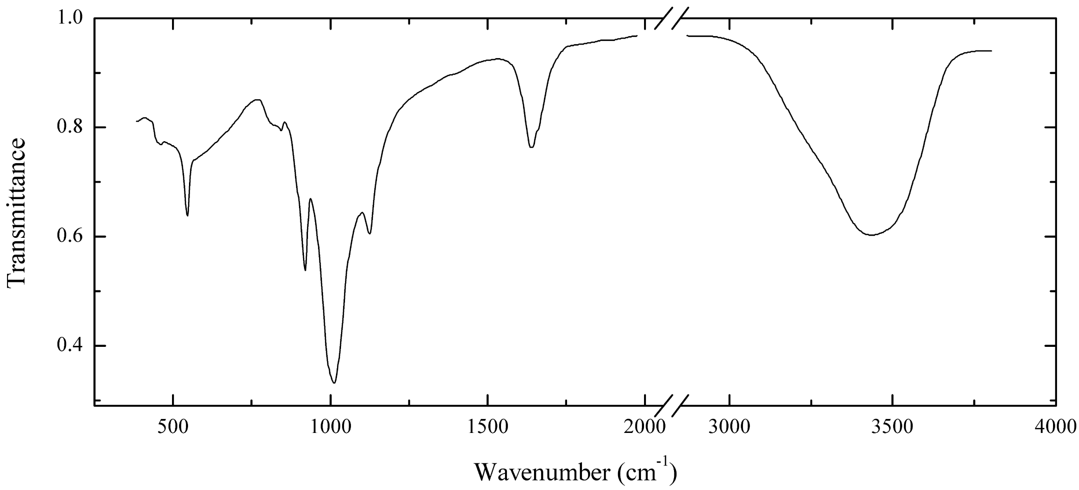
Locality: VanNavSan Claim, Eureka Co., Nevada, USA.
Description: Orange-yellow powdery.
Wavenumbers (cm^{-1}): 3565sh, 3410s, 3220sh, 1630, 1140sh, 1041s, 967s, 813w, 747w, 655sh, 597s, 540sh, 465sh.

P215 Morinite $NaCa_2Al_2(PO_4)_2(OH)F_4\cdot 2H_2O$



Locality: Ognyovka mine, Bakennoe deposit, Kalba range, Eastern Kazakhstan.
Description: Pink grains from pegmatite. Confirmed by powder X-ray diffraction pattern and IR spectrum.
Wavenumbers (cm^{-1}): 3490w, 3345, 2975, 2625w, 1602, 1153, 1102, 1052s, 1044s, 993, 957w, 894, 785w, 759w, 680, 629, 602, 569, 530, 500, 456.

P216 Meta-autunite $Ca(UO_2)_2(PO_4)_2 \cdot 2–6H_2O$

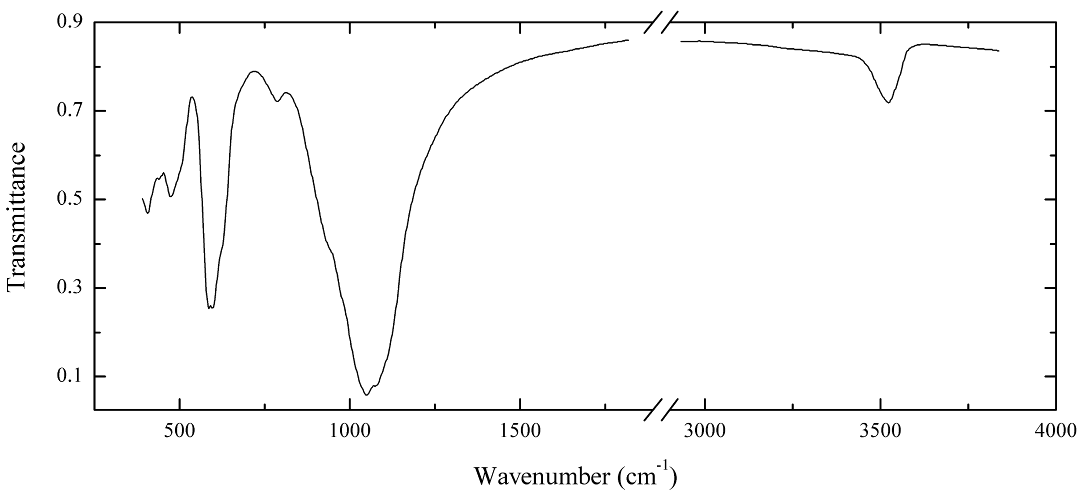


Locality: Synthetic.

Description: Yellow powdery. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3415, 3240sh, 1637, 1124, 1010s, 1000sh, 919s, 844w, 815sh, 600sh, 542, 460w.

P217 Wagnerite $Mg_2(PO_4)F$

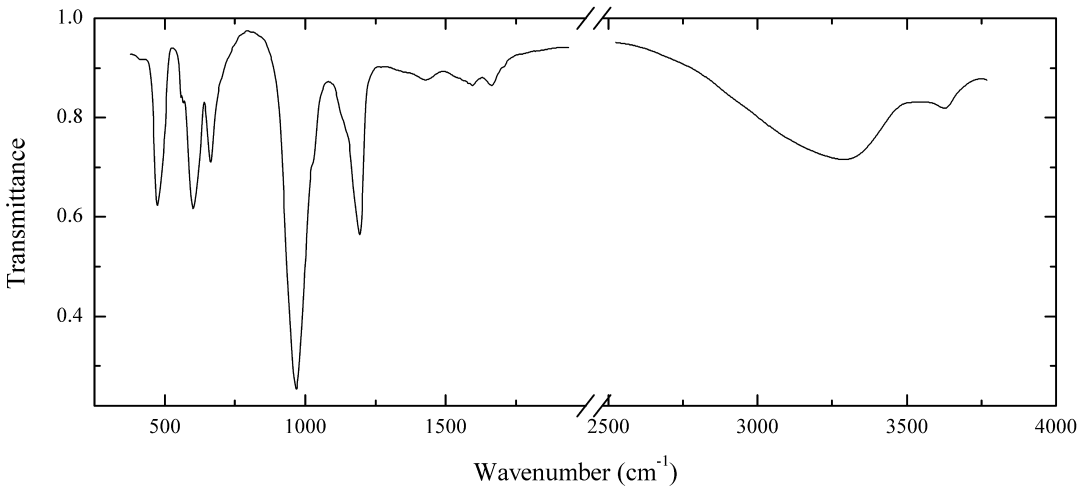


Locality: Kyrk-Bulak granite pegmatite, Turkestan range, Osh region, Kyrgyzstan.

Description: Red grains in pegmatite, in the association with quartz and muscovite. Fe- and Mn-rich variety. The empirical formula is (electron microprobe, OH calculated) $(Mg_{0.73}Fe_{0.68}Mn_{0.57})(PO_4)_{1.00}F_{0.7}(OH)_{0.3}$.

Wavenumbers (cm^{-1}): 3504, 1105sh, 1071s, 1048s, 980sh, 940sh, 900sh, 783w, 615sh, 587, 580, 495sh, 465, 434w, 398.

P218 Mitridatite $Ca_2Fe^{3+}{}_3(PO_4)_3O_2{\cdot}3H_2O$

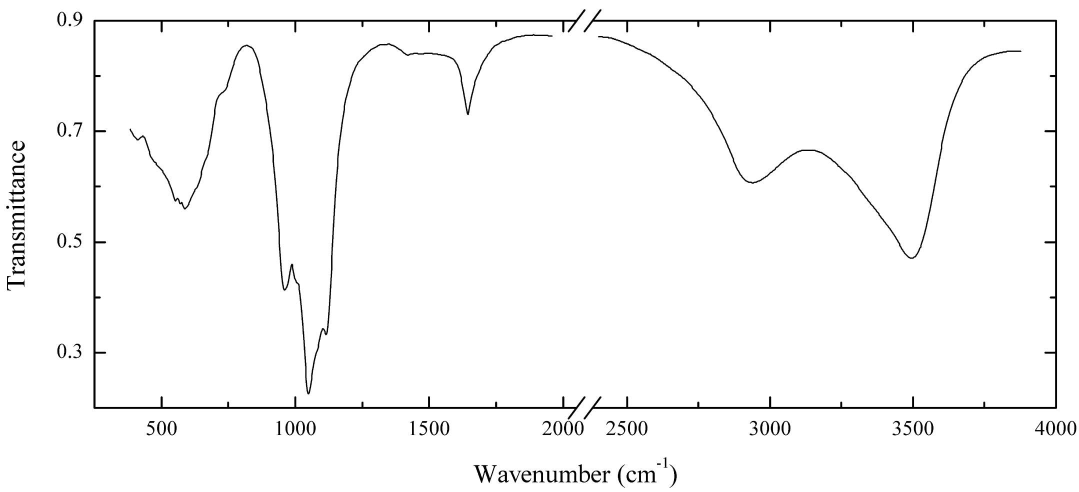


Locality: Quarry A, Kamysh-Burun deposit, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.

Description: Greenish-yellow pseudomorphs after vivianite crystals, from the association with goethite and santabarbaraite. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3600w, 3320, 1655w, 1590w, 1425w, 1192s, 1150sh, 1130sh, 1025sh, 967s, 662, 599s, 553, 480sh, 470s.

P219 Calcioferrite $Ca_4Mg(Fe^{3+},Al)_4(PO_4)_6(OH)_4{\cdot}12H_2O$

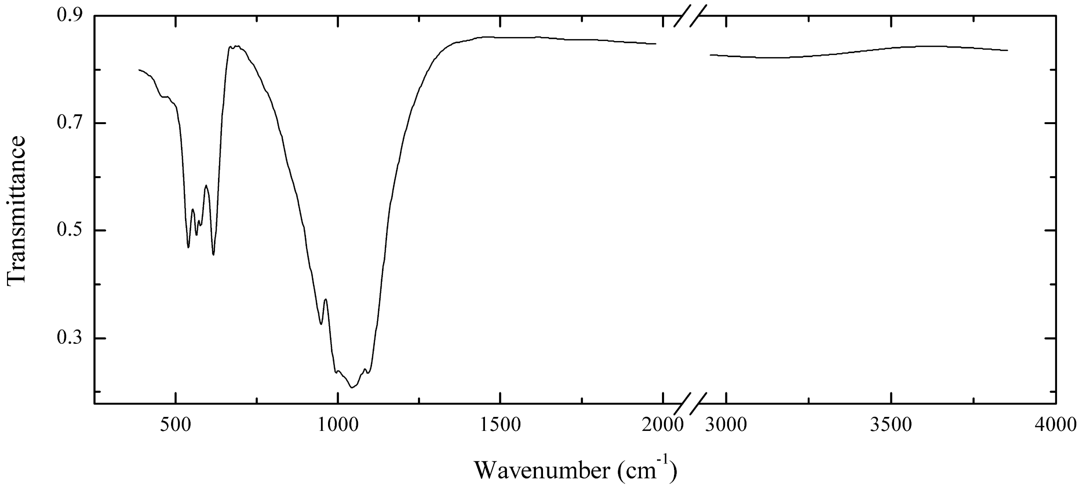


Locality: Bruguers, Gavá, Baix Llobregat, Barcelona, Catalonia, Spain.

Description: Greenish-yellow crust. Identified by IR spectrum and qualitative electron microprobe analysis.

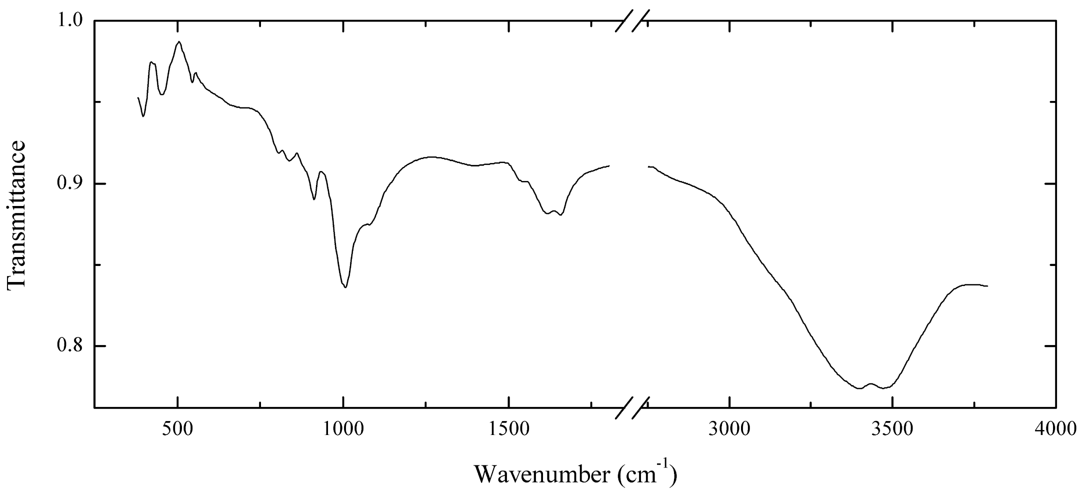
Wavenumbers (cm^{-1}): 3470, 2925, 1639, 1431w, 1113s, 1080sh, 1045s, 1000sh, 958s, 725sh, 650sh, 630sh, 603, 579, 548, 480sh, 410w.

P220 Monazite-(Ce) (Ce,La,Nd)$(PO_4)_2$



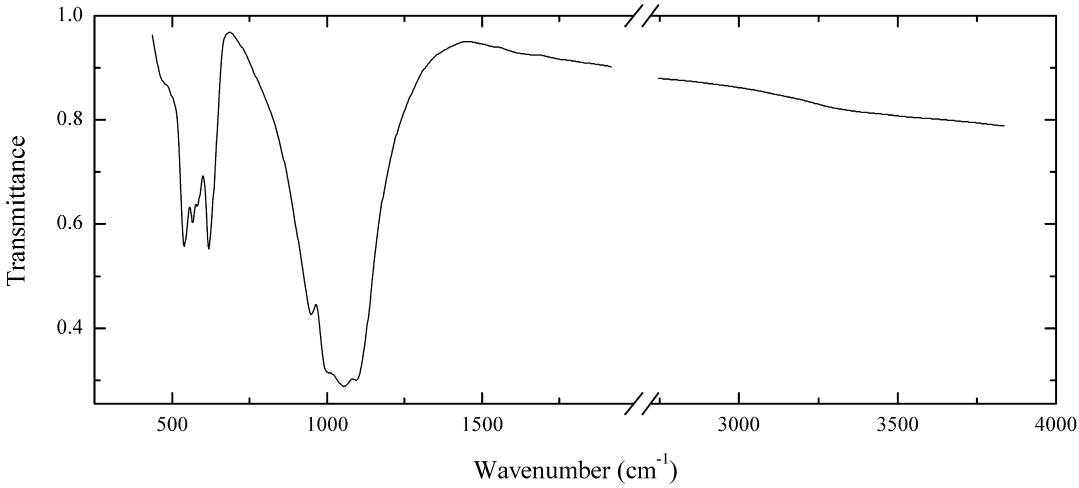
Locality: Uranium King mine, Trent Creek, Encampment district, Wyoming, USA.
Description: Red-brown massive, from the association with albite, quartz and fluorite. The empirical formula is (electron microprobe) $(Ce_{0.46}La_{0.21}Nd_{0.21}Pr_{0.07}Th_{0.04}Sm_{0.02})[(PO_4)_{0.98}(SiO_4)_{0.02}]$.
Wavenumbers (cm^{-1}): 1091s, 1044s, 995s, 950s, 617, 578, 564, 538.

P221 Metauranocircite $Ba(UO_2)_2(PO_4)_2 \cdot 6H_2O$



Locality: Menzenschwand U deposit, near Menzenschwand, Kunkelbach valley, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.
Description: Yellow platy crystal. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3460s, 3380s, 1660, 1620, 1540, 1400w, 1112, 1007s, 916, 843, 800, 542, 460, 390.

P222 Monazite-(Ce) (Ce,La,Nd)$(PO_4)_2$

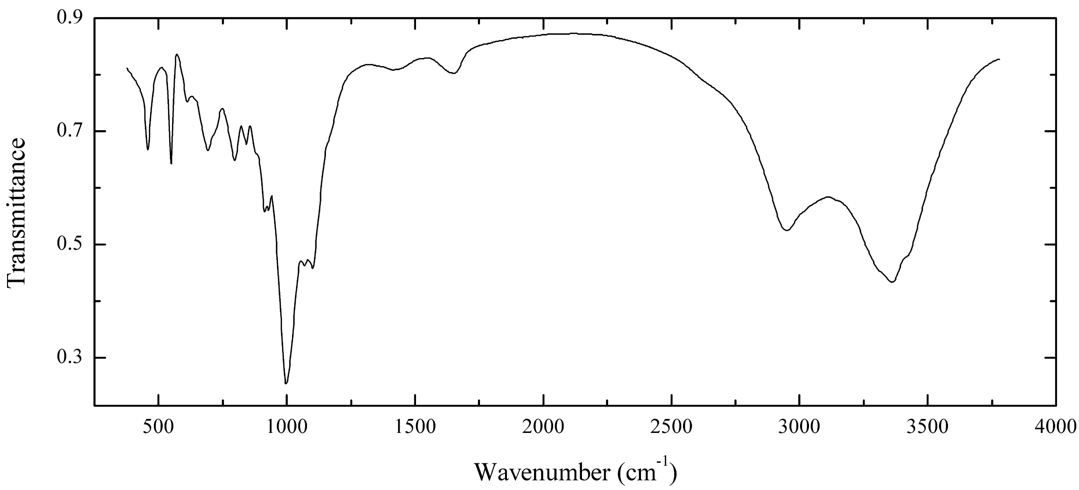


Locality: Malinovaya Varaka pegmatite, Chupa bay, Chupa pegmatite field, Northern Karelia, Karelia Republic, Russia.

Description: Brownish-yellow grains from the association with Mn-bearing apatite, plagioclase, microcline, muscovite and quartz. The empirical formula is (electron microprobe) $(Ce_{0.48}La_{0.30}Nd_{0.09}Pr_{0.03}Th_{0.12})[(PO_4)_{0.86}(SiO_4)_{0.14}]$.

Wavenumbers (cm^{-1}): 1095s, 1059s, 1013s, 950s, 616, 578, 563, 535, 470sh.

P223 Metatorbernite $Cu^{2+}(UO_2)_2(PO_4)_2{\cdot}8H_2O$

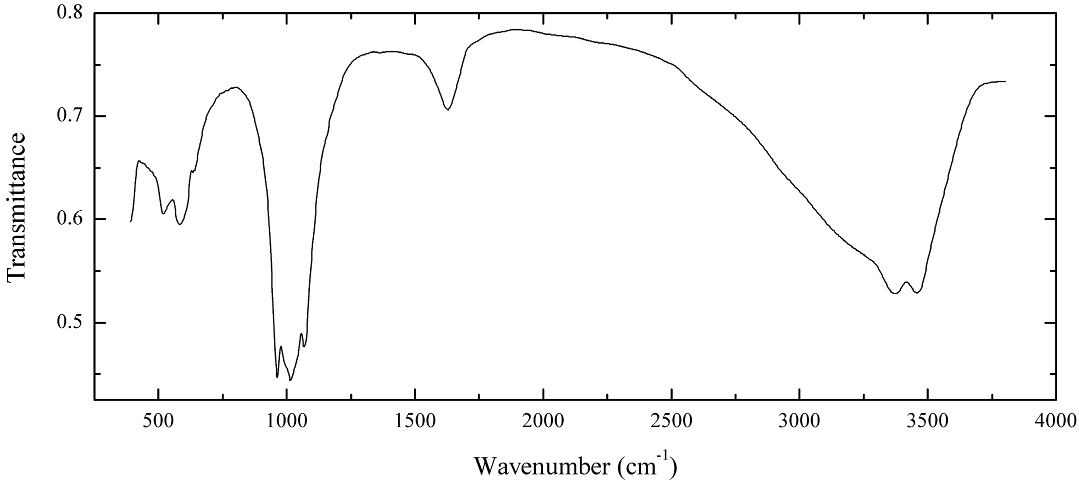


Locality: Adrasman, Karamazar Mts., Sogd region, Tajikistan.

Description: Green scaly aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3405sh, 3345s, 3310sh, 2935, 1650, 1437w, 1101s, 1075s, 996s, 930, 914, 880sh, 844, 799, 720sh, 695, 610w, 547, 462.

P224 Stewartite $Mn^{2+}Fe^{3+}{}_2(PO_4)_2(OH)_2\cdot 8H_2O$

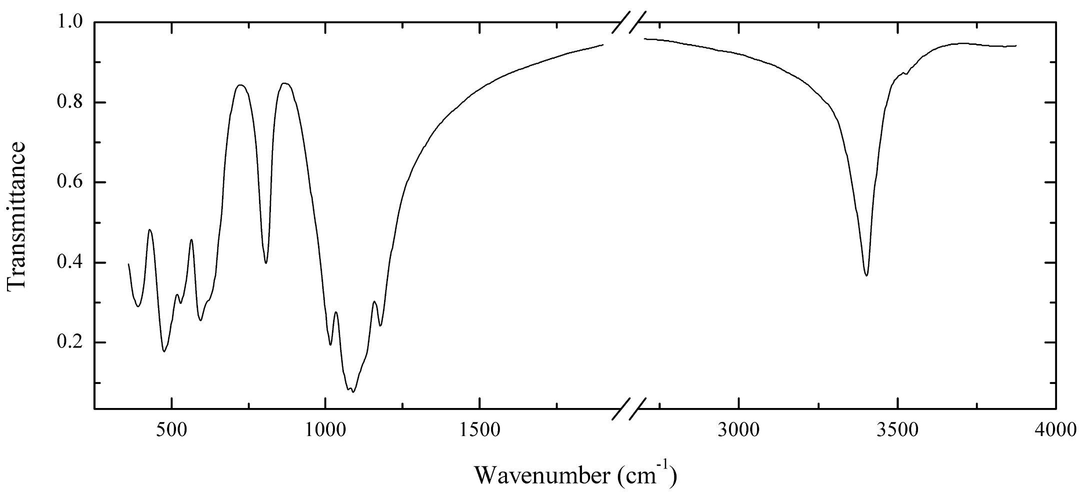


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Brownish yellow flattened prismatic crystals from the association with triphylite. Confirmed by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $Mn_{0.9}Mg_{0.1}Fe_{1.9}(PO_4)_{2.00}(OH)_2\cdot nH_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 10.05 (100), 6.76 (90), 5.86 (70), 3.94 (70), 3.047 (70), 2.596 (60), 2.503 (50).

Wavenumbers (cm^{-1}): 3445s, 3365s, 3250sh, 1630, 1069s, 1030sh, 1017s, 1005sh, 963s, 635sh, 585, 520.

P225 Montebrasite (Li,Na)Al(PO_4)(OH,F)

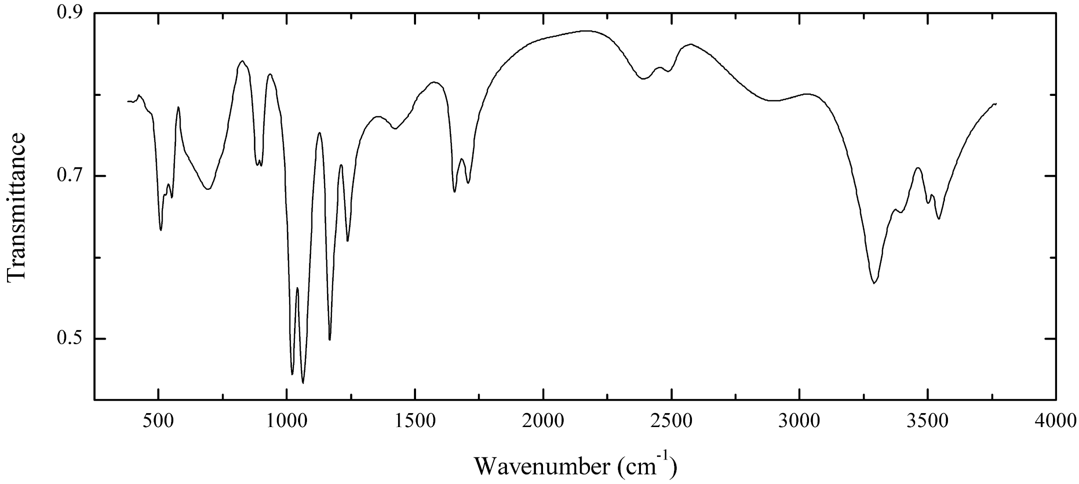


Locality: Goltsovskoe (Goltsy) deposit, Eastern Sayan Mts., Siberia, Russia.

Description: Grey coarse-grained aggregate. The empirical formula is (electron microprobe) $(Li_xNa_{0.05})Al_{0.98}(PO_4)_{1.00}[(OH)_{0.8}F_{0.2}]$.

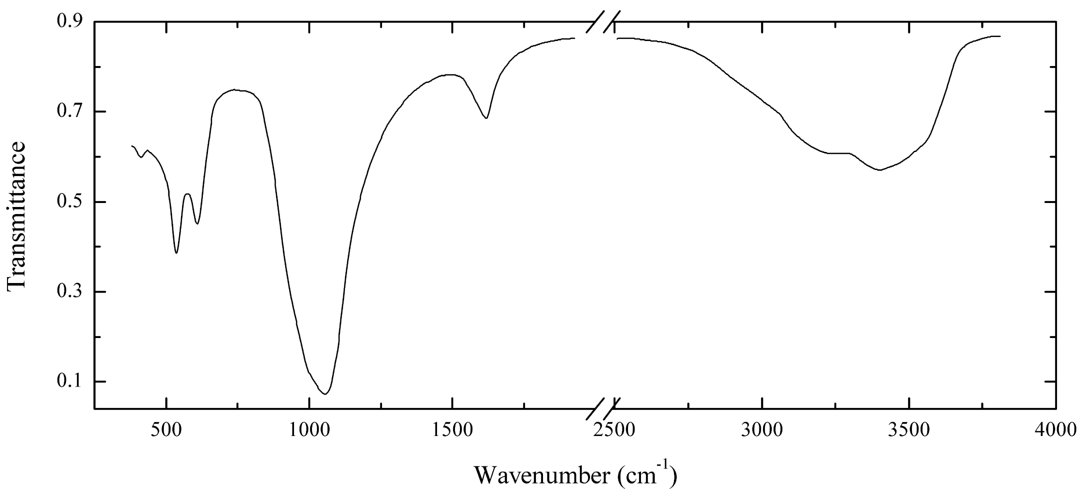
Wavenumbers (cm^{-1}): 3515sh, 3386, 1180s, 1130sh, 1093s, 1075s, 1019s, 808, 625sh, 592, 531, 478s, 400.

P226 Newberyite $Mg(HPO_4)\cdot 3H_2O$



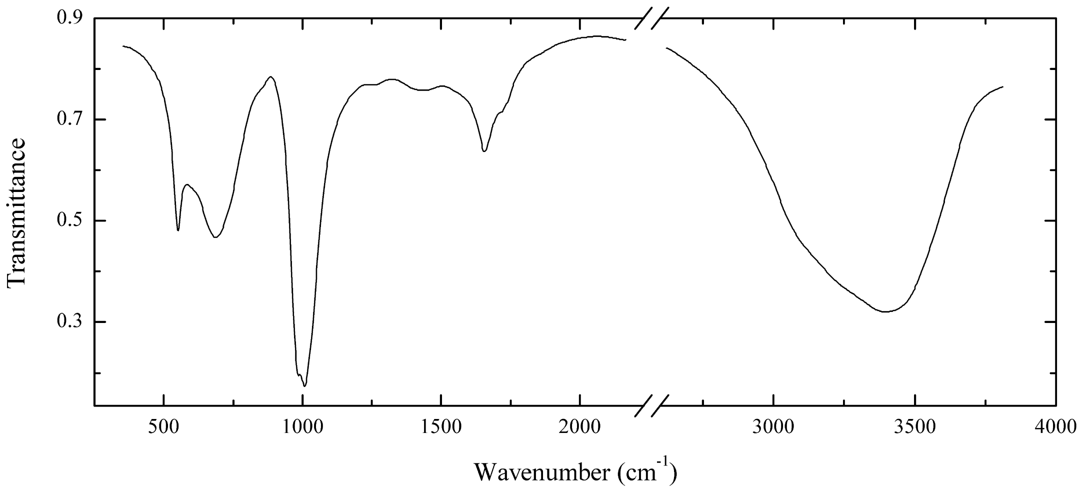
Locality: Searles Lake, San Bernardino Co., California, USA.
Description: Colourless crystals from the association with northupite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3520, 3480, 3375, 3275, 2890w, 2485w, 2390w, 1707, 1654, 1432w, 1236, 1167s, 1062s, 1022s, 899, 885, 735sh, 690, 605sh, 550, 530sh, 507.

P227 Tristramite $(Ca,U^{4+})(PO_4)\cdot 2H_2O$



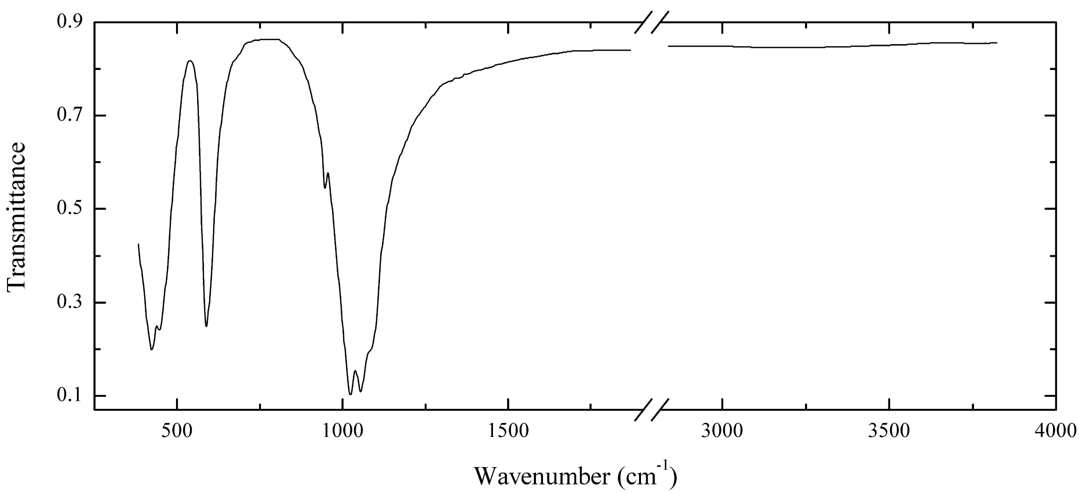
Locality: Maritsa U deposit, Simeonovgrad, Haskovo (Khaskovo) region, Bulgaria.
Description: Black massive. Identified by electron microdiffraction pattern and chemical composition. The empirical formula is (electron microprobe) $H_{0.2}Ca_{0.58}U_{0.41}(PO_4)_{1.00}[(OH)_{0.8}F_{0.2}]\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3530sh, 3460sh, 3380, 3210, 3000sh, 1620, 1056s, 1000sh, 613, 535, 412w.

P228 Natrophosphate $Na_7(PO_4)_2F{\cdot}19H_2O$



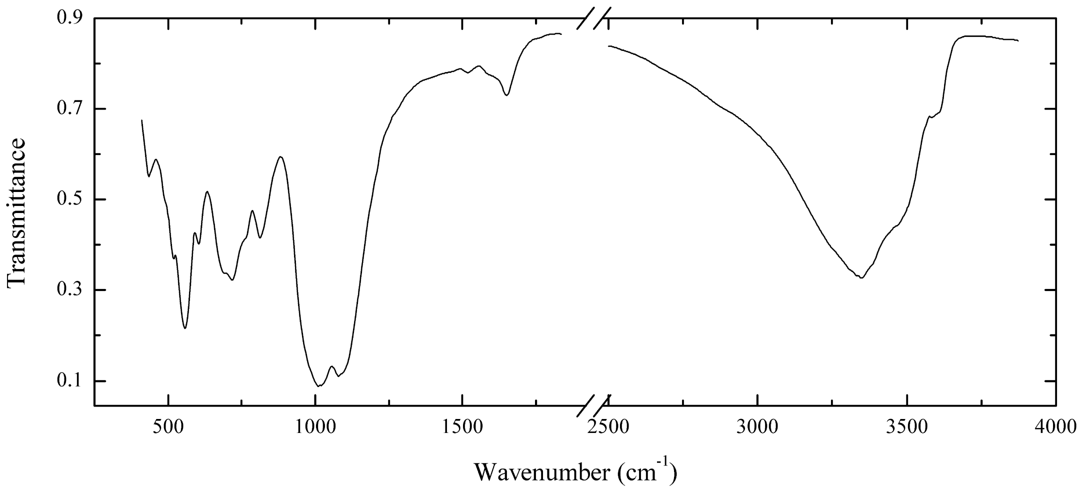
Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Soft colourless grains from peralkaline pegmatite. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3400s, 3150sh, 1710sh, 1655, 1450w, 1260w, 1007s, 985s, 740sh, 690, 546.

P229 Nalipoite $NaLi_2(PO_4)$



Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless crystals from peralkaline pegmatite. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 1085sh, 1053s, 1022s, 947, 588, 444, 424s.

P230 Ruifrancoite $Ca_2(\square,Mn^{2+})_2(Fe^{3+},Mg,Mn^{2+},Fe^{2+},Al)_4Be_4(PO_4)_6(OH)_6 \cdot 4H_2O$

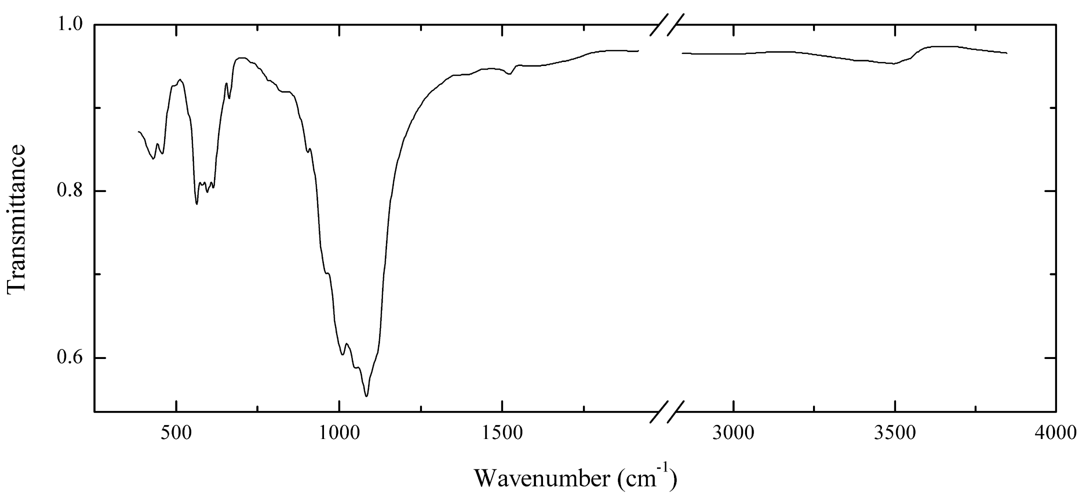


Locality: Sapucaia (Proberil) mine, Sapucaia do Norte, Galiléia Co., Minas Gerais, Brazil (type locality).

Description: Botryoidal aggregate of acicular crystals. Holotype sample. Monoclinic, space group *C*2/*c*, $a = 15.911(7)$, $b = 11.894(7)$, $c = 6.625(7)$, $\beta = 94.5(1)°$, $V = 1250(1)$ Å^3, $Z = 2$. The empirical formula is $Ca_{1.89}(Fe^{3+}{}_{1.69}Mn^{2+}{}_{1.43}Mg_{0.86}Fe^{2+}{}_{0.59}Al_{0.18})Be_{4.00}(PO_4)_{6.00}(OH)_{4.75} \cdot 5.15H_2O$. The ratio $Fe^{2+}:Fe^{3+}$ is calculated from Mössbauer spectroscopic data. $D_{meas} = 2.88$ (1) g/cm^3, $D_{calc} = 2.859$ g/cm^3. Optically biaxial (+), $\alpha = 1.665(3)$, $\beta = 1.665(3)$, $\gamma = 1.682(3)$, $2V_{meas} = 0 - -10$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 9.485 (44) (-110), 5.943 (100) (020), 4.821 (65) (310), 3.176 (44) (330), 2.784 (41) (240), 2.643 (42) (600).

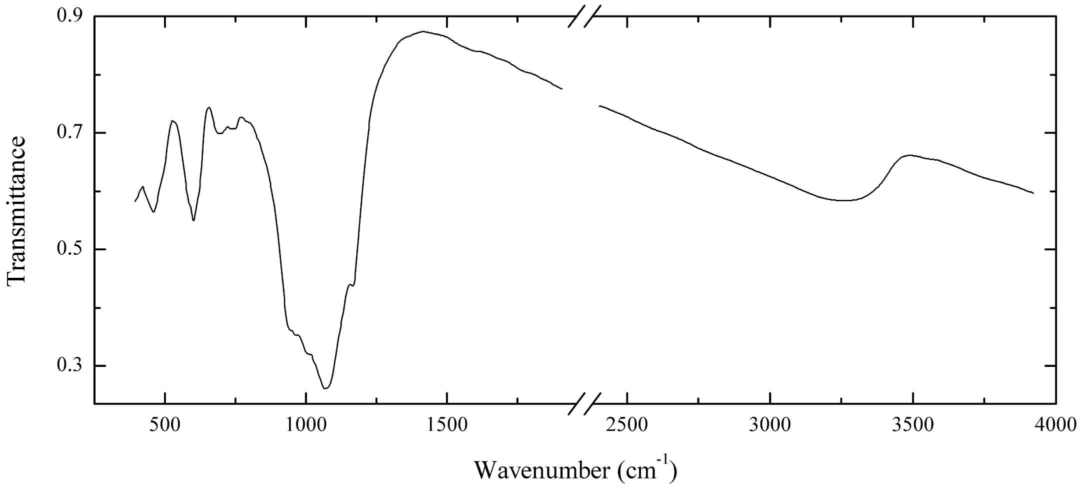
Wavenumbers (cm^{-1}): 3600sh, 3580, 3450sh, 3345s, 1660, 1605sh, 1525w, 1100sh, 1088s, 1030sh, 1015s, 970sh, 819, 760sh, 722, 700sh, 611, 600sh, 559s, 520, 500sh, 440.

P231 Arrojadite-(KNa) $KNa_5CaFe^{2+}{}_{13}Al(PO_4)_{11}(HPO_4)(OH)_2$



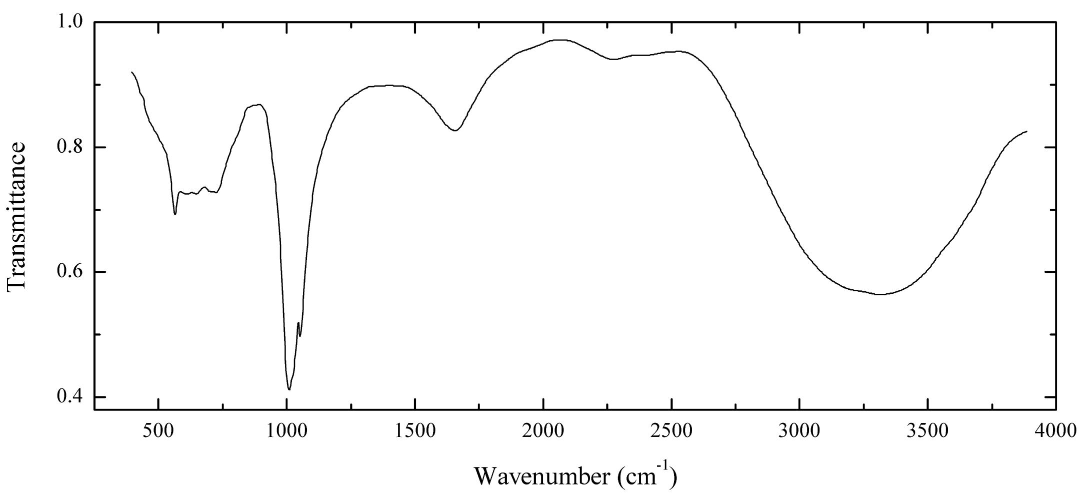
Locality: Rapid Creek, Richardson Mts., Yukon Territory, Canada (type locality).
Description: Yellow-brown crystals on quartz. The empirical formula is (electron microprobe) $K_{0.75}Na_{5.00}Ca_{1.02}(Fe_{10.05}Mg_{2.63}Mn_{0.37})Al_{1.13}(PO_4,HPO_4)_{12.00}(OH)_2$.
Wavenumbers (cm^{-1}): 3500w, 1515w, 1400w, 1100sh, 1081s, 1066s, 1050sh, 1013s, 1000sh, 960, 902, 659w, 600, 588, 575, 559, 457, 423.

P232 "Ferrilipscombite" $Fe^{3+}Fe^{3+}{}_2(PO_4)_2(OH)_2$



Locality: Anloua, Adamaoua (Adamawa) plateau, Cameroon.
Description: Dark green massive. Fe^{3+}-analogue (in both sites) of lipscombite? The empirical formula is (electron microprobe) $Fe_{2.81}Mg_{0.08}Mn_{0.03}(PO_4)_{2.00}(OH,O)_2$.
Wavenumbers (cm^{-1}): 3270, 1165s, 1070s, 1000s, 965sh, 742w, 695w, 600, 458.

P233 Nabaphite $NaBa(PO_4)·9H_2O$

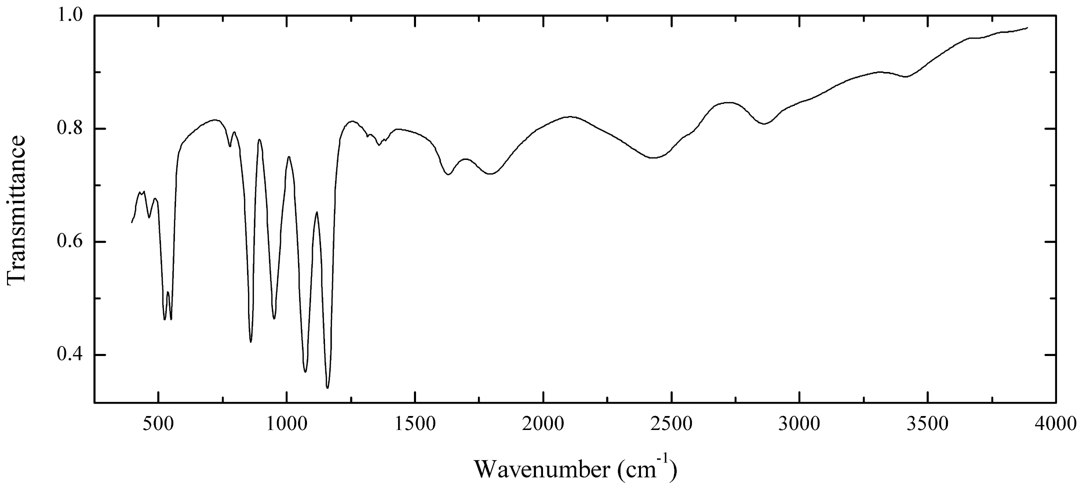


Locality: Kirovskiy mine, Kukisvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless tetrahedral crystals. The empirical formula is (electron microprobe) $(Na_{0.93}Ca_{0.04})(Ba_{0.63}Sr_{0.36})(PO_4)_{1.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3280s, 2260w, 1650, 1050s, 1025sh, 1005s, 716, 645, 603, 559, 505sh, 465sh.

P234 Nahpoite $Na_2H(PO_4)$

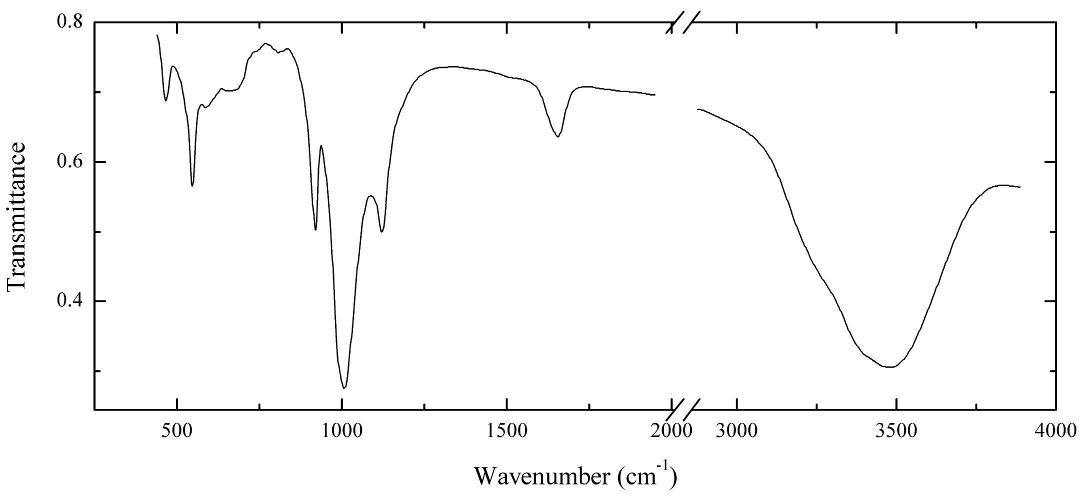


Locality: Umbozero (Umbozerskiy) mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless grains from peralkaline pegmatite. Identified by powder X-ray diffraction pattern and IR spectrum.

Wavenumbers (cm^{-1}): 3400w, 2850, 2550sh, 2425, 1800. 1620, 1390w, 1360w, 1315w, 1160s, 1073s, 950, 862s, 783w, 545, 522, 461, 403.

P235 Metanatroautunite $Na(UO_2)(PO_4)\cdot 3H_2O$

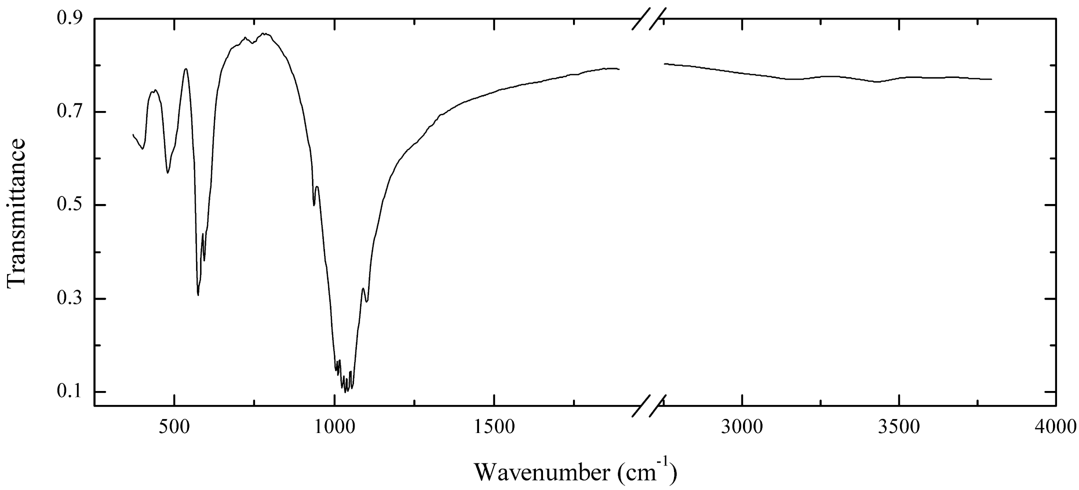


Locality: Kuruk U deposit, Khodzhent region, Tajikistan.

Description: Greenish-yellow platy crystals. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3465s, 3370sh, 3280sh, 1662, 1122, 1004s, 920, 816w, 645, 620sh, 595, 542, 465.

P236 Olympite $LiNa_5(PO_4)_2$

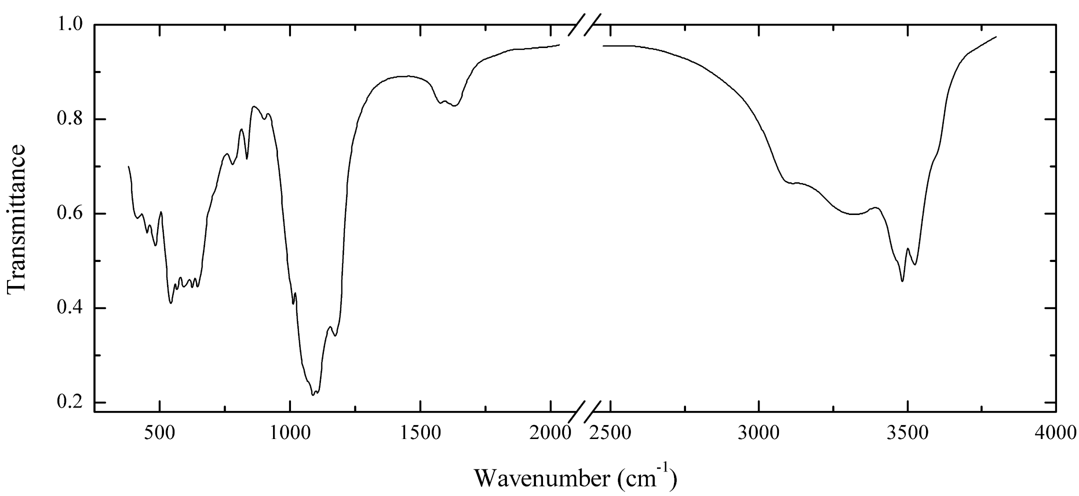


Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless grains from peralkaline pegmatite, from the association with natrosilite. Identified by IR spectrum.

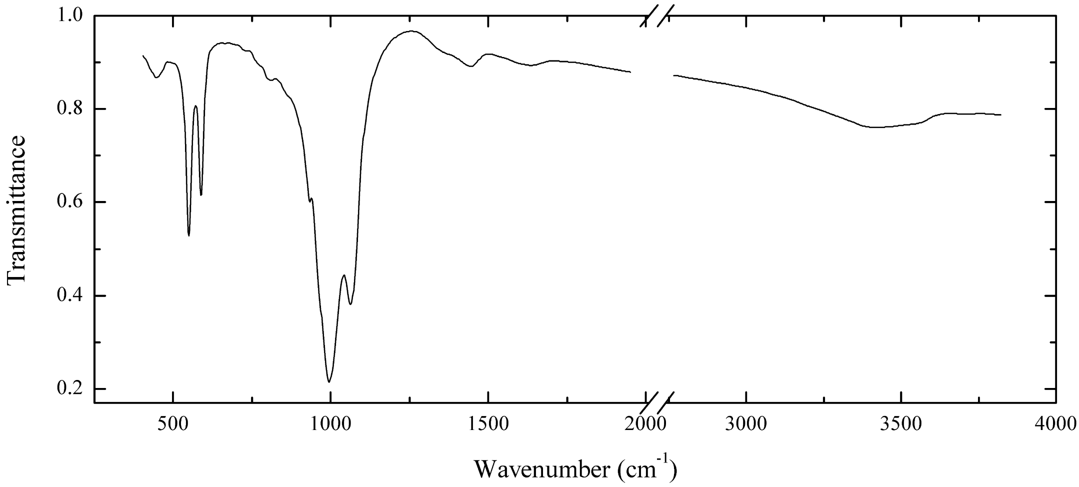
Wavenumbers (cm^{-1}): 3410w, 3150w, 1099, 1054s, 1041s, 1031s, 1021s, 1010s, 1003s, 936, 740w, 600sh, 591, 580sh, 567, 490sh, 476, 394.

P237 Planerite $\square Al_6(PO_4)_2(HPO_4)_2(OH)_8{\cdot}4H_2O$



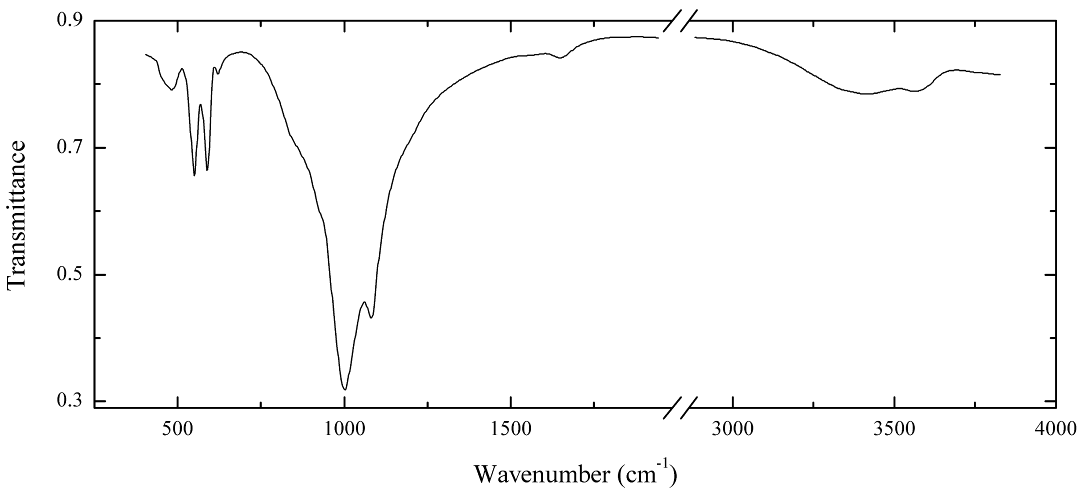
Locality: Chernovskaya Mt., Chernaya river, Verkhnyaya Sysert', Middle Urals, Russia.
Description: Light blue massive. The empirical formula is (electron microprobe) $(\square_{0.61}Cu_{0.18}Zn_{0.17}Ca_{0.04})(Al_{5.58}Fe_{0.40}Mg_{0.03})(PO_4,HPO_4)_{4.00}(OH)_8{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3580sh, 3515, 3475, 3450sh, 3310, 3090, 1635, 1585, 1190sh, 1174s, 1110s, 1091s, 1065sh, 1050sh, 1015, 902w, 836, 800sh, 783, 710sh, 645, 625, 592, 565, 540s, 484, 451, 410.

P238 Phosphohedyphane $Ca_2Pb_3(PO_4)_3Cl$



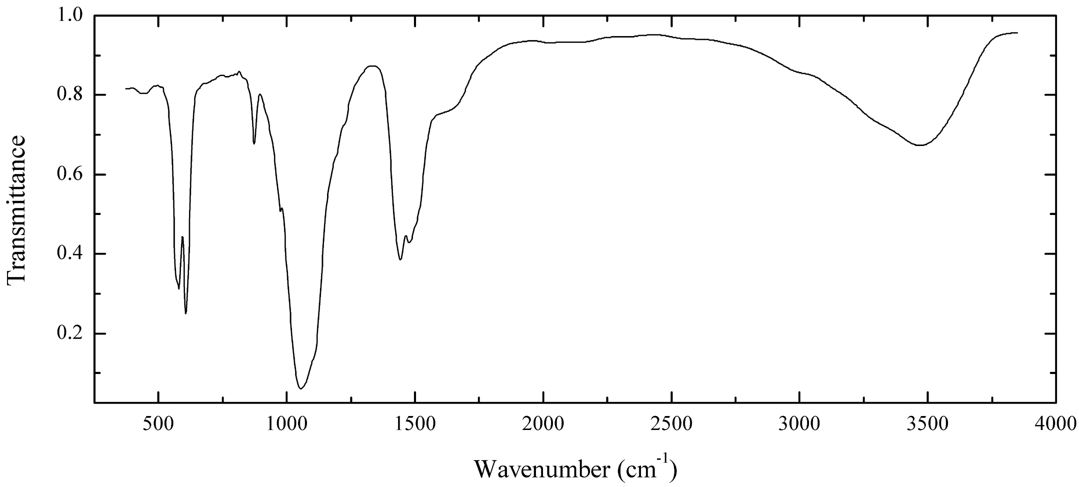
Locality: Ken'-Choku deposit, Karkaralinsk, Karagandy region, Kazakhstan.
Description: Grey crusts on pyromorphite crystals. The empirical formula is $Pb_{3.11}Ca_{1.89}[(PO_4)_{2.87}(SiO_4)_{0.05}(AsO_4)_{0.03}(CO_3)_{0.05}]Cl_{0.85}(OH)_{0.15}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3540sh, 3410w, 1640w, 1445w, 1370sh, 1067s, 999s, 939, 814w, 588, 547, 450w.

P239 "Hydroxylphosphohedyphane" $Ca_2Pb_3(PO_4)_3(OH)$



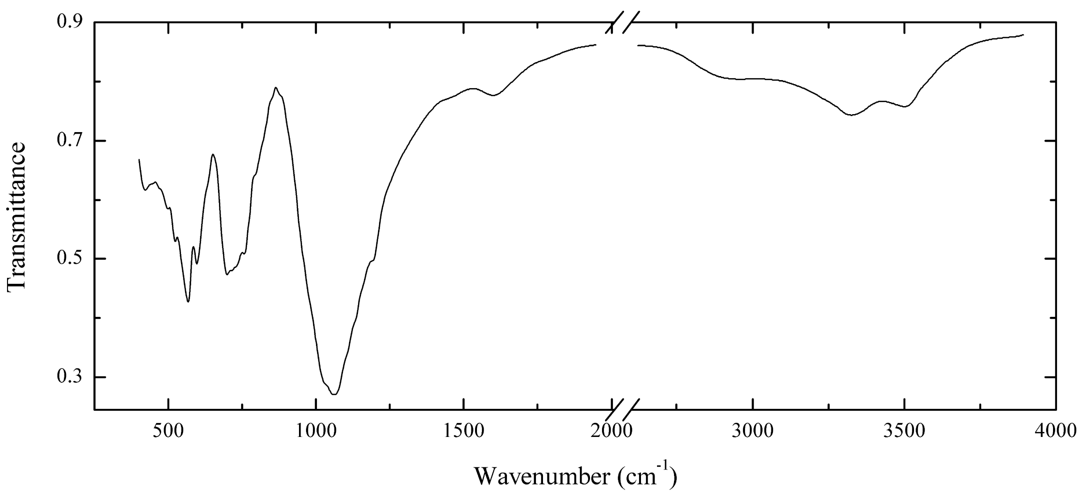
Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: OH-dominant analogue of phosphohedyphane. Grey massive. The empirical formula is $(Pb_{3.2}Ca_{1.3}Sr_{0.1}Y_{0.1}Na_{0.1})[(PO_4)_{2.1}(SiO_4)_{0.8}(SO_4)_{0.1}](OH,H_2O)_{0.8}Cl_{0.2}$.
Wavenumbers (cm^{-1}): 3550w, 3420, 1650w, 1084s, 1003s, 940sh, 880sh, 621w, 592, 552, 475w.

P240 Fluorapatite CO$_3$-rich $(Ca,H_2O,\square)_5(PO_4,CO_3)_3(F,OH,H_2O)$



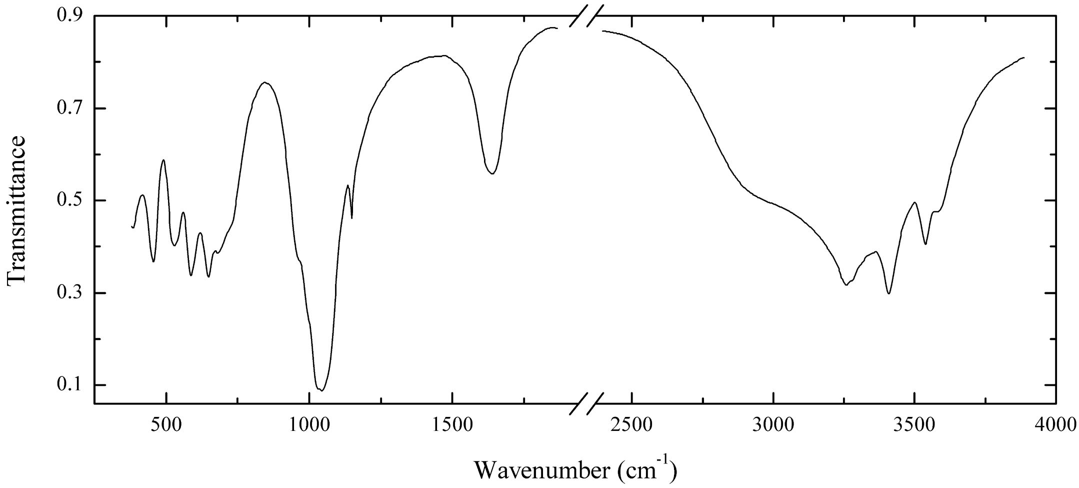
Locality: Flux quarry, Partizanski, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.
Description: Brown pseudomorph after coprolite of otter. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3395, 3250sh, 2950w, 1600sh, 1480sh, 1460, 1425, 1200sh, 1175sh, 1085sh, 1043s, 963, 864, 603s, 578, 565sh, 448w.

P241 Tiptopite $K_2(Li,Na,Ca)_6Be_6(PO_4)_6(OH)_2 \cdot H_2O$



Locality: Tip Top pegmatite, near Custer, South Dakota, USA (type locality).
Description: Colourless acicular crystals from the association with beryl, quartz and a roscherite-group mineral. The empirical formula is $K_{1.45}Na_{2.85}Ca_{0.56}Li_xBe_6(PO_4)_{6.00}(OH,H_2O)_y$.
Wavenumbers (cm^{-1}): 3485, 3315, 2930w, 1610w, 1190sh, 1060s, 1035sh, 790sh, 760, 725sh, 700, 595, 568, 522, 495, 420w.

P242 Paravauxite $Fe^{2+}Al_2(PO_4)_2(OH)_2·8H_2O$

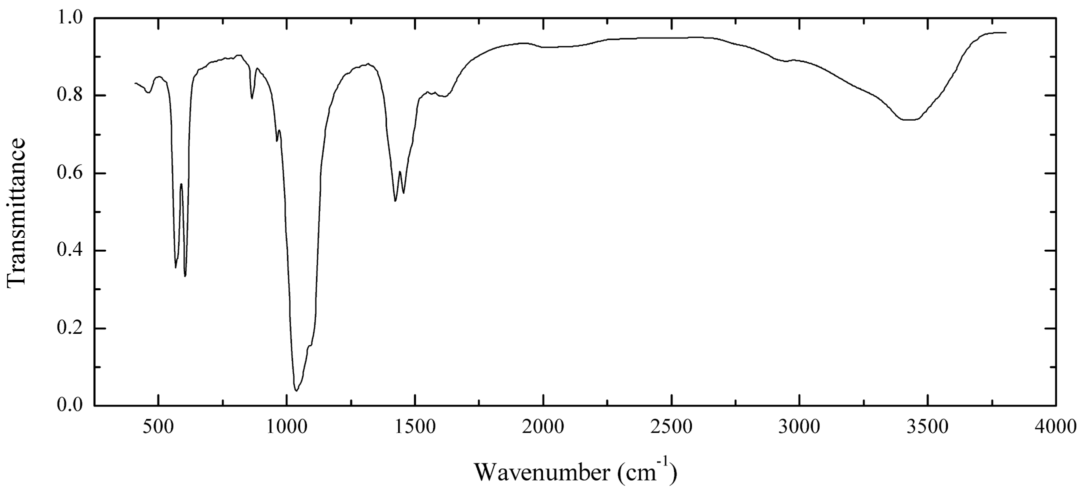


Locality: Siglo Veinte mine, Llallagua, Rafael Bustillo province, Potosí department, Bolivia (type locality).

Description: Blue crystals from the association with quartz, vauxite, sigloite and wavellite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3590, 3550, 3420s, 3270, 3000sh, 1650, 1155, 1051s, 1033s, 1000sh, 970sh, 730sh, 705sh, 650, 589, 531, 457, 373.

P243 Fluorapatite CO_3-rich $(Ca,H_2O,\square)_5(PO_4,CO_3)_3(F,OH,H_2O)$

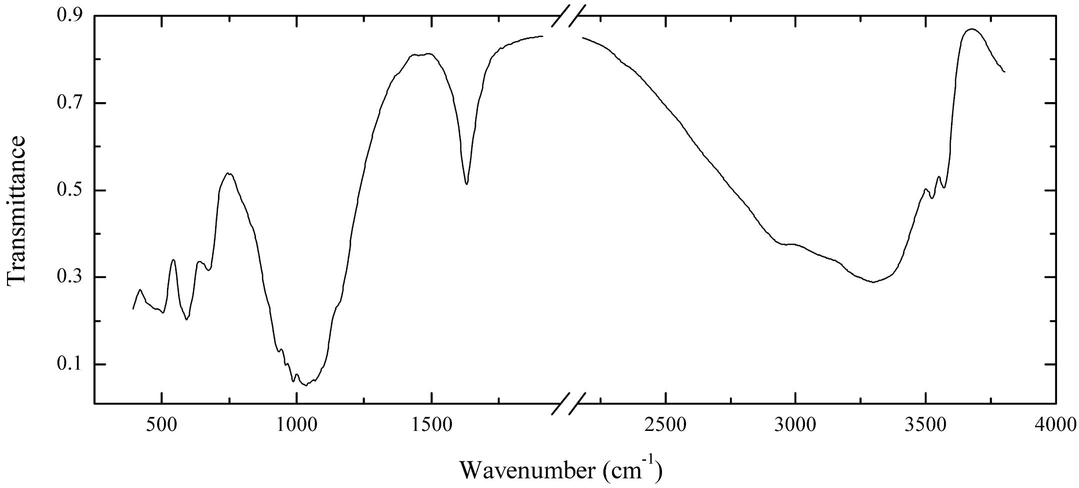


Locality: Devonian sediments of the northwestern part of the Russian platform.

Description: Pseudomorph after fishbone. Identified by IR spectrum. The empirical formula is $(Ca_{4.6}REE_{0.1}Na_{0.1})[(PO_4)_{2.65}(CO_3)_{0.3}(AlO_4)_{0.05}][F_{1.5}(H_2O)_{0.5}]·nH_2O$.

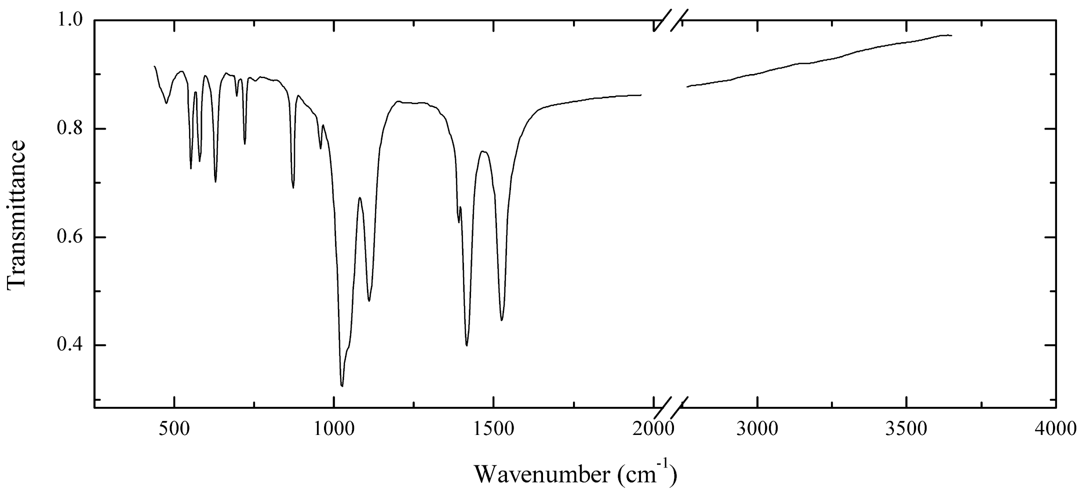
Wavenumbers (cm^{-1}): 3420, 3240sh, 2926w, 2000w, 1610w, 1458, 1427, 1096s, 1039s, 965, 867w, 605, 577, 568, 470w.

P244 "Oxyberaunite" $(Fe^{3+},Mn)Fe^{3+}{}_5(PO_4)_4(OH)_6·5H_2O$ (?)



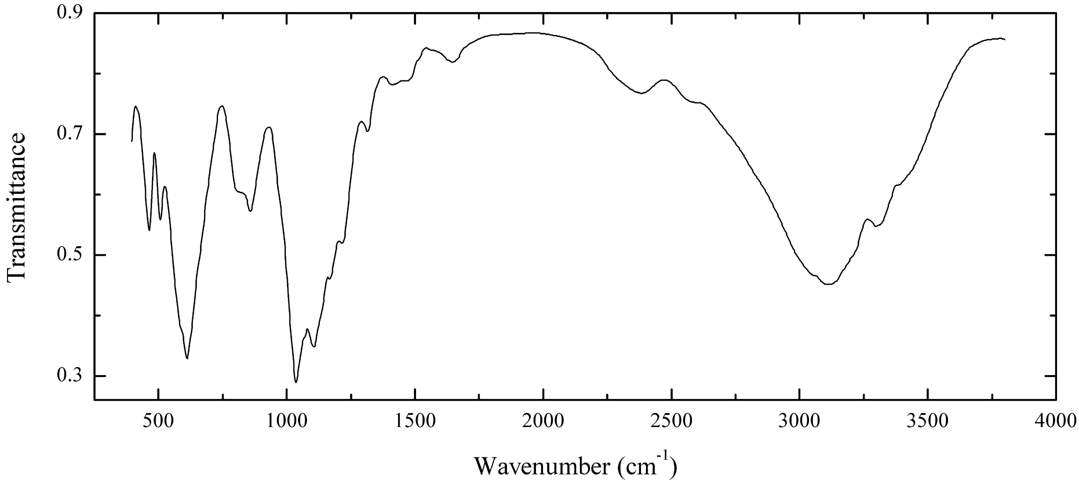
Locality: Rotläufchen mine, Waldgirmes, Germany.
Description: Brown prismatic crystals. Identified by qualitative electron microprobe analysis and IR spectrum. Related to beraunite. Needs further investigation.
Wavenumbers (cm^{-1}): 3550, 3510, 3280, 2950sh, 1627, 1150sh, 1065sh, 1034s, 1020sh, 988s, 963s, 935s, 673, 592, 570sh, 505, 475sh.

P245 Sidorenkite $Na_3Mn^{2+}(PO_4)(CO_3)$



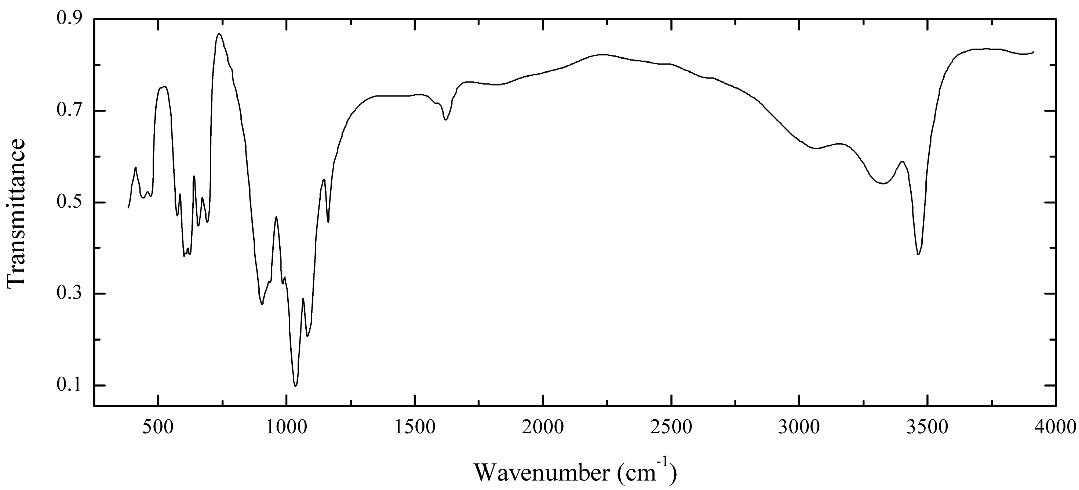
Locality: Umbozero (Umbozerskiy) mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Pink crystal from the association with aegirine, albite, korobitsynite, elpidite, natroxalate and sphalerite. Identified by electron microprobe analysis and IR spectrum. The empirical formula is $Na_{2.85}Ca_{0.17}Mn_{0.99}Fe_{0.02}(PO_4)_{1.00}(CO_3)_x$.
Wavenumbers (cm^{-1}): 1522s, 1413s, 1389, 1110s, 1043s, 1022s, 956w, 870, 718, 693w, 626, 576, 549, 473.

P246 Goyazite $SrAl_3(PO_4)_2(OH,H_2O)_6$



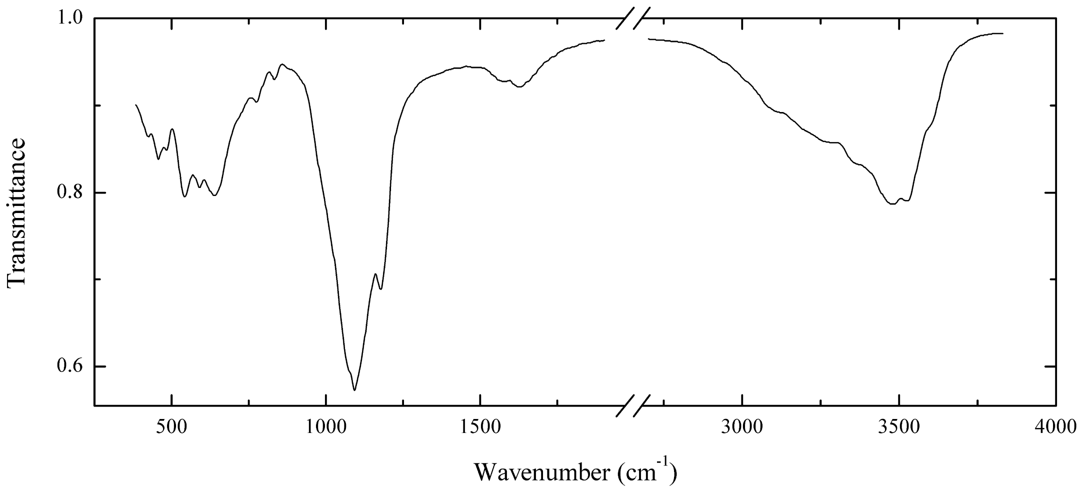
Locality: Edison Bird claim, Utahlite Hill, Lucin district, Pilot range, Box Elder Co., Utah, USA.
Description: White crystals from the association with variscite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3380sh, 3300, 3110s, 2590, 2400, 2300sh, 1655w, 1485w, 1415w, 1320, 1217, 1167, 1107s, 1036s, 860, 810, 610s, 585sh, 503, 463.

P247 Eosphorite $MnAl(PO_4)(OH)_2{\cdot}2H_2O$



Locality: Viitaniemi pegmatite, Eräjärvi area, Orivesi, Finland.
Description: Rose-coloured grains in pegmatite, in the association with albite and quartz. Identified by electron microprobe analysis and IR spectrum. The empirical formula is $Mn_{0.94}Al_{0.98}Fe_{0.07}(PO_4)_{1.00}(OH)_2{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3455, 3320, 3055, 1625w, 1162, 1090sh, 1081s, 1035s, 983, 934, 907s, 690, 655, 621, 609, 601, 573, 472, 440.

P248 Planerite $\square Al_6(PO_4)_2(HPO_4)_2(OH)_8 \cdot 4H_2O$

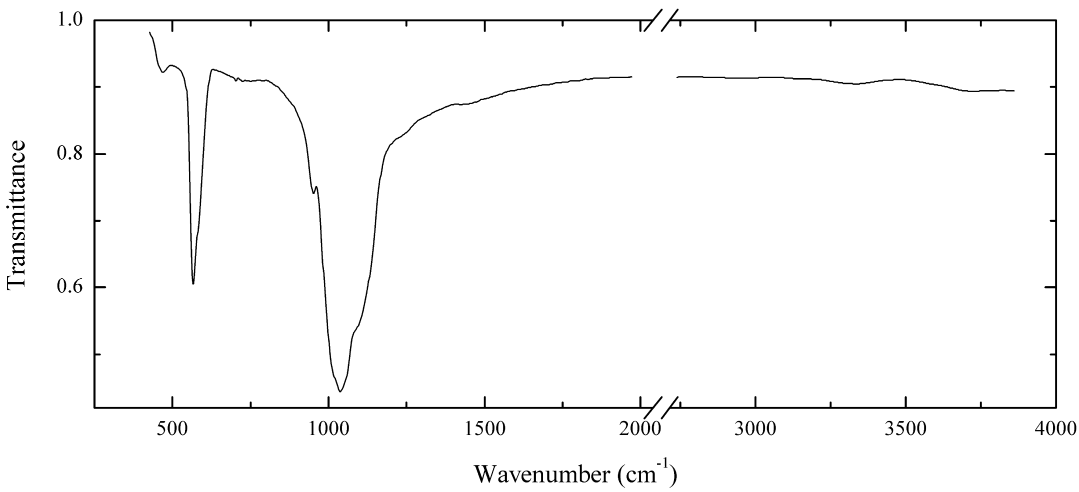


Locality: Chernovskaya Mt., Chernaya river, Verkhnyaya Sysert', Middle Urals, Russia.

Description: Light blue massive. The empirical formula is (electron microprobe) $(\square_{0.64}Cu_{0.15}Zn_{0.13}Ca_{0.08})(Al_{5.77}Fe_{0.23})(PO_4,HPO_4)_{4.00}(OH)_8 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3585sh, 3510, 3460, 3350sh, 3260sh, 3100sh, 1625w, 1570w, 1174s, 1115sh, 1092s, 1070sh, 836w, 775w, 635, 587, 540, 480, 435, 420w.

P249 Olgite (Ba,Sr)(Na,Sr,*REE*)$_2$Na(PO$_4$)$_2$

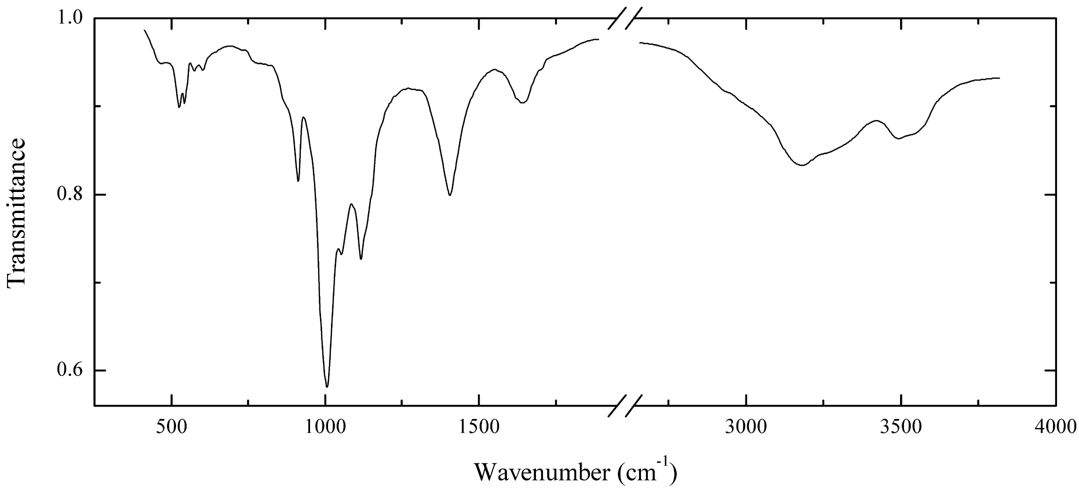


Locality: Karnasurt Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Light green grains from the association with natrosilite and analcime. Holotype sample. The crystal structure is solved. Trigonal, space group *P*3, $a = 5.565(2)$, $c = 7.050(3)$ Å, $Z = 1$. The empirical formula is $Na_{1.00}Sr_{0.47}Ba_{0.42}La_{0.03}Ca_{0.02}K_{0.02}Mn_{0.02}Ce_{0.01}P_{0.99}O_4$. $D_{meas} = 3.94$ g/cm^3, $D_{calc} = 3.96$ g/cm^3. Optically uniaxial (−), $\omega = 1.623(3)$, $\varepsilon = 1.619(3)$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 2.842 (100), 2.763 (100), 1.982 (63), 3.97 (41), 1.607 (37b), 1.647 (30), 6.99 (26).

Wavenumbers (cm^{-1}): 1100sh, 1035s, 1015sh, 947, 575sh, 560s, 460w, 410sh.

P250 "Pseudo-autunite" $(H_3O)_4Ca_2(UO_2)_2(PO_4)_4 \cdot 5H_2O$ (?)

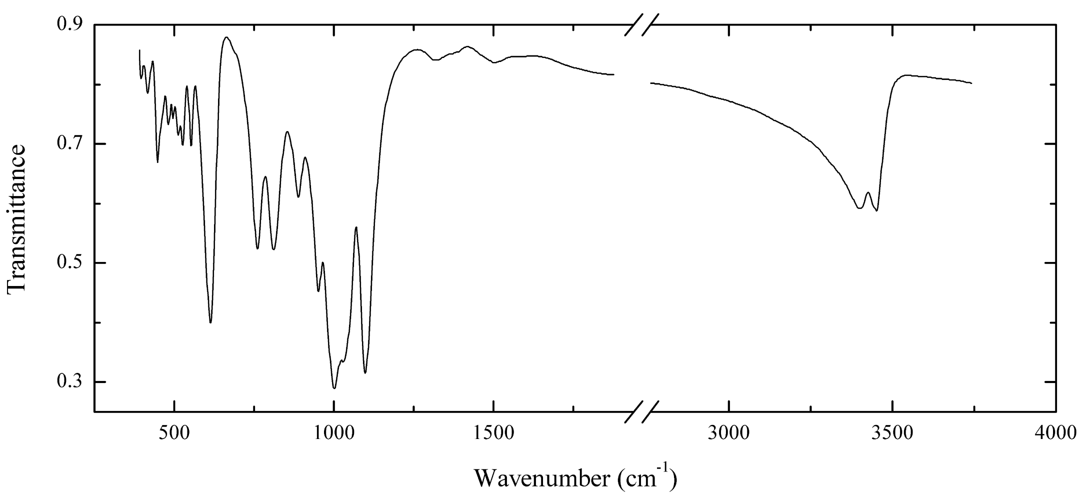


Locality: Vuoriyarvi massif, Northern Karelia, Russia (type locality).

Description: Yellow platelets. Specimen No. 69822 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Discredited mineral species. Needs further investigation. The band at 1,400 cm^{-1} can be due to NH_4^+ or H^+.

Wavenumbers (cm^{-1}): 3530sh, 3470, 3250sh, 3155, 1640, 1400, 1135, 1121, 1057, 1008s, 918, 875sh, 790sh, 601w, 587w, 542, 526, 460sh.

P251 Pseudomalachite $Cu^{2+}_5(PO_4)_2(OH)_4$

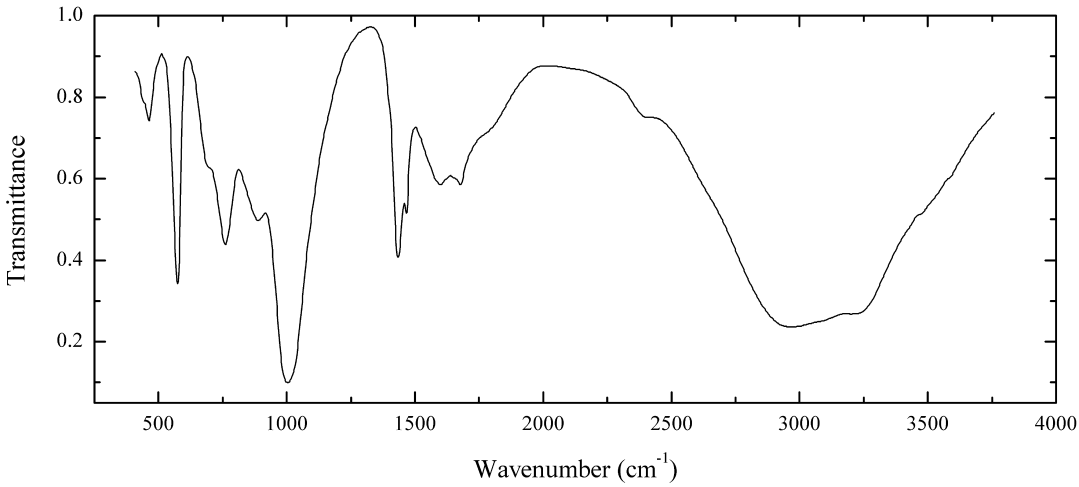


Locality: Mednorudyanskoe Cu deposit, Nizhniy Tagil, Middle Urals, Russia.

Description: Green crust from the association with libethenite and malachite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3448, 3392, 1505w, 1490sh, 1370w, 1315w, 1097s, 1030s, 1001s, 952, 888, 809, 757, 609s, 550, 524, 510, 495w, 478, 460sh, 445, 415, 395w.

P253 Struvite $(NH_4)Mg(PO_4)\cdot 6H_2O$

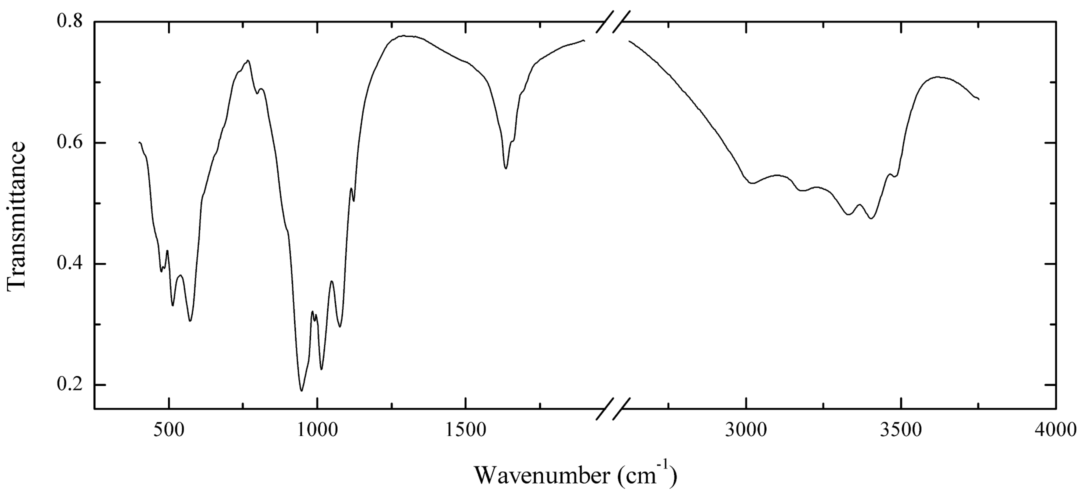


Locality: From canned hunchback salmon.

Description: Hemimorphic crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3580sh, 3470sh, 3235s, 3100sh, 2980s, 2400w, 1780sh, 1682, 1603, 1468, 1436, 1003s, 892, 761, 695sh, 571, 460w, 440sh.

P254 Switzerite $(Mn^{2+},Fe^{2+})_3(PO_4)_2\cdot 7H_2O$

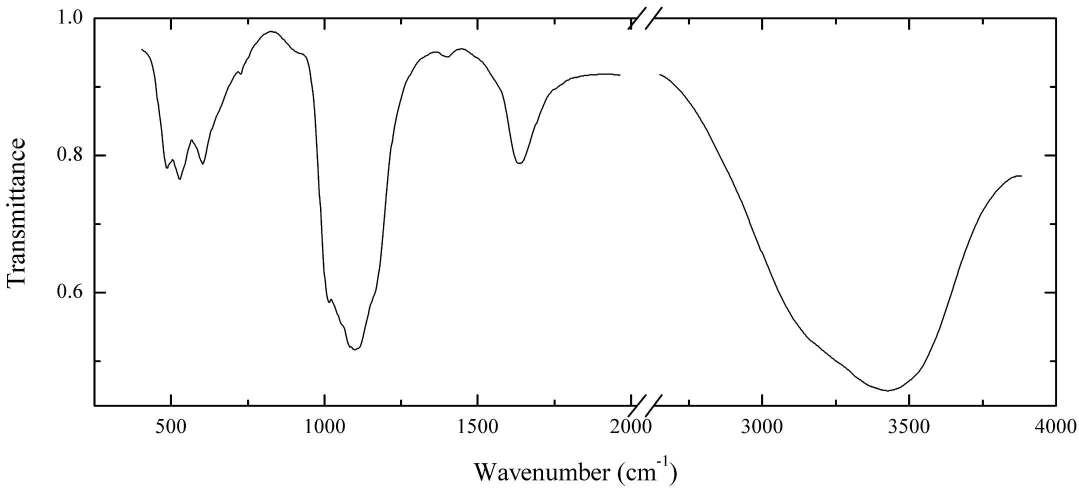


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Brownish massive. Possibly intergrowth with another phosphate. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 11.11 (100), 8.47 (50), 3.26 (80), 2.89 (70), 2.34 (60), 2.12 (60).

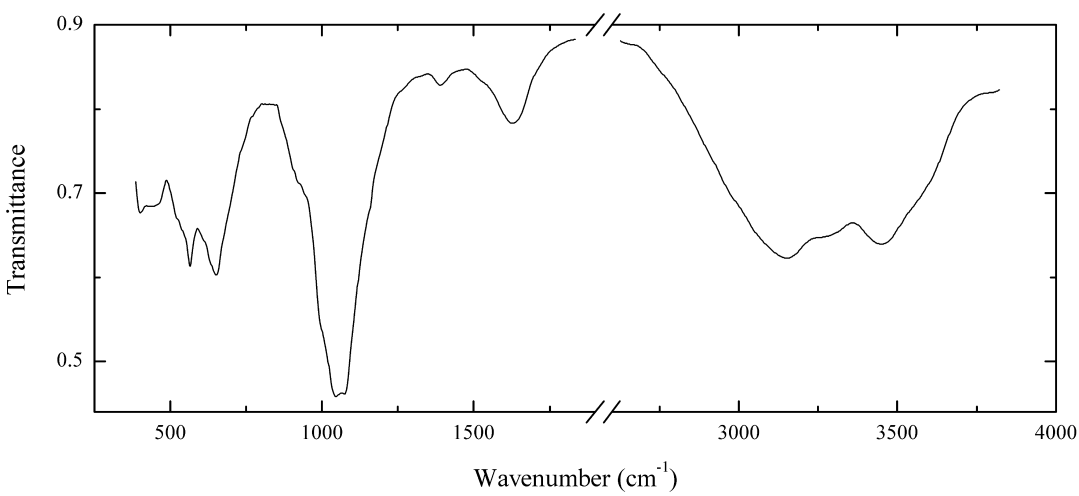
Wavenumbers (cm^{-1}): 3487, 3405, 3335, 3180, 3020, 1695sh, 1665sh, 1645, 1130, 1083s, 1021s, 998, 970sh, 952s, 905sh, 806w, 690sh, 651, 578, 516, 490, 477, 455sh.

P255 Sasaite $(Al,Fe^{3+})_6(PO_4,SO_4)_5(OH)_3 \cdot 35H_2O$



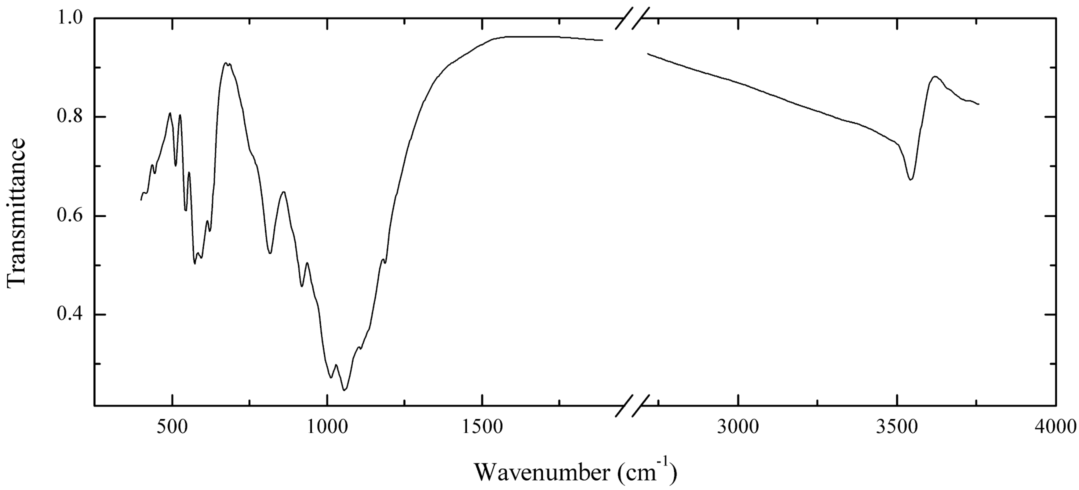
Locality: Breitenau mine, Hochlantsch, St. Jakob-Breitenau, Styria, Austria.
Description: Pale blue spherulitic crust.
Wavenumbers (cm^{-1}): 3430s, 3220sh, 1635, 1394w, 1170sh, 1110s, 1090sh, 1060sh, 1016s, 920w, 727w, 602, 525, 480.

P256 Sigloite $Fe^{3+}Al_2(PO_4)_2(OH)_3 \cdot 7H_2O$



Locality: Siglo Veinte mine, Llallagua, Rafael Bustillo province, Potosí department, Bolivia (type locality).
Description: Brownish-orange pseudomorph after paravauxite crystal. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3440, 3250, 3145, 1635, 1398w, 1200sh, 1155sh, 1077s, 1051s, 1010sh, 935sh, 649, 564, 460, 447.

P257 Satterlyite $(Fe^{2+},Mg)_{12}(PO_4)_5(HPO_4)(OH,O)_6$

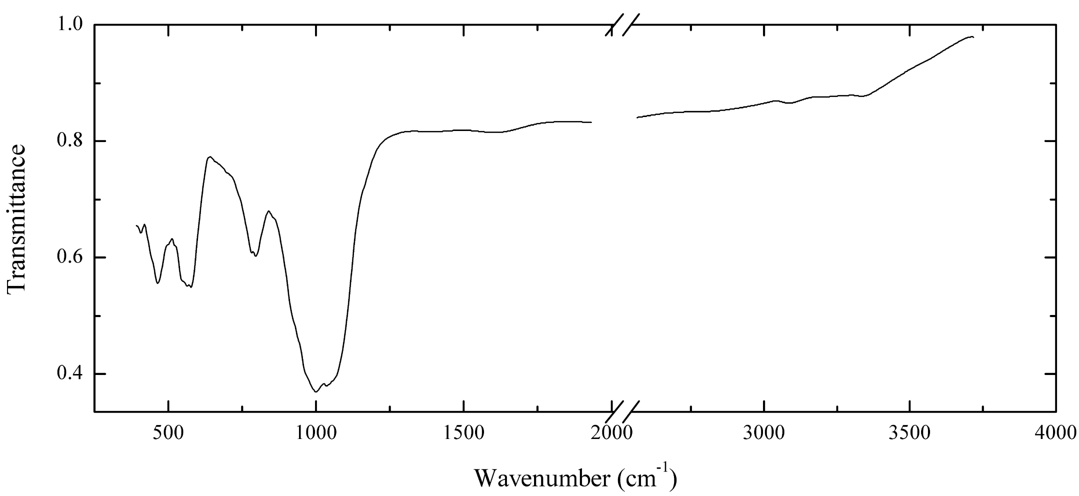


Locality: Big Fish River, Yukon Territory, Canada (type locality).

Description: Light brown columnar aggregate from the association with quartz. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Fe_{9.2}Mg_{2.0}Mn_{0.3}Ca_{0.2})(PO_4, HPO_4)_{6.00}(OH,O)_6$.

Wavenumbers (cm^{-1}): 3530, 1190sh, 1105sh, 1059s, 1013s, 960sh, 919, 816, 760sh, 621, 592, 570, 541, 508, 545, 410.

P258 Smrkovecite $Bi_2(PO_4)O(OH)$

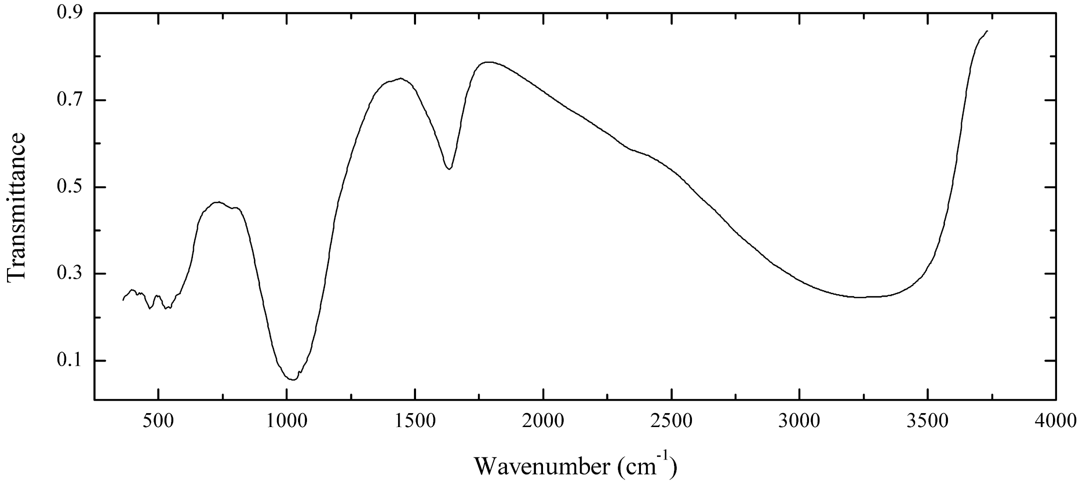


Locality: Old dumps near As–U deposit Smrkovec, Slavovsky Les Mts., near Mariánské Lázně, Czech Republic (type locality).

Description: Brown spherical aggregates from the association with quartz, bismutite and petitjeanite. Identified by powder X-ray diffraction pattern, IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3325w, 3075w, 1036s, 1002s, 965sh, 920sh, 796, 781, 574, 557, 545sh, 462, 410w.

P259 Santabarbaraite $Fe^{3+}{}_3(PO_4)_2(OH)_3{\cdot}5H_2O$

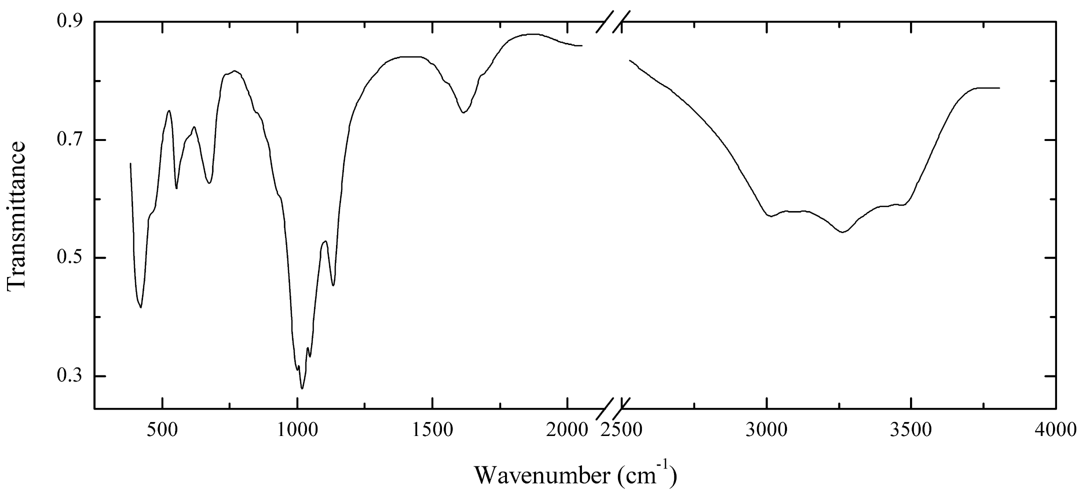


Locality: Castelnuovo mine, Santa Barbara lignite area, Upper Arno River valley, southeast of Florence, Italy.

Description: Brown pseudomorphs after vivianite crystals from the association with rodolicoite. Identified by IR spectrum. Amorphous. The empirical formula is (electron microprobe) $Fe_{2.8}Mn_{0.2}Mg_{0.1}(PO_4)_{2.0}(OH)_3{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3240s, 2360sh, 1633, 1023s, 790w, 580sh, 540, 468, 420, 375.

P260 Sincosite $Ca(V^{4+}O_2)_2(PO_4)_2{\cdot}5H_2O$

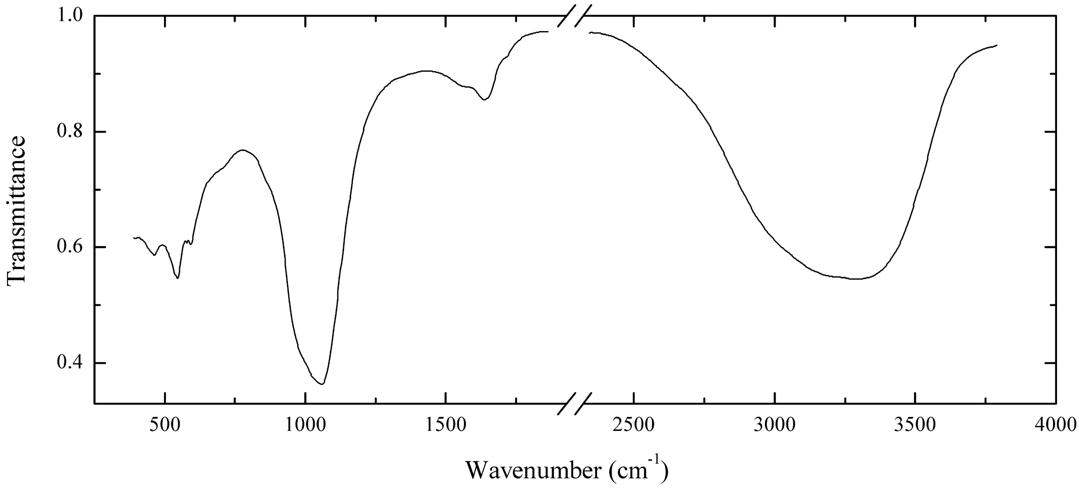


Locality: Ross Hannibal mine (North Star mine), Lead district, Lawrence Co., South Dakota, USA.

Description: Green platy crystals from the association with minyulite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3450, 3245, 2995, 1690sh, 1617, 1555sh, 1132, 1047s, 1018s, 1000s, 990sh, 930sh, 860sh, 675, 595sh, 549, 460sh, 411.

P261 Schoonerite $ZnMn^{2+}Fe^{2+}{}_2Fe^{3+}(PO_4)_3(OH)_2{\cdot}9H_2O$

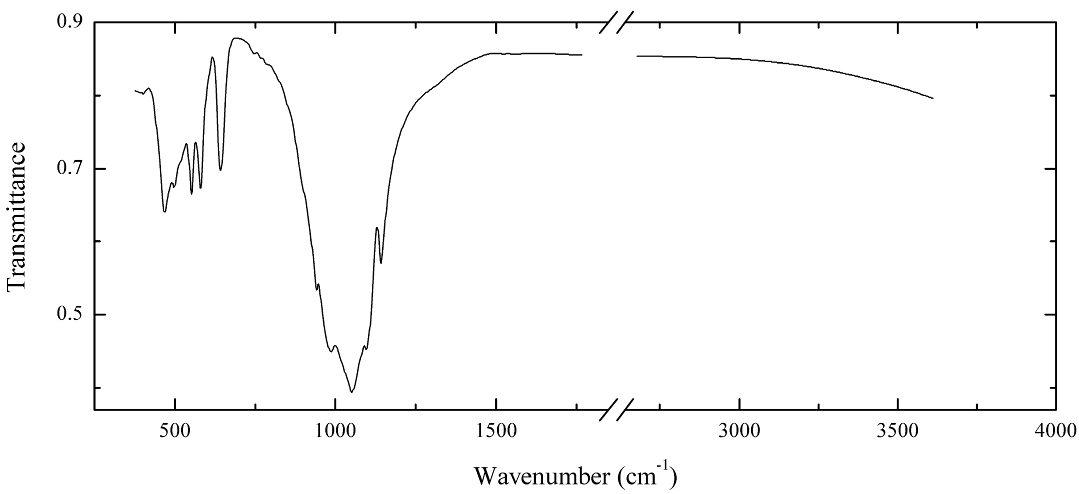


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Tan lath-like crystals from the association with rockbridgeite. The empirical formula is (electron microprobe) $Zn_{0.82}Mn_{1.12}Fe_{2.99}Mg_{0.02}Ca_{0.02}(PO_4)_{3.00}(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3290s, 3030sh, 1640, 1560sh, 1057, 990sh, 592, 543, 467.

P262 Triphylite $LiFe^{2+}(PO_4)$

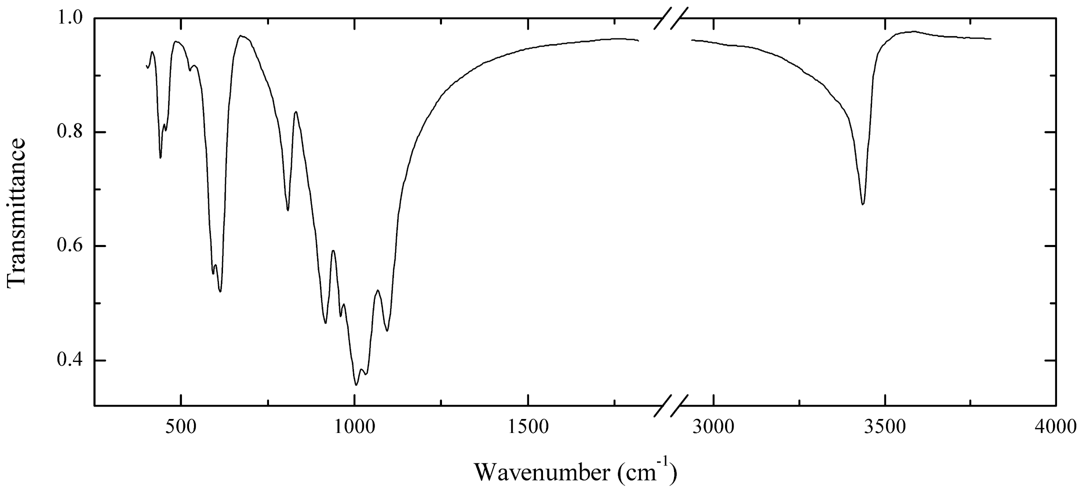


Locality: Ak-Kezen' pegmatite, Belogorskii town, Kalba range, Eastern Kazakhstan.

Description: Grey single-crystal grain. The empirical formula is (electron microprobe) $Li(Fe_{0.61}Mn_{0.35}Mg_{0.04})(PO_4)_{1.00}$.

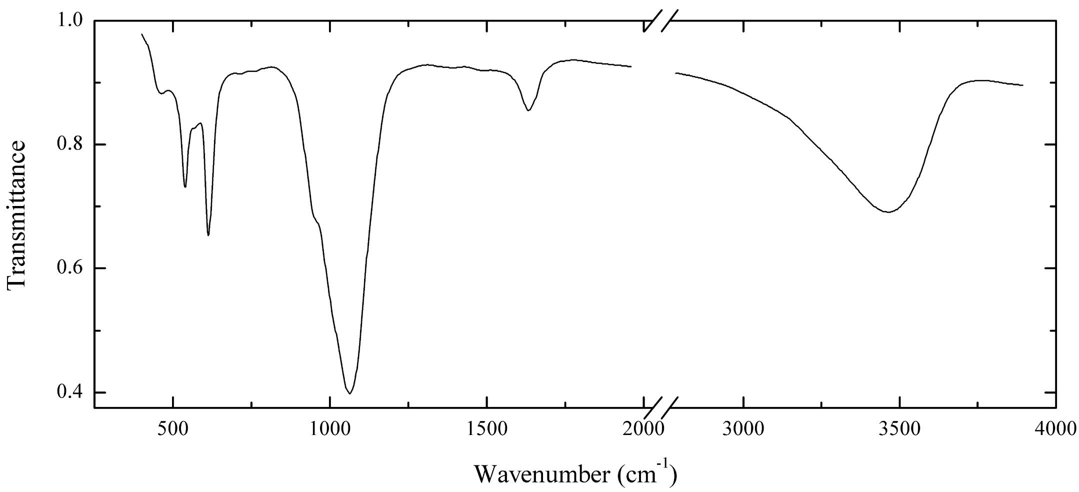
Wavenumbers (cm^{-1}): 1139, 1094s, 1049s, 987s, 940, 637, 577, 548, 494, 465.

P263 Tarbuttite $Zn_2(PO_4)(OH)$



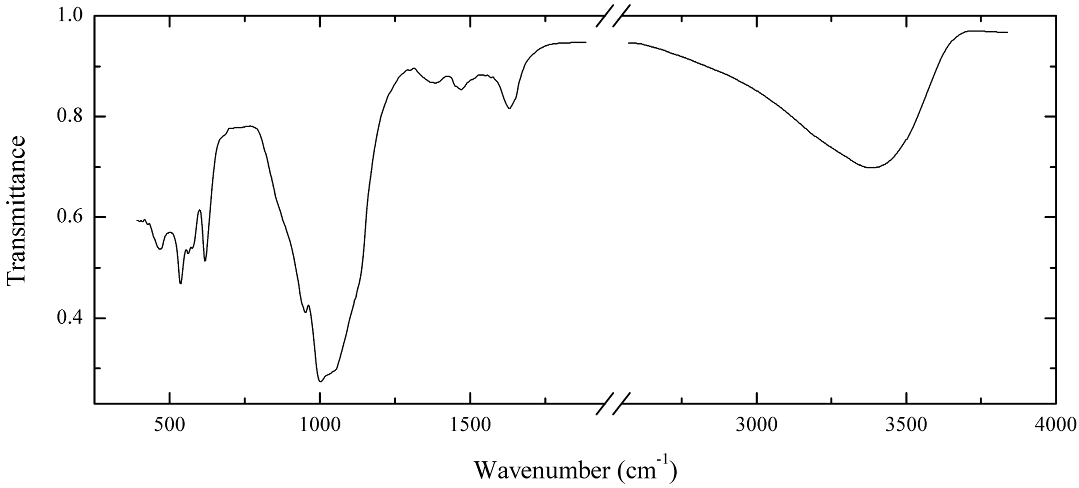
Locality: Kabwe (Broken Hill) mine, Kabwe (Broken Hill), Central province, Zambia (type locality).
Description: Colourless short-prismatic crystals from the association with hemimorphite and scholzite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3438, 1092s, 1031s, 1003s, 959s, 913s, 805, 606, 586, 522w, 452, 433, 397w.

P264 Rhabdophane-(Ce) $(Ce,La)(PO_4){\cdot}H_2O$



Locality: Umbozero (Umbozerskiy) mine, Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Yellow fine-grained pseudomorph after belovite-(Ce) from the association with ussingite, murmanite, manganoneptunite and gonnardite. The empirical formula is (electron microprobe) $(Ce_{0.49}La_{0.30}Nd_{0.08}Pr_{0.05}Ca_{0.05}Sr_{0.05}Th_{0.01})[(PO_4)_{0.92}(SiO_4)_{0.08}]{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3440, 1630, 1066s, 960sh, 613, 570w, 541, 462w.

P265 Rhabdophane-(La) (La,Ce)(PO_4)·H_2O

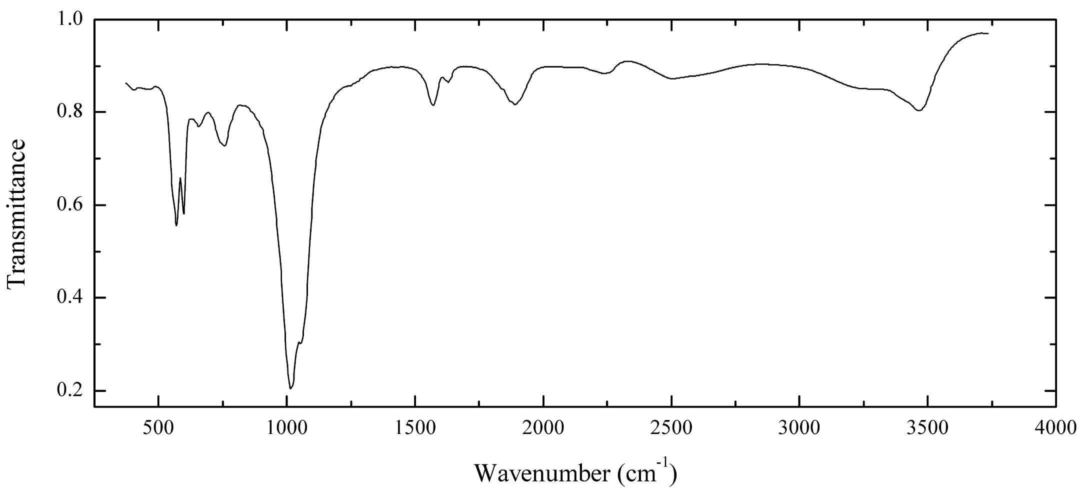


Locality: Lepkhe-Nelm Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Yellow fine-grained aggregate from the association with Monazite-(La) and natrolite. The empirical formula is ($La_{0.52}Ce_{0.21}Nd_{0.12}Pr_{0.05}Ca_{0.08}Sr_{0.02}$)[($PO_4$)$_{0.9}$($CO_3$)$_x$]·$n$$H_2O$. Contains admixture of monazite-(La).

Wavenumbers (cm^{-1}): 3390, 1638, 1475w, 1390w, 1130sh, 1055sh, 1031, 1004s, 955s, 885sh, 617, 578, 563, 535, 470.

P266 Landesite $Fe^{3+}Mn^{2+}_2(PO_4)_2(OH)·2H_2O$

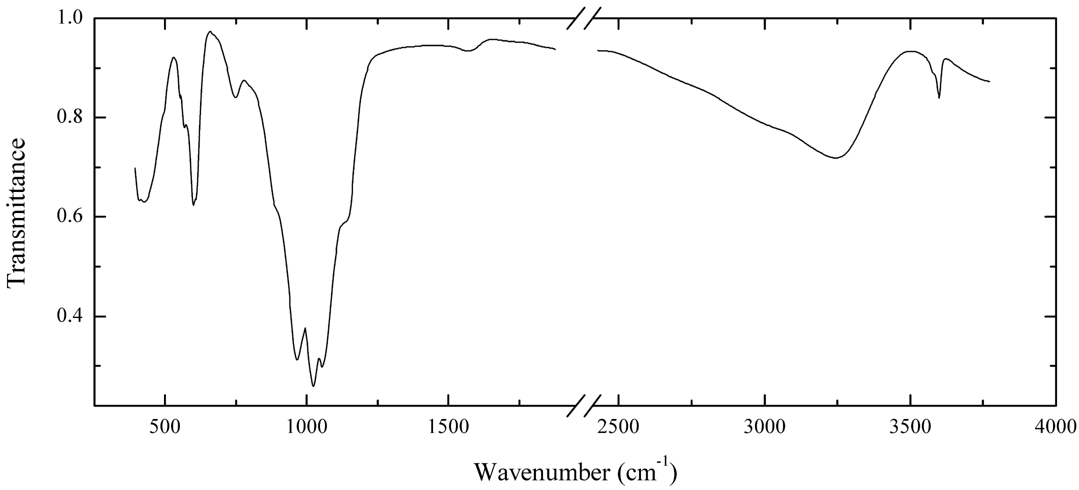


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Light brown transparent crystals. The empirical formula is (electron microprobe) $Mn_{1.57}Fe_{1.37}Ca_{0.03}Mn_{0.03}(PO_4)_{2.00}(OH)·nH_2O$.

Wavenumbers (cm^{-1}): 3450, 3235w, 2510w, 2235w, 1890, 1630w, 1573, 1053s, 1014s, 761, 745sh, 656w, 596, 568, 560sh, 445w, 401w.

P267 Rockbridgeite $Fe^{2+}Fe^{3+}_4(PO_4)_3(OH)_5$

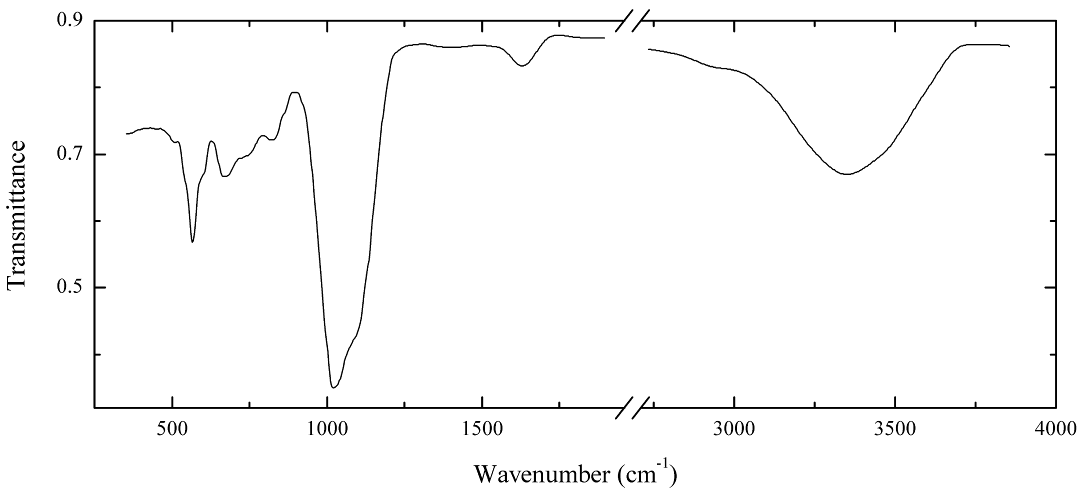


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Dark green radial aggregate. The empirical formula is (electron microprobe) $(Fe_{0.91}Mn_{0.04}Mg_{0.03})(Fe_{3.92}Al_{0.08})(PO_4)_{3.00}(OH)_5$.

Wavenumbers (cm^{-1}): 3575, 3555sh, 3240, 3030sh, 1575w, 1135sh, 1054s, 1021s, 967s, 890sh, 749, 605sh, 597, 565, 551, 490sh, 432, 412.

P268 Roscherite $Ca_2(Mn,Fe^{2+},Fe^{3+},Mg,Al,Zn)_5Be_4(PO_4)_6(OH)_4{\cdot}6H_2O$

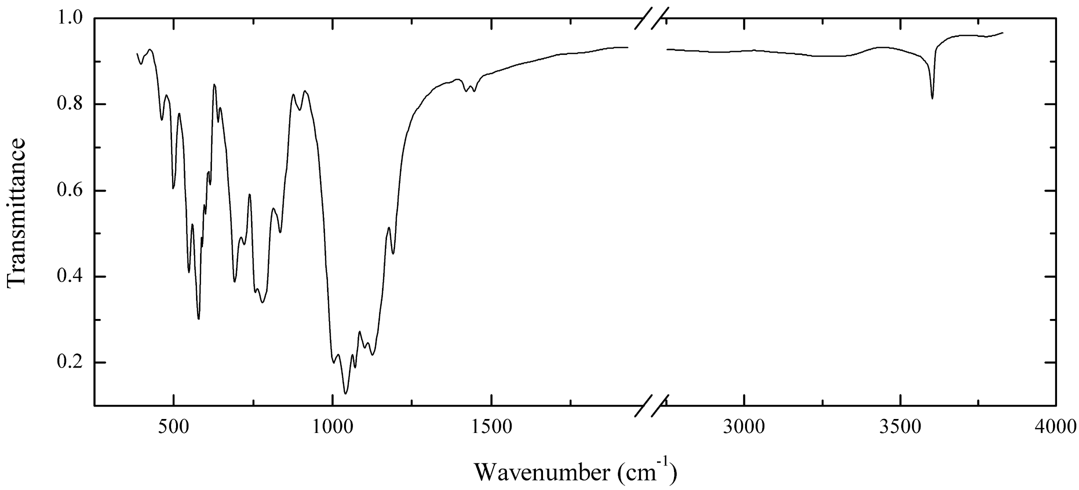


Locality: Ungursai Ta deposit, Kalba range, Eastern Kazakhstan region, Kazakhstan.

Description: Brown spherulites from the association with tantalite-(Mn). The empirical formula is (electron microprobe) $Ca_{1.9}(Fe_{2.9}Mn_{2.4}Zn_{0.1})Be_4(PO_4)_{6.0}(H_2O,OH)_{10}$. The valency of Fe was not determined. In case $Fe^{2+}:Fe^{3+} > 4.8$, this formula could correspond to greifensteinite.

Wavenumbers (cm^{-1}): 3460sh, 3325, 2950sh, 1630, 1090sh, 1028s, 826, 740sh, 679, 605sh, 573, 515w.

P269 Hurlbutite $CaBe_2(PO_4)_2$

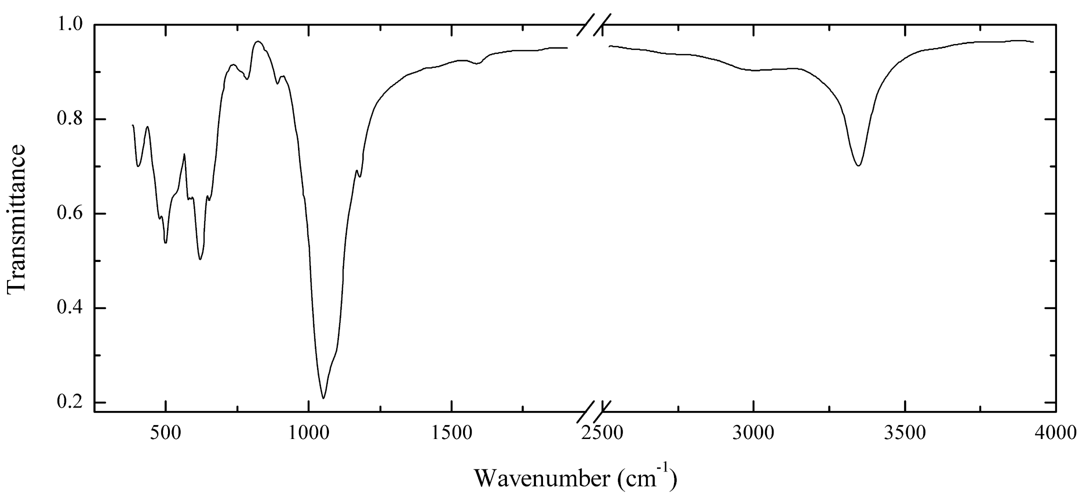


Locality: Viitaniemi pegmatite, Eräjärvi pegmatite, Orivesi, Finland.

Description: Light brown granular aggregate from the association with montebrasite and beryllonite. Contains additional groups CO_3^{2-} and $(OH)_4^{4-}$.

Wavenumbers (cm^{-1}): 3605, 1453w, 1427w, 1192, 1155sh, 1124s, 1102s, 1071s, 1043s, 1004s, 898w, 836, 777, 755, 720, 688, 638w, 615, 600, 589, 574s, 543, 510sh, 498, 462, 390w.

P270 Viitaniemiite $Na(Ca,Mn)Al(PO_4)(F,OH)_2(OH)$

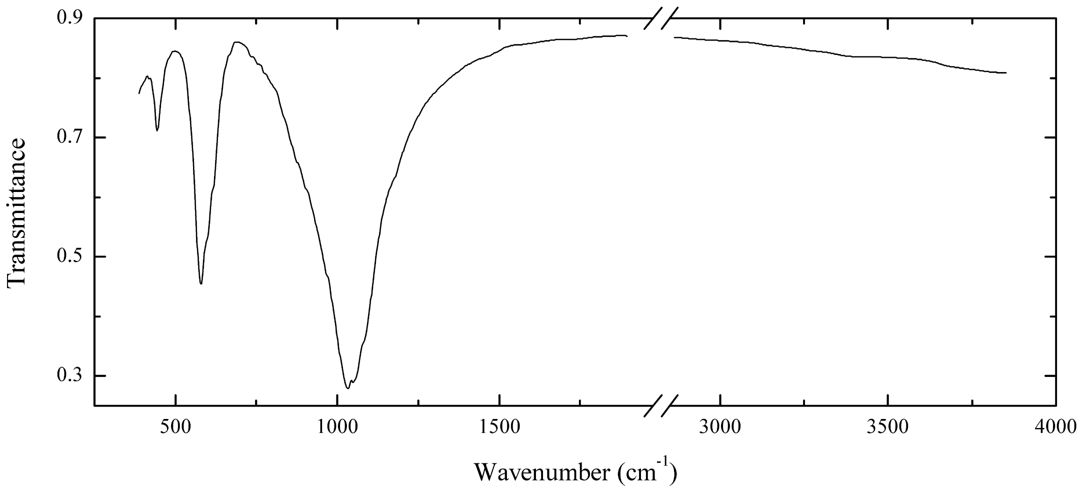


Locality: Viitaniemi pegmatite, Eräjärvi pegmatite field, Orivesi, Finland.

Description: Colourless grains from the association with eosphorite, fluorapatite, crandallite, montebrasite and morinite. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/m$; $a = 5.457(2)$, $b = 7.151(2)$, $c = 6.336(2)$ Å, $\beta = 109.36(3)°$, V = 251.68 Å^3, $Z = 2$. The empirical formula is $(Na_{0.91}K_{0.01})(Ca_{0.64}Mn^{2+}{}_{0.36}Fe^{2+}{}_{0.02}Mg_{0.02})Al_{1.07}P_{0.97}O_{4.11}[F_{1.57}(OH)_{1.33}]$. $D_{meas} = 3.245$ g/cm^3, $D_{calc} = 3.242$ g/cm^3. Optically biaxial (−), $\alpha = 1.557$,

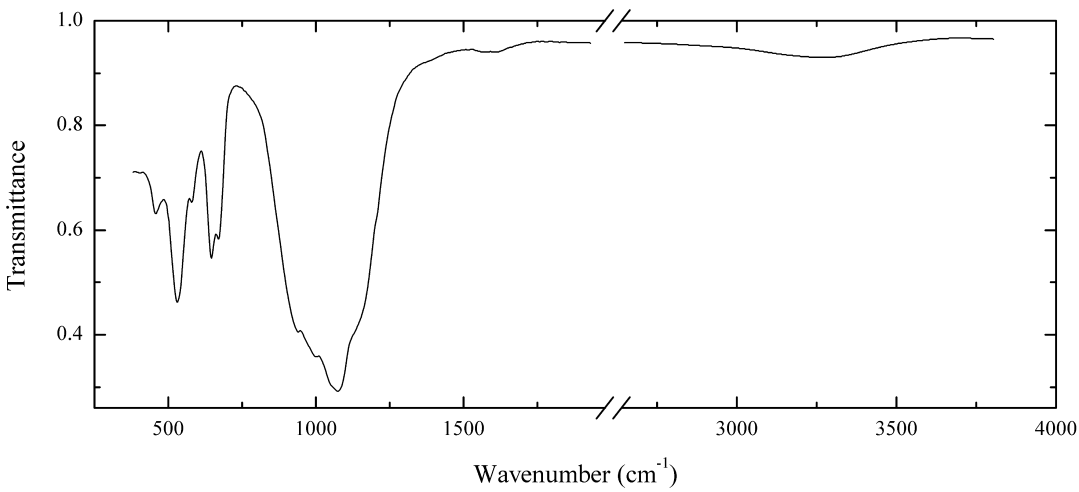
$\beta = 1.565, \gamma = 1.571, 2V_{meas} = -81°$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.883 (100), 2.937 (56), 3.223 (46), 2.160 (40), 2.569 (35), 4.885 (33), 1.915 (28).
Wavenumbers (cm^{-1}): 3337, 3000w, 1600w, 1183, 1095sh, 1054s, 985sh, 896w, 785w, 760sh, 657, 623, 592, 580, 535sh, 502, 478, 412.

P271 Triplite $Mn^{2+}_2(PO_4)F$



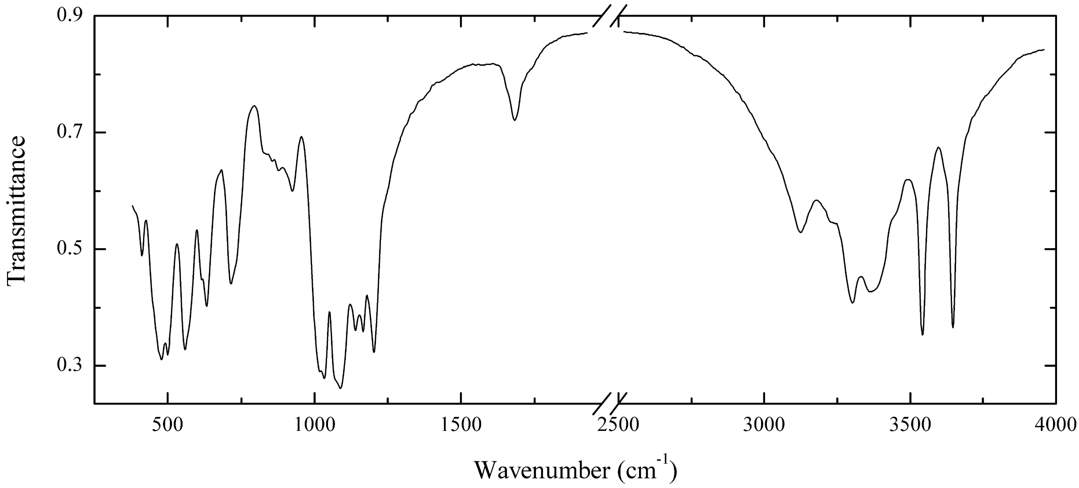
Locality: Viitaniemi pegmatite, Eräjärvi pegmatite, Orivesi, Finland.
Description: Crimson massive from the association with metavivianite and dufrenite. The empirical formula is (electron microprobe, OH calculated) $(Mn_{1.82}Fe_{0.16})(PO_4)_{1.00}[F_{0.98}(OH)_{0.02}]$.
Wavenumbers (cm^{-1}): 1160sh, 1080sh, 1055s, 1036s, 970sh, 615sh, 595sh, 578, 443.

P272 Sicklerite $Li_{1-x}(Mn^{2+},Fe^{3+})(PO_4)$



Locality: Tastyg deposit, Tuva Republic, Eastern Siberia, Russia.
Description: Brown massive from the association with albite and spodumene. The empirical formula is (electron microprobe) $Li_x(Mn_{0.77}Fe_{0.19})(PO_4)$.
Wavenumbers (cm^{-1}): 3360w, 1625w, 1205sh, 1077s, 1050sh, 1003s, 937s, 668, 644, 574, 528, 458.

P273 Senegalite $Al_2(PO_4)(OH)_3{\cdot}H_2O$

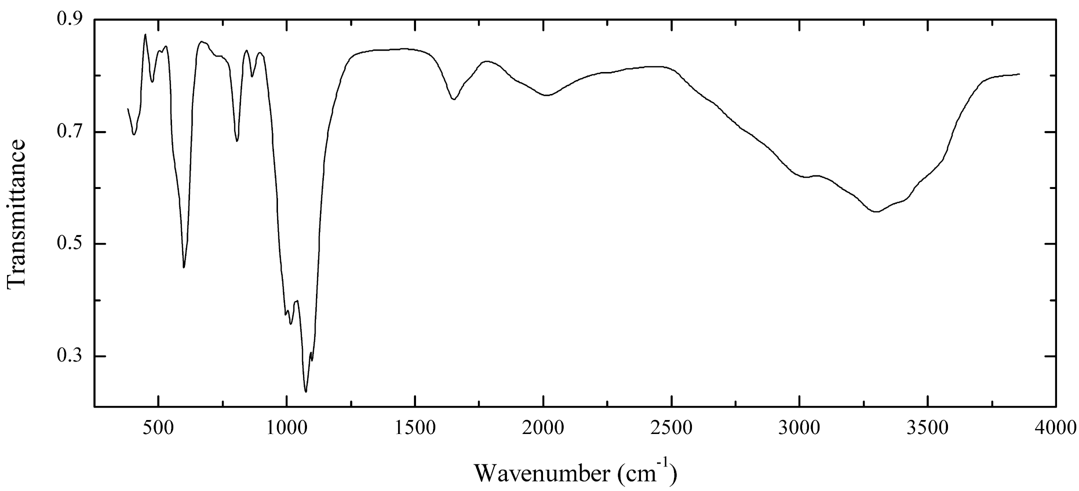


Locality: Kourou Diakouma (Kouroudiako) Mt., Saraya, Falémé River basin, Tambacounda region, Senegal (type locality).

Description: Colourless crystals from the association with turquoise and variscite. The empirical formula is (electron microprobe) $Al_{1.95}Fe_{0.07}(PO_4)_{1.00}(OH)_3{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3610, 3503, 3330, 3260, 3205sh, 3090, 1677, 1196s, 1162, 1137, 1083s, 1070sh, 1030s, 1014s, 925, 878, 857w, 835sh, 725sh, 712, 630, 610sh, 570sh, 555s, 495sh, 478s, 470sh, 440sh, 413.

P274 Rimkorolgite $Mg_5Ba(PO_4)_4{\cdot}8H_2O$

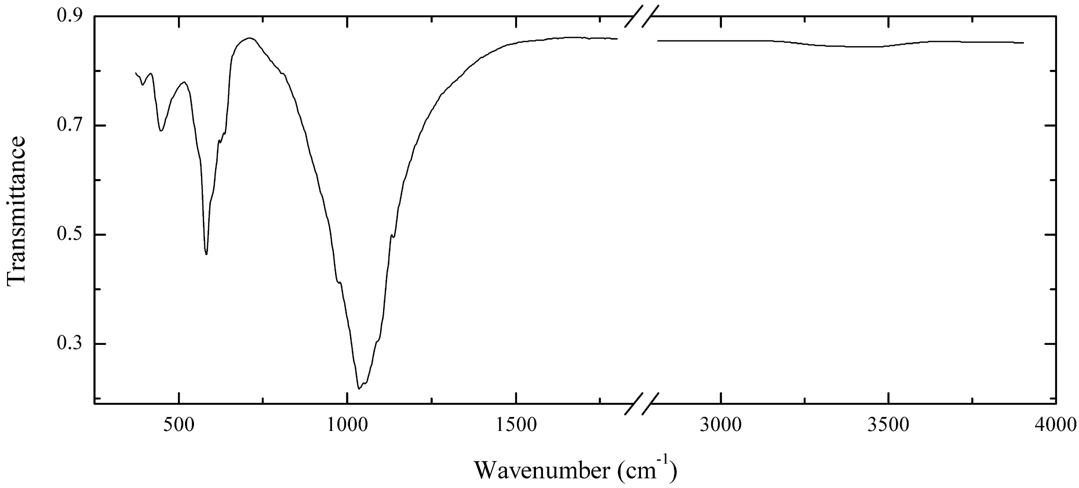


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Light brown prismatic crystals from dolomite carbonatite, from the association with collinsite, bobierrite, CO_3- and OH- rich fluorapatite and pyrite. Identified by IR spectrum. The band at 2,010 cm^{-1} indicates the presence of acid phosphate groups. The empirical formula is (electron microprobe) $H_x(Ba_{0.83}Sr_{0.09}Ca_{0.02})(Mg_{4.80}Fe_{0.11}Mn_{0.06})(PO_4)_{4.00}{\cdot}nH_2O$.

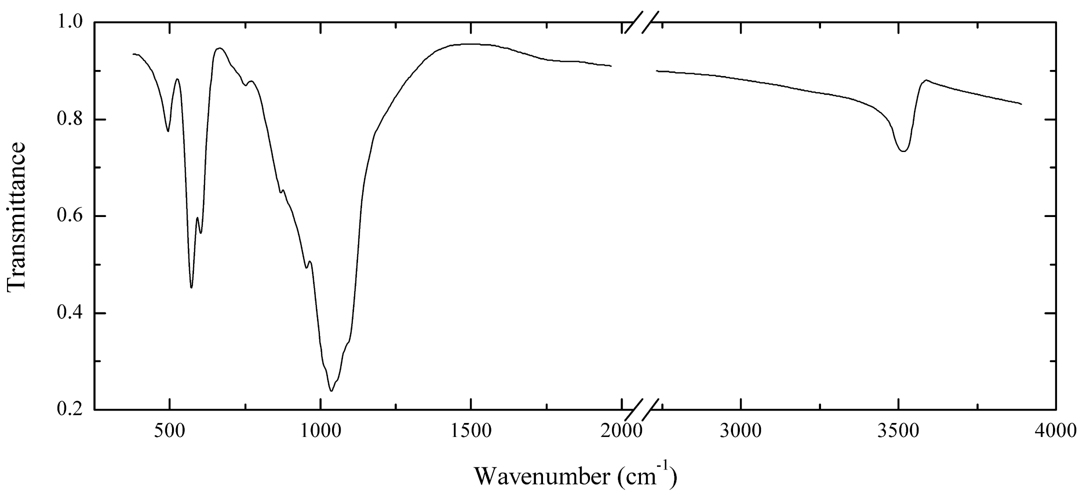
Wavenumbers (cm^{-1}): 3530sh, 3370sh, 3280, 3010, 2010, 1900sh, 1700sh, 1650, 1098s, 1072s, 1013s, 994s, 861, 803, 726w, 605sh, 594, 564sh, 535sh, 510w, 476, 420sh, 404.

P275 Triplite $Mn^{2+}_2(PO_4)F$



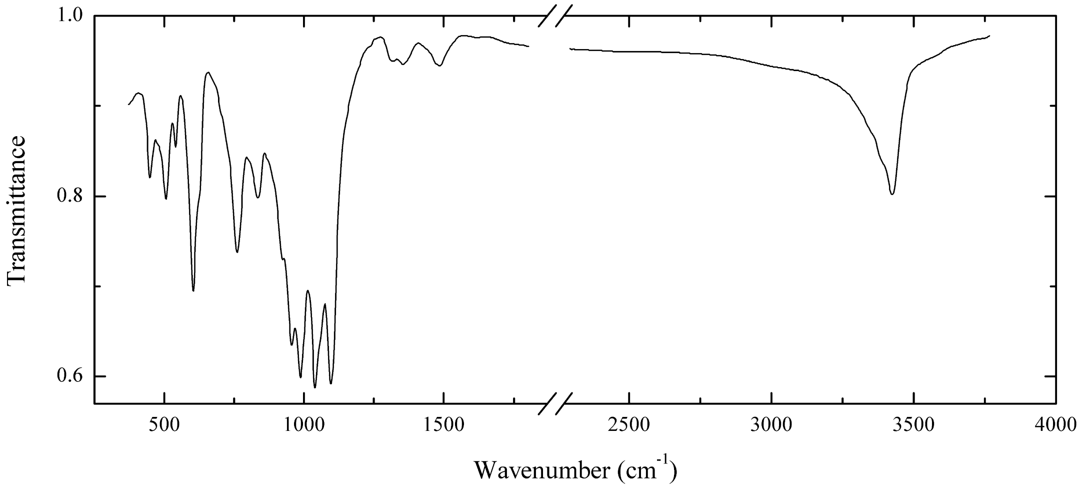
Locality: Viitaniemi pegmatite, Eräjärvi pegmatite field, Orivesi, Finland.
Description: Brownish-red massive from the association with microcline, elbaite, fluorapatite and lepidolite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Mn_{1.77}Fe_{0.23})(PO_4)_{1.00}F_{1.02}$.
Wavenumbers (cm^{-1}): 1137, 1095sh, 1059s, 1037s, 974, 632, 621, 595sh, 576, 550sh, 442, 400w.

P276 Triploidite $Mn^{2+}_2(PO_4)(OH)$



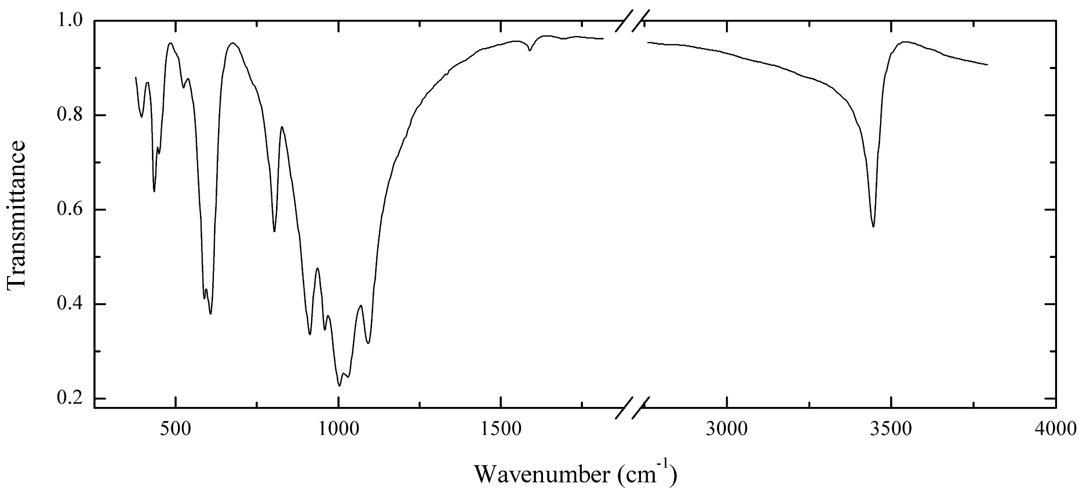
Locality: Kyrk-Bulak granite pegmatite, Turkestan range, Osh region, Kyrgyzstan.
Description: Brown massive. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3497, 1090sh, 1055sh, 1035s, 1010sh, 953, 920sh, 867, 752w, 599, 567, 490.

P277 Reichenbachite $Cu^{2+}_2(PO_4)_2(OH)_4$



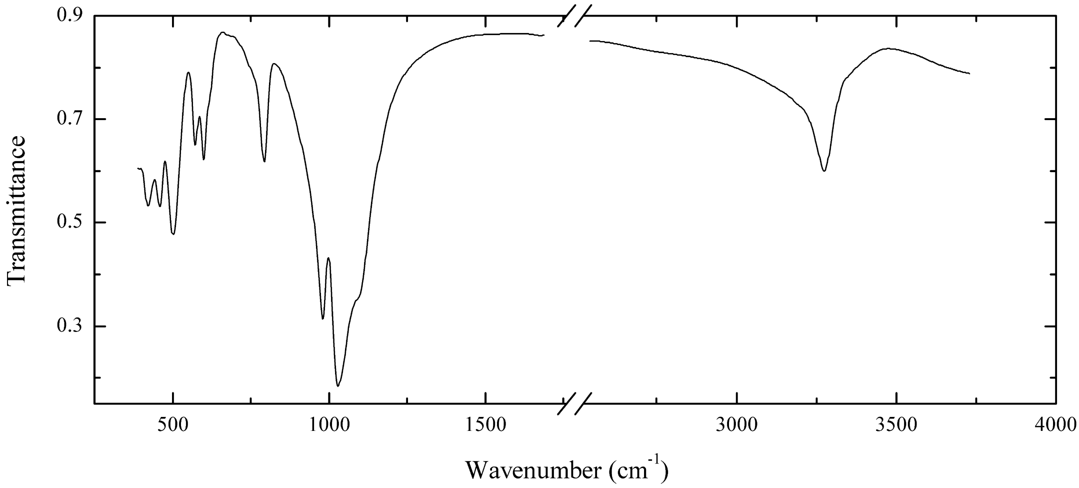
Locality: Kipushi mine, Kipushi, Katanga (Shaba), Democratic Republic of Congo (Zaïre).
Description: Green botryoidal crust from the association with kipushite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3395, 1485w, 1355w, 1315w, 1096s, 1040s, 988s, 957, 925, 838, 763, 615sh, 603, 545, 505, 449.

P278 Tarbuttite $Zn_2(PO_4)(OH)$



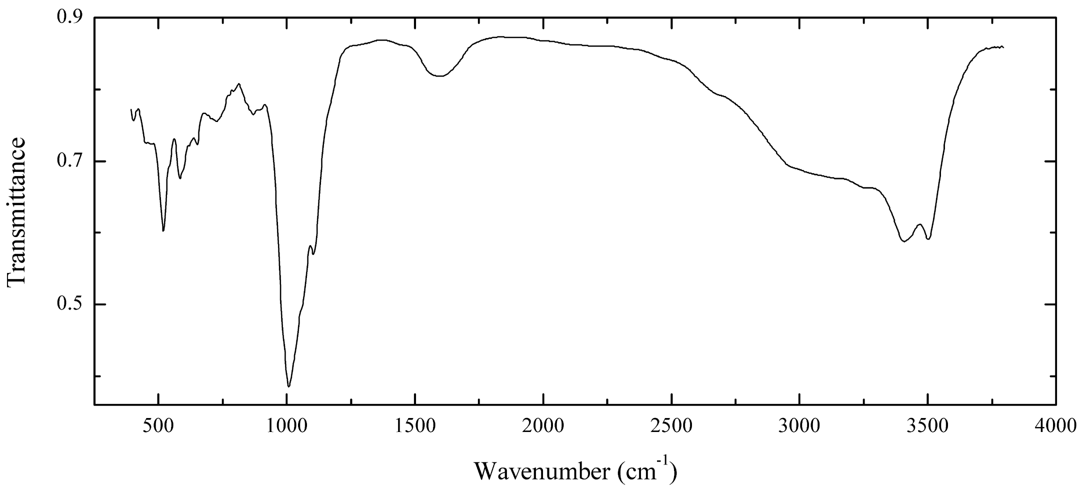
Locality: Kabwe (Broken Hill) mine, Kabwe (Broken Hill), Central province, Zambia (type locality).
Description: Colourless short-prismatic crystals from the association with scholzite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3440, 1700w, 1592w, 1093s, 1033s, 1004s, 959s, 914s, 805, 607, 586, 523w, 450, 433, 397w.

P279 Tavorite $LiFe^{3+}(PO_4)(OH,F)$



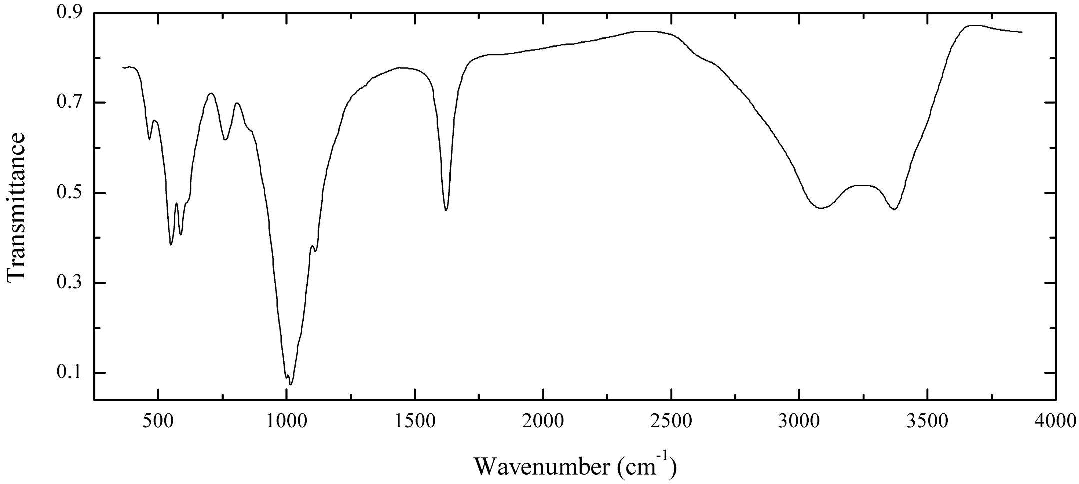
Locality: Tip Top pegmatite, near Custer, South Dakota, USA.
Description: Green massive, fine-grained aggregate. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3260, 1090sh, 1030s, 983s, 794, 615sh, 597, 571, 500, 456, 419.

P280 Ferristrunzite $Fe^{3+}Fe^{3+}{}_2(PO_4)_2(OH)_3{\cdot}5H_2O$



Locality: B224 Road cut, Aprath castle, Wuppertal, North Rhine-Westphalia, Germany.
Description: Straw-yellow acicular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3470, 3380, 3230, 3120sh, 2950sh, 2660sh, 1610, 1555, 1104, 1060sh, 1020sh, 1005s, 985sh, 866, 724, 649, 584, 517, 450w.

P281 Phosphosiderite $Fe^{3+}(PO_4)\cdot 2H_2O$

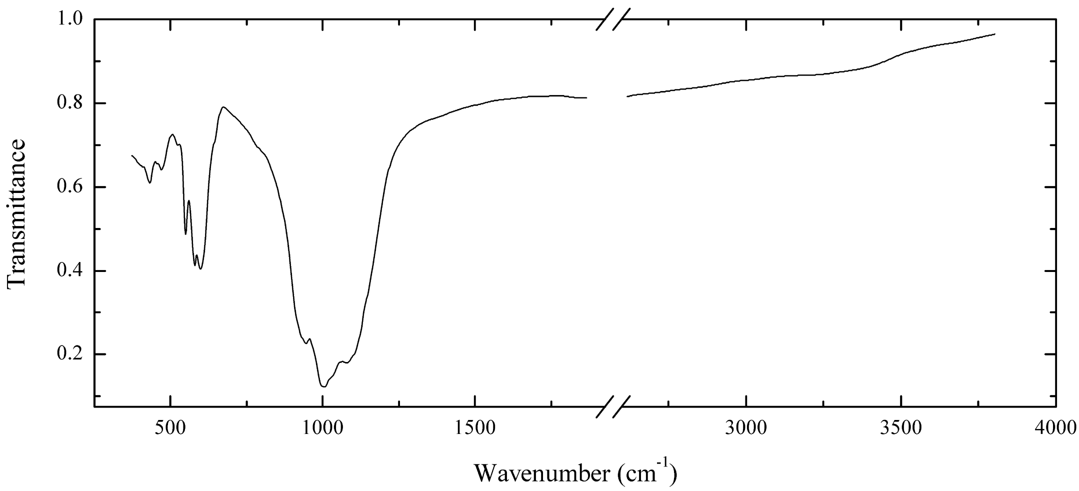


Locality: Folgosinho, Gouveia, Guarda district, Portugal.

Description: Brownish platy crystals from the association with strengite and benyacarite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Fe_{0.95}Mg_{0.03}Mn_{0.01})(PO_4)_{1.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3490sh, 3370, 3085, 2660sh, 1630, 1117, 1016s, 1000s, 850sh, 760, 605sh, 582, 545, 460.

P282 Ferroalluaudite $Na\square(Fe^{2+},Mn^{2+})Fe^{3+}_2(PO_4)_3$

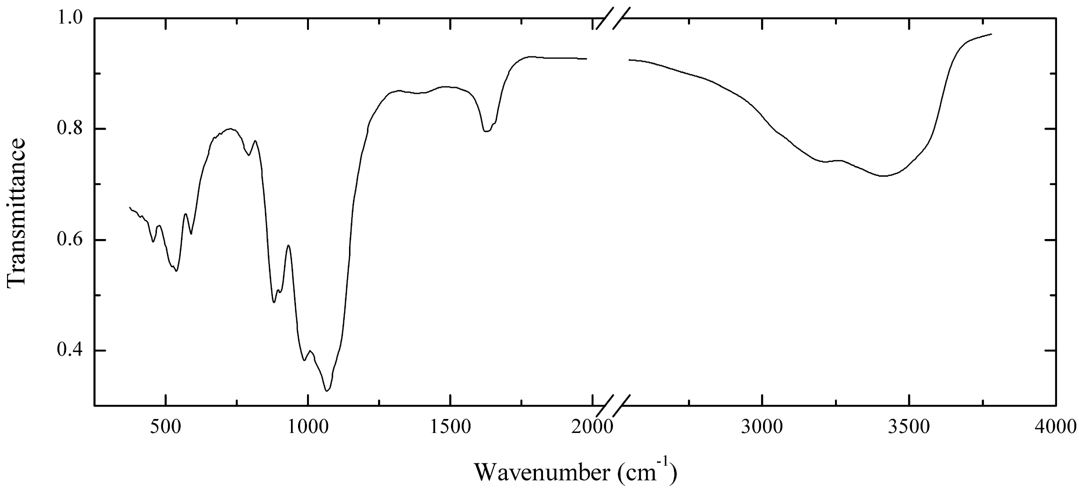


Locality: Rånö, Södermanland, Sweden.

Description: Very dark blue, massive. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1100sh, 1077s, 1040sh, 1002s, 943s, 596, 578, 548, 518w, 470, 430.

P283 Phosphuranylite $KNa(H_2O)_3(UO_2)_7(PO_4)_4O_4{\cdot}8H_2O$ (?)

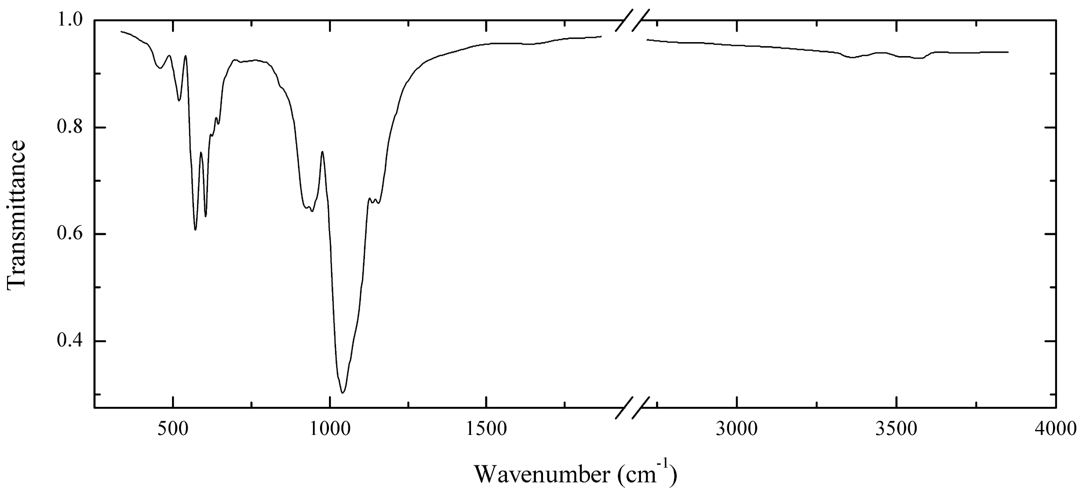


Locality: An unknown locality in Kazakhstan.

Description: Original material of structural investigation (Shashkin D.P., Sidorenko G.A. Doklady Akademii Nauk SSSR, 1975, vol. 220, pp. 1161–1164, in Russian).

Wavenumbers (cm^{-1}): 3510sh, 3400, 3200sh, 1655sh, 1628, 1395w, 1110sh, 1069s, 987s, 902, 878, 789w, 588, 538, 522, 450.

P284 Fluorapatite $Ca_5(PO_4)_3F$

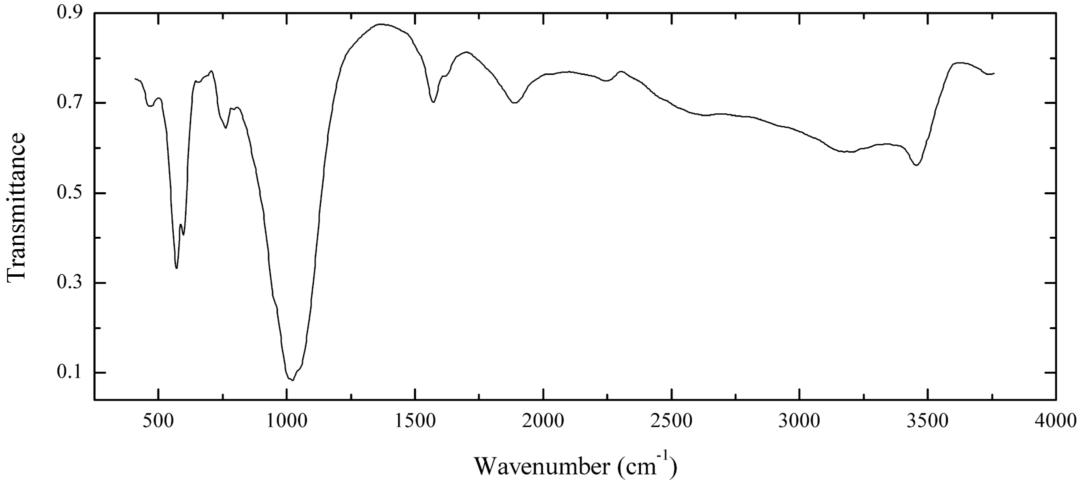


Locality: Shishimskie Mts., South Urals, Russia.

Description: Yellow crystal from the association with calcite, magnetite, clinochlore and vesuvianite. Si- and S-rich variety. The empirical formula is (electron microprobe, OH calculated) $(Ca_{4.94}Na_{0.08}Mn_{0.02})[(PO_4)_{2.17}(SiO_4)_{0.46}(SO_4)_{0.37}]F_{0.7}Cl_{0.15}(OH)_{0.15}$. The IR spectrum confirms the presence of SO_4^{2-} (the bands at 1,153, 1,137, 646 and 625 cm^{-1}) and SiO_4^{4-} (the bands at 947, 926 and 519 cm^{-1}).

Wavenumbers (cm^{-1}): 3540w, 3330w, 1153, 1137, 1085sh, 1040s, 960sh, 947, 926, 646, 625, 603, 572, 519, 460.

P285 Phosphoferrite $Fe^{2+}Fe^{2+}{}_2(PO_4)_2 \cdot 3H_2O$

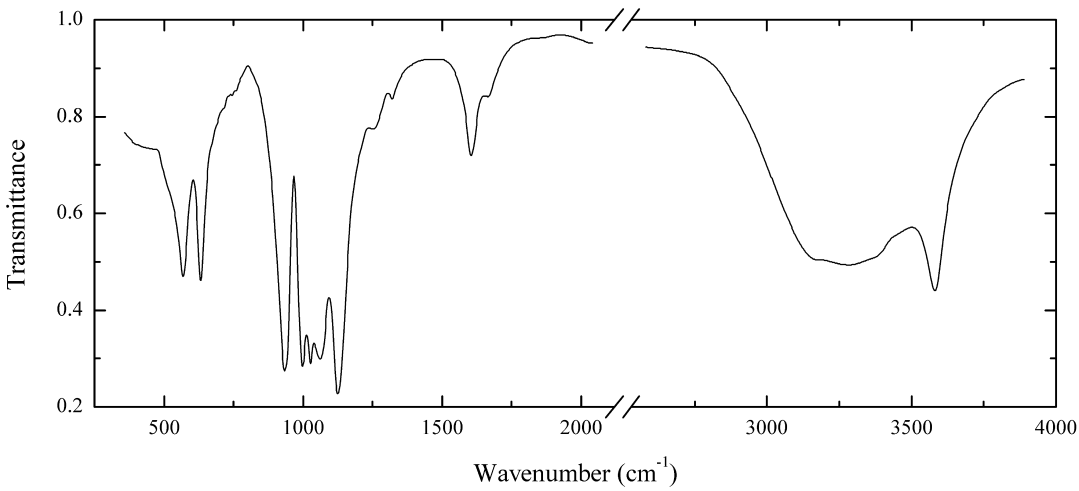


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Dark brownish-green massive from the association with ludlamite.

Wavenumbers (cm^{-1}): 3460, 3190, 2650, 2250w, 1890, 1625w, 1577, 1050sh, 1022s, 1010sh, 955sh, 765, 750sh, 660w, 597, 570, 470.

P286 Phosphophyllite $Zn_2(Fe^{2+},Mn^{2+})(PO_4)_2 \cdot 4H_2O$

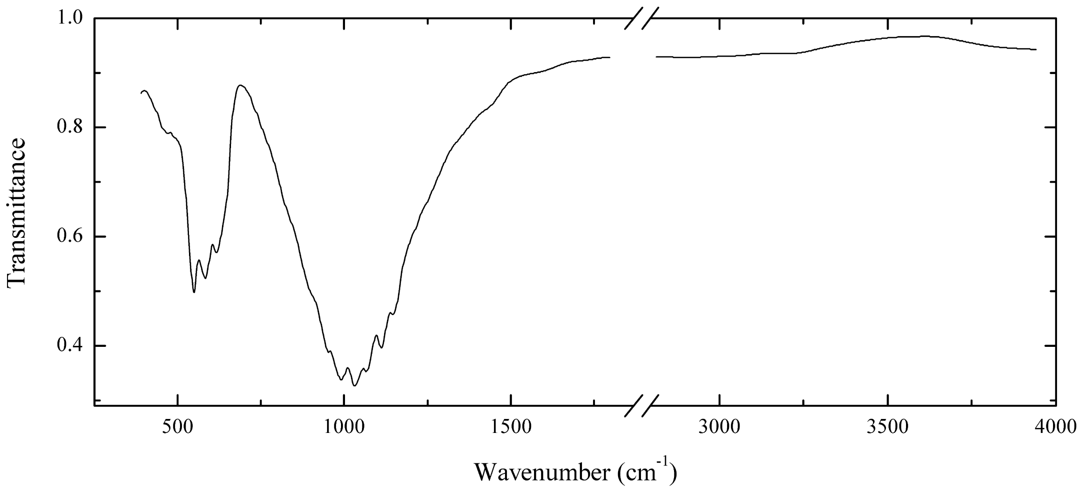


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Pale green crystals. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3565, 3250, 3145, 1667w, 1607, 1323w, 1252w, 1131s, 1068s, 1032s, 1002s, 938s, 636, 573, 525sh.

P287 Fillowite $Na_2Ca(Mn^{2+},Fe^{2+})_7(PO_4)_6$

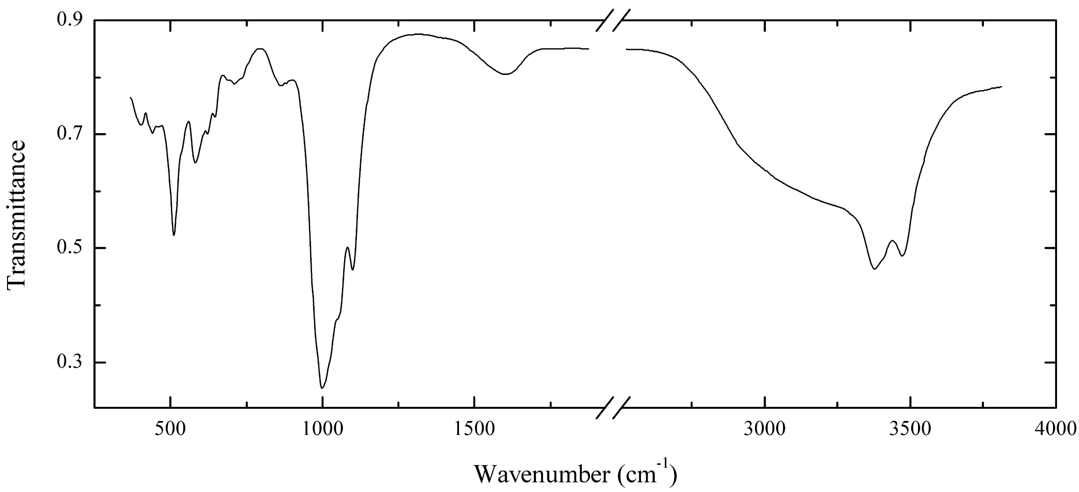


Locality: Ankole pegmatite field, Kabira, Mbarara district, Uganda.

Description: Brown massive. Identified by IR spectrum. The empirical formula is (electron microprobe) $Na_{2.02}(Ca_{0.92}Mn_{0.08})(Mn_{3.52}Fe_{3.32}Mg_{0.15})(PO_4)_{6.00}$.

Wavenumbers (cm^{-1}): 1149, 1117s, 1069s, 1036s, 991s, 955s, 940sh, 905sh, 645sh, 619, 584, 551, 495sh, 476w.

P288 Ferristrunzite $Fe^{3+}Fe^{3+}_2(PO_4)_2(OH)_3\cdot 5H_2O$

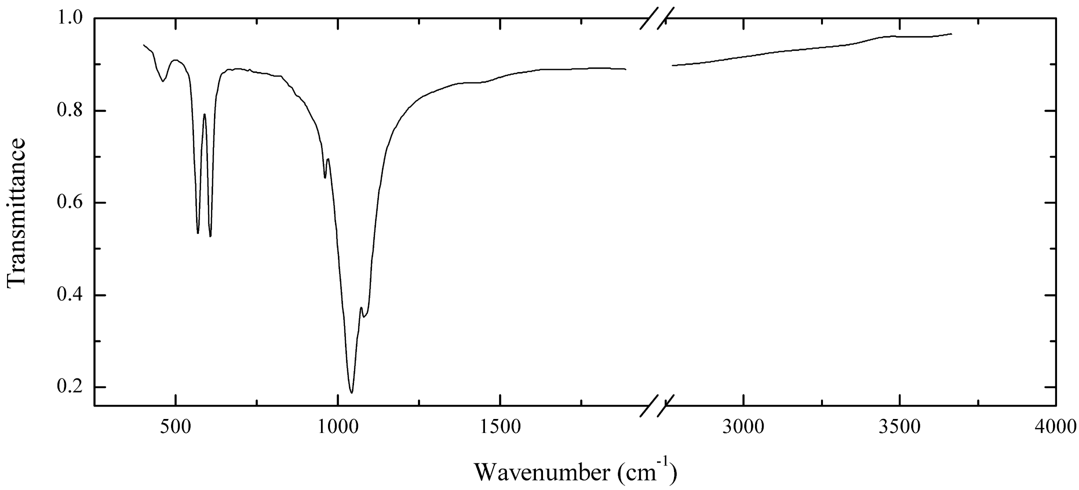


Locality: Blaton, Hainault, Belgium (type locality).

Description: Straw-yellow radial aggregates. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3465, 3365, 3150sh, 1615, 1103s, 1060sh, 1003s, 871, 722, 649, 622, 585, 513, 473, 442.

P289 Fluorapatite $Ca_5(PO_4)_3F$

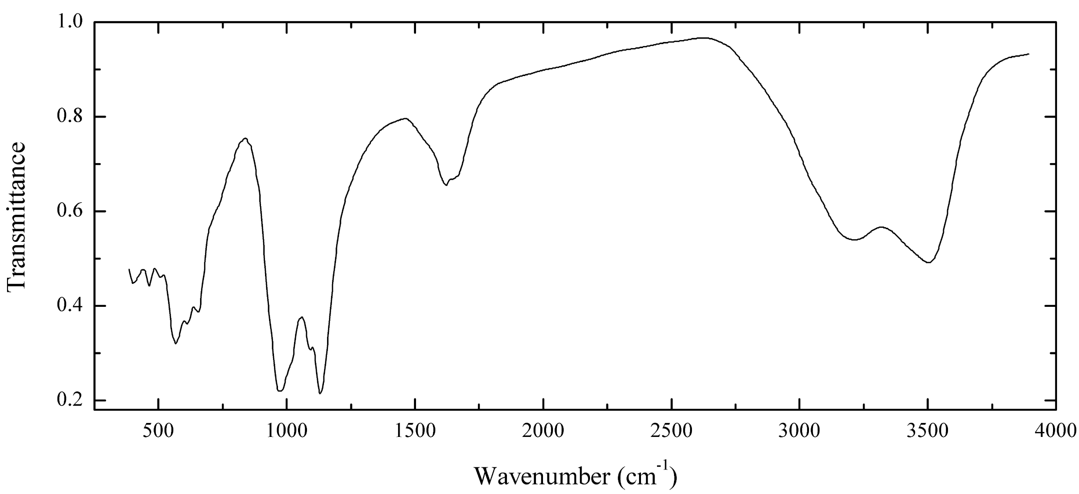


Locality: Aldan shield, Siberia, Russia.

Description: Green crystal. The empirical formula is (electron microprobe) $(Ca_{4.93}Na_{0.08})[(PO_4)_{2.94}(SO_4)_{0.06}]F_{1.0}$.

Wavenumbers (cm^{-1}): 1088s, 1080s, 1043s, 1030sh, 961, 606, 568, 474.

P290 Whiteite-(CaFeMg) $CaFe^{2+}Mg_2Al_2(PO_4)_4(OH)_2 \cdot 8H_2O$

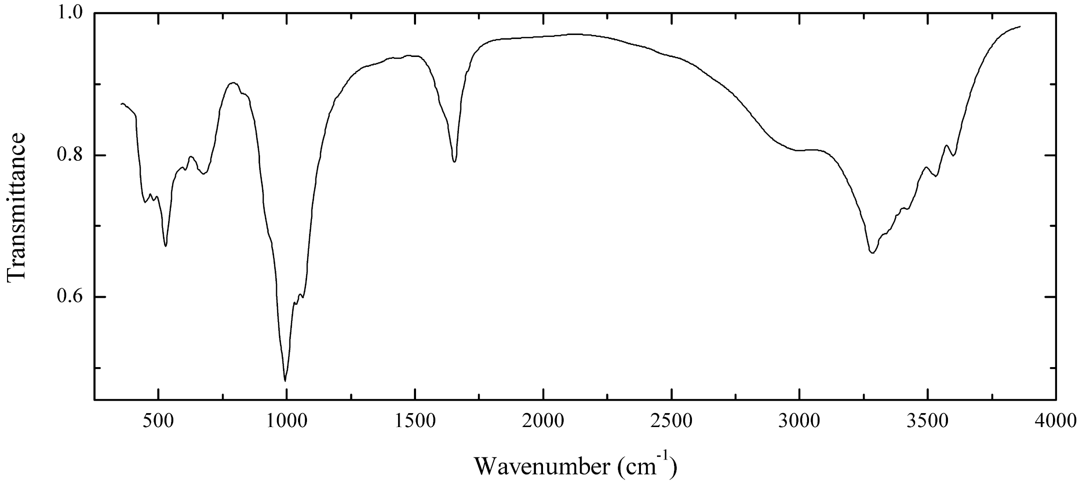


Locality: Rapid Creek, Dawson mining district, Yukon territory, Canada.

Description: Light brown tabular crystal. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $(Ca_{0.96}Na_{0.07})(Fe_{0.98}Ca_{0.02})(Mg_{1.81}Fe_{0.19})(Al_{1.96}Fe_{0.04})(PO_4)_{4.00}(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3510, 3210, 1650sh, 1625, 1550, 1133s, 1096s, 1015sh, 979s, 730sh, 657, 617, 568, 510, 465, 397.

P291 Ushkovite $MgFe^{3+}_2(PO_4)_2(OH)_2{\cdot}8H_2O$

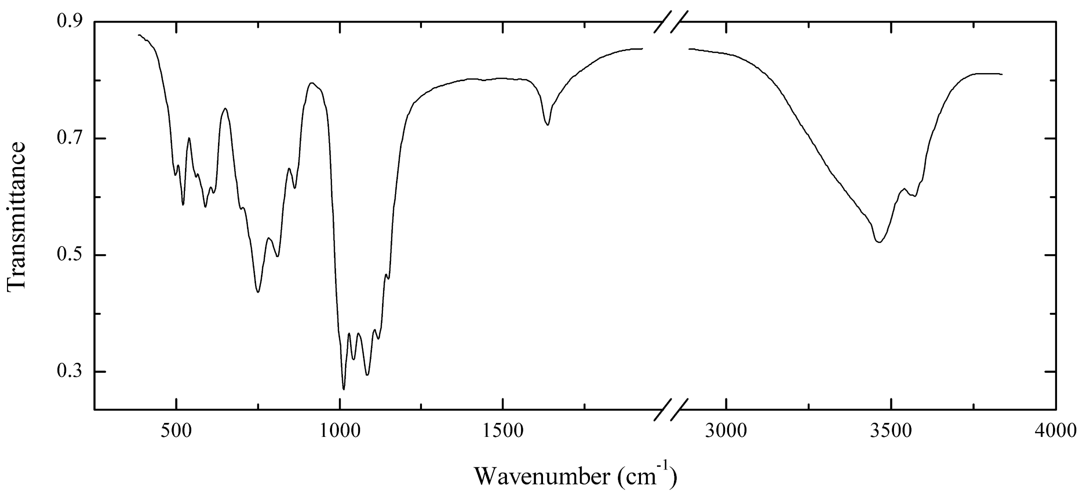


Locality: Linópolis, Divino das Laranjeiras, Minas Gerais State, Brazil.

Description: Orange split crystals from the association with albite, quartz, lepidolite, beryllonite, moraesite and atencioite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Mg_{1.00}(Fe_{1.99}Al_{0.01})(PO_4)_{2.00}(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3575, 3510, 3400, 3315sh, 3265, 2980, 1650, 1610sh, 1065s, 1043s, 995s, 980sh, 930sh, 830sh, 680, 615, 529, 480, 452.

P292 Uralolite $Ca_2Be_4(PO_4)_3(OH)_3{\cdot}5H_2O$

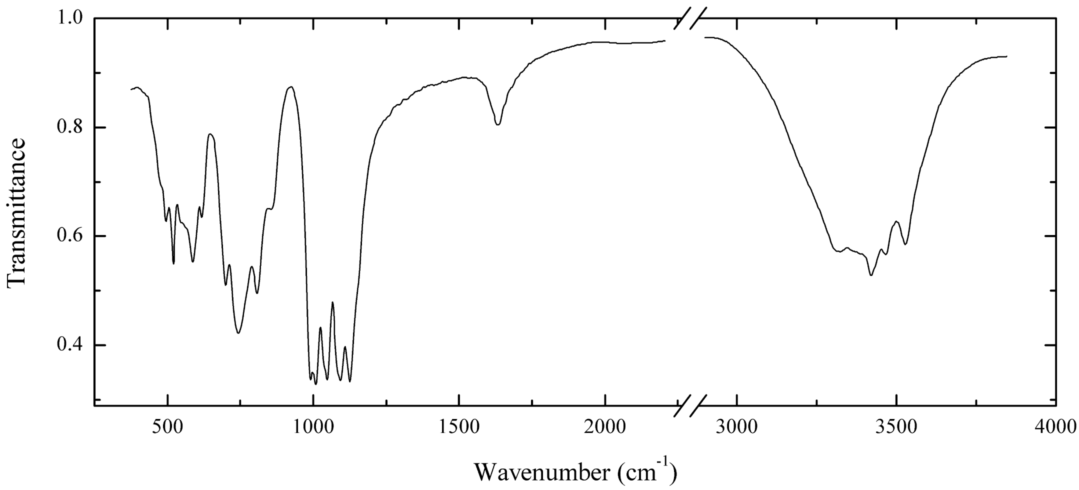


Locality: Boevskoe Be deposit, Kamensk-Ural'skii, Chelyabinsk region, South Urals, Russia (type locality).

Description: White spherulites with radial structure from the association with crandallite, moraesite and apatite. Identified by IR spectrum. Contains little admixture of glucine.

Wavenumbers (cm^{-1}): 3545, 3450, 3350sh, 1638, 1148, 1119s, 1085s, 1045s, 1012s, 995sh, 862, 808, 749, 700, 614, 589, 560, 520, 497.

P293 Uralolite $Ca_2Be_4(PO_4)_3(OH)_3{\cdot}5H_2O$

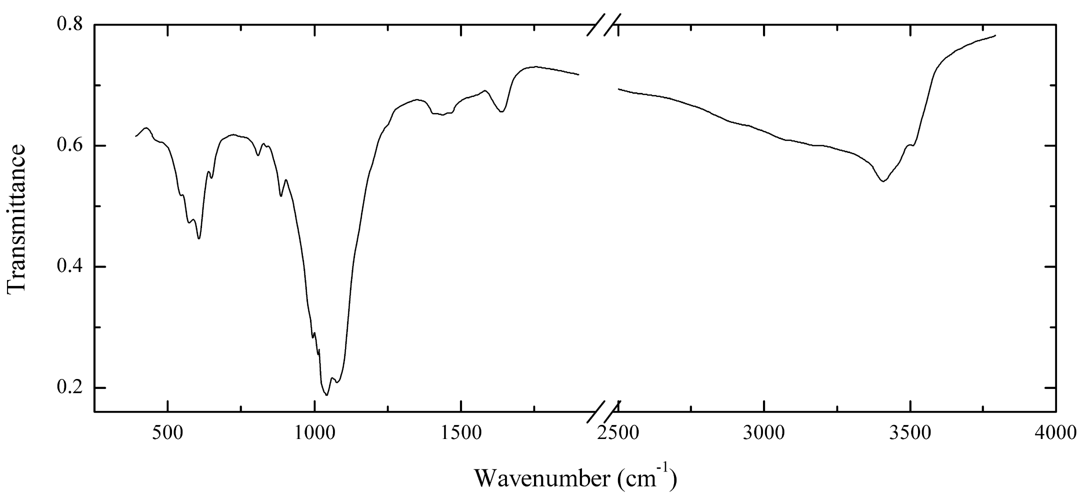


Locality: Boevskoe Be deposit, Kamensk-Ural'skii, Chelyabinsk region, South Urals, Russia (type locality).

Description: Brownish-yellow acicular crystals from the association with crandallite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3570sh, 3520, 3460, 3415, 3370sh, 3315, 1640, 1160sh, 1127s, 1096s, 1090sh, 1049s, 1040sh, 1010s, 992s, 856, 810, 796, 700, 618, 587, 550sh, 521, 495, 480sh.

P294 Ulrichite $CaCu^{2+}(UO_2)(PO_4)_2{\cdot}4H_2O$

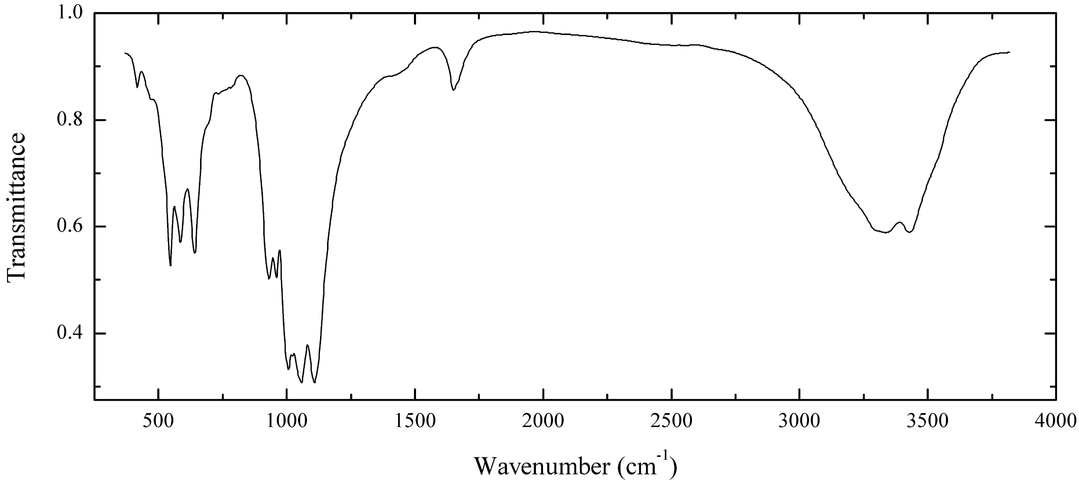


Locality: Lake Boga granite quarry, Victoria, Australia (type locality).

Description: Light green acicular crystals.

Wavenumbers (cm^{-1}): 3520, 3425, 1650, 1630sh, 1465w, 1440w, 1405w, 1145sh, 1090sh, 1078s, 1045s, 1035sh, 1012s, 994s, 888, 806, 648, 604, 566, 540, 470sh.

P295 Scholzite $CaZn_2(PO_4)_2{\cdot}2H_2O$

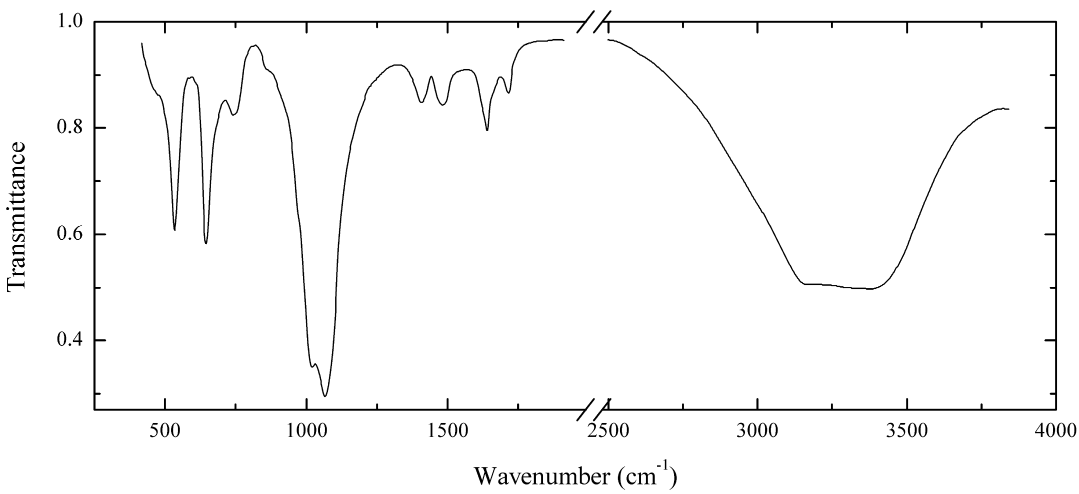


Locality: Reaphook Hill, Martins Well, South Flinders Ranges, South Australia, Australia.

Description: Radial aggregate of colourless flattened prismatic crystals. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{0.95}Zn_{1.97}Mg_{0.04}Mn_{0.02}Fe_{0.01}(PO_4)_{2.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3420, 3325, 3250sh, 1655w, 1110s, 1055s, 1024, 1006s, 960, 931, 770w, 690sh, 639, 585, 544, 416w.

P296 Churchite-(Y) $Y(PO_4)_2{\cdot}2H_2O$

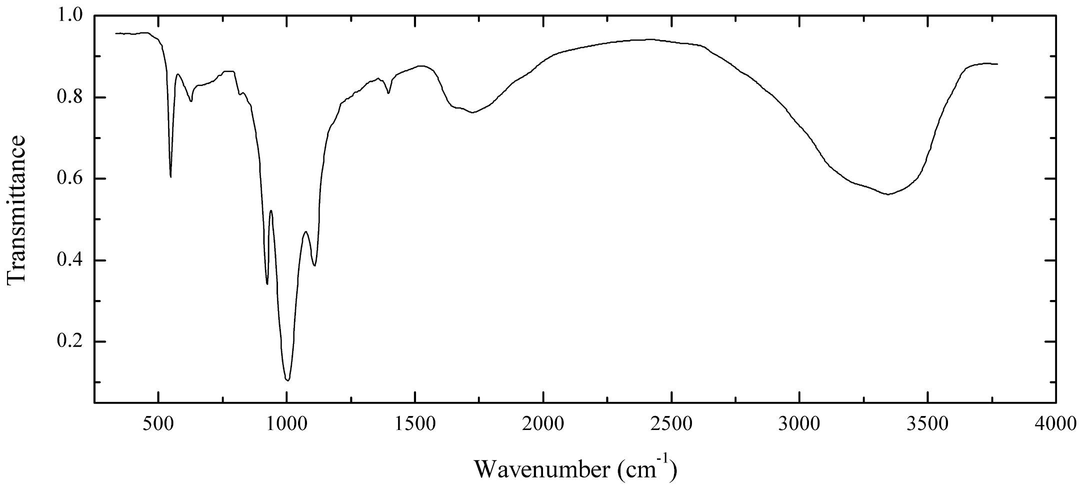


Locality: Svetlinskii pegmatite quarry, Svetlyi, near Plast, Kochkar' district, Chelyabinsk region, South Urals, Russia.

Description: Pink spherulitic crust from the association with lithiophorite. Confirmed by IR spectrum and qualitative electron microprobe analysis. CO_3^{2-}-bearing variety.

Wavenumbers (cm^{-1}): 3360, 3150, 1715, 1640, 1480, 1460sh, 1405, 1065s, 1018s, 973, 860w, 747, 644, 530, 470sh.

P297 Chernikovite $(H_3O)(UO_2)(PO_4)\cdot 3H_2O$

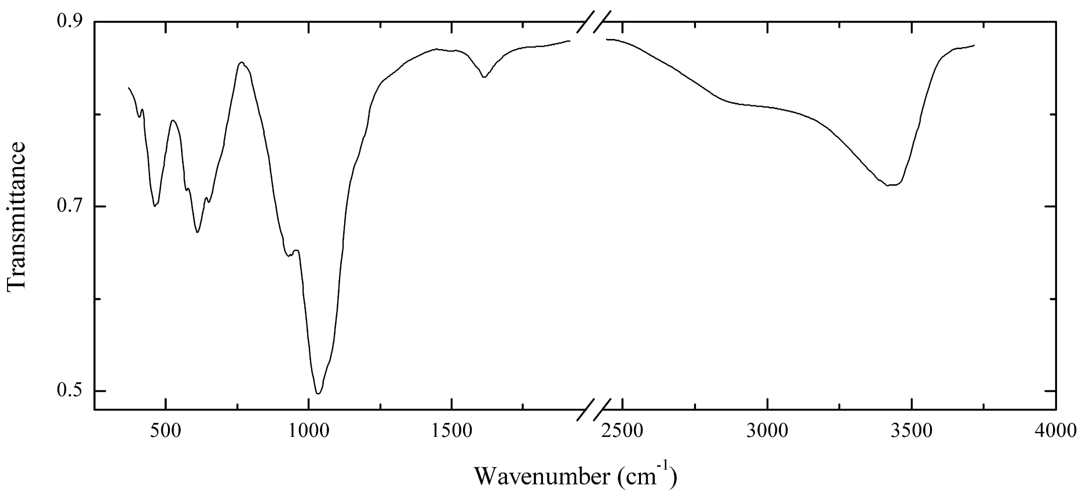


Locality: Djedeli U deposit, Kazakhstan.

Description: Yellow platy crystal. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $(H_3O)_xCa_{0.12}Na_{0.08}(UO_2)_{1.15}[(PO_4)_{0.97}(AsO_4)_{0.03}]\cdot nH_2O$. The hydronium cations are partly dissociated: the bands at 1,730 and 1,402 cm^{-1} correspond to H_3O^+ and H^+, respectively.

Wavenumbers (cm^{-1}): 3350, 3230sh, 1730, 1675, 1402ww, 1113s, 1006s, 925s, 824w, 680sh, 627, 545, 465w.

P298 Childrenite $Fe^{2+}Al(PO_4)(OH)_2\cdot H_2O$

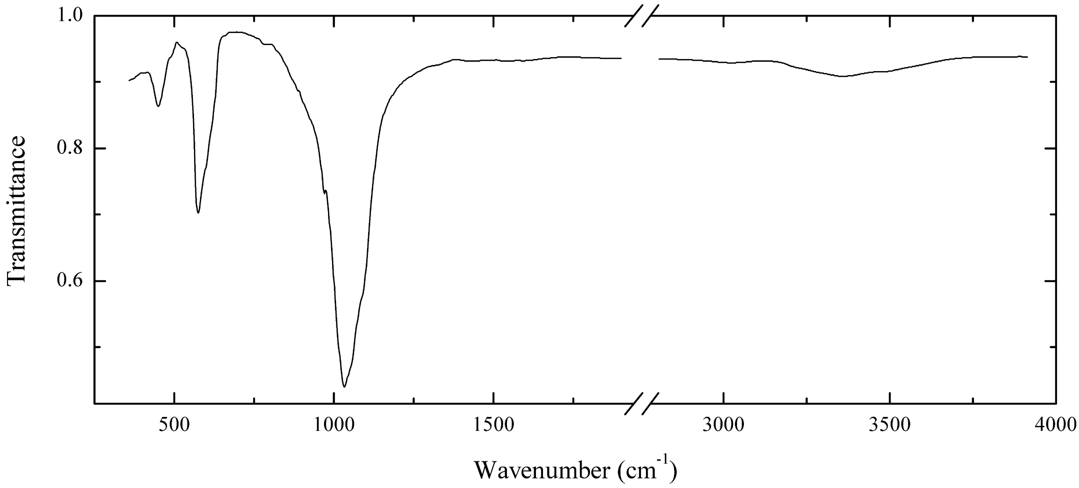


Locality: Palermo No. 1 mine, Groton, Grafton Co., New Hampshire, USA.

Description: Yellow crystal. The empirical formula is (electron microprobe) $(Fe_{0.56}Mn_{0.42}Mg_{0.05})(Al_{0.97}Fe_{0.03})(PO_4)_{1.00}(OH)_2\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3420, 2900sh, 1614w, 1175sh, 1075sh, 1033s, 940s, 656, 611, 572, 470, 380w.

P299 Zwieselite $(Fe^{2+},Mn)_2(PO_4)F$

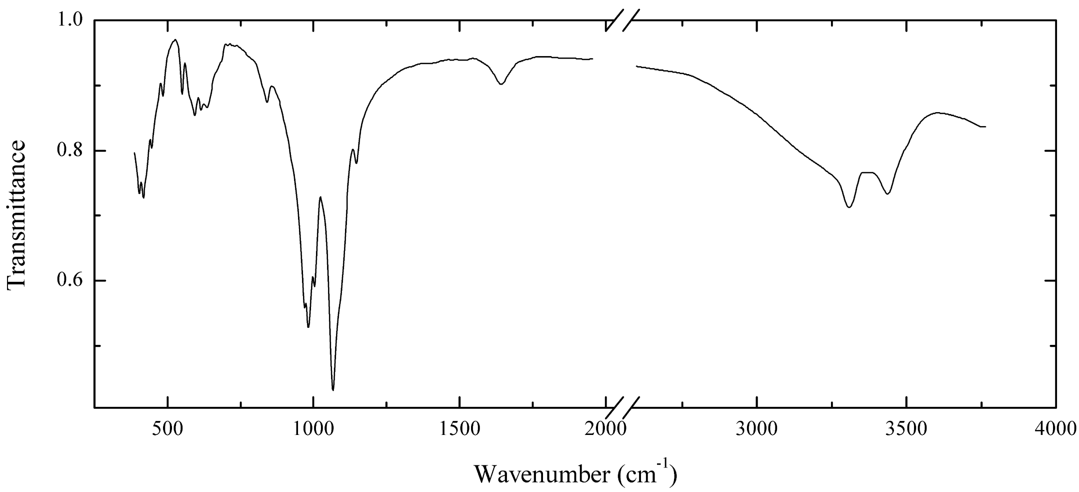


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Orange-brown grain. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Fe_{1.01}Mn_{0.84}Mg_{0.03}Ca_{0.04})(PO_4)_{1.00}[F_{0.95}(OH)_{0.05}]$.

Wavenumbers (cm^{-1}): 3320w, 1090sh, 1055sh, 1039s, 972, 615sh, 579, 454.

P300 Leucophosphite $NaFe^{3+}{}_2(PO_4)_2(OH)\cdot 2H_2O$

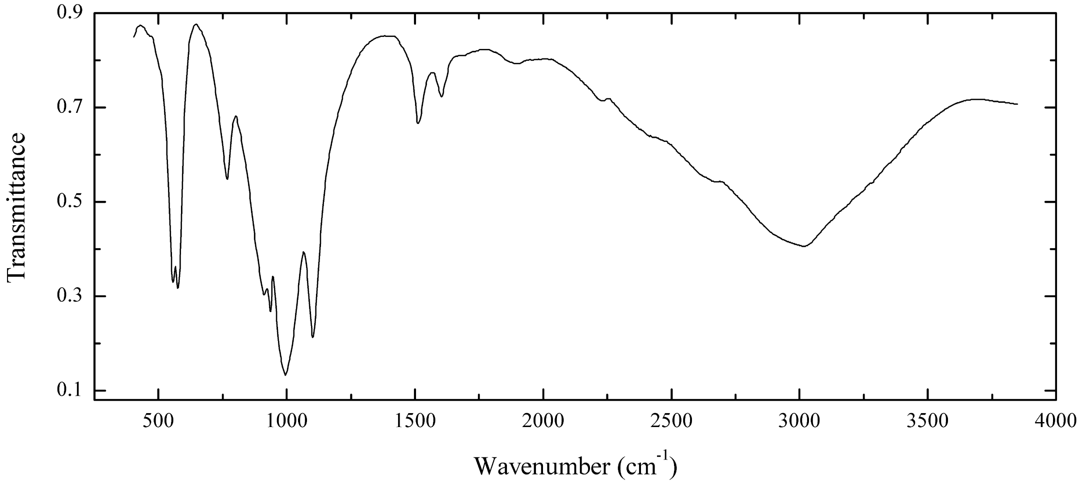


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Yellow crystals. Identified by IR spectrum and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3447, 3315, 3230sh, 1650w, 1152, 1090sh, 1069s, 1007s, 984s, 969s, 843w, 680sh, 637, 615, 592, 580sh, 551, 485w, 445, 421, 400.

P301 Hillite $Ca_2(Zn, Mg)(PO_4)_2{\cdot}2H_2O$

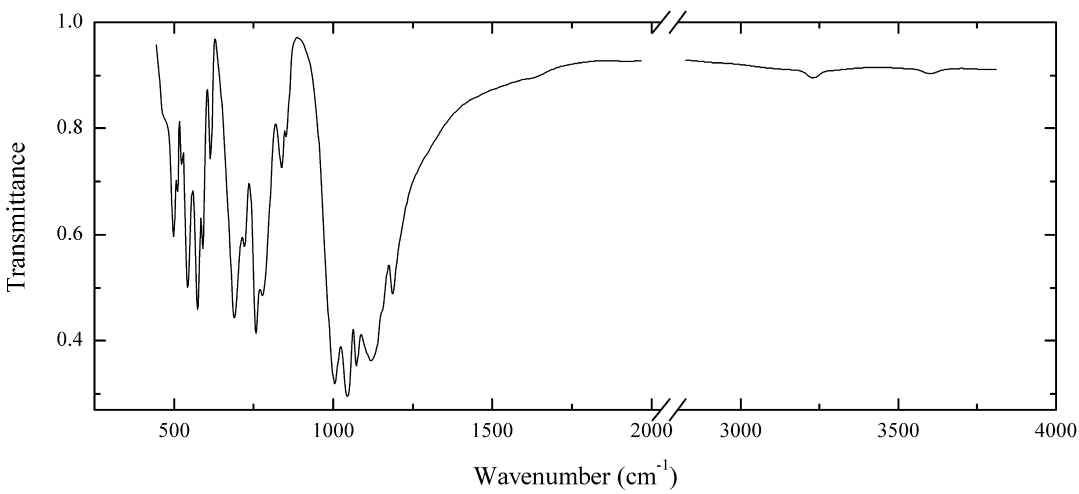


Locality: Reaphook Hill, near Blinman, about 100 km northeast of Hawker, Flinger Ranges, South Australia (type locality).

Description: Zone within kidney-like aggregate of zincian collinsite. Holotype sample. Associated minerals are scholzite, parahopeite, cryptomelane and goethite The crystal structure is solved. Triclinic, space group *P*-1, $a = 5.736(1)$, $b = 6.767(2)$, $c = 5.462(1)$ Å, $\alpha = 97.41(2)°$, $\beta = 108.59(2)°$, $\gamma = 107.19(2)°$, $V = 186.03(8)$ Å^3, $Z = 1$. The empirical formula is $(Ca_{1.91}Na_{0.01})_{1.92}(Zn_{0.64}Mg_{0.39})_{1.03}P_{2.02}O_8{\cdot}2H_2O$. $D_{meas} = 3.16(2)$ g/cm^3, $D_{calc} = 3.165$ g/cm^3. Optically biaxial (+), $\alpha = 1.6348(3)$, $\beta = 1.6495(5)$, $\gamma = 1.6686(3)$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.24 (34) (010), 3.230 (22) (1-10), 3.130 (37) (020), 3.038 (40) (101), 2.690 (100) (-121), 2.230 (14) (-130).

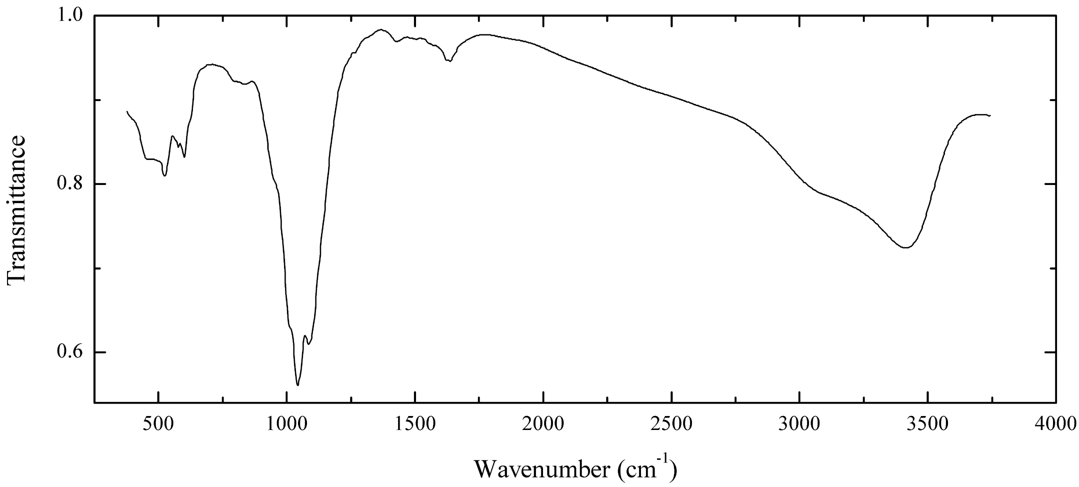
Wavenumbers (cm^{-1}): 3020, 2680, 2450sh, 2230w, 1900w, 1603w, 1513, 1103s, 996s, 940s, 915, 771, 685sh, 578, 559.

P302 Hurlbutite $CaBe_2(PO_4)_2$



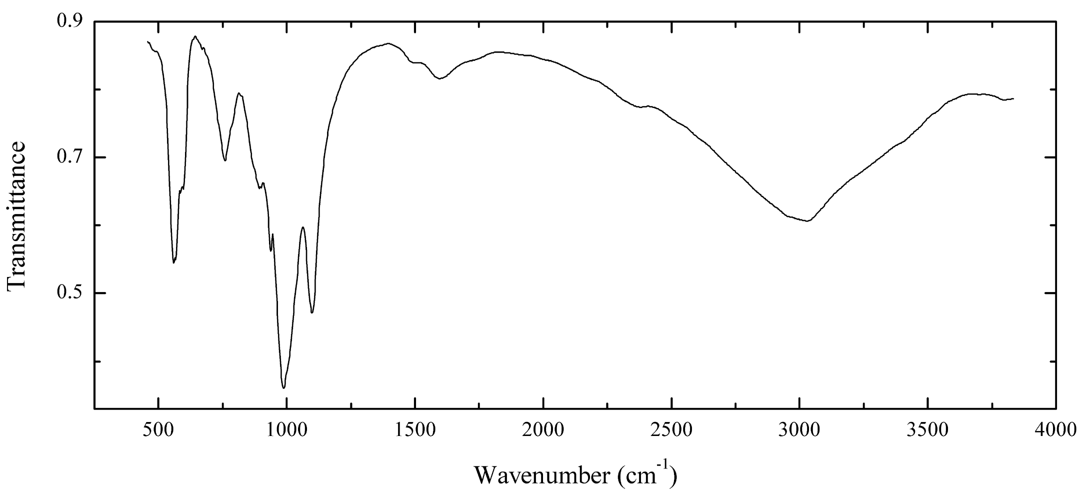
Locality: Viitaniemi pegmatite, Eräjärvi pegmatite, Orivesi, Finland.
Description: Beige fine-grained (porcelain-like) aggregate. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3600w, 3210w, 1192, 1155, 1123s, 1074s, 1043s, 1004s, 852, 837, 774, 754, 718, 687, 612, 589, 571, 540, 521w, 510, 495, 470sh.

P303 Chalcosiderite $Cu^{2+}Fe^{3+}{}_6(PO_4)_4(OH)_8{\cdot}4H_2O$



Locality: Huber Stock, Krásno, Horní Slavkov, Karlovy Vary region, Bohemia, Czech Republic.
Description: Green grains from the association with isokite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Cu_{0.88}Zn_{0.03}Ca_{0.03})(Fe_{4.84}Al_{1.11}Sc_{0.09})[(PO_4)_{3.90}(AsO_4)_{0.10}](OH)_8{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3410, 3100sh, 1630w, 1424w, 1091s, 1046s, 1015sh, 950sh, 837w, 802w, 620sh, 577, 523, 465sh.

P304 Fairfieldite $Ca_2Mn^{2+}(PO_4)_2{\cdot}2H_2O$

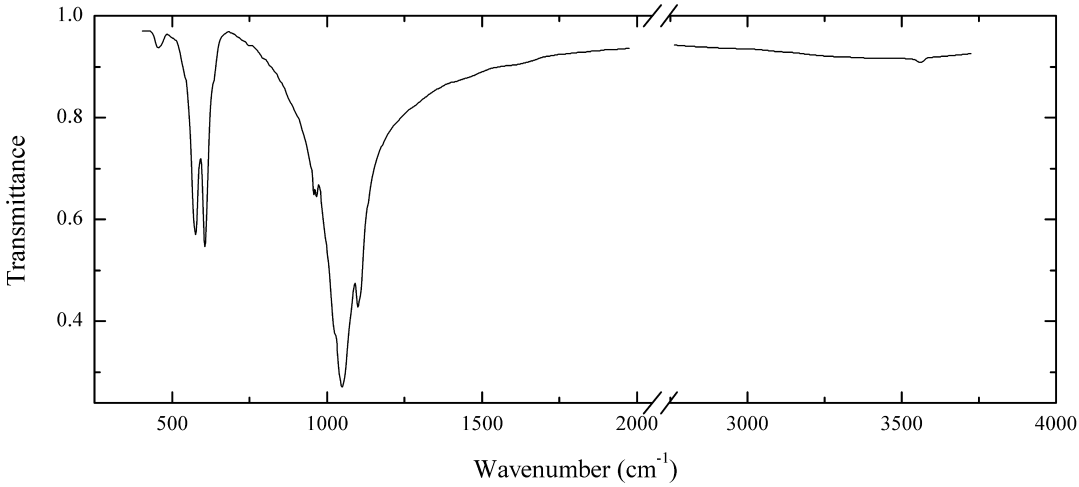


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Colourless crystals from the association with triphylite and kingsmountite. The empirical formula is $Ca_{1.88}Mn_{0.59}Fe_{0.37}Mg_{0.10}Zn_{0.04}(PO_4)_{2.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3030, 2360w, 1605w, 1500w, 1103s, 1010sh, 991s, 938, 892, 785sh, 759, 596, 586, 564, 557.

P305 Fluorapatite $Ca_5(PO_4)_3F$

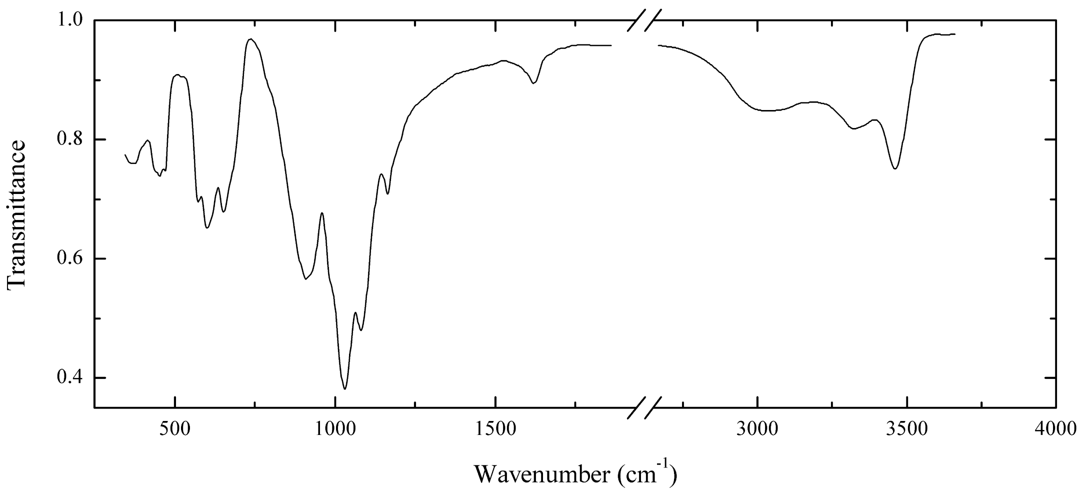


Locality: Okh-Myl'k Mt., Voron'i Tundras, Kola peninsula, Murnansk region, Russia.

Description: Deep blue grain from the association with elbaite and albite. The empirical formula is (electron microprobe, OH calculated) $(Ca_{4.76}Mn_{0.22})(PO_4)_{3.00}[F_{0.92}(OH)_{0.04}]$. The crystal structure is solved. All Mn is concentrated in one site. The doublet 965 + 957 cm^{-1} indicates the presence of two locally different PO_4^{3-} groups.

Wavenumbers (cm^{-1}): 3535w, 1105sh, 1095s, 1044s, 1025sh, 965, 957, 610sh, 601, 575, 570sh, 463w.

P306 Eosphorite $MnAl(PO_4)(OH)_2\cdot 2H_2O$

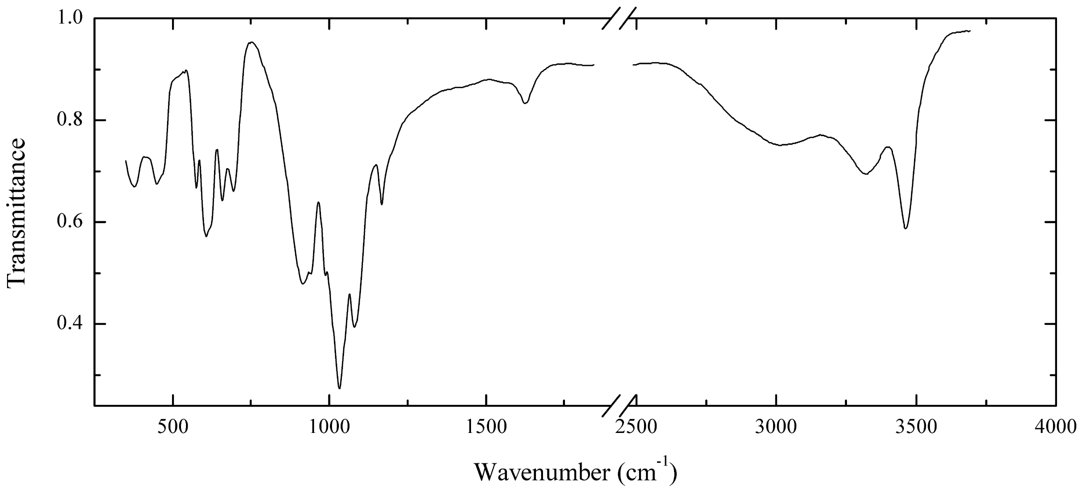


Locality: Taquaral, Itinga, Minas Gerais, Brazil.

Description: Rose-coloured crystals from the association with a roscherite-group mineral. Identified by electron microprobe analysis and IR spectrum. The empirical formula is $Mn_{0.87}Al_{1.01}Fe_{0.11}(PO_4)_{1.00}(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3448, 3325, 3025, 1622w, 1165, 1079s, 1031s, 985sh, 912s, 680sh, 653, 615sh, 602, 575, 470, 454, 374.

P308 Eosphorite $MnAl(PO_4)(OH)_2 \cdot 2H_2O$

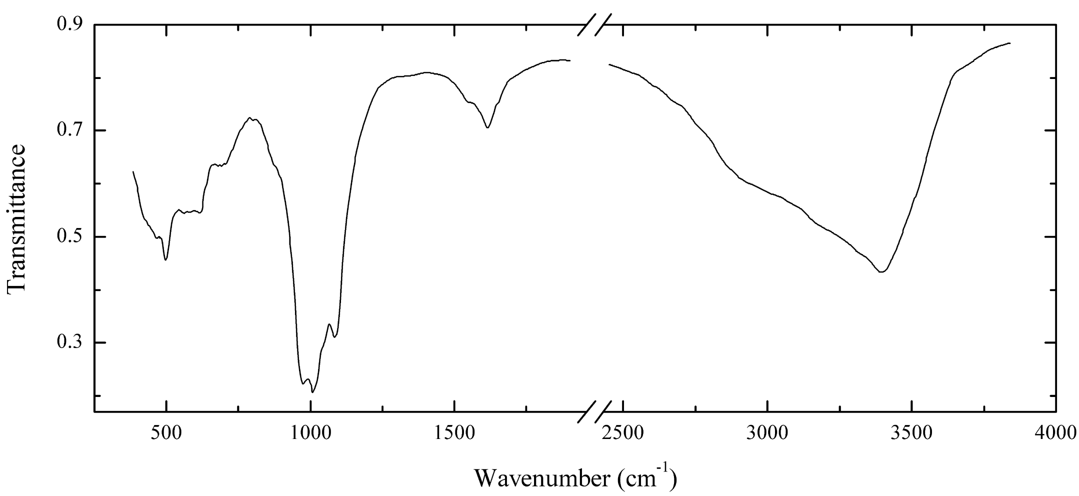


Locality: Fazenda Pomaroli, Linópolis, Divino das Laranjeiras, Doce valley, Minas Gerais, Brazil.

Description: Cream-coloured crystal from pegmatite. Identified by electron microprobe analysis and IR spectrum. Fe-rich variety. The empirical formula is $(Mn_{0.53}Fe_{0.44}Ca_{0.02}Mg_{0.01})(Al_{0.85}Fe_{0.15})(PO_4)_{1.00}(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3450, 3310, 3000, 1618w, 1169, 1083s, 1033s, 987s, 940sh, 918s, 695, 658, 620sh, 605, 575, 465sh, 450, 420, 376.

P309 Strunzite $Mn^{2+}Fe^{3+}_2(PO_4)_2(OH)_2 \cdot 6H_2O$

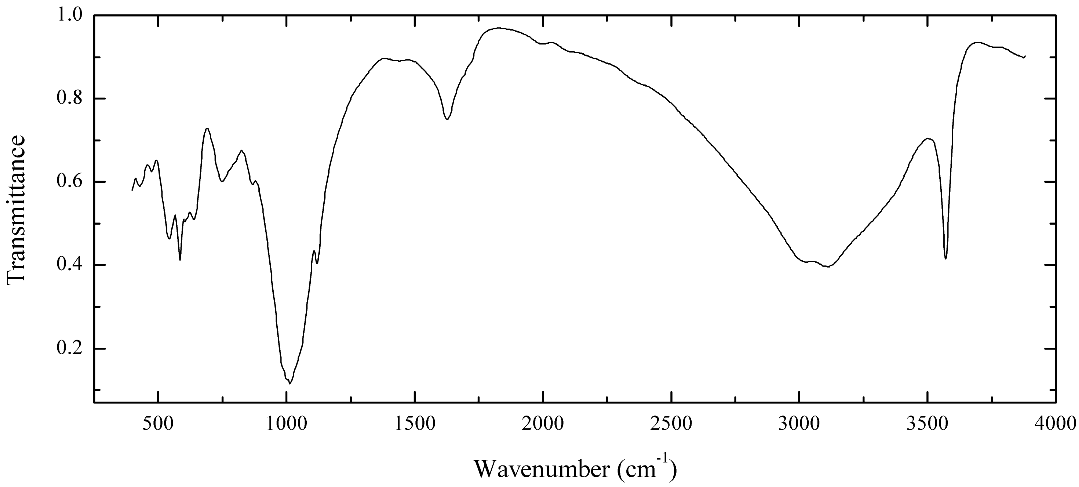


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Straw-yellow acicular crystals. Specimen No. 75159 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3380s, 3180sh, 2950sh, 1620, 1560sh, 1088s, 1013s, 976s, 697, 619, 595, 570, 502, 469, 440sh.

P310 Strengite $Fe^{3+}(PO_4)_2{\cdot}2H_2O$

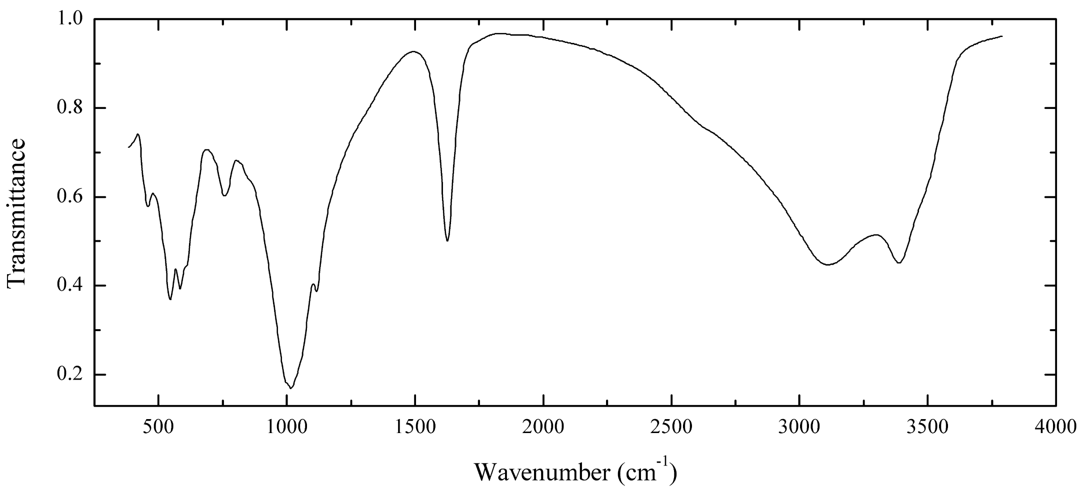


Locality: Leveäniemi mine, Svappavaara, Kiruna district, Lappland, Sweden.

Description: Violet spherulite from the association with cacoxenite. Al-bearing variety.

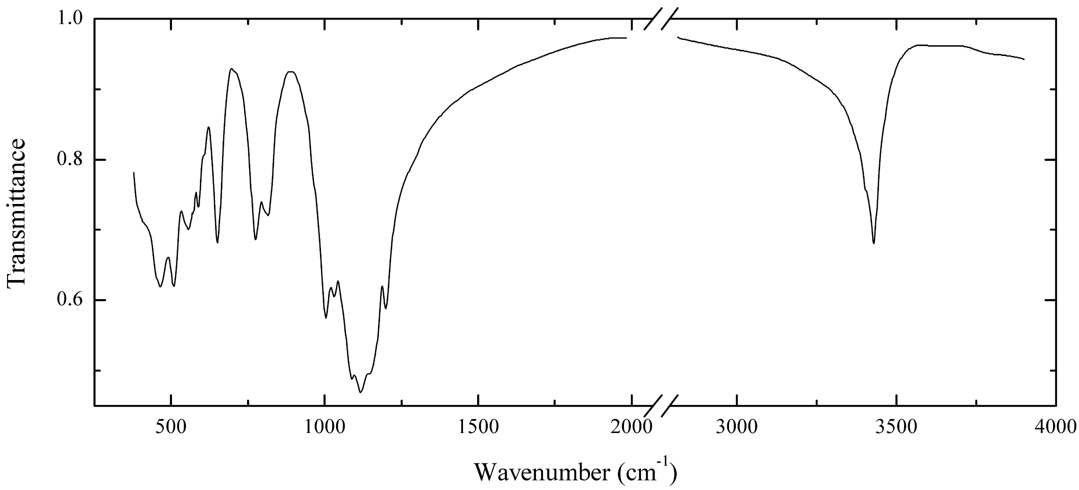
Wavenumbers (cm^{-1}): 3557, 3350sh, 3110s, 3025, 2110w, 1990w, 1720sh, 1628, 1123s, 1045sh, 1018s, 1005sh, 990sh, 870, 785sh, 752, 640, 604, 582, 541, 472, 436.

P311 Strengite $Fe^{3+}(PO_4)_2{\cdot}2H_2O$



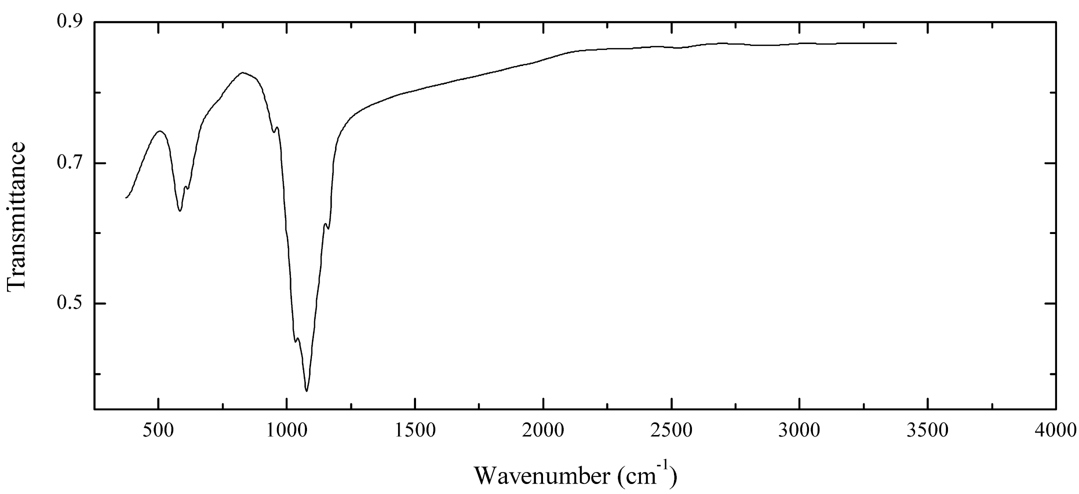
Locality: Folgosinho, Gouveia, Guarda district, Portugal.
Description: Purple spherulite from the association with phosphosiderite and benyacarite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3560sh, 3385, 3100, 1628, 1118s, 1018s, 1000sh, 855sh, 762, 615sh, 578, 547, 460.

P312 Lazulite $MgAl_2(PO_4)_2(OH)_2$



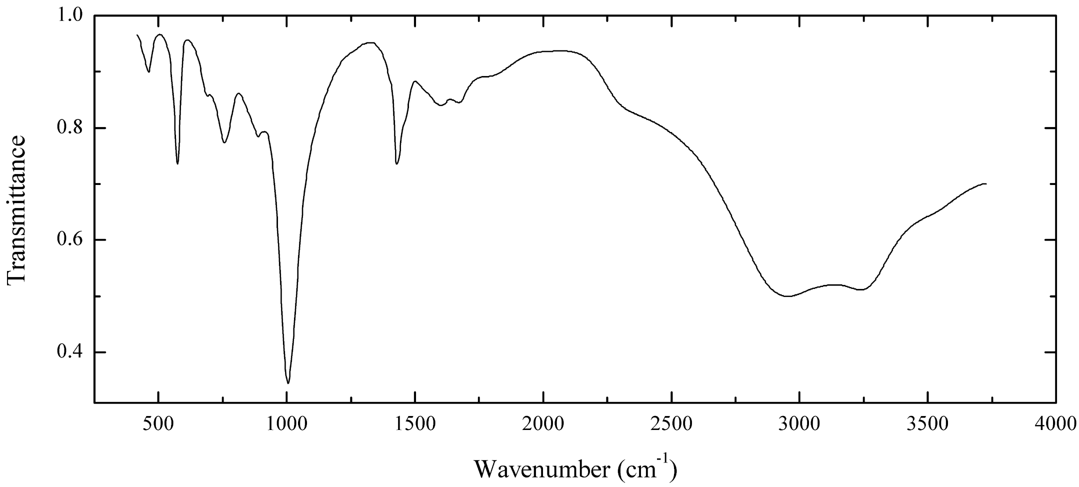
Locality: Horrsjöberget, Torsby, Värmland, Sweden.
Description: Dark blue granular aggregate from the association with kyanite, rutile and wagnerite. The empirical formula is (electron microprobe) $Mg_{0.78}Fe_{0.25}Al_{1.97}(PO_4)_{2.00}(OH)_2$.
Wavenumbers (cm^{-1}): 3403, 1198s, 1150sh, 1117s, 1087s, 1030, 1003s, 811, 773, 650, 605sh, 585, 548, 507, 468, 410sh.

P313 Stanfieldite $Ca_4(Mg,Fe^{2+})_5(PO_4)_6$



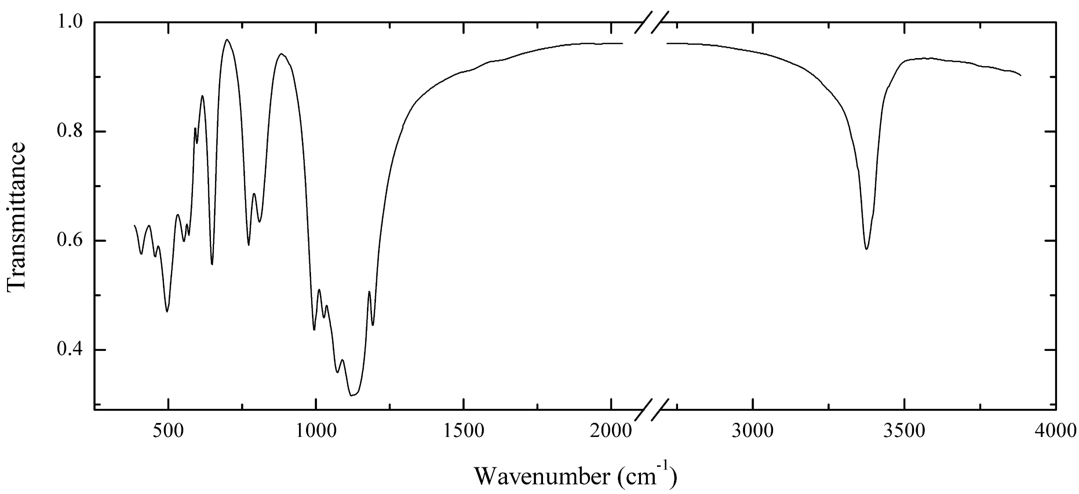
Locality: Finmarken pallasite meteorite, Alta, Finnmark, Norway.
Description: Grains from the association with olivine and troilite. Investigated by S.N. Britvin. The empirical formula is (electron microprobe) $Ca_{4.01}(Mg_{4.66}Fe_{0.29})(PO_4)_{6.01}O_{24}$.
Wavenumbers (cm^{-1}): 1155, 1069s, 1028s, 1000sh, 941, 610, 588.

P314 Struvite $(NH_4)Mg(PO_4)\cdot 6H_2O$



Locality: Kidney stone of a cat.
Description: Grey crystalline aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3230s, 2960s, 2400sh, 1780w, 1665, 1625, 1460sh, 1432, 1005s, 894, 760, 695, 571, 460.

P315 Scorzalite $(Fe^{2+},Mg)Al_2(PO_4)_2(OH)_2$

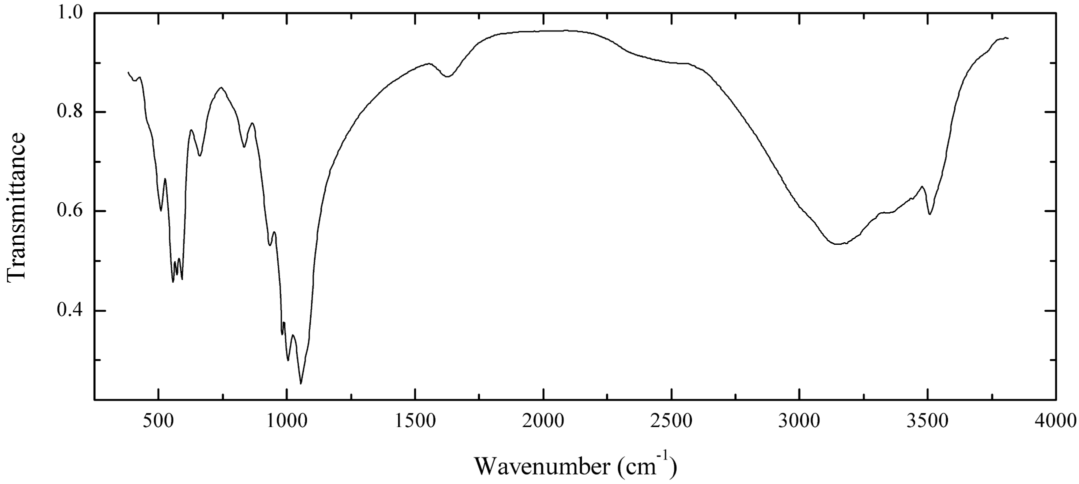


Locality: Varsonofievoi Mt., Balban'yu River basin, Subpolar Urals, Russia.
Description: Dark blue pseudomorph after augelite from the association with quartz, crandallite and florencite. The empirical formula is (electron microprobe) $Fe_{0.90}Mg_{0.21}Al_{1.89}(PO_4)_{2.00}(OH)_2$.

The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.17 (40) (100), 4.73 (40) (011), 3.249 (80) (112), 3.215 (100) (111), 3.145 (70) (120), 3.079 (70) (200), 2.259 (50) (121), 2.270 (40) (130), 1.980 (60) (123), 1.606 (50) (222), 1.572 (40) (042). The refractive indices are $\alpha = 1.638$, $\gamma = 1.677$.

Wavenumbers (cm^{-1}): 3385, 1195s, 1140sh, 1122s, 1075s, 1028s, 994s, 809, 769, 645, 596w, 565, 551, 491, 450, 401.

P316 Spencerite $Zn_4(PO_4)_2(OH)_2{\cdot}3H_2O$

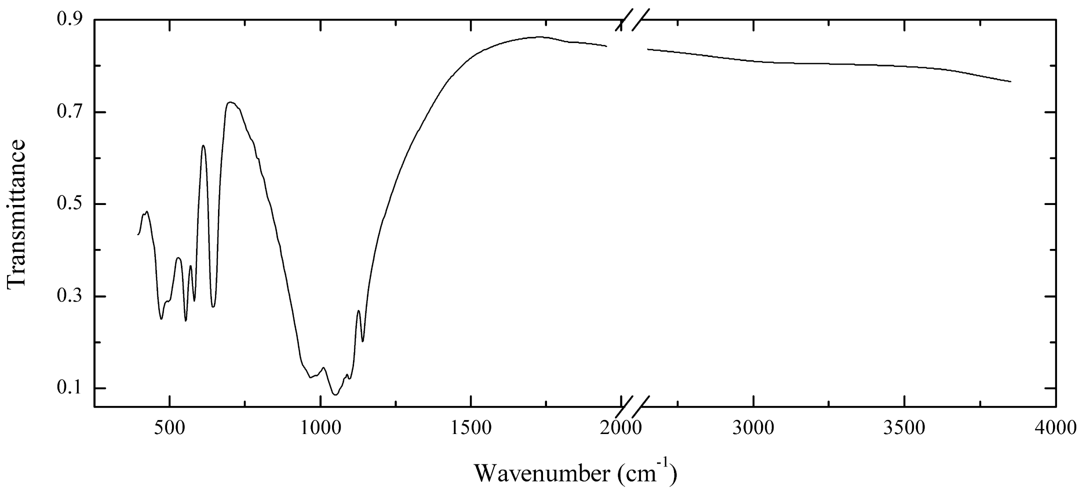


Locality: Hudson Bay mine, about 8 km southeast of Salmo, near Nelson, Kootenay district, British Columbia, Canada (type locality).

Description: Colourless crystals from the association with hemimorphite. Confirmed by IR spectrum.

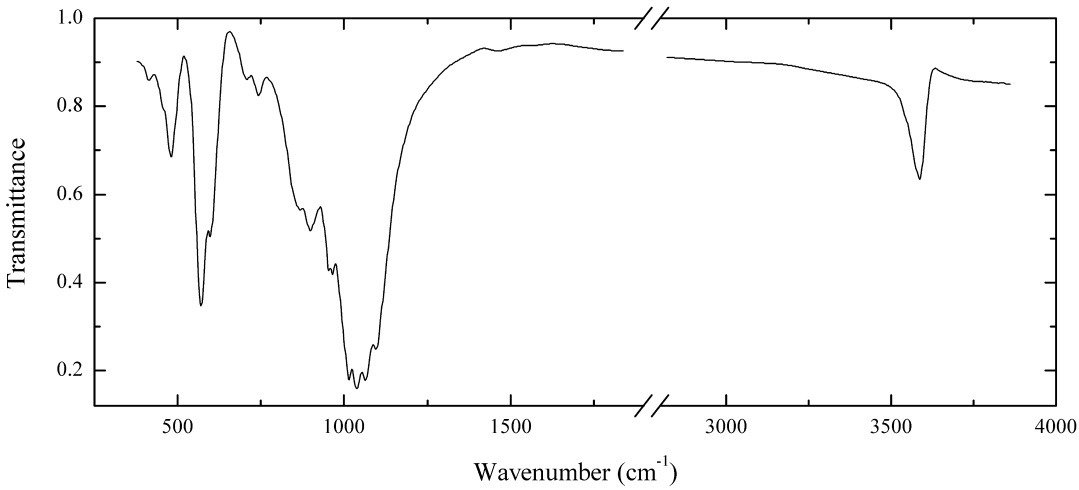
Wavenumbers (cm^{-1}): 3510, 3320, 3160, 3010sh, 2500sh, 1660, 1090sh, 1068s, 1016s, 995, 945, 845, 666, 596, 578, 562, 514, 465sh, 410w.

P318 Triphylite $LiFe^{2+}(PO_4)$



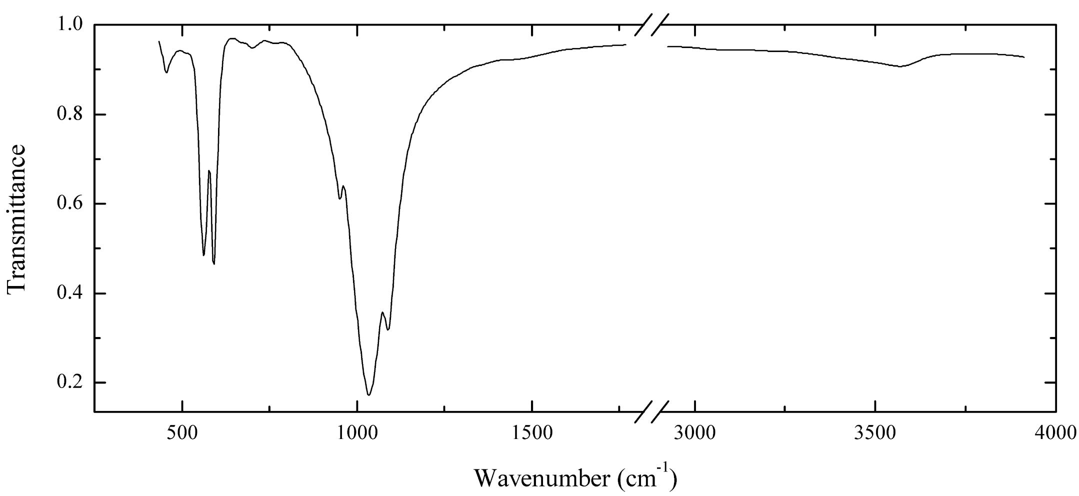
Locality: Palermo No. 1 mine, Groton, Grafton Co., New Hampshire, USA.
Description: Grey massive from the association with childrenite. The empirical formula is (electron microprobe) $Li(Fe_{0.77}Mn_{0.23})(PO_4)_{1.00}$.
Wavenumbers (cm^{-1}): 1138, 1097s, 1053s, 987s, 970s, 945sh, 645sh, 638, 576, 407, 466.

P319 Triploidite $Mn^{2+}{}_2(PO_4)(OH)$



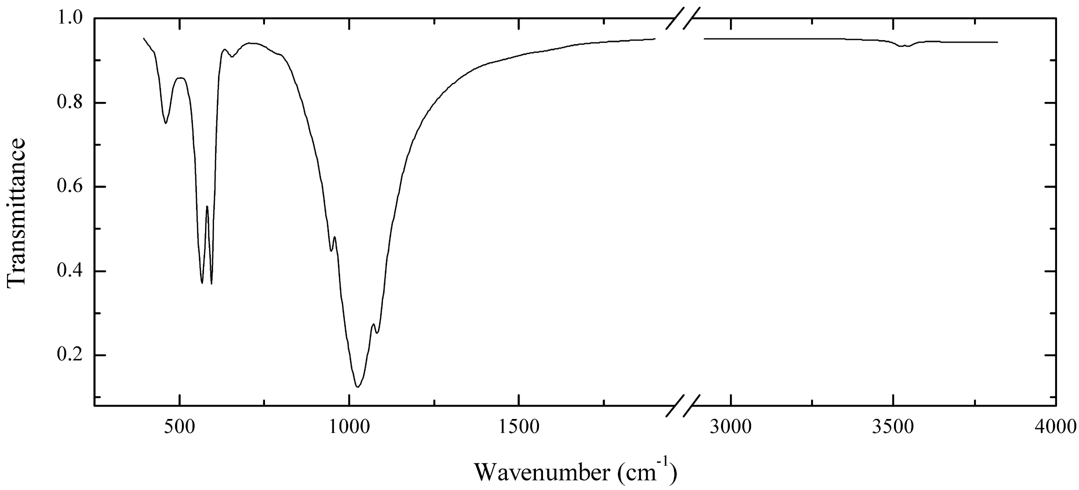
Locality: Capoeira mine, Parelhas, Borborema mineral province, Rio Grande do Norte, Brazil.
Description: Red granular aggregate from the association with lithiophilite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3502, 1400w, 1088s, 1053s, 1030s, 1005s, 960, 949, 893, 858, 739w, 701w, 588, 567, 480, 455sh, 414w.

P320 Fluorstrophite $SrCaSr_3(PO_4)_3F$



Locality: Rasvumchorr Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Colourless prismatic crystals from the association with natrite, thermonatrite, nacaphite and villiaumite. The crystal-chemical formula is $(Sr_{0.75}Ca_{0.25})(Ca_{0.7}Sr_{0.3})(Sr_{2.6}Ca_{0.4})(PO_4)_3(F,OH)$.
Wavenumbers (cm^{-1}): 3535w, 1087s, 1034s, 953, 708w, 595, 569, 565sh, 460w.

P321 Fluorstrophite $SrCaSr_3(PO_4)_3F$

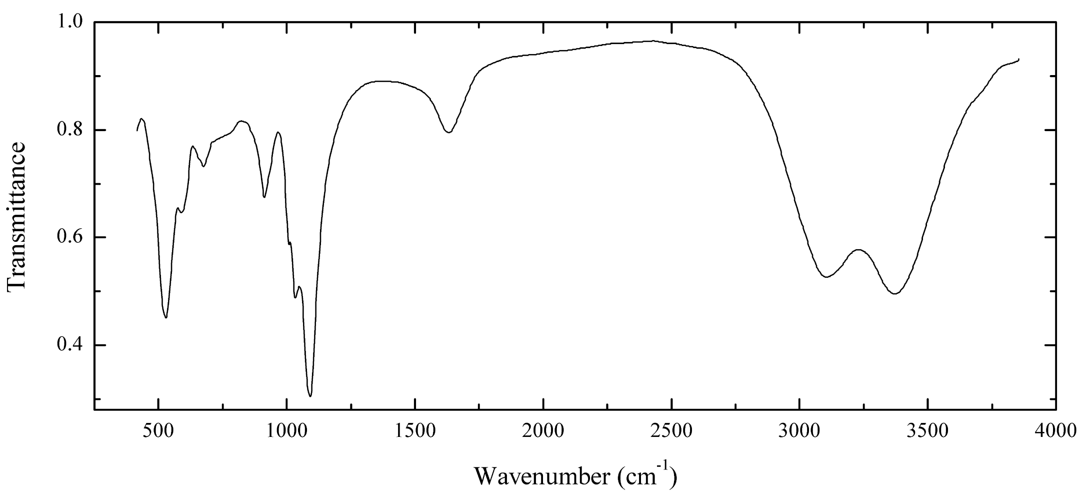


Locality: Inagli massif, Aldan shield, Sakha Republic (Yakutia), Eastern Siberia, Russia (type locality).

Description: Pale green crystal from the association with batisite, innelite, lorenzenite, eudialyte, aegirine, eckermannite, microcline, magnesio-arfvedsonite and albite. Holotype sample (initially described with the name "strontium-apatite"). The crystal structure is solved. Hexagonal, space group $P6_3/m$ or $P6_3$, $a = 9.565(8)$ $c = 7.115(3)$ Å, $Z = 2$. The empirical formula is $Sr_{2.96}Ca_{1.28}Mg_{0.27}REE_{0.15}Na_{0.15}Ba_{0.12}Th_{0.01}Fe_{0.01}[(P_{0.95}Si_{0.03}Al_{0.02})O_4]_3(F,OH)_{1.03}$. The crystal-chemical formula is $[(Sr,Ba)][Ca][Sr,Ca,\mathit{REE},Na]_3(PO_4)_3(F,OH)$. $D_{meas} = 3.84$ g/cm^3, $D_{calc} = 2.95$ g/cm^3. Optically uniaxial (−), $\omega = 1.651$, $\varepsilon = 1.637$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.89 (100), 3.167 (70), 2.78 (70), 2.005 (70), 1.909 (70), 1.467 (60), 2.32 (50).

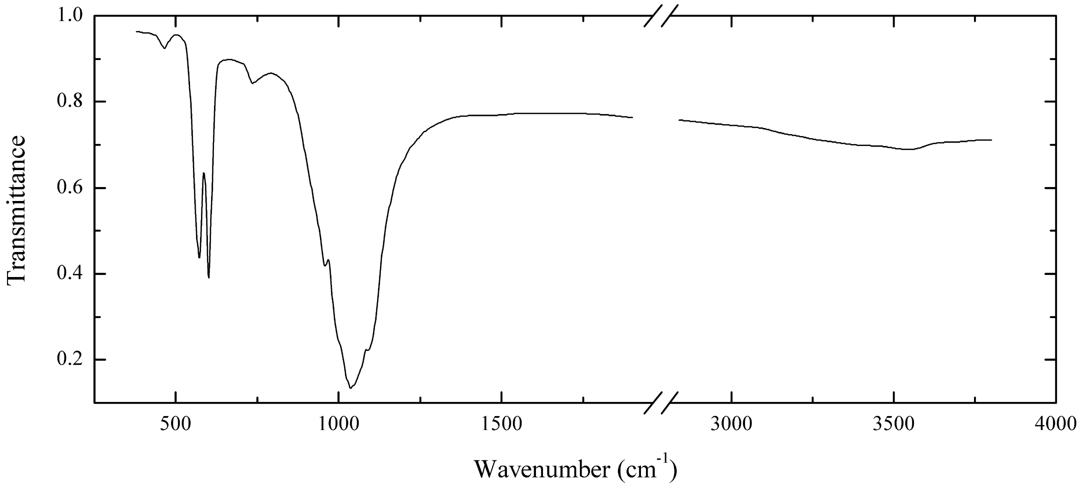
Wavenumbers (cm^{-1}): 3535w, 1085s, 1026s, 948, 663w, 593, 565, 460.

P322 Fluellite $Al_2(PO_4)F_2(OH){\cdot}7H_2O$



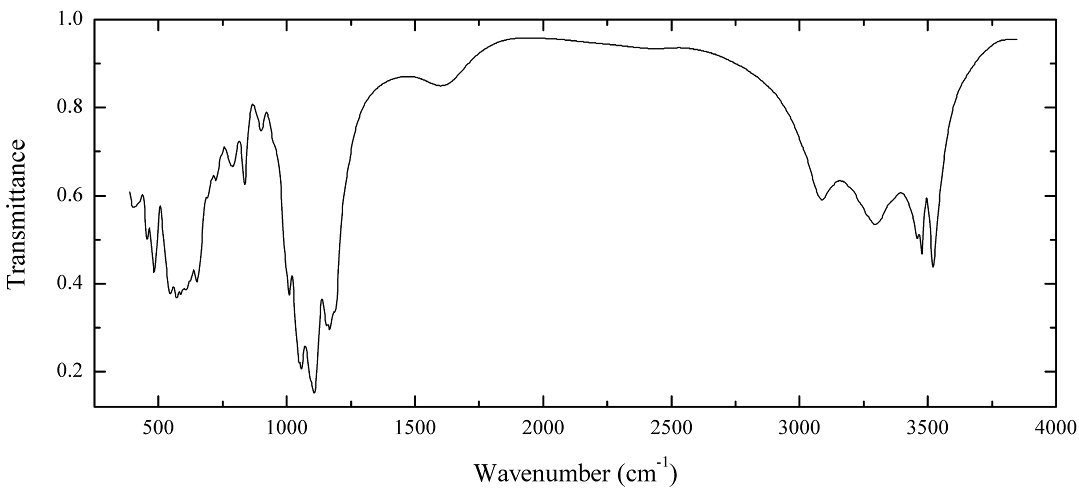
Locality: Kapunda mine, Kapunda, Mt. Lofly Ranges, South Australia, Australia.
Description: Crystalline crust. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3350s, 3095s, 1650, 1092s, 1035, 1010, 935sh, 914, 670, 595, 528s.

P323 Fluorcaphite $Ca(Sr,Na,Ca)(Ca,Sr,Ce)_3(PO_4)_3F$



Locality: Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Yellow grains from the association with raslakite, terskite and aegirine. Identified by IR spectrum. The empirical formula is $Ca_{3.08}Sr_{1.09}Na_{0.38}Ce_{0.22}La_{0.13}Nd_{0.07}(PO_4)_{3.00}F_{0.7}(OH)_{0.3}$.
Wavenumbers (cm^{-1}): 3540w, 1100sh, 1090sh, 1039s, 1000sh, 960, 742w, 601, 573, 567sh, 465w.

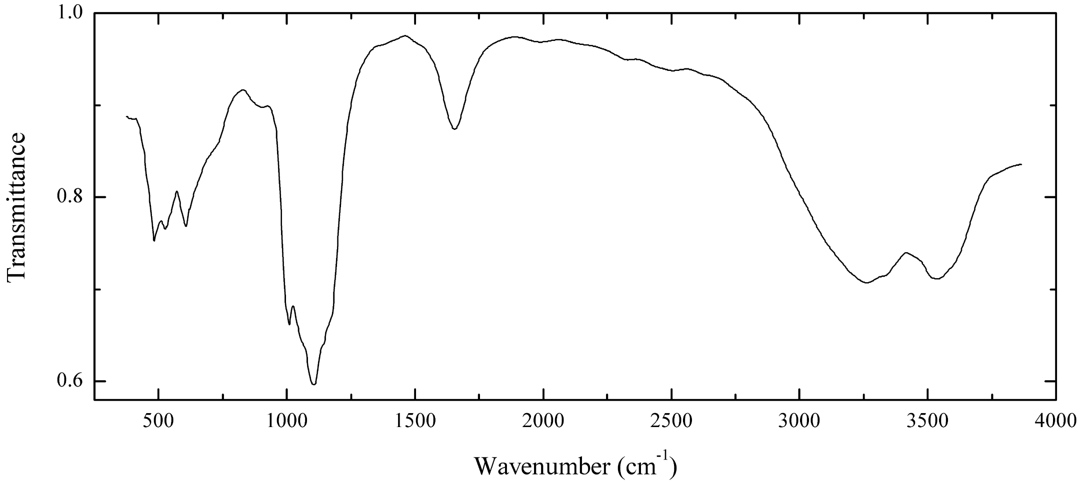
P324 Turquoise $Cu^{2+}Al_6(PO_4)_4(OH)_8{\cdot}4H_2O$



Locality: Weißenberg, Oberlausitz, Saxony, Germany.
Description: Green crust. Fe-rich variety. The empirical formula is $(Cu_{0.8}Zn_{0.1}Ca_{0.1})(Al_{3.8}Fe_{2.2})(PO_4)_{4.0}(OH)_8{\cdot}nH_2O$.

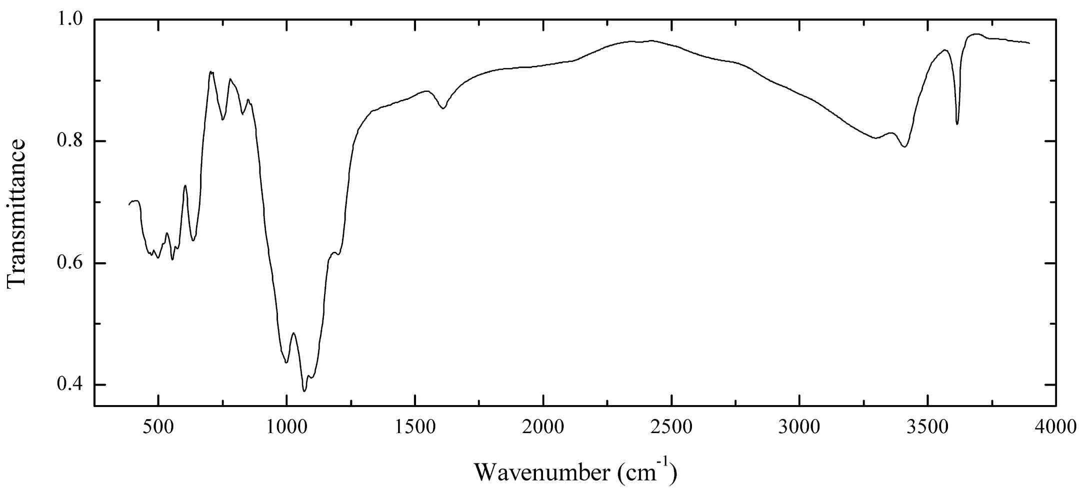
Wavenumbers (cm^{-1}): 3508, 3463, 3445, 3280, 3075, 1620w, 1189, 1168s, 1158s, 1108s, 1090sh, 1058s, 1050sh, 1010, 990sh, 950sh, 903w, 836, 786w, 725w, 685sh, 650, 608, 689, 572, 545, 483, 455, 425sh, 400.

P325 Vashegyite $Al_{11}(PO_4)_9(OH)_6 \cdot 38H_2O$



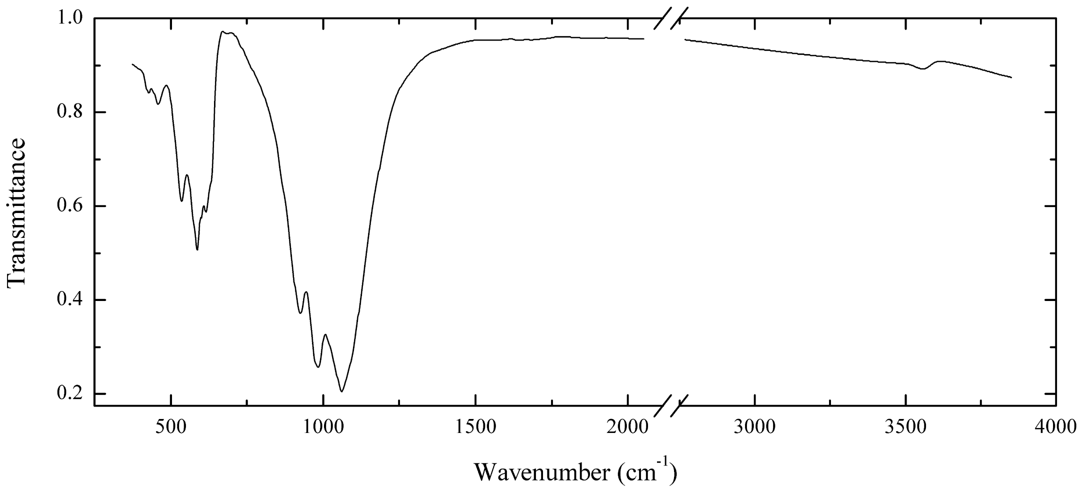
Locality: Kociha, Rimanská Sobota Co., Banská Bystrica region, Slovakia.
Description: White powdery from the association with evansite and koninckite. Confirmed by qualitative electron microprobe analysis and IR spectrum.
Wavenumbers (cm^{-1}): 3525s, 3250s, 1654, 1165sh, 1140sh, 1105s, 1060sh, 1007s, 915w, 885sh, 860sh, 700sh, 604, 526, 483.

P326 Souzalite $Mg_3Al_4(PO_4)_4(OH)_6 \cdot 2H_2O$



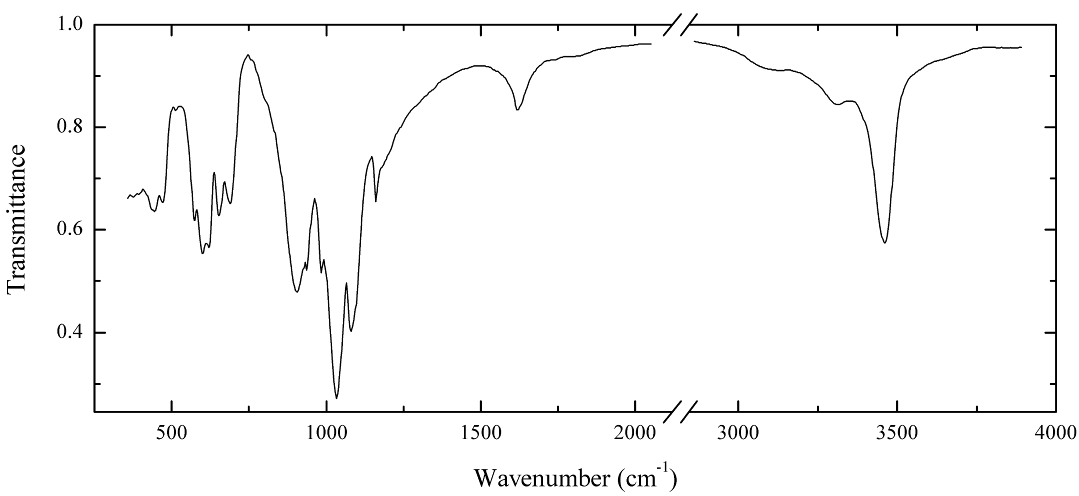
Locality: Rapid Creek, Richardson Mts., Yukon Territory, Canada.
Description: Blue-green crystals from the association with goyazite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3614, 3414, 3290, 1617, 1202, 1095s, 1072s, 996s, 827w, 749, 635, 571, 550sh, 494. 468.

P327 Sarcopside $Fe^{3+}(PO_4)_2$



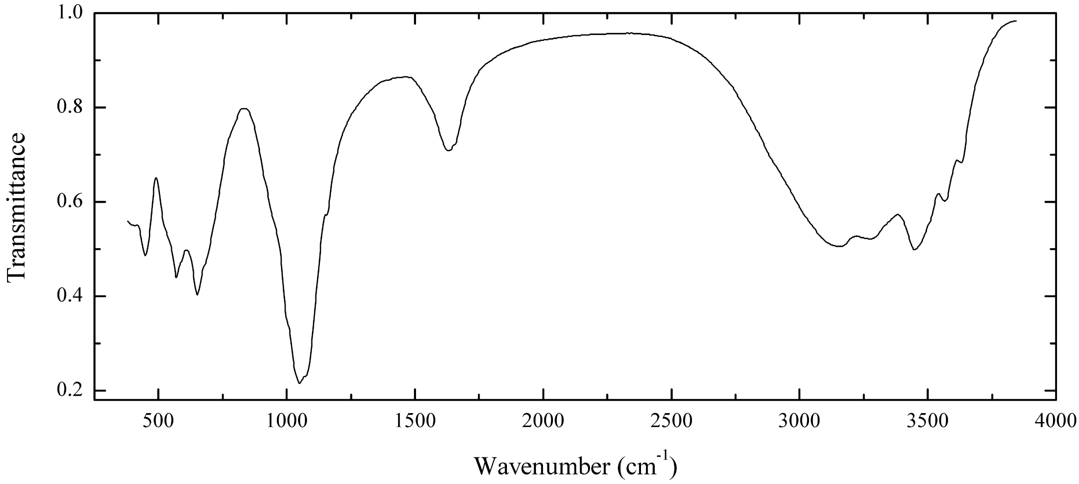
Locality: Palermo No. 1 mine, Groton, Grafton Co., New Hampshire, USA.
Description: Dark grey-green massive from the association with triphylite. The empirical formula is $(Fe_{2.45}Mn_{0.55})(PO_4)_{2.00}$.
Wavenumbers (cm^{-1}): 3550w, 1060s, 982s, 926s, 800sh, 615, 588, 538, 455w, 435w.

P328 Eosphorite $MnAl(PO_4)(OH)_2{\cdot}2H_2O$



Locality: Fillow (Branchville) quarry, Branchville, Redding, Fairfield Co., Connecticut, USA (type locality).
Description: Light brown massive from the association with lithiophilite and triploidite. Identified by electron microprobe analysis and IR spectrum. The empirical formula is $Mn_{0.85}Al_{0.99}Fe_{0.15}(PO_4)_{1.00}(OH)_2{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3445, 3300w, 3110w, 1625w, 1164, 1081s, 1034s, 984, 936, 903s, 689, 655, 620, 602, 573, 469, 443.

P329 Sigloite $Fe^{3+}Al_2(PO_4)_2(OH)_3 \cdot 7H_2O$

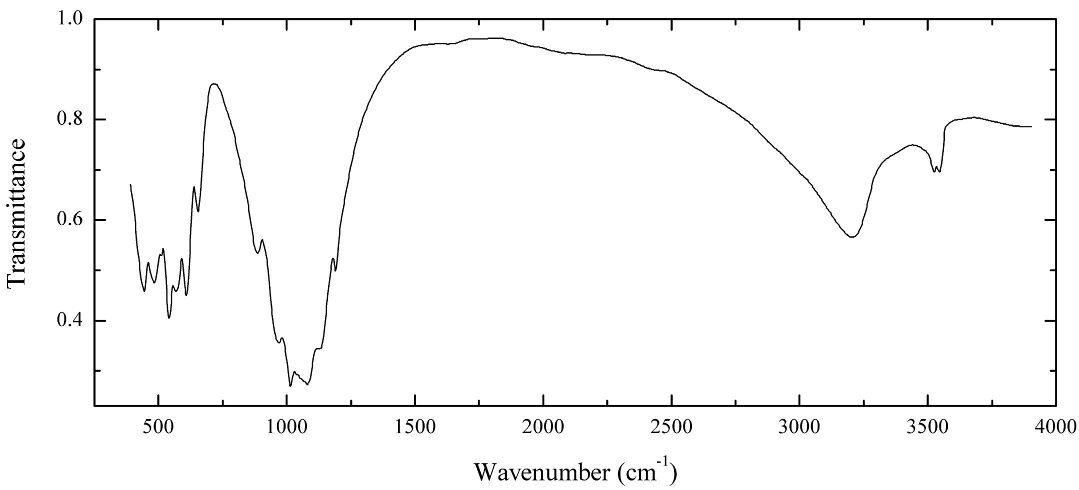


Locality: Siglo Veinte mine, Llallagua, Rafael Bustillo province, Potosí department, Bolivia (type locality).

Description: Brownish pseudomorph after paravauxite crystal from the association with vauxite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3610, 3545, 3435, 3260, 3140, 1650sh, 1630, 1155, 1070sh, 1050s, 1000sh, 935sh, 680sh, 647, 567, 525sh, 443.

P330 Kulanite $BaFe^{2+}{}_2Al_2(PO_4)_3(OH)_3$

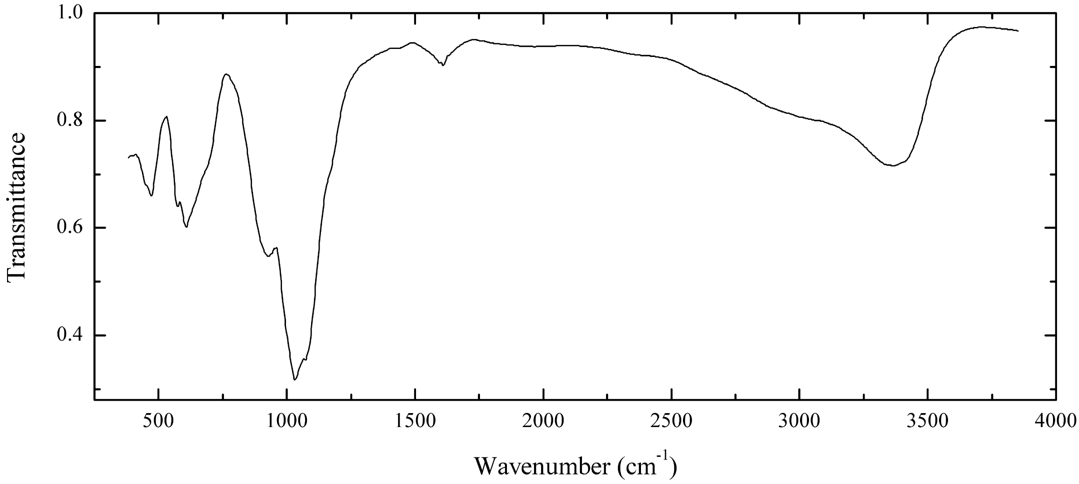


Locality: Big Fish River, Dawson mining district, Yukon territory, Canada.

Description: Dark blue crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

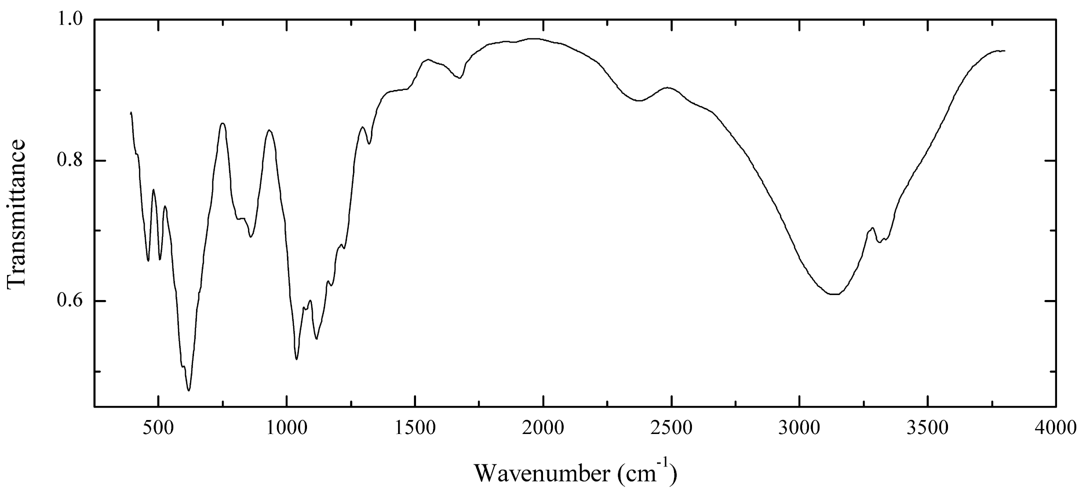
Wavenumbers (cm^{-1}): 3520, 3505, 3185, 1192, 1126s, 1078s, 1014s, 968s, 889, 654, 608, 567, 541s, 510, 484, 445.

P331 Ernstite $(Mn^{2+},Fe^{3+})Al(PO_4)(OH,O)_2 \cdot H_2O$



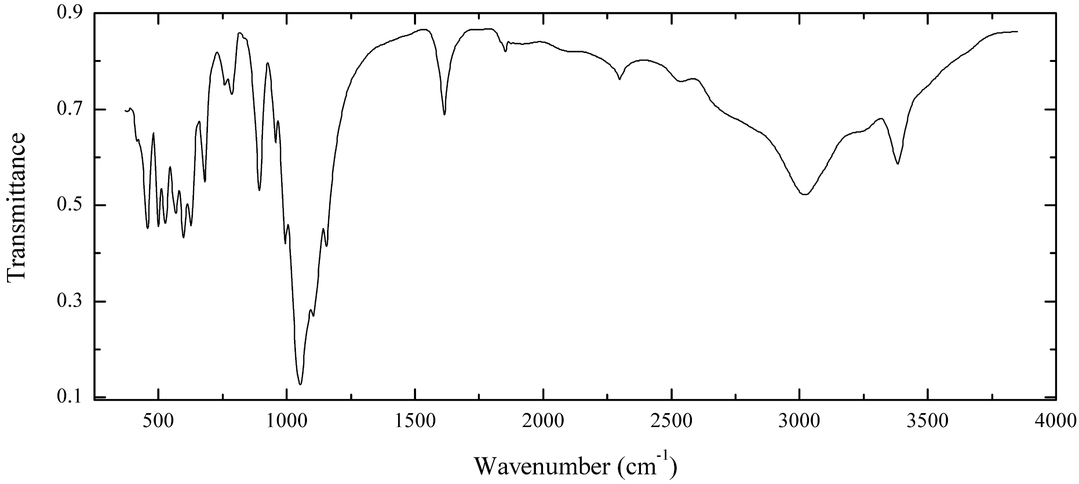
Locality: Fazenda Pomaroli, Linópolis, Divino das Laranjeiras, Doce valley, Minas Gerais, Brazil.
Description: Dark red-brown crystal from pegmatite. Identified by electron microprobe analysis and IR spectrum. The empirical formula is $(Mn_{0.59}Fe_{0.30}Mg_{0.08}Ca_{0.02})(Al_{0.92}Fe_{0.08})(PO_4)_{1.00}(OH,O)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3410sh, 3365, 3050sh, 1618w, 1170sh, 1070s, 1033s, 927s, 670sh, 608, 574, 472, 450sh.

P332 Crandallite $CaAl_3(PO_4)_2(OH,H_2O)_6$



Locality: Zavetnoe village, Kerch iron-ore basin, Kerch peninsula, Crimea, Ukraine.
Description: Beige crystalline crust from the association with vivianite, goethite and siderite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{0.95}Al_{3.02}Fe_{0.02}[(PO_4)_{1.96}(SO_4)_{0.02}(SiO_4)_{0.02}](OH,H_2O)_6$.
Wavenumbers (cm^{-1}): 3450sh, 3315, 3290, 3115, 2585sh, 2360, 1660w, 1477w, 1325, 1227, 1172, 1113s, 1074s, 1037s, 1015sh, 995sh, 862, 810, 614s, 590s, 505, 456.

P333 Morinite $NaCa_2Al_2(PO_4)_2(OH)F_4 \cdot 2H_2O$

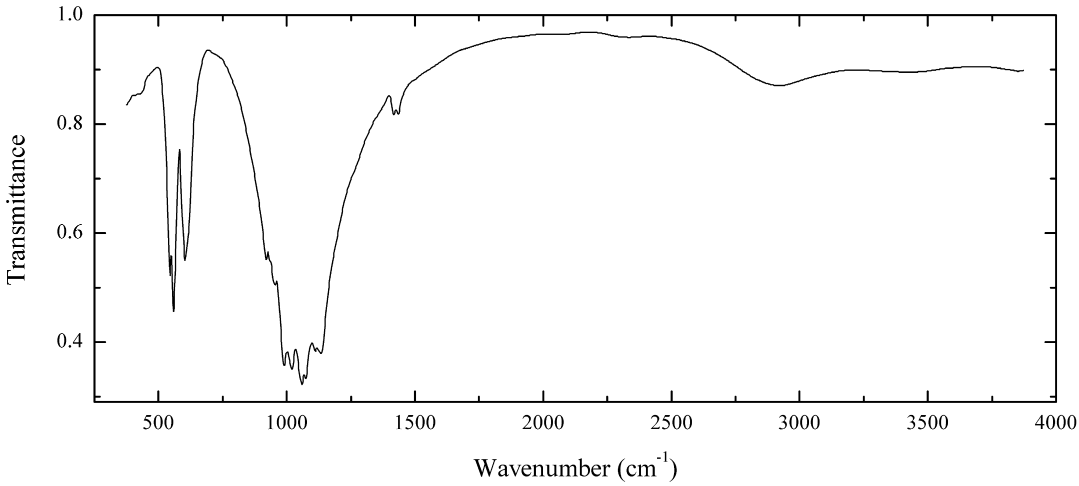


Locality: Viitaniemi pegmatite, Eräjärvi pegmatite, Orivesi, Finland.

Description: Lilac-red grains from the association with beryllite, montebrasite and albite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3340, 3200sh, 2975, 2750sh, 2520w, 2280w, 2120sh, 1925w, 1845w, 1610, 1153, 1102s, 1052s, 1045sh, 992, 954, 893, 785w, 759w, 681, 630, 601, 569, 530, 500, 457, 420w.

P334 Whitlockite $Ca_9Mg(HPO_4)(PO_4)_6$

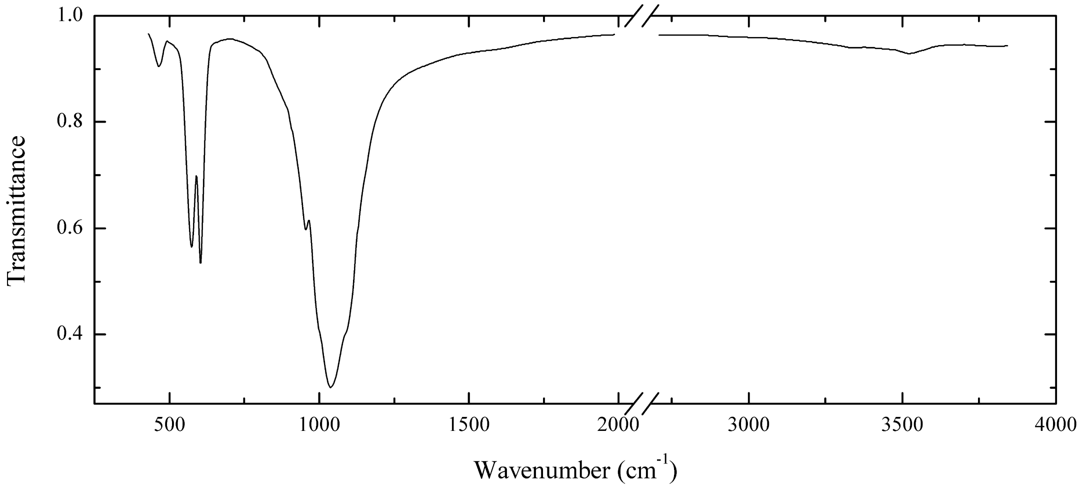


Locality: Big Fish River, Dawson mining district, Yukon territory, Canada.

Description: Colourless platy crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 2920w, 2350w, 1540sh, 1442w, 1422w, 1135s, 1114s, 1074s, 1061s, 1023s, 991s, 953, 940sh, 922, 617sh, 610sh, 603, 595sh, 557, 544.

P335 Fluorcaphite $Ca(Sr,Na,Ca)(Ca,Sr,Ce)_3(PO_4)_3F$

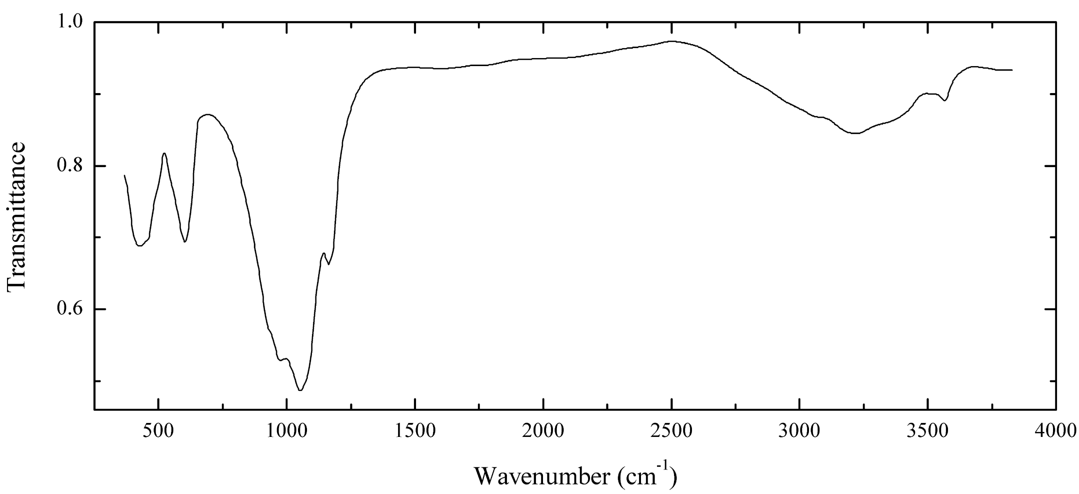


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Yellow grains from the association with deloneite-(Ce), belovite-(Ce), alkalic amphibole, lamprophyllite, labuntsovite, wadeite, sazykinaite-(Y), remondite-(La), sphalerite, galena, fluorite and graphite. Holotype sample. The crystal structure is solved. Hexagonal, space group $P6_3$, $a = 9.485(3)$, $c = 7.000(3)$ Å, $Z = 2$. The empirical formula is $Ca_{3.16}Sr_{1.16}Na_{0.32}Ce_{0.17}La_{0.10}Nd_{0.05}Pr_{0.01}[(PO_4)_{2.06}(SiO_4)_{0.06}][F_{0.66}(OH)_{0.34}]$. $D_{meas} = 3.60$ g/cm^3, $D_{calc} = 3.57$ g/cm^3. Optically uniaxial (−), $\omega = 1.649$, $\varepsilon = 1.637$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.838 (100), 2.740 (53), 2.814 (48), 3.498 (45), 1.865 (31), 3.104 (22), 1.963 (21).

Wavenumbers (cm^{-1}): 3520w, 1090sh, 1039s, 1000sh, 953, 601, 573, 460w.

P336 Frondelite $Mn^{2+}Fe^{3+}{}_4(PO_4)_3(OH)_5$

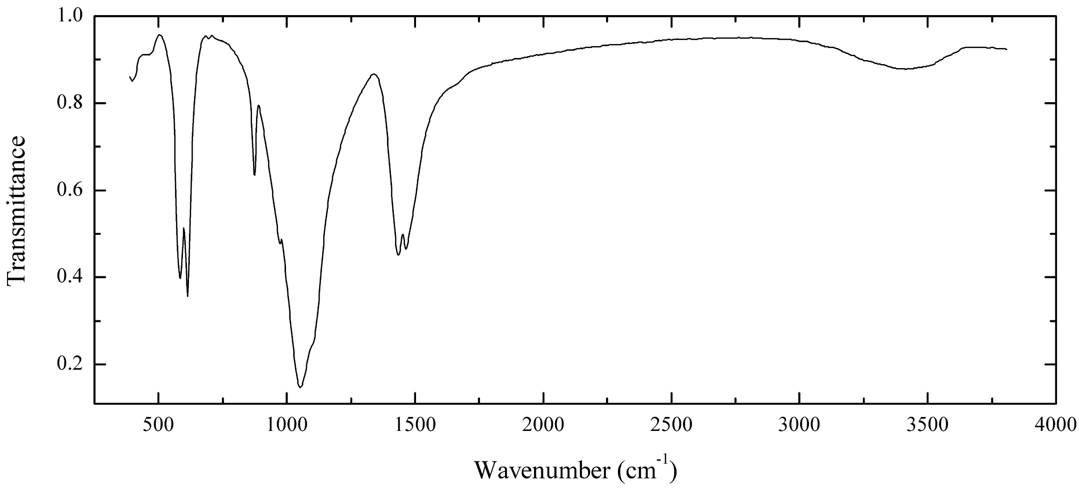


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Dark greenish-brown columnar aggregate. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Mn_{0.72}Fe_{0.26})(Fe_{3.92}Al_{0.08})(PO_4)_{3.00}(OH)_5$.

Wavenumbers (cm^{-1}): 3545w, 3300sh, 3195, 1169, 1055s, 977s, 950sh, 599, 450sh, 412.

P337 Fluorapatite CO$_3$-rich $(Ca,H_2O,\square)_5(PO_4,CO_3)_3(F,OH,H_2O)$

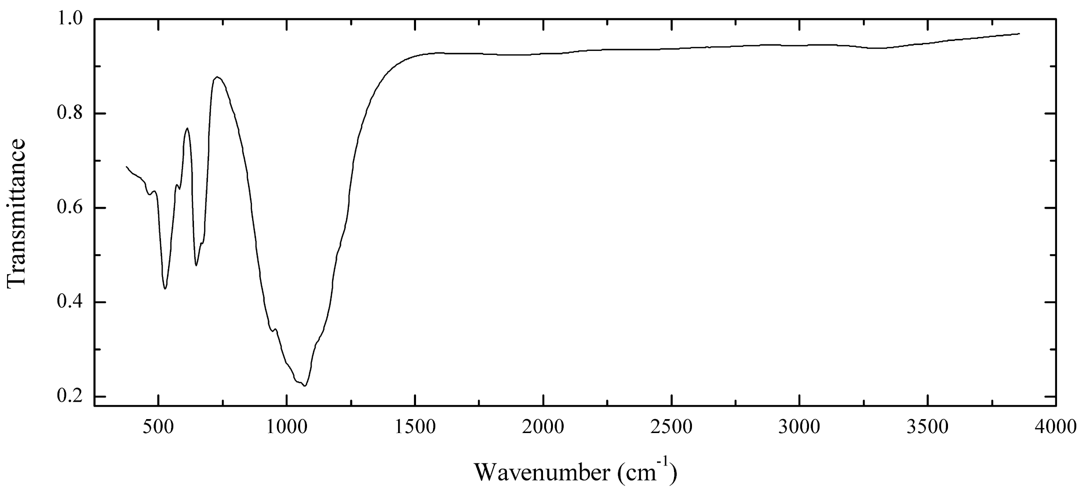


Locality: Alluaiv Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: Light brown pseudomorphs after an unknown mineral from the association with zaolites. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3400, 1640w, 1458, 1427, 1090sh, 1045s, 963, 865, 725w, 600, 574, 565sh, 466w, 394.

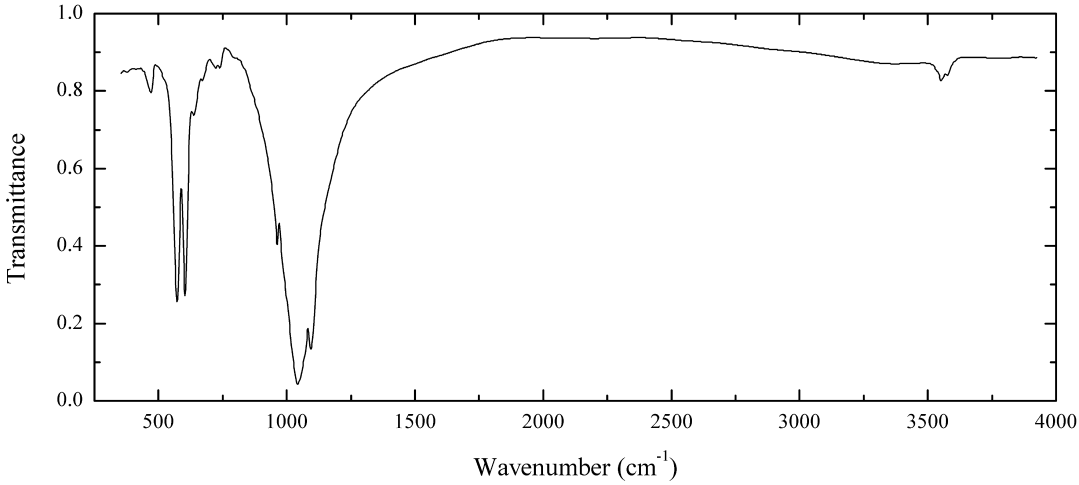
P338 Ferrisicklerite $Li_{1-x}(Fe^{3+},Fe^{2+},Mn^{2+})(PO_4)$



Locality: Karasu granite pegmatite, Turkestan range, Osh region, Kyrgyzstan.

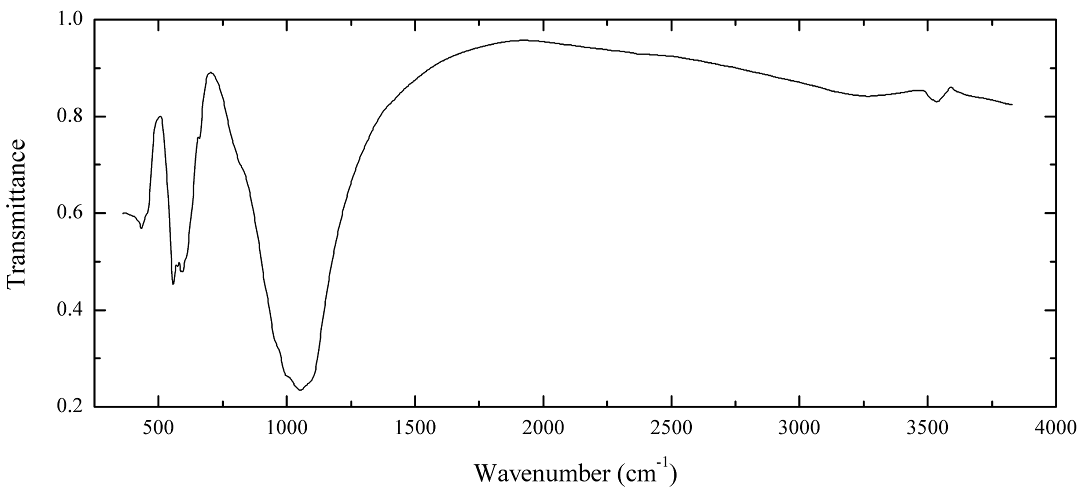
Description: Brown massive. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1225sh, 1125sh, 1070s, 1046s, 1015sh, 945s, 662, 641, 574, 521, 460.

P339 Hydroxylapatite $Ca_5(PO_4)_3(OH)$



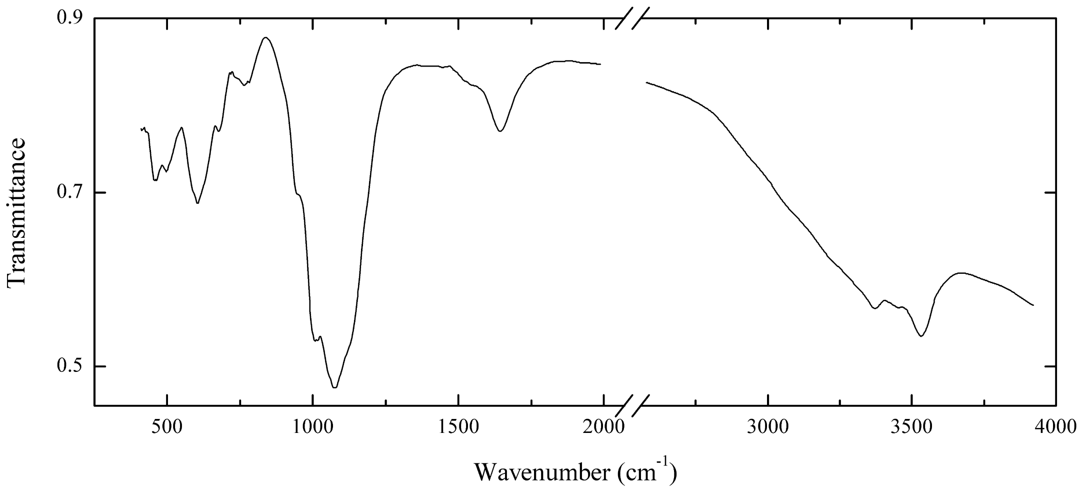
Locality: Mo I Rana, Nordland, Norway.
Description: White massive. The empirical formula is $Ca_{5.00}[(PO_4)_{2.94}(CO_3)_x][(OH,O)_{0.66}F_{0.22}Cl_{0.12}]$.
Wavenumbers (cm^{-1}): 3560w, 3535w, 1460w, 1433w, 1092s, 1043s, 963, 737w, 722w, 638, 603, 573, 468w.

P340 Arrojadite-(BaFe) $BaNa_3Ca(Fe^{2+},Mg,Mn)_{14}Al(PO_4)_{12}(OH)_2$



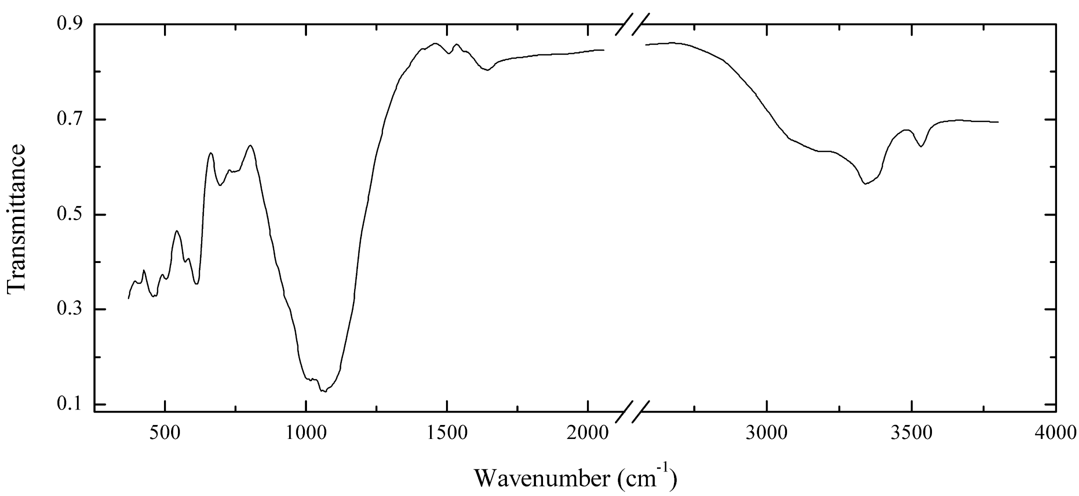
Locality: Big Fish River, Dawson mining district, Yukon territory, Canada.
Description: Light brown crystals. The empirical formula is $Ba_{1.04}Na_{2.94}Ca_{1.08}(Fe_{10.33}Mg_{2.02}Mn_{0.73}Na_{0.92})Al_{1.06}(PO_4)_{12.00}(OH)_2$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3525w, 3250w, 1095sh, 1056s, 1000sh, 960sh, 825sh, 660, 625sh, 610sh, 592, 570sh, 558, 450sh, 434.

P341 Zinclipscombite $ZnFe^{3+}_2(PO_4)_2(OH)_2$



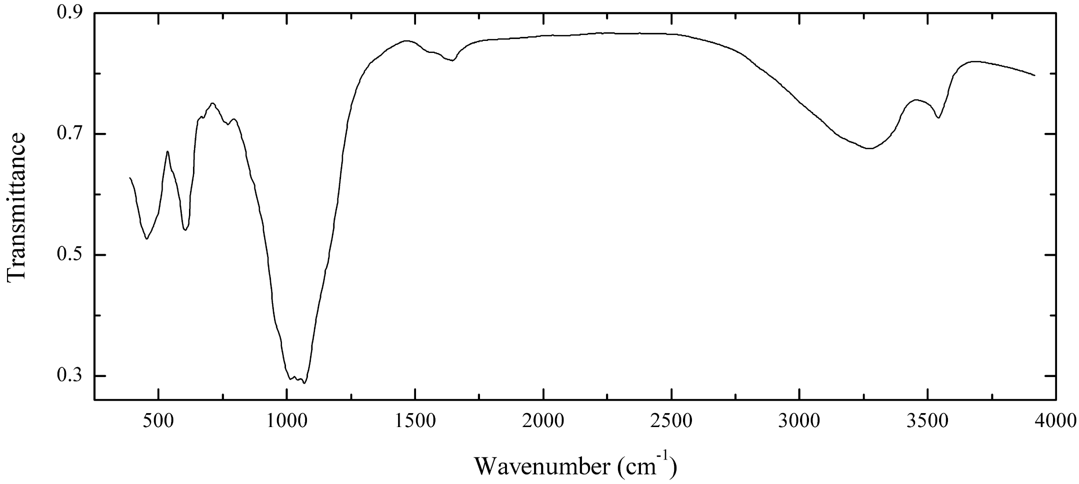
Locality: Silver Coin mine, Valmy, Edna Mountains, Humboldt Co., Nevada, USA (type locality).
Description: Brown spherulites from the association with apophyllite, quartz, baryte, jarosite, plumbojarosite, turquoise and calcite. The empirical formula is $(Zn_{0.55}Fe_{0.45})(Fe^{3+}_{1.69}Al_{0.28}V_{0.03})[(PO_4)_{1.91}(AsO_4)_{0.09}](OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3530, 3430, 3365, 1650, 1570sh, 1125sh, 1078s, 1013s, 950sh, 766, 679, 607, 500, 459.

P342 Zinclipscombite $ZnFe^{3+}_2(PO_4)_2(OH)_2$



Locality: Silver Coin mine, Valmy, Edna Mountains, Humboldt Co., Nevada, USA (type locality).
Description: Green spherulites from the association with apophyllite, quartz, baryte, jarosite, plumbojarosite, turquoise and calcite. The empirical formula is $(Zn_{0.59}Fe_{0.23}Cu_{0.07}Mg_{0.04})(Fe^{3+}_{1.75}Al_{0.25})[(PO_4)_{1.96}(AsO_4)_{0.04}](OH)_2 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3530. 3340, 3165, 1650w, 1510w, 1090sh, 1068s, 1009s, 950sh, 755, 700, 614, 572, 505, 463, 410.

P343 Zinclipscombite $ZnFe^{3+}_2(PO_4)_2(OH)_2$

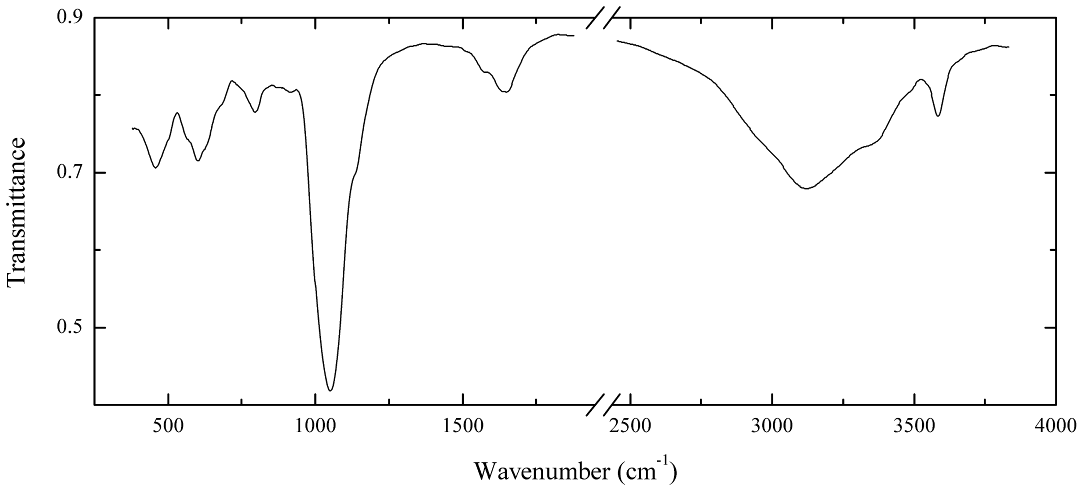


Locality: Silver Coin mine, Valmy, Edna Mountains, Humboldt Co., Nevada, USA (type locality).

Description: Green spherulites from the association with apophyllite, quartz, baryte, jarosite, plumbojarosite, turquoise and calcite. The empirical formula is $(Zn_{0.74}Fe_{0.11}Cu_{0.03})(Fe^{3+}_{1.78}Al_{0.22})[(PO_4)_{1.82}(AsO_4)_{0.18}](OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3535, 3260, 1650w, 1575sh, 1070s, 1055s, 1024s, 970sh, 771w, 680w, 607, 459.

P344 Variscite $Al(PO_4) \cdot 2H_2O$

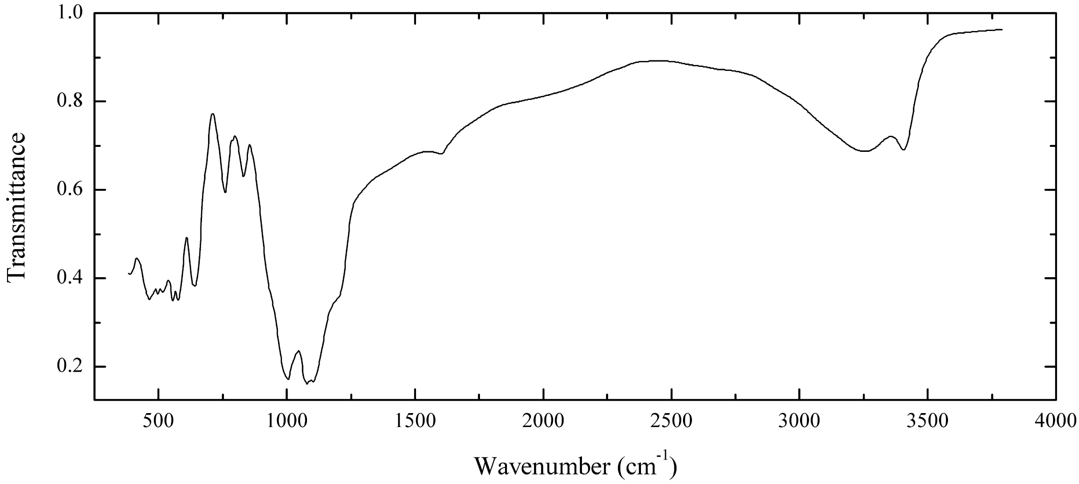


Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.

Description: Brownish spherulites from the association with kingite, alunite and kaolinite. Fe-rich variety. The empirical formula is (electron microprobe) $(Al_{0.60}Fe_{0.40})(PO_4)_{1.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3575, 3340sh, 3120, 2950sh, 1648, 1580sh, 1130sh, 1053s, 915w, 800, 680sh, 597, 570sh, 490sh, 458.

P345 Souzalite $Mg_3Al_4(PO_4)_4(OH)_6{\cdot}2H_2O$

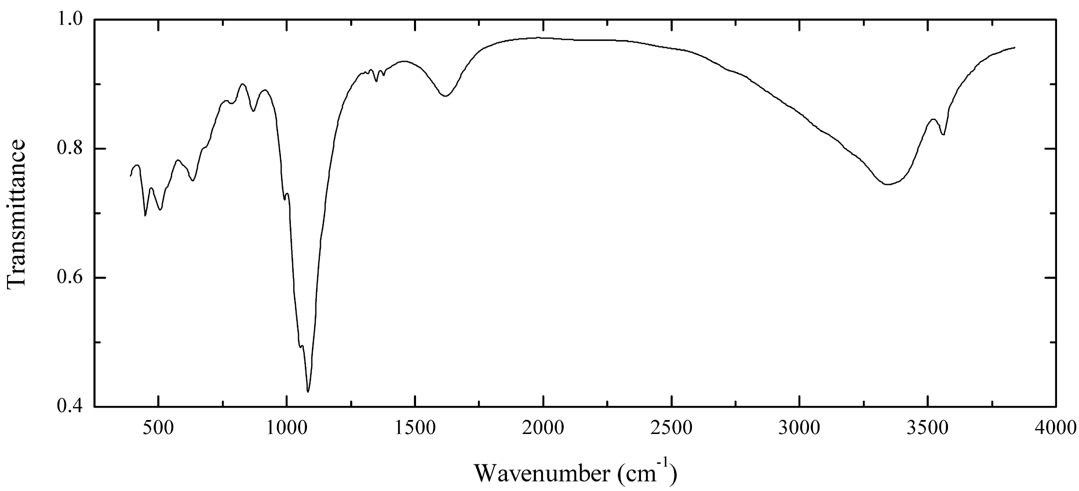


Locality: Linópolis, Divino das Laranjeiras, Doce valley, Minas Gerais, Brazil.

Description: Blue-green crystals. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $(Mg_{2.0}Fe^{2+}{}_{1.0})(Al_{3.8}Fe^{3+}{}_{0.2})(PO_4)_{4.0}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3617, 3410, 3260, 1610w, 1200sh, 1090s, 1070s, 1004s, 935sh, 832, 759, 640, 574, 553, 517, 496, 463.

P346 Cloncurryite $Cu_{0.5}(VO)_{0.5}Al_2(PO_4)_2F_2{\cdot}5H_2O$

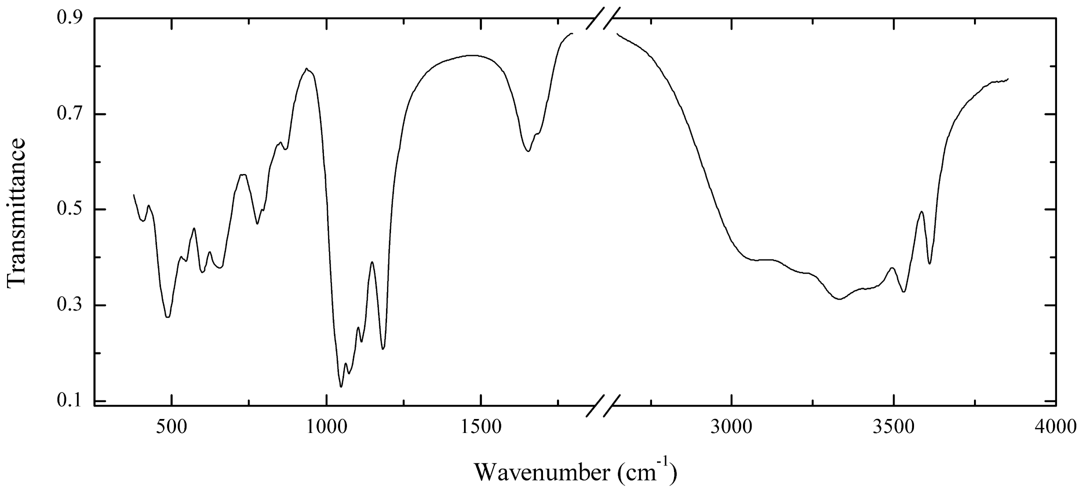


Locality: Great Australia mine, Cloncurry, Cloncurry district, Isa Mt., Queensland, Australia (type locality).

Description: Blue acicular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

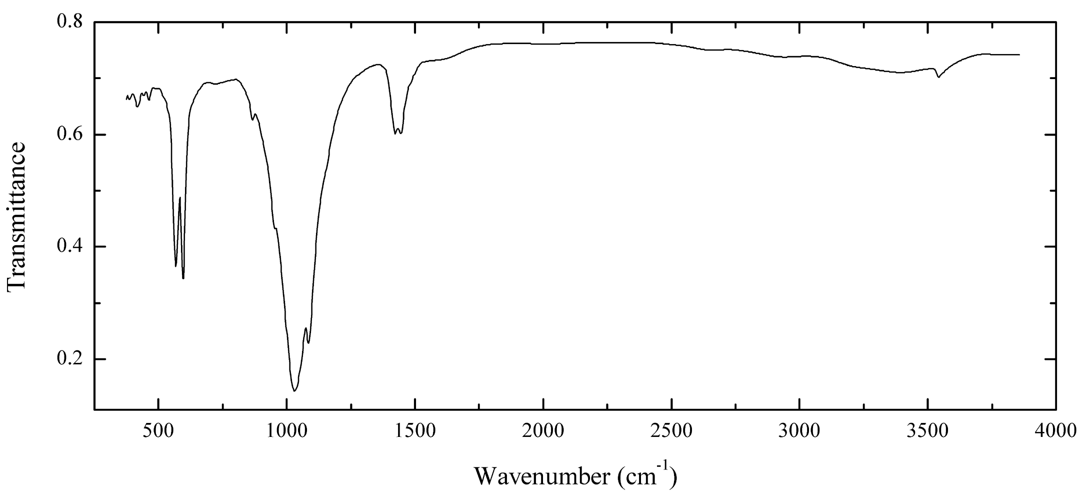
Wavenumbers (cm^{-1}): 3545, 3340, 1625, 1380w, 1350w, 1082s, 1054s, 989, 870w, 785w, 680sh, 636, 535sh, 510, 448.

P347 "Fluorkingite" $Al_3(PO_4)_2(F,OH)_3 \cdot 9H_2O$



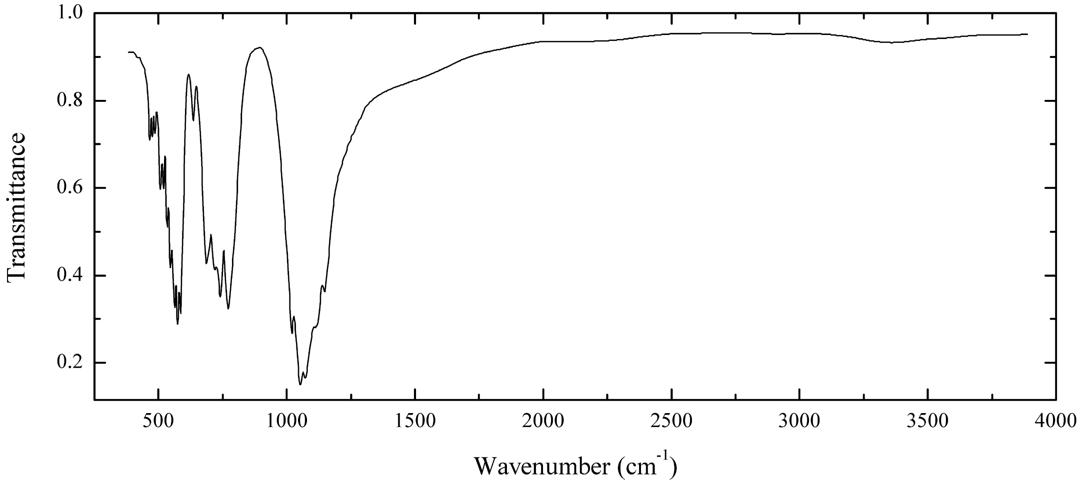
Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.
Description: White massive. F-dominant analogue of kingite. Not approved by the IMA CNMNC. The empirical formula is (electron microprobe, OH calculated) $(Al_{2.83}Fe_{0.18})(PO_4)_{2.00}F_{2.06}(OH)_{0.97} \cdot nH_2O$. Confirmed by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3590, 3515, 3405, 3315s, 3185sh, 3050, 1685sh, 1660, 1185s, 1115s, 1072s, 1046s, 867, 795sh, 777, 656, 597, 546, 488s, 412, 400.

P348 Fluorstrophite $SrCaSr_3(PO_4)_3F$



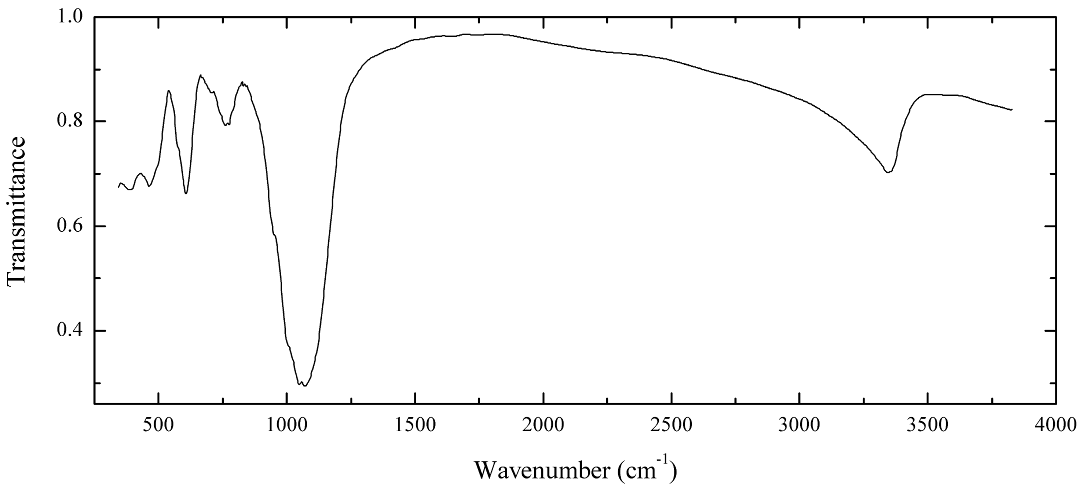
Locality: Alluaiv Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.
Description: Pink spherulites from the association with albite, lorenzenite and bitumen. CO_3-bearing variety. The empirical formula is (electron microprobe, CO_3 calculated) $Sr_{3.7}Ca_{1.0}Ba_{0.2}[(PO_4)_{2.7}(CO_3)_{0.3}]F_{0.9}(OH)_{0.2}$.
Wavenumbers (cm^{-1}): 3530w, 1453, 1427, 1086s, 1030s, 954, 864, 597, 566, 465w, 418w.

P349 Beryllonite $NaBe(PO_4)$



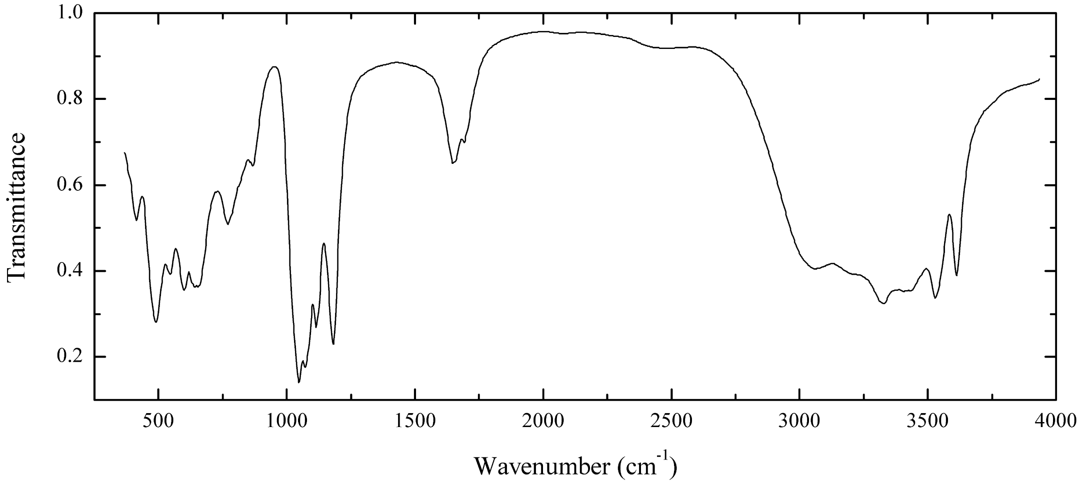
Locality: Nyet-Bruk, Braldu valley, Skardu district, Baltistan, Gilgit–Baltistan, Pakistan.
Description: Colourless pseudohexagonal crystal from the association with albite, quartz, microcline, elbaite, lepidolite and hydroxylherderite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1149, 1115sh, 1072s, 1053s, 1021, 790sh, 771, 739, 721, 685, 636w, 586, 573, 562, 543, 532, 518, 507, 487w, 474w, 467w.

P350 Zinclipscombite $ZnFe^{3+}{}_2(PO_4)_2(OH)_2$



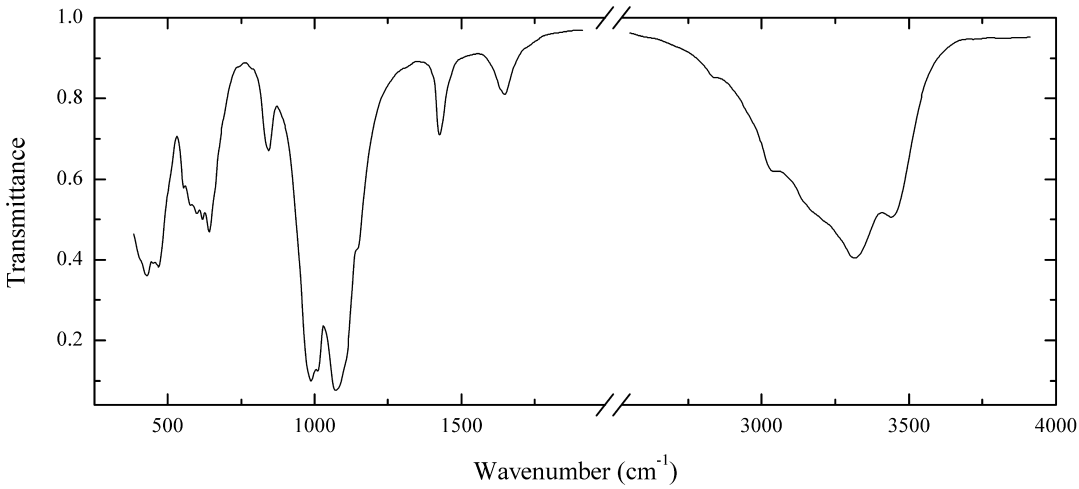
Locality: Silver Coin mine, Valmy, Edna Mountains, Humboldt Co., Nevada, USA (type locality).
Description: Green spherulites from the association with apophyllite, quartz, baryte, jarosite, plumbojarosite, turquoise and calcite. H_2O-free variety. The empirical formula is $(Zn_{0.81}Fe_{0.10}Mg_{0.04}Mn_{0.03}Cu_{0.02})(Fe^{3+}{}_{1.83}Al_{0.17})[(PO_4)_{1.98}(AsO_4)_{0.02}](OH)_2$.
Wavenumbers (cm^{-1}): 3347, 1070s, 1050s, 1010sh, 950sh, 763, 705sh, 608, 575sh, 495sh, 465, 390.

P351 Kingite $Al_3(PO_4)_2(OH,F)_3{\cdot}9H_2O$



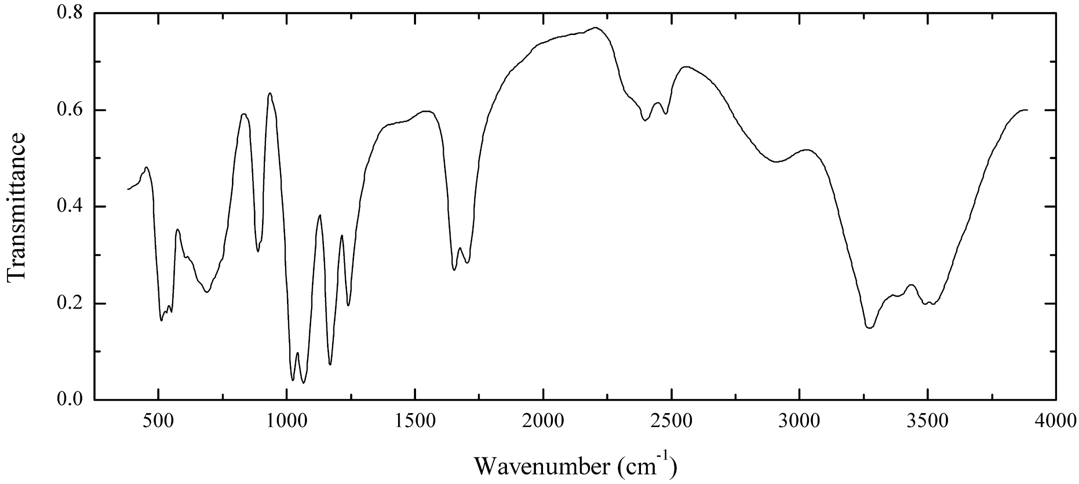
Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.
Description: Yellow powdery aggregate. The empirical formula is (electron microprobe, OH calculated) $(Al_{2.75}Fe_{0.25})(PO_4)_{2.00}F_{1.36}(OH)_{1.64}{\cdot}nH_2O$. Confirmed by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3595, 3510s, 3400, 3310s, 3190sh, 3050, 1695, 1650, 1182s, 1125sh, 1113s, 1080sh, 1071s, 1046s, 1025sh, 865, 820sh, 771, 700, 602, 545, 492s, 412, 380sh.

P352 Leucophosphite $KFe^{3+}{}_2(PO_4)_2(OH){\cdot}2H_2O$



Locality: Silver Coin mine, Valmy, Edna Mountains, Humboldt Co., Nevada, USA.
Description: Light brown crystalline crust from the association with apophyllite and calcite. NH_4- and Al-rich variety. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $K_{0.64}(NH_4)_{0.36}(Fe_{1.61}Al_{0.38})[(PO_4)_{1.99}(AsO_4)_{0.01}](OH){\cdot}nH_2O$. The bands at 3,043 and 1,432 cm^{-1} correspond to stretching and banding vibrations of the group NH_4^+, respectively.
Wavenumbers (cm^{-1}): 3448, 3315, 3180sh, 3043, 2837, 1654, 1432, 1125sh, 1073s, 1013s, 988s, 845, 643, 617, 598, 575, 551, 470, 426.

P353 Newberyite $Mg(HPO_4)\cdot 3H_2O$

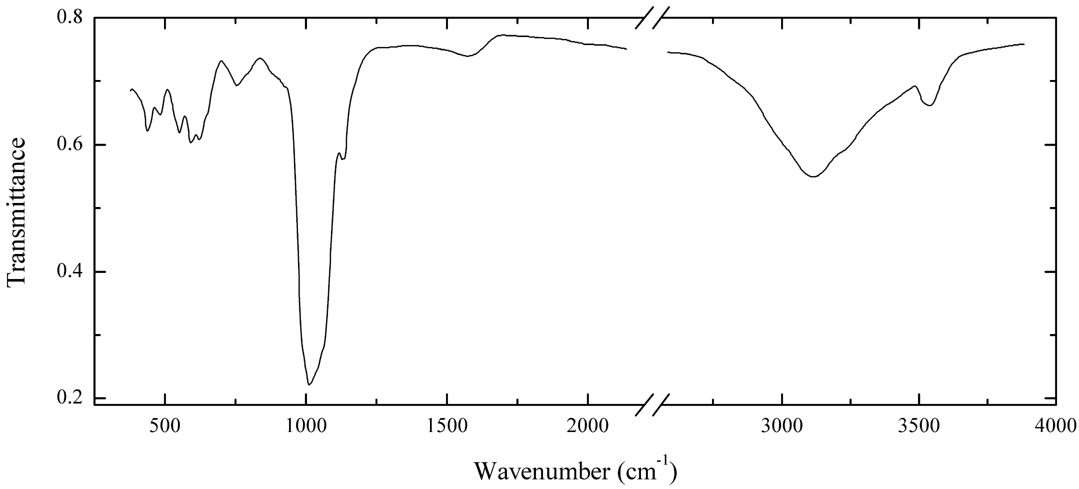


Locality: Guañape island, Virù, Trujillo province, La Libertad department, Peru.

Description: White massive from guano, from the association with stercorite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3505, 3475, 3360, 3260, 2910, 2475, 2395, 2330sh, 1705, 1655, 1240, 1167s, 1063s, 1020s, 995sh, 988, 730sh, 685, 650sh, 605sh, 548, 528, 506.

P354 Strengite $Fe^{3+}(PO_4)_2\cdot 2H_2O$

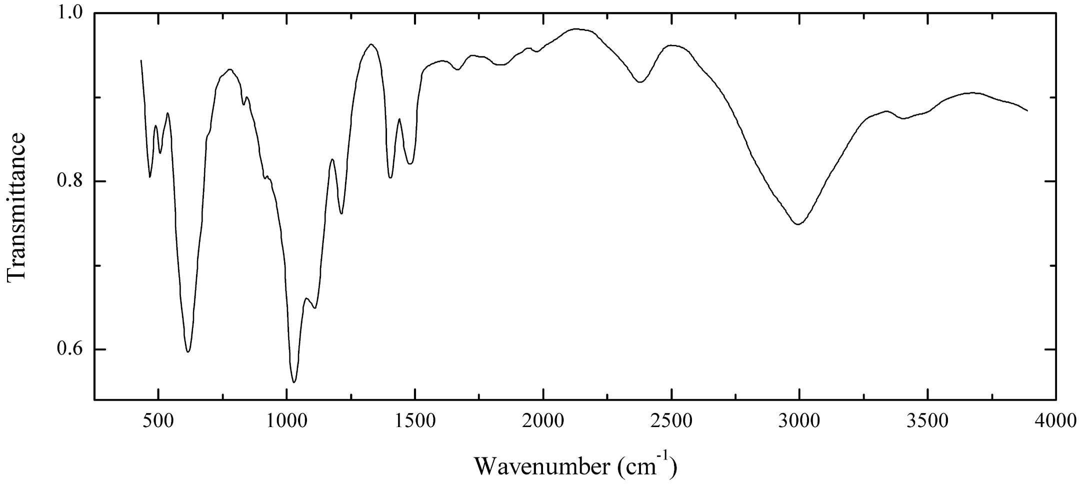


Locality: Leveäniemi mine, Svappavaara, Kiruna district, Lappland, Sweden.

Description: White outer zone of violet spherulite of Al-rich strengite, from the association with cacoxenite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3510, 3200sh, 3090, 1585w, 1130, 1060sh, 1030sh, 1013s, 995sh, 900sh, 753w, 617, 592, 551, 484, 438.

P355 Florencite-(La) $LaAl_3(PO_4)_2(OH,H_2O)_6$

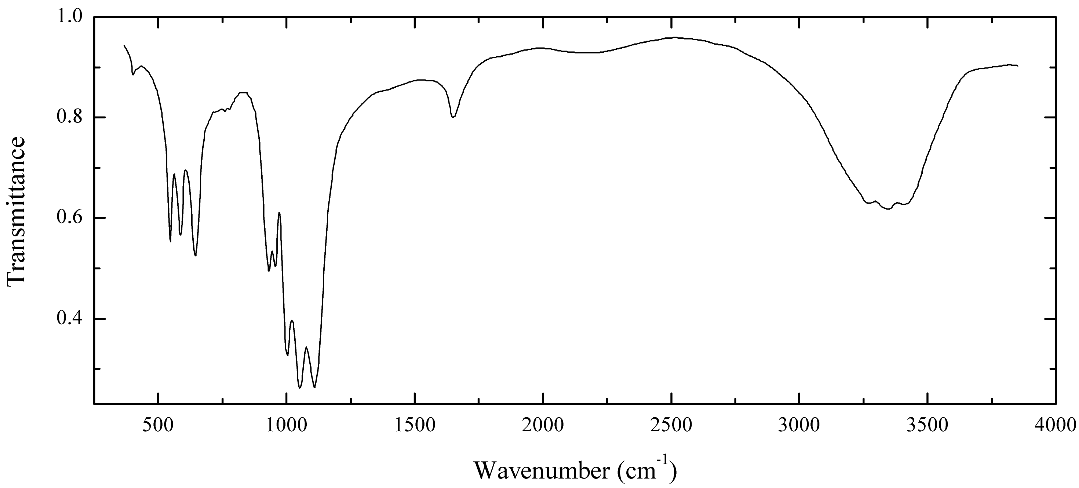


Locality: Igarapé Bahia mine, Parauapebas, Carajás mineral province, Pará, Brazil.

Description: Beige split crystals on goethite. CO_3-bearing variety. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3425sh, 3385w, 2985, 2380, 1960w, 1835w, 1670w, 1490, 1406, 1210, 1110, 1026s, 915, 832w, 705sh, 612s, 506, 466.

P356 Parascholzite $CaZn_2(PO_4)_2{\cdot}2H_2O$

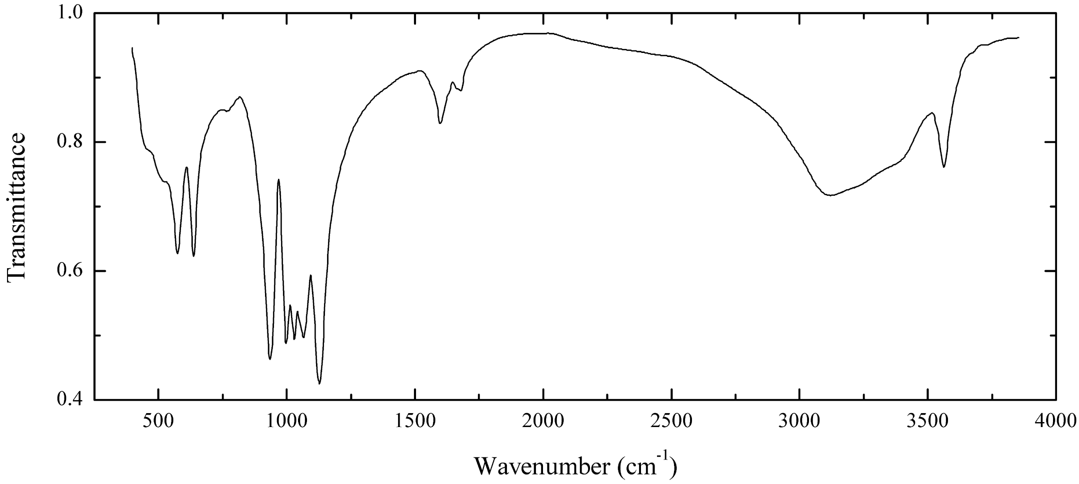


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Colourless prismatic crystals from the association with phosphophyllite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3405, 3340, 3270, 1660, 1111s, 1054s, 1005s, 958, 932, 760sh, 642, 586, 545, 405w.

P357 Phosphophyllite $Zn_2(Fe^{2+},Mn^{2+})(PO_4)_2 \cdot 4H_2O$

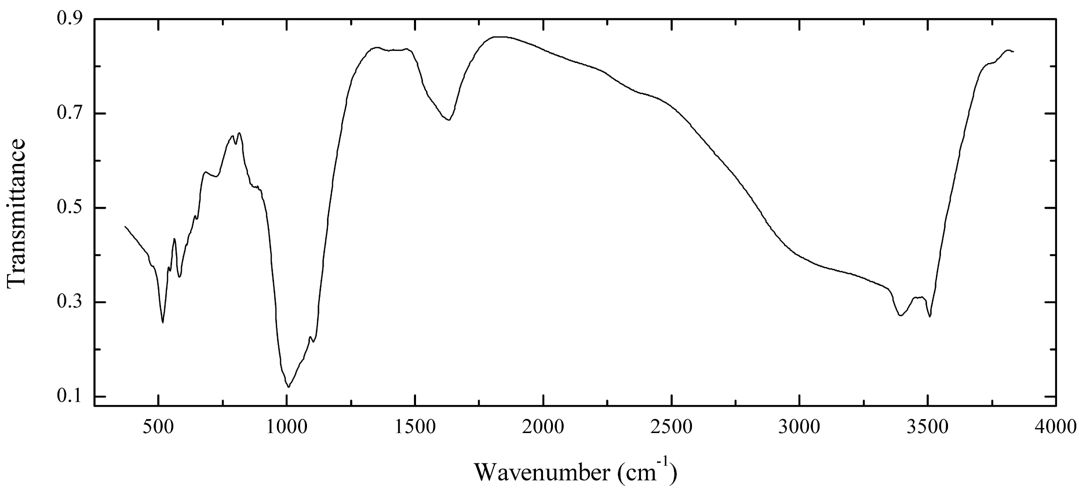


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Pale green crystals from the association with parascholzite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Zn_{1.92}(Fe_{0.77}Mn_{0.24}Mg_{0.06})(PO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3565, 3350sh, 3120, 1680w, 1605, 1129s, 1065s, 1055sh, 1033s, 1002s, 936s, 765w, 636, 572, 520sh, 465sh.

P358 Ferristrunzite $Fe^{3+}Fe^{3+}_2(PO_4)_2(OH)_3 \cdot 5H_2O$

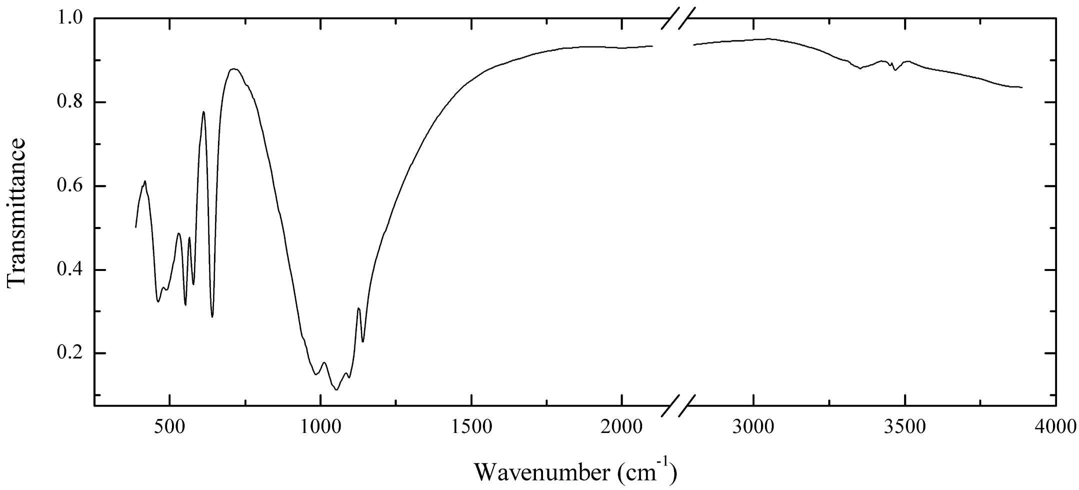


Locality: B224 Road cut, Aprath castle, Wuppertal, North Rhine-Westphalia, Germany.

Description: Straw-yellow acicular crystals. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Fe_{2.82}Mn_{0.8}(PO_4)_{2.00}(OH)_3 \cdot nH_2O$.

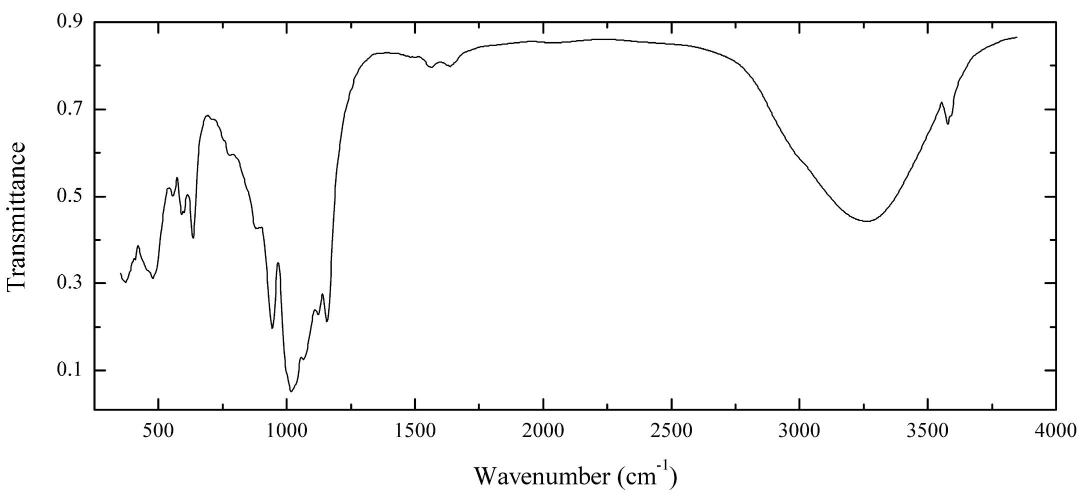
Wavenumbers (cm^{-1}): 3470s, 3360s, 3100sh, 2400sh, 1630, 1560sh, 1400w, 1103, 1050sh, 1006s, 875, 800w, 715, 648, 584, 518s, 475sh.

P359 Lithiophilite $LiMn^{2+}(PO_4)$



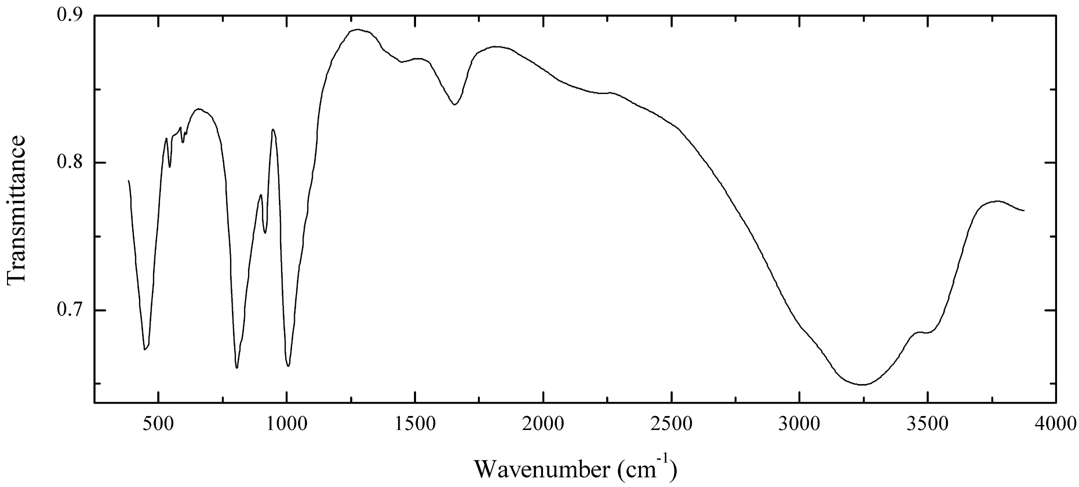
Locality: Branchville, Fairfield Co., Connecticut, USA.
Description: Ping fragment of a single crystal. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3455w, 3340w, 1138s, 1093s, 1049s, 983s, 637, 577, 550, 491, 459.

P360 Kidwellite $NaFe^{3+}{}_9(PO_4)_6(OH)_{10}{\cdot}5H_2O$



Locality: Leveäniemi mine, Svappavaara, Kiruna district, Lappland, Sweden.
Description: Yellow-green aggregate of acicular crystals from the association with cacoxenite, strengite and natrodufrenite. Confirmed by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3560, 3225, 3250sh, 1640w, 1560w, 1157s, 1121s, 1066s, 1018s, 1025sh, 945s, 885, 778, 634, 594, 555, 475, 372.

P361 Saléeite $Mg(UO_2)_2(PO_4)_2{\cdot}10H_2O$

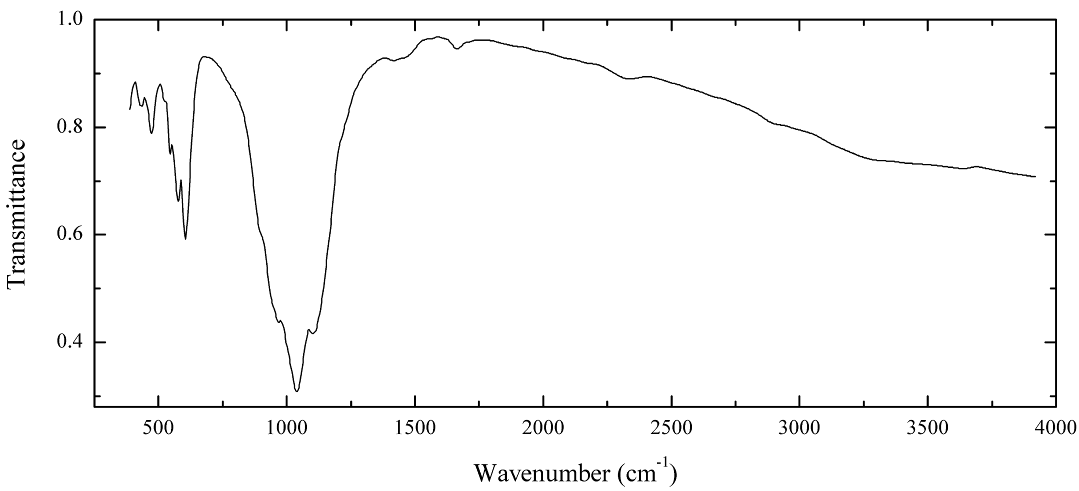


Locality: Proberil mine, Galiléia, Minas Gerais, Brazil.

Description: Yellow-brown platy crystals from the association with pharmacosiderite. The crystal structure is solved. Monoclinic, space group $P2_1/1$, $a = 6.952(2)$, $b = 19.865(5)$, $c = 6.969(2)$ Å, $\beta = 90.806(4)^o$, $Z = 2$. The empirical formula is (electron microprobe) $(Mg_{0.84}Fe_{0.23})(UO_2)_{2.00}[(P_{0.67}As_{0.32})O_4]_2{\cdot}nH_2O$. The crystal-chemical formula (by structural data) is $(Mg_{0.81}Fe_{0.19})[UO_2(P_{0.67}As_{0.33})O_4]_2{\cdot}10H_2O$.

Wavenumbers (cm^{-1}): 3500, 3215s, 3010sh, 2200w, 1650w, 1100sh, 1008s, 915, 825sh, 807s, 605w, 594w, 544w, 450.

P362 Alluaudite $(Na,Ca,\square)\square Mn^{2+}Fe^{3+}{}_2(PO_4)_3$

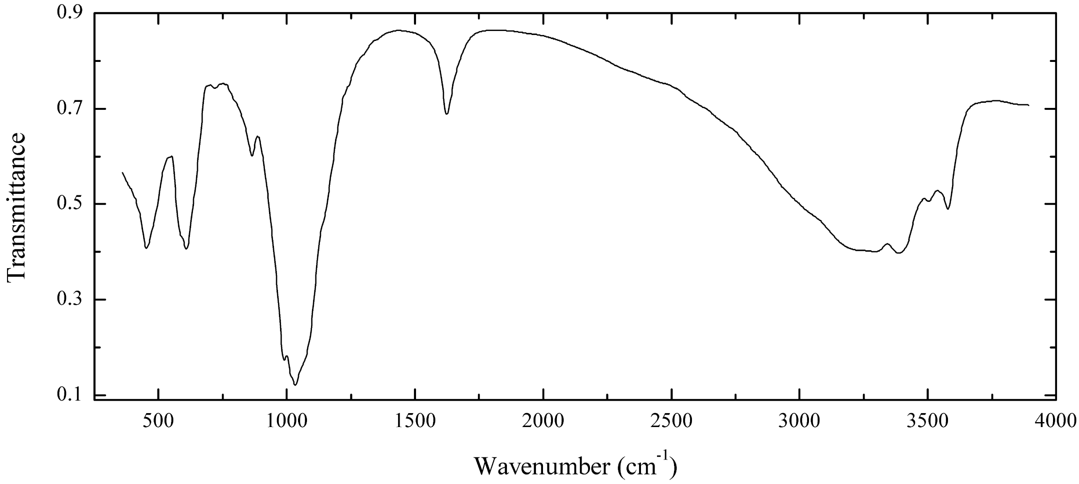


Locality: Dyke Lode, Custer, Custer district, Custer Co., South Dakota, USA.

Description: Brown massive. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Na_{0.72}Ca_{0.26})(Mn_{0.62}Fe_{0.22}Mg_{0.16})Fe_{2.04}(PO_4)_{3.00}(CO_3)_x$.

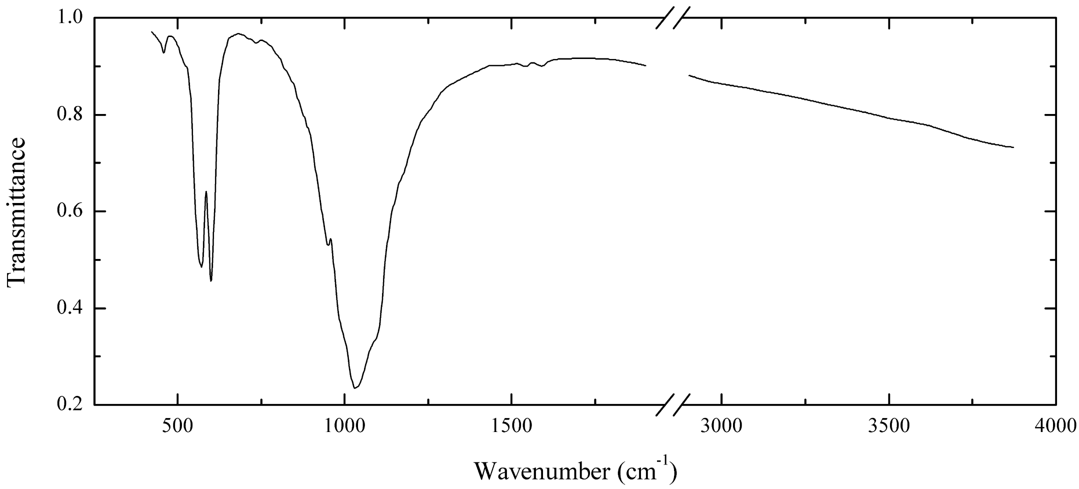
Wavenumbers (cm^{-1}): 3300w, 2900sh, 2320w, 1660w, 1460sh, 1410w, 1200sh, 1100s, 1036s, 965s, 905sh, 603, 576, 565sh, 543, 525sh, 473, 433w.

P363 Beraunite $Fe^{2+}Fe^{3+}{}_5(PO_4)_4(OH)_5{\cdot}4H_2O$



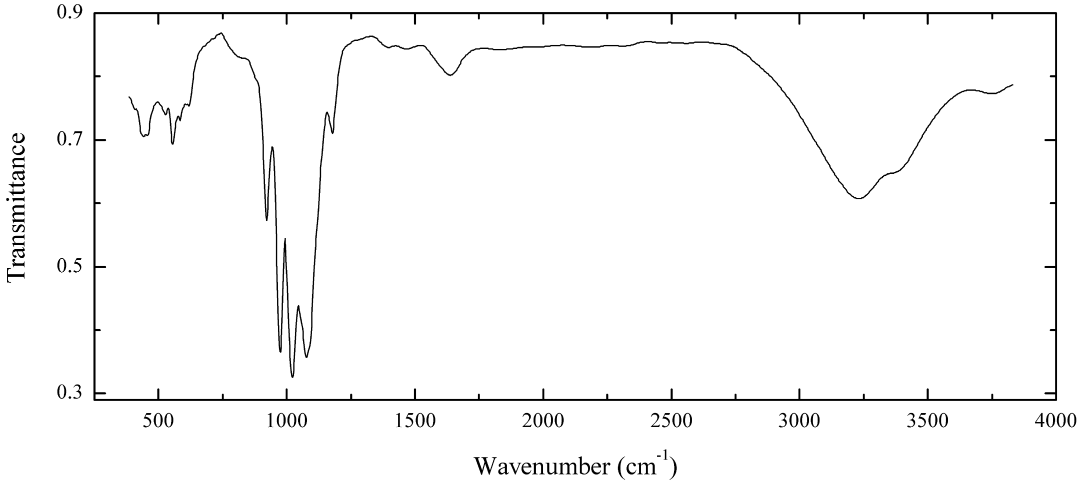
Locality: Leveäniemi mine, Svappavaara, Kiruna district, Lappland, Sweden.
Description: Radial aggregate of very dark blue-green prismatic crystals. Identified by IR spectrum. The empirical formula is $(Fe^{2+}{}_{0.92}Mg_{0.04})(Fe^{3+}{}_{4.73}Al_{0.27})(PO_4)_{4.00}(OH)_5{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3565, 3490, 3370, 3260, 3190, 3040sh, 1630, 1070sh, 1033s, 1015sh, 990s, 866, 720w, 608, 590sh, 454.

P364 Fluorcaphite $Ca(Sr,Na,Ca)(Ca,Sr,Ce)_3(PO_4)_3F$



Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).
Description: Yellow grains from the association with villiaumite, lomonosovite and barytolamprophyllite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1600w, 1550w, 1090sh, 1039s, 1000sh, 953, 601, 573, 565sh, 460w.

P365 Meurigite-K $KFe^{3+}_7(PO_4)_5(OH)_7 \cdot 8H_2O$

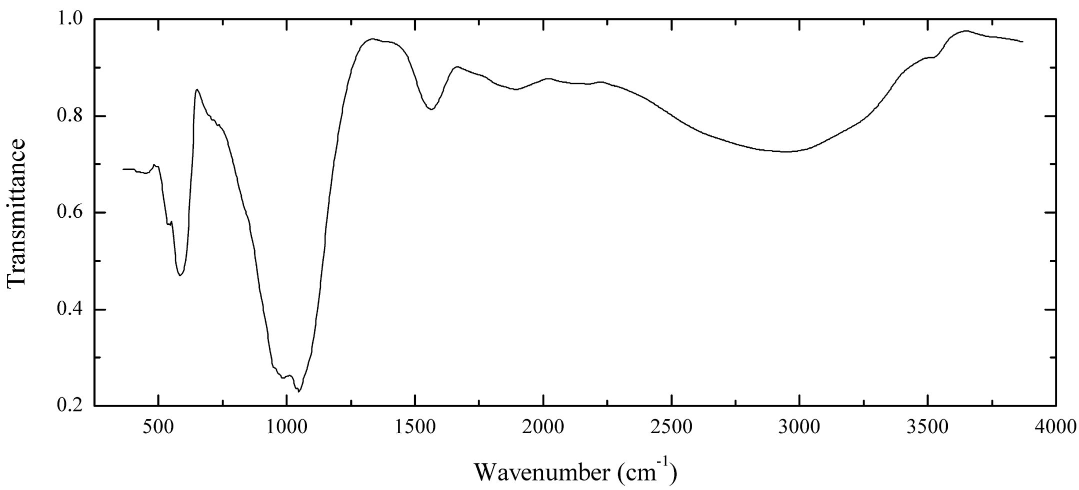


Locality: Teškov quarry, Holoubkov, Bohemia, Czech Republic.

Description: Yellow spherulite from the association with leucophosphite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $(K_{0.84}Na_{0.11})(Fe_{6.48}Al_{0.55})(PO_4)_{5.00}(OH)_7 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3370sh, 3205, 1650, 1480w, 1410w, 1186, 1078s, 1024s, 975s, 922, 630w, 590, 554, 527, 447.

P366 Kryzhanovskite $(Fe^{3+},Fe^{2+},Mn)(Fe^{3+},Mn^{3+})_2(PO_4)_2(OH,H_2O)_3$

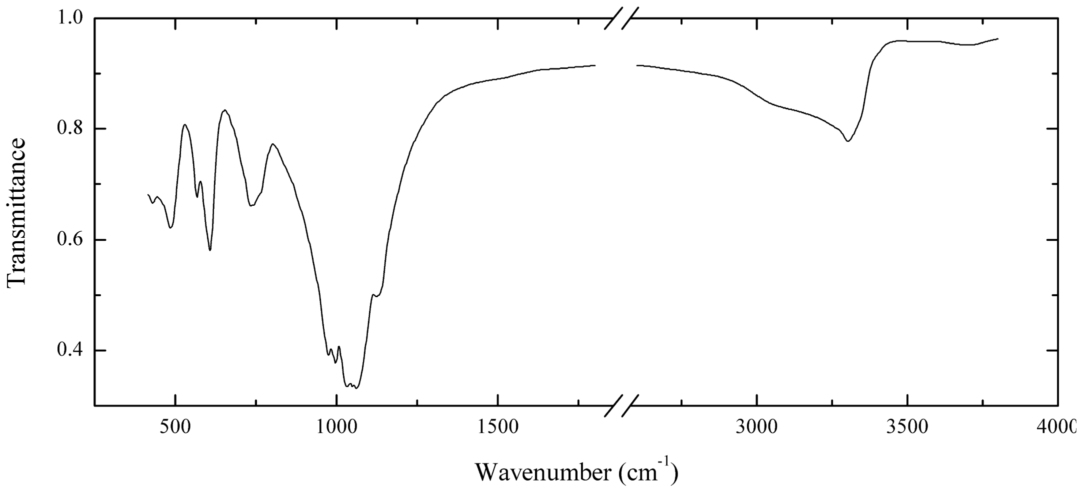


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany.

Description: Dark red-brown crystals from the association with ludlamite and siderite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Fe_{2.13}Mn_{0.89}(PO_4)_{2.00}(OH,H_2O)_3$.

Wavenumbers (cm^{-1}): 3515w, 2980, 2140w, 1795, 1560, 1048s, 985s, 955sh, 835sh, 720sh, 582, 540, 450.

P367 Barbosalite $Fe^{2+}Fe^{3+}{}_2(PO_4)_2(OH)_2$

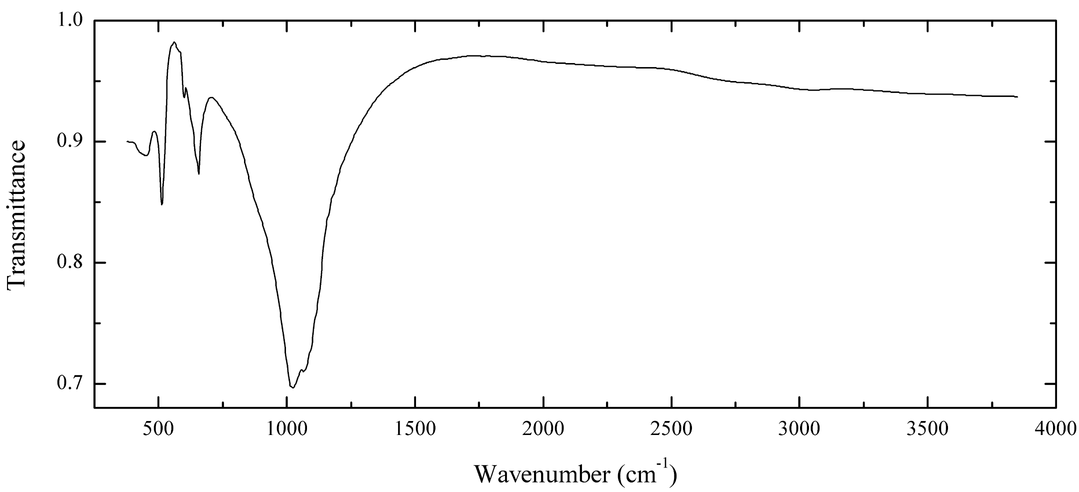


Locality: Near Boa Vista creek, Galiléia, Minas Gerais, Brazil.

Description: Very dark blue crystals from the association with strengite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Fe_{2.88}Mn_{0.08}Mg_{0.06}(PO_4)_{2.00}(OH)_2$.

Wavenumbers (cm^{-1}): 3320sh, 3295, 3100sh, 1132, 1065s, 1050sh, 1032s, 999s, 977s, 760sh, 736, 608, 595sh, 563, 483, 430w.

P368 Pretulite $Sc(PO_4)$

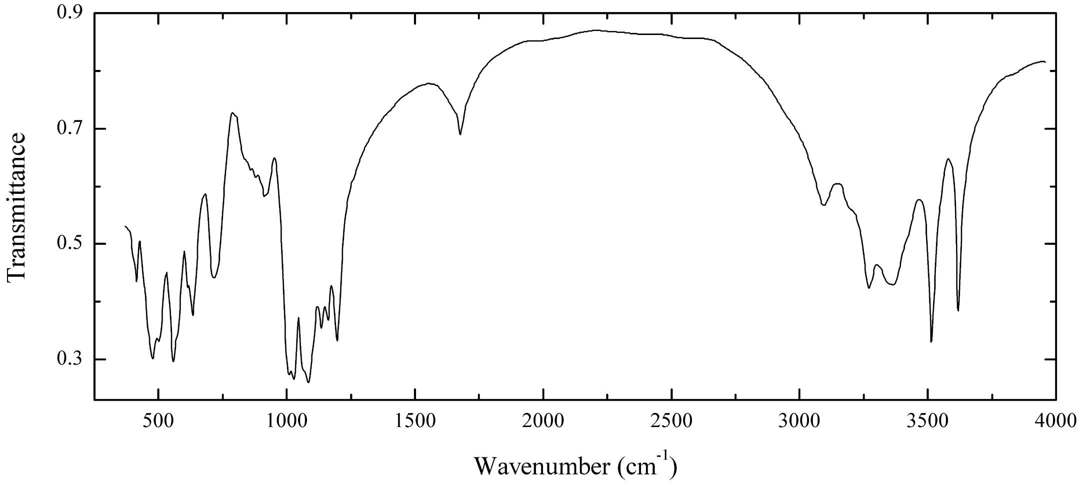


Locality: Höllkogel, 12 km south-southwest of Mürzzuschlag, Fischbacher Alpen. Styria, Austria (type locality).

Description: Light brown crystals from the association with apatite. The empirical formula is $Sc_{0.98}Al_{0.01}Fe_{0.01}(PO_4)_{1.00}$.

Wavenumbers (cm^{-1}): 1067s, 1025s, 885sh, 655, 630sh, 600w, 512, 450.

P369 Senegalite $Al_2(PO_4)(OH)_3 \cdot H_2O$

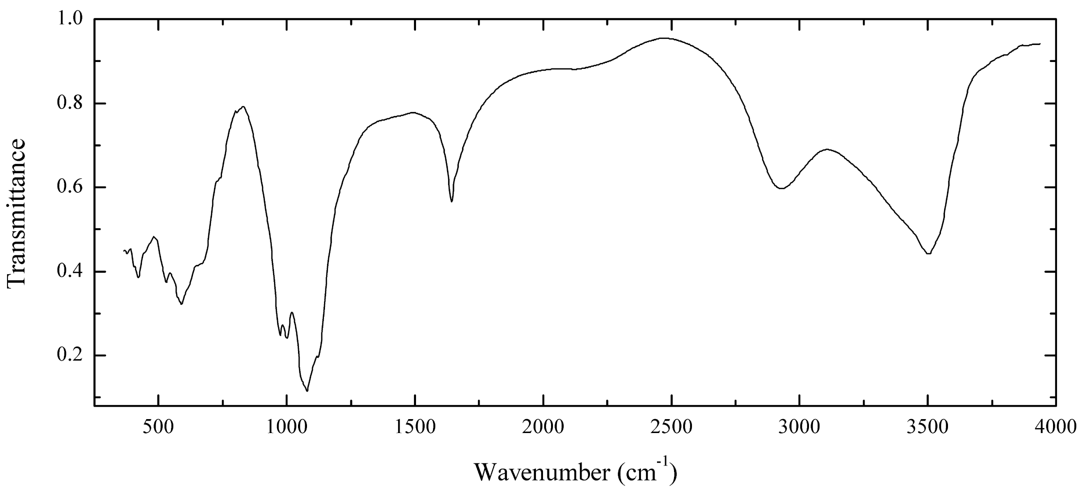


Locality: Kourou Diakouma (Kouroudiako) Mt., Saraya, Falémé River basin, Tambacounda region, Senegal (type locality).

Description: Colourless crystals from the association with turquoise. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3608, 3503, 3340, 3258, 3200sh, 3085, 1678, 1650sh, 1196s, 1162, 1137, 1084s, 1070sh, 1030s, 1013s, 923, 879, 856w, 835sh, 713, 630, 610, 570sh, 556s, 498, 477s, 470sh, 445sh, 413.

P370 Montgomeryite $Ca_2MgAl_4(PO_4)_6(OH)_4 \cdot 12H_2O$

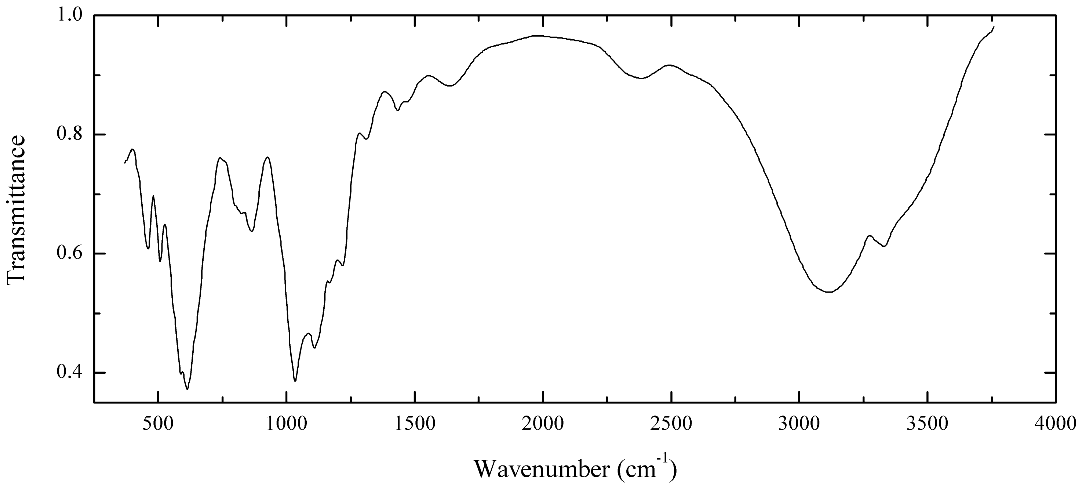


Locality: Parwan lava cave, Bacchus Marsh, Victoria, Australia.

Description: Beige crust from the association with parwanite, taranakite and montmorillonite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3480, 3380sh, 2905, 2110w, 1645, 1120s, 1074s, 999s, 973s, 730sh, 655sh, 589, 534, 422, 380.

P371 Crandallite $CaAl_3(PO_4)_2(OH,H_2O)_6$

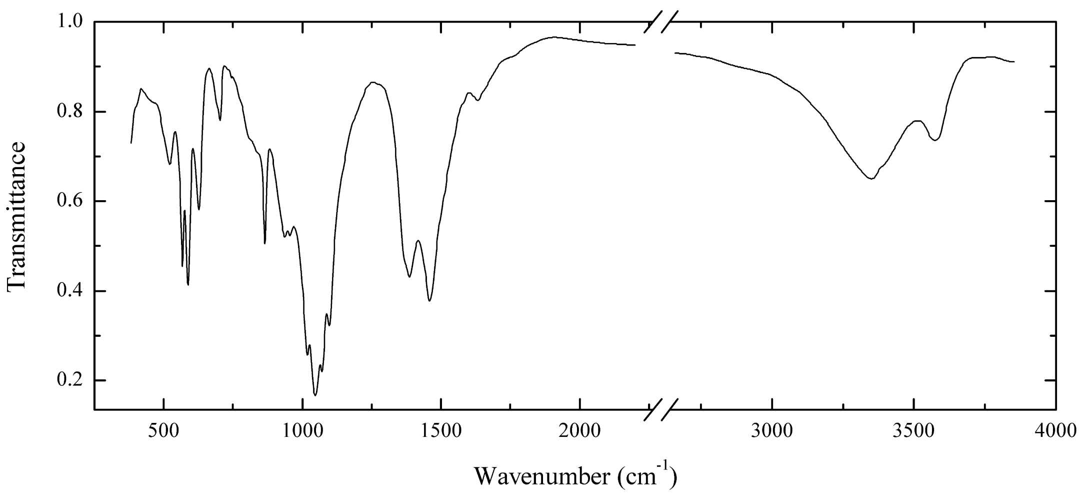


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White massive from dolomite carbonatite. SO_4- and CO_3-bearing variety. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3400sh, 3325, 3105s, 2375, 1645, 1473w, 1440, 1317, 1225, 1168, 1111s, 1035s, 767, 735, 610s, 588s, 505, 458.

P372 Skorpionite $Ca_3Zn_2(PO_4)_2(CO_3)(OH)_2 \cdot H_2O$

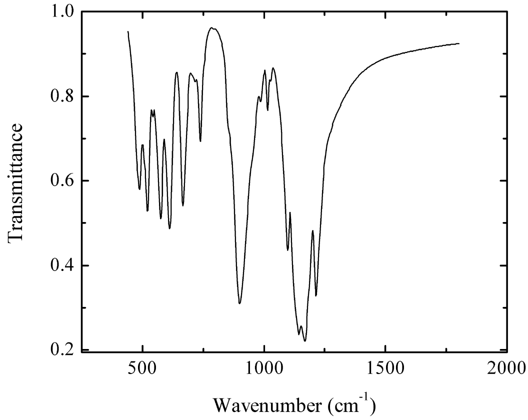


Locality: Skorpion mine, Rosh Pinah, Lüderitz district, Karas region, Namibia (type locality).

Description: Colourless acicular crystals from the association with tarbuttite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3565, 3335, 1637w, 1464s, 1390, 1097s, 1070s, 1047s, 1020s, 955, 936, 865, 840sh, 810sh, 770sh, 702, 690sh, 625, 588, 567, 520, 455sh.

P373 Sodium triphosphate $Na_5P_3O_{10}$

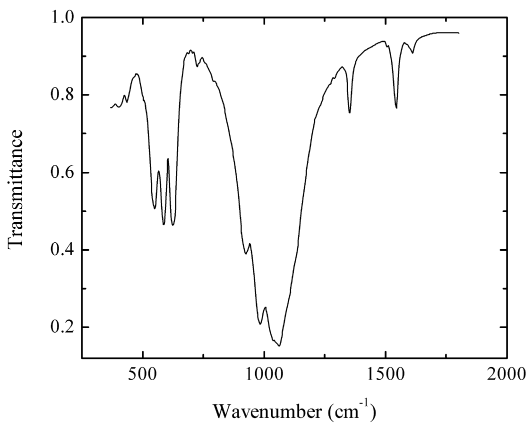


Locality: Synthetic.

Description: Colourless crystals. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1213s, 1185sh, 1167s, 1143s, 1096, 1028w, 1016, 988w, 903s, 850sh, 738, 717w, 665, 608, 573, 541w, 520, 510sh, 487.

P374 Graftonite $Fe^{2+}{}_3(PO_4)_2$

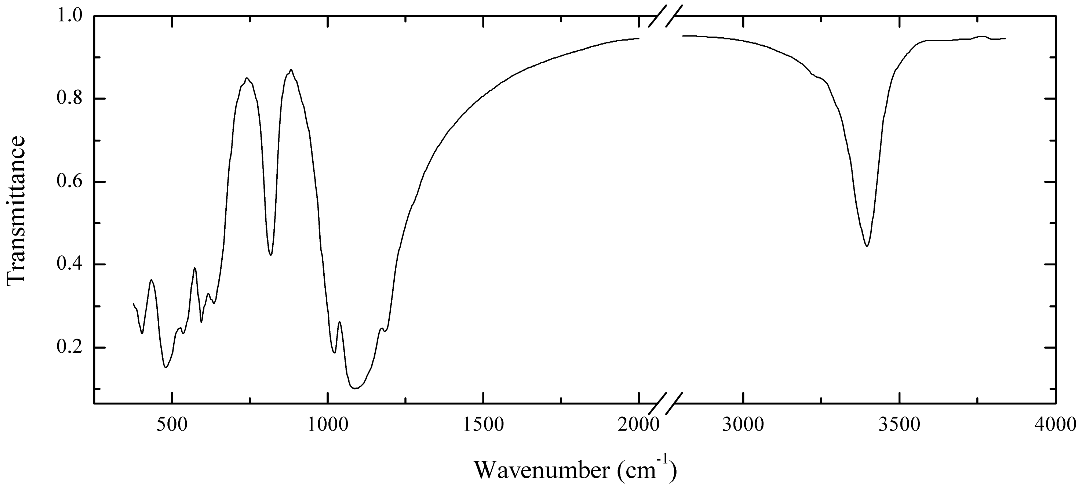


Locality: Solleftea, Ångermanland, Sweden.

Description: Light brown massive. Mn-rich and CO_3-bearing variety. The empirical formula is $Fe_{1.24}Mn_{1.15}Ca_{0.46}Mg_{0.10}(PO_4)_{1.94}(CO_3)_x$.

Wavenumbers (cm^{-1}): 1615w, 1548, 1356, 1063s, 1040sh, 986s, 972, 721w, 625, 588, 550, 432w, 400w.

P375 Montebrasite (Li,Na)Al(PO_4)(OH,F)

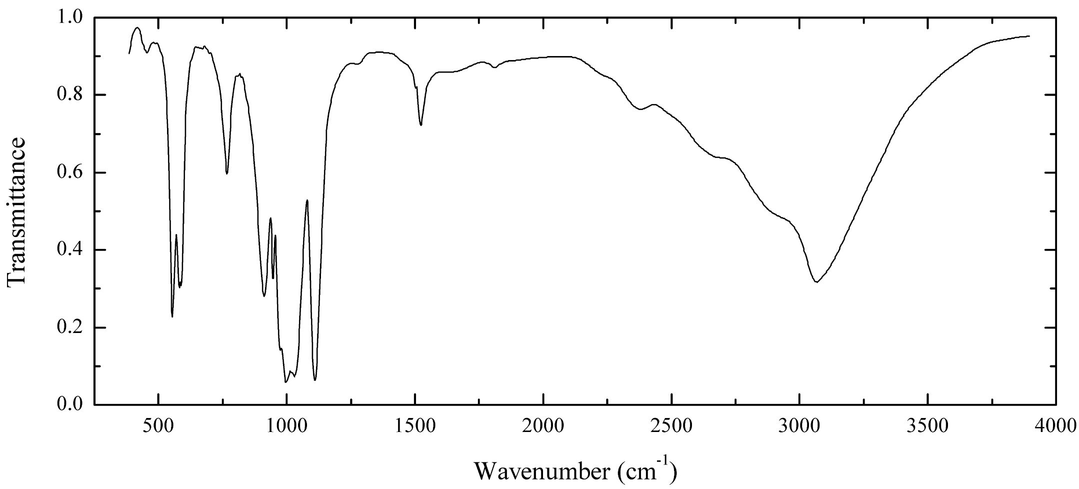


Locality: Këster deposit, Arga-Ynnakh-Khaiskaya intrusion, Yana river basin, Sakha (Yakutia) Republic, Russia.

Description: Pale green granular aggregate from the association with kësterite. The empirical formula is (electron microprobe) ($Li_xNa_{0.03}$)$Al_{1.00}$(PO_4)$_{1.00}$[(OH)$_{0.67}$$F_{0.33}$].

Wavenumbers (cm^{-1}): 3380, 1185s, 1089s, 1020s, 816, 638, 596, 539s, 482s, 405s.

P376 Collinsite $Ca_2Mg(PO_4)_2{\cdot}2H_2O$

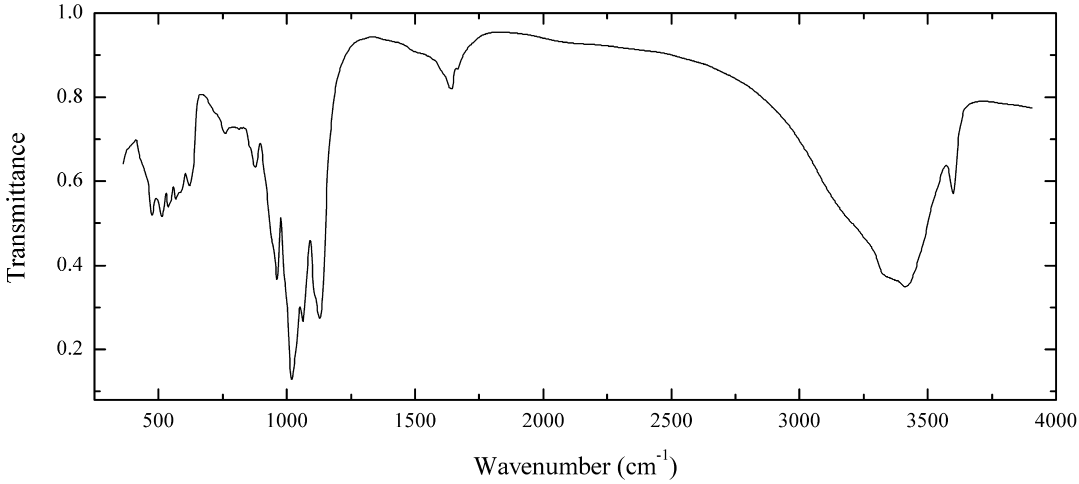


Locality: Iron mine, Kovdor, Kovdor alkaline ultramafic complex, Kola peninsula, Murnansk region, Russia.

Description: White powdery from dolomite carbonatite. Identified by IR spectrum and electron microprobe analysis. Close to the collinsite endmember. The empirical formula is $Ca_{2.00}Mg_{1.00}(PO_4)_{2.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3045, 2900sh, 2650, 2370, 2230sh, 1800w, 1630w, 1520, 1500sh, 1275w, 1110s, 1030s, 997s, 974s, 945, 910, 766, 590, 582, 555s, 450w.

P378 Tinticite $Fe^{3+}{}_4(PO_4)_3(OH)_3 \cdot 5H_2O$ (?)

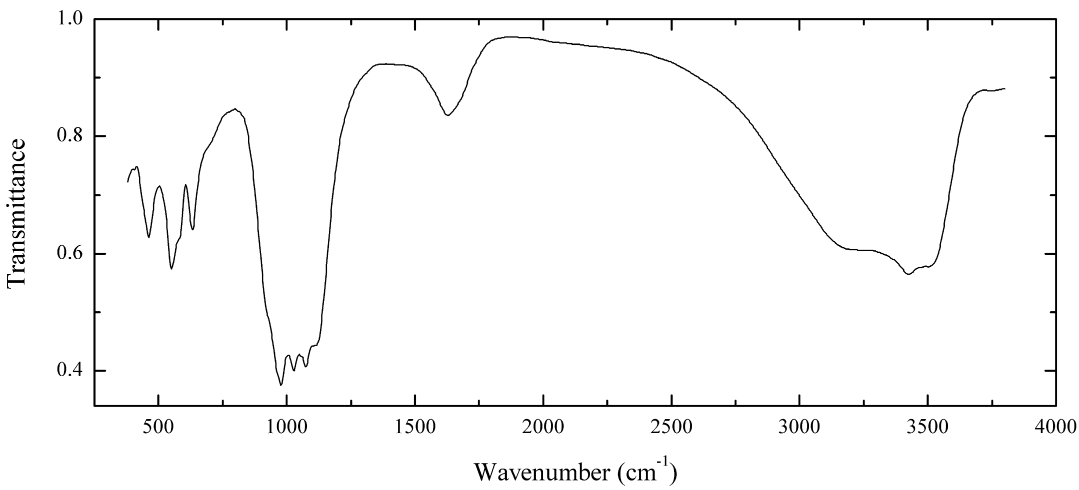


Locality: Weckersdorf, Zeulenroda, Thuringia, Germany.

Description: Pale yellow fine-grained aggregate forming nest in limonite. Identified by IR spectrum and semiquantitative electron microprobe analysis. Probably correct formula of tinticite is $Fe^{3+}{}_3(AsO_4)_2(OH)_3 \cdot 3H_2O$.

Wavenumbers (cm^{-1}): 3575, 3385s, 3320sh, 3220sh, 1660w, 1638, 1503w, 1127s, 1105sh, 1063s, 1017s, 990sh, 962s, 945sh, 873, 812w, 760w, 620, 585sh, 555, 535, 512, 475, 436sh.

P379 Jahnsite-(CaMnFe) $CaMn^{2+}Fe^{2+}{}_2Fe^{3+}{}_2(PO_4)_4(OH)_2 \cdot 8H_2O$

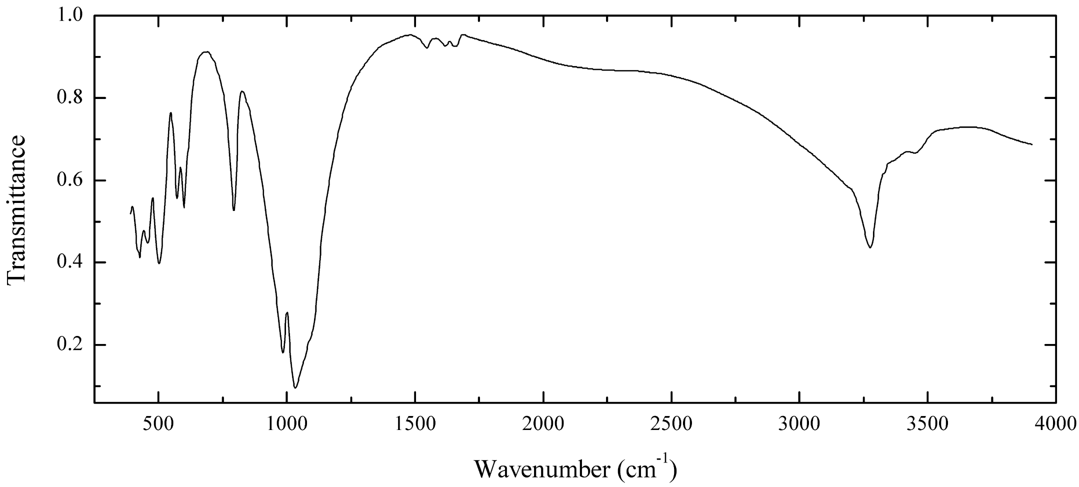


Locality: Palermo No. 1 mine, North Groton, Grafton Co., New Hampshire, USA (type locality).

Description: Brown crystals from the association with rockbridgeite. The empirical formula is (electron microprobe) $(Ca_{0.9}Na_{0.1})Mn_{1.00}(Fe_{1.0}Mg_{0.5}Mn_{0.3}Zn_{0.2})Fe_{2.0}(PO_4)_{4.0}(OH)_2 \cdot nH_2O$.

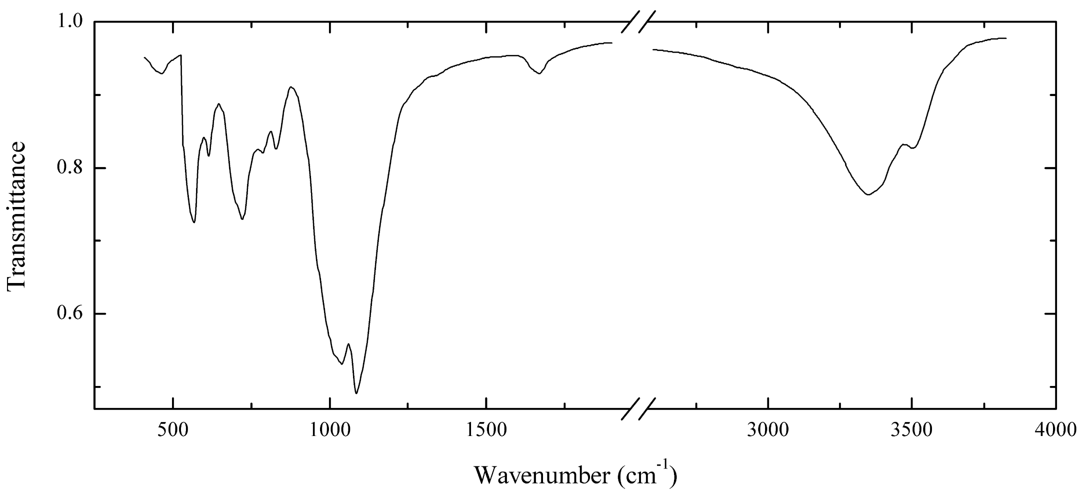
Wavenumbers (cm^{-1}): 3475, 3400, 3185, 1630, 1110sh, 1075s, 1027s, 975s, 675sh, 633, 575sh, 560sh, 548, 464.

P380 Tavorite $LiFe^{3+}(PO_4)(OH,F)$



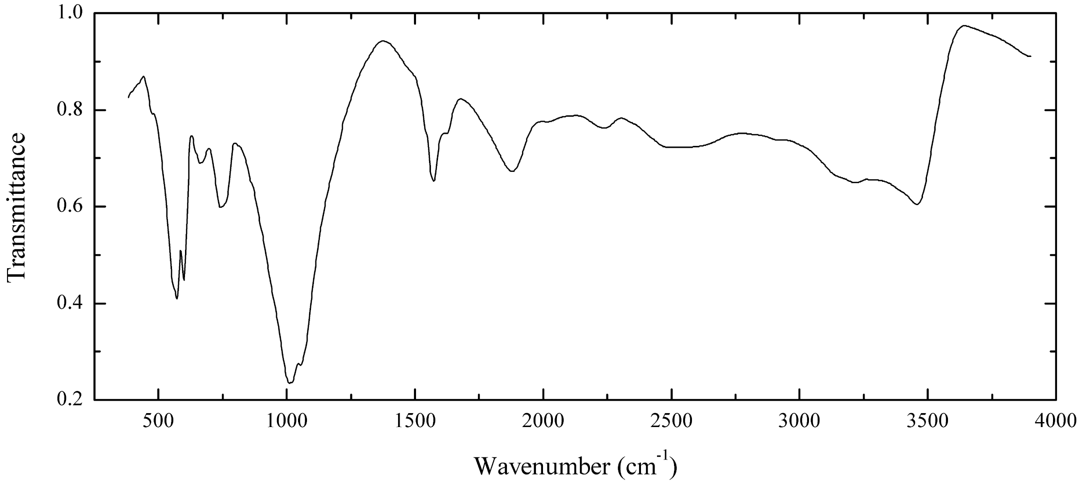
Locality: Tip Top pegmatite, near Custer, South Dakota, USA.
Description: Green grains from the association with triphylite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3435w, 3260, 1660w, 1620w, 1545w, 1090sh, 1031s, 983s, 794, 599, 570, 500, 456, 420.

P381 Zanazziite $Ca_2(Mg,Fe^{2+})(Mg,Fe^{2+},Al)_4Be_4(PO_4)_6(OH)_4{\cdot}6H_2O$



Locality: Sapucaia (Proberil) mine, Sapucaia do Norte, Galiléia, Doce valley, Minas Gerais, Brazil.
Description: Greenish-brown spherulites on feldspar. The empirical formula is (electron microprobe) $(Ca_{1.98}Sr_{0.02})(Mg_{2.58}Fe_{1.57}Al_{0.40}Mn_{0.22}Fe_{0.05})Be_4(PO_4)_{6.00}(OH)_4{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3480, 3330, 1665w, 1077s, 1038s, 1015sh, 830, 780, 722, 700sh, 615, 568, 522, 500sh, 457.

P382 Correianevesite $Fe^{2+}Mn^{2+}{}_2(PO_4)_2 \cdot 3H_2O$

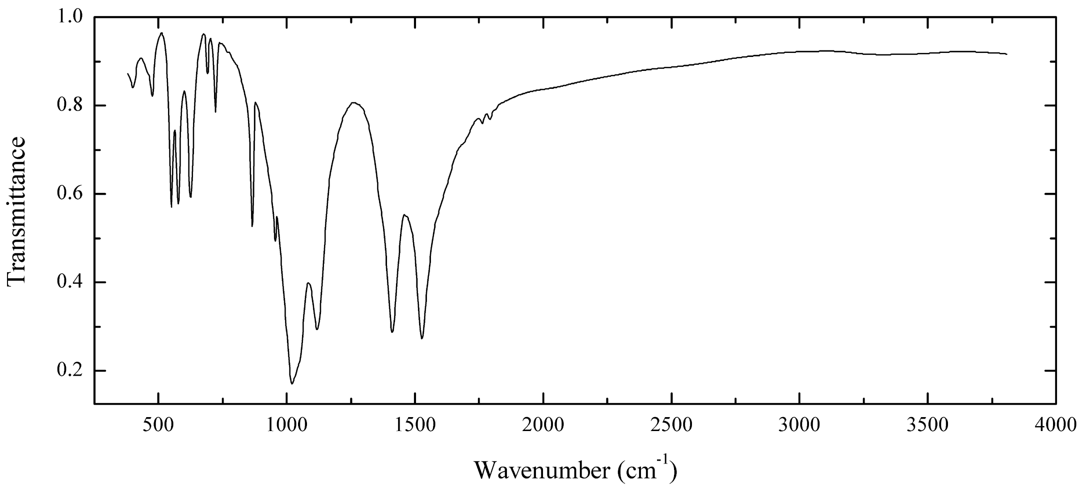


Locality: Cigana mine, Galiléia, Doce valley, Minas Gerais, Brazil.

Description: Brown crystals from the association with hureaulite. The empirical formula is (electron microprobe) $Fe_{1.20}Mn_{1.80}(PO_4)_{2.00}(H_2O,OH)_3$.

Wavenumbers (cm^{-1}): 3450, 3210, 2500, 2230w, 2015w, 1880, 1625w, 1575, 1055s, 1010s, 760sh, 745, 665, 599, 570, 560sh.

P383 Bonshtedtite $Na_2Fe(PO_4)(CO_3)$

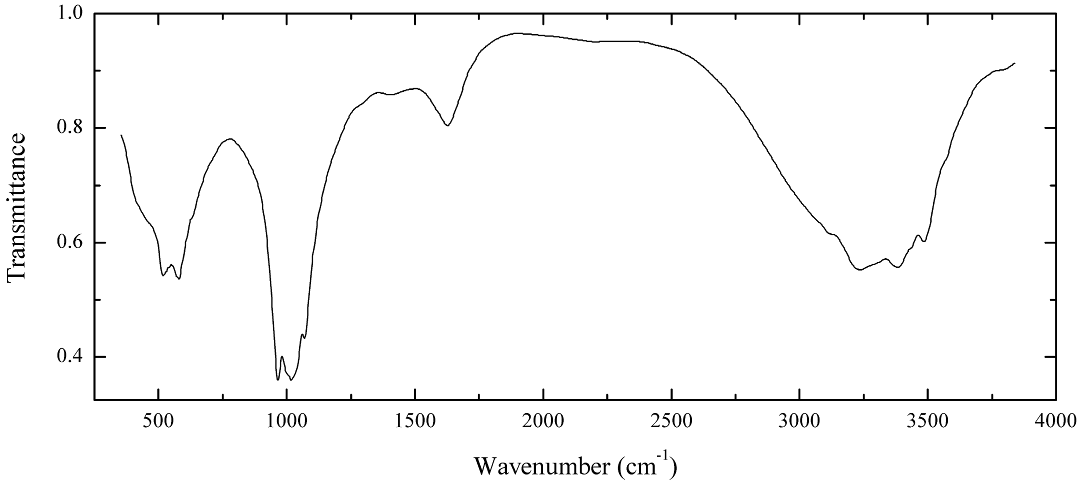


Locality: Vuonnemiok River valley, Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Colourless grains from the association with shortite, thermonatrite, eitelite, neighborite, trona, burbankite, barentsite, siderite and aegirine. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/m$, $a = 8.921$, $b = 6.631$, $c = 5.151$ Å, $\beta = 90.4°$, $Z = 2$. The empirical formula is $Na_{2.00}(Fe_{0.63}Mg_{0.17}Na_{0.12}Mn_{0.06})(PO_4)_{1.01}(CO_3)_{1.00}$. $D_{meas} = 2.95$ g/cm^3. Optically biaxial (−), $\alpha = 1.520$, $\beta = 1.568$, $\gamma = 1.591$, $2V_{meas} = -68°$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.318 (100), 2.662 (30), 8.923 (20), 2.578 (20), 2.146 (18), 1.658 (18), 1.851 (15).

Wavenumbers (cm^{-1}): 1795w, 1765w, 1545sh, 1532s, 1412s, 1122s, 1050sh, 1030sh, 1023s, 957, 868, 722, 691w, 627, 578, 550, 475, 404.

P384 Stewartite $Mn^{2+}Fe^{3+}{}_2(PO_4)_2(OH)_2 \cdot 8H_2O$

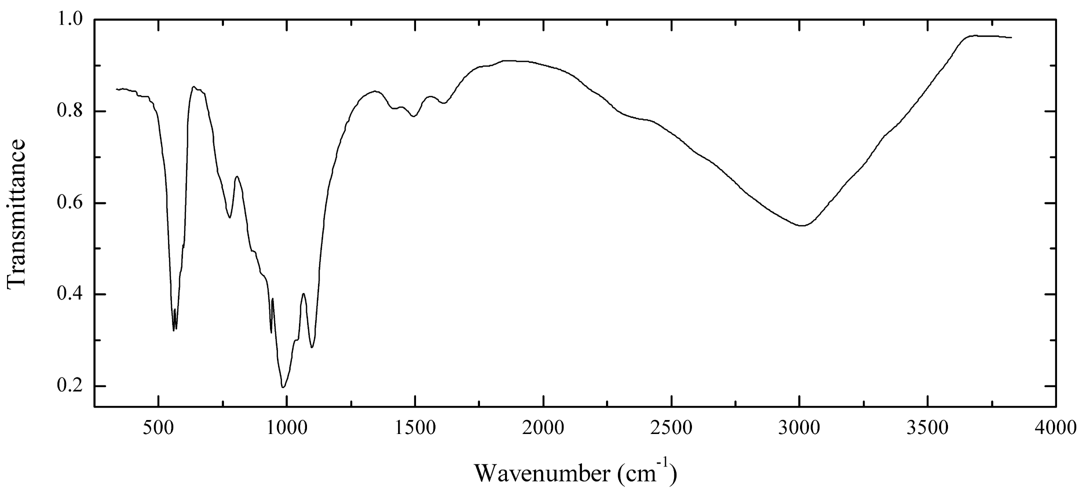


Locality: Etta mine, Keystone, Keystone district, South Dakota, USA.

Description: Aggregate of yellow prismatic crystals from the association with strengite and altered triphylite. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $H_x(Mn_{0.96}Zn_{0.02}Na_{0.02}Ca_{0.01})(Fe_{1.85}Al_{0.05}Mg_{0.03}Cr_{0.01})(PO_4)_{2.00}(OH,H_2O)_{10}$.

Wavenumbers (cm^{-1}): 3460, 3350, 3215, 3100sh, 3020sh, 1623, 1410w, 1068s, 1030sh, 1017s, 1005sh, 965s, 635sh, 578, 565sh, 512, 450sh.

P385 Fairfieldite $Ca_2(Mn^{2+},Fe^{2+})(PO_4)_2 \cdot 2H_2O$

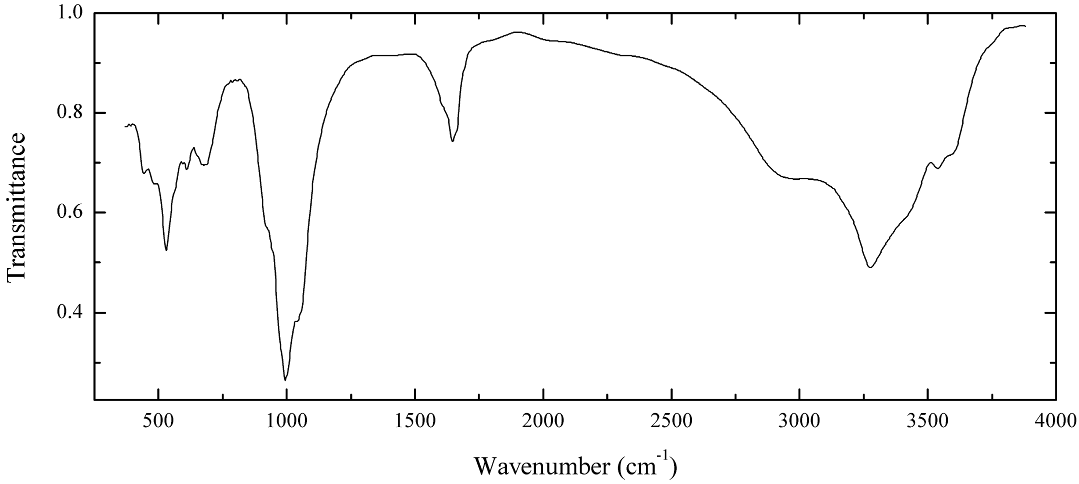


Locality: Palermo No. 1 mine, North Groton, Grafton Co., New Hampshire, USA.

Description: Light brown crystals. Identified by IR spectrum and semiquantitative electron microprobe analysis (Mn:Fe ≈ 3:2).

Wavenumbers (cm^{-1}): 3010, 2360, 1615w, 1505w, 1425w, 1100s, 1025sh, 987s, 939s, 910sh, 865, 775, 745sh, 597, 590sh, 568s, 558s.

P386 Ushkovite $MgFe^{3+}_2(PO_4)_2(OH)_2{\cdot}8H_2O$

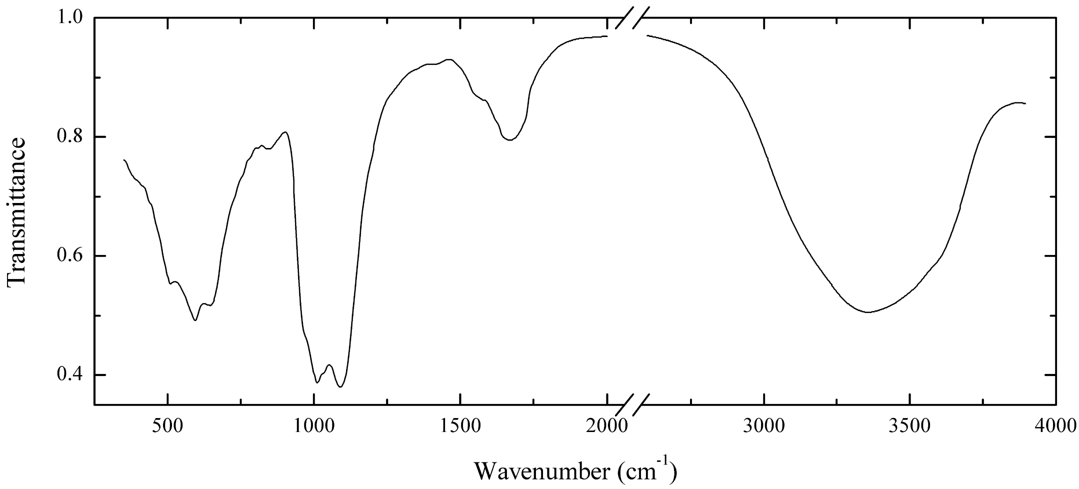


Locality: Palermo No. 1 mine, North Groton, Grafton Co., New Hampshire, USA.

Description: Orange split crystals. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $(Mg_{0.97}Fe_{0.02})(Fe_{1.86}Mn_{0.14})(PO_4)_{2.00}(OH)_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3570sh, 3510, 3255, 2950, 1645, 1040s, 993s, 945sh, 920sh, 680, 611, 530, 490, 446.

P387 Angastonite $CaMgAl_2(PO_4)_2(OH)_4{\cdot}7H_2O$

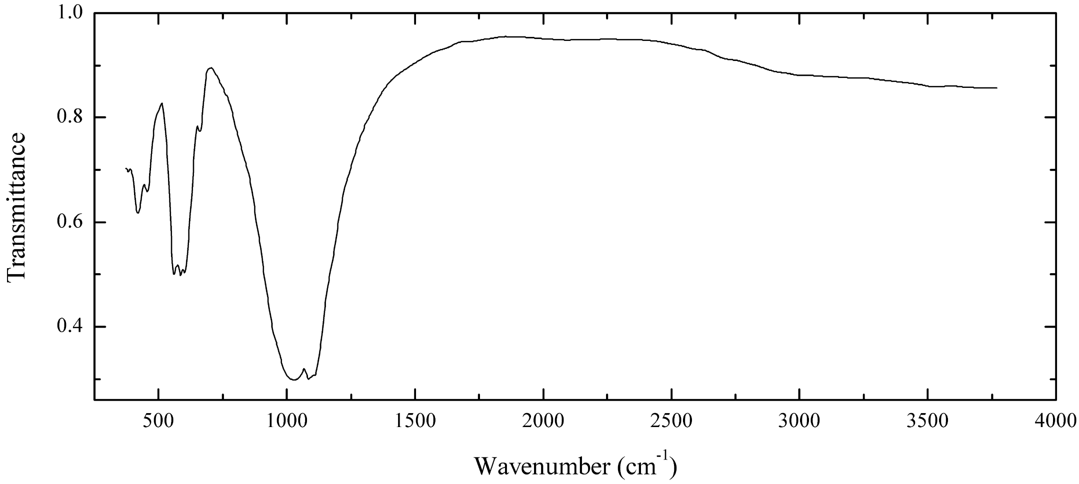


Locality: Angaston, Lofty Ranges, 100 km north-northeast of Adelaide, South Australia, Australia (type locality).

Description: White crystals.

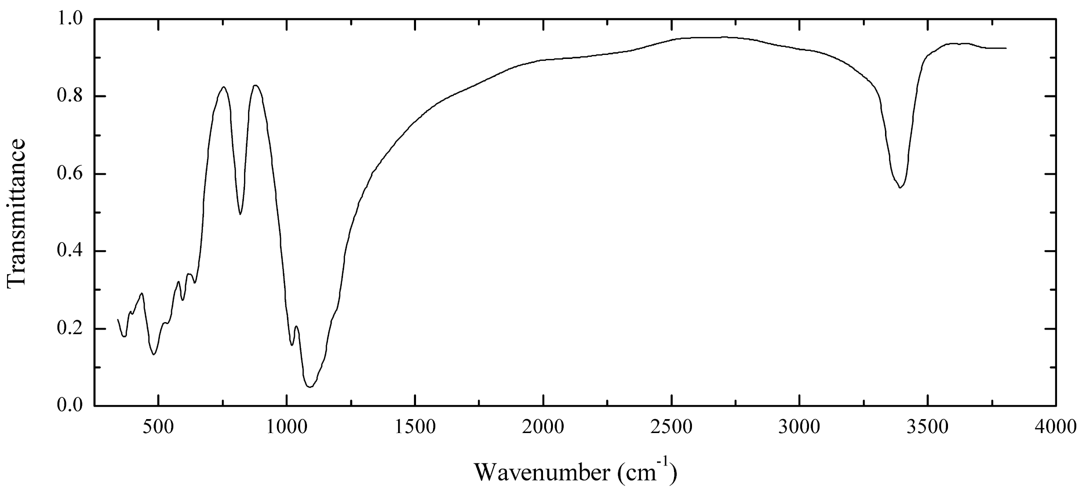
Wavenumbers (cm^{-1}): 3615sh, 3340s, 1670, 1560sh, 1412w, 1090s, 1035sh, 1012s, 970sh, 845w, 644, 593, 507, 400sh.

P388 Arrojadite-(KFe) $(KNa)Fe^{2+}(CaNa_2)Fe^{2+}{}_{13}Al(PO_4)_{11}(HPO_4)(OH)_2$



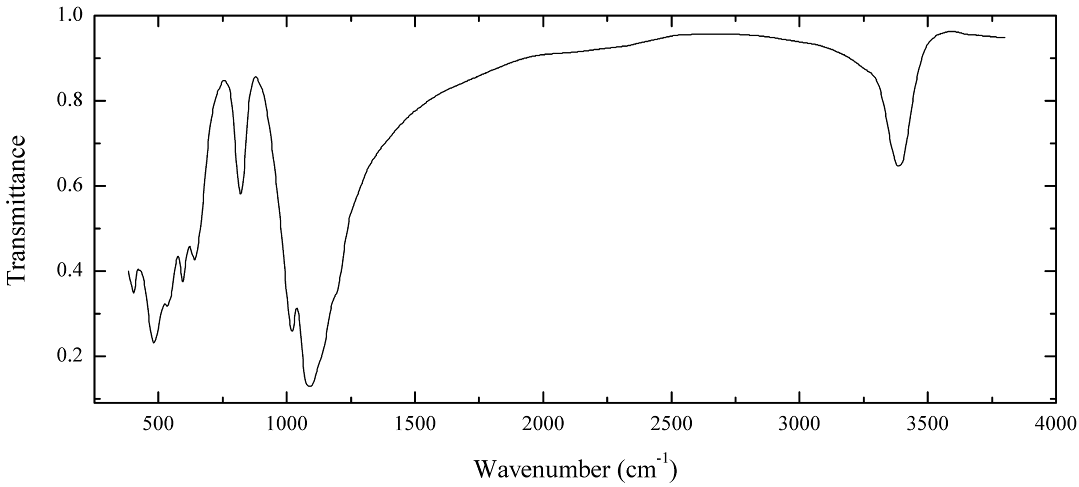
Locality: Nickel Plate mine, Keystone district, Pennington Co., South Dakota, USA (type locality).
Description: Dark green massive from the association with muscovite. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3525w, 1105sh, 1084s, 1028s, 660w, 600, 585, 558, 455, 419.

P389 Amblygonite $(Li,Na)Al(PO_4)(F,OH)$



Locality: Vasin-Myl'k Mt., Voron'i Tundras, Kola peninsula, Murnansk region, Russia.
Description: White coarse-grained aggregate from Li-rich pegmatite. The empirical formula is (electron microprobe, OH calculated) $(Li_xNa_{0.14})Al_{1.10}(PO_4)_{1.00}[F_{0.55}(OH)_{0.45}]$.
Wavenumbers (cm^{-1}): 3368, 1190sh, 1090s, 1020s, 819.5, 644, 597, 536s, 484s, 402. 365s.

P390 Amblygonite (Li,Na)Al(PO_4)(F,OH)

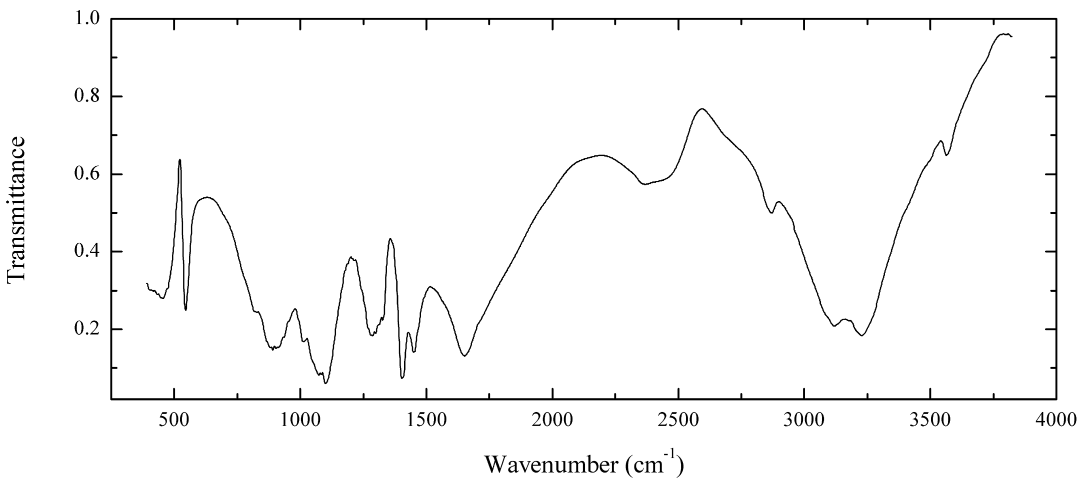


Locality: Tin Mountain mine, Fourmile, Custer district, Custer Co., South Dakota, USA.

Description: White single-crystal grain from Li-rich pegmatite. The empirical formula is (electron microprobe, OH calculated) $Li_xAl_{1.06}(PO_4)_{1.00}[F_{0.60}(OH)_{0.40}]$.

Wavenumbers (cm^{-1}): 3360, 1190sh, 1093s, 1080sh, 1019s, 820, 641, 596, 537, 484s, 406.

P391 Biphosphammite (NH_4)H_2(PO_4)

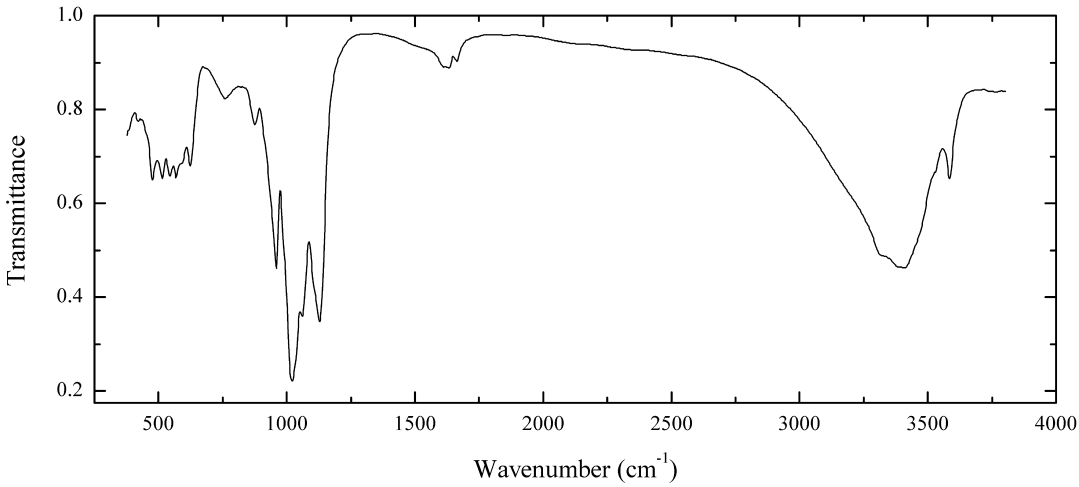


Locality: Petrogale cave, Eucla, Western Australia, Australia.

Description: Light grey massive from guano, from the association with aphthitalite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3575, 3235s, 3125s, 2870, 2430sh, 2360, 1648s, 1448, 1401s, 1320sh, 1292, 1106s, 1070s, 1018, 920sh, 887, 822, 544, 450, 410sh.

P392 Tinticite $Fe^{3+}_4(PO_4)_3(OH)_3 \cdot 5H_2O$ (?)

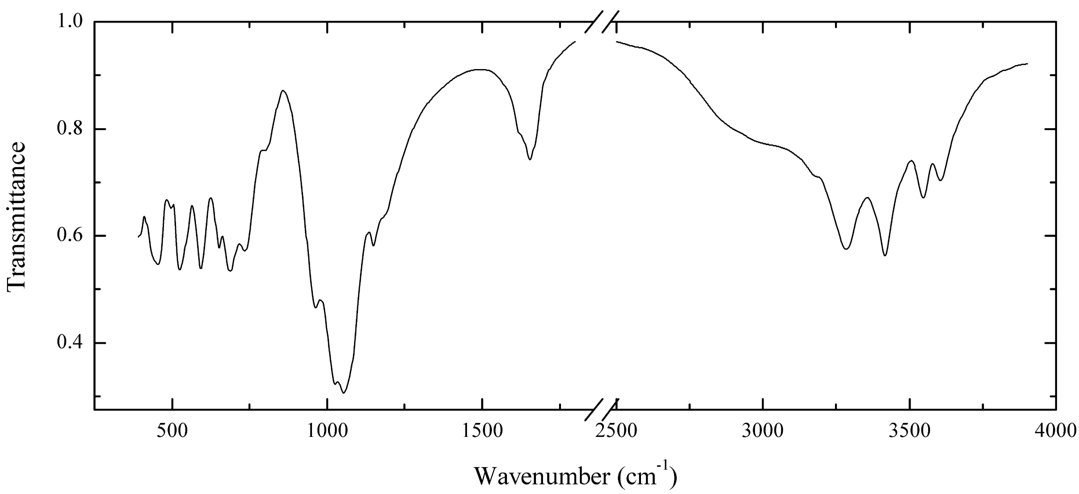


Locality: Rocabruna mine, Bruguers, Gavá, Barcelona, Spain.

Description: Pale yellow fine-grained aggregate forming concretion. Identified by IR spectrum and semiquantitative electron microprobe analysis. Probably correct formula of tinticite is $Fe^{3+}_3(AsO_4)_2(OH)_3 \cdot 3H_2O$.

Wavenumbers (cm^{-1}): 3580, 3385, 3320sh, 3200sh, 1665w, 1630w, 1129s, 1062s, 1021s, 990sh, 961s, 875, 758w, 623, 585sh, 557, 539, 512, 475, 430w.

P393 Gordonite $MgAl_2(PO_4)_2(OH)_2 \cdot 8H_2O$

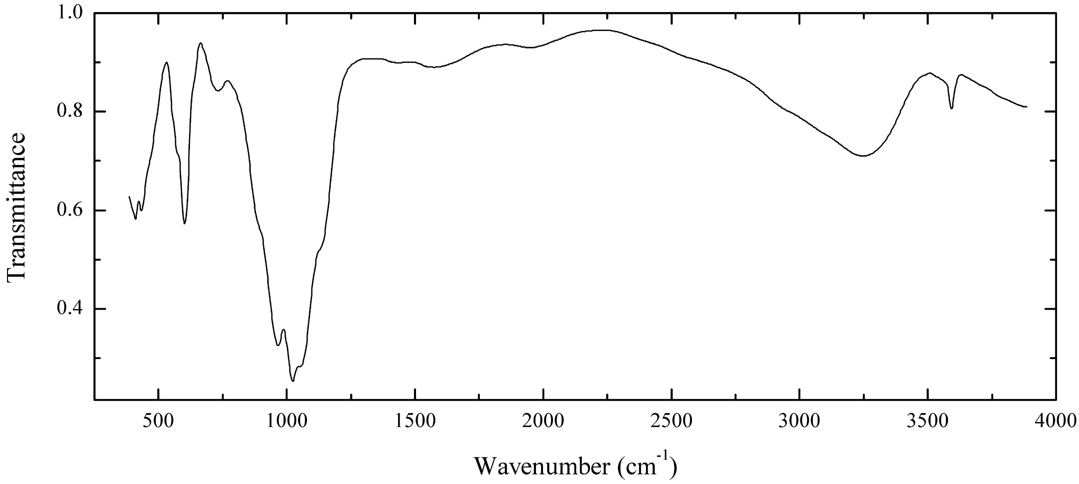


Locality: Tip Top pegmatite, near Custer, South Dakota, USA.

Description: Colourless pseudomorph after beryl. Confirmed by IR spectrum. The empirical formula is (electron microprobe, OH calculated) $(Mg_{0.98}Mn_{0.02}Zn_{0.01})(Al_{1.92}Fe_{0.04})(PO_4)_{2.00}(H_2O,OH)_{10}$.

Wavenumbers (cm^{-1}): 3600, 3540, 3410, 3275, 3175sh, 3020sh, 1658, 1630sh, 1180sh, 1153, 1055s, 1027s, 964, 795w, 786, 688, 651, 593, 527, 499w, 454.

P394 Frondelite $Mn^{2+}Fe^{3+}_4(PO_4)_3(OH)_5$

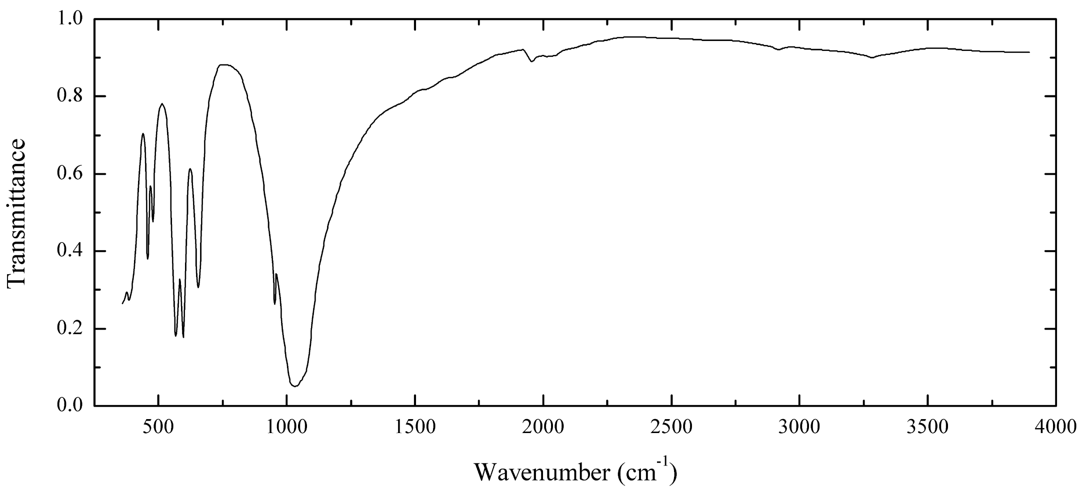


Locality: Cigana mine, Galiléia, Doce valley, Minas Gerais, Brazil.

Description: Dark green radial aggregates from the association with hureaulite and landesite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Mn_{0.98}Fe_{0.01})(Fe_{4.00})(PO_4)_{3.00}(OH)_5$.

Wavenumbers (cm^{-1}): 3575, 3240, 1950w, 1580w, 1440w, 1130sh, 1055s, 1024s, 967s, 900sh, 730, 640sh, 601, 580sh, 436, 412.

P395 Isokite $CaMg(PO_4)F$

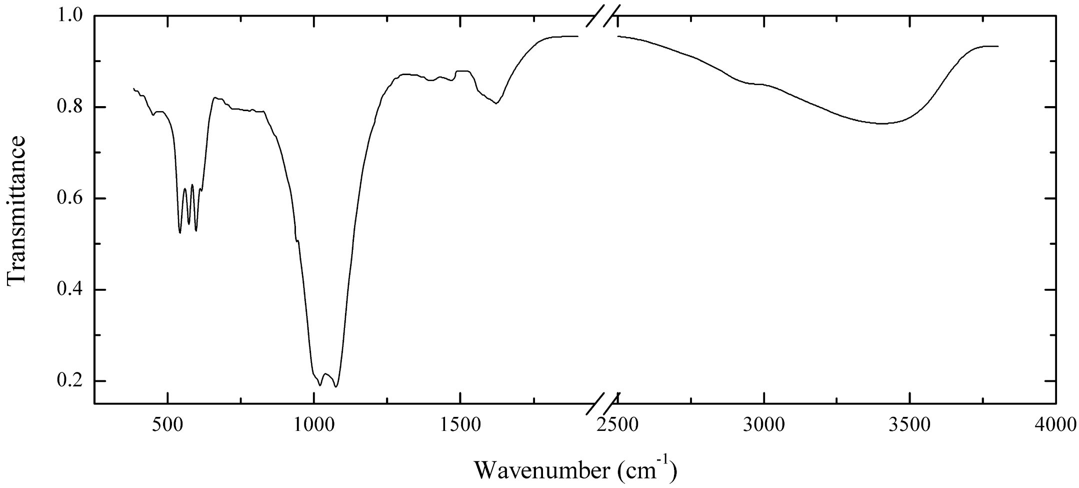


Locality: Mariinskoe deposit, Emerald Mines, Middle Urals, Russia.

Description: Light pink single-crystal grain from the association with talc and phlogopite. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $(Ca_{0.96}Sr_{0.02}Ce_{0.01})(Mg_{0.99}Al_{0.01})(PO_4)_{1.00}(F,OH)$. $D_{meas} = 3.2$ g/cm^3. Optically biaxial (+), $\alpha = 1.590, \beta = 1.596, \gamma = 1.612$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 3.19 (100) (111), 3.02 (90) (202), 2.78 (40) (200), 2.63 (60) (131), 2.58 (300) (022), 2.30 (50) (132).

Wavenumbers (cm^{-1}): 3225w, 2912w, 2020w, 1956w, 1650w, 1550w, 1070sh, 1034s, 952, 653, 594s, 565s, 477, 457, 385.

P396 Kuannersuite-(Ce) $Ba_6Na_2(Ce,REE)_2(PO_4)_6(F,Cl)$

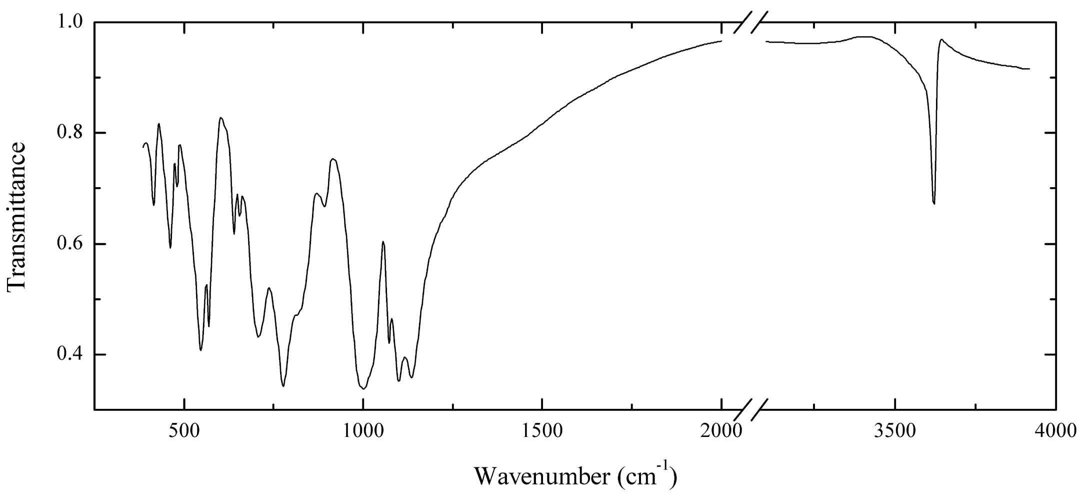


Locality: Kvanefjeld, Ilímaussaq alkaline complex, South Greenland.

Description: Light rose-colored hexagonal prismatic crystals from the association with aegirine, analcime, beryllite, chkalovite, galena, gmelinite, gonnardite, lovdarite, nabesite, neptunite, pectolite, polylithionite, pyrochlore, sphalerite and tugtupite. Holotype sample. The crystal structure is solved. Hexagonal, space group *P*-3, $a = 9.9097(6)$, $c = 7.4026(6)$ Å, $Z = 1$. $D_{calc.} = 4.51(1)$ g/cm^3. Optically uniaxial (−), $\varepsilon = 1.669(1)$, $\omega = 1.694(1)$. The empirical formula is $Ba_{5.61}Sr_{0.15}K_{0.03}Na_{2.14}Ce_{1.00}Nd_{0.43}La_{0.25}Sm_{0.05}Th_{0.02}P_{6.02}Si_{0.14}O_{23.72}F_{1.7}Cl_{0.58}$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 2.969 (100) (211, 112), 2.867 (60) (300), 1.965 (80) (320, 213). The bands at 3,400, 1,635 and 615 cm^{-1} are due to the admixture of rhabdophane-(Ce).

Wavenumbers (cm^{-1}): 3400, 2915sh, 1635, 1590sh, 1473w, 1403w, 1075s, 1022s, 1005sh, 942, 750w, 615, 595, 573, 542, 452w.

P397 Hydroxylherderite $CaBe(PO_4)(OH,F)$

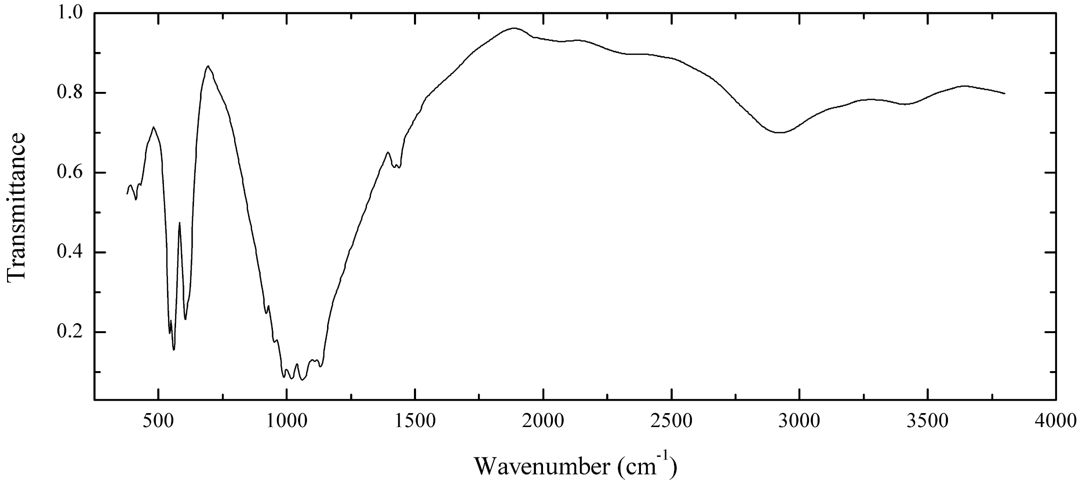


Locality: Foote Mine, Kings Mountain, Cleveland Co., North Carolina, USA.

Description: Colourless grains from pegmatite. Identified by IR spectrum. Differs from herderite by rather strong band at 3,597 cm^{-1} and the absence of band in the range 3,550–3,580 cm^{-1}.

Wavenumbers (cm^{-1}): 3597, 1136s, 1101s, 1073, 1001s, 892, 820sh, 776s, 708, 656w, 640, 569, 546s, 481w, 463, 415.

P398 Whitlockite $Ca_9Mg(HPO_4)(PO_4)_6$

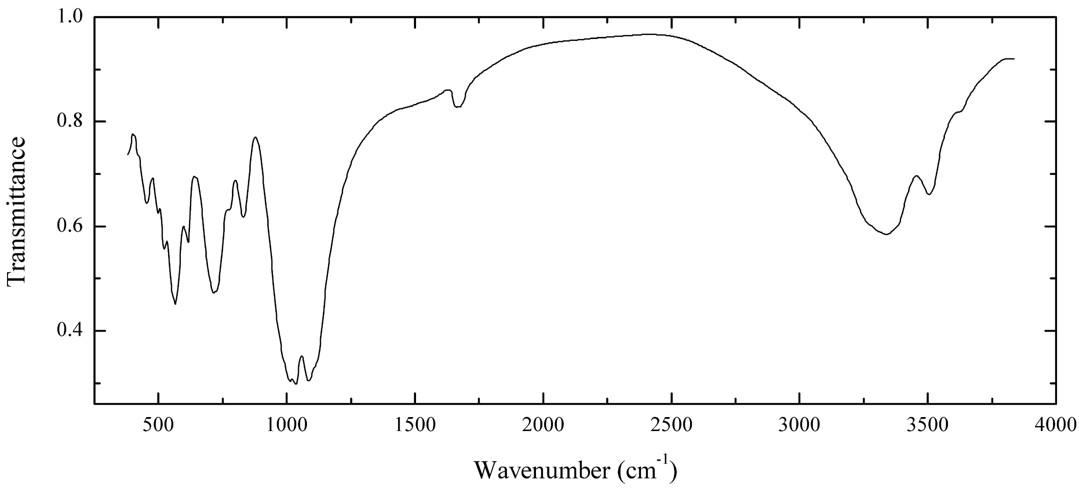


Locality: Foote Mine, Kings Mountain, Cleveland Co., North Carolina, USA.

Description: Colourless platy crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3410w, 2920, 2350w, 2090w, 1980sh, 1440, 1420, 1133s, 1114, 1075sh, 1060s, 1022s, 990s, 953, 922, 755w, 615sh, 608, 558, 543, 425, 412.

P399 Zanazziite $Ca_2(Mg,Fe^{2+})(Mg,Fe^{2+},Al)_4Be_4(PO_4)_6(OH)_4 \cdot 6H_2O$

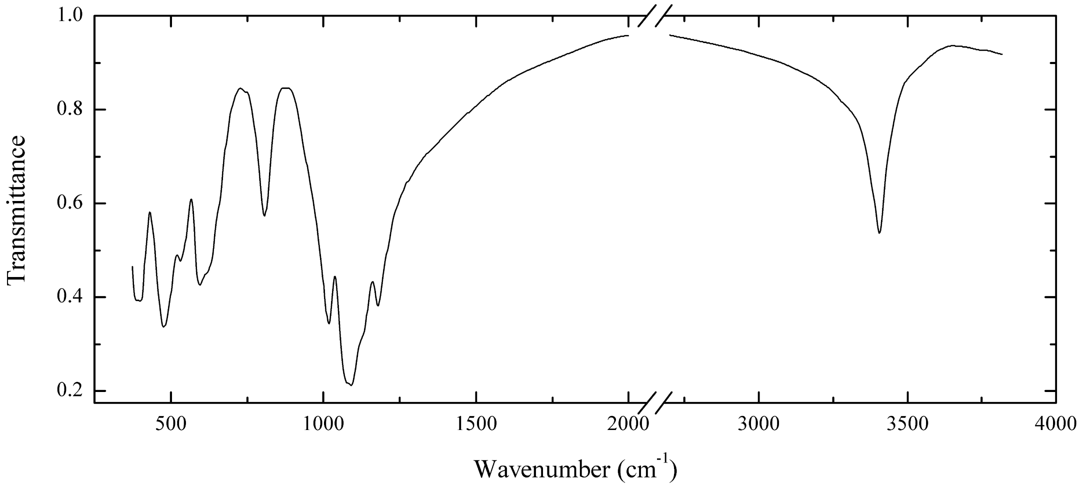


Locality: Araçuaí, Jequitinhonha valley, Minas Gerais, Brazil.

Description: Light brown spherulites from the association with hydroxylherderite, montebrasite, albite and quartz. The empirical formula is (electron microprobe) $(Ca_{1.91}Na_{0.06})(Mg_{4.54}Al_{0.31}Fe_{0.17}Mn_{0.13})Be_4(PO_4)_{6.00}(OH)_4 \cdot nH_2O$.

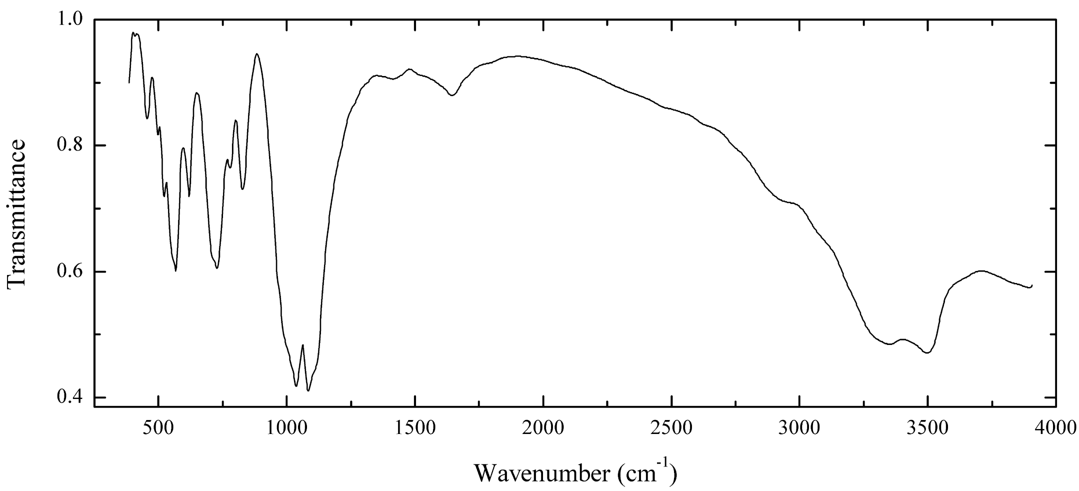
Wavenumbers (cm^{-1}): 3590sh, 3485, 3325, 1665w, 1110sh, 1087s, 1035s, 1013s, 990sh, 830, 777, 720, 616, 565, 520, 497, 454.

P400 Montebrasite (Li,Na)Al(PO_4)(OH,F)



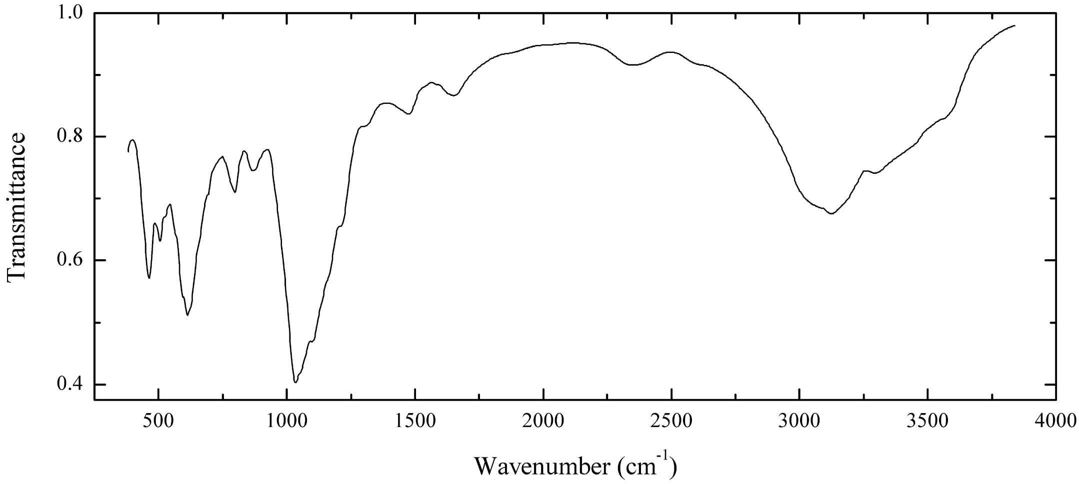
Locality: Telirio mine, Linópolis, Divino das Laranjeiras, Doce valley, Minas Gerais, Brazil.
Description: Pale yellow crystal from the association with brazilianite and albite. F-poor variety. The empirical formula is (electron microprobe) $Li_xAl_{1.06}(PO_4)_{1.00}[(OH)_{0.90}F_{0.10}]$.
Wavenumbers (cm^{-1}): 3387, 1178s, 1125sh, 1091s, 1075sh, 1017s, 806, 615sh, 595, 530, 475s, 392.

P401 Zanazziite $Ca_2(Mg,Fe^{2+})(Mg,Fe^{2+},Al)_4Be_4(PO_4)_6(OH)_4{\cdot}6H_2O$



Locality: Araçuaí, Jequitinhonha valley, Minas Gerais, Brazil.
Description: Violet crystals from the association with hydroxylherderite. The empirical formula is (electron microprobe) $(Ca_{1.93}Na_{0.07})(Mg_{4.15}Al_{0.42}Mn_{0.25}Fe_{0.18})Be_4(PO_4)_{6.00}(OH)_4{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3485, 3335, 2950sh, 1650w, 1420w, 1115sh, 1086s, 1036s, 1000sh, 970sh, 827, 782, 727, 710sh, 620, 565, 550sh, 521, 496, 456.

P402 Crandallite $CaAl_3(PO_4)_2(OH,H_2O)_6$

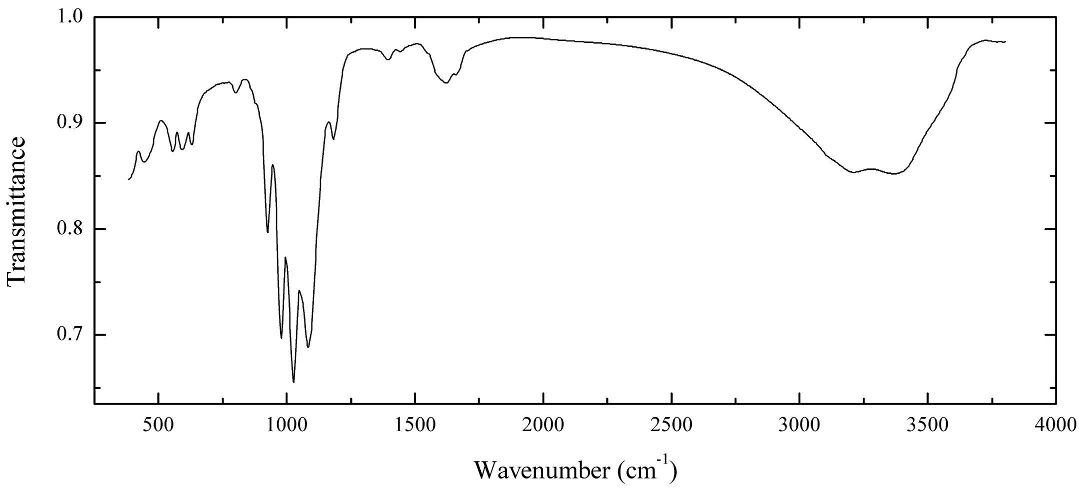


Locality: Temir Mt. quarry, Zauralovo, Chelyabinsk region, South Urals, Russia.

Description: White prismatic crystals from the association with wavellite. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3540sh, 3380sh, 3295, 3125, 3080sh, 2520sh, 2355w, 1655w, 1480w, 1305w, 1217, 1165sh, 1105s, 1036s, 870w, 795, 690sh, 612, 593, 525sh, 504, 459.

P403 Meurigite-Na $NaFe^{3+}{}_7(PO_4)_5(OH)_7 \cdot 8H_2O$

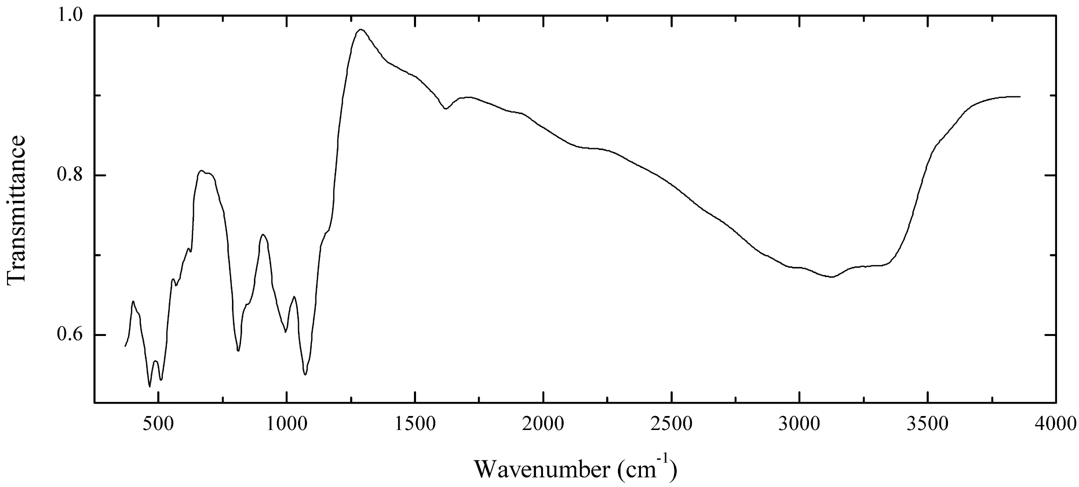


Locality: Tom's quarry, Kapunda, North Mt. Lofty Ranges, South Australia, Australia.

Description: Yellow spherulitic crust from the association with kapundaite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $(Na_{0.93}K_{0.09})(Fe_{6.25}Al_{0.66}Mg_{0.10})(PO_4)_{5.00}(OH)_7 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3570sh, 3350, 3195, 1660w, 1625, 1452w, 1398w, 1184, 1082s, 1026s, 979s, 924, 800w, 690w, 628, 591, 556, 445.

P404 Kintoreite $PbFe^{3+}_3(PO_4)_2(OH,H_2O)_6$

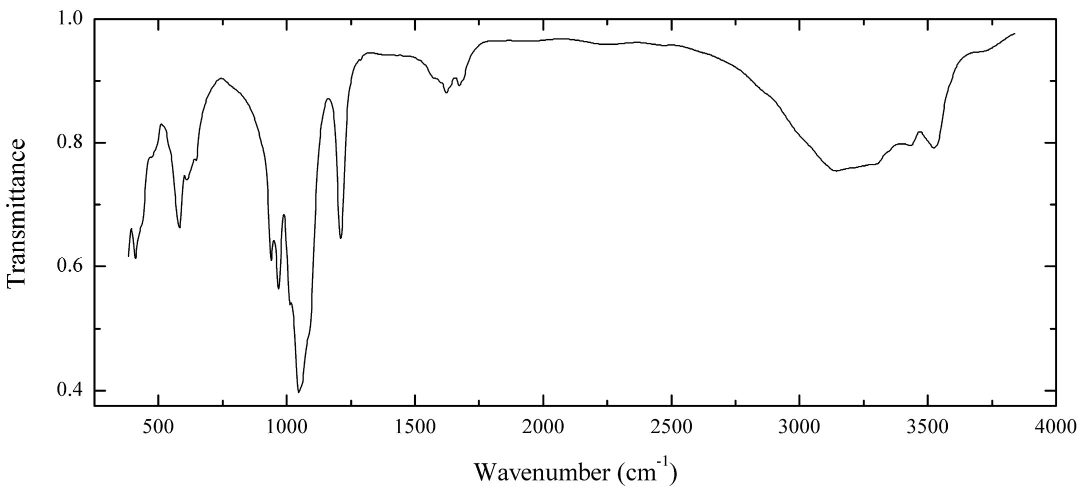


Locality: Jean Baptiste Mine, Kamariza (Kamareza) Mines, Agios Konstantinos, Lavrion mining district, Attikí (Attika) prefecture, Greece.

Description: Brown spherulitic crust from the association with segnitite and beudantite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $(Pb_{0.9}Na_{0.1})(Fe_{2.4}Al_{0.25}Zn_{0.15}Cu_{0.1})[(PO_4)_{1.1}(AsO_4)_{0.5}(SO_4)_{0.4}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3330, 3130, 2950, 2150sh, 1618w, 1160sh, 1073s, 996s, 960sh, 850sh, 811s, 625, 565, 509s, 463s.

P405 Kapundaite $CaNaFe^{3+}_4(PO_4)_4(OH)_3{\cdot}5H_2O$

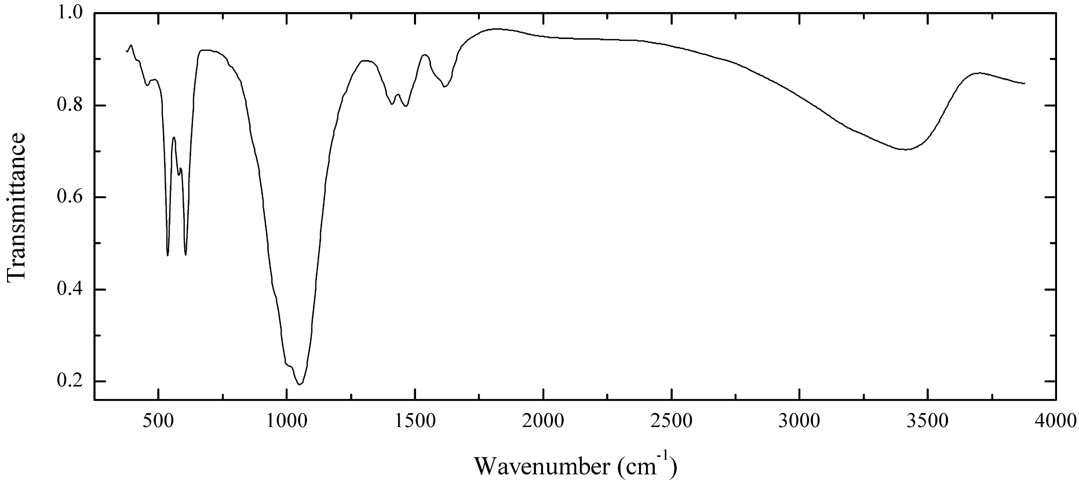


Locality: Tom’s quarry, Kapunda, North Mt. Lofty Ranges, South Australia, Australia.

Description: Yellow-brown radial aggregate from the association with meurigite-Na. The empirical formula is (electron microprobe) $Ca_{1.1}Na_{1.1}Fe_{3.9}(PO_4)_{4.0}(H_2O,OH)_8$.

Wavenumbers (cm^{-1}): 3510, 3410, 3275, 3120, 2980sh, 1673w, 1620w, 1600sh, 1212, 1085sh, 1060sh, 1045s, 1012, 969, 939, 648, 610, 581, 465sh, 410.

P406 Rhabdophane-(Ce) $(Ce,La)(PO_4)\cdot H_2O$

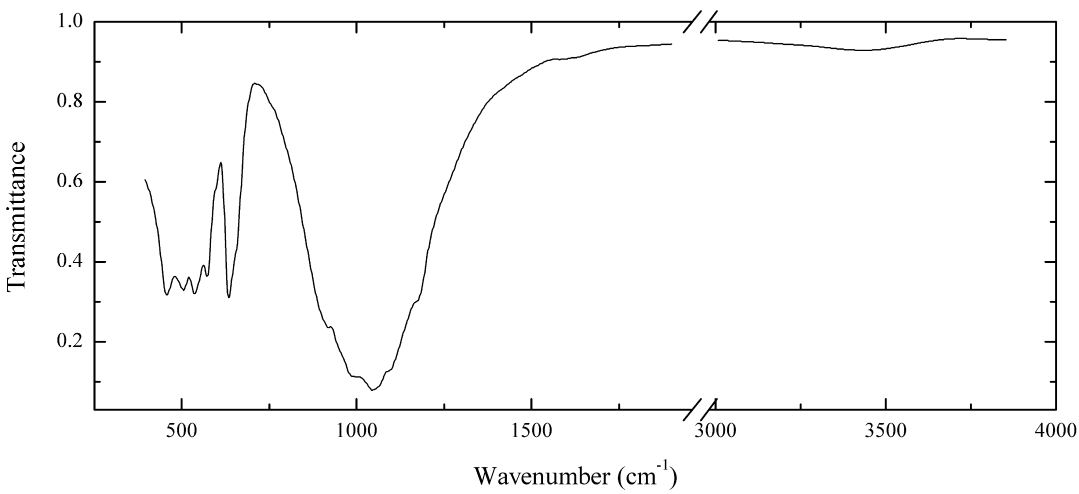


Locality: Koashva Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Beige fine-grained aggregate from the association with burbankite, pectolite and aegirine. The empirical formula is (electron microprobe) $(Ce_{0.42}La_{0.36}Nd_{0.10}Pr_{0.04}Ca_{0.04}Sr_{0.04})[(PO_4)_{0.92}(CO_3)_x]\cdot nH_2O$. The bands at 1474 + 1412 and 875 cm^{-1} correspond to stretching and bending vibrations of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3400, 1620w, 1474, 1412, 1051s, 1010sh, 955sh, 875sh, 606, 580, 537, 455w.

P407 Lithiophilite $LiMn^{2+}(PO_4)$

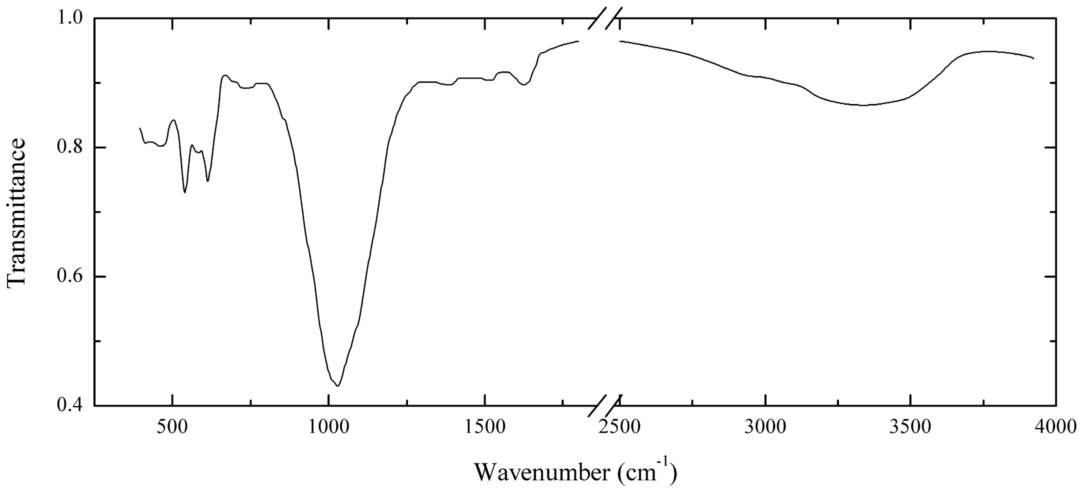


Locality: Veshnyakovskoe (Elash) Rb-Ta deposit, Eastern Sayan Mts., Siberia, Russia.

Description: Brown massive from Li-rich pegmatite. Partly oxidized variety. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3410w, 1175sh, 1095sh, 1053s, 991s, 921s, 655sh, 635, 576, 550sh, 538, 505, 457.

P408 Grayite $(Th,Pb,Ca)(PO_4)\cdot H_2O$

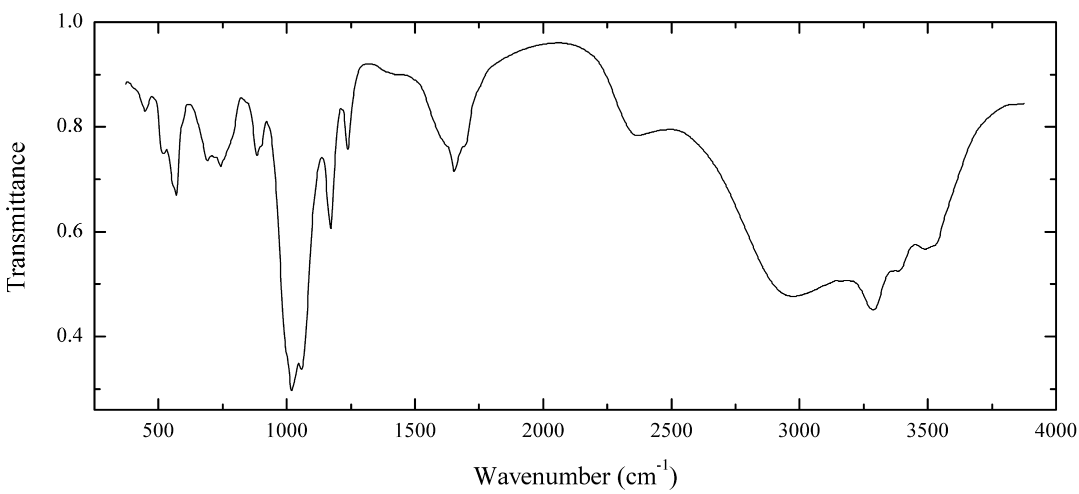


Locality: Brabant pegmatite, Brabant Farm 168, Karibib district, Erongo region, Namibia.

Description: Yellow powdery aggregate from the association with brabantite, columbite-(Mn) and uranophane. Identified by IR spectrum and chemical composition. Pb-poor variety. The empirical formula is (electron microprobe) $(Th_{0.48}Ca_{0.46}U_{0.045}Pb_{0.045})Fe_{0.07}[(PO_4)_{0.90}(SiO_4)_{0.10}]\cdot nH_2O$. Very weak bands at 1,520 and 1,380 cm^{-1} indicate the presence of trace amount of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 3350, 3000sh, 1627, 1520w, 1380w, 1090sh, 1030s, 955sh, 735w, 615, 580, 541, 460, 415.

P409 Struvite-(K) $KMg(PO_4)\cdot 6H_2O$

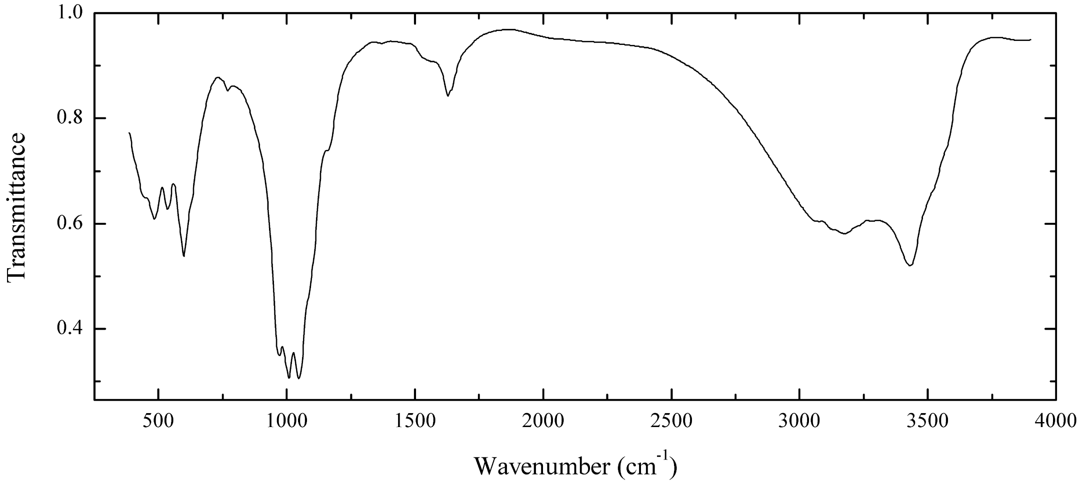


Locality: Rossblei mine, Eschach Alp, Obertalbach valley, Schladming, Styria, Austria (type locality).

Description: Grey crystals. Identified by IR spectrum and chemical composition. NH_4-and H_3O-bearing variety. The empirical formula is (electron microprobe) $[K_{0.49}(NH_4,H_3O,\square)_{0.48}Na_{0.03}](Mg_{0.88}Ca_{0.06}Fe_{0.03}Cu_{0.02})(PO_4)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3460, 3350, 3260s, 2950s, 2350, 1675sh, 1650, 1615sh, 1238, 1173, 1056s, 1017s, 1000sh, 900sh, 885, 780sh, 744, 692, 570, 545sh, 521, 451w.

P410 Allanpringite $Fe_3(PO_4)_2(OH)_3 \cdot 5H_2O$

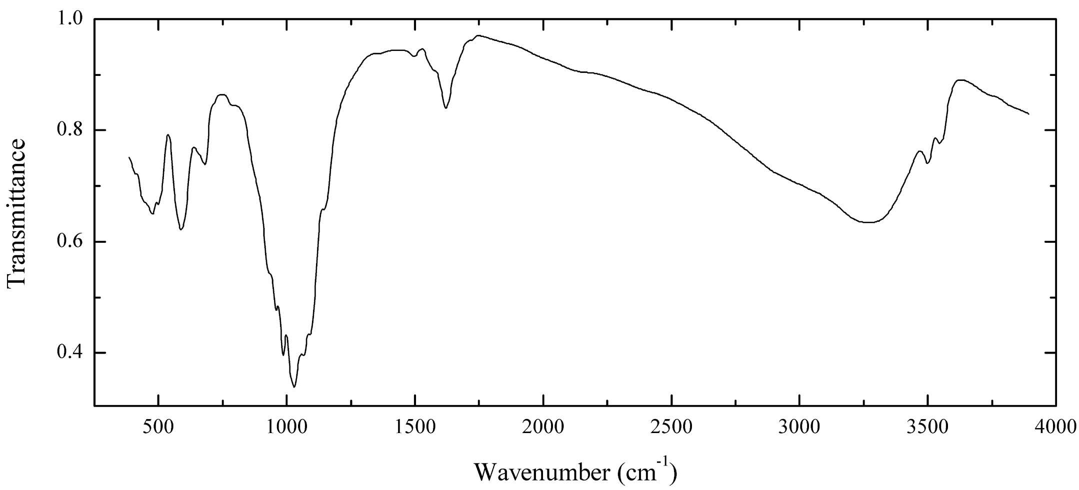


Locality: Grube Mark (Mark mine) near Essershausen, ca. 5 km SE of Weilburg/Lahn, Taunus, Hesse, Germany (type locality).

Description: Clusters of yellow acicular crystals from the association with "oxiberaunite", cacoxenite, strengite and cryptomelane.

Wavenumbers (cm^{-1}): 3550sh, 3500sh, 3417s, 3160, 3055, 1630, 1565w, 1160, 1080sh, 1048s, 1011s, 970s, 769w, 625sh, 598, 534, 484, 450sh.

P411 "Oxyberaunite" $(Fe^{3+},Mn)Fe^{3+}{}_5(PO_4)_4(OH)_6 \cdot 5H_2O$ (?)

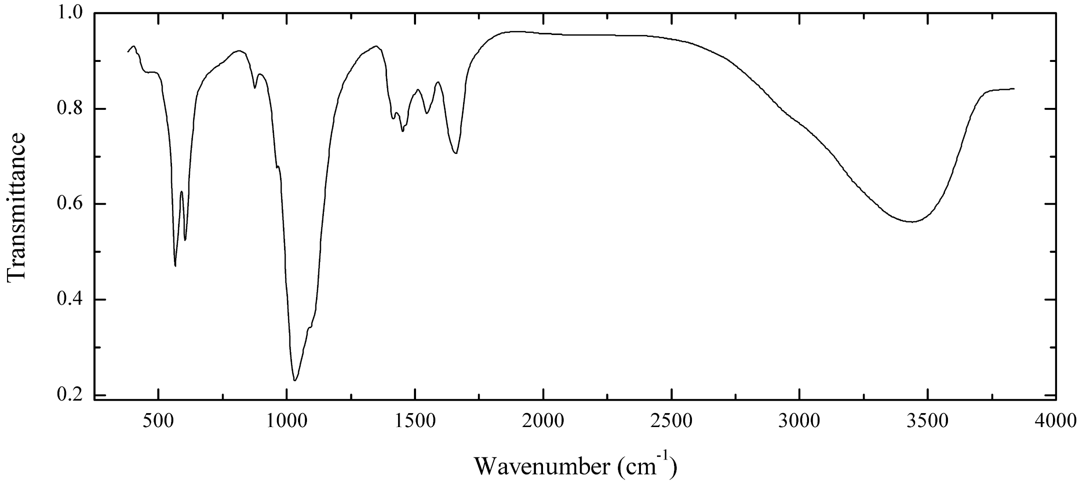


Locality: Grube Mark (Mark mine) near Essershausen, ca. 5 km SE of Weilburg/Lahn, Taunus, Hesse, Germany.

Description: Reddish brown acicular crystals from the association with allanpringite, cacoxenite, strengite and cryptomelane. Identified by IR spectrum. Related to beraunite. Needs further investigation.

Wavenumbers (cm^{-1}): 3550, 3500, 3260, 2980sh, 2160sh, 1627, 1580sh, 1502w, 1147, 1094s, 1068s, 1031s, 1015sh, 987s, 959s, 920sh, 895sh, 790w, 678, 585, 499, 474, 445sh, 410sh.

P412 Fluorapatite CO_3-rich $(Ca,H_2O,\square)_5(PO_4,CO_3)_3(F,CO_3,H_2O)$

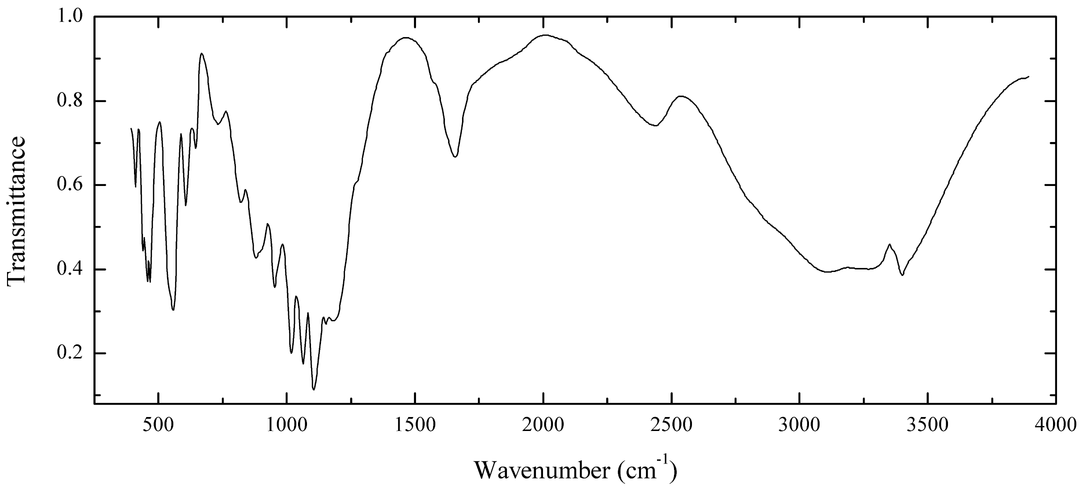


Locality: Omsk region, Siberia, Russia.

Description: White massive aggregate in mammoth tusk. Identified by IR spectrum. The band at 1,547 cm^{-1} indicates the presence of $CO_3{}^{2-}$ groups in F-dominant site.

Wavenumbers (cm^{-1}): 3440, 3000sh, 1660, 1547, 1455, 1416, 1090s, 1033s, 960, 873, 602, 562, 450w.

P413 Taranakite $KAl_5(HPO_4)_6(PO_4)_2 \cdot 18H_2O$

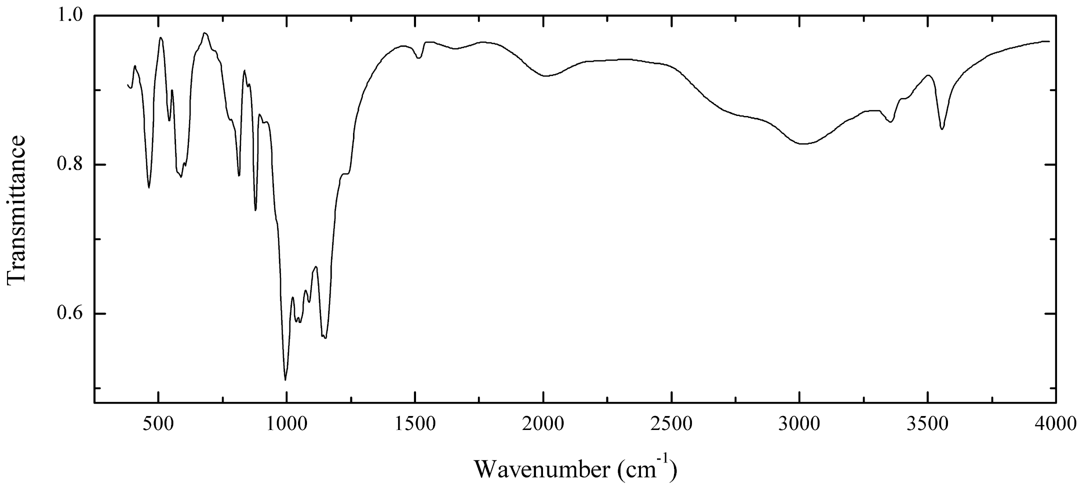


Locality: Eastern part of Cerro Mejillones, Mejillones Peninsula, Mejillones, Antofagasta, II Region, Chile.

Description: White fine-grained aggregate from the association with tinsleyite and gypsum. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3425sh, 3375, 3240, 3085, 2900sh, 2430, 1770sh, 1655, 1575sh, 1275sh, 1174s, 1153s, 1105s, 1063s, 1017s, 965sh, 954, 890sh, 880, 821, 774w, 646, 607, 557s, 545sh, 467, 456, 444, 412.

P414 Mejillonesite $NaMg_2(PO_3OH)(PO_4)(OH){\cdot}H_5O_2$

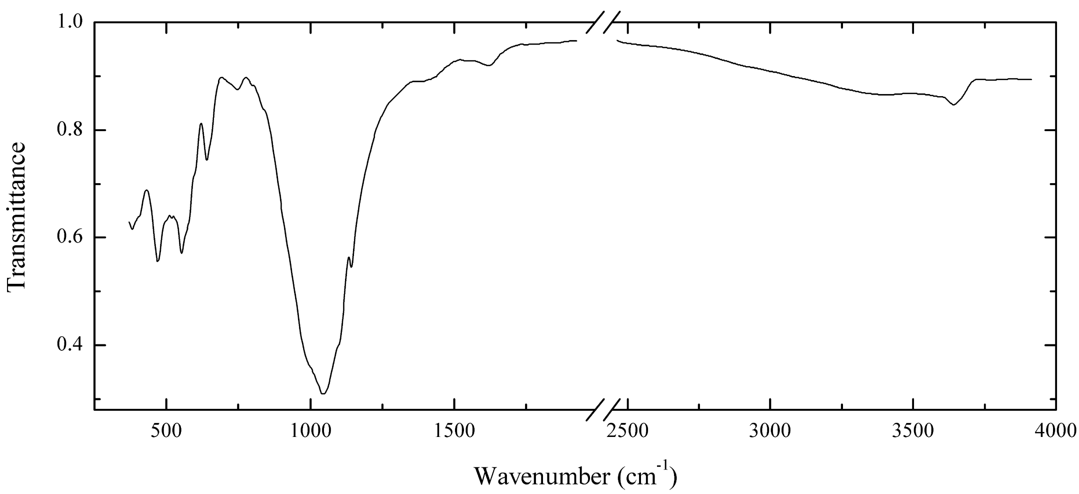


Locality: North slope of Cerro Mejillones, Mejillones Peninsula, Mejillones, Antofagasta, II Region, Chile (type locality).

Description: Radial aggregate of colourless prismatic crystals from the association with bobierrite, opal, clinoptilolite-Na, clinoptilolite-K, and gypsum. Holotype sample. The crystal structure is solved. Orthorhombic, space group *Pbca*, $a = 16.295(1)$ $b = 13.009(2)$, $c = 8.434(1)$ Å, $V = 1787.9(4)$ Å^3, $Z = 8$. The empirical formula is $Na_{0.93}Mg_{2.08}(PO_3OH)_{1.00}(PO_4)_{1.06}(OH)_{0.86}{\cdot}0.95H_5O_2$. Optically biaxial (−), $\alpha = 1.507(2)$, $\beta = 1.531(2)$, $\gamma = 1.531(2)$, $2V_{meas} = 15(10)°$. $D_{meas} = 2.36(1)$ g/cm^3, $D_{calc} = 2.367$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 8.095 (100) (200), 6.846 (9) (210), 6.470 (8) (111), 3.317 (5) (302), 2.959 (5) (132), 2.706 (12) (113), 2.157 (19) (333), 2.153 (9) (622).

Wavenumbers (cm^{-1}): 3530, 3385w, 3330. 2990, 2770sh, 2000, 1760w, 1515w, 1230, 1151s, 1137s, 1087. 1054s, 1037s, 995s, 954, 910w, 877, 848w, 813, 775, 610, 580, 570sh, 543, 461, 390w.

P415 Johnsomervilleite $Na_2Ca(Fe^{3+},Mg,Mn)_7(PO_4)_6$

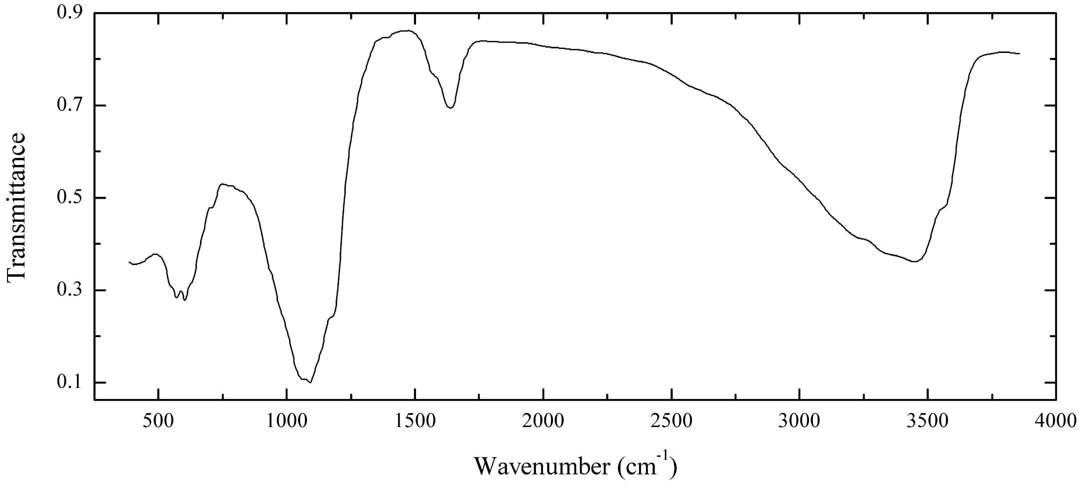


Locality: Sapucaia (Proberil) mine, Sapucaia do Norte, Galiléia, Doce valley, Minas Gerais, Brazil.

Description: Brown massive. Hydrated and almost amorphous (powder X-ray diffraction pattern contains only two reflections, at 2.964 and 2.794 Å). The empirical formula is (electron microprobe) $Na_{1.8}Ca_{1.0}(Fe_{3.1}Mg_{2.1}Mn_{1.5})(PO_4)_{6.0}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3620, 3380w, 1630w, 1400w, 1145, 1100sh, 1046s, 1000sh, 752w, 643, 600sh, 580sh, 554, 472, 385.

P416 Kobokoboite $Al_6(PO_4)_4(OH)_6\cdot 11H_2O$

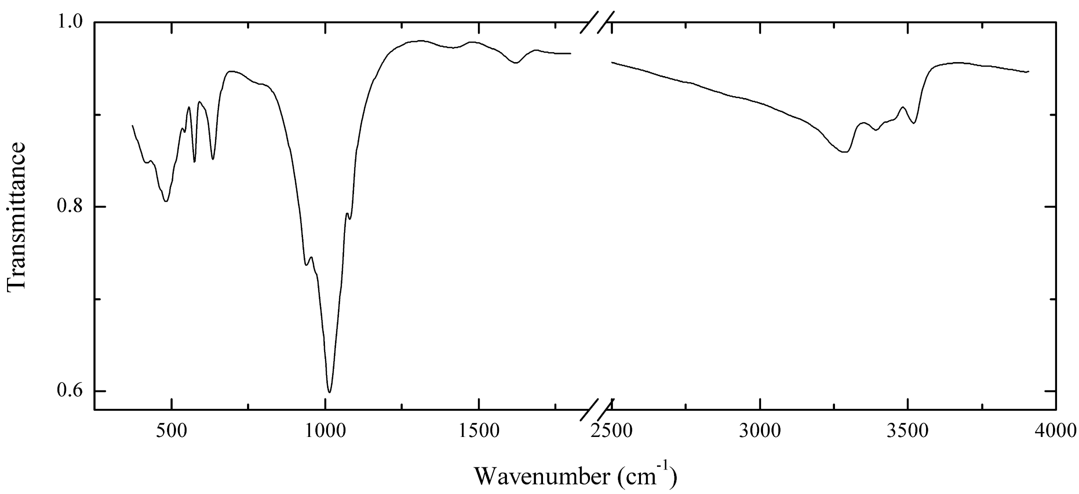


Locality: Kobokobo pegmatite, Lusungu River district, Kivu, Democratic Republic of Congo (type locality).

Description: White crust from the association with variscite and wavellite. Confirmed by semiquantitative electron microprobe analysis (Al:P ≈ 3:2).

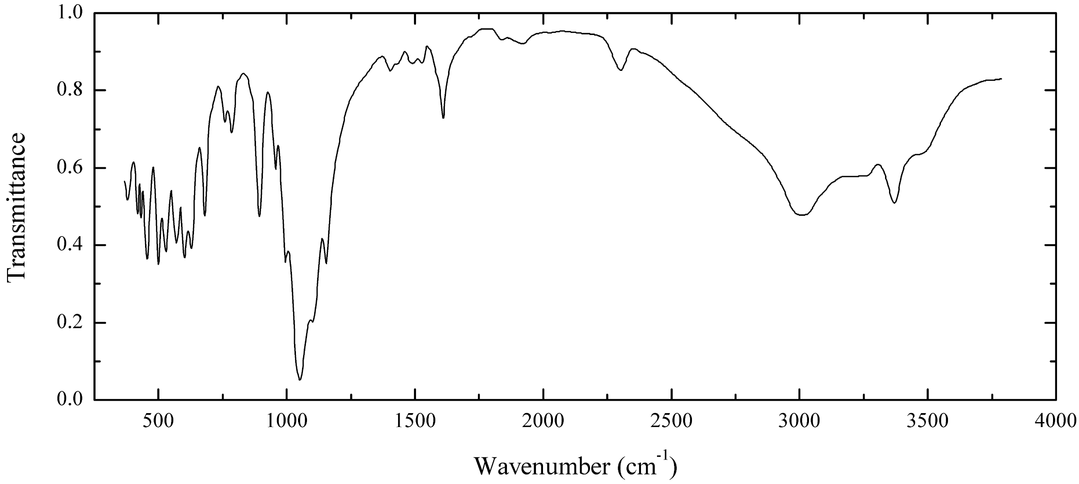
Wavenumbers (cm^{-1}): 3570sh, 3450s, 3340sh, 3240sh, 2920sh, 1644, 1580sh, 1180sh, 1093s, 1065s, 930sh, 700sh, 625sh, 604, 567, 550sh, 410.

P417 Pattersonite $PbFe^{3+}{}_3(PO_4)_2(OH)_5\cdot H_2O$



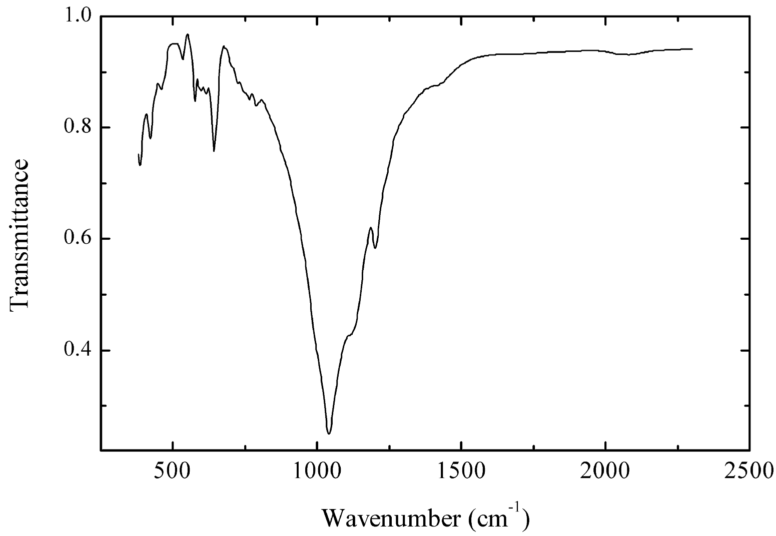
Locality: Grube Vereinigung (Vereinigung mine), near Eisenbach, Taunus, Hesse, Germany (type locality).
Description: Greenish-brown crystals.
Wavenumbers (cm^{-1}): 3508, 3430sh, 3375, 3275, 1635w, 1435w, 1082, 1016s, 970sh, 941, 790sh, 635, 575, 545w, 480, 420.

P418 Morinite $NaCa_2Al_2(PO_4)_2(OH)F_4 \cdot 2H_2O$



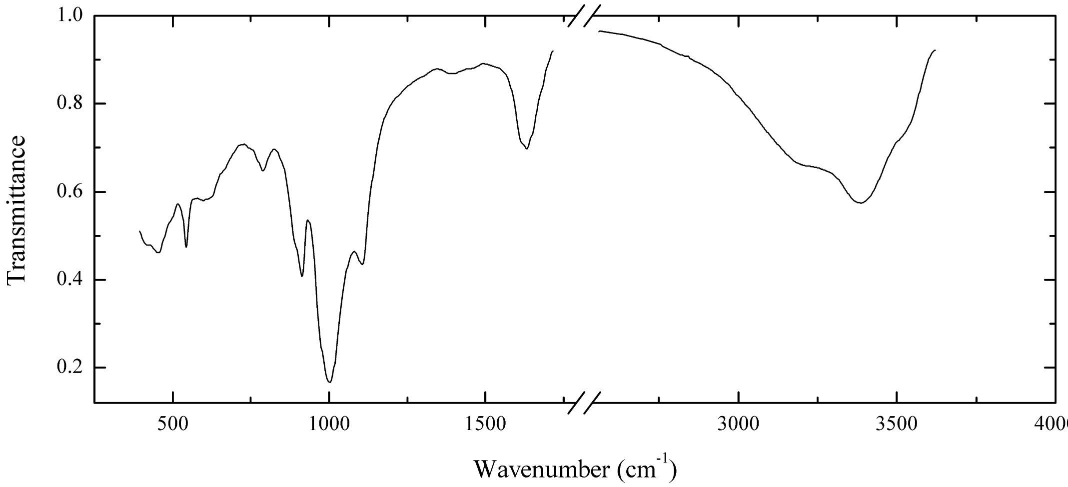
Locality: Cleveland tin mine, near Luina, western Tasmania, Australia.
Description: Colourless grain from the association with coulsellite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3445, 3348, 3200, 2985, 2770sh, 2314, 1923w, 1841w, 1607, 1538w, 1495w, 1406w, 1154, 1101s, 1052s, 995, 956, 894, 786, 759, 681, 629, 602, 570, 530, 501, 457, 432, 419, 391.

P419 Kosnarite $KZr_2(PO_4)_3$



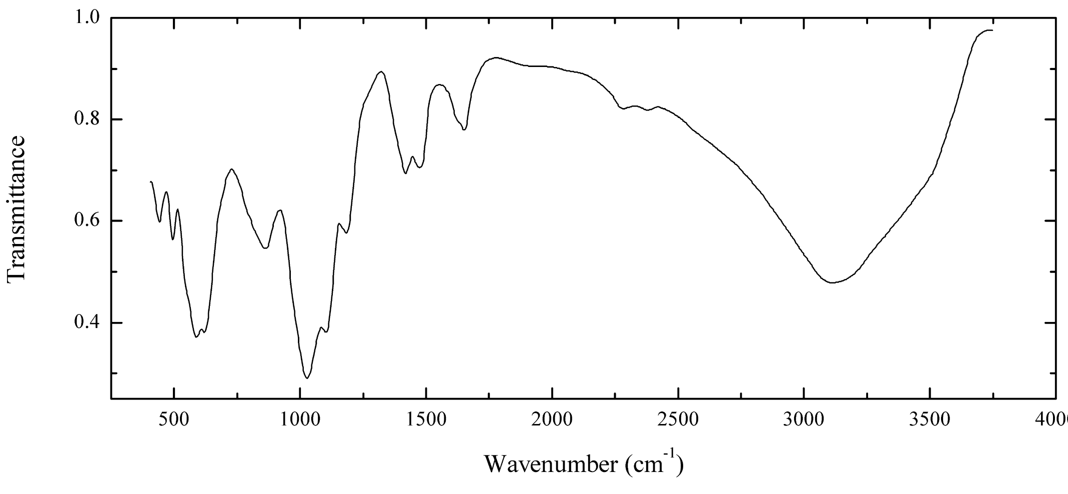
Locality: Jorge pegmatite, Jenipapo district, Itinga, Jequitinhonha valley, Minas Gerais, Brazil.
Description: Brown crystals from the association with zanazziite and albite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 2086w, 2044w, 1430w, 1200, 1110sh, 1038, 790w, 763w, 746w, 728w, 639, 615w, 594w, 573, 532w, 463w, 425, 400sh, 387.

P420 **Bassetite** $Fe^{2+}(UO_2)_2(PO_4)_2 \cdot 8H_2O$



Locality: Koscheka U deposit, Auminzatau Mts., Central Kyzylkum region, Kyzylkum desert, Uzbekistan.
Description: Brown platy crystals becoming dark brown on grinding. Investigated by L.N. Belova.
Wavenumbers (cm^{-1}): 3530sh, 3385, 3215sh, 1635, 1450sh, 1400w, 1112, 1005s, 918, 895sh, 795w, 609, 544, 460, 430sh.

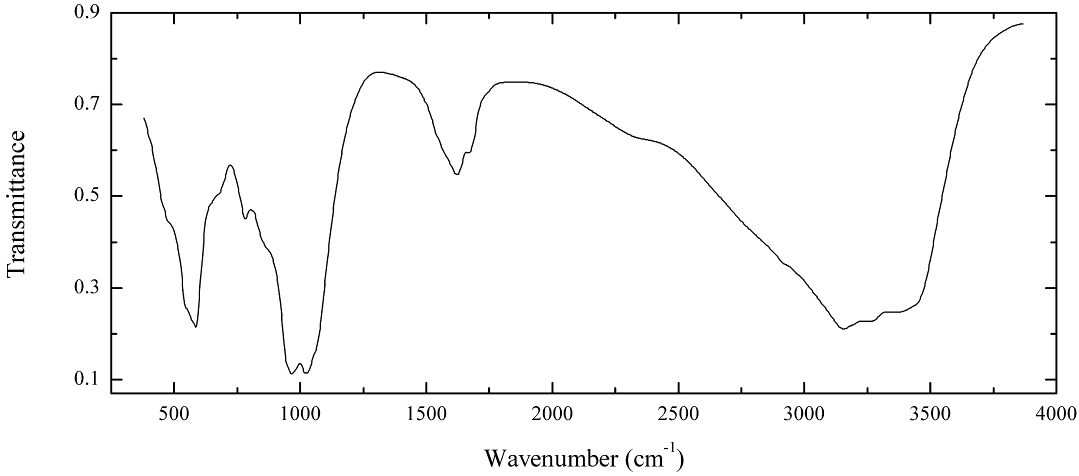
P421 **Plumbogummite** $PbAl_3(PO_4)_2(OH)_5 \cdot H_2O$



Locality: Roughton Gill, Caldbeck Fells, Cumberland, England, UK.
Description: Blue veinlet from the association with mimetite. The empirical formula is (electron microprobe) $Pb_{1.08}Al_{3.00}[(PO_4)_{1.58}(AsO_4)_{0.20}(CO_3)_x](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3475sh, 3120s, 2875w, 2775w, 1658, 1635sh, 1480, 1423, 1187, 1105s, 1027s, 862, 800sh, 618s, 588s, 550sh, 494, 440.

P422 Metavivianite $Fe^{2+}Fe^{3+}_2(PO_4)_2(OH)_2{\cdot}6H_2O$

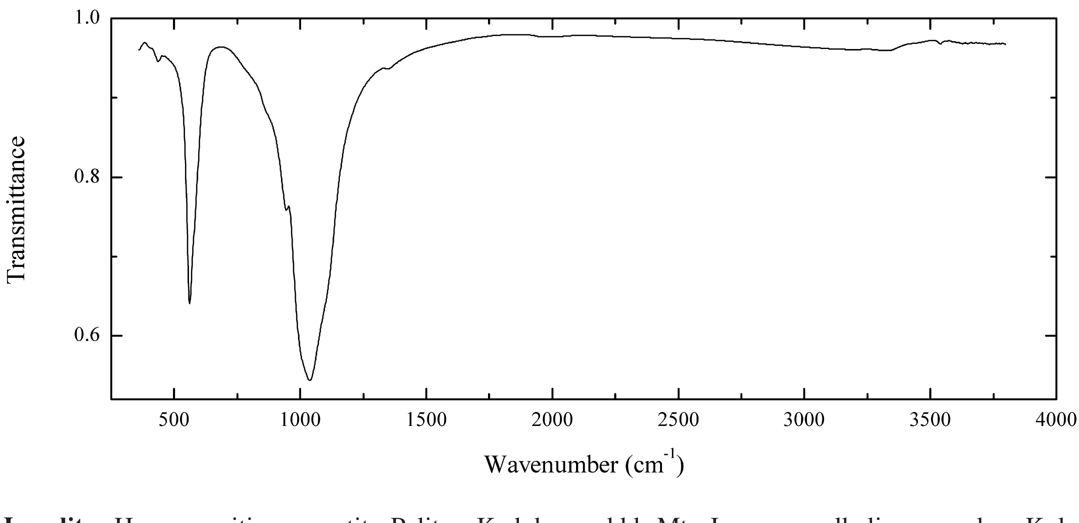


Locality: Boa Vista pegmatite, near Galiléia, Minas Gerais, Brazil.

Description: Dark blue-green prismatic crystals from the association with siderite, ludlamite, albite and muscovite. The crystal structure is solved. Triclinic, space group $P\overline{1}$, $a = 4.629(1)$, $b = 7.989(1)$, $c = 9.321(2)$ Å, $\alpha = 108.59(2), \beta = 97.34(1), \gamma = 95.96(1)°, Z = 1$. The empirical formula is $(Fe^{3+}_{1.64}Fe^{2+}_{1.23}Mg_{0.085}Mn_{0.06})(PO_4)_{1.98}(OH)_{1.72}{\cdot}6.36H_2O$. Optically biaxial (+), $\alpha = 1.600, \beta = 1.640$, $\gamma = 1.685$, $2V$ (meas.) $= 85(5)°$. $D_{meas} = 2.56(2)$, $D_{calc} = 2.579$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 8.72 (40) (001); 6.95 (100) (01-1); 4.926 (32) (011); 3.804 (34) (1-11, 11-1, 101); 3.060 (23) (01-3, 111); 2.974 (24) (1-1-2); 2.776 (24) (1-22, 12-2).

Wavenumbers (cm^{-1}): 3350, 3240, 3145s, 2900sh, 2370sh, 1670sh, 1625, 1580sh, 1060sh, 1024s, 967s, 945sh, 865sh, 777, 670sh, 582s, 570sh, 545sh, 475sh.

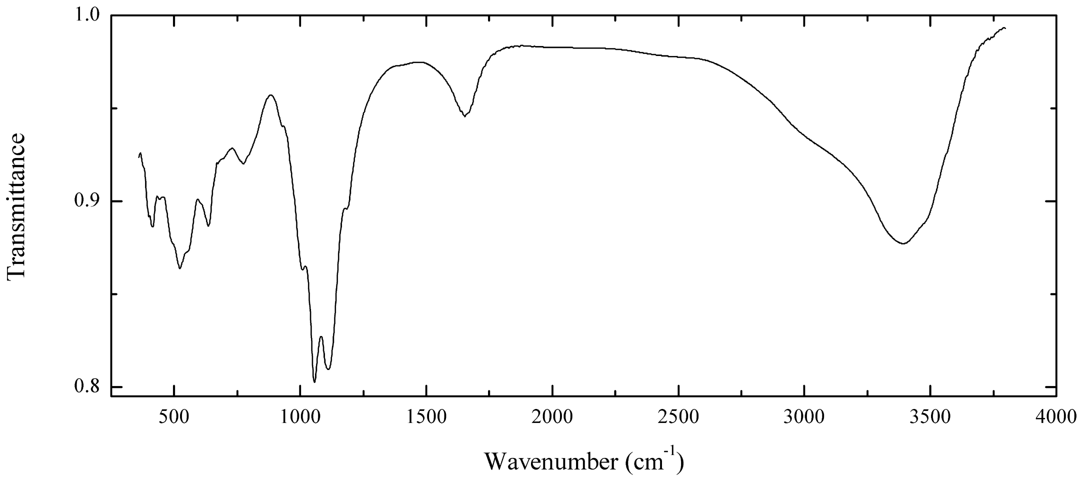
P423 Bario-olgite $Ba(Na,Sr,\mathit{REE})_2Na[PO_4]_2$



Locality: Hyperagpaitic pegmatite Palitra, Kedykverpakhk Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

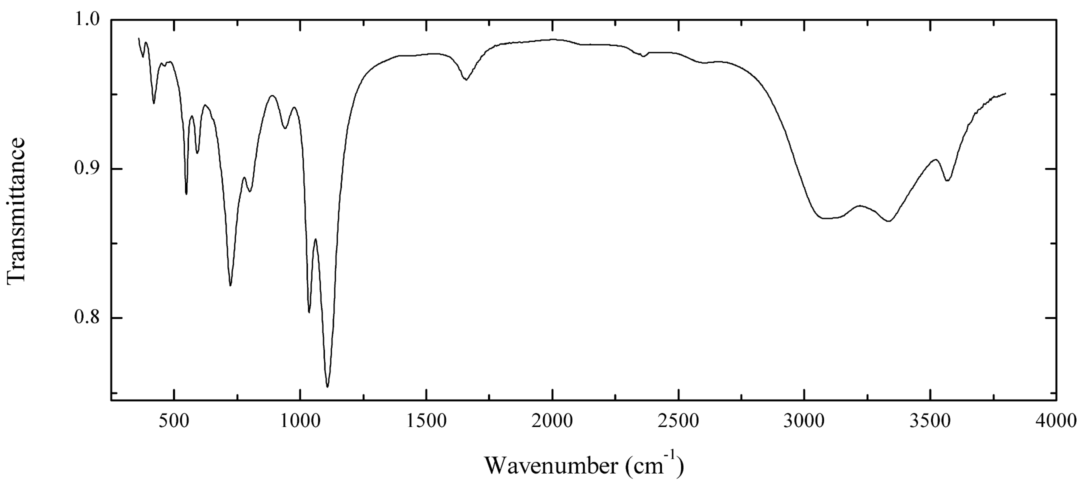
Description: Green grains from the association with manaksite, natrosilite, villiaumite, aegirine, ussingite, sodalite, serandite, chkalovite and vuonnemite. Holotype sample. The crystal structure is solved. Trigonal, space group *P*3, $a = 5.549(1)$, $c = 7.032(2)$ Å. The empirical formula is $(Na_{2.14}K_{0.08}Ca_{0.03}Mn_{0.02}Sr_{0.72}Ba_{0.91}La_{0.07}Ce_{0.05})P_{2.01}O_8$. Optically uniaxial (−), $\omega = 1.628$, $\varepsilon = 1.623$. $D_{meas.} = 4.00$, $D_{calc.} = 3.986$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 7.044 (22) (001); 3.964 (60) (101, 011); 2.839 (100) (012); 2.774 (100) (110); 1.984 (40) (202), 1.611 (26) (21–2, 122).
Wavenumbers (cm^{-1}): 3543w, 3327w, 1970w, 1349w, 1090sh, 1037s, 948, 870sh, 561s, 436w, 405sh.

P424 Vantasselite $Al_4(PO_4)_3(OH)_3{\cdot}9H_2O$



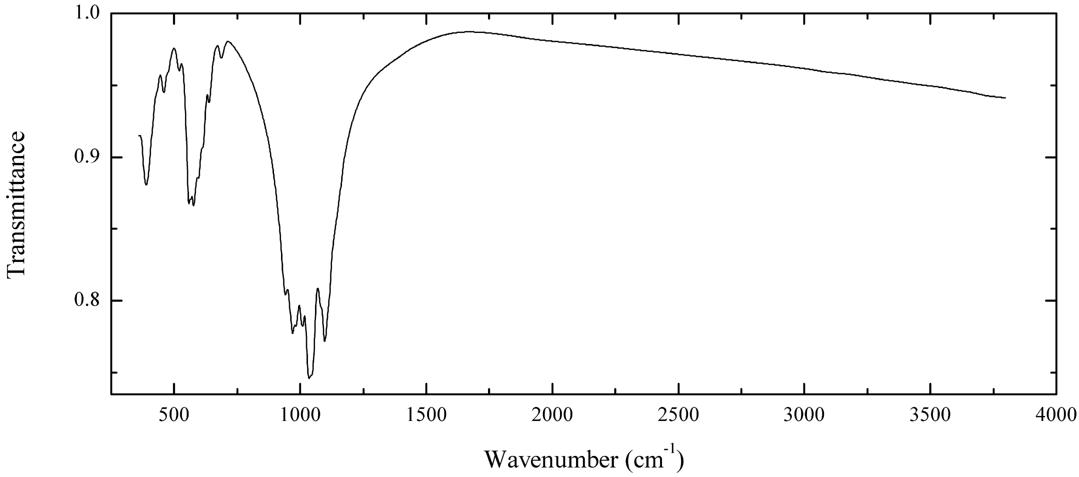
Locality: Bihain, Stavelot massif, Belgium (type locality).
Description: Radial aggregates of colourless crystals. The empirical formula is (electron microprobe) $Al_{3.5}Fe_{0.5}(PO_4)_{3.0}(OH)_3{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3565sh, 3470sh, 3389, 3000sh, 1653, 1183, 1112s, 1056s, 1012, 930sh, 815sh, 775, 690sh, 636, 550sh, 522, 500sh, 445, 414.

P425 Moraesite $Be_2(PO_4)(OH{\cdot}4H_2O)$



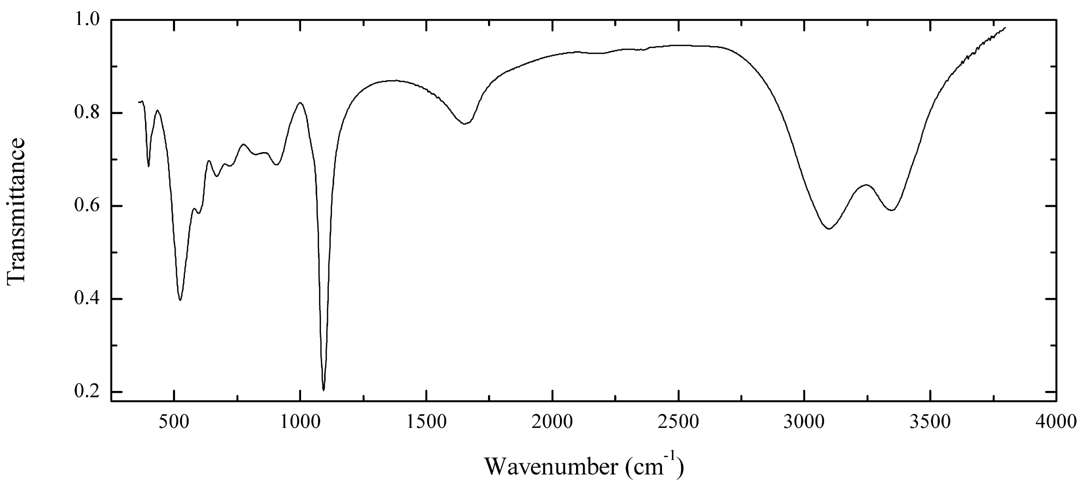
Locality: Fazenda Pomaroli, Linópolis, Divino das Laranjeiras, Doce valley, Minas Gerais, Brazil.
Description: White aggregates of acicular crystals from the association with leucophosphite, zanazziite, beryllonite and natrodufrenite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3564, 3337, 3130sh, 3080, 2603w, 2350w, 1659, 1108s, 1035s, 940, 800, 723s, 592, 548, 462w, 419, 376w.

P426 Qingheiite-(Mn^{2+}) $Na_2Na(Mn^{2+},Mg,Fe^{2+})_6(Al,Fe^{3+})(PO_4)_6$



Locality: Santa Ana pegmatite, Totoral pegmatite field, Coronel Pringles department, San Luis, Argentina.
Description: Green grains from the association with beusite and lithiophilite. The empirical formula is (electron microprobe) $Na_{3.0}Ca_{0.1}Mn_{3.0}Mg_{1.7}Fe_{1.5}Al_{0.8}(PO_4)_{6.0}$.
Wavenumbers (cm^{-1}): 1110sh, 1097s, 1080sh, 1045sh, 1035s, 1009s, 980s, 970s, 943, 687w, 638, 615sh, 600sh, 577, 559, 520w, 475sh, 459, 393.

P427 Fluellite $Al_2(PO_4)F_2(OH){\cdot}7H_2O$

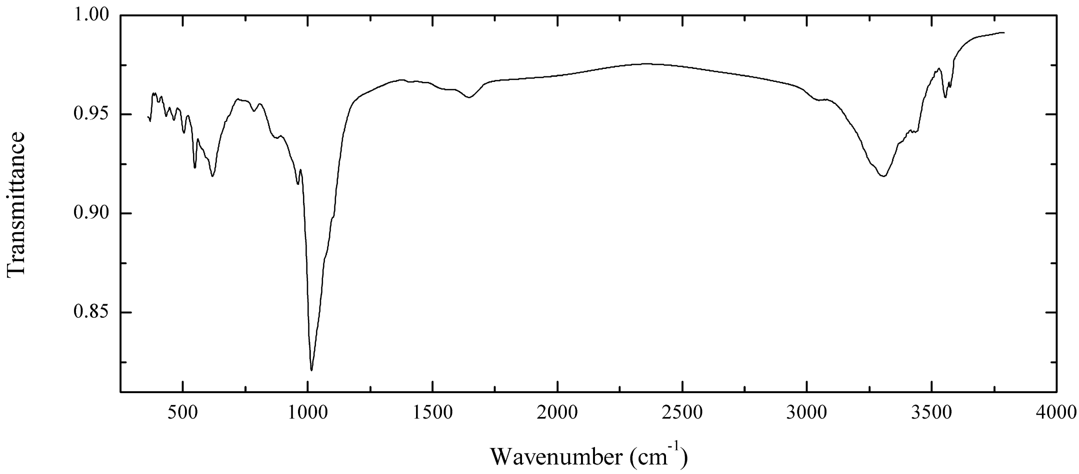


Locality: Azcárate quarry, Eugui, Esteríbar, Navarre, Spain.

Description: Brownish crystals from the association with crandallite and metavariscite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3347s, 3096s, 2340w, 2180w, 1654, 1093s, 906, 823, 722, 669, 598, 524, 399.

P428 Veszelyite $(Cu^{2+},Zn)_3(PO_4)(OH)_3{\cdot}2H_2O$

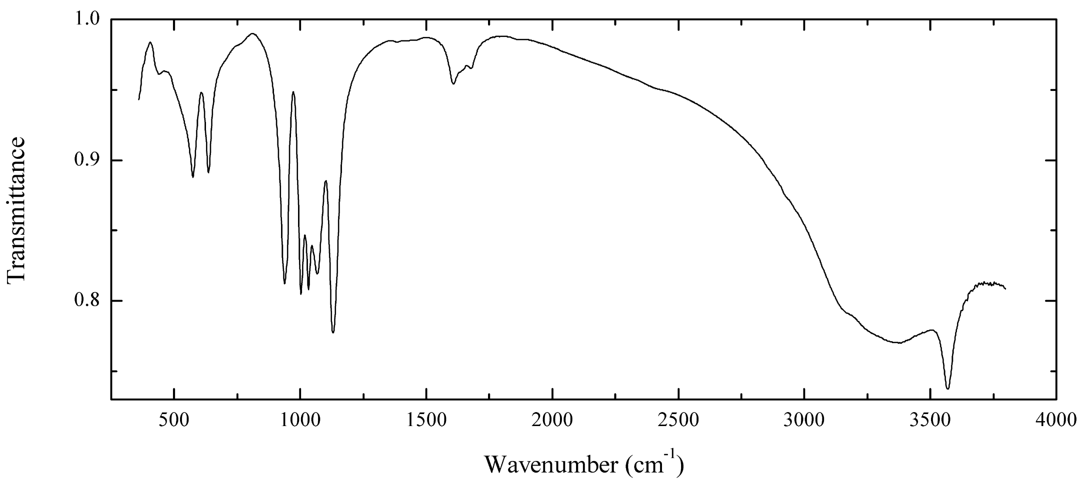


Locality: Leochang, Gejiu, Yunnan province, China.

Description: Blue crust from the association with hemimorphite and scholzite. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3574, 3554, 3433, 3307, 3265sh, 3051, 1651, 1560sh, 1100sh, 1070sh, 1015s, 961, 877, 784w, 618, 595sh, 575sh, 548, 504, 464, 433, 400w, 367.

P429 Phosphophyllite $Zn_2(Fe^{2+},Mn^{2+})(PO_4)_2{\cdot}4H_2O$

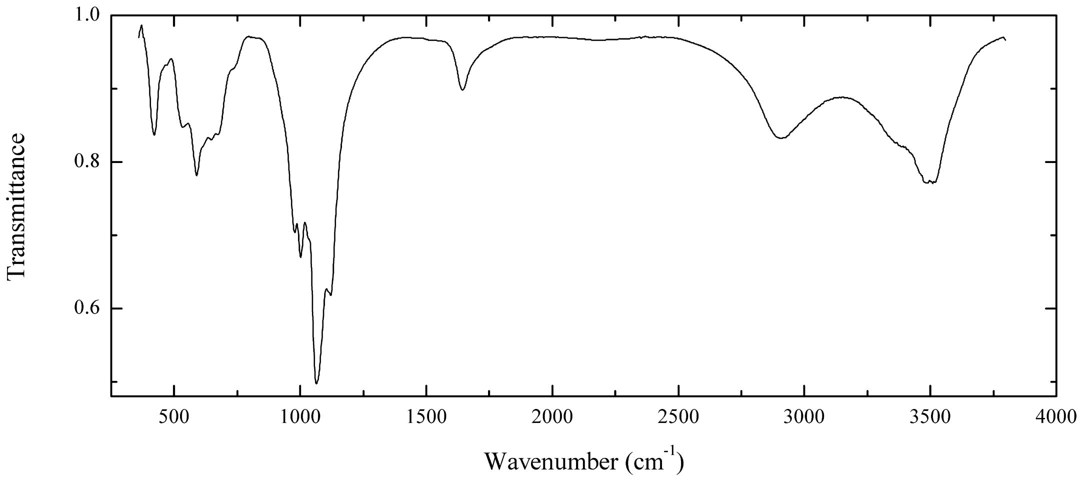


Locality: Hagendorf South pegmatite, Hagendorf, Oberpfälzer Wald, Upper Palatinate, Bavaria, Germany (type locality).

Description: Soft yellow crystals from the association with schoonerite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Zn_{1.88}Fe_{0.84}Mn_{0.22}Mg_{0.03}Al_{0.01}(PO_4)_{2.00}·nH_2O$.

Wavenumbers (cm^{-1}): 3567s, 3374, 3265sh, 3175sh, 2400sh, 1878w, 1678, 1640sh, 1608, 1450w, 1130s, 1068s, 1033s, 1003s, 938s, 750sh, 636, 575, 442.

P430 Montgomeryite $Ca_2MgAl_4(PO_4)_6(OH)_4·12H_2O$

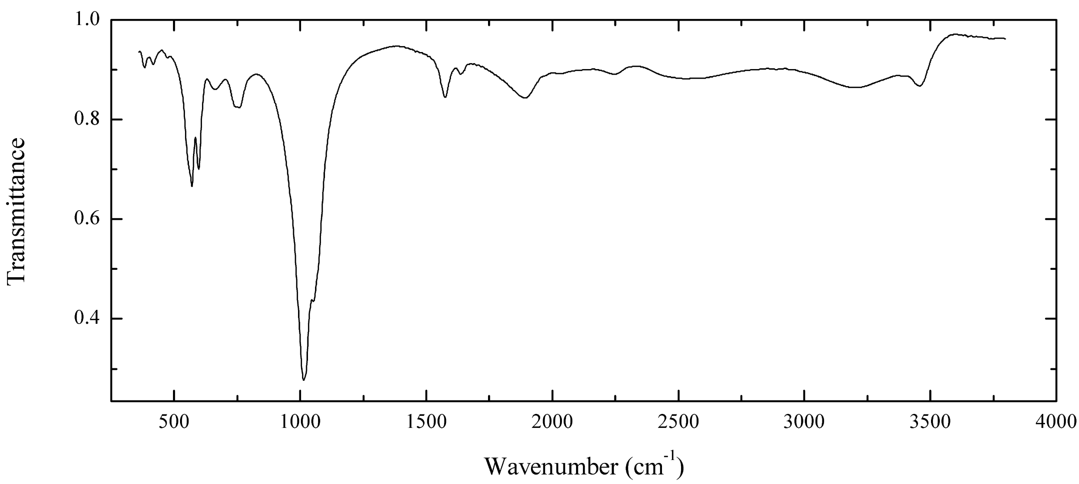


Locality: Montcada Hill quarry, Montcada I Reixac, Vallés Occidental, Barcelona, Spain.

Description: Green crystals. The empirical formula is (electron microprobe) $Ca_{4.04}Mg_{1.00}(Al_{3.71}Fe_{0.20}Cr_{0.05})(PO_4)_{6.00}(OH)_4·nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3509, 3485, 3390sh, 2906, 2195w, 1645, 1121s, 1064s, 1035sh, 1002s, 978, 730, 674, 649, 589, 538, 421.

P431 Correianevesite $Fe^{2+}Mn^{2+}_2(PO_4)_2·3H_2O$



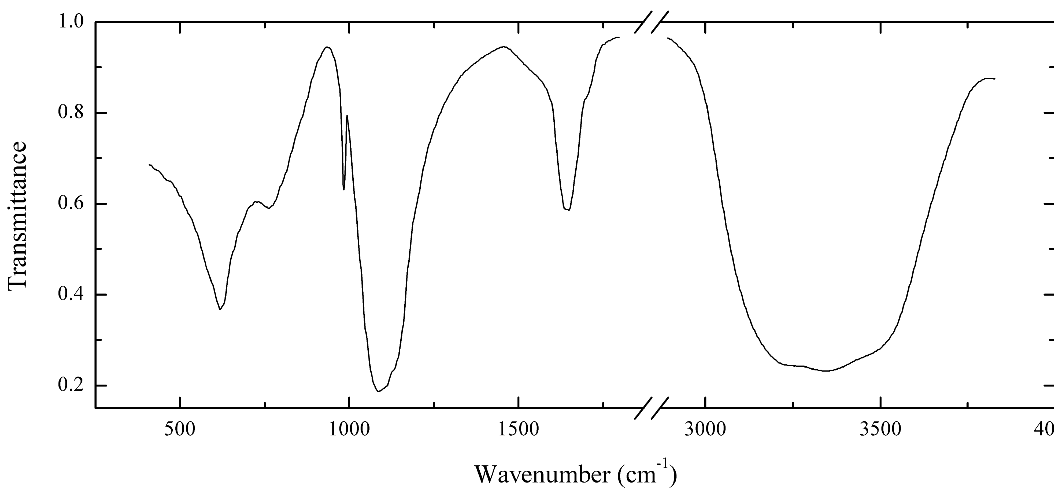
Locality: Cigana mine, Conselheiro Pena, Rio Doce valley, Minas Gerais, Brazil (type locality).

Description: Light brown transparent isometric crystals from the association with microcline, albite, muscovite, quartz, schorl, elbaite, beryl, spodumene, triphylite, hureaulite, columbite, tantalite, fluorapatite, triphylite, lithiophilite, frondelite, eosphorite, fairfieldite, leucophosphite, phosphosiderite, pyrite, arsenopyrite, *etc*. The crystal structure is solved. Monoclinic, space group *Pbna*, $a = 9.4887(2)$, $b = 10.1149(2)$, $c = 8.7062(2)$ Å, $V = 835.60(3)$ Å^3, $Z = 4$. The empirical formula is $H_{5.78}Mn_{1.70}Fe^{2+}{}_{1.25}Fe^{3+}{}_{0.08}P_{2.015}O_{11}$. Optically biaxial (+), $\alpha = 1.661(5)$, $\beta = 1.673(5)$, $\gamma = 1.703(5)$, $2V_{meas} = 70(10)°$. $D_{meas.} = 3.25(2)$, $D_{calc.} = 3.275$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.08 (43) (020); 4.314 (28) (210); 3.220 (100) (221, 202); 3.125 (25) (122); 2.756 (35) (230); 2.686 (25) (113); 2.436 (22) (123); 2.233 (23) (411, 331). IR bands in the range 1800–2600 reflect partial protonation of PO_4^{3-} groups as a result of H^+ transfer from water molecules.

Wavenumbers (cm^{-1}): 3457, 3200, 2530, 2247w, 2033w, 1890, 1636w, 1575, 1054s, 1013s, 758, 750sh, 661w, 597, 570, 555sh, 476w, 417w, 384w.

2.9 Sulfates, Carbonato-Sulfates, Phosphato-Sulfates and Sulfides

S1 Nickelhexahydrite $Ni(SO_4)·6H_2O$

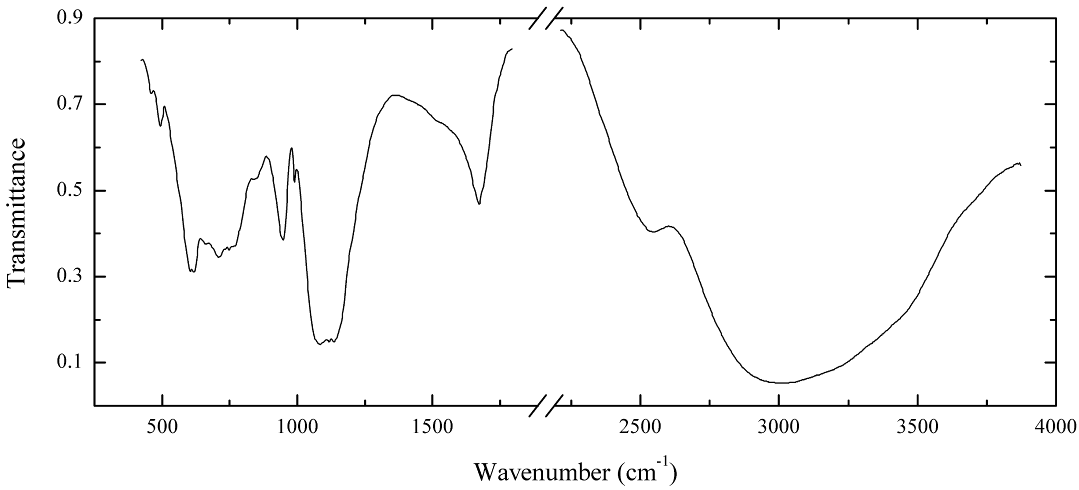


Locality: Severnaya open-pit mine, Noril'sk, Putorana Plateau, Taimyr peninsula, Krasnoyarsk Krai, Eastern Siberia, Russia (type locality).

Description: Light green powdery aggregate. Identified by IR spectrum, powder X-ray diffraction pattern and chemical composition. The empirical formula is (electron microprobe) $H_{0.02}(Ni_{0.65}Mg_{0.28}Cu_{0.06})(SO_4)_{1.00}·nH_2O$.

Wavenumbers (cm^{-1}): 3470sh, 3340s, 3245s, 1700sh, 1650, 1140sh, 1100sh, 1089s, 984, 762, 625sh, 616.

S2 Tamarugite $NaAl(SO_4)_2{\cdot}6H_2O$

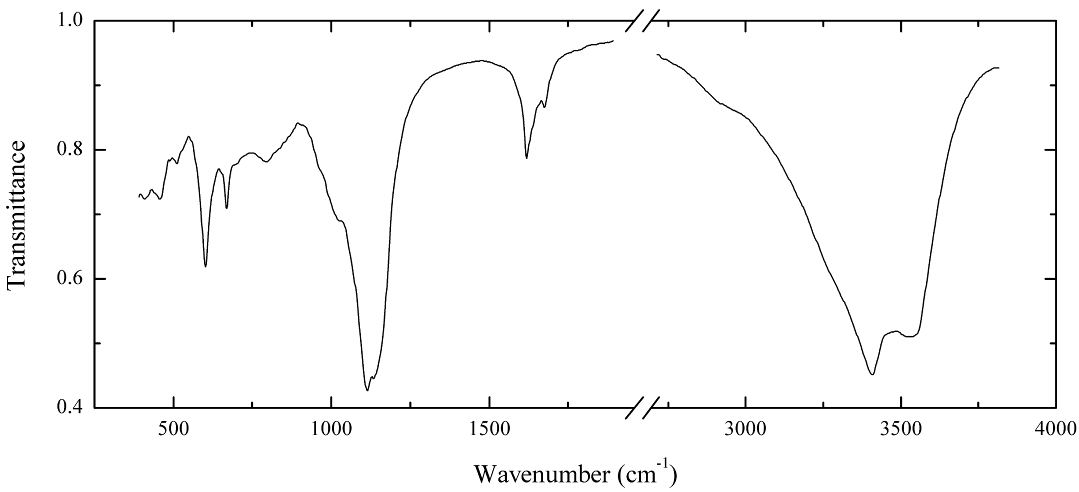


Locality: Cerro Pintados (Cerros Pintados), Tamarugal Pampa, Iquique province, Tarapacá region, Chile (type locality).

Description: White granular aggregate from the association with natroalunite. Confirmed by electron microprobe analysis. The empirical formula is $Na_{1.00}(Al_{0.98}Fe_{0.02}Cu_{0.01})(SO_4)_{1.00}{\cdot}nH_2O$. Possibly intermixed with alum-(Na).

Wavenumbers (cm^{-1}): 3410sh, 3000s, 2550, 1677, 1136s, 1122s, 1089s, 1075sh, 992, 946, 756, 707, 665, 621, 603, 493w, 453w.

S3 Gordaite $NaZn_4(SO_4)Cl(OH)_6{\cdot}6H_2O$

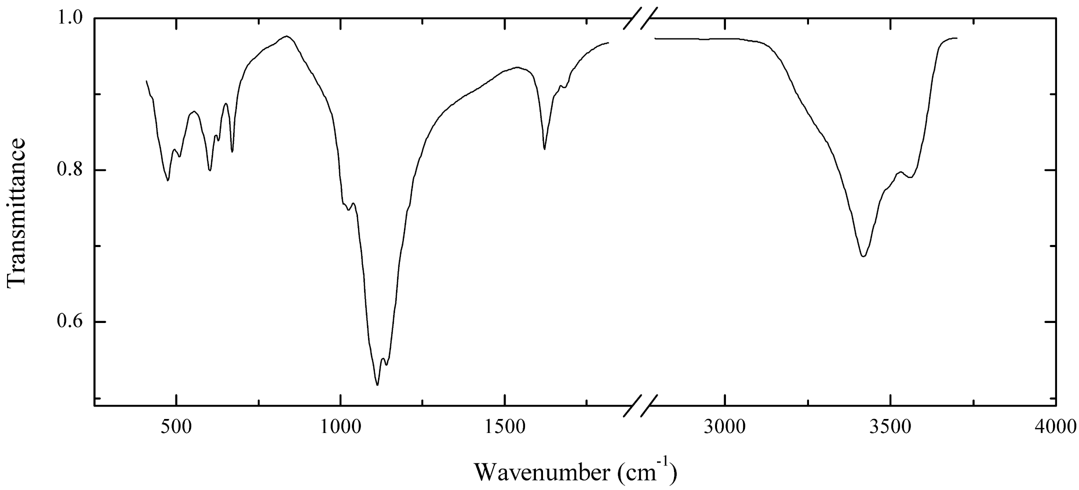


Locality: Lead smelter Kupferkammer 2, Hettstedt, Mansfeld basin, Saxony-Anhalt, Germany.

Description: Pale greenish-blue scaly crystals in slag.

Wavenumbers (cm^{-1}): 3530s, 3403s, 1675, 1621, 1137s, 1116s, 1030sh, 1010sh, 970sh, 800, 668, 602, 509w, 456, 418.

S4 Slavíkite $NaMg_2Fe^{3+}{}_5(SO_4)_7(OH)_6{\cdot}33H_2O$

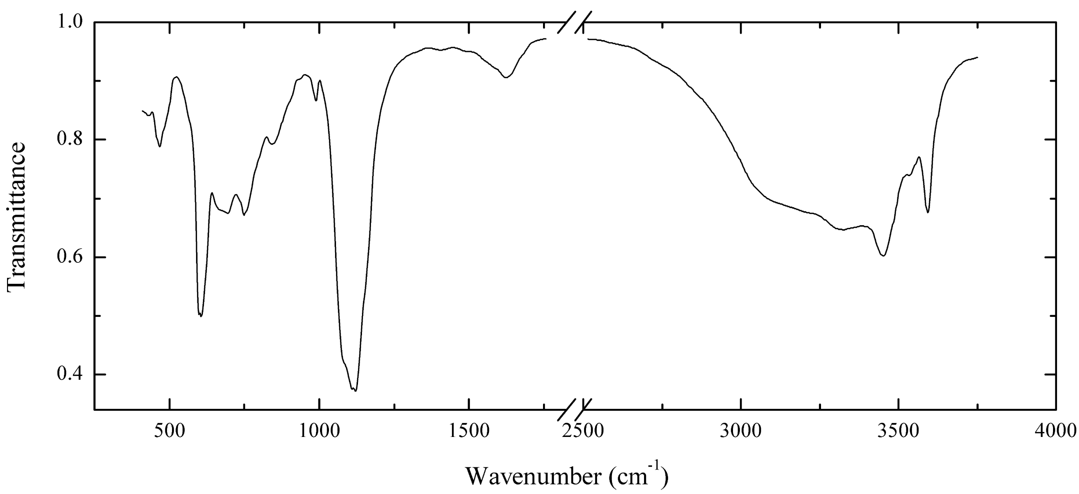


Locality: Sulitjelma Cu mines, Sulitjelma, Fauske, Nordland, Norway.

Description: Yellow-brown crust. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3530, 3390, 3220sh, 1683w, 1621, 1141s, 1114s, 1095sh, 1023, 1013, 668, 627, 600, 505, 473.

S5 Christelite $Zn_3Cu_2(SO_4)_2(OH)_6{\cdot}4H_2O$

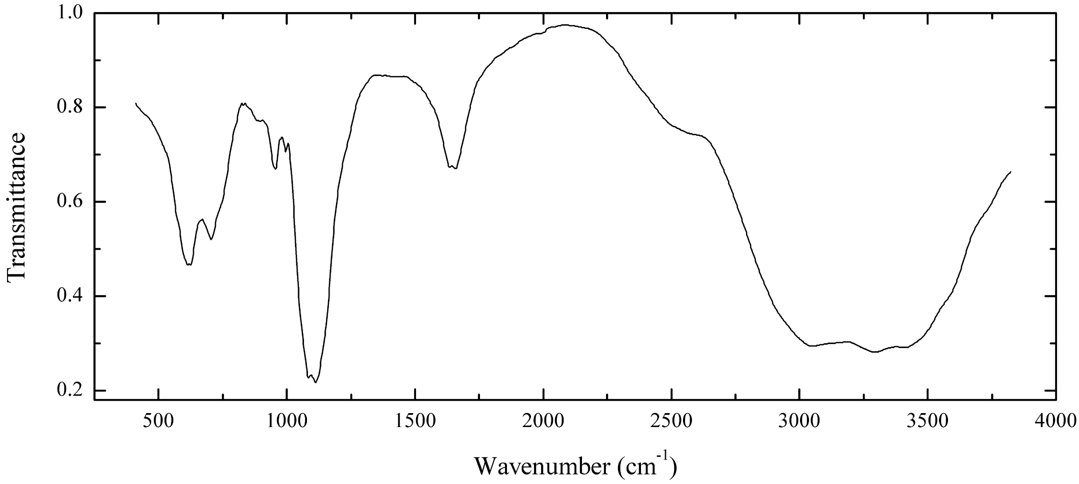


Locality: San Francisco mine, Caracoles, Sierra Gorda district, Antofagasta province, Chile (type locality).

Description: Blue crust from the association with herbertsmithite. Confirmed by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3600, 3545w, 3458, 3325, 3140sh, 1630w, 1415w, 1150sh, 1124s, 1113s, 1075sh, 993w, 984w, 849, 755, 691, 660sh, 614s, 605s, 465, 425w.

S6 Pickeringite $MgAl_2(SO_4)_4{\cdot}22H_2O$

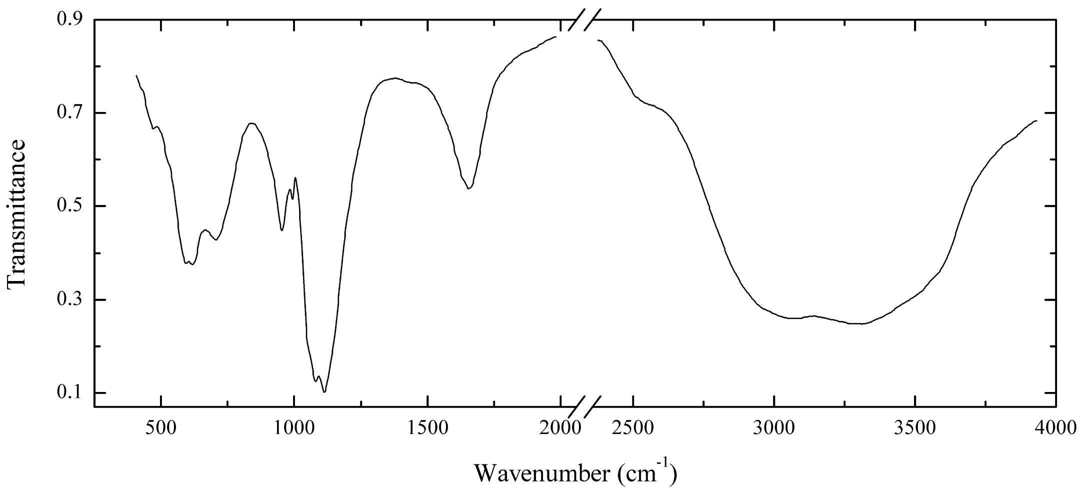


Locality: Kladno (Schöller) mine, Libušin, Kladno, Central Bohemia, Czech Republic.

Description: White fibrous aggregate from the association with khademite. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $Mg_{0.94}Al_{1.99}Fe_{0.06}(SO_4)_{4.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3410s, 3290s, 3040s, 2580sh, 1658, 1635, 1118s, 1091s, 996w, 954, 890w, 735sh, 704, 621, 608, 600sh.

S7 Halotrichite $Fe^{2+}Al_2(SO_4)_4{\cdot}22H_2O$

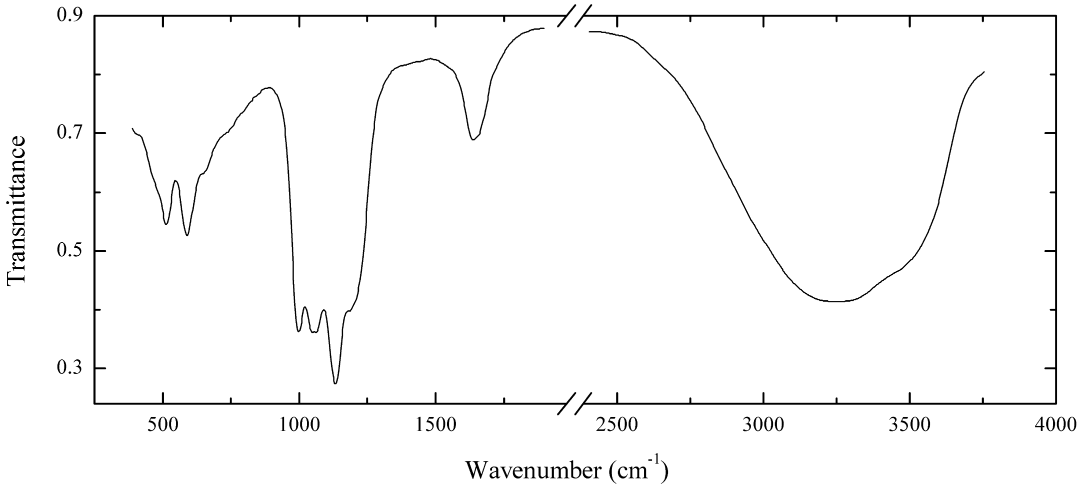


Locality: Libanka, Dubník, Prešov region, Slovakia.

Description: Yellowish to beige fibrous aggregate from the association with fibroferrite. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $(Fe_{0.5}Mg_{0.4}Zn_{0.1})(Al_{1.9}Fe_{0.1})(SO_4)_{4.0}{\cdot}nH_2O$.

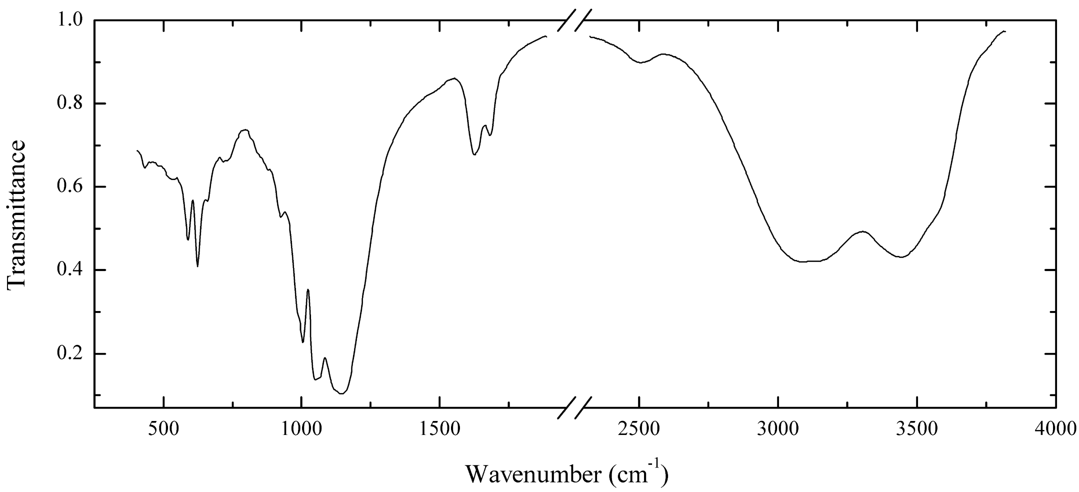
Wavenumbers (cm^{-1}): 3550sh, 3275s, 3055s, 2550sh, 1655, 1114s, 1083s, 1055sh, 993w, 975sh, 954, 709, 618, 596, 470w.

S8 Fibroferrite $Fe^{3+}(SO_4)(OH)\cdot 5H_2O$



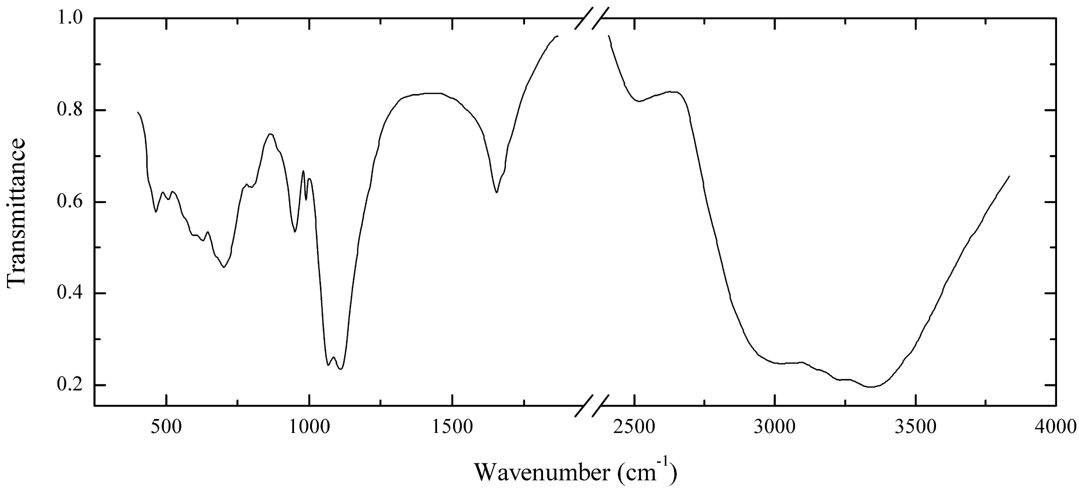
Locality: Le Cetine di Cotorniano mine, Chiusdino, Siena province, Tuscany, Italy.
Description: Brown fibrous aggregate.
Wavenumbers (cm^{-1}): 3460sh, 3230s, 1643, 1197, 1137s, 1074s, 1049s, 1001s, 655sh, 595, 516.

S9 Voltaite $K_2Fe^{2+}{}_5Fe^{3+}{}_3Al(SO_4)_{12}\cdot 18H_2O$



Locality: Alcaparrosa mine, Cerritos Bayos, Calama, El Loa province, Antofagasta region, Chile.
Description: Black octahedral crystal from the association with aluminocopiapite, coquimbite and szomolnokite. Identified by IR spectrum, powder X-ray diffraction pattern and chemical composition. The empirical formula is (electron microprobe) $K_{2.0}(Fe_{4.2}Mg_{0.6}Zn_{0.2})(Fe_{2.7}Al_{0.3})Al_{1.0}(SO_4)_{12.0}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3535sh, 3430, 3140sh, 3080, 2500w, 1685, 1627, 1145s, 1125sh, 1065sh, 1053s, 1007s, 990sh, 917, 875sh, 724w, 660, 624, 591, 521w, 435w.

S11 Aubertite $Cu^{2+}Al(SO_4)_2Cl{\cdot}14H_2O$

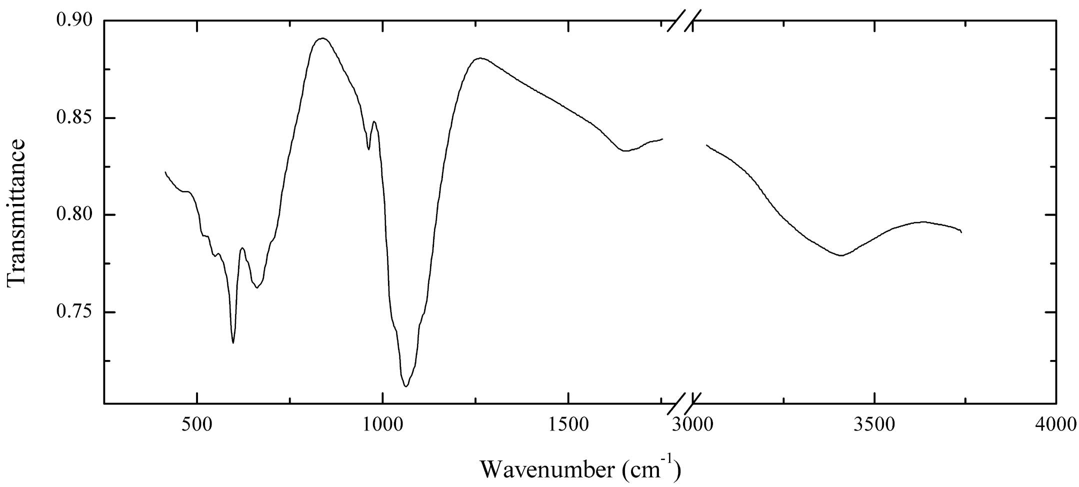


Locality: Cerro Pintados (Cerros Pintados), Tamarugal Pampa, Iquique province, Tarapacá region, Chile.

Description: Blue massive. The empirical formula is (electron microprobe) $(Cu_{0.60}Mg_{0.38}Co_{0.03})Al_{1.04}(SO_4)_{1.98}Cl_{1.08}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3340s, 3220s, 3140sh, 3010s, 2515w, 1670sh, 1655, 1115, 1070, 990, 951, 791sh, 704, 680sh, 624, 597, 506w, 466, 440sh.

S12 Coquandite $Sb^{3+}{}_6(SO_4)O_8{\cdot}H_2O$

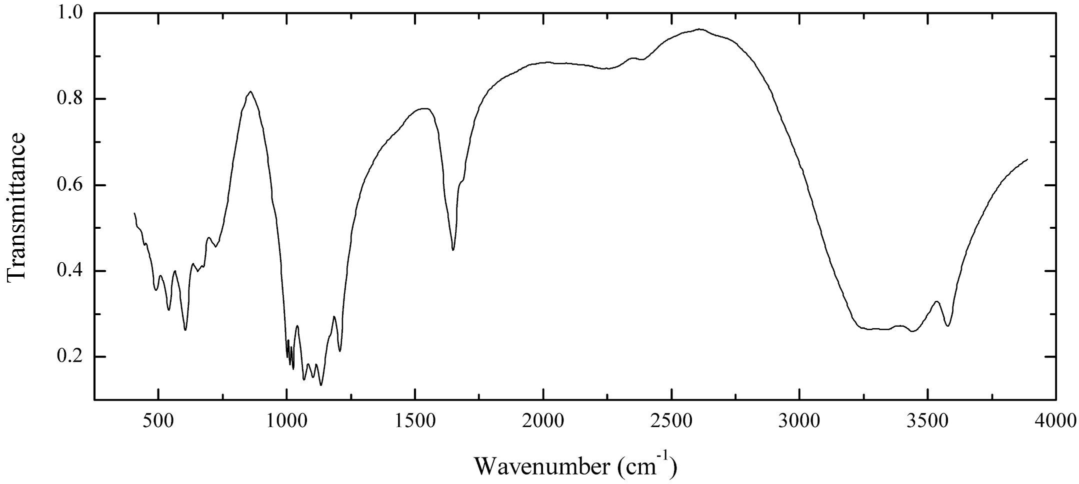


Locality: Pereta mine, Pereta, Tuscany, Italy (type locality).

Description: White crust on stibnite.

Wavenumbers (cm^{-1}): 3375, 3300sh, 1650w, 1105sh, 1066s, 1025sh, 961w, 735sh, 700sh, 664, 600s, 549, 519, 470sh.

S13 Botryogen $MgFe^{3+}(SO_4)_2(OH)\cdot 7H_2O$

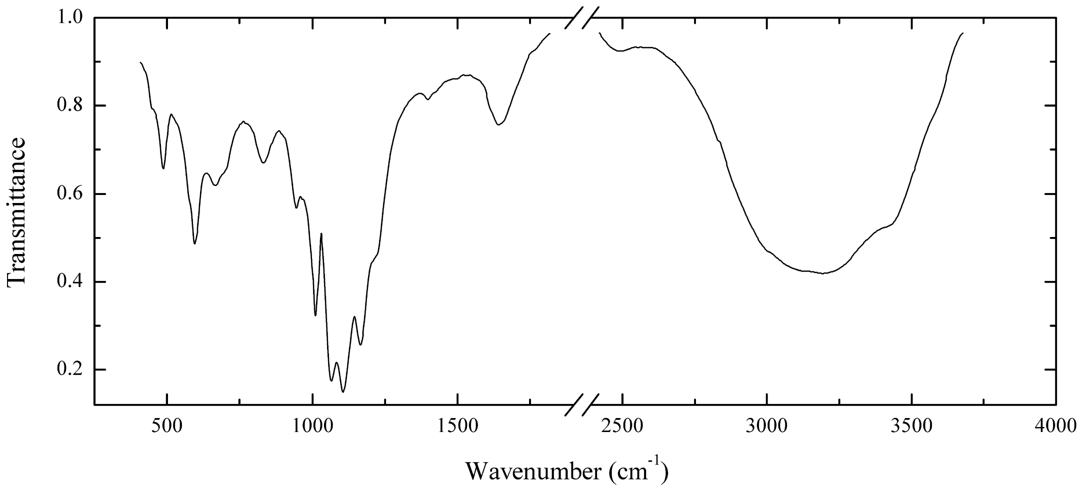


Locality: Le Cetine di Cotorniano mine, Chiusdino, Siena province, Tuscany, Italy.

Description: Orange crystals. The empirical formula is (electron microprobe) $(Mg_{1.00}Fe_{0.02})(Fe_{0.96}Al_{0.04})(SO_4)_{2.00}(OH)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3572, 3435, 3330, 3265, 2380w, 2240w, 1685sh, 1647, 1625sh, 1212s, 1165sh, 1137s, 1108s, 1072s, 1025s, 1012s, 1002s, 721, 673, 651, 604, 538, 488, 445, 415sh.

S14 Coquimbite $Fe^{3+}{}_2(SO_4)_3\cdot 9H_2O$

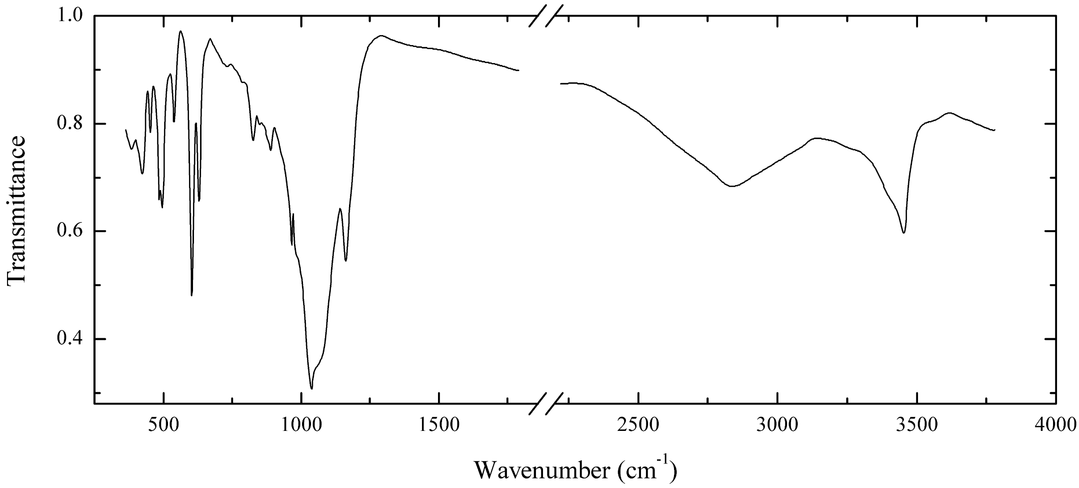


Locality: Cerro Pintados (Cerros Pintados), Tamarugal Pampa, Iquique province, Tarapacá region, Chile.

Description: White powdery aggregate. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 9.43 (70), 8.35 (100), 5.48 (70), 4.60 (80), 4.17 (90), 3.67 (60), 3.52 (60), 3.38 (90), 2.775 (90).

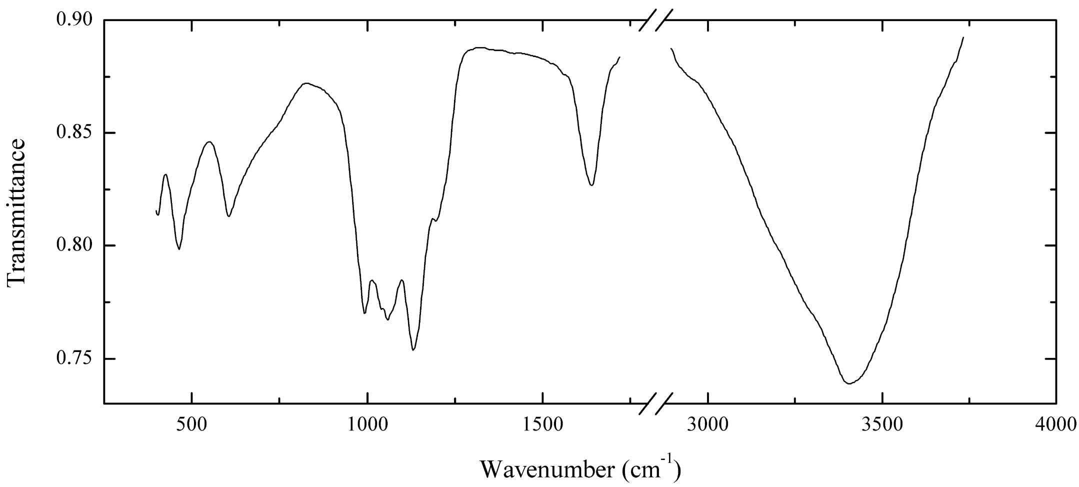
Wavenumbers (cm^{-1}): 3410, 3190, 3075sh, 3000sh, 2505w, 1650, 1400w, 1215sh, 1170s, 1109s, 1068s, 1024, 1013s, 995sh, 947, 831, 690sh, 666, 605sh, 593, 575sh, 484, 442w, 420sh.

S15 Linarite $PbCu^{2+}(SO_4)(OH)_2$



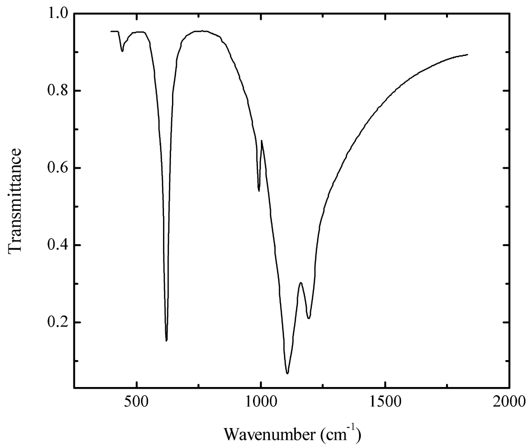
Locality: Kaban Mt., Western Keivy massif, Kola peninsula, Murnansk region, Russia.
Description: Greenish-blue aggregate from quartz-astrophyllite vein, from the association with galena. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3440, 3400sh, 2825, 1166, 1080sh, 1070sh, 1040s, 985sh, 966, 890, 852w, 826, 783w, 736w, 628, 602s, 536, 495, 485, 449, 424, 380.

S16 Anorthominasragrite $V^{4+}(SO_4)O{\cdot}5H_2O$



Locality: North Mesa mine No. 5, Temple Mt. mining district, Emery Co., Utah, USA (type locality).
Description: Blue spherulites. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3415s, 1640, 1203, 1138s, 1074, 1051, 996s, 700sh, 604, 460.

S17 Aphthitalite $(K,Na)_3Na(SO_4)_2$

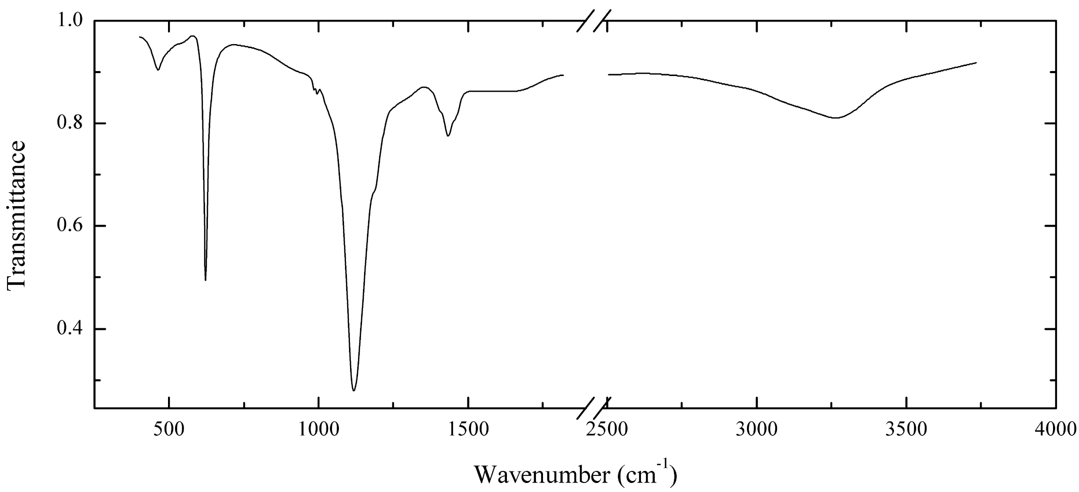


Locality: Merkers, Merkers-Kieselbach, Thuringia, Germany.

Description: Light grey granular aggregate from the association with halite. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1188s, 1103s, 990, 617s, 445w.

S18 Arcanite $K_2(SO_4)$

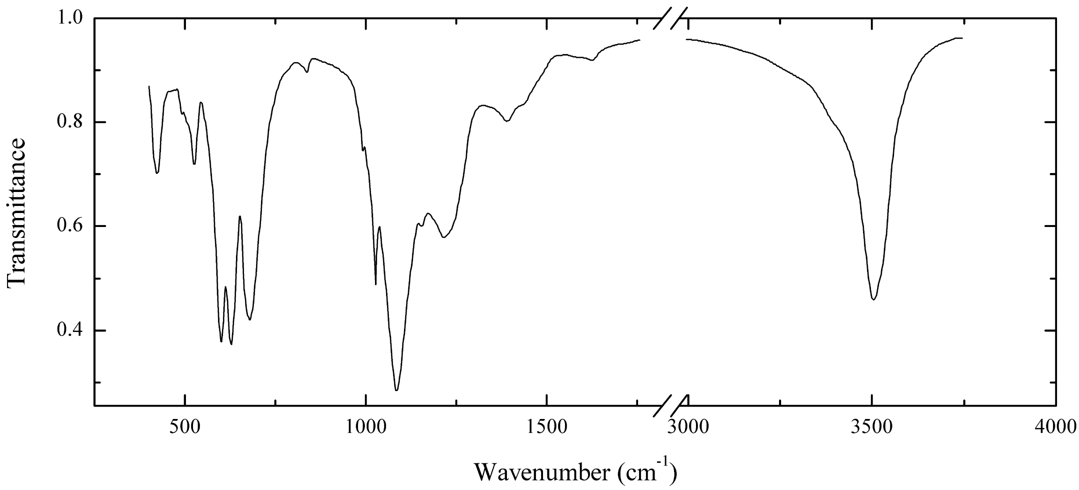


Locality: Dingo Donga cave, Madura Motel, Eucla, Western Australia, Australia.

Description: White crystals. Identified by IR spectrum. The empirical formula is (electron microprobe) $H_x[K_{0.73}(NH_4)_{0.18}Na_{0.06}](SO_4)_{1.00}$. The bands at 3,240, 3,140, 1,450, 1,430 and 1,405 cm^{-1} correspond to vibrations of NH_4^+ groups.

Wavenumbers (cm^{-1}): 3240, 1450sh, 1430, 1405sh, 1180sh, 1115s, 990w, 980w, 618s, 450.

S21 Alunite $KAl_3(SO_4)_2(OH)_6$

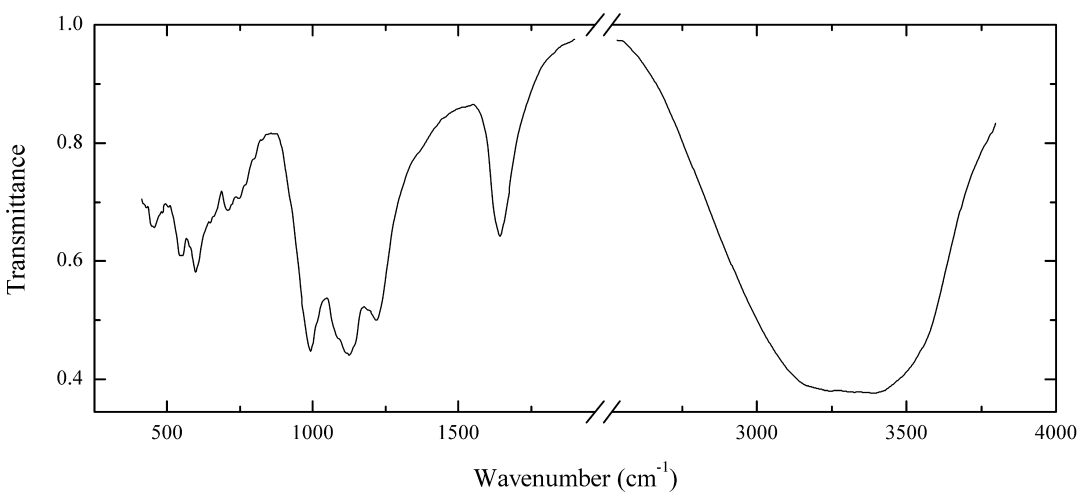


Locality: Empire mine, Tombstone district, Tombstone Hills, Cochise Co., Arizona, USA.

Description: White spherulites. The empirical formula is (electron microprobe) $H_xK_{0.7}Pb_{0.05}Al_{2.9}Fe_{0.1}(SO_4)_{2.0}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3490, 1625w, 1425sh, 1388, 1220, 1159, 1083s, 1026, 838w, 677, 670sh, 626s, 599s, 523, 502w, 487w, 422.

S22 Aluminocopiapite $(Al_{2/3}\square_{1/3})Fe^{3+}_4(SO_4)_6(OH)_2{\cdot}20H_2O$

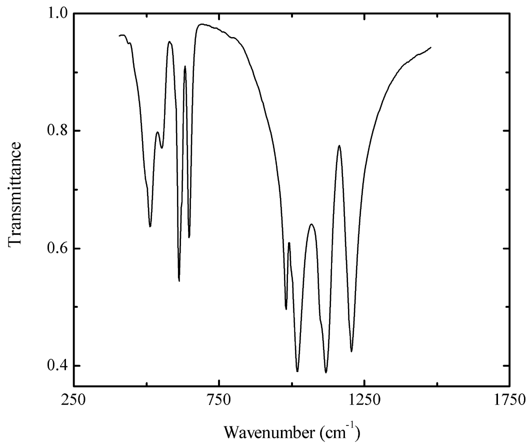


Locality: Dresden, Saxony, Germany.

Description: Yellow concretion. Al-rich variety. The empirical formula is (electron microprobe) $Al_{0.67}(Fe_{2.10}Al_{1.90})(SO_4)_{6.00}(OH)_2{\cdot}nH_2O$.

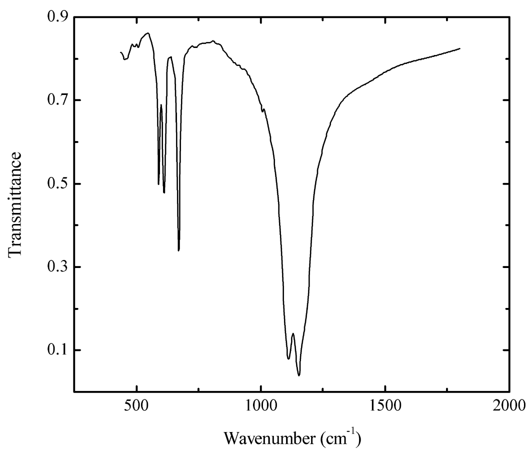
Wavenumbers (cm^{-1}): 3520sh, 3400s, 3260s, 3200s, 1642, 1230, 1133s, 1085sh, 997s, 772w, 748w, 724, 670sh, 635sh, 597, 553, 445.

S23 Piypite $K_4Cu^{2+}{}_4(SO_4)_4O_2(Na,Cu^+)Cl$



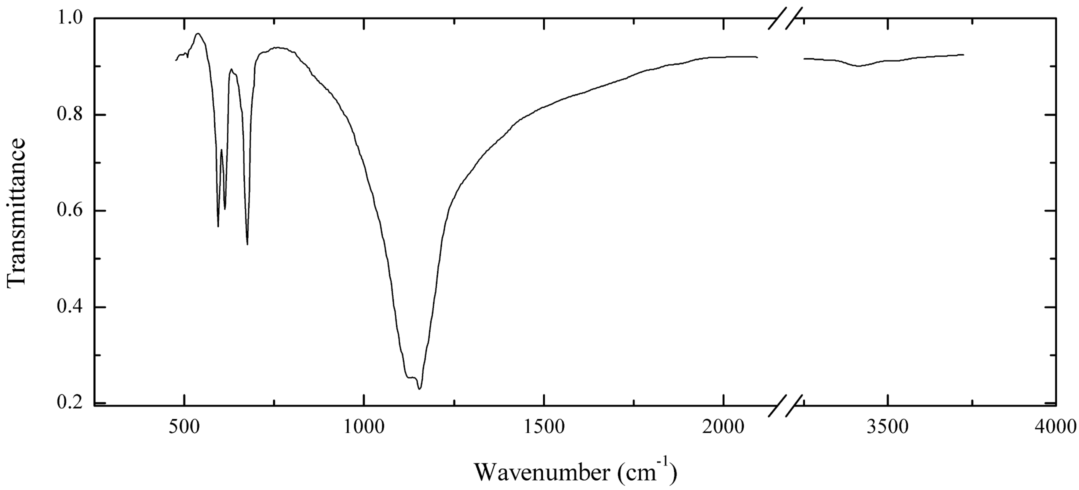
Locality: North Breach of the Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia (type locality).
Description: Green prismatic crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1207s, 1117s, 1021s, 983s, 648, 613, 555, 514, 500sh.

S24 Anhydrite $Ca(SO_4)$



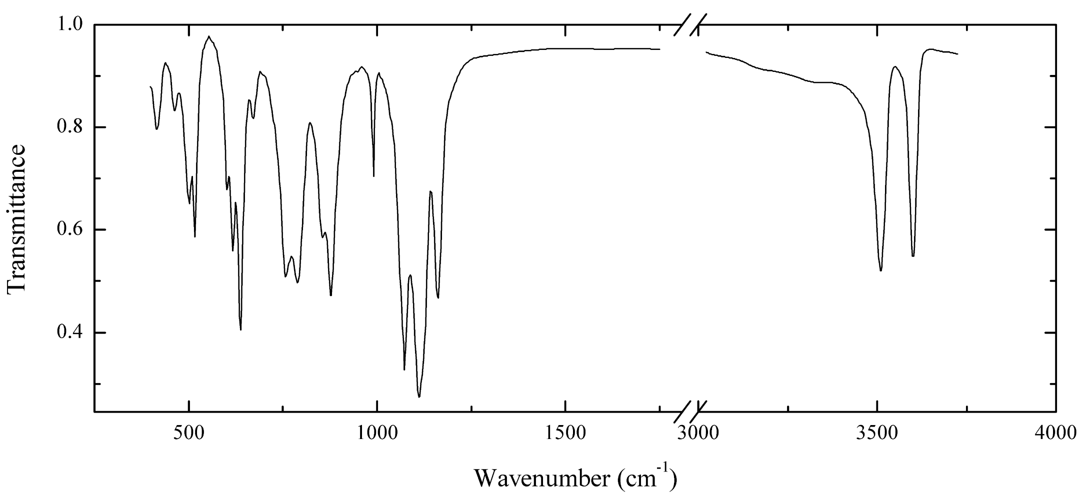
Locality: Zastávka, near Brno, South Moravia, Czech Republic.
Description: Light grey prismatic crystals from the association with koktaite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1175sh, 1156s, 1117s, 1009w, 676, 617, 595, 507w, 455w.

S25 Anhydrite $Ca(SO_4)$



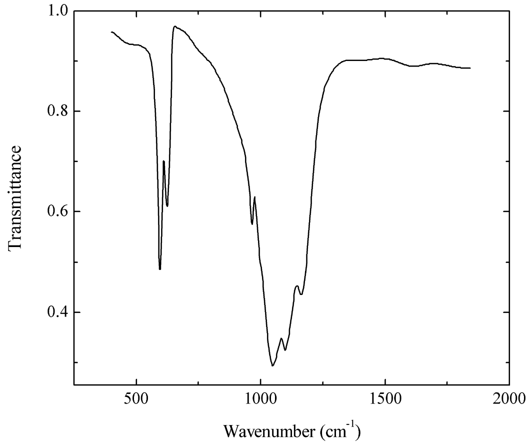
Locality: Tyret' railway station, Irkutsk region, Siberia, Russia.
Description: White crust from the association with tyretskite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1170sh, 1155s, 1125s, 674, 613, 593, 505w.

S26 Antlerite $Cu^{2+}_3(SO_4)(OH)_4$



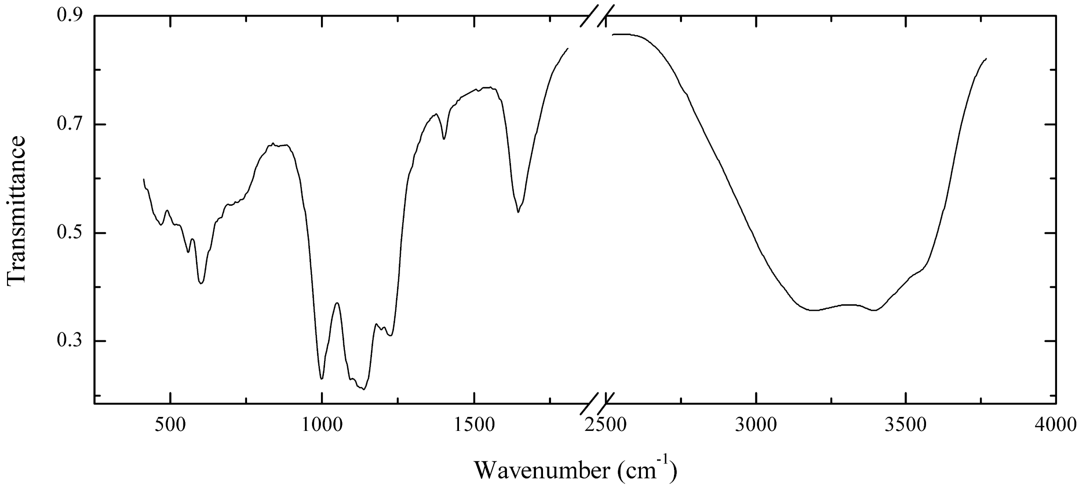
Locality: Ľubietová, Banská Bystrica region, Slovakia.
Description: Green crystals from the association with parnauite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3578, 3485, 1159, 1109s, 1070s, 988, 876, 854, 789, 756, 670w, 636s, 616, 601, 515, 500, 458w, 412.

S27 Anglesite $Pb(SO_4)$



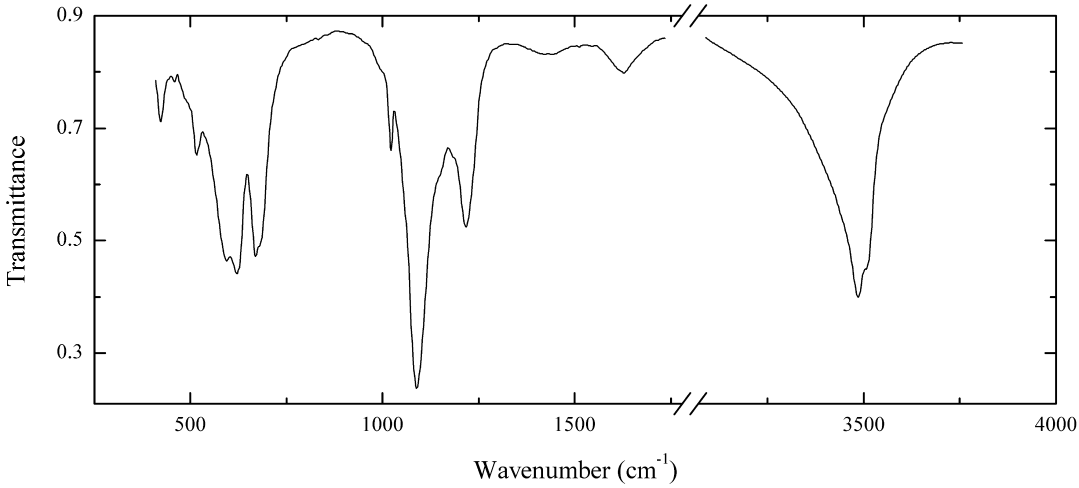
Locality: Mibladene (Mibladén), Upper Moulouya lead district, Midelt, Khénifra province, Morocco.
Description: Colourless crystal. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1168, 1110sh, 1100s, 1051s, 967, 622, 595.

S28 Aluminocopiapite $(Al_{2/3}\square_{1/3})Fe^{3+}_4(SO_4)_6(OH)_2\cdot 20H_2O$



Locality: Alcaparrosa mine, Cerritos Bayos, Calama, El Loa province, Antofagasta region, Chile.
Description: Yellow fine-grained aggregate from the association with voltaite, coquimbite and szomolnokite. The empirical formula is (electron microprobe) $(Al_{0.42}Mg_{0.26}Cu_{0.11}Fe_{0.08})Fe_{4.00}(SO_4)_{6.00}(OH)_2\cdot nH_2O$. The band at 1,397 cm^{-1} can be due to the presence of H^+ or NH_4^+.
Wavenumbers (cm^{-1}): 3535sh, 3360s, 3165s, 1645, 1397w, 1220, 1190, 1139s, 1120sh, 1096s, 1015sh, 997s, 710sh, 670sh, 630sh, 598, 556, 513w, 473w, 445sh.

S29 Alunite $KAl_3(SO_4)_2(OH)_6$

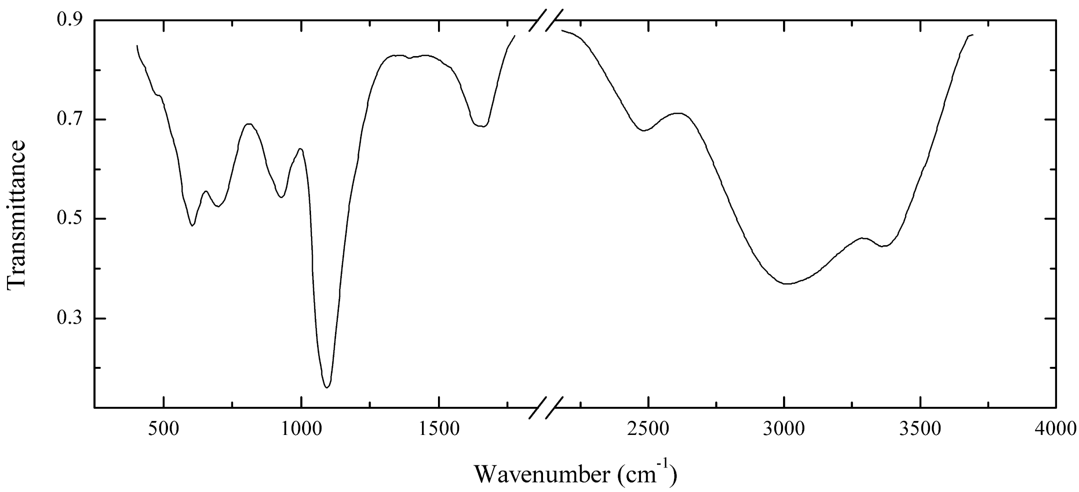


Locality: Madneuli mine, Bolnisi district, Kvemo Kartli region, Georgia.

Description: Green fine-grained porcelain-like aggregate. Fe-rich variety. The empirical formula is (electron microprobe) $(K_{0.83}Na_{0.08})(Al_{2.46}Fe_{0.50}Cu_{0.02})(SO_4)_{2.00}(OH,H_2O)_x$.

Wavenumbers (cm^{-1}): 3500sh, 3470s, 3400sh, 1635w, 1430w, 1229, 1055sh, 1099s, 1028, 685sh, 675, 630, 601, 522, 455w, 427.

S30 Alunogen $Al_2(SO_4)_3{\cdot}17H_2O$

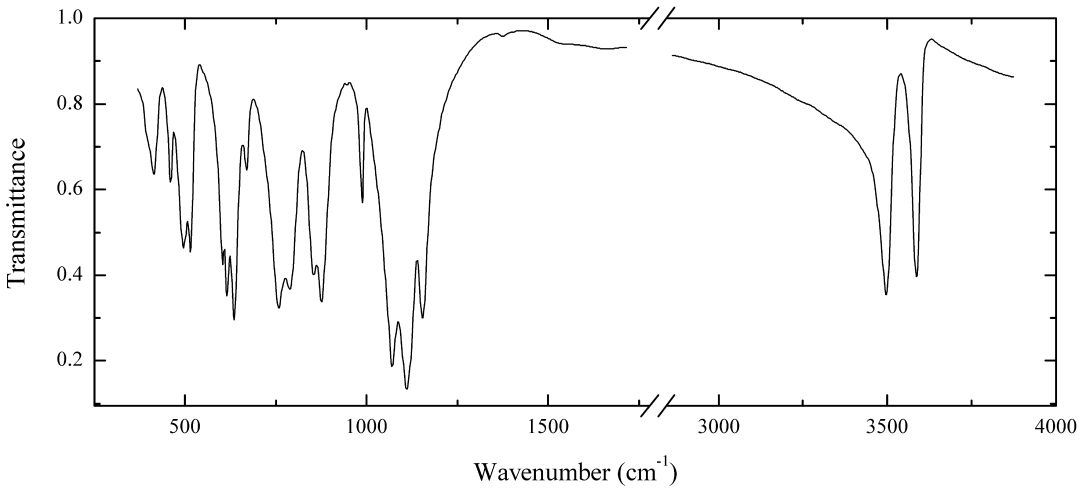


Locality: Le Cetine mine, Chiusdino, Siena province, Tuscany, Italy.

Description: White fine-grained aggregate. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Al_{1.99}Fe_{0.02})(SO_4)_{3.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3360, 3000s, 2480, 1670, 1640sh, 1391w, 1096s, 930, 697, 605, 475sh.

S31 Antlerite $Cu^{2+}_3(SO_4)(OH)_4$

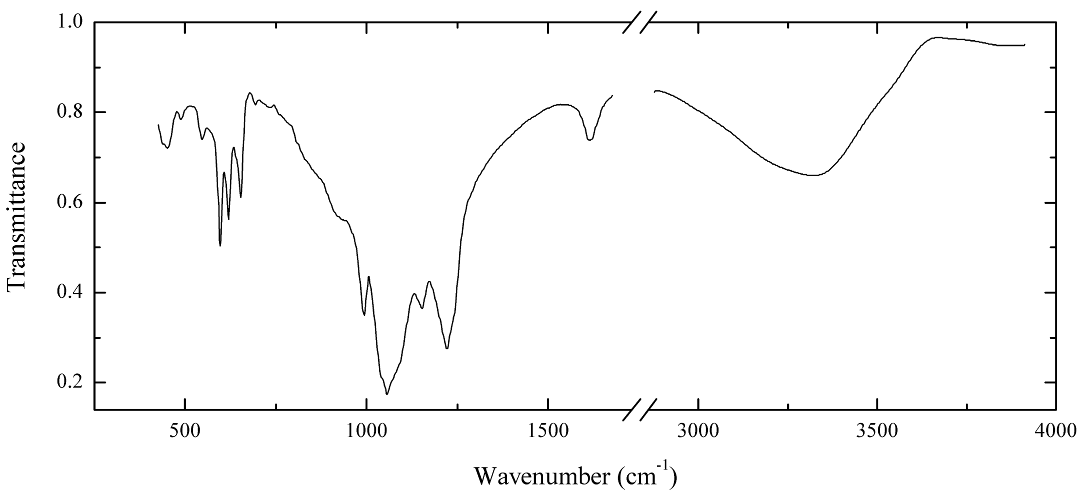


Locality: Chuquicamata copper mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile.

Description: Emerald-green fibrous aggregate forming veinlet, from the association with natrochalcite and kröhnkite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3575, 3485, 1156, 1112s, 1072s, 988, 877, 855, 789, 757, 670w, 636s, 616, 603, 516, 496, 460w, 416w.

S32 Natrochalcite $NaCu_2(SO_4)_2(OH){\cdot}H_2O$

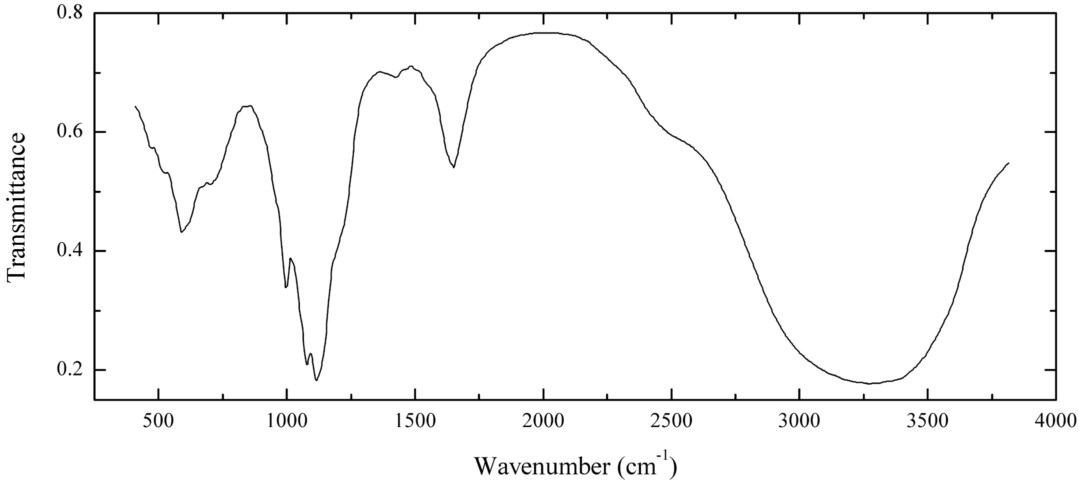


Locality: North Breach of the Great Fissure Tolbachik volcano, Kamchatka peninsula, Russia.

Description: Green pseudomorphs after euchlorine crystals. Identified by IR spectrum. K-rich variety of natrochalcite or (in case of ordering of K and Na) a potentially new mineral species. The empirical formula is (electron microprobe, limits of formula units are indicated) $(Na_{0.48–0.55}K_{0.46–0.51})(Cu_{1.91–1.98}Zn_{0–0.04}Fe_{0.01}Al_{0–0.03})(SO_4)_{2.00}(OH)_{0.9}Cl_{0.1}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3330, 1627, 1252s, 1265sh, 1158, 1090sh, 1061s, 1045sh, 997, 940sh, 860sh, 687w, 658, 623, 600, 545w, 490w, 452w.

S33 Fibroferrite $Fe^{3+}(SO_4)(OH)\cdot 5H_2O$

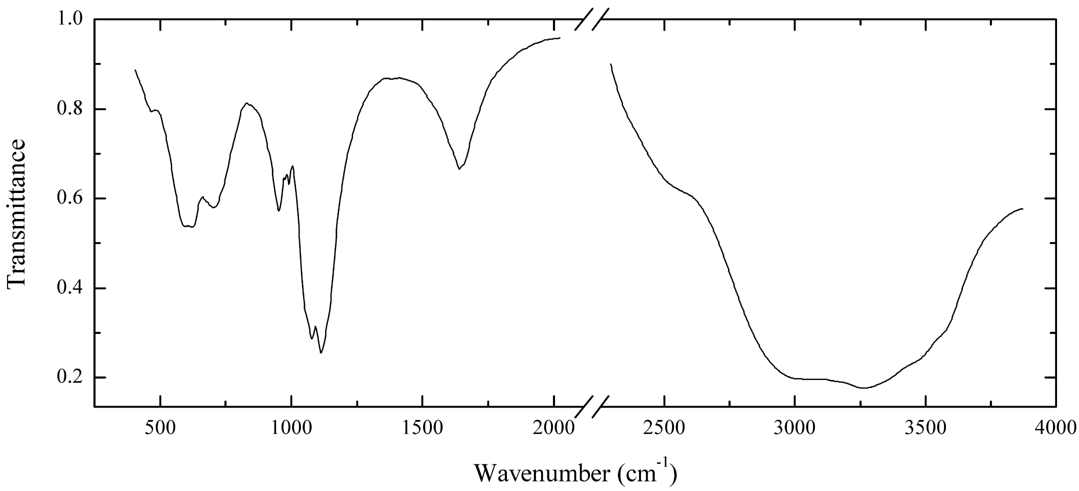


Locality: Libanka, Dubník, Prešov region, Slovakia.

Description: Beige fibrous aggregate from the association with halotrichite. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 11.93 (100), 6.93 (80), 4.35 (80, split), 4.02 (70), 3.47 (80), 3.36 (60), 3.00 (80).

Wavenumbers (cm^{-1}): 3270s, 2520sh, 1642, 1426w, 1200sh, 1135sh, 1115s, 1078s, 998, 690sh, 597, 520.

S34 Halotrichite $Fe^{2+}Al_2(SO_4)_4\cdot 22H_2O$

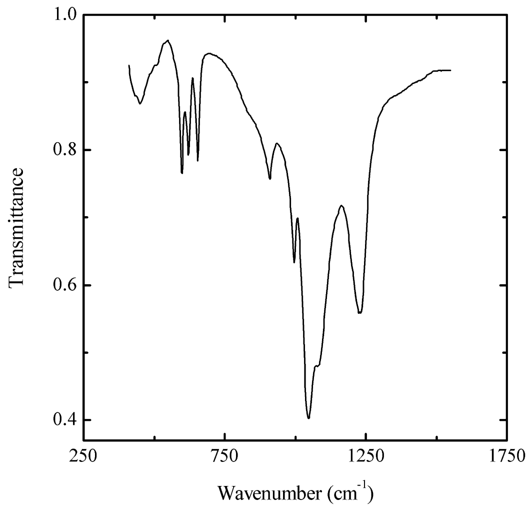


Locality: Libanka, Dubník, Prešov region, Slovakia.

Description: Yellowish to beige fibrous aggregate from the association with fibroferrite. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $(Fe_{0.94}Mg_{0.02}Ca_{0.02})Al_{1.03}(SO_4)_{4.00}\cdot nH_2O$.

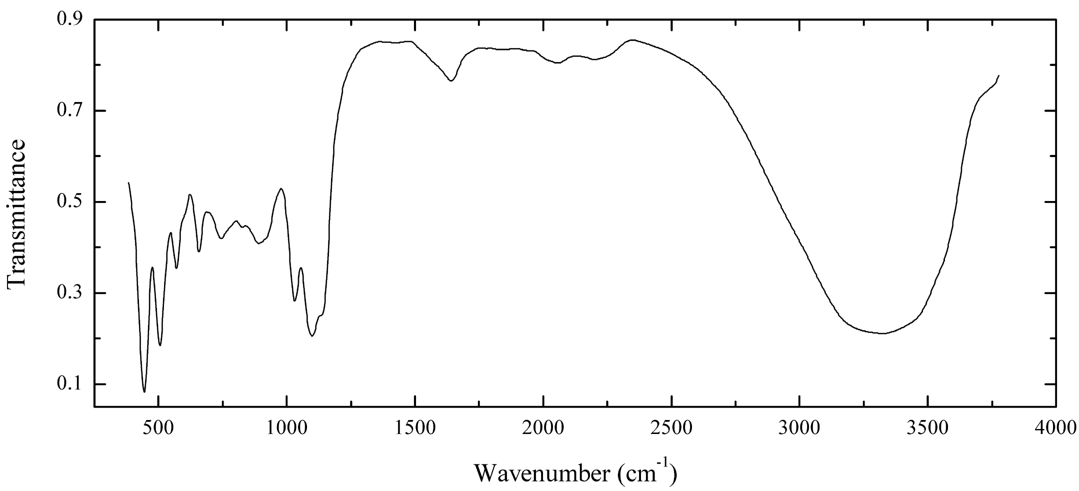
Wavenumbers (cm^{-1}): 3560sh, 3460sh, 3250s, 3010s, 2570sh, 1650, 1140sh, 1113s, 1081s, 1055sh, 993, 978w, 954, 709, 625, 597, 470w.

S35 Kamchatkite $KCu^{2+}{}_3(SO_4)_2OCl$



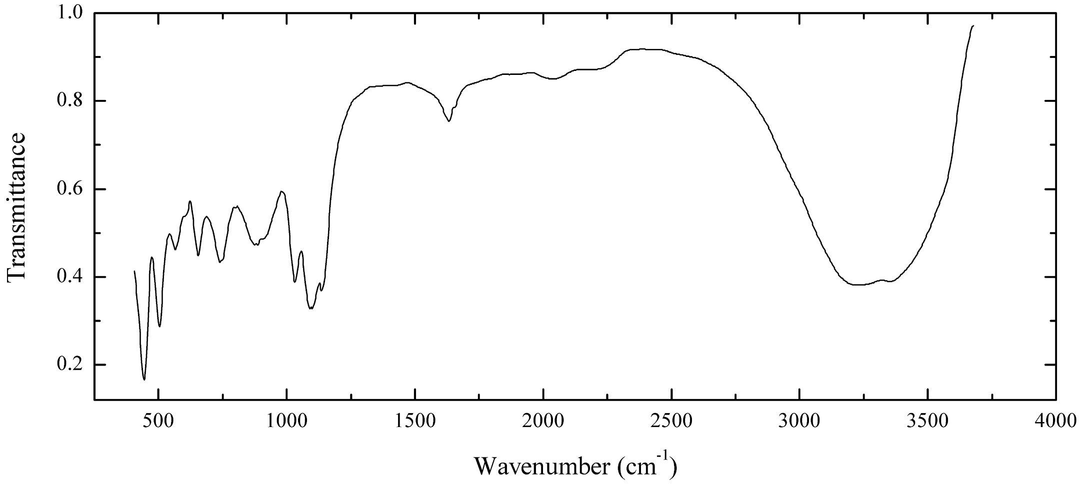
Locality: Second Scoria Cone of the Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia (type locality).
Description: Greenish-brown crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1238, 1083s, 1050s, 999, 913, 657, 624, 599, 450.

S36 Cyanotrichite $Cu^{2+}{}_4Al_2(SO_4)(OH)_{12}{\cdot}2H_2O$



Locality: Tungui, Guangxi, China.
Description: Blue radial aggregates of acicular crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3540sh, 3310s, 2200w, 2050w, 1650w, 1590sh, 1136s, 1101s, 1034s, 905, 833w, 780sh, 746, 660, 610sh, 573, 504s, 443s.

S37 Cyanotrichite $Cu^{2+}{}_4Al_2(SO_4)(OH)_{12}\cdot 2H_2O$

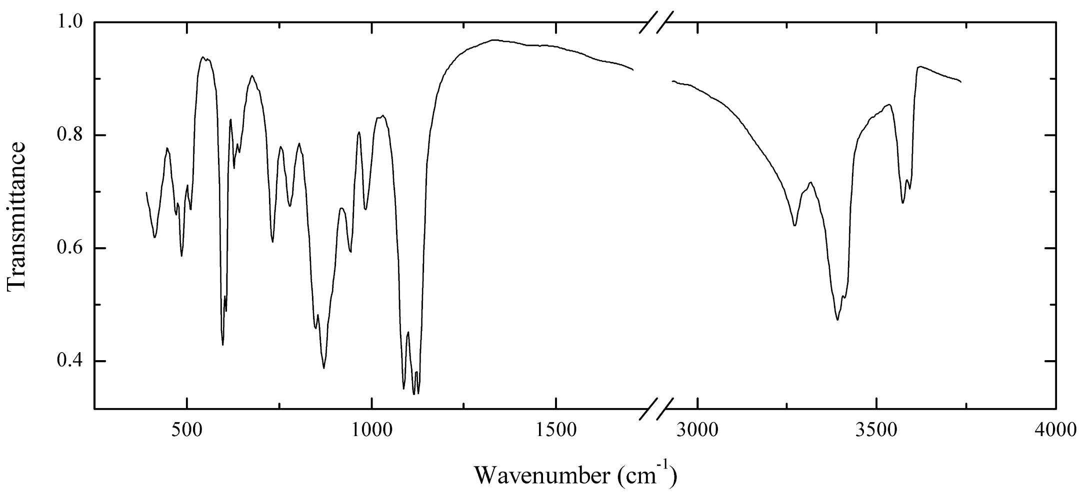


Locality: Tungui, Guangxi, China.

Description: Blue radial aggregates of acicular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3540sh, 3350s, 3230s, 2200w, 2050w, 1650w, 1590sh, 1136s, 1102s, 1034s, 910sh, 898, 833w, 780sh, 748, 659, 574, 503s, 444s.

S38 Brochantite $Cu^{2+}{}_4(SO_4)(OH)_6$

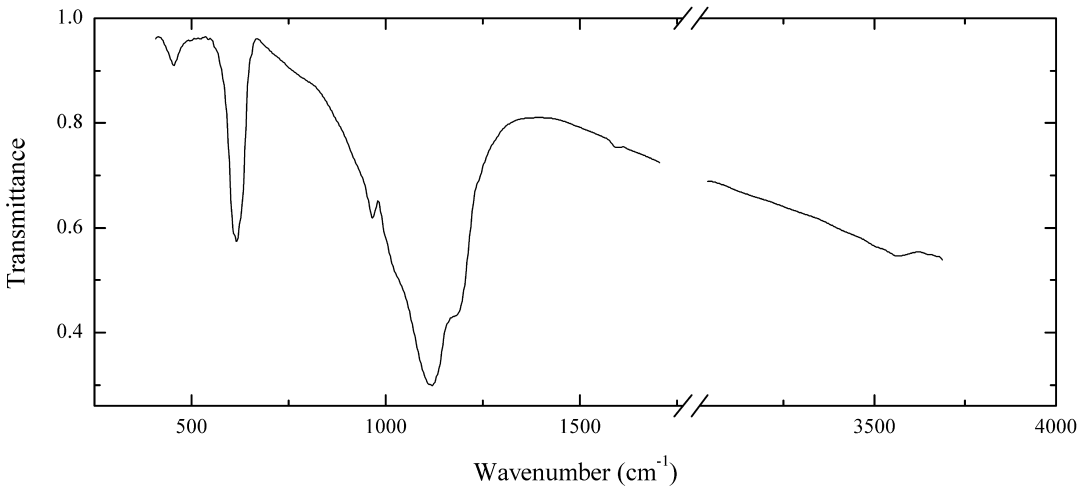


Locality: Udokan (Udokanskoe) Cu deposit, Udokan, Chita region, Transbaikal area, Eastern Siberia, Russia.

Description: Green acicular crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3580, 3560, 3400, 3380s, 3265, 1127s, 1117s, 1089s, 986, 944, 895sh, 871s, 848, 780, 733, 641w, 626, 606, 597s, 509, 485, 470, 460sh, 413.

S39 Caracolite $Na_3Pb_2(SO_4)_3Cl$

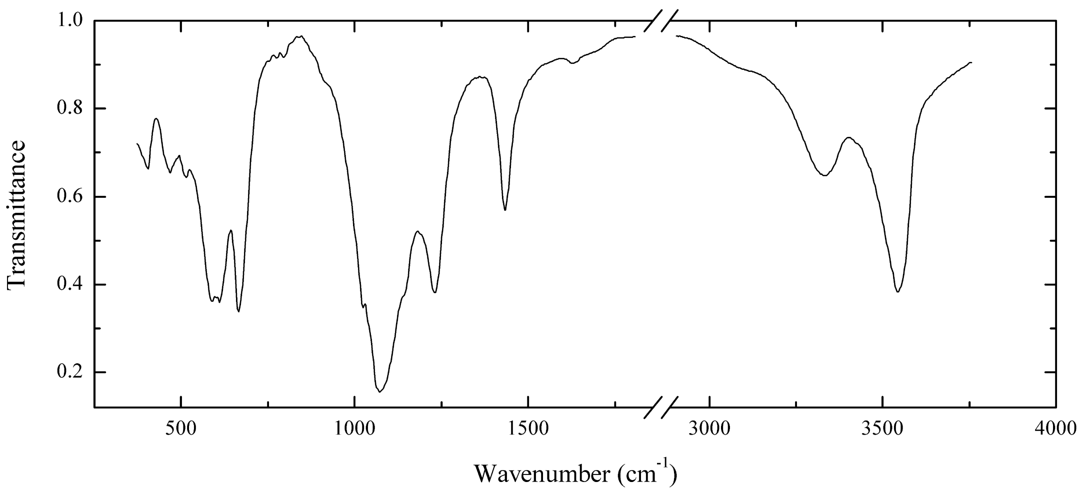


Locality: Mina Beatriz, near Caracoles, Sierra Gorda, Atacama, Chile (type locality).

Description: Colourless pseudohexagonal crystals. The empirical formula is (electron microprobe) $Na_{2.9}K_{0.05}Pb_{2.07}(SO_4)_{3.00}Cl_{0.87}(OH)_x$.

Wavenumbers (cm^{-1}): 3560w, 1595w, 1182, 1170sh, 1116s, 1038s, 968, 625sh, 617, 608, 454w.

S40 Ammonioalunite $(NH_4)Al_3(SO_4)_2(OH)_6$

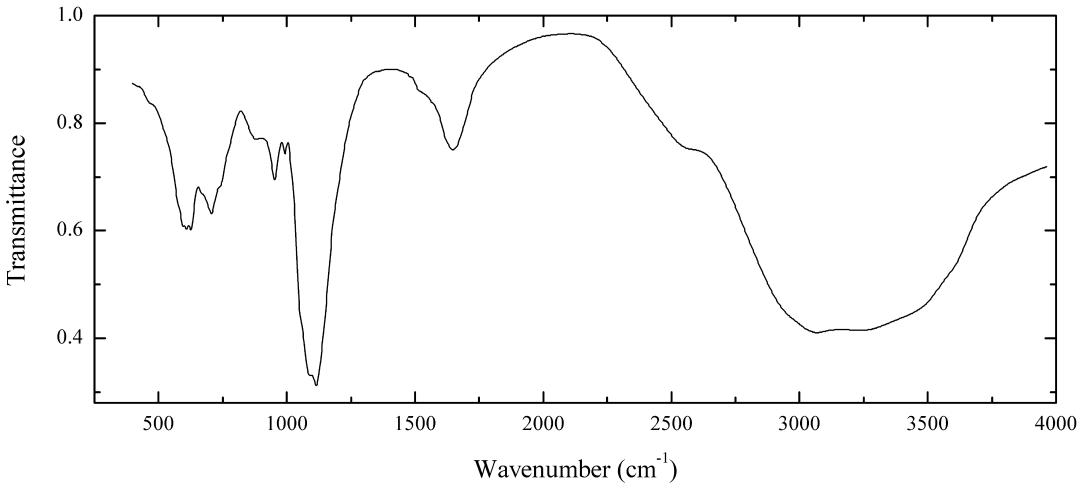


Locality: Kladno (Schöller) mine, Libušin, Kladno, Central Bohemia, Czech Republic.

Description: Light grey massive. Confirmed by IR spectrum and qualitative electron microprobe analysis. The bands at 3,305 + 3,390 and 1,433 cm^{-1} correspond to stretching and banding vibrations of NH_4^+ groups, respectively.

Wavenumbers (cm^{-1}): 3514, 3305, 3090, 1627w, 1433, 1231s, 1075s, 1045sh, 1025s, 797w, 667s, 612s, 593s, 515, 473, 407.

S41 Dietrichite $ZnAl_2(SO_4)_4 \cdot 22H_2O$

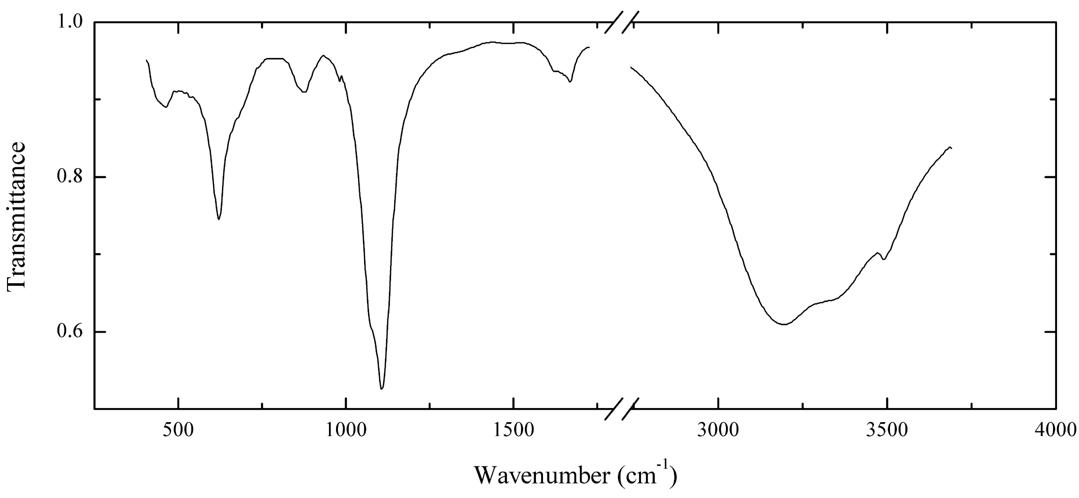


Locality: Campiglia Marittima, Livorno province, Tuscany, Italy.

Description: White crust. Confirmed by IR spectrum. The empirical formula is (electron microprobe) $(Zn_{0,6}Mg_{0.3}Fe_{0.1})Al_{2.0}(SO_4)_{4.0} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3550sh, 3450sh, 3210, 3030s, 2550, 1625, 1525sh, 1113s, 1087s, 993w, 954, 885w, 740sh, 704, 670sh, 622, 608, 595.

S42 Bonattite $Cu^{2+}(SO_4) \cdot 3H_2O$

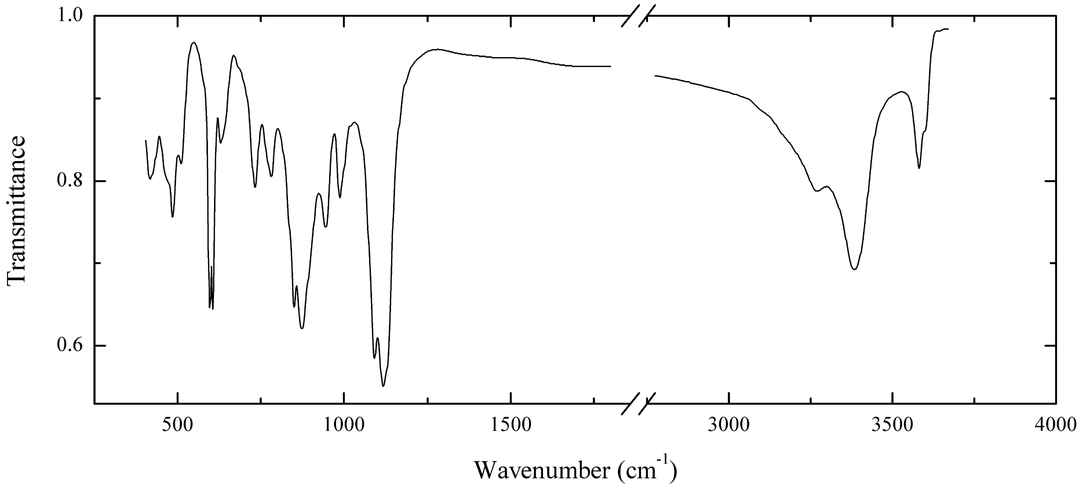


Locality: Blyava Cu deposit, Sakmara zone, Mednogorsk district, Orenburg region, South Urals, Russia.

Description: Pale blue crust. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3470, 3320sh, 3180s, 1671, 1630sh, 1107s, 1075sh, 982w, 875, 680sh, 622, 640.

S43 Brochantite $Cu^{2+}_4(SO_4)(OH)_6$

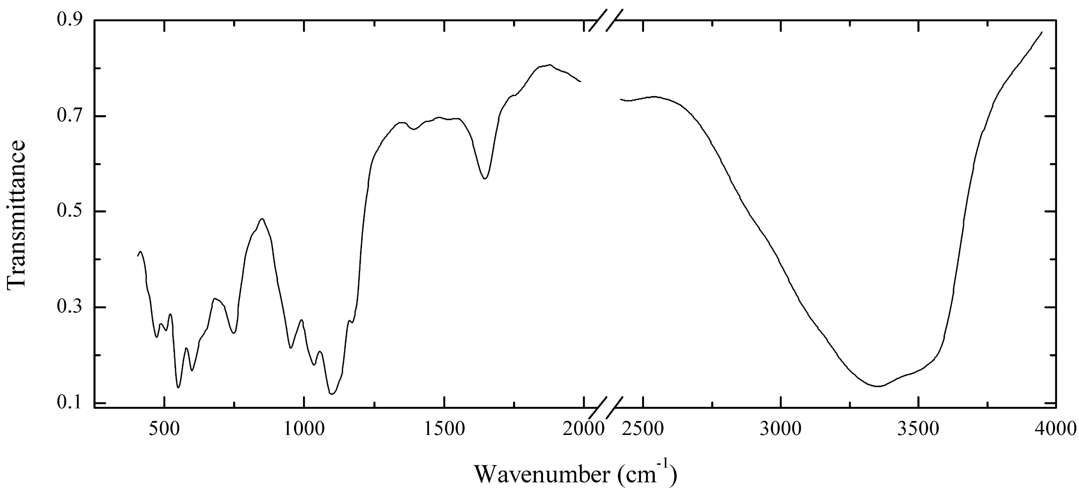


Locality: Northern Dzhezkazgan mine, Dzhezkazgan (Zhezkazgan), Karagandy region, Kazakhstan.

Description: Green split crystals on cuprite. Identified by IR spectrum and qualitative electron microprobe analysis (only Cu and S have been detected).

Wavenumbers (cm^{-1}): 3590sh, 3565, 3375s, 3255, 1125sh, 1118s, 1091s, 985, 945, 874s, 850, 780, 733, 635sh, 625, 605, 597s, 508, 482, 412.

S44 Felsőbányaite $Al_4(SO_4)(OH)_{10}{\cdot}4H_2O$

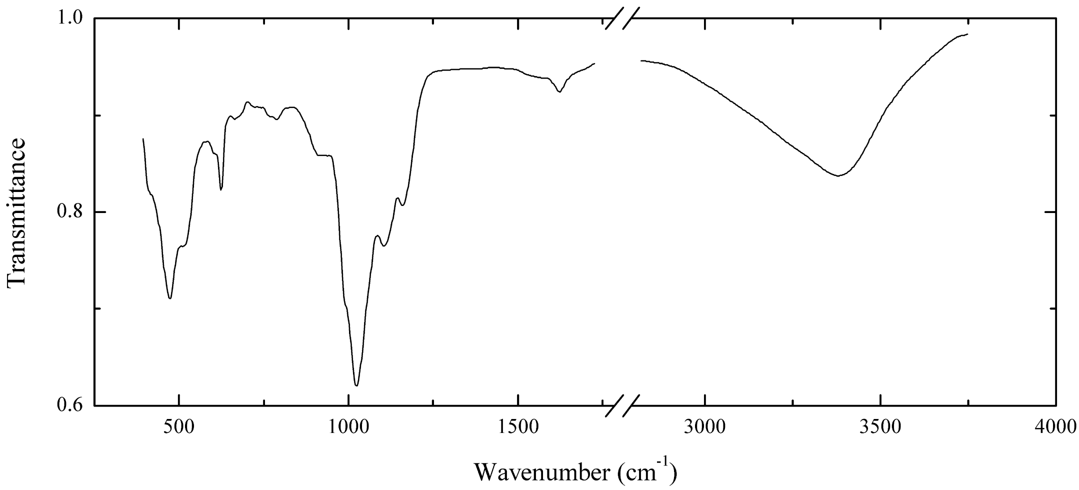


Locality: Satinka village, Tula region, Russia.

Description: White concretion. Identified by IR spectrum.

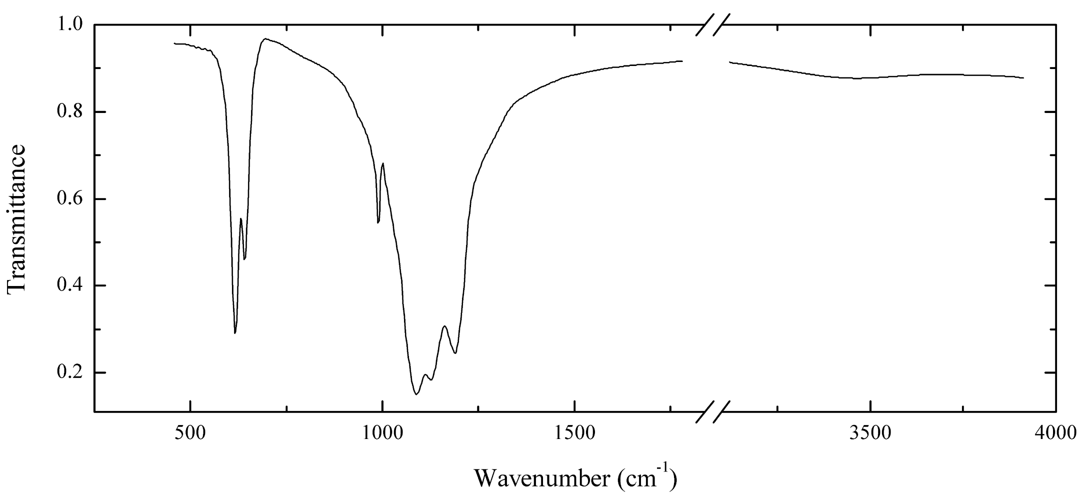
Wavenumbers (cm^{-1}): 3580sh, 3490sh, 3325s, 2960sh, 1645, 1390w, 1180, 1100s, 1039s, 957, 750, 655sh, 608s, 549s, 506, 474.

S45 Beaverite-(Cu) $Pb(Fe,Cu^{2+})_3(SO_4)_2(OH,H_2O)_6$



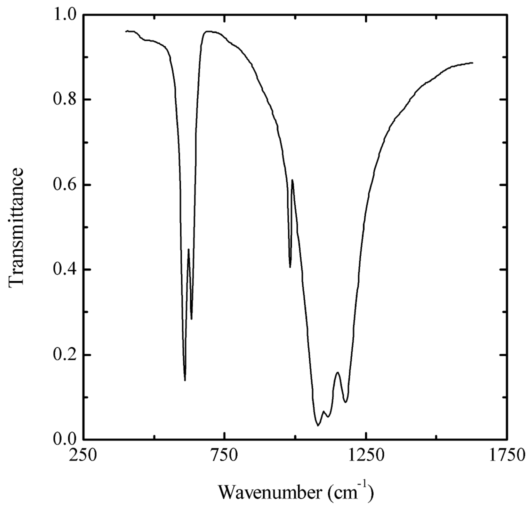
Locality: Balta-Tau deposit, East Baimak ore field, the Republic of Bashkortostan, Russia.
Description: Yellow powdery aggregate from the association with azurite, malachite, chrysocolla, cerussite and mimetite. Identified by IR spectrum, electron microprobe analysis and powder X-ray diffraction pattern. The empirical formula is $Pb_{0.8}Fe_{2.0}Cu_{0.9}(SO_4)_{2.0}(OH,H_2O)_6$.
Wavenumbers (cm^{-1}): 3365, 1622w, 1163, 1108, 1024s, 990sh, 917, 798w, 667w, 622, 600w, 515, 472s, 435sh.

S46 Baryte $Ba(SO_4)$



Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.
Description: Pale yellow platy crystal on microcline. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ba_{0,99}Sr_{0.02}Ca_{0.01}S_{1.00}O_{4.02}$.
Wavenumbers (cm^{-1}): 1179s, 1117s, 1082s, 984, 633, 608s.

S47 Baryte $Ba(SO_4)$

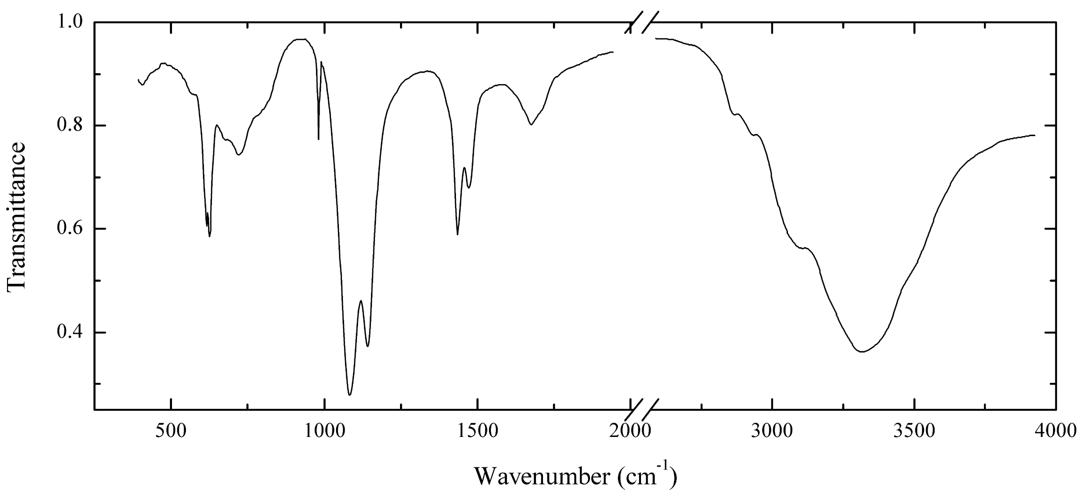


Locality: Quartz quarry, Altrandsberg, Miltach, Lower Bavaria, Bavaria, Germany.

Description: Colourless crystals from the association with quartz and pyrite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ba_{0,94}Sr_{0.06}(SO_4)_{1.00}$.

Wavenumbers (cm^{-1}): 1179s, 1118s, 1084s, 983, 636, 610s.

S48 Boussingaultite $(NH_4)_2Mg(SO_4)_2{\cdot}6H_2O$

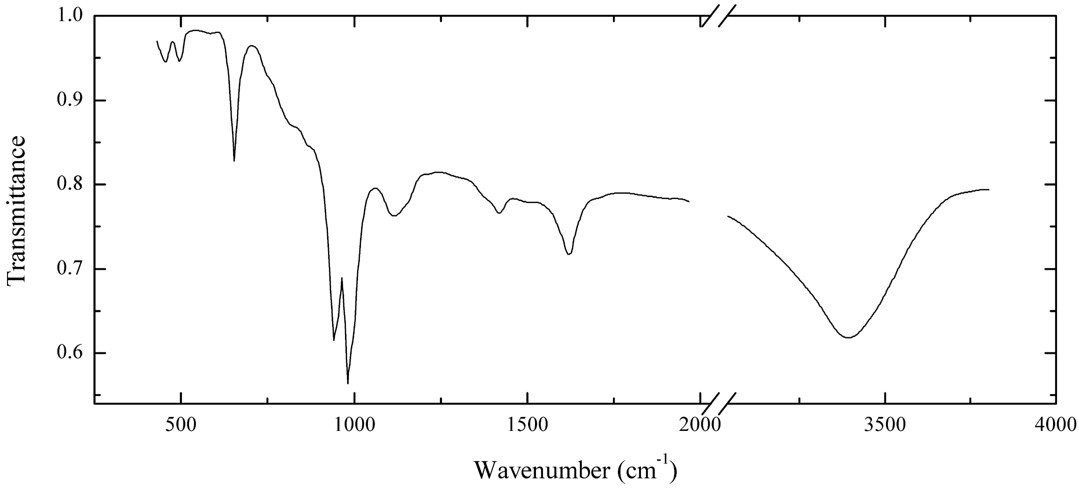


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Colourless crystals from the association with ammoniojarosite and salammoniac. Investigated by B.V. Chesnokov. Confirmed by IR spectrum and qualitative chemical analysis. $D_{meas} = 1.72(1)$ g/cm^3. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 5.34 (64) (011), 4.23 (100) (-121, 210), 3.80 (87) (130), 3.14 (80) (201, 040), 2.744 (32) (-212, 041), 2.455 (28) (-331).

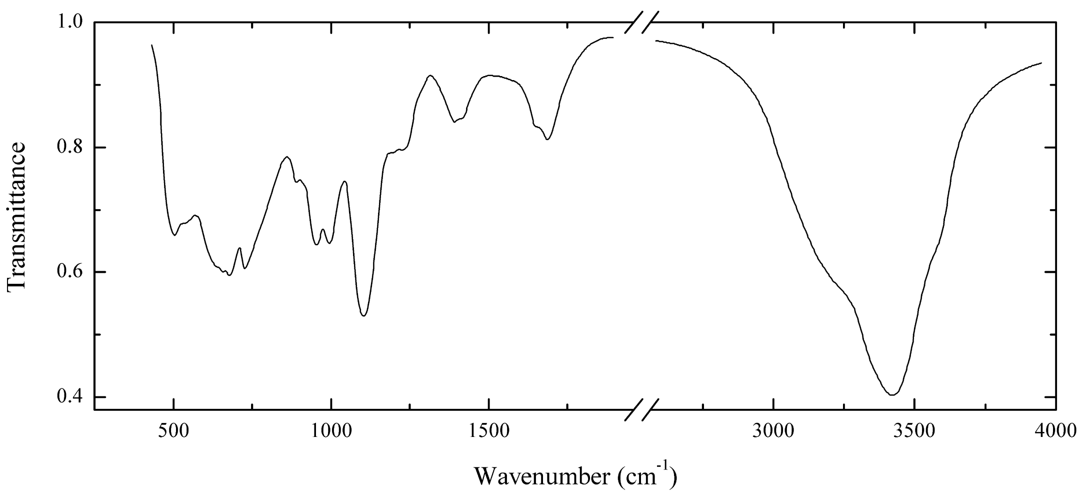
Wavenumbers (cm^{-1}): 3480sh, 3290s, 3080, 2920, 2850, 1670, 1474, 1434, 1142s, 1082s, 981, 790sh, 724, 670sh, 627, 617, 565sh, 400w.

S50 Bazhenovite $CaS_5 \cdot CaS_2O_3 \cdot 6Ca(OH)_2 \cdot 20H_2O$



Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia (type locality).
Description: Yellow platy crystals from the association with siderite, pyrite, iron, sulfur, oldhamite, portlandite, periclase, troilite, pyrrhotite and fluorite. Holotype sample. The crystal structure is solved. Monoclinic, space group $P2_1/c$, $a = 8.45(1)$, $b = 17.47(1)$, $c = 8.24(1)$ Å, $\beta = 119.5(2)°$, $Z = 1$. The empirical formula is $CaS_{4.85} \cdot CaS_{2.25}O_3 \cdot Ca_{6.00}(OH)_{12.20} \cdot 20.14H_2O$. $D_{meas} = 1.82(1)$ g/cm^3, $D_{calc} = 1.845$ g/cm^3. Optically biaxial (+), $\alpha = 1.595(2)$, $\beta = 1.619(2)$, $\gamma = 1.697(3)$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 8.76 (100), 4.39 (100), 1.996 (70), 2.91 (60), 2.81 (50), 2.62 (50), 2.28 (50). Weak bands at 1,420 and 868 cm^{-1} are due to the admixture of siderite.
Wavenumbers (cm^{-1}): 3370, 1620, 1420w, 1120, 990sh, 981s, 943s, 868w, 815sh, 651, 496, 455.

S51 Buryatite $Ca_3(Si,Fe^{3+},Al)(SO_4)[B(OH)_4](OH)_5O \cdot 12H_2O$

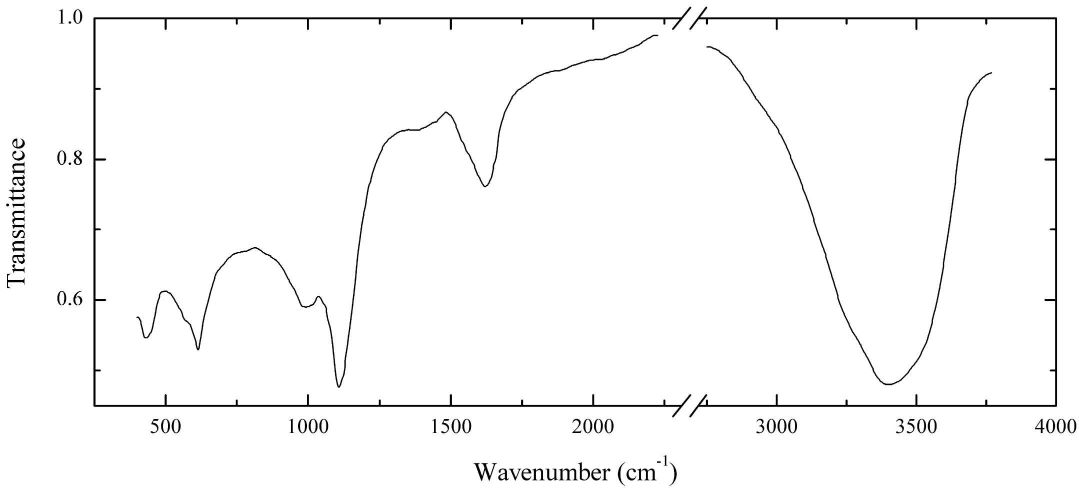


Locality: Borehole at the Solongo boron deposit, basin of the Vitim river, southern part of the Vitimskoe plateau, Buryatia, Transbaikal Region, Russia (type locality).

Description: Light grey (with violet shade) fine-grained aggregate from the association with calcite, fluoborite, frolovite, magnetite, kurchatovite, clinokurchatovite, fedorovskite, sakhaite, vimsite, pentahydroborite, hexahydroborite and borcarite. Holotype sample. Trigonal, space group $P3_1c$ (?); a = 11.14(1), c = 20.99(5) Å, V = 2256(7) Å^3, Z = 4. The empirical formula is $Ca_{6.00}(Si_{1.21}Fe^{3+}{}_{0.36}Al_{0.19}Mg_{0.12}Mn^{4+}{}_{0.04})(SO_4)_{2.03}[B(OH)_4]_{2.13}[(OH)_{11.30}O_{0.70}] \cdot 23.13H_2O$. D_{calc} = 1.895(10) g/cm^3. Optically uniaxial (−), ω = 1.532(3), ε = 1.523(3). The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 9.70 (80) (100), 3.85 (60) (105), 3.04 (80) (032), 2.736 (60) (304), 2.596 (100) (132), 2.374 (60) (306), 2.121 (90) (136), 1.833 (60) (332), 1.498 (70) (248).

Wavenumbers (cm^{-1}): 3600sh, 3422s, 3210sh, 1683, 1650, 1422, 1394, 1235, 1190, 1105s, 999, 956, 894w, 750sh, 726, 676, 658, 636, 540sh, 499.

S52 Woodwardite $Cu^{2+}{}_4Al_2(SO_4)(OH)_{12} \cdot 2–4H_2O$ (?)

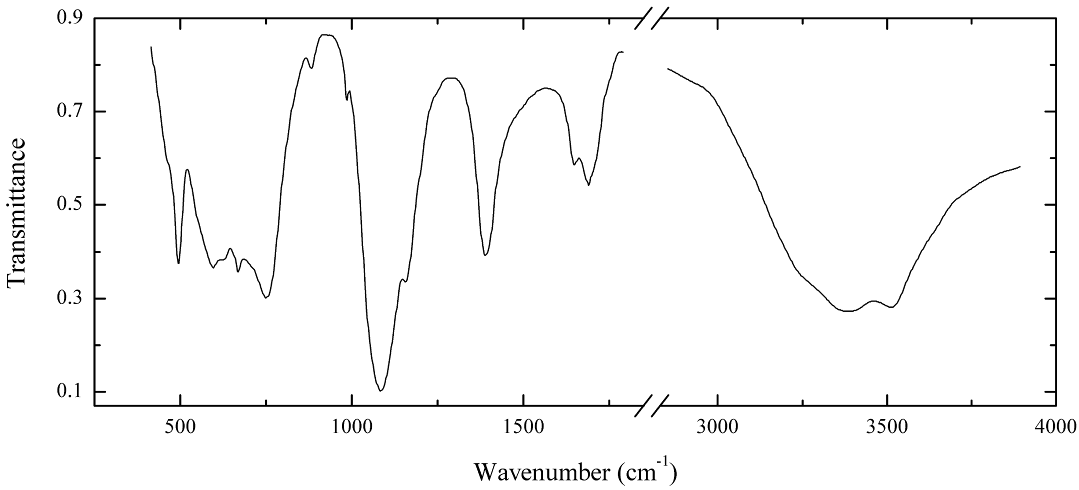


Locality: Kamariza (Kamareza) Mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light blue powdery aggregate. Confirmed by IR spectrum and qualitative chemical analysis.

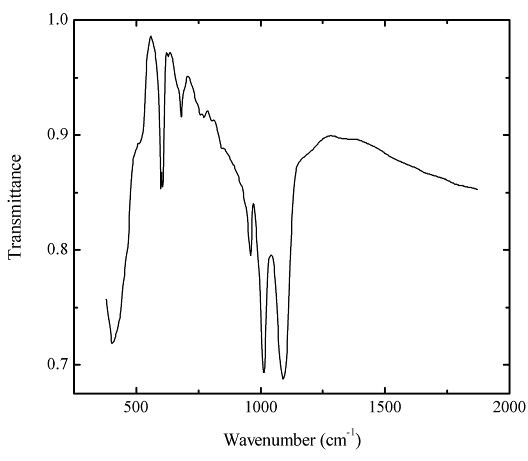
Wavenumbers (cm^{-1}): 3385s, 3290sh, 1623, 1390w, 1120sh, 1108s, 995, 650sh, 617, 590sh, 435.

S53 Kottenheimite $Ca_3Si(SO_4)_2(OH)_6{\cdot}12H_2O$



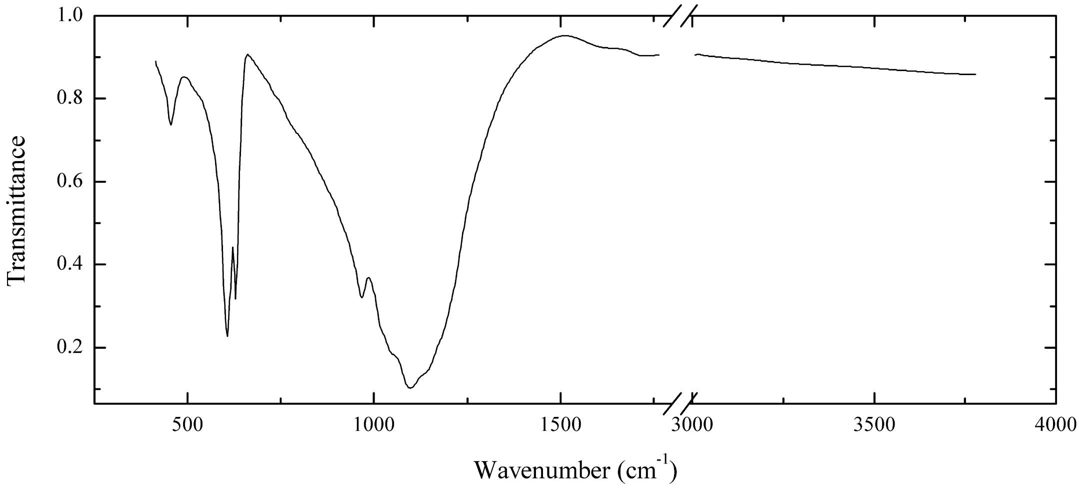
Locality: Gumeshevskoe Cu deposit, Middle Urals, Russia.
Description: White acicular crystals from the association with fukalite. Identified by IR spectrum. CO_3-rich variety. The empirical formula is (CO_3 calculated) $Ca_{3.00}(Si_{0.92}Al_{0.05})[(SO_4)_{1.39}(CO_3)_{0.61}](OH,H_2O)_6{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3505s, 3395s, 3240sh, 1695, 1652, 1397, 1159, 1088s, 986w, 884w, 751, 675, 623, 597, 555sh, 495, 460sh.

S54 Sundiusite $Pb_{10}(SO_4)Cl_2O_8$



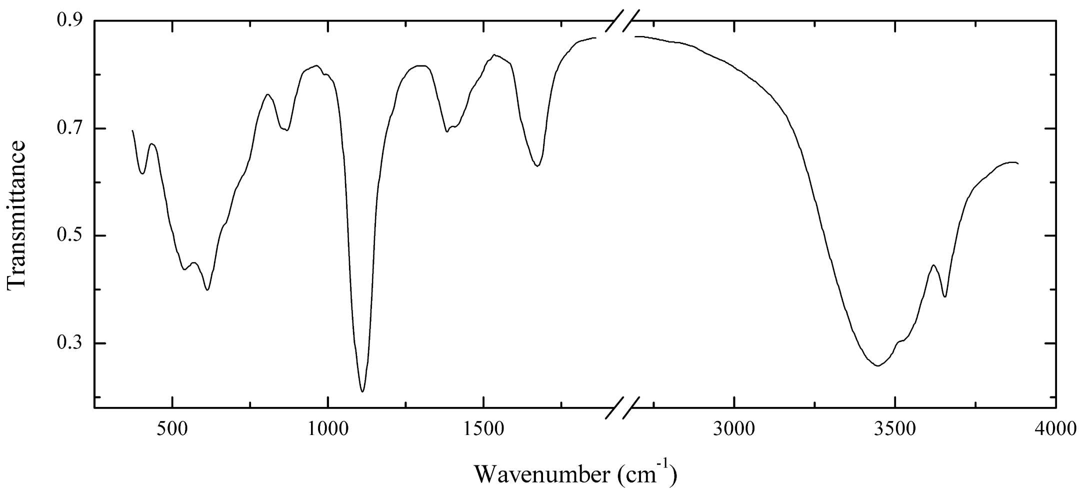
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: White single-crystal platy grain in skarn.
Wavenumbers (cm^{-1}): 1097s, 1015s, 962, 785w, 765w, 690sh, 681, 675sh, 631w, 606, 600, 520sh, 416s.

S55 Caracolite $Na_3Pb_2(SO_4)_3Cl$



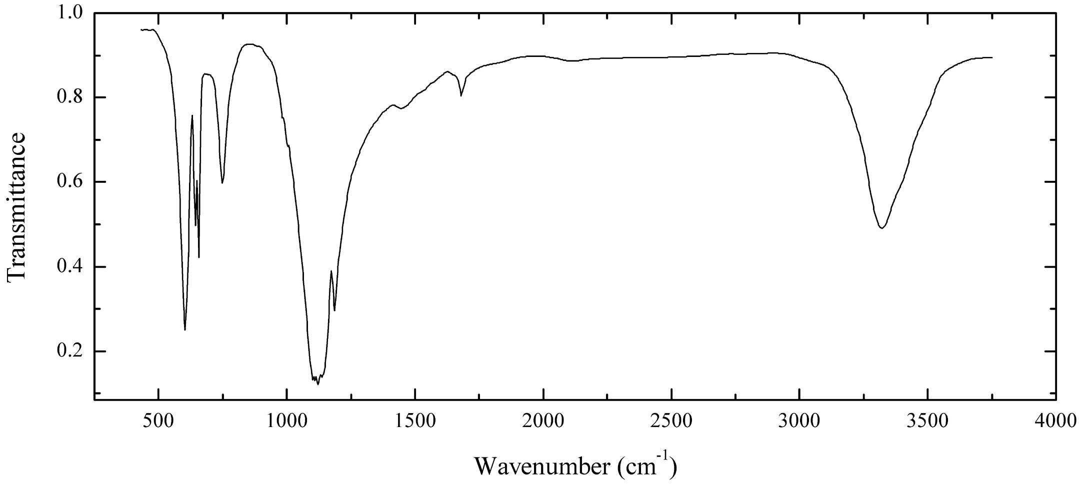
Locality: Mina Beatriz, near Caracoles, Sierra Gorda, Atacama, Chile (type locality).
Description: Colourless pseudohaxagonal crystals. The empirical formula is (electron microprobe) $Na_{2.8}Pb_{2.15}(SO_4)_{3.0}Cl_{1.1}$.
Wavenumbers (cm^{-1}): 1135sh, 1091s, 1040sh, 1010sh, 968, 631, 615sh, 607s, 454.

S57 Ettringite $Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$



Locality: Hatrurim formation ("Mottled Zone"), Israel.
Description: Yellow prismatic crystals. Cr-bearing variety. The empirical formula is $Ca_{6.00}(Al_{1.84}Si_{0.10})[(SO_4)_{2.46}(CrO_4)_{0.34}(CO_3)_x](OH)_{12}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3632, 3500sh, 3420s, 1675, 1410, 1385, 1114s, 989w, 874, 857, 725sh, 665sh, 616, 544, 490sh, 410.

S58 Syngenite $K_2Ca(SO_4)_2{\cdot}H_2O$

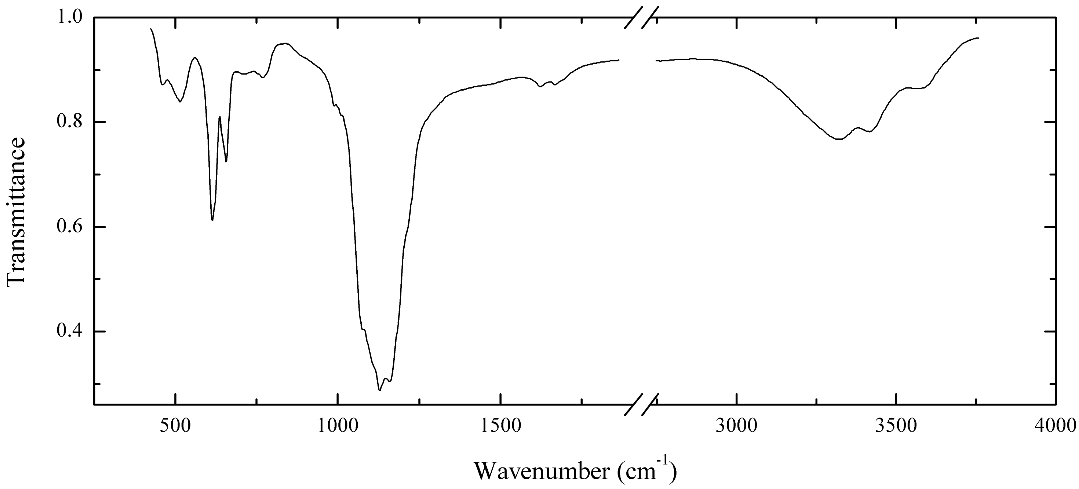


Locality: Kalush salt deposit, Kalush area, the Precarpathian depression, Ukraine.

Description: Colourless flattened prismatic crystal from the association with sylvite, langbeinite and kainite. Confirmed by IR spectrum and qualitative chemical analysis.

Wavenumbers (cm^{-1}): 3490sh, 3380sh, 3310, 1678w, 1445w, 1192, 1139s, 1124s, 1108s, 1103s, 1002w, 981w, 750, 659, 644, 603s.

S59 Hydroglauberite $Na_{10}Ca_3(SO_4)_8{\cdot}6H_2O$

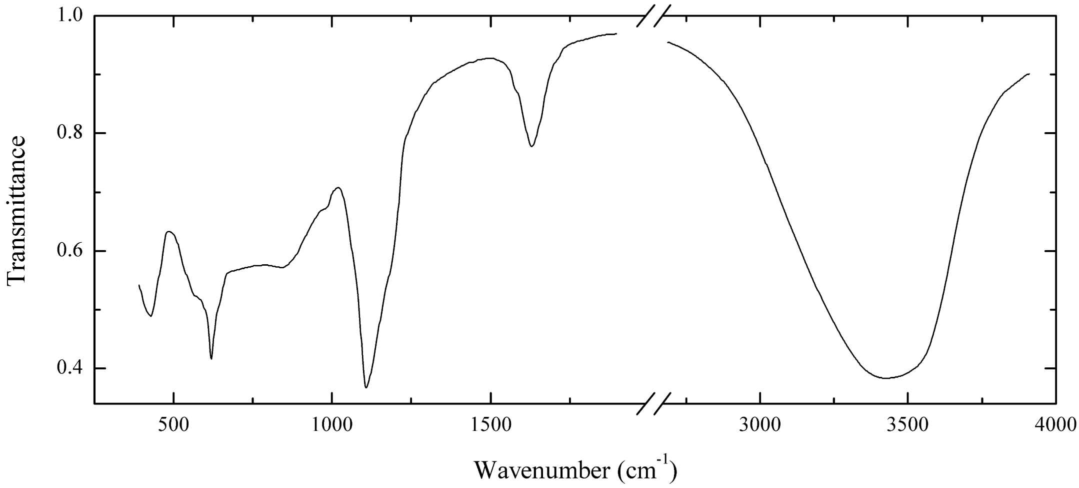


Locality: Kushkanatau salt deposit, lower Amu Darya river, the Republic of Karakalpakia, Uzbekistan (type locality).

Description: White aggregate of fibrous crystals from the association with glauberite, halite, mirabilite, polyhalite, thenardite and blödite. Holotype sample. Orthorhombic or monoclinic. $D_{meas} = 1.51$ g/cm^3. Optically biaxial (–), $\alpha = 1.488$, $\gamma = 1.500$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.08 (100), 9.20 (90), 2.78 (90b), 4.60 (80), 2.90 (70), 4.20 (60), 3.52 (60).

Wavenumbers (cm^{-1}): 3580w, 3410, 3310, 1670w, 1623w, 1210sh, 1185sh, 1160s, 1128s, 1110sh, 1090sh, 1074s, 1007w, 987w, 770w, 705w, 653, 645sh, 609, 510, 458.

S60 Glaucocerinite $(Zn,Cu^{2+})_{10}Al_6(SO_4)_3(OH)_{32}\cdot18H_2O$

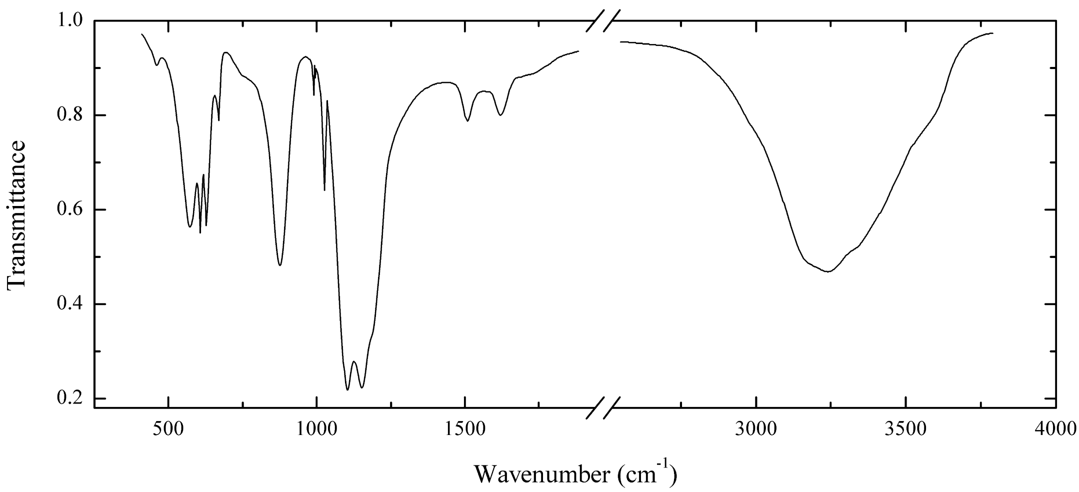


Locality: Christiana mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece (type locality).

Description: Light green spherulitic crust from the association with goethite, smithsonite, zincolivenite, malachite, pyrite, galena and sphalerite. The empirical formula is $Zn_{7.4}Cu_{2.3}Mg_{0.1}Al_{6.2}(SO_4)_{3.0}(OH)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3440, 3395s, 2070w, 1630, 1160sh, 1112s, 965sh, 780, 617s, 560sh, 414.

S61 Gunningite $Zn(SO_4)\cdot H_2O$

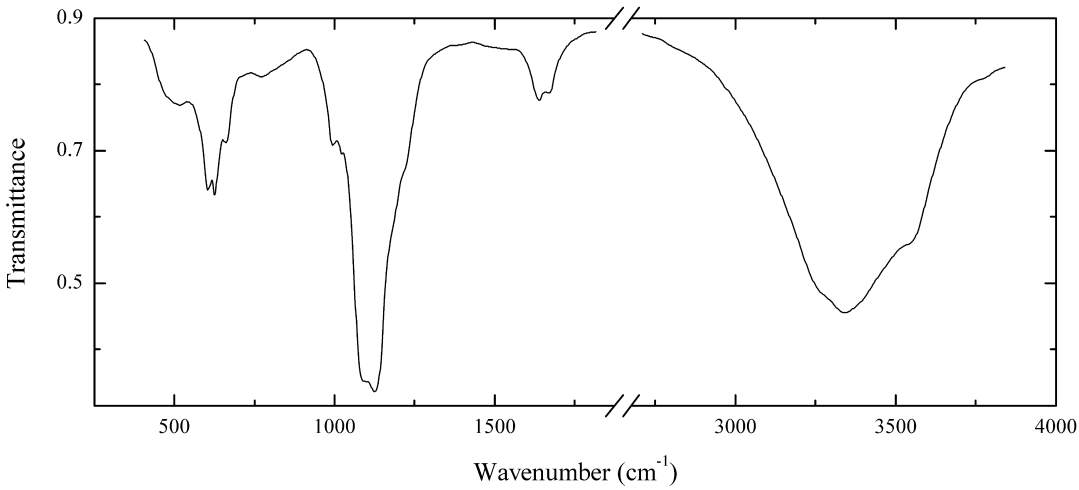


Locality: Degtyarskoe deposit, Revda district, Middle Urals, Russia.

Description: White powdery aggregate. Sample number 1806/1 from the Mining Museum, St. Petersburg Mining Institute. The empirical formula is $Zn_{0.81}Fe_{0.12}Mg_{0.05}(SO_4)_{1.00}\cdot nH_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 4.82 (38), 4.77 (42), 3.414 (100), 3.357 (22), 3.063 (49), 2.525 (51).

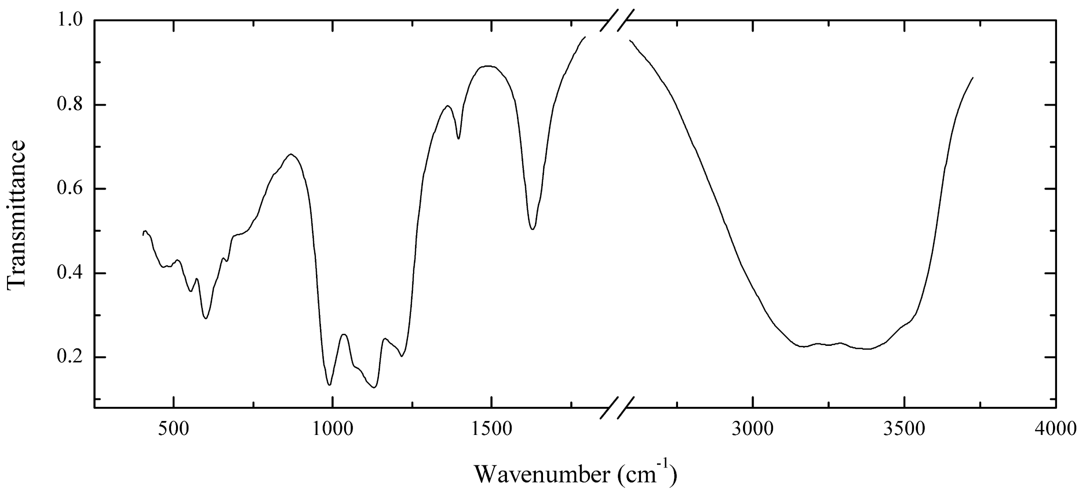
Wavenumbers (cm^{-1}): 3550sh, 3300sh, 3220s, 3140sh, 1620w, 1507w, 1085sh, 1049s, 1100s, 1021, 985w, 871s, 667w, 625, 604, 570, 460w.

S62 Goslarite $Zn(SO_4)\cdot 7H_2O$



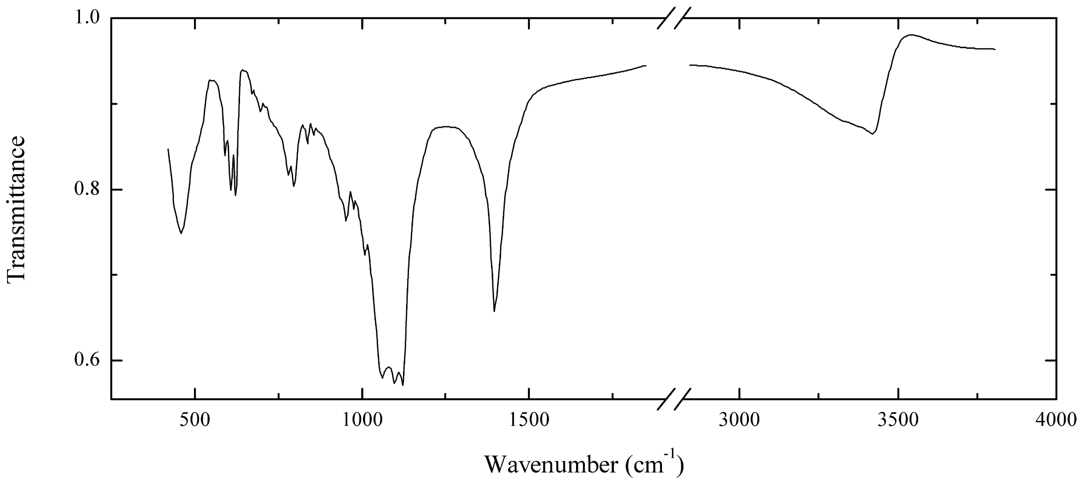
Locality: Rammelsberg mine, near Goslar, Harz, Germany (type locality).
Description: White powdery aggregate. The empirical formula is $Zn_{0.63}Mn_{0.30}Mn_{0.07}(SO_4)_{1.00}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3520sh, 3315s, 3235sh, 1665, 1635, 1210sh, 1125s, 1000s, 1020, 990, 767w, 660, 628, 607, 515.

S63 Ferricopiapite $(Fe^{3+}{}_{2/3}\square_{1/3})Fe^{3+}{}_4(SO_4)_6(OH)_2\cdot 20H_2O$



Locality: Cerro Tazna, Atocha-Quechisla district, Nor Chichas province, Potosí department, Bolivia.
Description: Orange-yellow fine-grained aggregate. The empirical formula is (electron microprobe) $(Fe_{0.63}Cu_{0.06})Fe_{4.00}(SO_4)_{6.00}(OH)_2\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3470sh, 3370s, 3250s, 3170s, 1665sh, 1640, 1405, 1225, 1135s, 1084sh, 995s, 718, 666, 635sh, 610sh, 597, 555, 490, 472.

S64 Caledonite $Pb_5Cu_2(SO_4)_3(CO_3)(OH)_6$

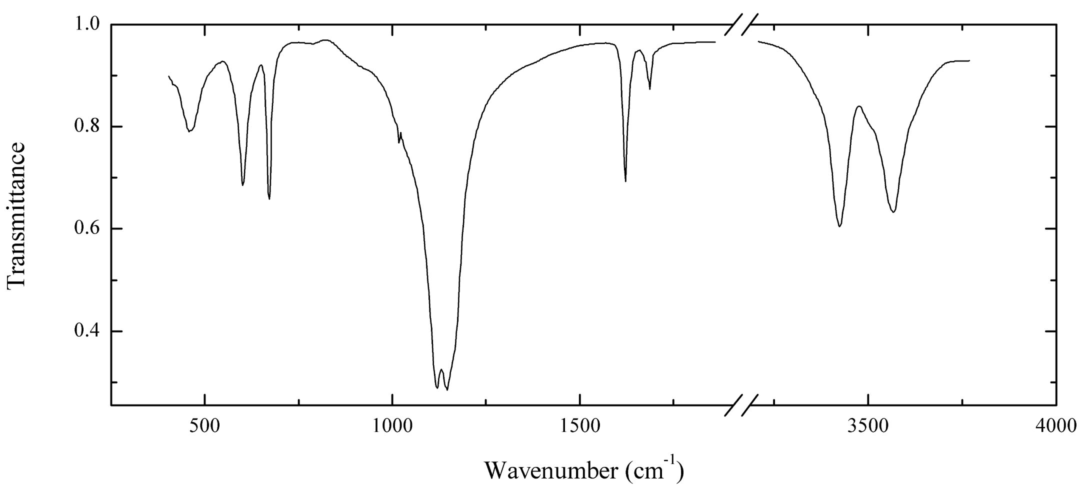


Locality: Gold Hill mine, Gold Hill district, Deep Creek Mts., Tooele Co., Utah, USA.

Description: Blue-green crust from the association with cerussite and quartz. The empirical formula is (electron microprobe) $Pb_{5.2}Cu_{2.1}(SO_4)_{2.7}(SiO_4)_{0.1}(CO_3)_x(OH)_6$. The absorption maxima at 798, 780 and 695 cm^{-1} are due to the admixture of quartz.

Wavenumbers (cm^{-1}): 3400, 3300sh, 1397, 1120s, 1100s, 1059s, 1006, 953, 938, 856w, 837w, 798, 780, 695w, 670w, 620, 606, 571, 500sh, 460.

S65 Gypsum $Ca(SO_4)\cdot 2H_2O$

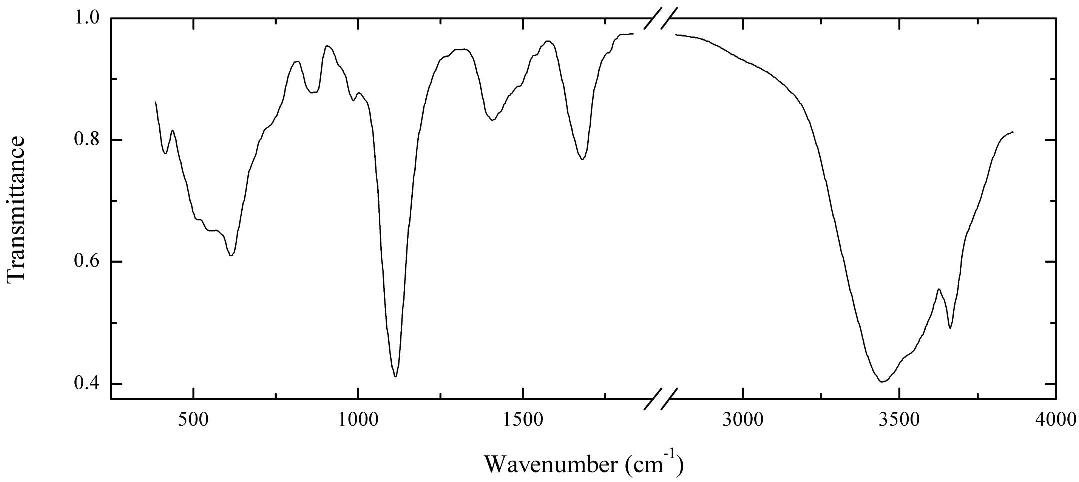


Locality: Kladno (Schöller) mine, Libušin, Kladno, Central Bohemia, Czech Republic.

Description: White powdery aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3395, 3230sh, 1688, 1625, 1142s, 1116s, 1005w, 777w, 669, 601, 460.

S66 Ettringite $Ca_6Al_2(SO_4)_3(OH)_{12}·26H_2O$

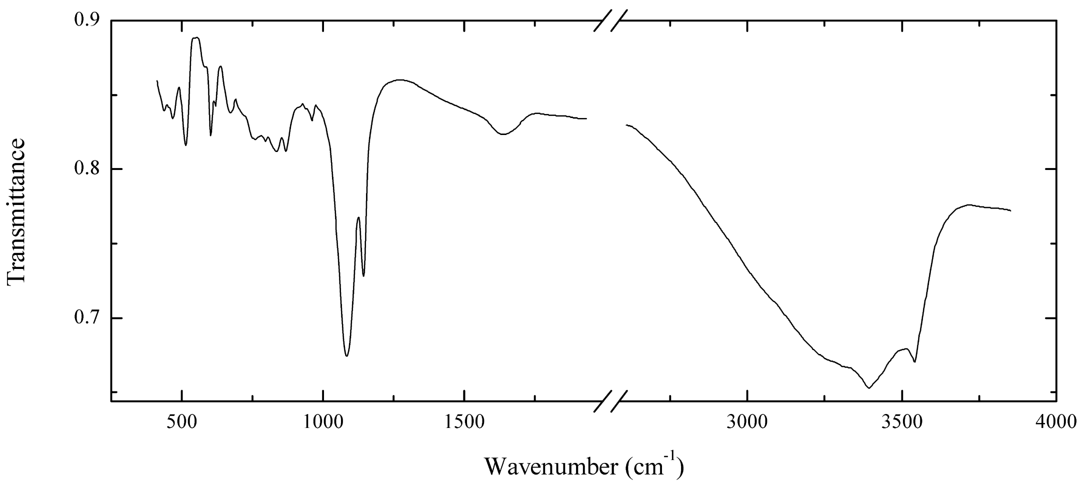


Locality: Hatrurim formation ("Mottled Zone"), Israel.

Description: Violet veinlet in calcite–aragonite–spurrite rock. Cr-bearing variety. The empirical formula is $Ca_{6.00}(Al_{1.93}Si_{0.08})[(SO_4)_{2.46}(CrO_4)_{0.32}(CO_3)_x](OH)_{12}·nH_2O$. The colour corresponds to Cr^{3+}, but the stoichiometry and the doublet 870 + 854 cm^{-1} indicate that most part of Cr is present as CrO_4^{2-} anion.

Wavenumbers (cm^{-1}): 3635, 3510sh, 3420s, 1685, 1490sh, 1410, 1112s, 988, 950sh, 870, 854, 730sh, 615, 544, 505, 418.

S67 Wroewolfeite $Cu^{2+}{}_4(SO_4)(OH)_4·2H_2O$

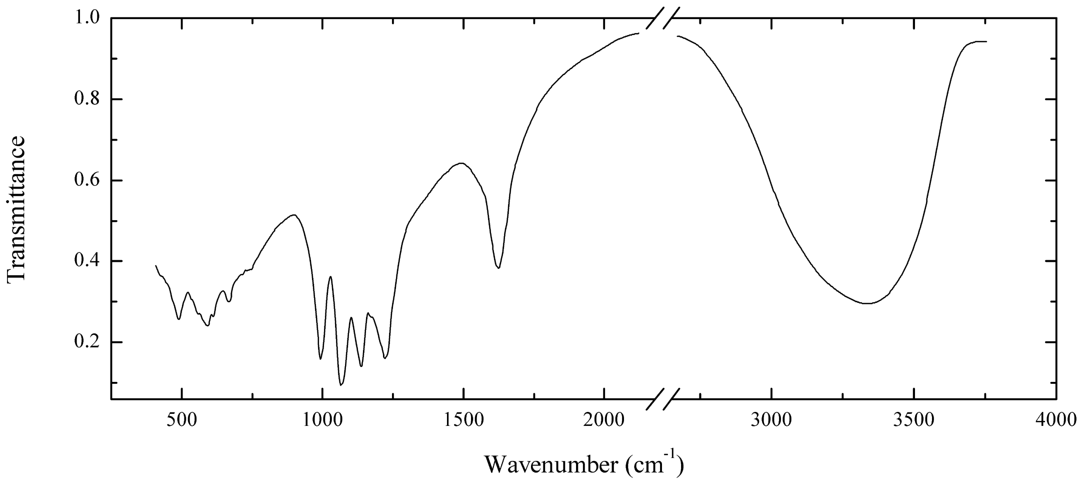


Locality: Barkevik, Barkevik area, Langesundsfjord, Larvik, Vestfold, Norway.

Description: Turquoise-blue grains. Identified by IR spectrum.

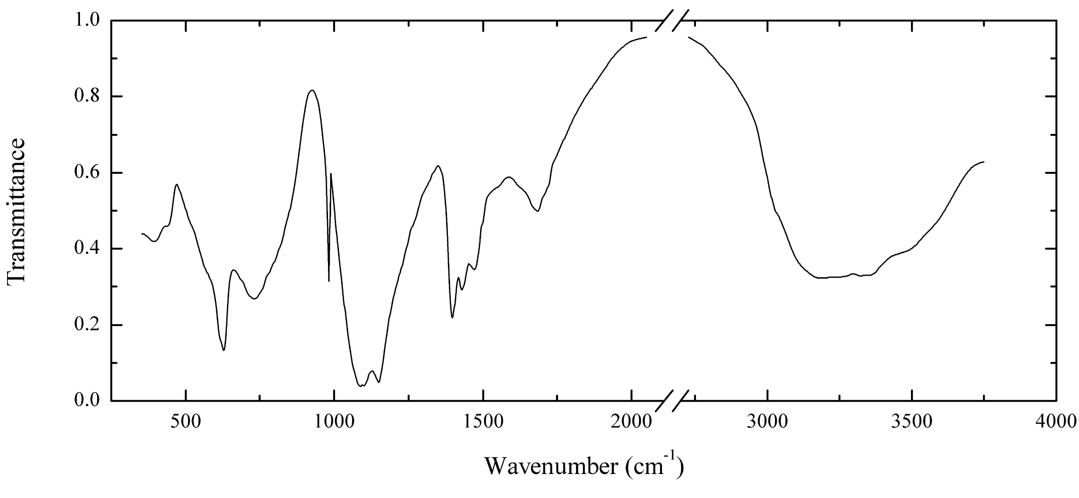
Wavenumbers (cm^{-1}): 3540, 3395s, 3270sh, 1625w, 1144s, 1087s, 965w, 870, 843, 815, 766, 674, 624, 601, 512, 467, 421.

S68 Sideronatrite $Na_2Fe^{3+}(SO_4)_2(OH)\cdot 3H_2O$



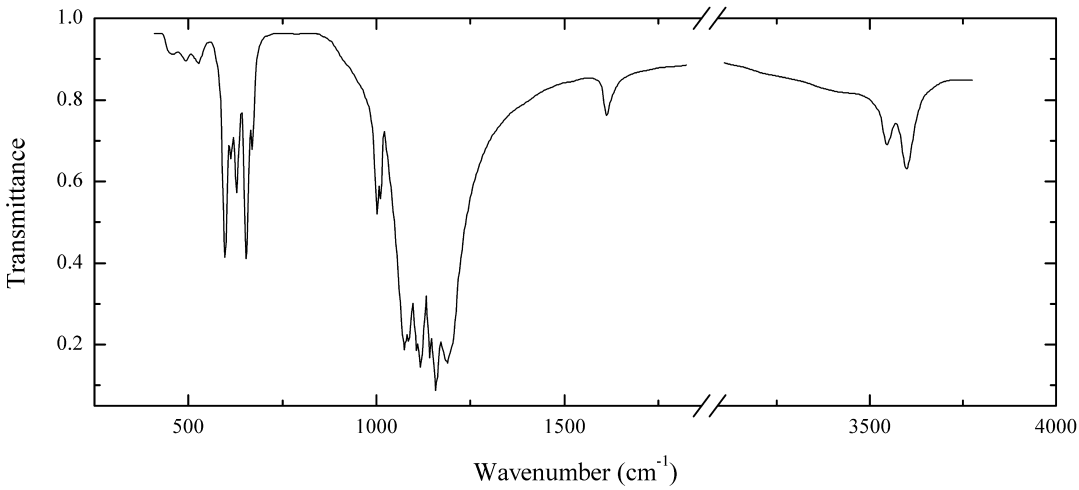
Locality: Sasso, Tuscany, Italy.
Description: Yellow botryoidal aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3330s, 1626, 1233s, 1135s, 1063s, 995s, 730sh, 667, 613, 590, 560sh, 490.

S69 Boussingaultite $(NH_4)_2Mg(SO_4)_2\cdot 6H_2O$



Locality: Larderello, Pomarance, Pisa province, Tuscany, Italy.
Description: Grey granular aggregate. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3450sh, 3330s, 3190s, 3010sh, 1685, 1476, 1434, 1401s, 1146s, 1093s, 983, 731, 626s, 610s, 440, 420sh, 400.

S71 Görgeyite $K_2Ca_5(SO_4)_6{\cdot}H_2O$

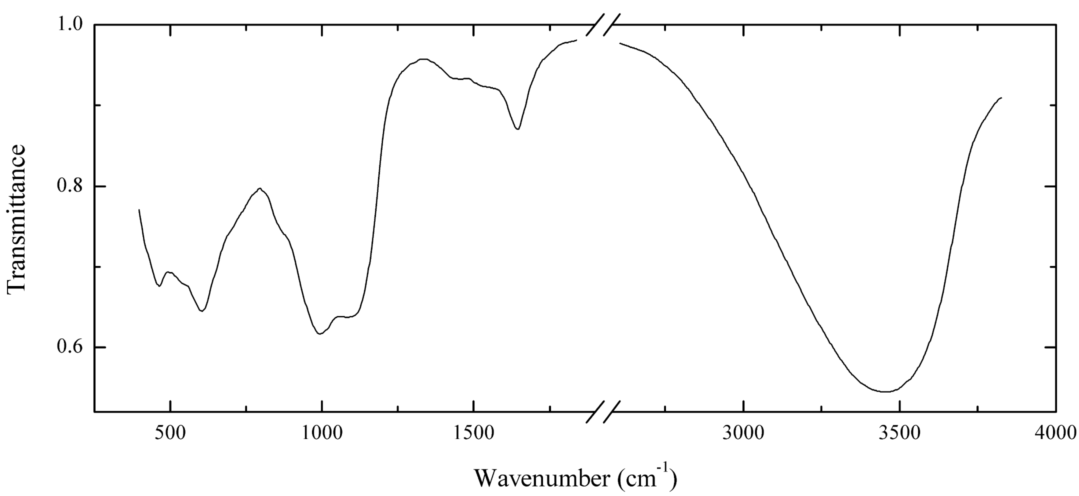


Locality: Inder boron deposit, Atyrau region, Kazakhstan.

Description: Brown platy crystal from the association with halite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3570, 3520w, 1612w, 1200sh, 1187s, 1180sh, 1158s, 1141s, 1117s, 1106s, 1085s, 1073s, 1007, 998, 670w, 653, 627, 611w, 595, 526w, 492w, 457w.

S72 Hydrowoodwardite $Cu_{1-x}Al_x(SO_4)_{x/2}(OH)_2{\cdot}nH_2O$

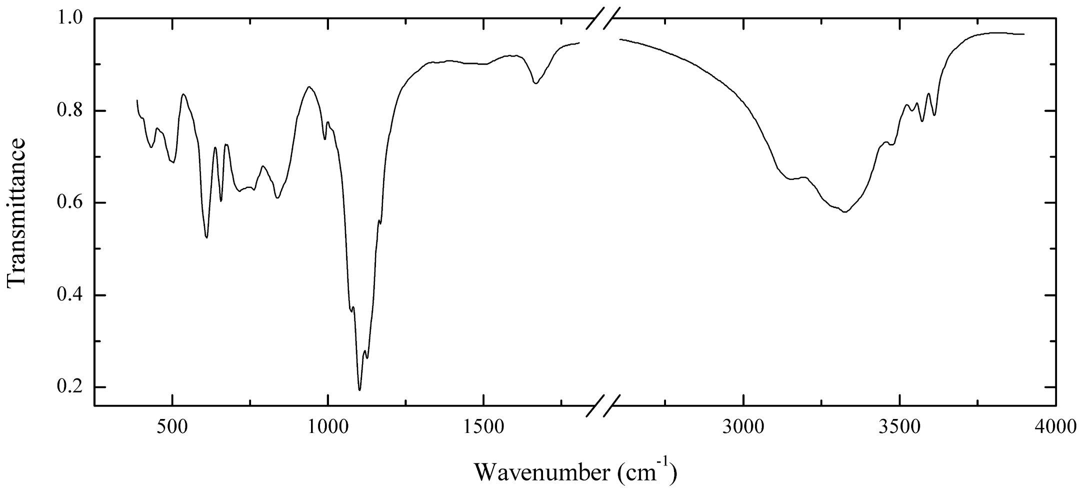


Locality: Wolkenstein, Saxony, Germany.

Description: Blue colloform. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3425s, 1640, 1540w, 1445w, 1093s, 994s, 870sh, 690sh, 596, 540sh, 459.

S73 Devilline $CaCu^{2+}_4(SO_4)_2(OH)_6 \cdot 3H_2O$

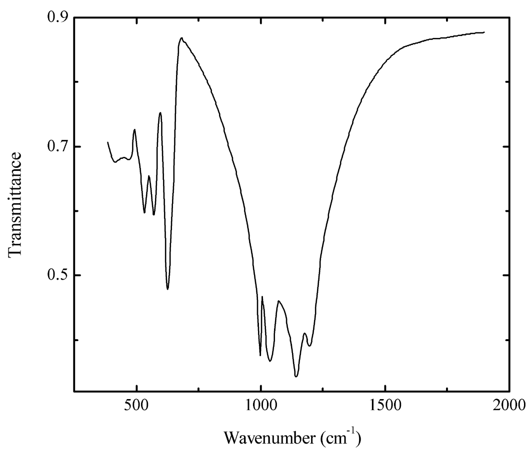


Locality: Richtárová, Staré Hory, Banská Bystrica Co., Banská Bystrica region, Slovakia.

Description: Greenish-blue acicular crystals. The empirical formula is $Ca_{0.97}Cu_{3.99}Zn_{0.05}Fe_{0.01}(SO_4)_{2.00}(OH,H_2O)_9$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3595, 3555, 3525, 3460, 3315, 3270sh, 3150, 1668w, 1505w, 1170, 1140sh, 1125s, 1102s, 1074s, 1100sh, 989w, 860sh, 836, 756, 714, 655, 609, 600sh, 501, 490sh, 427, 400sh.

S74 Dolerophanite $Cu^{2+}_2(SO_4)O$

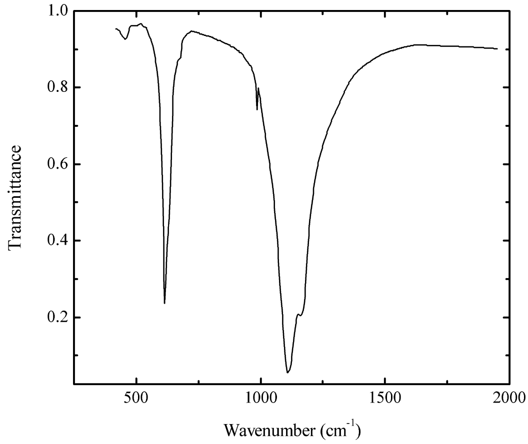


Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: Brown crystals from the association with chalcocyanite and euchlorine. The empirical formula is $Cu_{1.96}Fe_{0.02}(SO_4)_{1.00}O_{0.98}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1201s, 1150s, 1040s, 999s, 640sh, 626, 570, 531, 480, 434.

S75 Kalistrontite $K_2Sr(SO_4)_2$

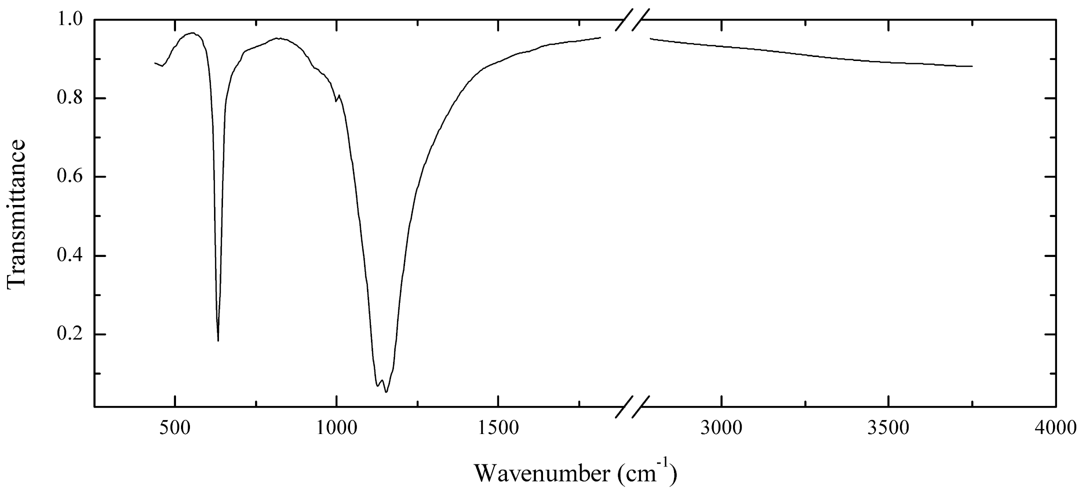


Locality: Borehole near Alshtan village, Sterlitamak district, the Republic of Bashkortostan, Russia (type locality).

Description: Colourless platy crystal from the association with halite, anhydrite, dolomite, sylvite and clay minerals. Holotype sample. Trigonal space group R-3m; a = 5.45(3), c = 20.7(1) Å, Z = 3. The empirical formula is $(K_{0.85}Na_{0.14})(Sr_{0.94}Mg_{0.01})S_{2.00}O_{1.945}$. D_{meas} = 3.30 g/cm^3, D_{calc} = 3.32 g/cm^3. Optically uniaxial (−), ω = 1.569(2), ε = 1.549(2). The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 6.7 (6), 3.14 (100), 2.73 (8), 2.06 (6), 1.904 (9), 1.236 (8), 1.041 (7).

Wavenumbers (cm^{-1}): 1165s, 1111s, 986, 670sh, 630sh, 615s, 465w.

S76 Kogarkoite $Na_3(SO_4)F$

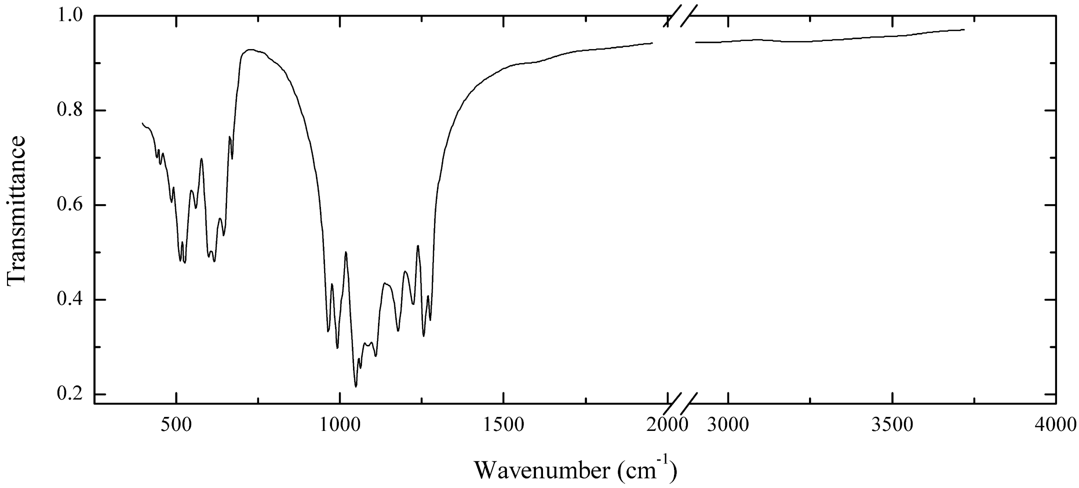


Locality: Kedykverpakhk Mt., Lovozero alkaline massif, Kola peninsula, Murnansk region, Russia.

Description: White grains with strong blue fluorescence under short-wave UV radiation. The empirical formula is $Cu_{1.96}Fe_{0.02}(SO_4)_{1.00}O_{0.98}$. Identified by IR spectrum and qualitative electron microprobe analysis.

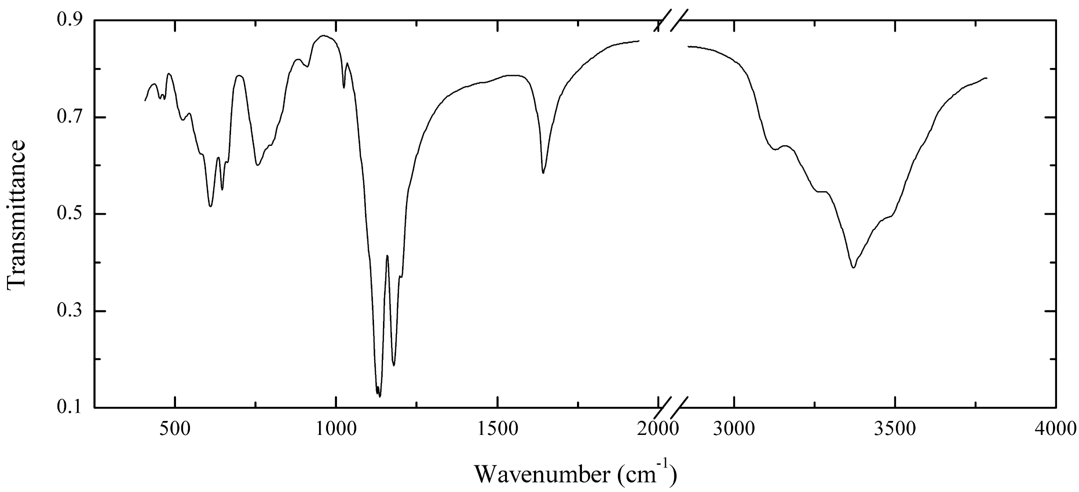
Wavenumbers (cm^{-1}): 1190sh, 1165sh, 1148s, 1123s, 998w, 940sh, 645sh, 629s, 464w.

S77 Klyuchevskite $K_3Cu^{2+}_3(Fe^{3+},Al)(SO_4)_4O_2$



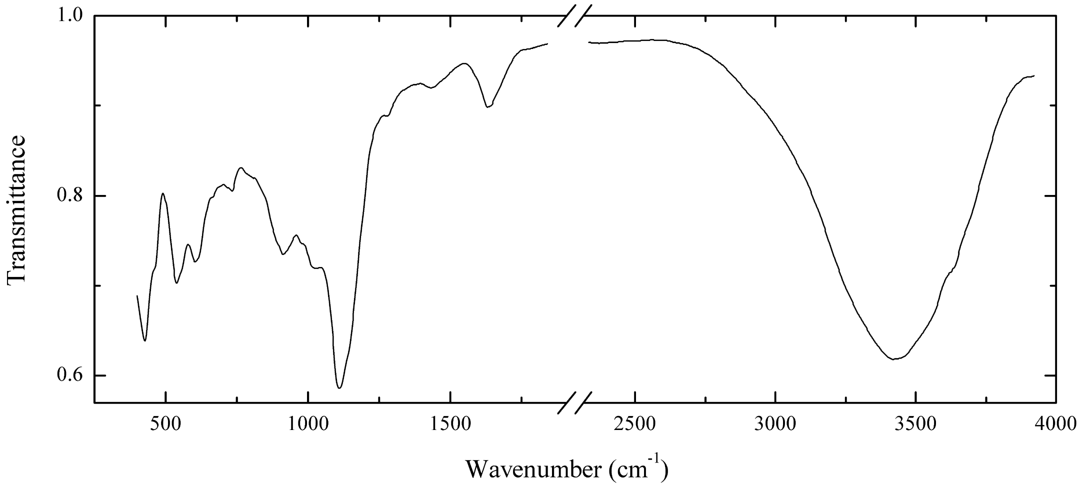
Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.
Description: Green crystals from the association with fedotovite, lammerite, nabokoite, atlasovite, ponomarevite, hematite and tenorite. Investigated by E.Y. Bykova.
Wavenumbers (cm^{-1}): 1274, 1255s, 1222, 1179s, 1109s, 1086s, 1062s, 1048s, 1035sh, 1010sh, 1000sh, 992s, 966s, 669w, 646, 617, 597, 561, 525, 511, 485, 451w, 440w.

S78 Kainite $KMg(SO_4)Cl{\cdot}3H_2O$



Locality: Stebnik salt deposit, near Drohobych, the Precarpathian depression, Ukraine.
Description: Yellowish grains from the association with halite and clay minerals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3460sh, 3355, 3255, 3110, 1640, 1201, 1175s, 1135s, 1127s, 1023w, 906w, 820sh, 796, 756, 660, 642, 607, 575sh, 524w, 467w, 450w.

S79 Carrboydite $(Ni,Cu)_{14}Al_9(SO_4,CO_3)_6(OH)_{43}\cdot 7H_2O$ (?)

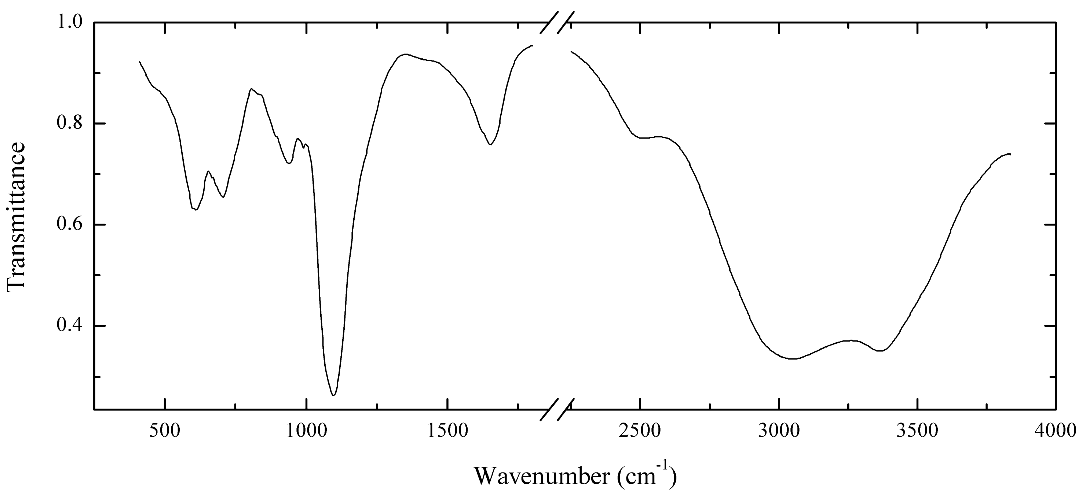


Locality: Carr Boyd Ni mine, Goongarrie, near Kalgoorlie-Boulder, Goldfields-Esperance region, Western Australia, Australia (type locality).

Description: Green spherulites from the association with gaspéite and nickelalumite. The empirical formula is (electron microprobe) $Ni_{15.9}Cu_{0.5}Al_{8.4}(SO_4)_{5.0}(OH,CO_3)_x\cdot nH_2O$. Confirmed by IR spectrum. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 10.23 (100), 5.12 (56), 2.52 (29), 2.31 (18), 1.49 (11).

Wavenumbers (cm^{-1}): 3525sh, 3400, 1635, 1435w, 1275w, 1135sh, 1110s, 1025, 985sh, 919, 730w, 602, 542, 460sh, 428s.

S80 Alum-(K) $KAl(SO_4)_2\cdot 12H_2O$

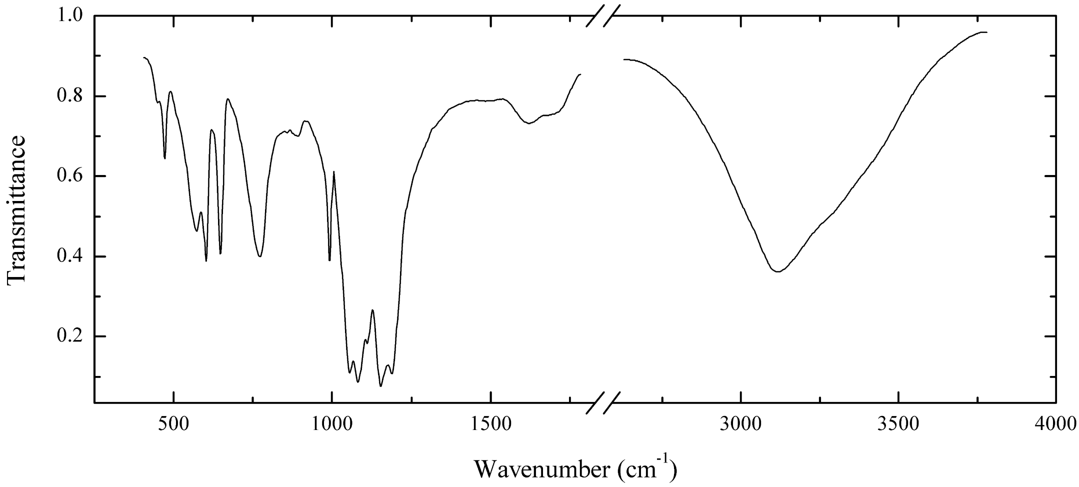


Locality: Kladno (Schöller) mine, Libušin, Kladno, Central Bohemia, Czech Republic.

Description: White crust. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3350s, 3030s, 2485, 1650, 1096s, 991w, 934, 704, 612, 598.

S81 Kröhnkite $Na_2Cu^{2+}(SO_4)_2{\cdot}2H_2O$

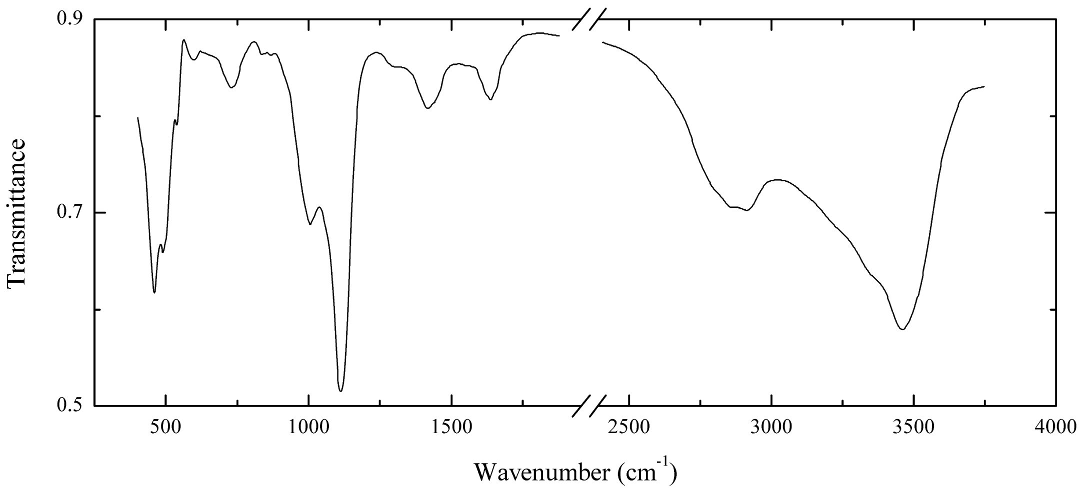


Locality: Chuquicamata copper mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile (type locality).

Description: Light blue massive, from the association with natrochalcite and antlerite. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Na_{1.98}Cu_{1.03}(SO_4)_{2.00}Cl_{0.03}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3400sh, 3250sh, 3085s, 1680, 1620w, 1187s, 1160sh, 1149s, 1110s, 1081s, 1054s, 992, 894w, 771, 648, 603, 572, 473, 453w.

S83 Connellite $Cu^{2+}{}_{19}(SO_4)Cl_4(OH)_{32}{\cdot}3H_2O$

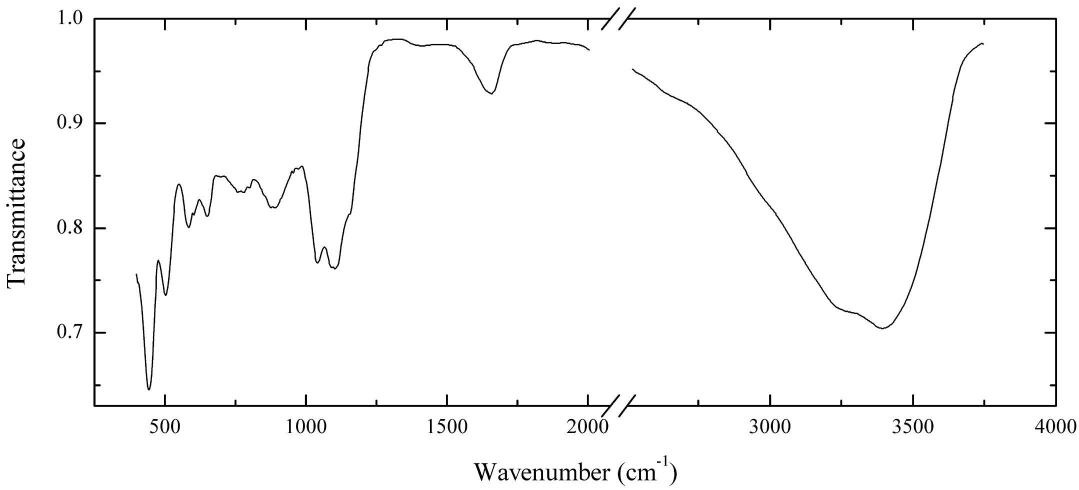


Locality: Kurumsak V deposit, Karatau range, southern Kazakhstan region, Kazakhstan.

Description: Light blue massive from the association with cyanotrichite. Confirmed by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $Cu_{19.00}[(SO_4)_{0.91}(SbO_4)_{0.02}(CO_3)_x]Cl_{4.04}(OH)_y{\cdot}nH_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 7.9 (70), 3.37 (80), 3.22 (60), 2.76 (80), 250 (60), 2.28 (100), 1.602 (70), 1.476 (60), 1.302 (60).

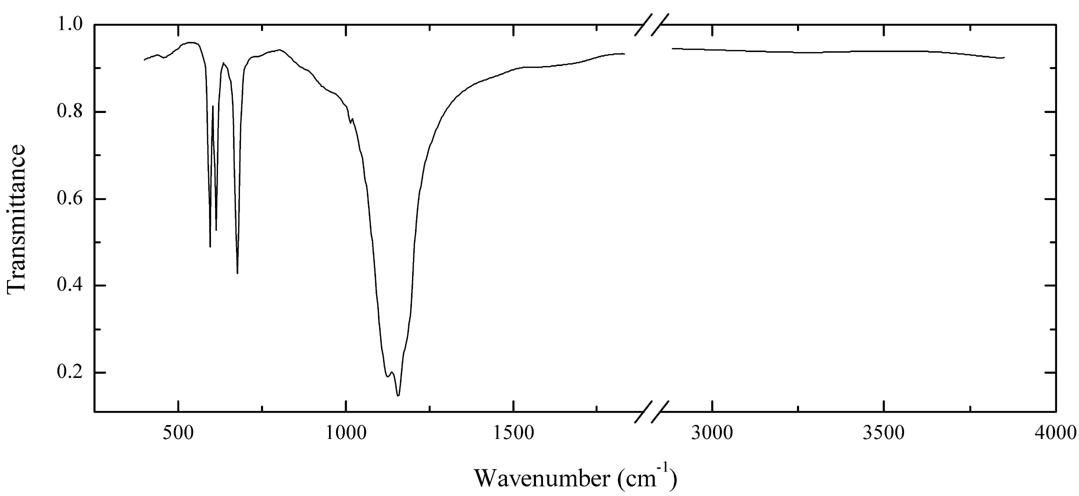
Wavenumbers (cm^{-1}): 3442, 3400sh, 2900, 2845, 2790sh, 1633w, 1417w, 1280w, 1101s, 1007, 875w, 848w, 737, 710sh, 591w, 536, 485, 457s.

S85 Sulfate-antimonate S85 $Cu^{2+}{}_4Al_2(HSbO_4,SO_4)_2(OH)_{10}\cdot nH_2O$ ($n \approx 2$)



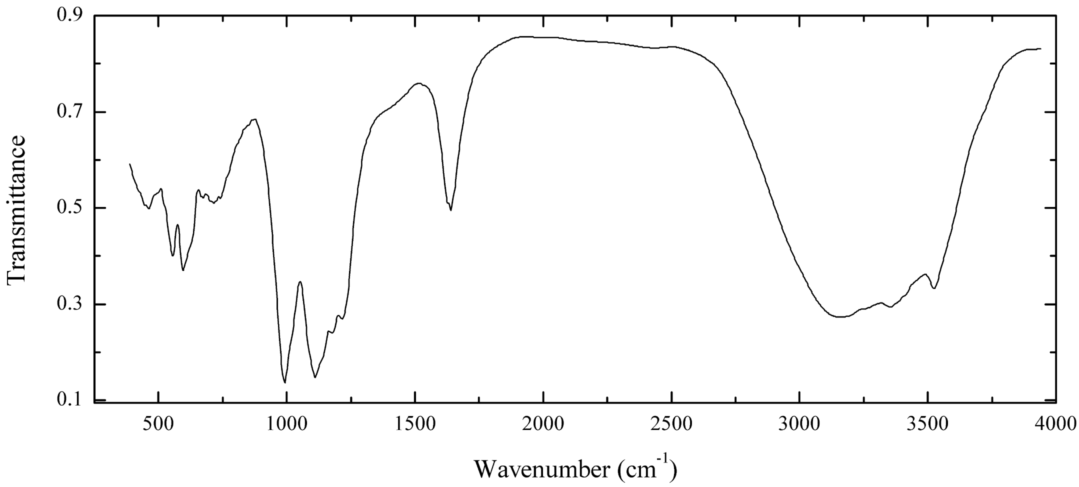
Locality: L'ubietová-Svätoduška, Banská Bystrica Co., Banská Bystrica region, Slovakia.
Description: Light blue acicular crystals. The empirical formula is $Cu_{4.00}(Al_{1.90}Fe_{0.06})[(HSbO_4)_{0.83}(SO_4)_{0.66}(CO_3)_x](OH)_y\cdot nH_2O$. Related to camerolaite and cyanotrichite. Needs further investigation.
Wavenumbers (cm^{-1}): 3365, 3240sh, 2950sh, 1648, 1420w, 1150sh, 1090s, 1037s, 890, 760, 645, 600sh, 578, 501, 442s.

S86 Anhydrite $Ca(SO_4)$



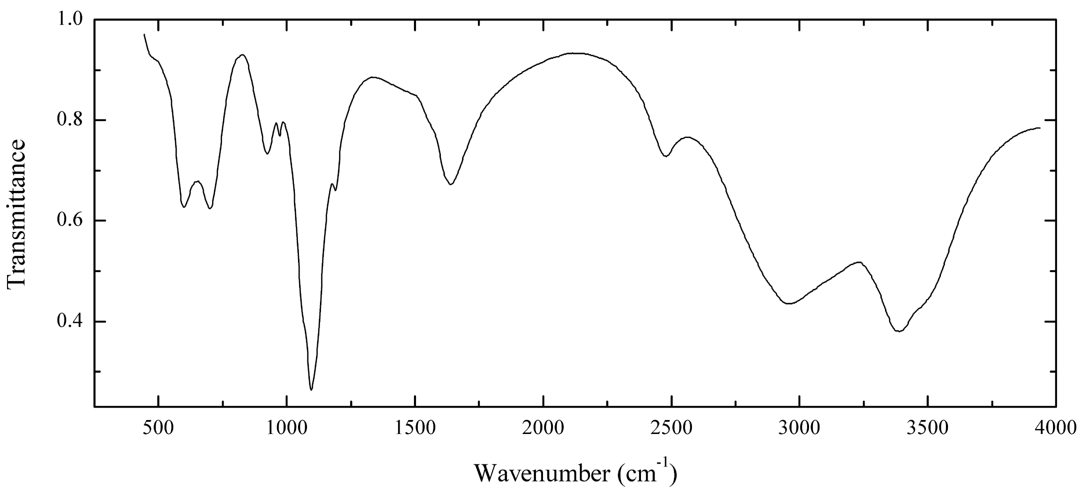
Locality: Kohnstein Quarry, Niedersachswerfen, Nordhausen, Harz, Thuringia, Germany.
Description: Colourless crystals from the association with howlite and hydroboracite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 1175sh, 1156s, 1120s, 1012w, 676, 617, 595.

S87 Copiapite $Fe^{2+}Fe^{3+}_4(SO_4)_6(OH)_2{\cdot}20H_2O$



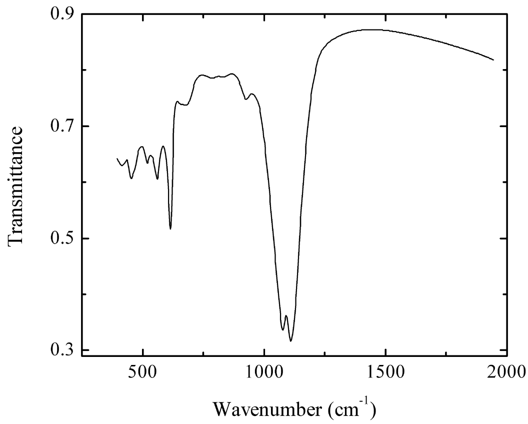
Locality: Atocha mine, Argue province, Cochabamba department, Bolivia.
Description: Yellow-brown massive from the association with ferricopiapite. The empirical formula is (electron microprobe) $Cu_{0.1}Fe_{4.8}(SO_4)_{6.00}(OH)_2{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3525, 3350, 3155s, 1647, 1220s, 1180s, 1140sh, 1115s, 993s, 750sh, 723, 672, 630sh, 594, 554, 464, 445, 425sh.

S88 Kalinite $KAl(SO_4)_2{\cdot}11H_2O$



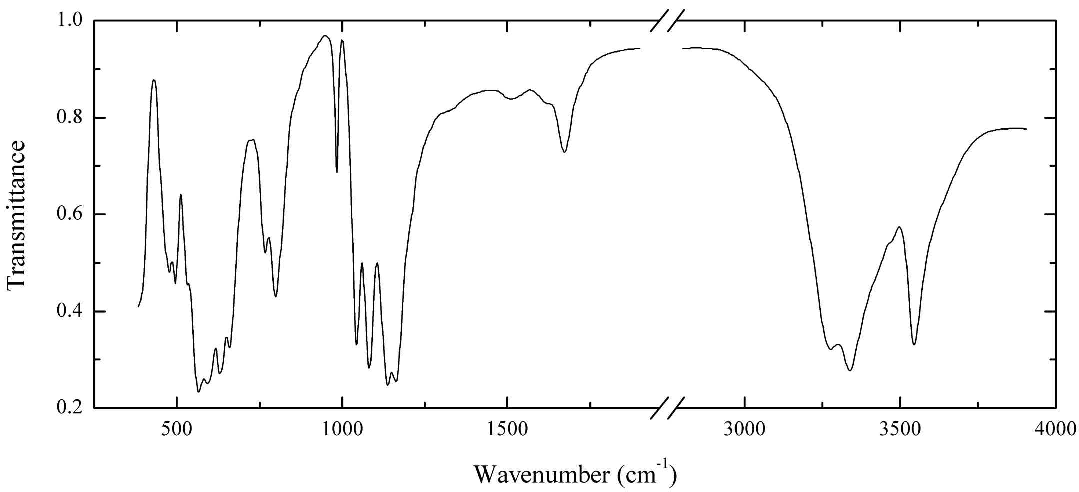
Locality: Blyava Cu deposit, Mednogorsk district, Orenburg region, South Urals, Russia.
Description: Colourless grains forming coarse-grained aggregate. Investigated by P.M. Kartashov.
Wavenumbers (cm^{-1}): 3470sh, 3390s, 2960, 2480, 1643, 1194, 1100s, 1070sh, 976, 926, 697, 597, 470sh.

S89 Cannonite $Bi_2(SO_4)O(OH)_2$



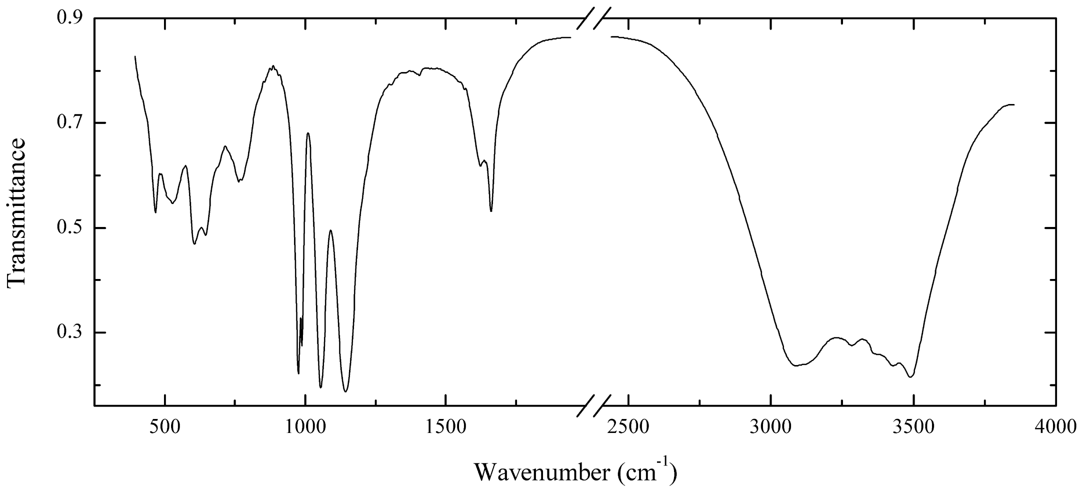
Locality: Duadello mine, Fraine, Pisogne, Camonica valley, Brescia province, Lombardy, Italy.
Description: Colourless acicular crystals. Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Bi_{1.97}Pb_{0.04}(SO_4)_{1.00}O(OH)_2$.
Wavenumbers (cm^{-1}): 1112s, 1078s, 930w, 830w, 785w, 675w, 617, 562, 520, 454, 401.

S90 Creedite $Ca_3Al_2(SO_4)(OH)_2F_8{\cdot}2H_2O$



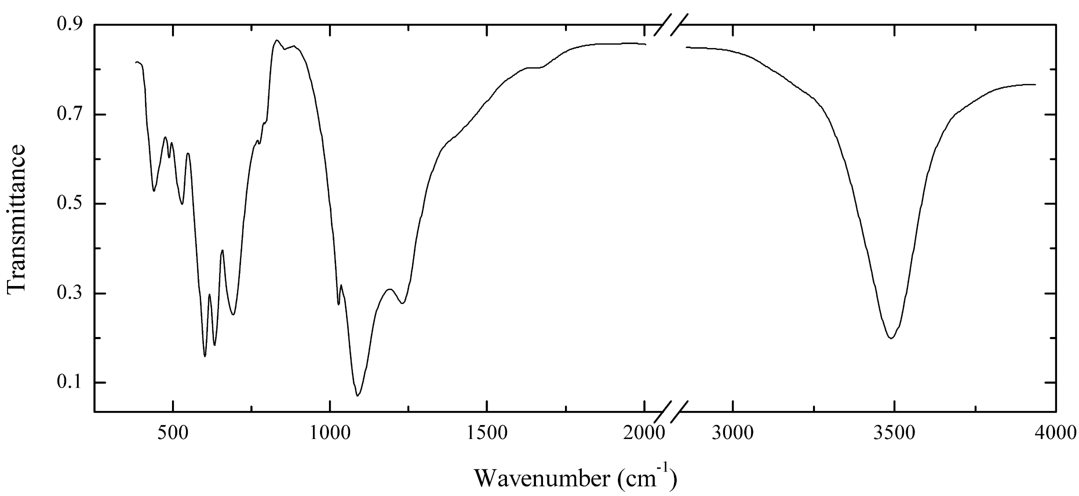
Locality: Akchatau mine, Akchatau, Karagandy region, Kazakhstan.
Description: Transparent violet spindle-like crystals from the association with gearksutite, pyrite and quartz. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3530, 3315s, 3250, 1673, 1620sh, 1510w, 1325sh, 1163s, 1138s, 1083s, 1045s, 985, 798, 766, 657s, 627s, 590s, 563s, 529, 491, 472, 465sh, 390sh.

S91 Minasragrite $V^{4+}(SO_4)O\cdot5H_2O$



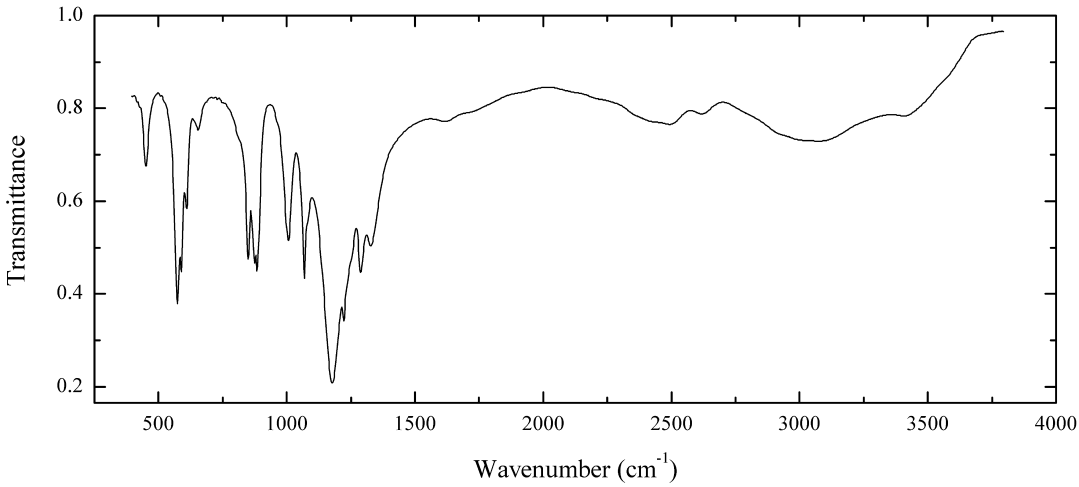
Locality: Ragra mine (Minasragra), Huayllay district, Pasco province, Peru (type locality).
Description: Bright blue split crystals from the association with patronite.
Wavenumbers (cm^{-1}): 3465s, 3405s, 3360, 3260, 3070s, 1657, 1617, 1400w, 1141s, 1053s, 989, 976s, 768, 690sh, 645, 606, 521, 510sh, 468.

S92 Minamiite $(Na,Ca,H_2O,\square)Al_3(SO_4)_2(OH,H_2O)_6$



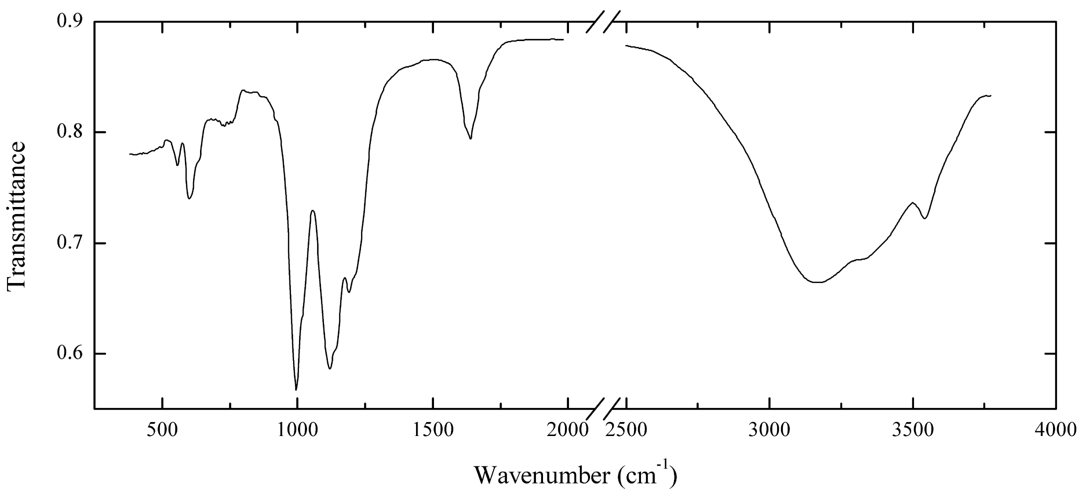
Locality: Okumanza, western foothills of Mt. Sharane, Gunma prefecture, Japan (type locality).
Description: White powdery aggregate from the association with alunite, natroalunite, huangite and quartz. The empirical formula is (electron microprobe) $(Na_{0.35}Ca_{0.30}K_{0.07})(Al_{2.88}Fe_{0.02})(SO_4)_{2.00}(OH,H_2O)_6$. Probably minamiite should be considered as Ca-bearing variety of natroalunite.
Wavenumbers (cm^{-1}): 3483s, 1630w, 1380sh, 1230, 1087s, 1027, 857w, 795, 775, 691, 632s, 601s, 530, 487, 439.

S93 Mercallite $KH(SO_4)$



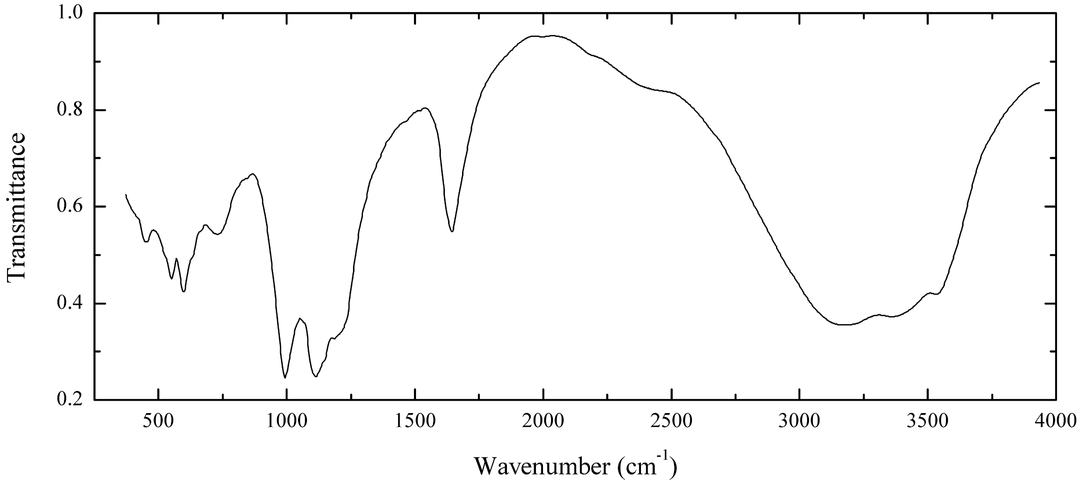
Locality: Vesuvius volcanic complex, Naples province, Campania, Italy (type locality).
Description: Tabular crystals from the association with halite and hieratite.
Wavenumbers (cm^{-1}): 3385, 3040, 2600, 2485, 2420sh, 2350sh, 1700sh, 1610w, 1327, 1284, 1221, 1183s, 1080sh, 1007, 887, 875, 852, 658w, 612, 590, 577, 452.

S94 Metahohmannite $Fe^{3+}{}_2(SO_4)_2O{\cdot}4H_2O$



Locality: Chuquicamata copper mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile (type locality).
Description: Orange massive.
Wavenumbers (cm^{-1}): 3525, 3320sh, 3150, 1640, 1225sh, 1212, 1140sh, 1122s, 1020sh, 995s, 730w, 630sh, 597, 556.

S95 Copiapite $Fe^{2+}Fe^{3+}_4(SO_4)_6(OH)_2·20H_2O$

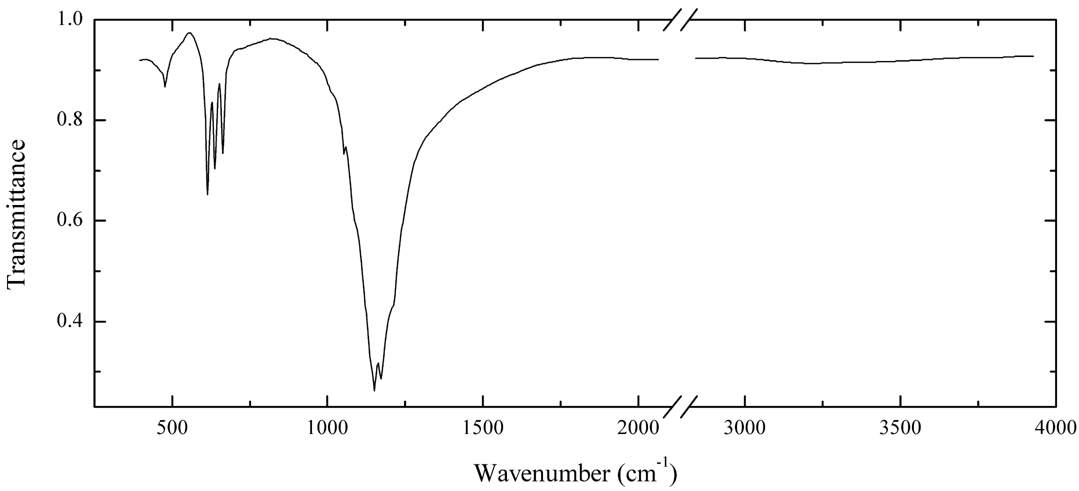


Locality: Caracoles, Sierra Gorda district, Antofagasta province, Chile.

Description: Yellow tabular crystals from the association with amarantite. The empirical formula is (electron microprobe) $Fe_{1.00}(Fe_{3.97}Al_{0.03})(SO_4)_{6.00}(OH)_2·nH_2O$.

Wavenumbers (cm^{-1}): 3520, 3335s, 3150s, 2450sh, 1643, 1225sh, 1182, 1145sh, 1113s, 994s, 730, 665, 630sh, 597, 533, 450, 425sh.

S96 Langbeinite $K_2Mg_2(SO_4)_3$

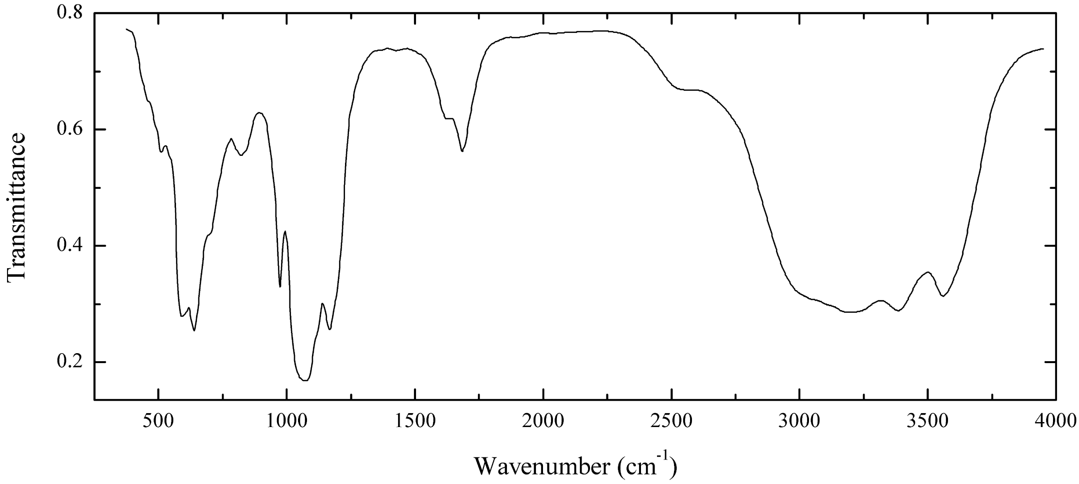


Locality: Inder boron deposit, Atyrau region, Kazakhstan.

Description: Light grey granular aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 1205sh, 1171s, 1151s, 1140sh, 1090sh, 1051, 1010sh, 658, 635, 609, 472.

S97 Meta-aluminite $Al_2(SO_4)(OH)_4 \cdot 5H_2O$

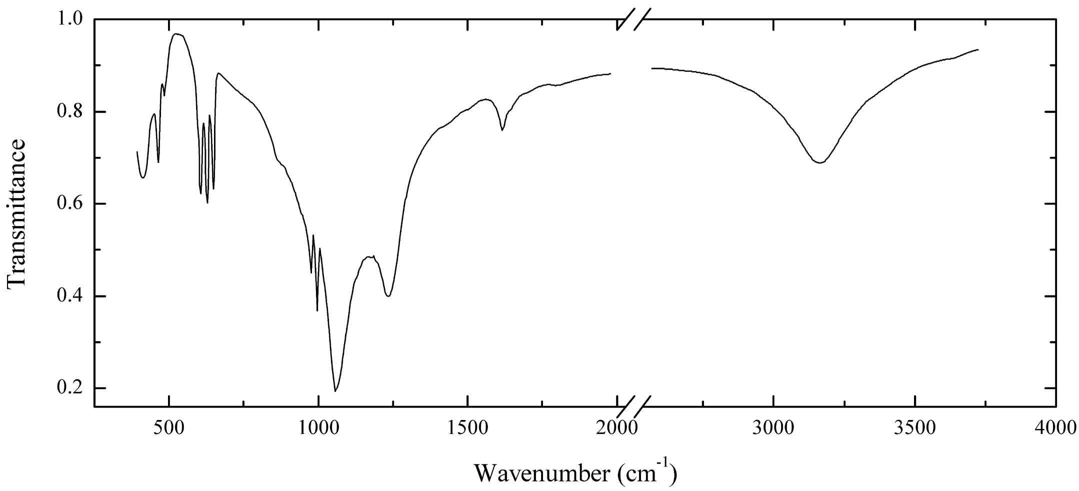


Locality: Balym village, Elbrus district, Kabardino-Balkaria Republic, northern Caucasus.

Description: White concretion from the association with gypsum. Identified by IR spectrum and powder X-ray diffraction pattern. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 8.42 (36), 6.92 (39), 4.52 (100), 4.38 (63), 3.74 (49), 3.62 (40).

Wavenumbers (cm^{-1}): 3530, 3365, 3180, 3000sh, 2550, 1683, 1630, 1185sh, 1166s, 1110sh, 1071s, 1050sh, 973, 822, 695sh, 638s, 592, 505w.

S98 Natrochalcite $NaCu_2(SO_4)_2(OH) \cdot H_2O$

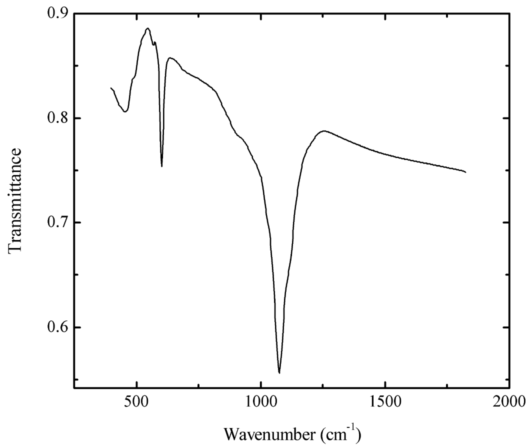


Locality: Chuquicamata copper mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile (type locality).

Description: Green crust from the association with antlerite and kröhnkite. Identified by IR spectrum.

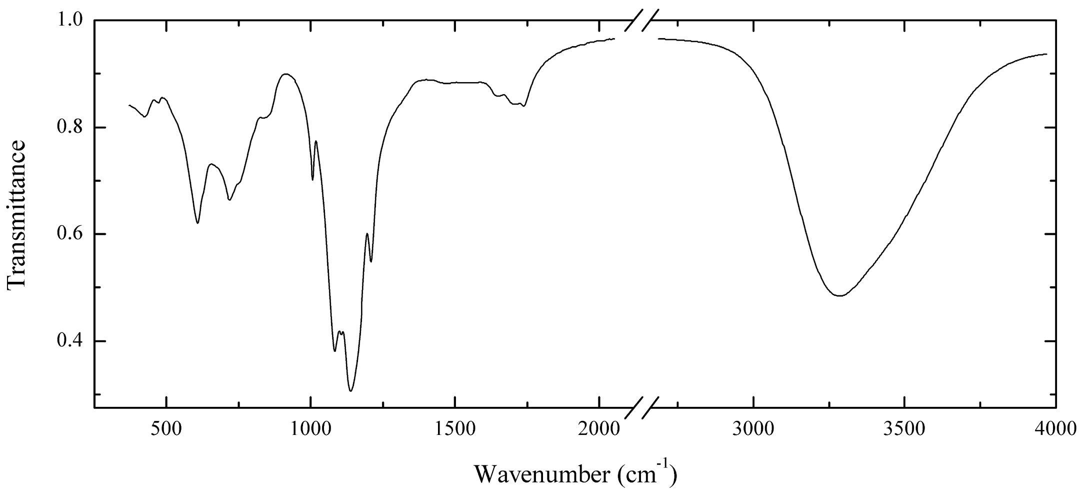
Wavenumbers (cm^{-1}): 3155, 3090sh, 1620w, 1236s, 1061s, 995s, 975s, 880sh, 646, 626, 602, 485sh, 480, 462, 407.

S99 Lanarkite $Pb_2(SO_4)O$



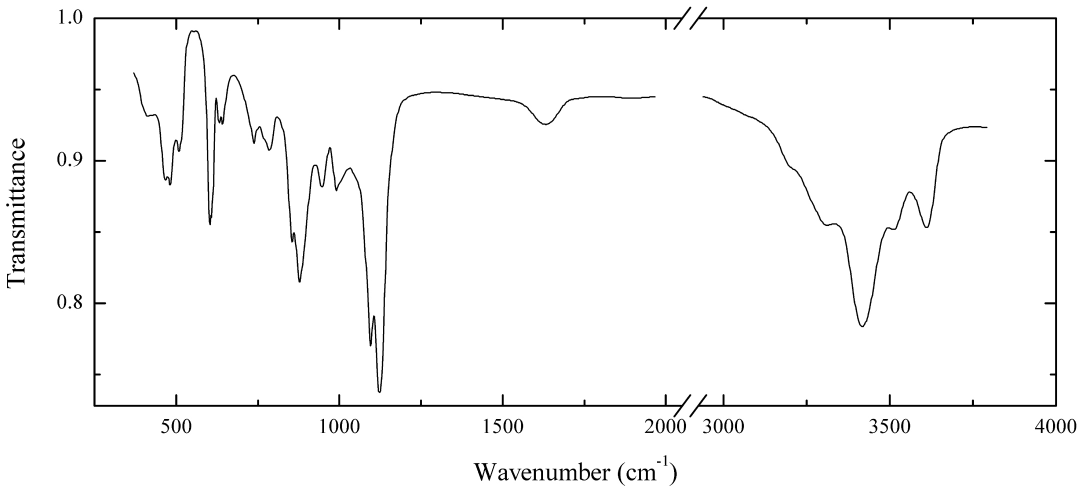
Locality: Susanna mine, Leadhills, Lanarkshire, Scotland, UK (type locality).
Description: Pale yellow crystals from the association with cerussite.
Wavenumbers (cm^{-1}): 1115sh, 1073s, 1020sh, 990sh, 915sh, 598, 574w, 490sh, 455.

S100 Leonite $K_2Mg(SO_4)_2{\cdot}4H_2O$



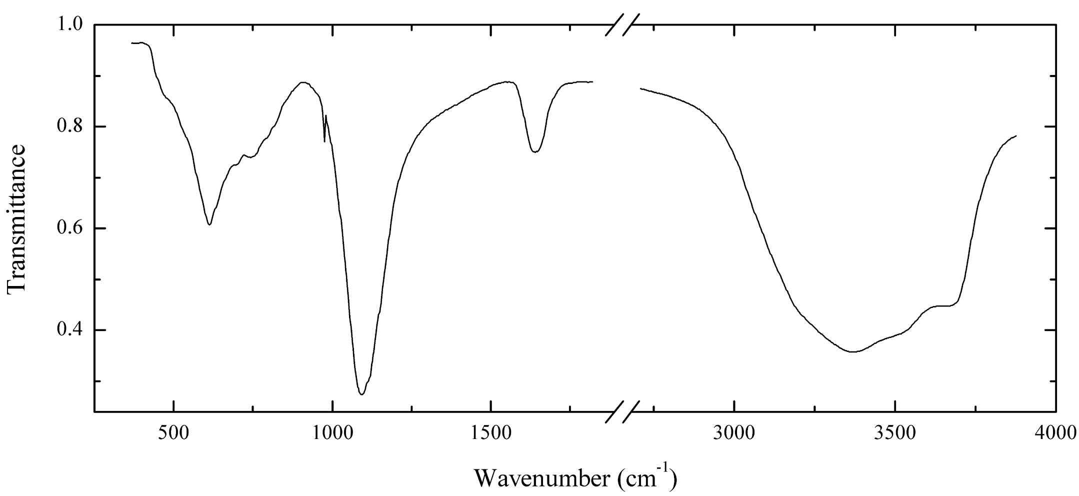
Locality: Potash Mine, Roßleben, Thuringia, Germany.
Description: Yellow prismatic crystals. The empirical formula is (electron microprobe, H_2O determined by thermogravimetry data) $(K_{1.92}Na_{0.02}Ca_{0.01})(Mg_{1.01}Fe_{0.02})(SO_4)_{2.00}{\cdot}3.88H_2O$.
Wavenumbers (cm^{-1}): 3400sh, 3250s, 1725, 1695w, 1640w, 1208, 1135s, 1103s, 1081s, 1005, 840w, 745sh, 717, 635sh, 614, 456w, 427.

S101 Langite $Cu^{2+}{}_4(SO_4)(OH)_6{\cdot}2H_2O$



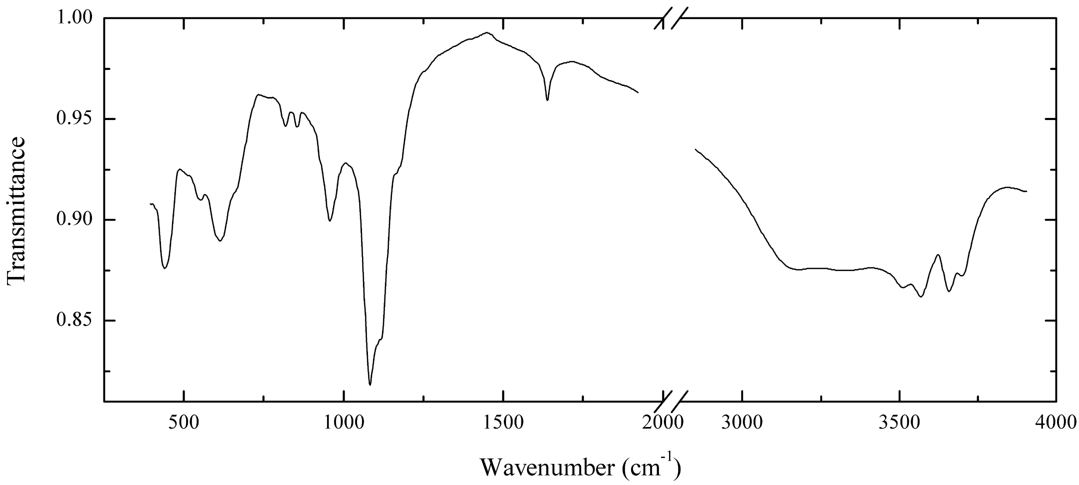
Locality: Erzgebirge (Ore Mts.), Saxony, Germany.
Description: Blue massive.
Wavenumbers (cm^{-1}): 3575, 3465, 3390s, 3280, 3170sh, 1620, 1115s, 1089s, 986, 944, 875s, 852, 779, 734, 638, 627, 604, 597, 507, 483, 466, 415.

S102 Ferrohexahydrite $Fe^{2+}(SO_4){\cdot}6H_2O$



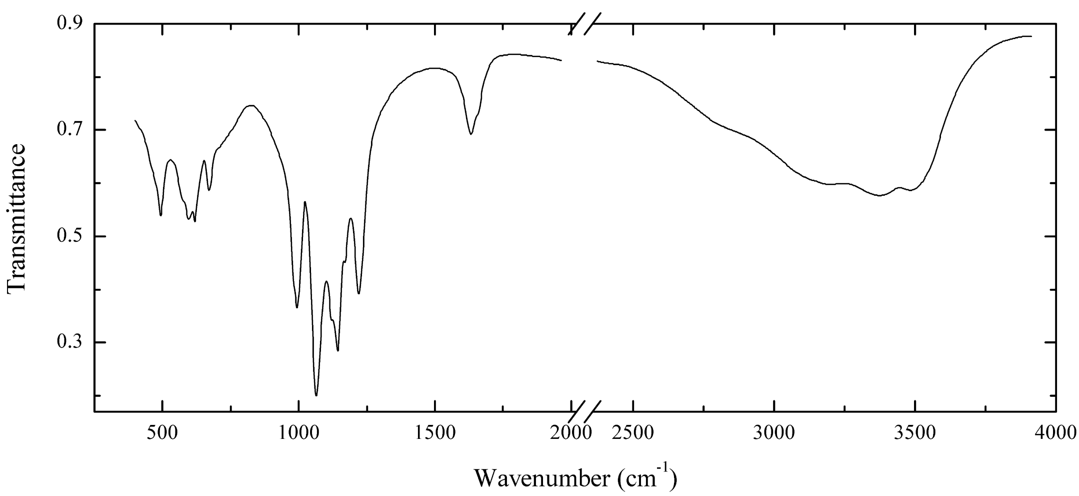
Locality: Le Cetine di Cotorniano mine, Chiusdino, Siena province, Tuscany, Italy.
Description: Bluish-white, massive. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3660, 3490sh, 3370s, 3200sh, 1640, 1110sh, 1094s, 977, 757, 620, 485sh.

S103 Mooreite $Mg_9Zn_4Mn_2(SO_4)_2(OH)_{26}\cdot 8H_2O$



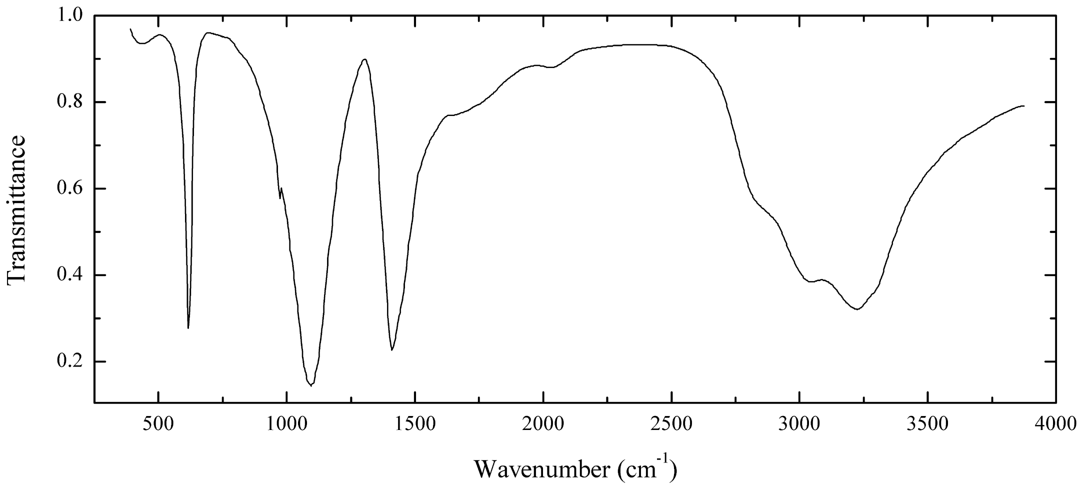
Locality: Sterling Hill mine, Ogdensburg, Sussex Co., New Jersey, USA (type locality).
Description: Brownish crust from the association with rhodochrosite and zincite.
Wavenumbers (cm^{-1}): 3675, 3630, 3540, 3485, 3350, 3150, 1637w, 1165sh, 1115sh, 1086s, 961, 855w, 818w, 660sh, 620, 558, 445.

S104 Metavoltine $Na_6K_2Fe^{2+}Fe^{3+}{}_6(SO_4)_{12}O_2\cdot 18H_2O$



Locality: Carola mine (Carolaschacht), Freital, Dresden, Saxony, Germany.
Description: Yellow powdery aggregate from the association with halotrichite and gypsum. The empirical formula is (electron microprobe) $Na_{5.8}K_{2.1}Fe_{6.8}Mg_{0.1}(SO_4)_{12.0}(O,OH)_2\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3450, 3350, 3190, 2860sh, 1655sh, 1635, 1216, 1169, 1143s, 1120s, 1063s, 996, 980sh, 671, 617, 592, 570sh, 493.

S105 Mascagnite $(NH_4)_2(SO_4)$

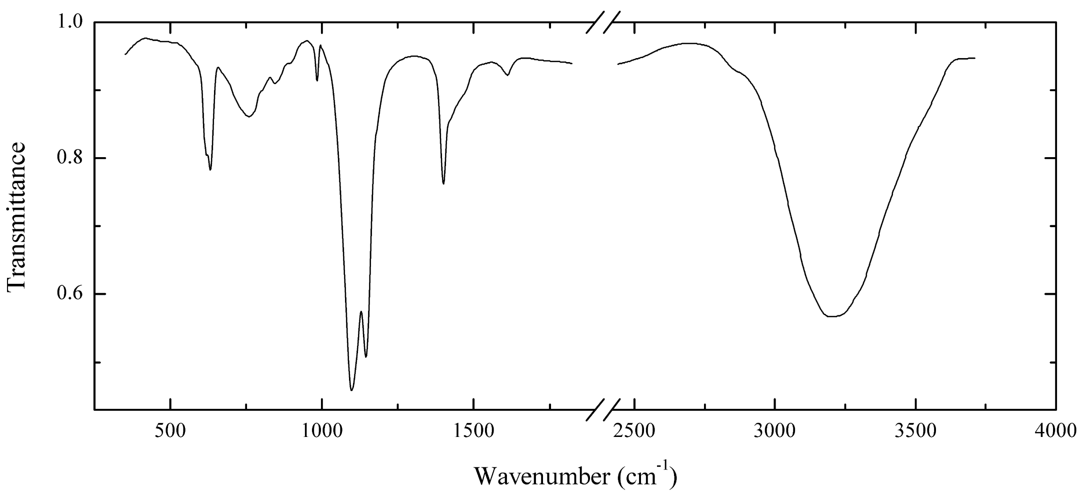


Locality: Near the former settlement of Ravat, about 3 km east of the confluence of the rivers Jagnob and Iskanderdar'ja, Tajikistan.

Description: White curved prismatic crystals from the association with salammonoac. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3300sh, 3225s, 3050, 2850sh, 2035w, 1650sh, 1401s, 1107s, 990, 619s, 440w.

S108 Nickelboussingaultite $(NH_4)_2Ni(SO_4)_2·6H_2O$

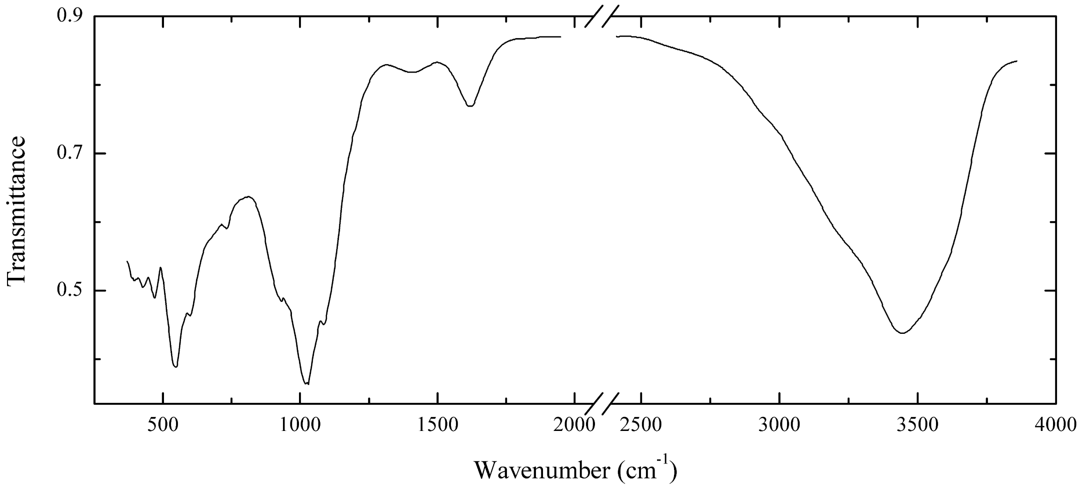


Locality: Noril'sk Cu–Ni deposit, Putorana Plateau, Taimyr peninsula, Siberia, Russia (type locality).

Description: Green powdery coating on sulfide Cu–Ni ore. Holotype sample. Associated minerals are pentlandite and chalcopyrite. Monoclinic, space group $P2_1/b$, $a = 9.241(2)$, $b = 12.544(15)$, $c = 6.243(5)$ Å, $\beta = 105.97(6)°$, $Z = 2$. The empirical formula is $[(NH_4)_{1.59}Na_{0.07}](Ni_{0.90}Mg_{0.23}Cu_{0.14}Fe_{0.02})(SO_4)_{2.00}·6H_2O$. $D_{calc} = 1.85$ g/cm^3. Optically biaxial (+), $\alpha = 1.490$, $\beta = 1.494$, $\gamma = 1.501$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 11.7 (70), 4.153 (100), 3.759 (80), 3.022 (60), 2.793 (60), 2.119 (70), 1.806 (60).

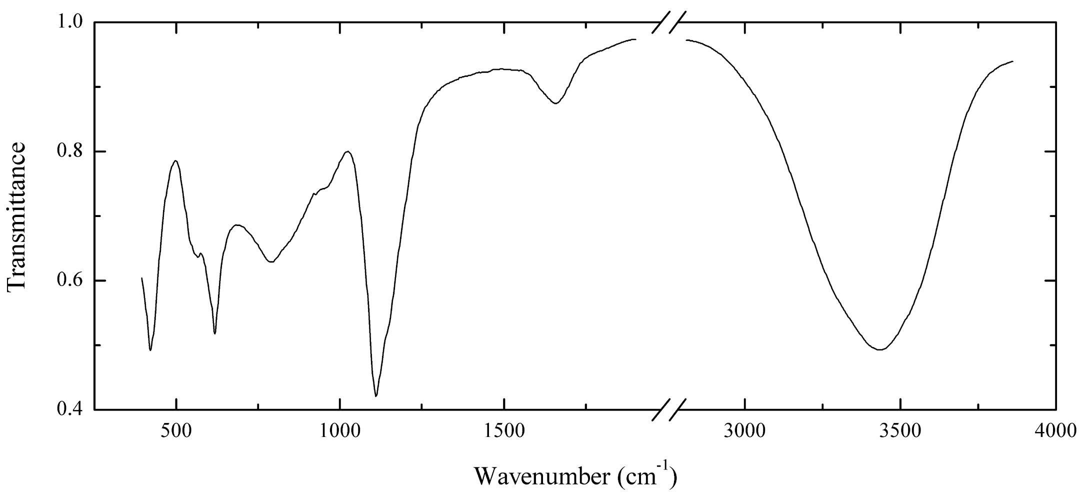
Wavenumbers (cm^{-1}): 3190s, 2850sh, 1615w, 1460sh, 1401, 1144s, 1099s, 984, 900sh, 849w, 770, 631, 615.

S109 Nickelalumite $NiAl_4(SO_4)(OH)_{12}{\cdot}3H_2O$



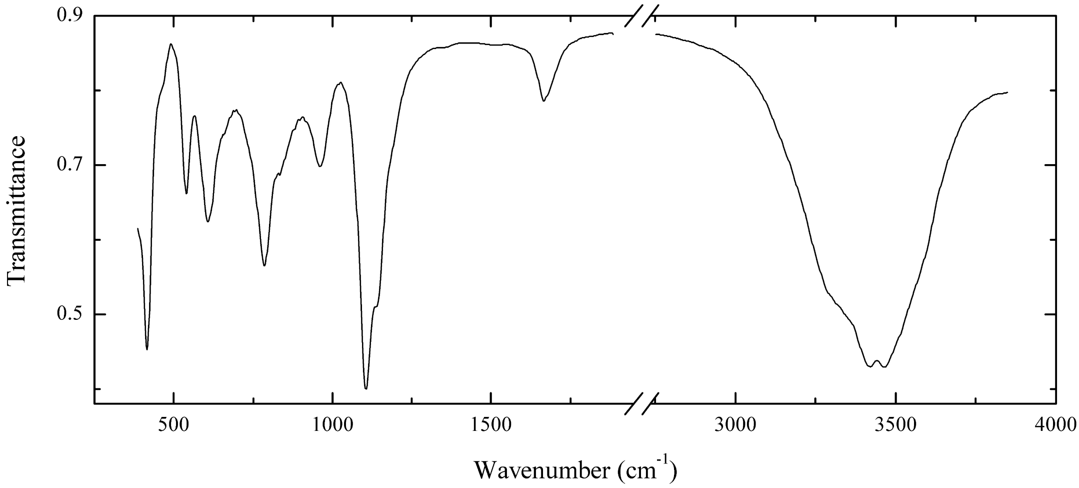
Locality: Kara-Chagyr Mt., Alai range, Osh region, Kyrgyzstan.
Description: Pale blue crust. The empirical formula is (electron microprobe) $(Ni_{0.90}Zn_{0.04})Al_{4.05}(SO_4)_{1.00}(OH)_{12}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3600sh, 3440s, 3250sh, 1625, 1410w, 1095, 1026s, 930, 728w, 596, 544s, 467, 430, 400.

S110 Natroglaucocerinite $Na_x(Zn_{8-y}Al_y)(SO_4)_{x/2+y/2}(OH)_{16}{\cdot}6H_2O$



Locality: Hilarion mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece (type locality).
Description: Light blue massive. The empirical formula is (electron microprobe) $Na_{0.6}Zn_{4.5}Cu_{1.4}Al_{2.8}(SO_4)_{1.7}(OH)_{16}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3420s, 1655, 1165sh, 1109s, 950sh, 840sh, 787, 616s, 555, 420s.

S111 Nikischerite $NaFe^{2+}{}_6Al_3(SO_4)_2(OH)_{18}\cdot 12H_2O$

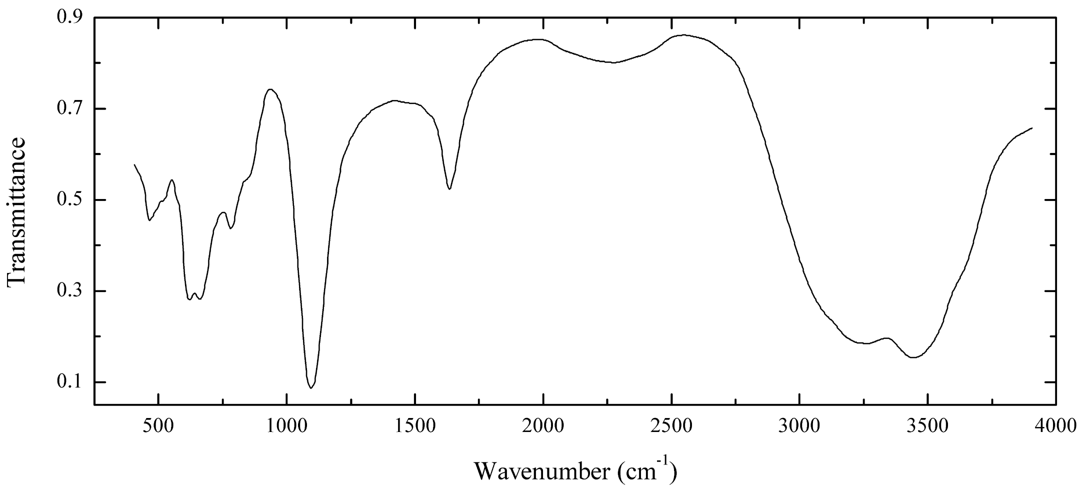


Locality: Huanuni Sn mine, about 50 km southwest of Oruro city, Dalence province, Oruro department, Bolivia (type locality).

Description: Dark green crystals from the association with vivianite.

Wavenumbers (cm^{-1}): 3450s, 3410s, 3300sh, 1665, 1190sh, 1140sh, 1107s, 962, 825sh, 786, 615sh, 604, 537, 414s.

S112 Retgersite $Ni(SO_4)\cdot 6H_2O$

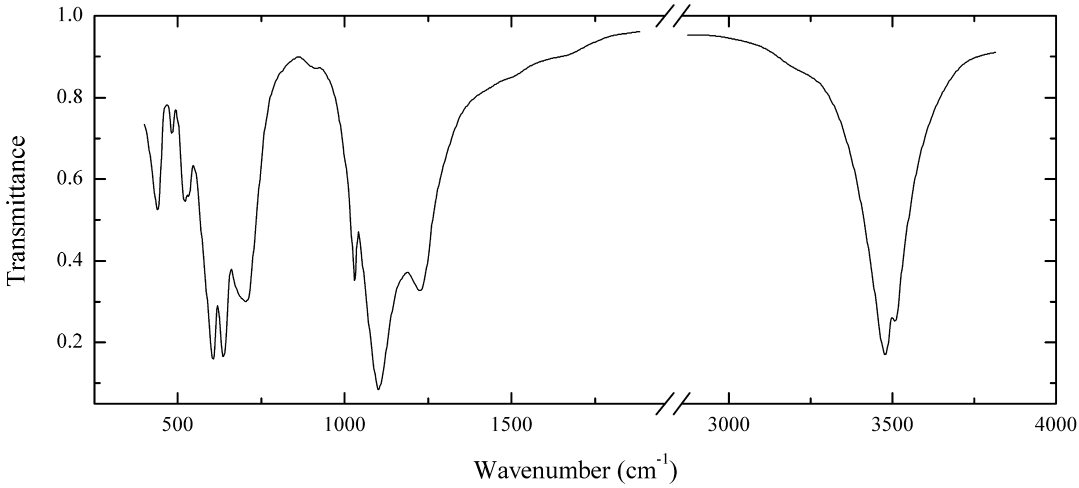


Locality: Jáchymov, Krušné Hory Mts. (Ore Mts.), Bohemia, Czech Republic.

Description: Bluish-green crust. Identified by IR spectrum and qualitative electron microprobe analysis.

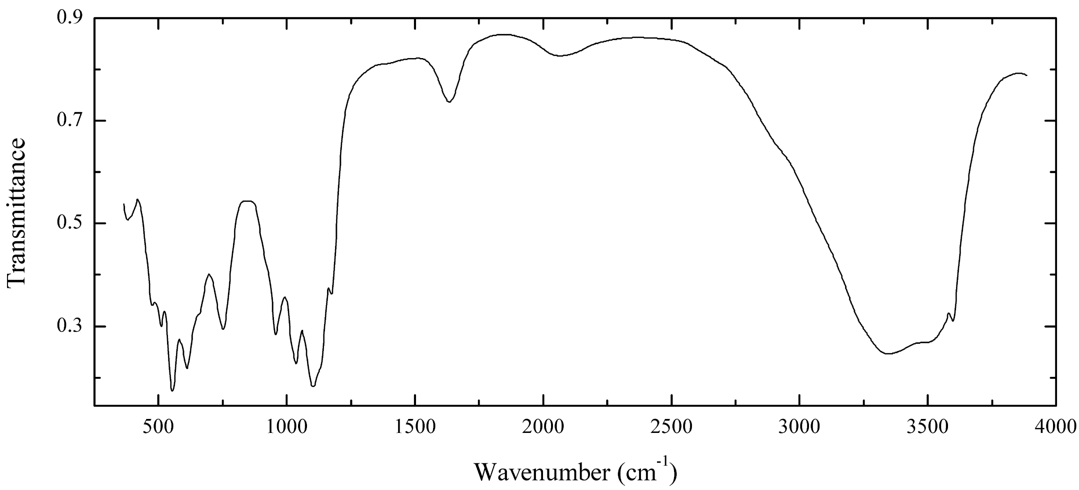
Wavenumbers (cm^{-1}): 3440s, 3250s, 2280w, 1645, 1094s, 840sh, 784, 663, 623, 505sh, 470.

S113 Natroalunite $NaAl_3(SO_4)_2(OH)_6$



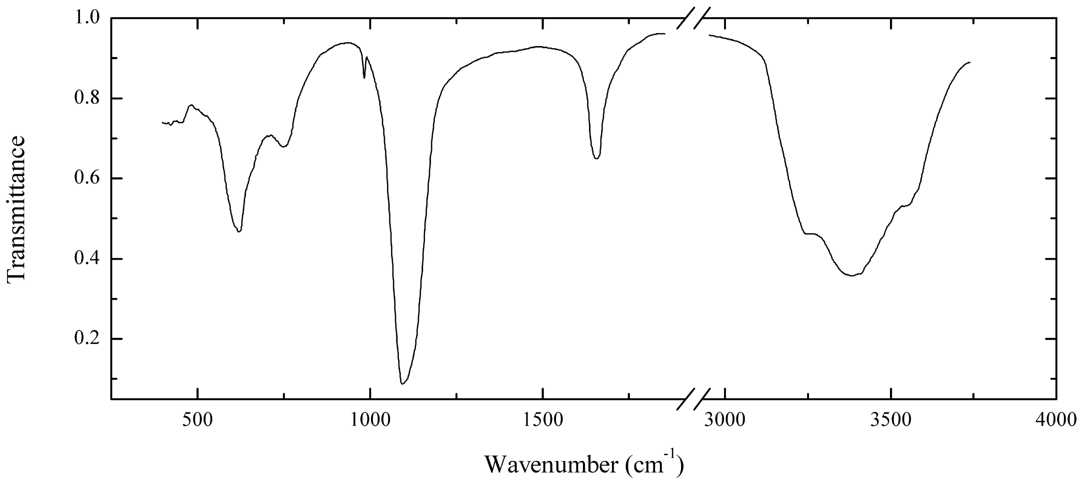
Locality: Pella, Orange river, Northern Cape province, South Africa.
Description: White massive. The empirical formula is (electron microprobe) $H_x(Na_{0.63}Ca_{0.03}K_{0.02})Al_{3.00}(SO_4)_{2.00}(OH)_6$.
Wavenumbers (cm^{-1}): 3490s, 3460s, 1225, 1096s, 1029, 700, 631s, 601s, 534, 520, 487w, 441.

S115 Felsőbányaite $Al_4(SO_4)(OH)_{10}{\cdot}4H_2O$



Locality: Yurkino township, Kerch peninsula, Kerch iron-ore basin, Crimea, Ukraine.
Description: White concretion from the association with gypsum and natrojarosite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3595, 3495, 3390sh, 3340s, 3240sh, 2165w, 1645, 1174, 1125sh, 1103s, 1038s, 957, 920sh, 750, 650sh, 609s, 548s, 505, 473, 380.

S116 Hexahydrite $Mg(SO_4)\cdot 6H_2O$

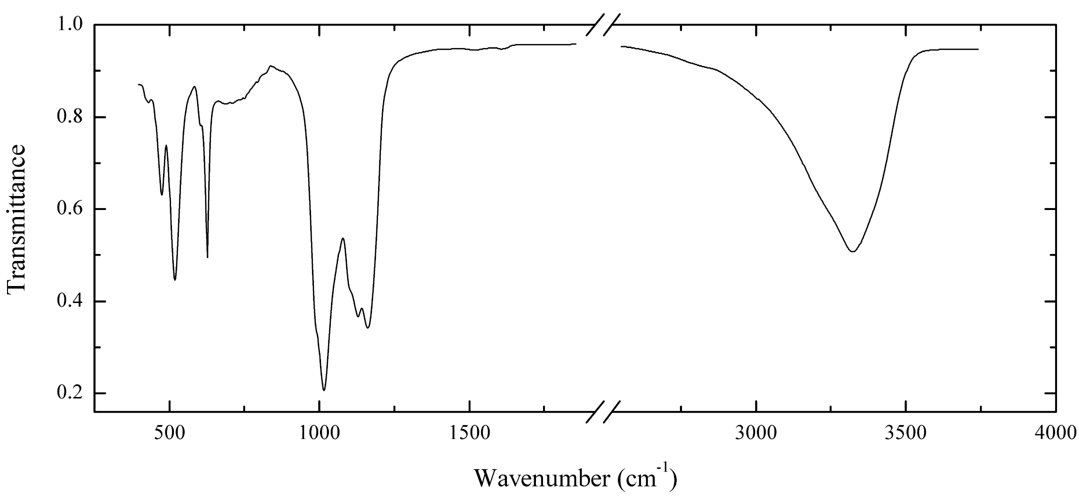


Locality: An unknown locality in Sakha Republic (Yakutia), Russia.

Description: White fine-grained aggregate. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3550sh, 3385, 3250, 1660, 1105sh, 1087s, 984w, 753, 660sh, 619, 455w, 416w.

S117 Beaverite-(Cu) $Pb(Fe,Cu)_3(SO_4)_2(OH,H_2O)_6$

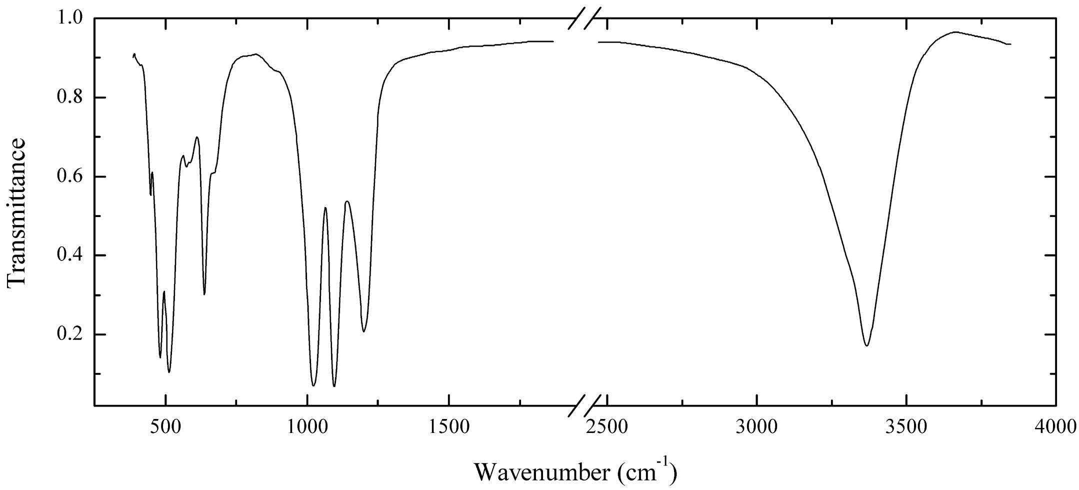


Locality: Megala Pefka mine No. 28, Megala Pefka area, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Yellow powdery from the association with cerussite and goethite. The empirical formula is (electron microprobe) $Pb_{0.95}Cu_{1.0}Fe_{2.0}(SO_4)_{2.0}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3325, 3250sh, 1624w, 1530w, 1165s, 1132s, 1105sh, 1018s, 992sh, 720sh, 693w, 628, 605w, 518, 474, 433w.

S118 Natrojarosite $NaFe^{3+}_3(SO_4)_2(OH)_6$

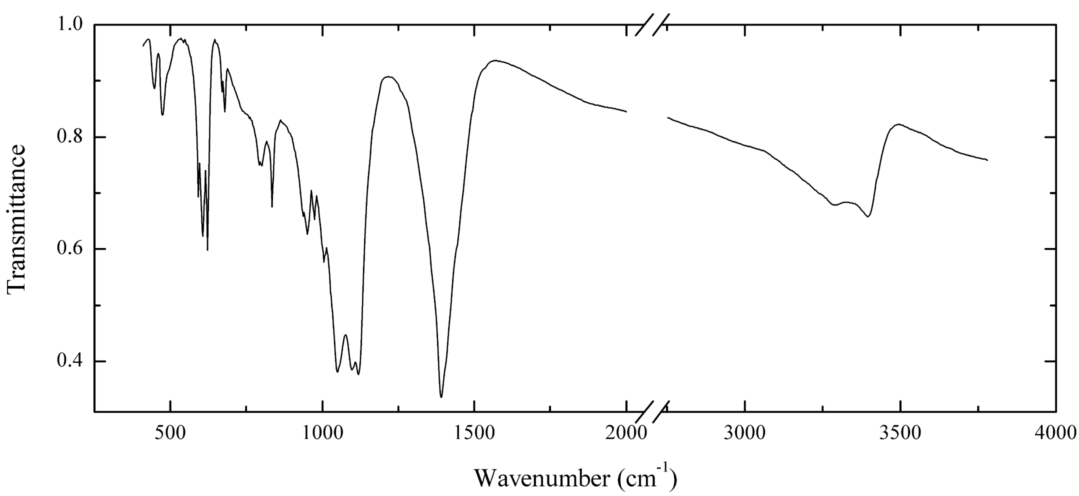


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining district, Attikí (Attika, Attica) prefecture, Greece.

Description: Yellow massive from the association with scorodite. The empirical formula is (electron microprobe) $(Na_{0.86}K_{0.13})(Fe_{2.98}Al_{0.02}Zn_{0.02})(SO_4)_{2.00}(OH)_6$.

Wavenumbers (cm^{-1}): 3354s, 3275sh, 1201, 1094s, 1023s, 890sh, 665, 639, 585sh, 571, 510s, 478s, 445.

S119 Caledonite $Pb_5Cu_2(SO_4)_3(CO_3)(OH)_6$

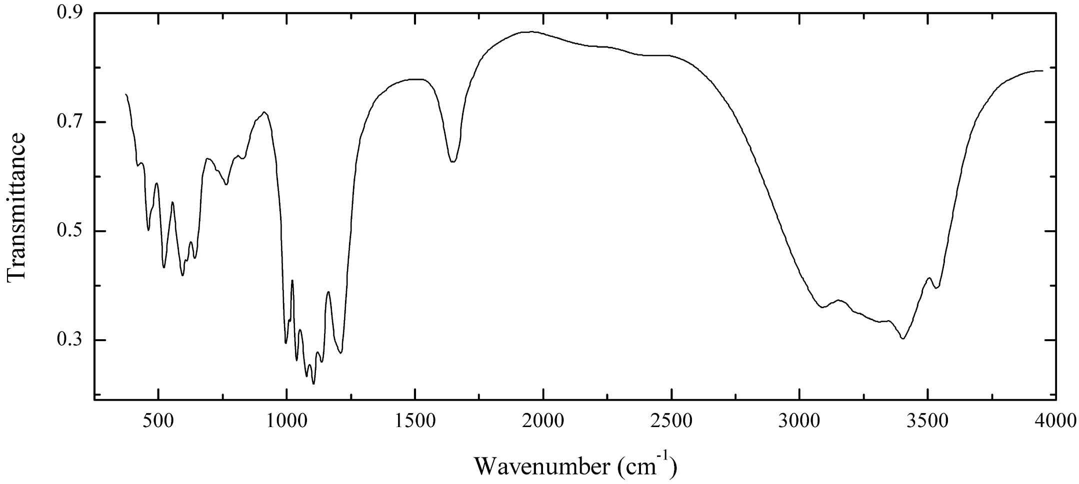


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Semitransparent green crusts. The empirical formula is (electron microprobe) $Pb_{5.00}Cu_{2.00}[(SO_4)_{2.98}(AsO_4)_{0.02}](CO_3)(OH)_6$.

Wavenumbers (cm^{-1}): 3395, 3285, 1410sh, 1397s, 1122s, 1100s, 1055s, 1008, 977, 953, 938, 838, 801, 745, 679, 670w, 595sh, 589, 574, 560, 473, 444.

S120 Amarantite $Fe^{3+}{}_2(SO_4)_2O{\cdot}7H_2O$

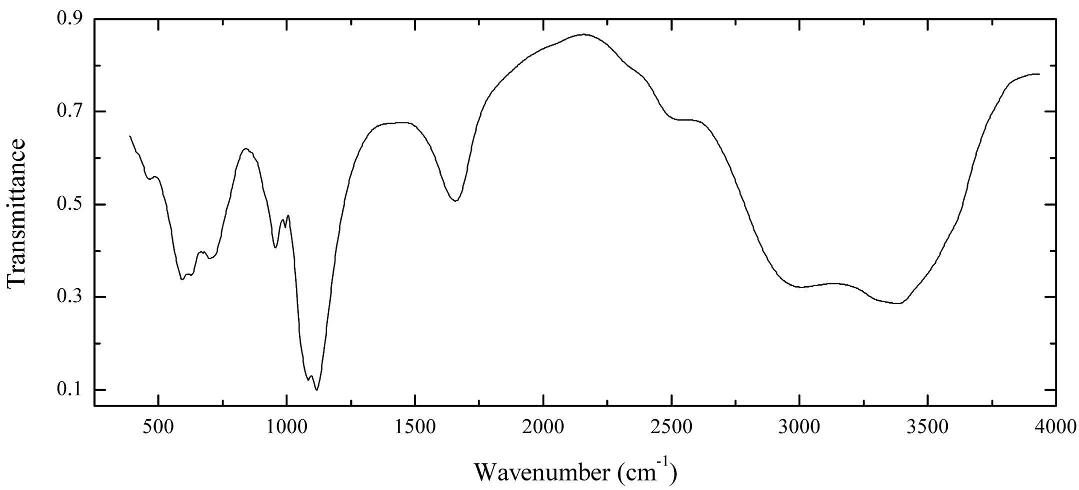


Locality: Caracoles, Sierra Gorda district, Antofagasta province, Chile (type locality).

Description: Orange-red crystals from the association with copiapite and coquimbite. The empirical formula is (electron microprobe) $Fe_{1.99}Ca_{0.01}(SO_4)_{2.00}O{\cdot}nH_2O$. According to Mössbauer spectrum, all iron is trivalent. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 11.5 (100), 8.8 (100), 5.1 (80), 4.9 (30), 4.54 (70), 3.68 (70), 3.47 (70), 3.10 (90), 2.60 (50).

Wavenumbers (cm^{-1}): 3520, 3385s, 3290, 3210sh, 3075, 2390w, 2200w, 1648, 1208s, 1139s, 1107s, 1081s, 1040s, 1014, 1000s, 837w, 773, 644, 615, 597, 522, 475sh, 459, 423w.

S121 Pickeringite $MgAl_2(SO_4)_4{\cdot}22H_2O$

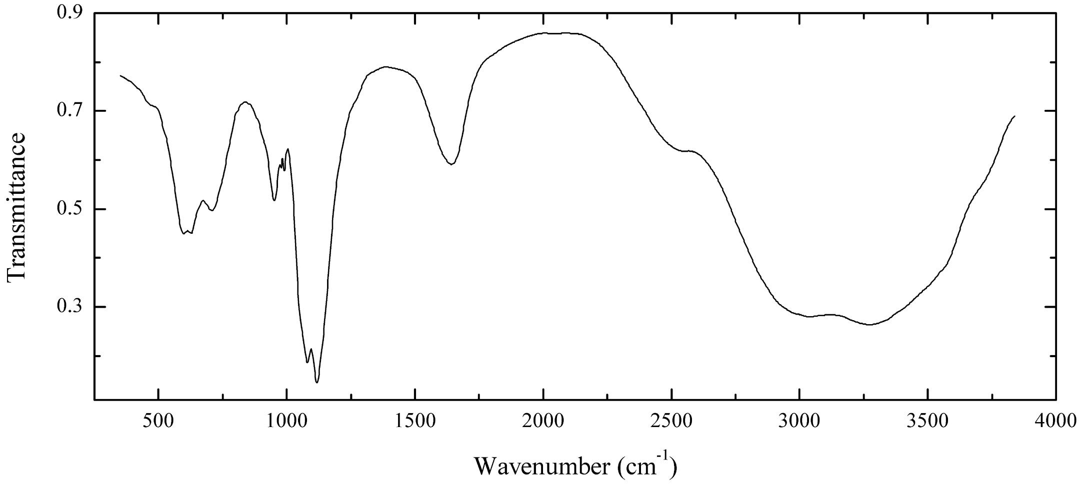


Locality: Le Cetine di Cotorniano mine, Chiusdino, Siena province, Tuscany, Italy.

Description: Yellowish fibrous aggregate from the association with fibroferrite. Fe^{2+}- and Fe^{3+}-rich variety. The empirical formula is (electron microprobe) $(Mg_{0.65}Fe^{2+}{}_{0.35})(Al_{1.5}Fe^{3+}{}_{0.5})(SO_4)_{4.0}{\cdot}nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3480sh, 3370s, 3300sh, 2990, 2510w, 2360sh, 1655, 1113s, 1082s, 994, 954, 705, 627, 595, 465w.

S122 Pickeringite $MgAl_2(SO_4)_4 \cdot 22H_2O$

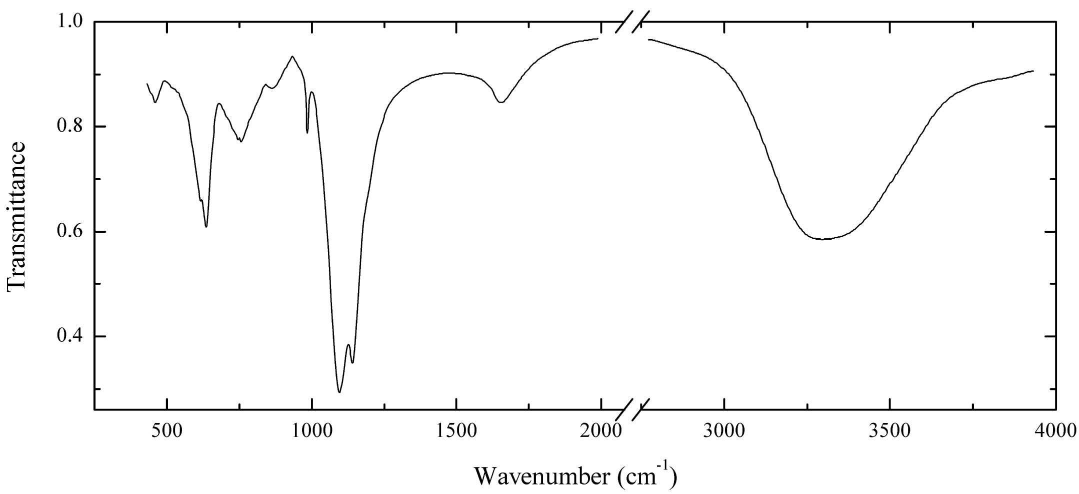


Locality: Slate quarry near Lehesten, Wurzbach, Thuringia, Germany.

Description: White fibrous aggregate from the association with copiapite and slavíkite. Fe^{2+}- rich variety. The empirical formula is (electron microprobe) $(Mg_{0.7}Fe^{2+}_{0.3})Al_{2.0}(SO_4)_{4.0} \cdot nH_2O$. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3700sh, 3640sh, 3580sh, 3280s, 3060s, 2560, 1653, 1260sh, 1117s, 1081s, 1055sh, 994, 978w, 953, 710, 626, 597, 475sh.

S123 Picromerite $K_2Mg(SO_4)_2 \cdot 6H_2O$

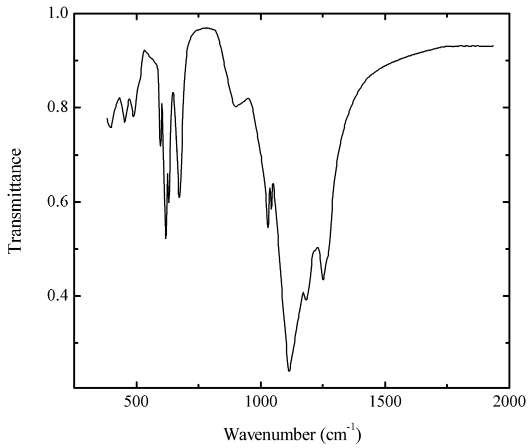


Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: White granular aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3340sh, 3280, 1652w, 1147s, 1100s, 985, 866w, 750, 630, 614, 450w.

S124 "Perkovaite" $Mg_3Ca_2(SO_4)_5$

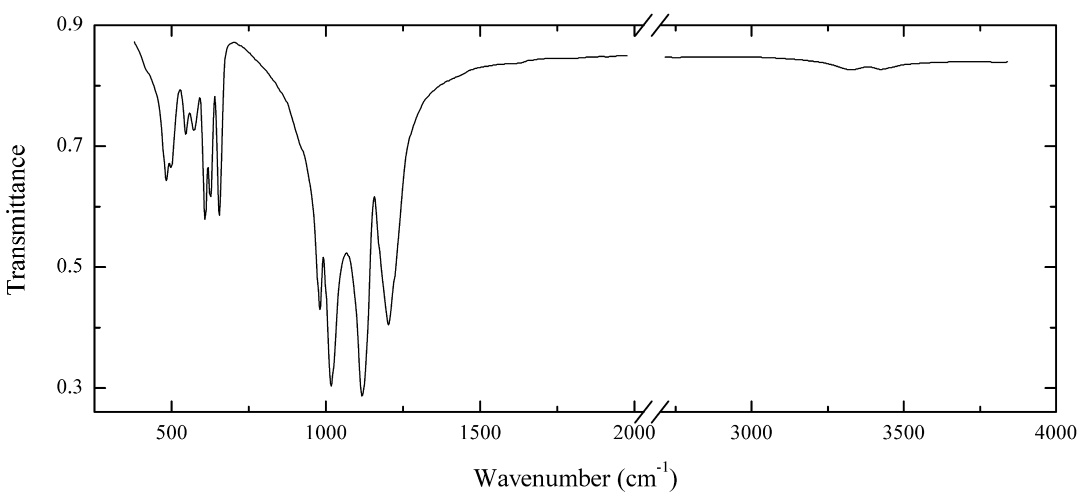


Locality: Burned dump of the Chelyabinsk coal basin, Kopeisk, South Urals, Russia.

Description: Brownish-grey fine-grained aggregate from the association with magnesioferrite, bassanite, anhydrite, pentahydrite, kieserite and fluorite. Investigated by B.V. Chesnokov. Not approved by the IMA CNMNC. Cubic, a = 10.36 Å, Z = 3. The empirical formula is (electron microprobe) $Mg_{3.00}Ca_{1.95}K_{0.05}(SO_4)_{5.00}$. D_{meas} = 2.77(2) g/cm^3, D_{calc} = 1.84 g/cm^3. Optically isotropic, n = 1.560(2). The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 3.66 (100) (220), 3.26 (40) (310), 2.78 (70) (321), 2.41 (50) (411), 2.30 (40) (420), 2.20 (40) (332), 2.12 (40) (422), 1.815 (60) (522, 441).

Wavenumbers (cm^{-1}): 1270sh, 1253s, 1184s, 1112s, 1043, 1030, 904, 671, 630, 619, 596, 487, 451, 400.

S125 Piypite $(Na,Cu^+)K_4Cu^{2+}{}_4(SO_4)_4O_2Cl$

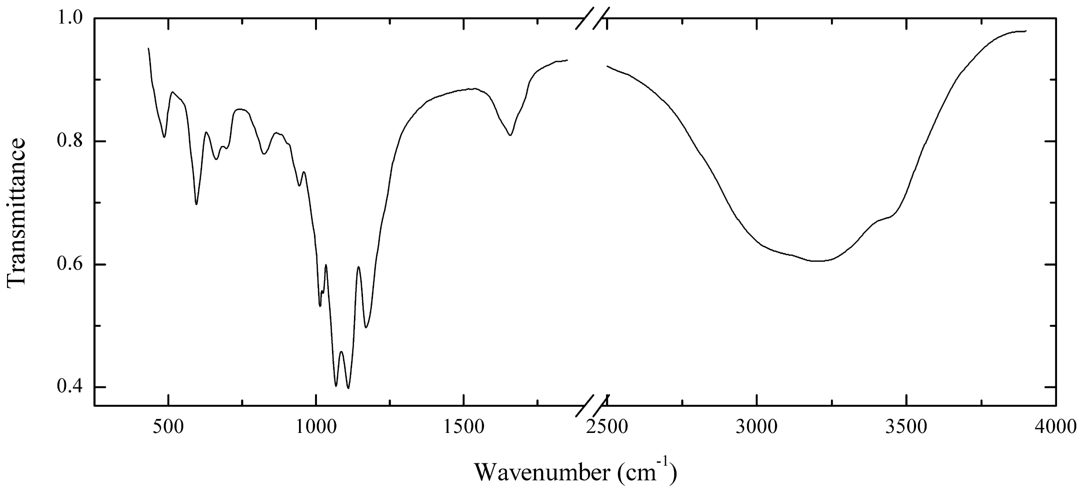


Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: Dark green acicular crystals. Investigated by V.A. Popov and V.I. Popova.

Wavenumbers (cm^{-1}): 3430w, 3335w, 1211, 1123s, 1018s, 981, 650, 624, 608, 567, 543, 497, 480.

S126 Para-coquimbite $Fe^{3+}_2(SO_4)_3 \cdot 9H_2O$

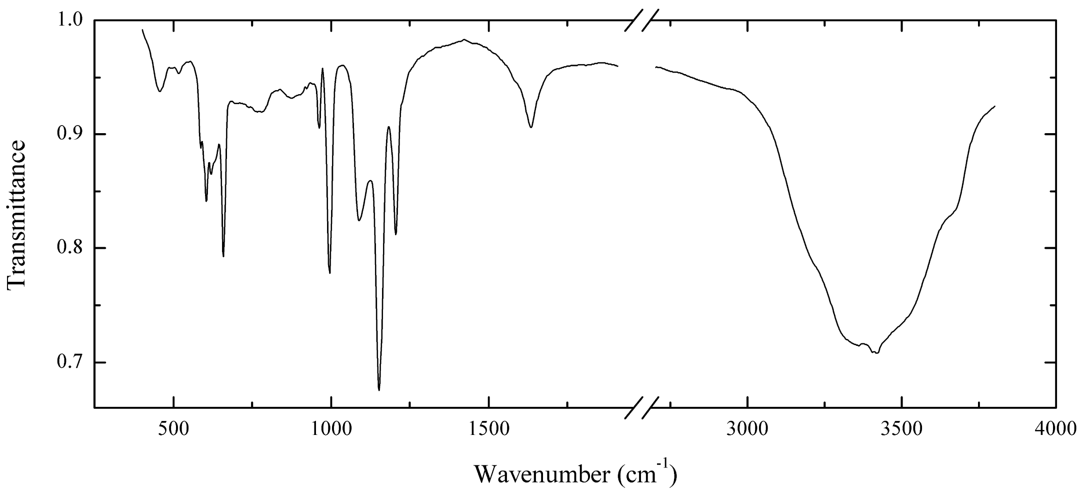


Locality: Chile (type locality?).

Description: Yellow granular aggregate. Specimen No. 1/12721 from the Mining Museum, St. Petersburg Mining Institute.

Wavenumbers (cm^{-1}): 3410sh, 3200, 3050sh, 1700sh, 1660, 1620sh, 1180sh, 1170, 1109s, 1068s, 1025sh, 1013, 945, 830, 695, 660, 605sh, 593, 575sh, 484, 450sh.

S127 Poitevinite $Cu(SO_4) \cdot H_2O$

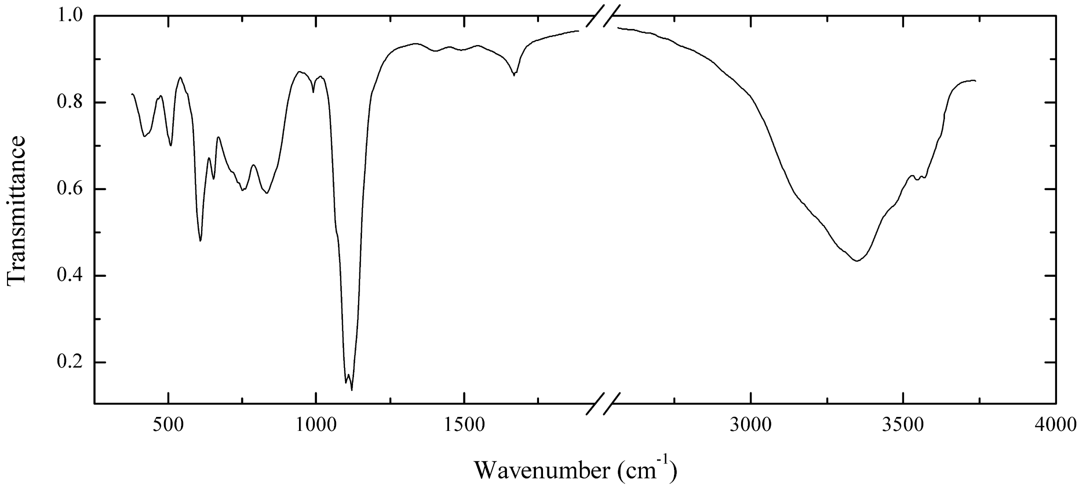


Locality: Beryozovsk, Middle Urals, Russia.

Description: Yellow crust. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3630sh, 3480sh, 3400s, 3340, 3200sh, 1625, 1204, 1154s, 1093, 996s, 962, 875w, 775w, 659s, 630sh, 617, 604, 586, 515w, 457.

S128 Orthoserpierite $CaCu^{2+}_4(SO_4)_2(OH)_6 \cdot 3H_2O$

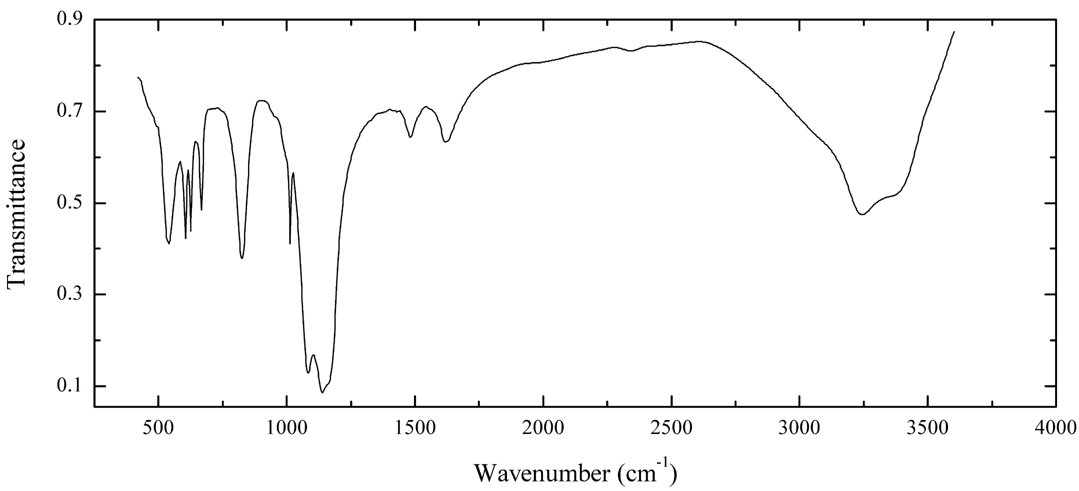


Locality: Childs-Aldwinkle mine, Copper Creek, Bunker Hill district, Galiuro Mts., Pinal Co., Arizona, USA.

Description: Blue crystalline crust. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ca_{1.00}Cu_{3.91}Mg_{0.09}(SO_4)_{2.00}(OH)_6 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3620sh, 3570, 3545, 3470sh, 3350, 3200sh, 1670, 1490w, 1405w, 1123s, 1103s, 1070sh, 990w, 830, 754, 705sh, 653, 606, 600sh, 504, 431.

S129 Szomolnokite $Fe^{2+}(SO_4) \cdot H_2O$

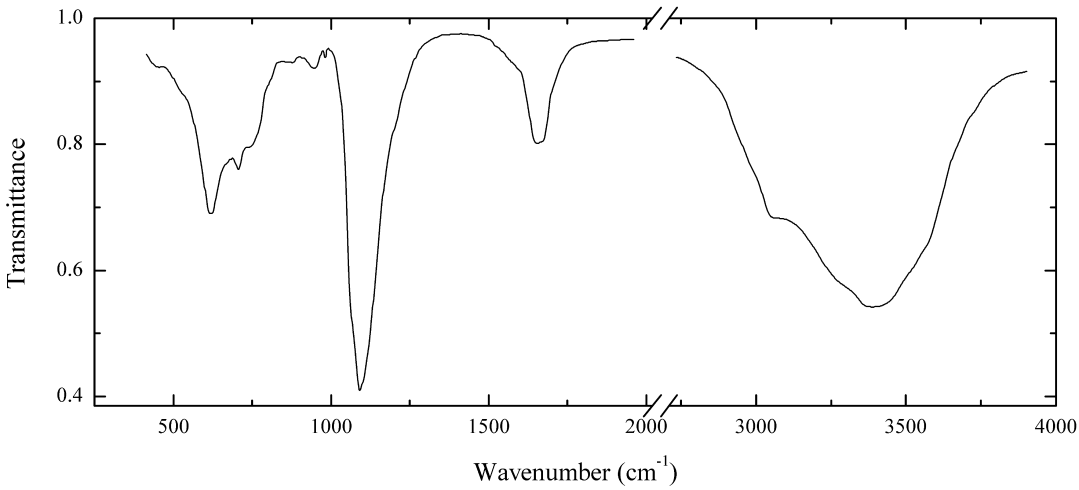


Locality: Joe Bishop mine, White Canyon district, San Juan Co., Utah, USA.

Description: Pale yellow crust. Identified by IR spectrum and qualitative electron microprobe analysis.

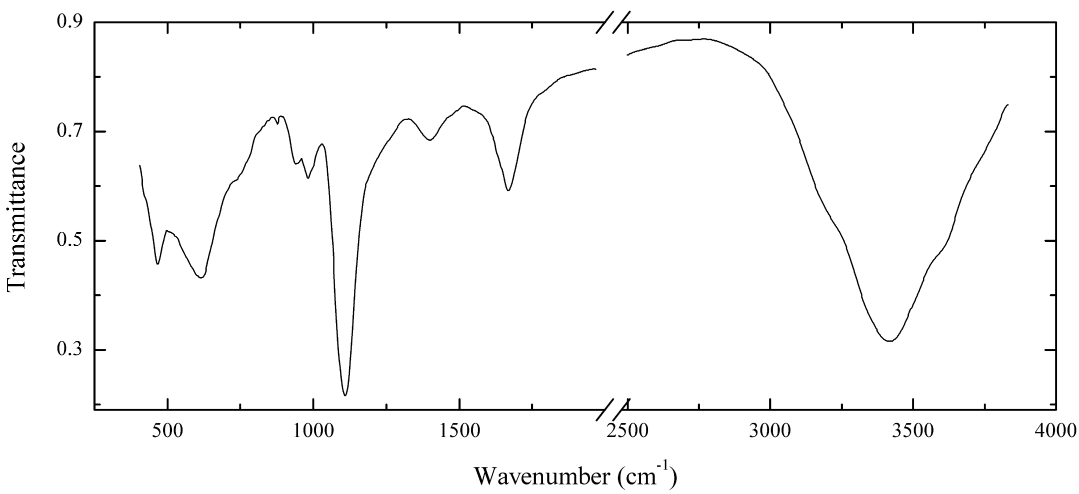
Wavenumbers (cm^{-1}): 3380sh, 3245, 3060sh, 2340w, 1630, 1490, 1170sh, 1144s, 1088s, 1017, 827, 667, 626, 604, 536.

S130 Svyazhinite $MgAl(SO_4)_2F \cdot 14H_2O$



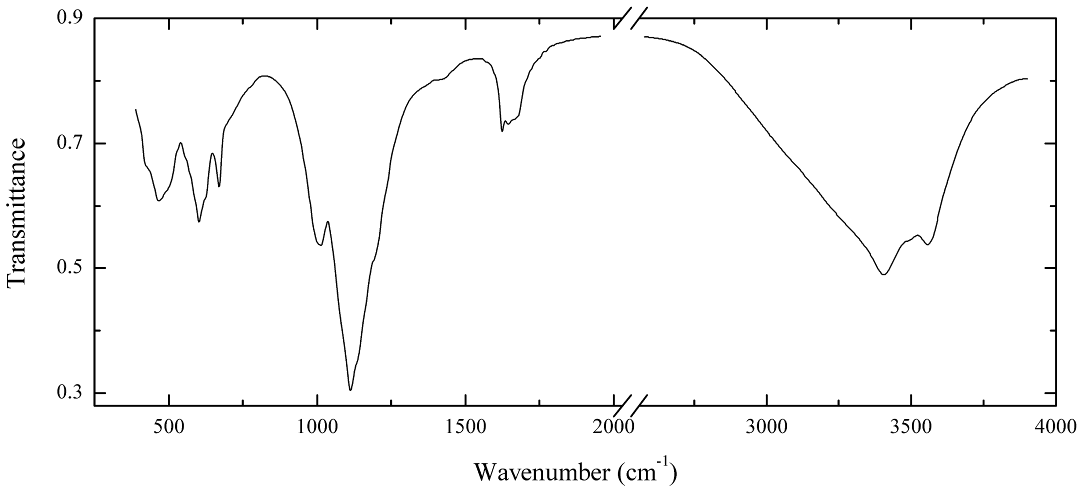
Locality: Ilmeny (Il'menskie) Mts., Chelyabinsk region, South Urals, Russia.
Description: White granular aggregate. The empirical formula is (electron microprobe) $Mg_{0.85}Al_{1.1}(SO_4)_{2.00}(F,OH) \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3550sh, 3375, 3270sh, 3030, 1660, 1094s, 982w, 946w, 742, 703, 621.

S131 Sturmanite $Ca_6(Fe^{3+},Al,Mn^{2+})_2(SO_4)_2[B(OH)_4](OH)_{12} \cdot 25H_2O$



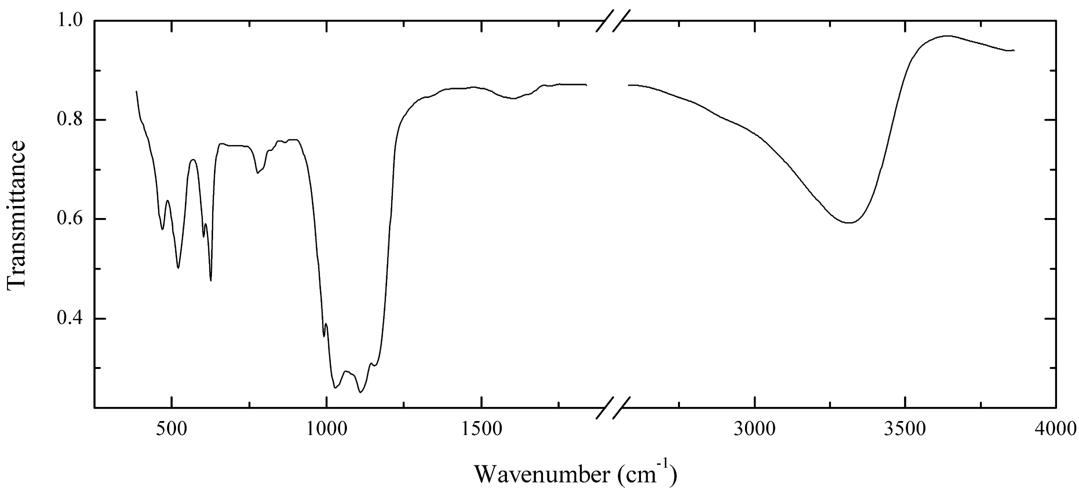
Locality: Wessels mine, Hotazel, Kalahari manganese fields, Northern Cape province, South Africa.
Description: Brownish-yellow semitransparent crystal. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3610sh, 3420s, 3230sh, 1680, 1410, 1113s, 987, 945w, 879w, 750sh, 618s, 595sh, 467.

S132 Slavíkite $NaMg_2Fe^{3+}{}_5(SO_4)_7(OH)_6 \cdot 33H_2O$



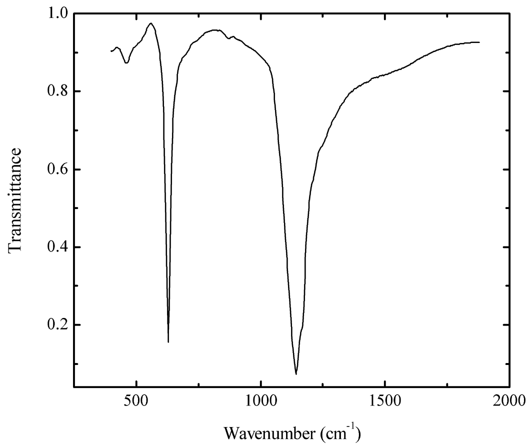
Locality: Valachov Hill, near Skřivany, Bohemia, Czech Republic (type locality).
Description: Yellowish crust. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3535, 3470sh, 3385, 3240sh, 1670sh, 1645, 1622, 1420w, 1190sh, 1130sh, 1115s, 1085sh, 1008, 667, 620sh, 602, 490sh, 473, 420sh.

S133 Beaverite-(Cu) $Pb(Fe,Cu)_3(SO_4)_2(OH,H_2O)_6$



Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.
Description: Olive green powdery from the association with cerussite. The empirical formula is (electron microprobe) $Pb_{1.05}Cu_{1.0}Fe_{1.7}Al_{0.2}Mg_{0.1}[(SO_4)_{1.7}(PO_4)_{0.1}(AsO_4)_{0.1}(SiO_4)_{0.1}](OH,H_2O)_6$.
Wavenumbers (cm^{-1}): 3300, 1602w, 1157s, 1114s, 1031s, 991, 865w, 812w, 785sh, 775, 624, 602, 519, 470.

S135 Sulphohalite $Na_6(SO_4)_2FCl$

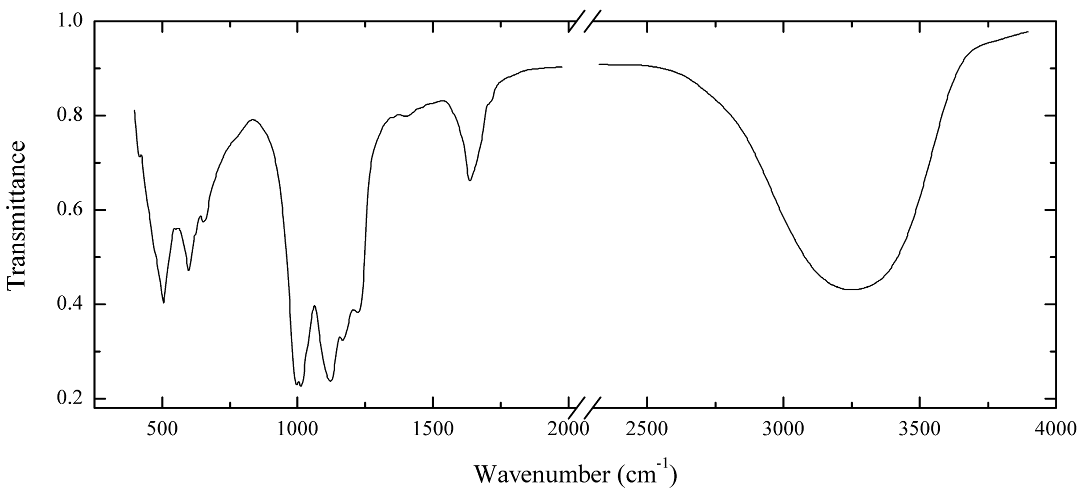


Locality: Searles Lake, San Bernardino Co., California, USA (type locality).

Description: Octahedral crystal from the association with halite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 1160sh, 1140s, 871w, 690sh, 627s, 500sh, 460w.

S136 Butlerite $Fe^{3+}(SO_4)(OH)\cdot 2H_2O$

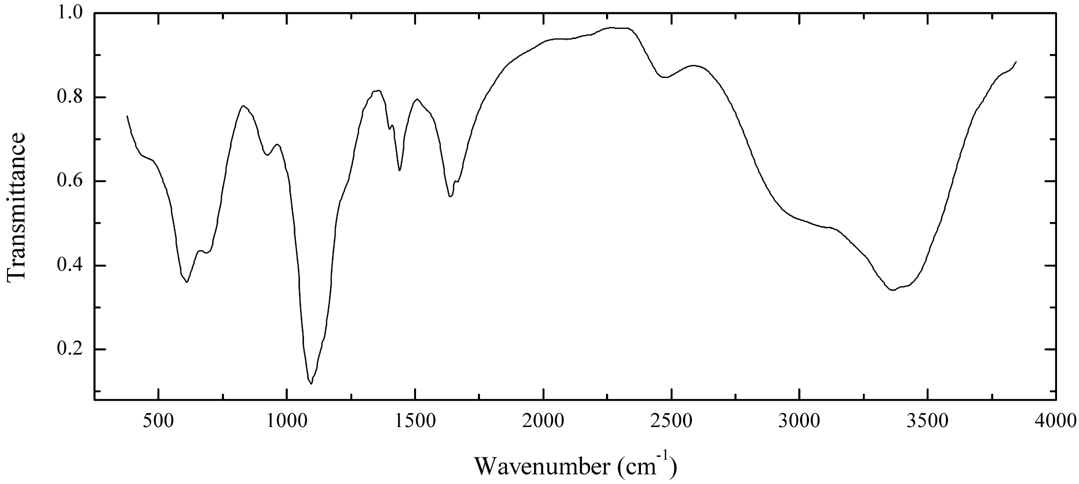


Locality: Chuquicamata copper mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile.

Description: Yellow-orange granular aggregate from the association with copiapite. Identified by IR spectrum, electron microprobe analysis and powder X-ray diffraction pattern. The empirical formula is $Fe_{0.92}Al_{0.03}Mg_{0.02}(SO_4)_{1.00}(OH,H_2O)\cdot nH_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 4.98 (100), 4.75 (60), 3.61 (70), 3.24 (60), 3.16 (90), 3.07 (70), 2.50 (70).

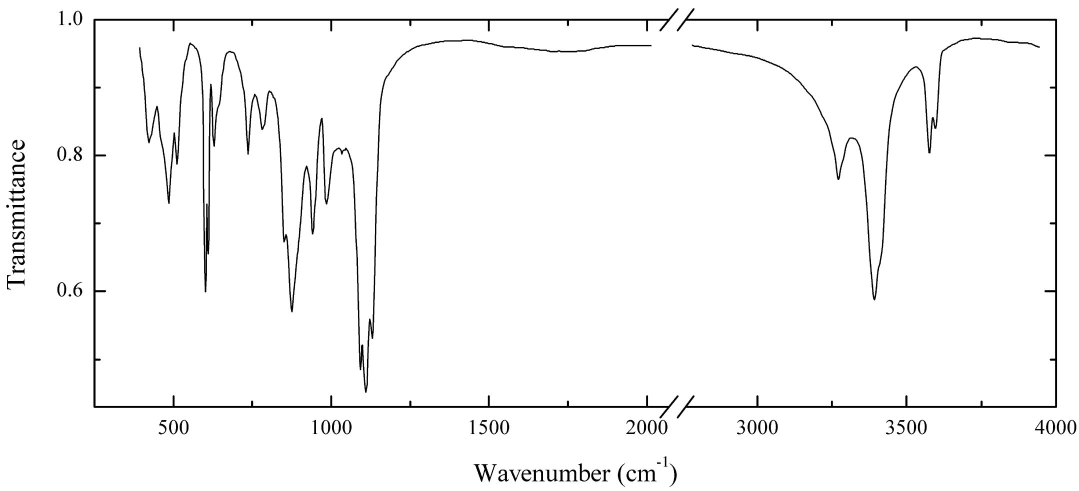
Wavenumbers (cm^{-1}): 3250, 1705sh, 1645, 1400w, 1230, 1168, 1125s, 1011s, 995s, 655, 598, 550, 505, 410.

S137 Tschermigite $(NH_4)Al(SO_4)_2 \cdot 12H_2O$



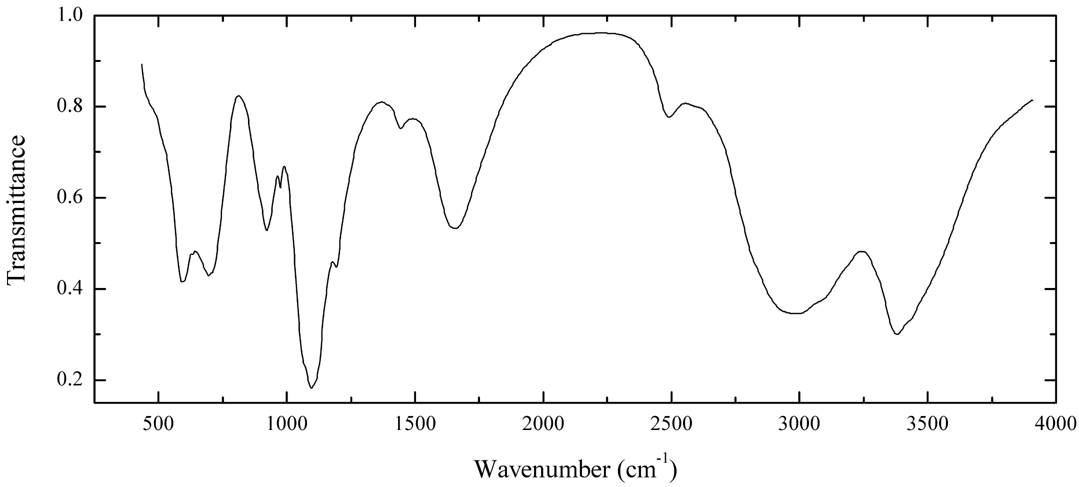
Locality: An unknown locality at Elba Island, Italy.
Description: White granular aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3425sh, 3360s, 3020sh, 2475w, 1665, 1640, 1440, 1400w, 1200sh, 1140sh, 1093s, 925, 682, 605, 450sh.

S138 Brochantite $Cu^{2+}{}_4(SO_4)(OH)_6$



Locality: Majuba Hill mine, Antelope district, Pershing Co., Nevada, USA.
Description: Blue-green powdery aggregate from the association with chrysocolla and malachite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3580, 3560, 3400sh, 3375s, 3255, 1130s, 1107s, 1092s, 1037w, 984, 944, 875s, 853, 782, 735, 640sh, 627, 607, 600s, 510, 484, 470sh, 425.

S139 Kalinite $KAl(SO_4)_2 \cdot 11H_2O$

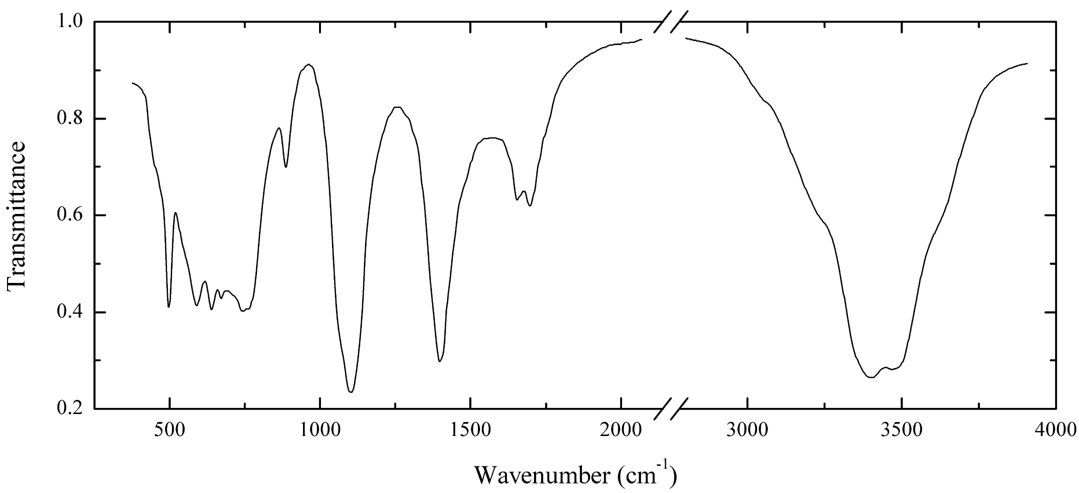


Locality: Duchcov (Dux), Ústí region, Bohemia, Czech Republic.

Description: Colourless crystal. Identified by IR spectrum. NH_4-bearing variety.

Wavenumbers (cm^{-1}): 3500sh, 3400sh, 3355s, 3100sh, 2965s, 2475w, 1650, 1440w, 1195, 1097s, 1070sh, 975, 925, 698, 596, 475sh.

S140 Thaumasite $Ca_6Si_2(CO_3)_2(SO_4)_2(OH)_{12} \cdot 24H_2O$

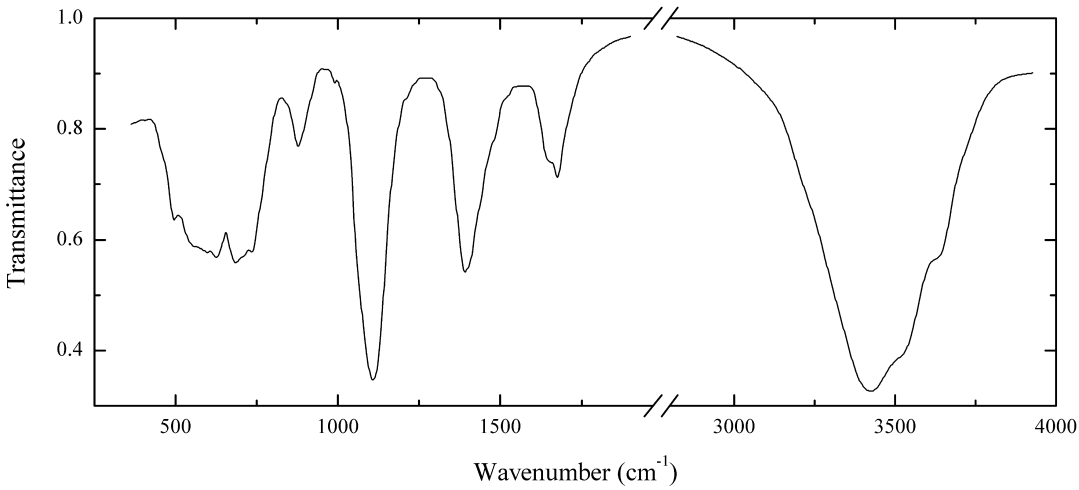


Locality: Uraveli river, near Akhaltsikhe, Georgia.

Description: White granular aggregate from the association with apophyllite and clinoptilolite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{6.00}(Si_{1.84}Al_{0.06}Mg_{0.06})(CO_3)_x(SO_4)_{2.14}(OH,O)_{12} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3630sh, 3480s, 3400s, 3250sh, 3070sh, 1692, 1650, 1394s, 1100s, 887, 764, 749, 674, 639, 589, 498.

S141 Thaumasite $Ca_6Si_2(CO_3)_2(SO_4)_2(OH)_{12}{\cdot}24H_2O$

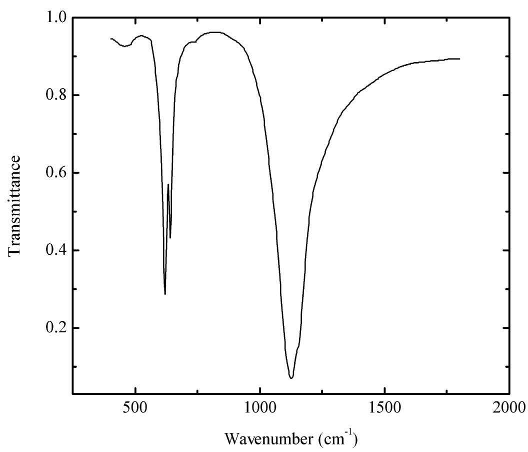


Locality: Yukspor Mt., Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia.

Description: Colourless acicular crystals from the association with tobermorite. CO_3- and Si-deficient variety. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3620sh, 3500sh, 3410s, 1680, 1650sh, 1399s, 1111s, 992w, 878, 727, 705sh, 685, 625, 600sh, 570sh, 496.

S142 Thenardite $Na_2(SO_4)$

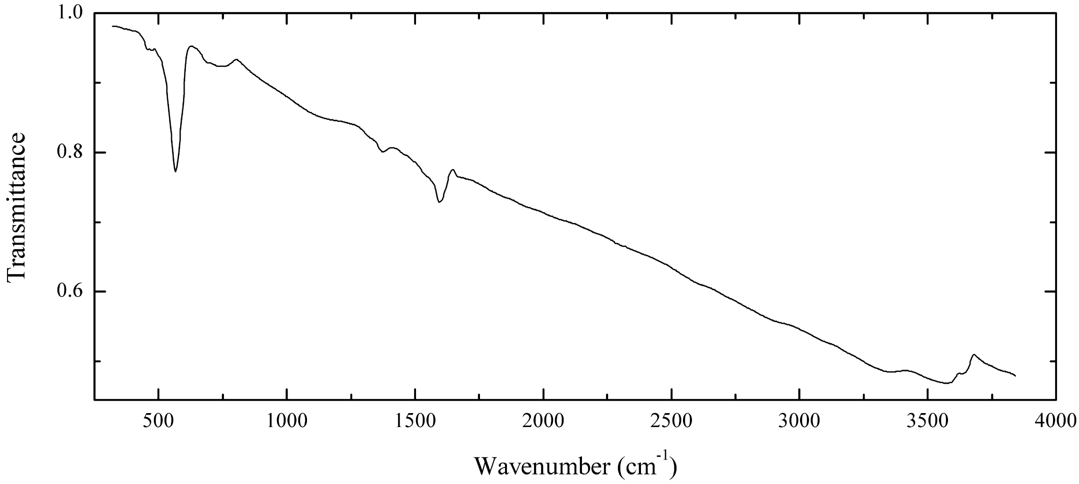


Locality: Searles Lake, San Bernardino Co., California, USA.

Description: Colourless grains from the association with sborgite. Specimen No. 79230 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Identified by IR spectrum.

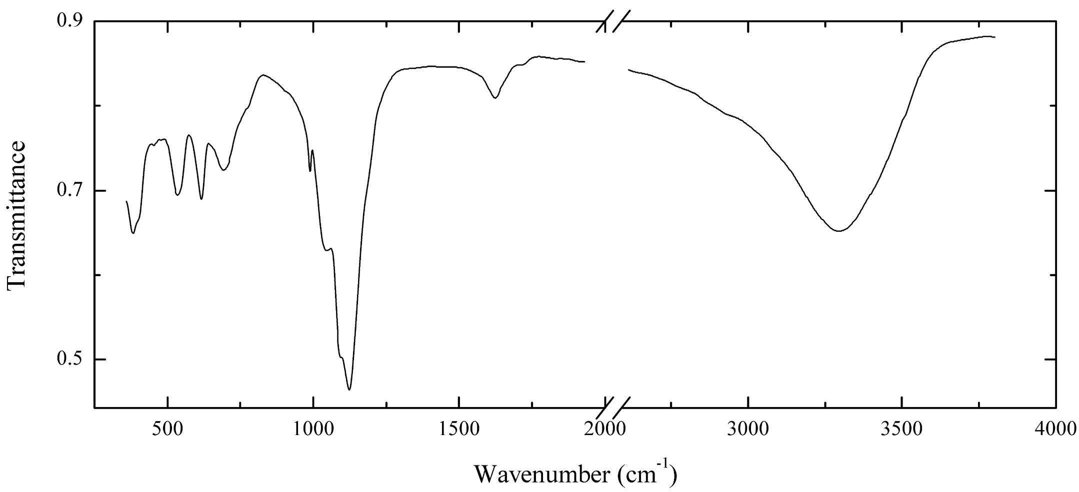
Wavenumbers (cm^{-1}): 1155sh, 1129s, 638, 616s, 460w.

S143 Tochilinite $6(FeS)\cdot5[Mg(OH)_2]$



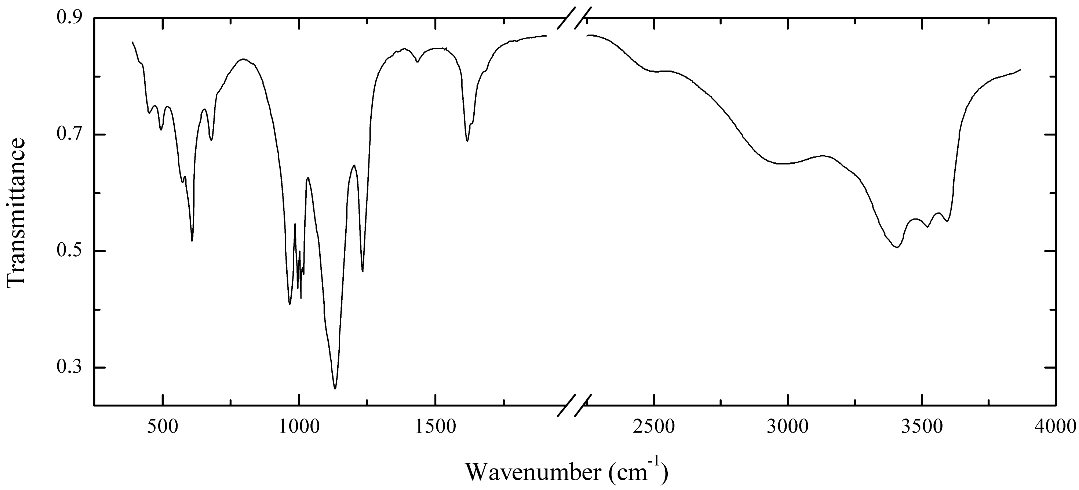
Locality: Udachnaya kimberlite pipe, Sakha Republic (Yakutia), Siberia, Russia.
Description: Black acicular crystals. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3620, 3555, 3335, 1598, 1370, 1190w, 740w, 690sh, 565s, 470w.

S144 Fleischerite $Pb_3Ge(SO_4)_2(OH)_6\cdot3H_2O$



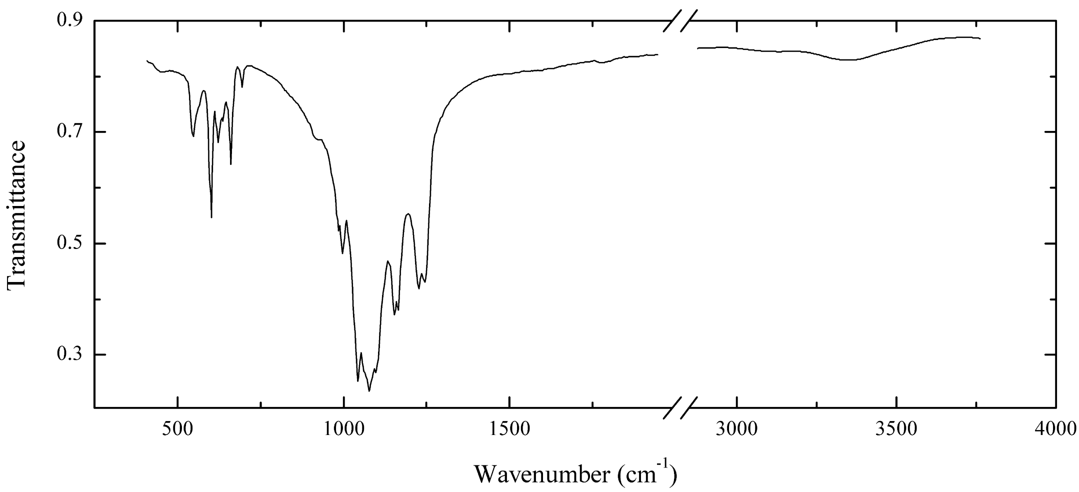
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: Colourless acicular crystals from the association with cerussite and mimetite. The empirical formula is $Pb_{3.1}Ge_{1.1}(SO_4)_{1.9}(OH,O)_6\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3290, 1700w, 1618w, 1185sh, 1124s, 1100sh, 1043, 989, 760sh, 691, 617, 550, 400sh, 373.

S145 Ferrinatrite $Na_3Fe^{3+}(SO_4)_3 \cdot 3H_2O$



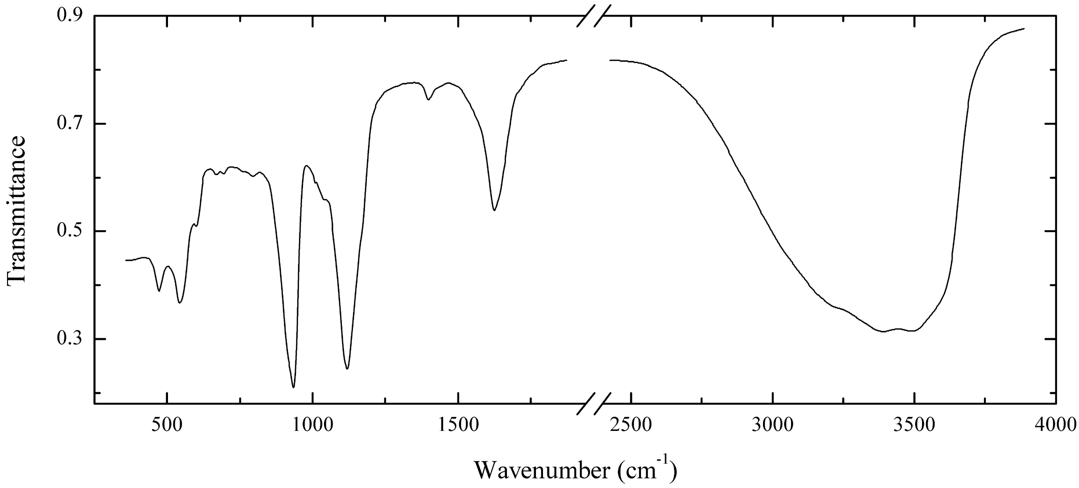
Locality: Le Cetine mine, Chiusdino, Siena province, Tuscany, Italy.
Description: White spherulites from the association with sideronatrite.
Wavenumbers (cm^{-1}): 3584, 3510, 3400, 2970, 2485w, 1685sh, 1635, 1618, 1439w, 1229, 1133s, 1060sh, 1014, 1005s, 995, 967s, 679, 670sh, 606, 575, 490, 451, 390sh.

S146 Fedotovite $K_2Cu^{2+}{}_3(SO_4)_3O$



Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia (type locality).
Description: Bright green crystals from the association with bonattite. The empirical formula is $(K_{1.7}Na_{0.2})Cu_{2.9}(SO_4)_{3.0}(O,OH)$.
Wavenumbers (cm^{-1}): 3320w, 1615w, 1241, 1223, 1157, 1148, 1094s, 1073s, 1060sh, 1041s, 993, 982, 920, 693w, 658, 633w, 620, 600, 546, 450w.

S147 Uranopilite $(UO_2)_6(SO_4)(OH)_{10}\cdot 12H_2O$

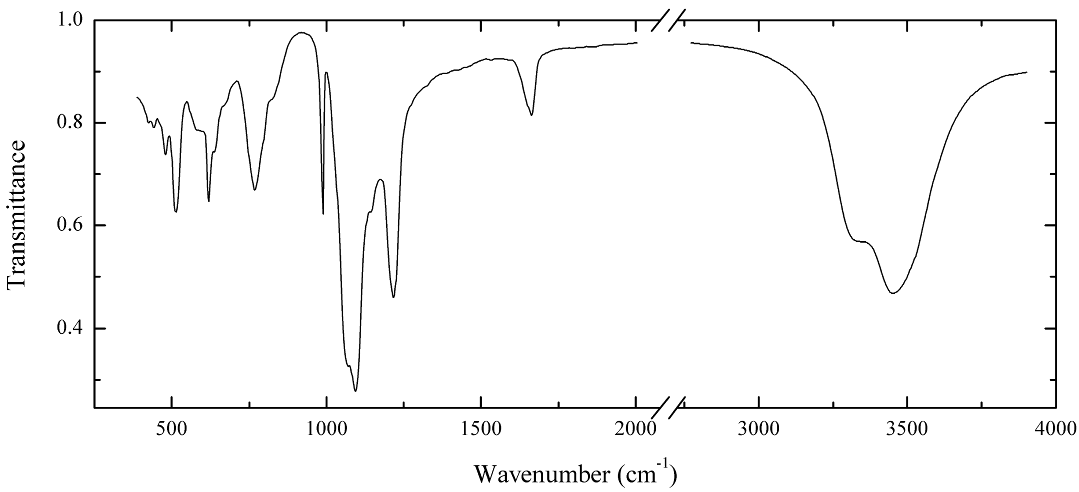


Locality: Jáchymov, Bohemia, Krušné Hory Mts. (Ore Mts.), Czech Republic.

Description: Bright yellow spherulites. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3550sh, 3480s, 3380s, 3230sh, 1626, 1400w, 1119s, 1110sh, 1040sh, 1010w, 925s, 910sh, 780w, 695w, 665w, 600, 585sh, 540, 470.

S148 Uklonskovite $NaMg(SO_4)F\cdot 2H_2O$

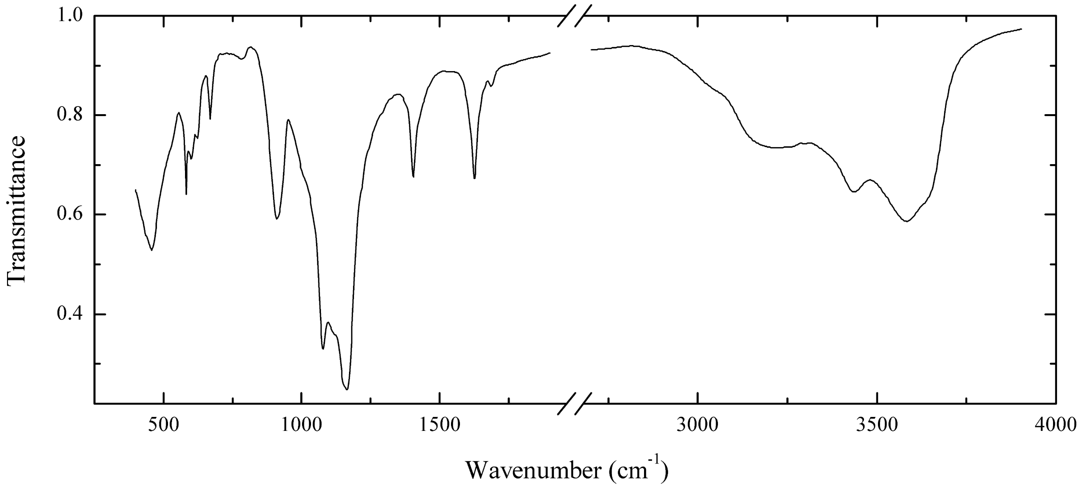


Locality: Kushkanatau salt deposit, lower Amu Darya River, Karakalpakstan, Uzbekistan (type locality).

Description: Flattened prismatic crystals. Holotype sample. Monoclinic, space group $P2_1/m$, $a = 7.202(1)$, $b = 7.214(1)$, $c = 5.734(1)$ Å, $\beta = 113.23(1)°$, $Z = 2$. $D_{meas} = 2.42$ g/cm^3, $D_{calc} = 2.414$ g/cm^3. Optically biaxial (+), $\alpha = 1.476(1)$, $\gamma = 1.500(1)$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 6.608 (78), 5.270 (60), 3.505 (100), 3.309 (46), 3.154 (56), 3.008 (46), 2.970 (54).

Wavenumbers (cm^{-1}): 3430, 3320, 1665, 1219s, 1155sh, 1095s, 1072s, 988, 820sh, 768, 670sh, 640, 621, 595sh, 515, 483, 445w, 426w.

S149 Zippeite $K_{2-4}(UO_2)_6(SO_4)_3(OH)_{8-10}\cdot 4H_2O$ (?)

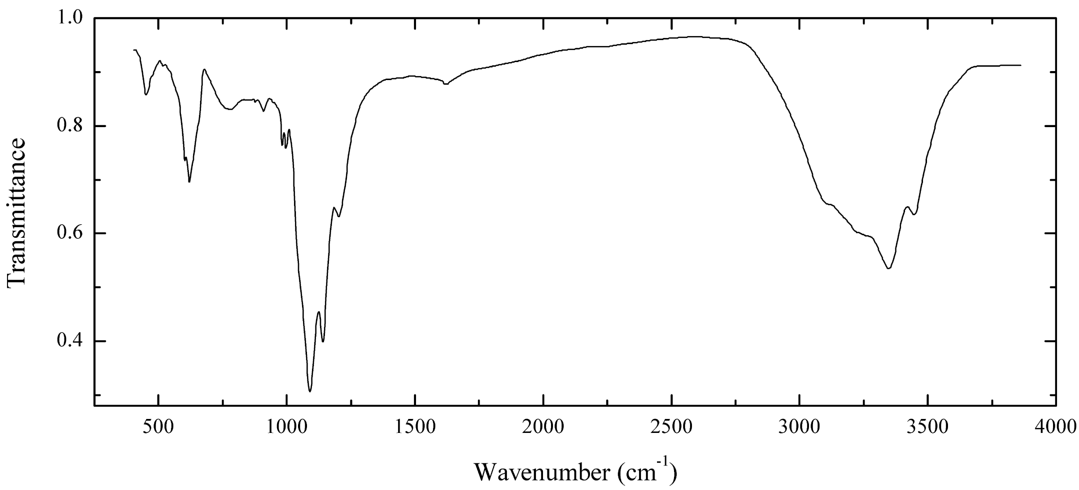


Locality: An unknown locality in Central Kazakhstan.

Description: Yellow crusts. Investigated by G.A. Sidorenko.

Wavenumbers (cm^{-1}): 3620sh, 3565, 3405, 3200, 3020sh, 1685w, 1623, 1402, 1160s, 1145sh, 1115sh, 1074s, 1010sh, 908, 780w, 668, 623, 600, 581, 455, 440sh.

S150 Cyanochroite $K_2Cu^{2+}(SO_4)_2\cdot 6H_2O$

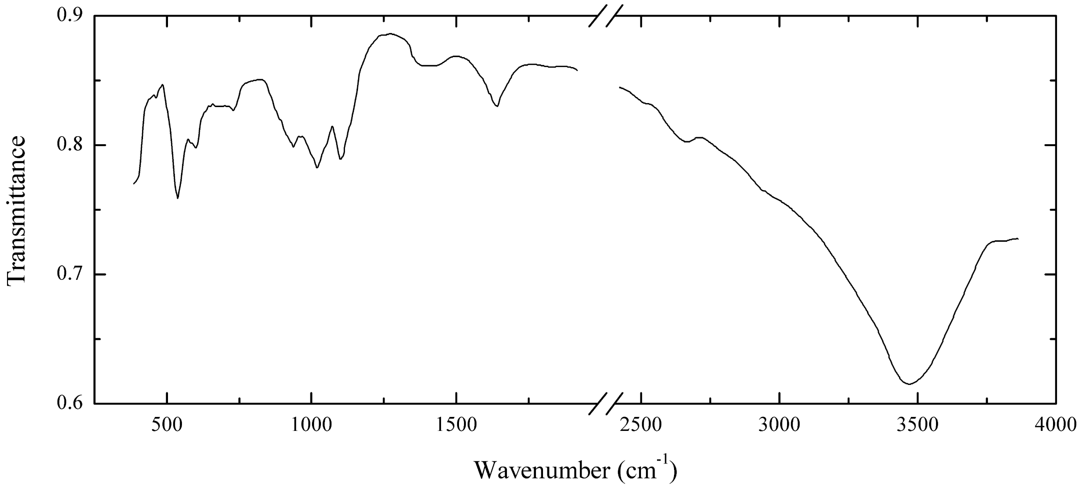


Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: Light green pseudomorphs after piypite crystals. The empirical formula is $K_{1.96}(Cu_{0.89}Mg_{0.13})(SO_4)_{2.00}\cdot nH_2O$. Confirmed by powder X-ray diffraction pattern.

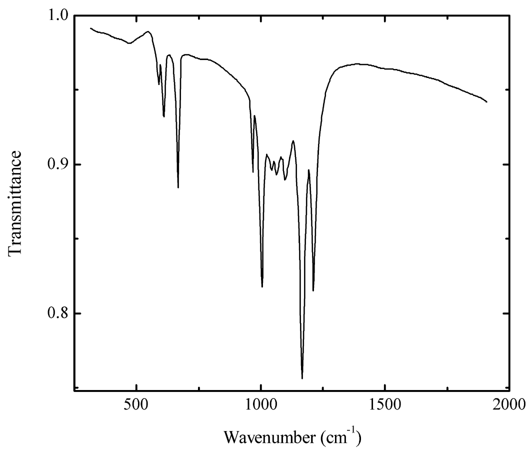
Wavenumbers (cm^{-1}): 3445, 3345, 3250sh, 3110sh, 1625w, 1212, 1145s, 1094s, 1070sh, 999, 984, 894w, 778w, 750w, 650sh, 618, 598, 451.

S151 Kyrgyzstanite $ZnAl_4(SO_4)(OH)_{12}{\cdot}3H_2O$



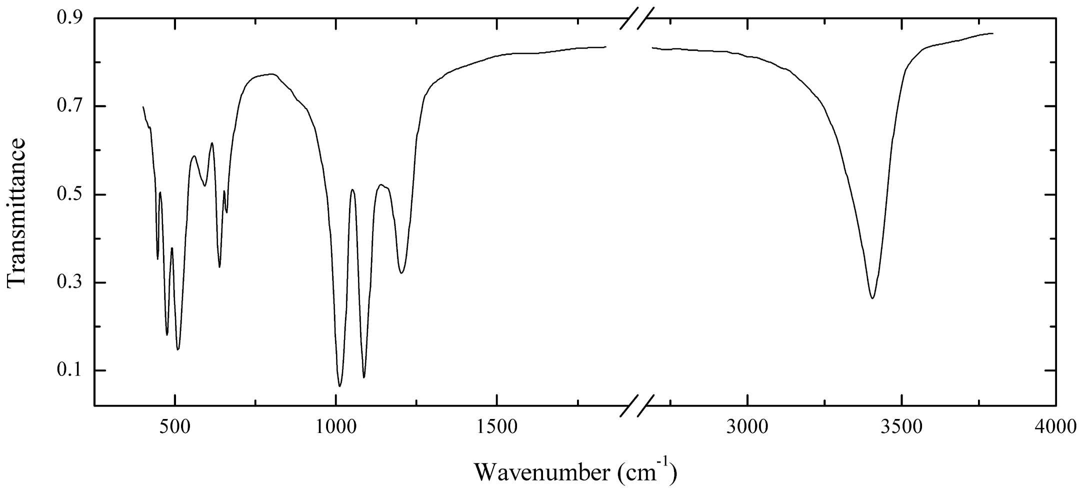
Locality: Kara-Tangi U deposit, Batken region, Kyrgyzstan (type locality).
Description: Pale blue crust from the association with allophane and böhmite. Confirmed by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Zn_{0.75}Ni_{0.33}Cu_{0.02})(Al_{3.88}Fe_{0.02})[(SO_4)_{0.93}(SiO_4)_{0.02}(VO_4)_{0.01}(NO_4)_x](OH)_{12}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3450s, 2655w, 1633, 1430sh, 1375, 1106s, 1023s, 937, 725, 601, 540s, 465w.

S153 Chlorothionite $K_2Cu^{2+}(SO_4)Cl_2$



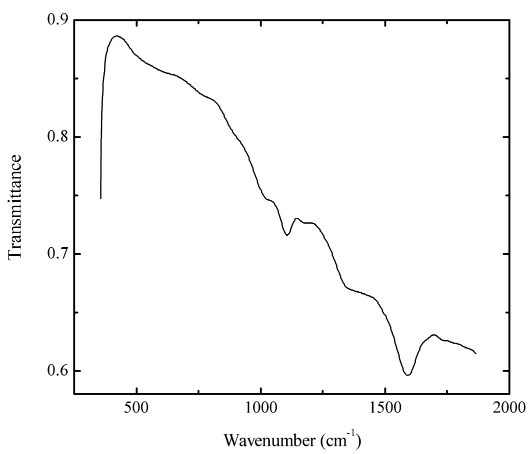
Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.
Description: Green crust. Confirmed by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 1208s, 1162s, 1098w, 1059w, 1040w, 999s, 964, 662, 605, 588.

S154 Jarosite $KFe^{3+}_3(SO_4)_2(OH)_6$



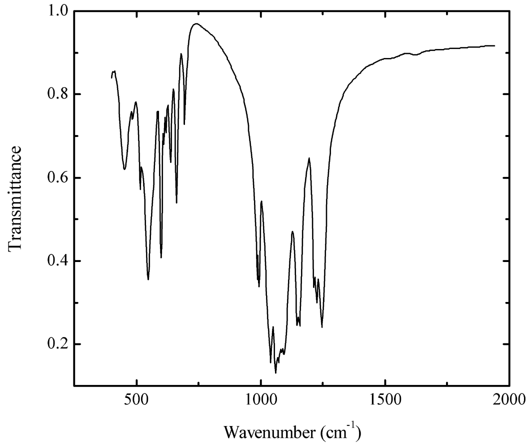
Locality: Sainte-Lucie mine, St. Léger-de-Peyre, Marvejols, Lozère, Languedoc-Roussillon, France.
Description: Brownish-yellow fine-grained aggregate. The empirical formula is (electron microprobe) $H_x(K_{0.76}Na_{0.14}Pb_{0.02})(Fe_{2.94}Al_{0.05}Zn_{0.01})(SO_4)_{2.00}(OH)_6$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3390, 1207, 1084s, 1009s, 660, 636, 591, 507s, 473s, 445, 410sh.

S155 Erdite $NaFeS_2{\cdot}2H_2O$



Locality: Coyote Peak, near Orick, Humboldt Co., California, USA (type locality).
Description: Black flattened prismatic crystal. Specimen No. 80141 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.
Wavenumbers (cm^{-1}): 1597s, 1360, 1105, 1018, 510sh.

S156 Euchlorine $KNaCu^{2+}{}_3(SO_4)_3O$

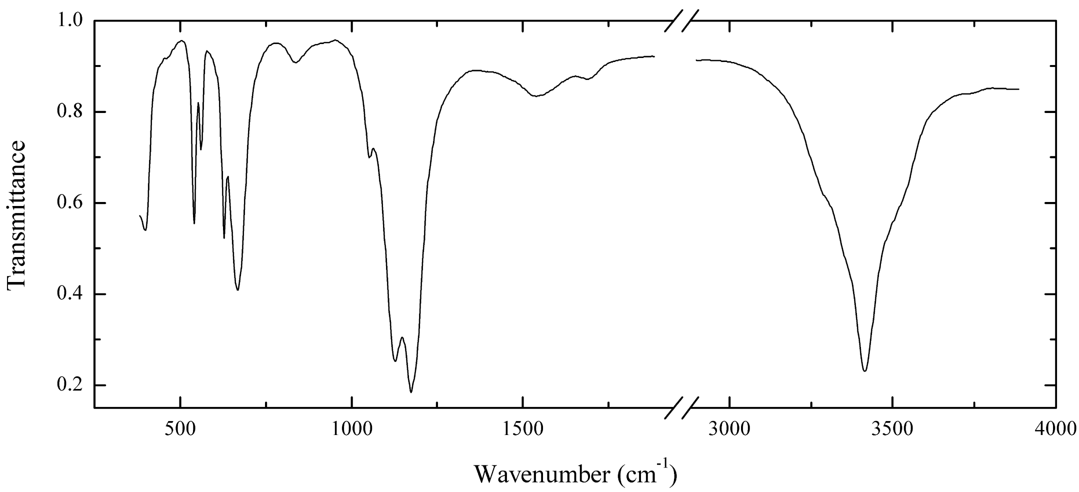


Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: Bright green crystals from the association with dolerophanite and chalcocyanite. The empirical formula is (electron microprobe) $K_{1.08}Na_{0.83}Cu_{3.05}(SO_4)_{3.00}O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1247s, 1223, 1211, 1159s, 1149s, 1096s, 1090sh, 1073s, 1060s, 1040s, 993, 987, 695, 662, 636, 618w, 609w, 599, 545, 516, 484w, 451.

S157 Schaurteite $Ca_3Ge(SO_4)_2(OH)_6{\cdot}3H_2O$

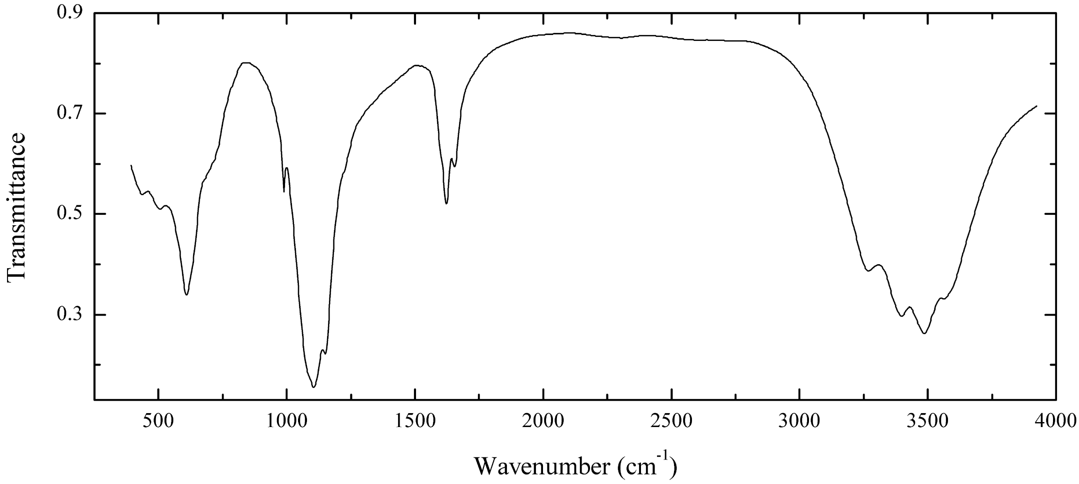


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).

Description: White fibrous aggregate from the association with germanite. The empirical formula is (electron microprobe) $(Ca_{2.90}Mg_{0.11}K_{0.03}Pb_{0.02})Ge_{1.00}(SO_4)_{2.00}(OH,O)_6{\cdot}nH_2O$.

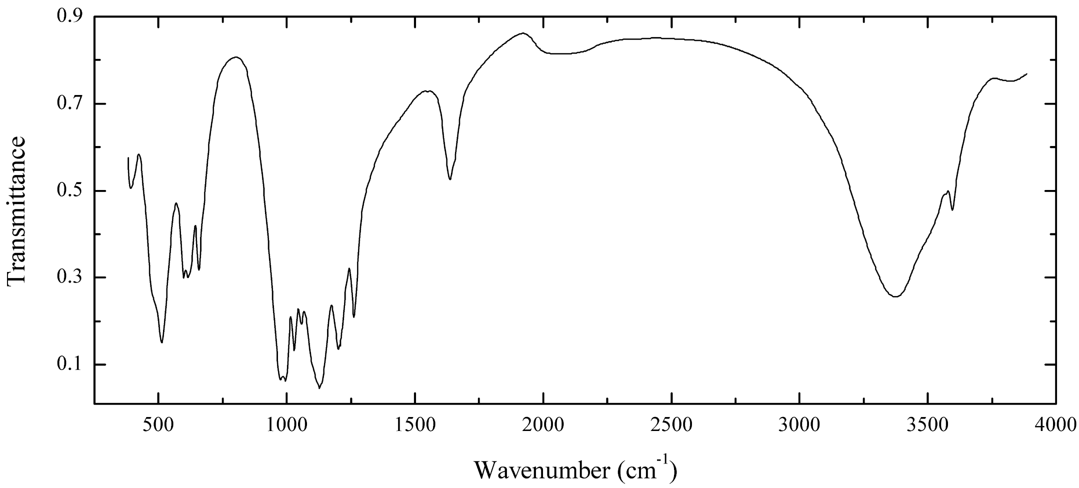
Wavenumbers (cm^{-1}): 3510sh, 3412s, 3300sh, 1690w, 1537w, 1117s, 1131s, 1056, 843w, 667, 628, 559, 540, 395.

S160 Rozenite $Fe(SO_4){\cdot}4H_2O$



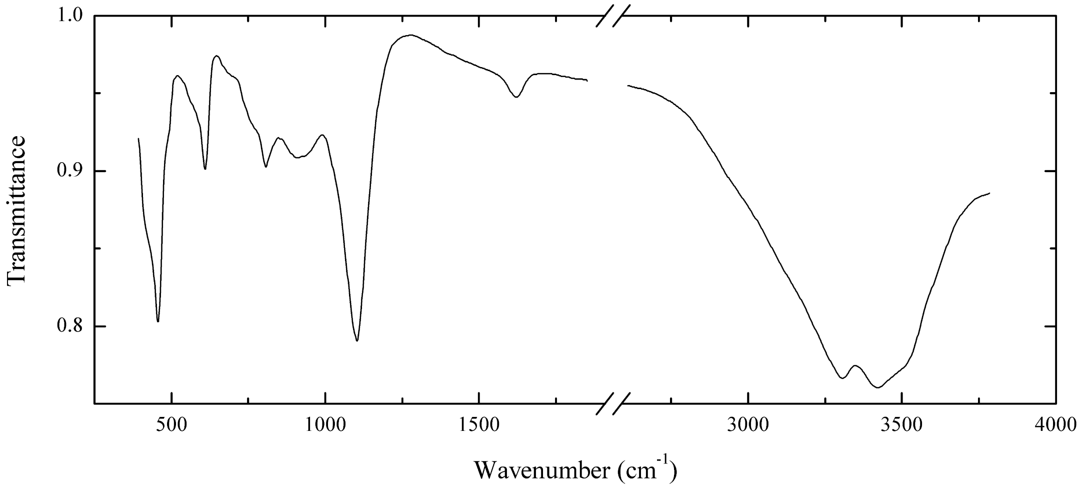
Locality: Mikhailovskiy mine, Zheleznogorsk, Kursk region, Russia.
Description: White crust on pyrite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3545, 3460s, 3370, 3240, 1655, 1620, 1148s, 1105s, 1085sh, 988, 700sh, 611, 503, 436.

S161 Metasideronatrite $Na_2Fe^{3+}(SO_4)_2(OH){\cdot}1.5H_2O$



Locality: Namib lead mine, Swakopmund, Erongo region, Namibia.
Description: Orange crust from the association with sideronatrite and natrojarosite. The empirical formula is (electron microprobe) $Na_{2.2}Fe_{0.9}(SO_4)_{2.0}(OH)_{1-x}{\cdot}nH_2O$. Confirmed by powder X-ray diffraction pattern. Contains admixture of sideronatrite.
Wavenumbers (cm^{-1}): 3597, 3380, 2150sh, 2040w, 1644, 1267, 1201s, 1129s, 1058, 1031s, 998s, 976s, 670sh, 656, 625sh, 612, 597, 510s, 480sh, 405.

S162 Spangolite $Cu^{2+}{}_6Al(SO_4)(OH)_{12}Cl{\cdot}3H_2O$

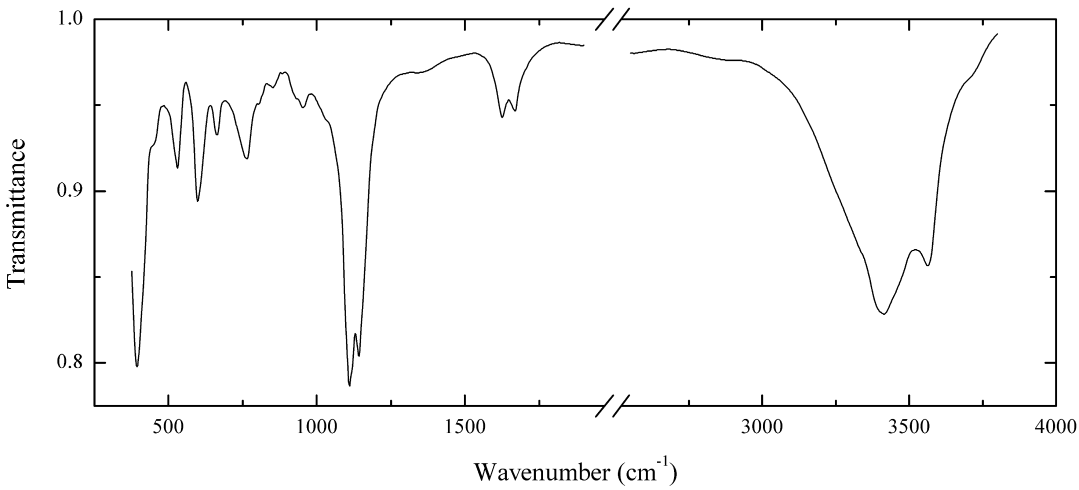


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Green-blue crystals from the association with cyanotrichite. The empirical formula is (electron microprobe) $Cu_{5.4}Zn_{0.3}Al_{1.2}(SO_4)_{1.0}(OH)_{12.1}Cl_{0.9}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3490sh, 3400, 3280, 1618w, 1099s, 958, 910sh, 808, 770sh, 605, 485sh, 453s, 420sh.

S163 Shigaite $NaAl_3Mn^{2+}{}_6(SO_4)_2(OH)_{18}{\cdot}12H_2O$

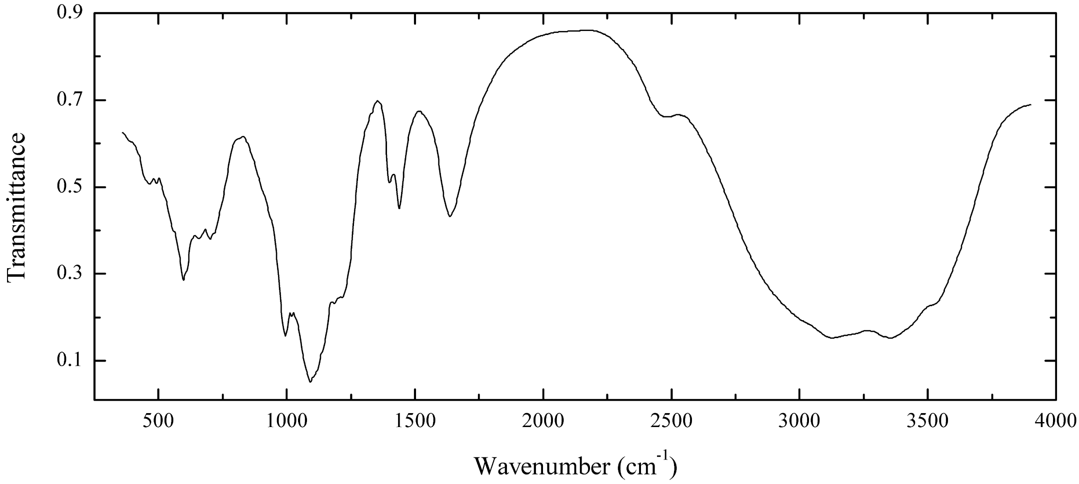


Locality: N'Chwaning mine, Kuruman, Kalahari manganese fields, Northern Cape province, South Africa.

Description: Yellow transparent crystals from the association with rhodochrosite and gypsum. Na-deficient variety or Na-deficient analogue of shigaite. The empirical formula is (electron microprobe) $Na_{0.1}(Al_{2.6}Mg_{0.15}Fe_{0.1})Mn_{6.0}(SO_4)_{2.0}(OH,H_2O)_x$.

Wavenumbers (cm^{-1}): 3540, 3390s, 3280sh, 1655, 1620, 1370w, 1141s, 1113s, 1015sh, 953, 849w, 770, 667, 603, 528, 460sh, 395s.

S165 Lonecreekite $(NH_4)(Fe^{3+},Al)(SO_4)_2{\cdot}12H_2O$

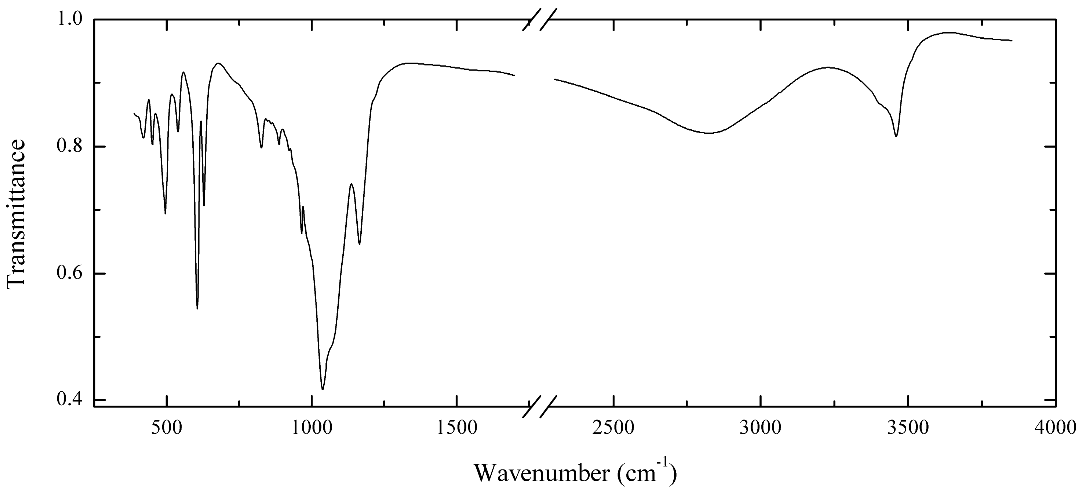


Locality: Copiapó, Chile.

Description: Yellow massive, from the association with copiapite. The empirical formula is (electron microprobe) $(NH_4)_x(Fe_{1.02}Al_{0.14})[(SO_4)_{1.97}(SiO_4)_{0.03}]{\cdot}nH_2O$. Contains admixture of copiapite.

Wavenumbers (cm^{-1}): 3515sh, 3335s, 3120s, 2460w, 1640, 1441, 1402, 1210, 1175, 1090s, 1017, 996s, 700, 653, 605sh, 595, 555sh, 495, 465.

S166 Linarite $PbCu^{2+}(SO_4)(OH)_2$

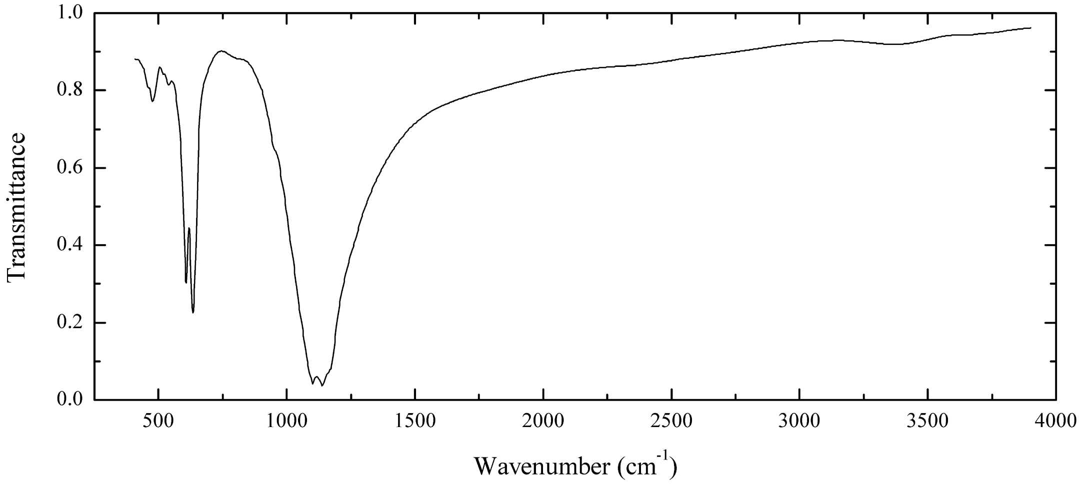


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Blue granular aggregate from the association with malachite and arsentsumebite. Identified by IR spectrum and semiquantitative electron microprobe analysis (Pb:Cu:S $\approx$ 1:1:1).

Wavenumbers (cm^{-1}): 3440, 3400sh, 2810, 1165, 1070sh, 1038s, 980sh, 965, 888w, 828, 628, 604s, 538, 496, 449, 424.

S167 Glauberite $Na_2Ca(SO_4)_2$

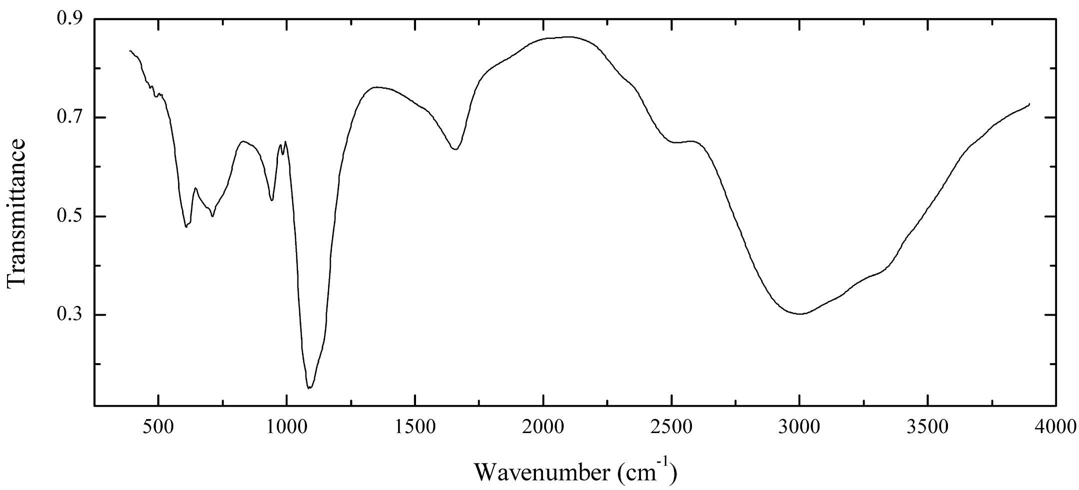


Locality: Westeregeln, Stassfurt potash deposit, Saxony-Anhalt, Germany.

Description: Colourless grains. The empirical formula is (electron microprobe) $Na_{2.04}Ca_{0.98}(SO_4)_{2.00}$.

Wavenumbers (cm^{-1}): 3395w, 1160sh, 1136s, 1102s, 640sh, 632, 607, 543w, 476w.

S168 Alum-(Na) $NaAl(SO_4)_2 \cdot 12H_2O$

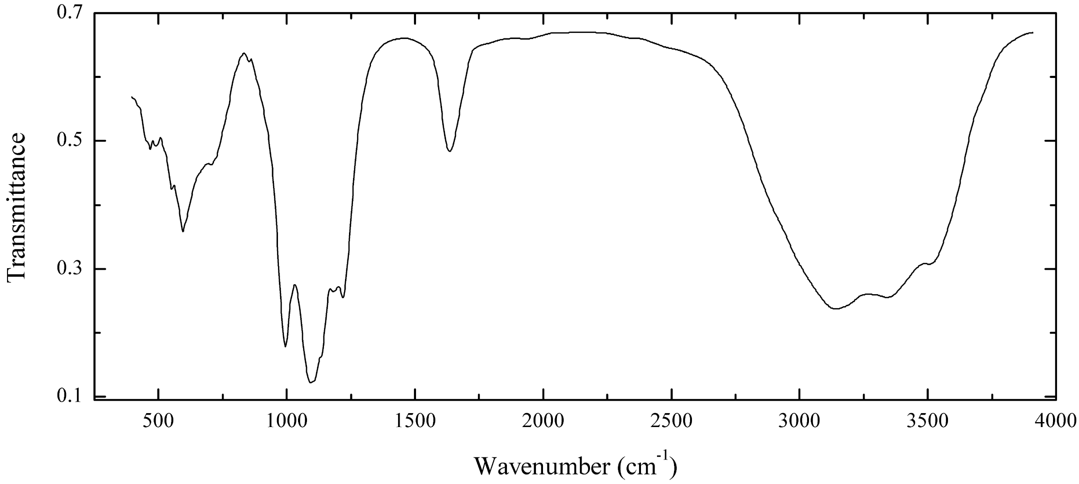


Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: White granular aggregate. The empirical formula is (electron microprobe) $Na_{0.96}Al_{1.015}(SO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3320sh, 3000s, 2560, 1675, 1140sh, 1092s, 990w, 945, 740sh, 710, 610, 494w.

S169 Copiapite $Fe^{2+}Fe^{3+}_4(SO_4)_6(OH)_2 \cdot 20H_2O$

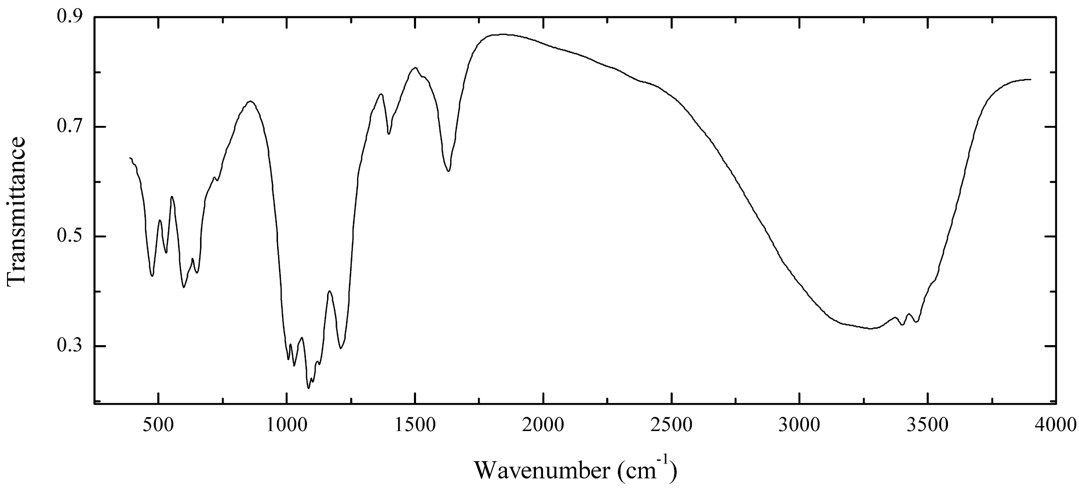


Locality: Caracoles, Sierra Gorda district, Antofagasta province, Chile.

Description: Orange-brown granular aggregate. The empirical formula is (electron microprobe) $Fe_{0.86}(Fe_{3.96}Al_{0.04})(SO_4)_{6.00}(OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3525, 3340s, 3140s, 1640, 1222, 1185, 1135sh, 1096s, 995s, 705, 594, 551, 490, 468.

S170 Hohmannite $Fe^{3+}_2(SO_4)_2O_2 \cdot 8H_2O$

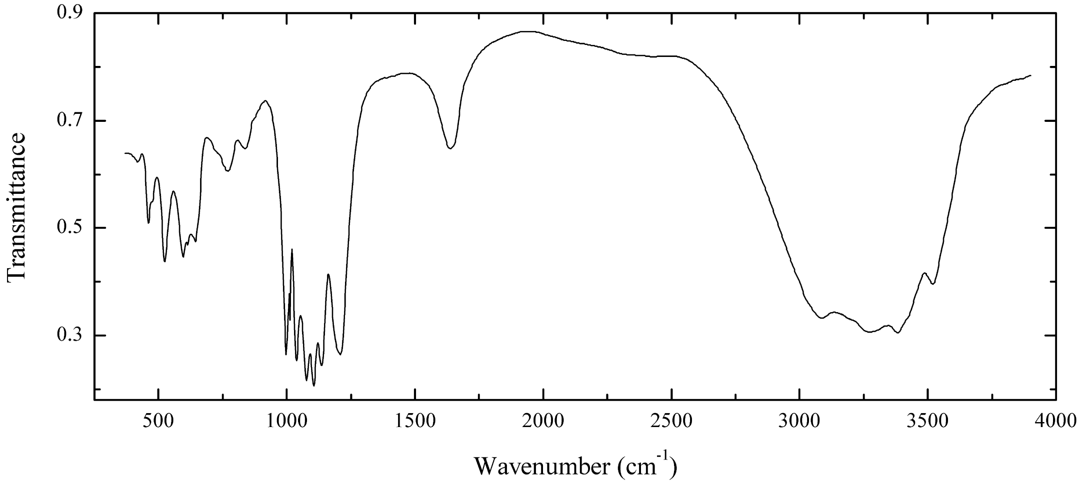


Locality: Caracoles, Sierra Gorda district, Antofagasta province, Chile.

Description: Orange granular aggregate.

Wavenumbers (cm^{-1}): 3525sh, 3415, 3400, 3290, 1637, 1403w, 1215, 1130s, 1104s, 1088s, 1030s, 1006s, 995sh, 728, 648, 597, 529, 474.

S171 Amarantite $Fe^{3+}{}_2(SO_4)_2O \cdot 7H_2O$

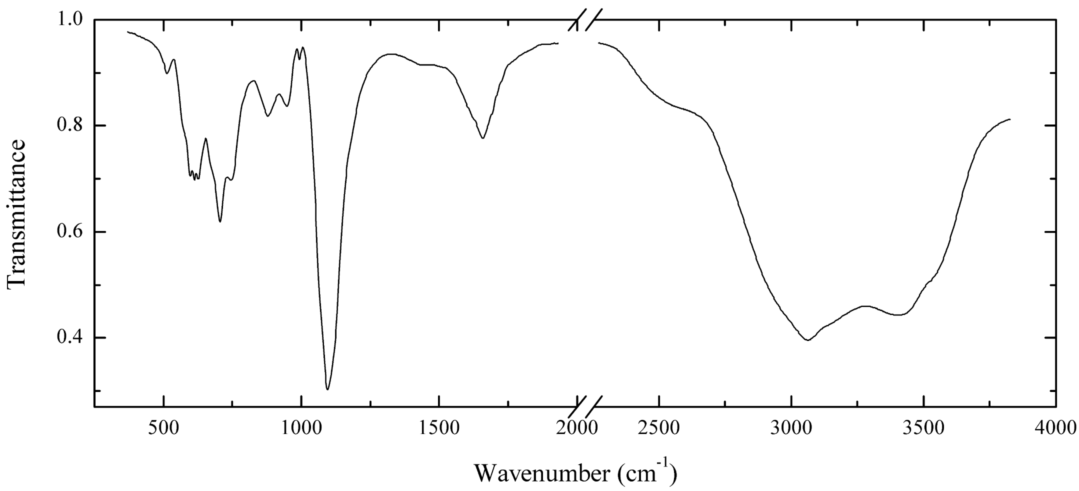


Locality: Caracoles, Sierra Gorda district, Antofagasta province, Chile (type locality).

Description: Red crystals from the association with copiapite. Confirmed by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3525, 3385s, 3270s, 3080s, 2400w, 1648, 1208s, 1138s, 1107s, 1080s, 1040s, 1015, 999s, 837, 774, 730sh, 645, 614, 596, 522, 475sh, 459, 420w.

S172 Khademite $Al(SO_4)F \cdot 5H_2O$

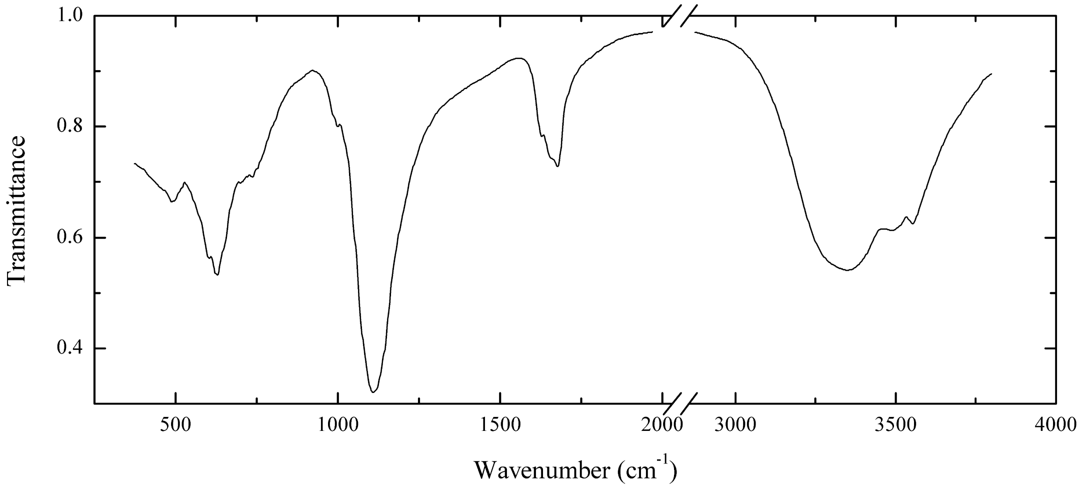


Locality: Kladno (Schöller) mine, Libušin, Kladno, Central Bohemia, Czech Republic (type locality).

Description: White granular aggregate from the association with pickeringite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500sh, 3400, 3035s, 2940sh, 2580sh, 1660, 1445w, 1095s, 992w, 948, 883, 743, 705, 627, 610, 594, 580sh, 513w.

S173 Goslarite $Zn(SO_4)\cdot 7H_2O$

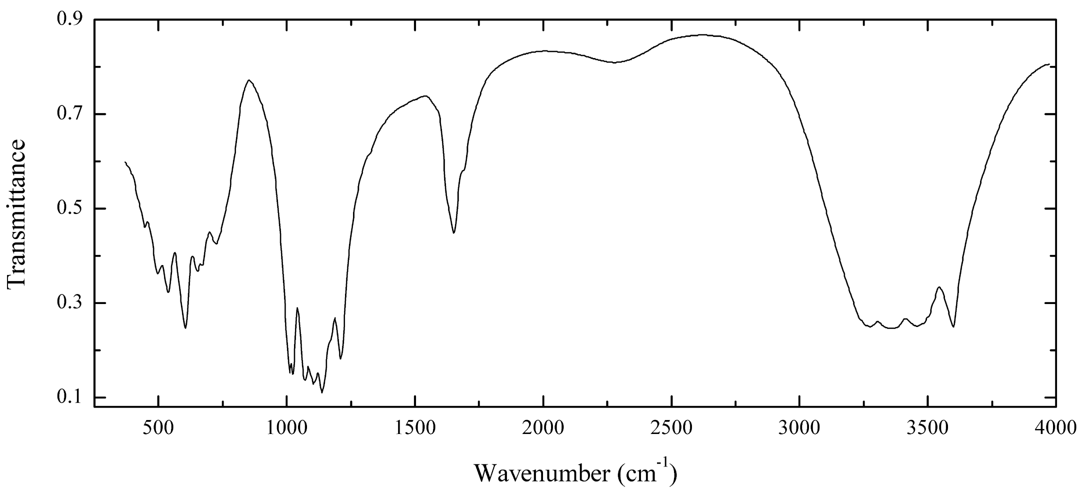


Locality: Rammelsberg mine, near Goslar, Harz, Germany (type locality).

Description: White powdery aggregate. The empirical formula is (electron microprobe) $(Zn_{0.5}Fe_{0.3}Mg_{0.2})(SO_4)_{1.0}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3545, 3480, 3340, 3270sh, 1685, 1660sh, 1633, 1110, 1001w, 725sh, 627, 602, 492.

S174 Botryogen $MgFe^{3+}(SO_4)_2(OH)\cdot 7H_2O$

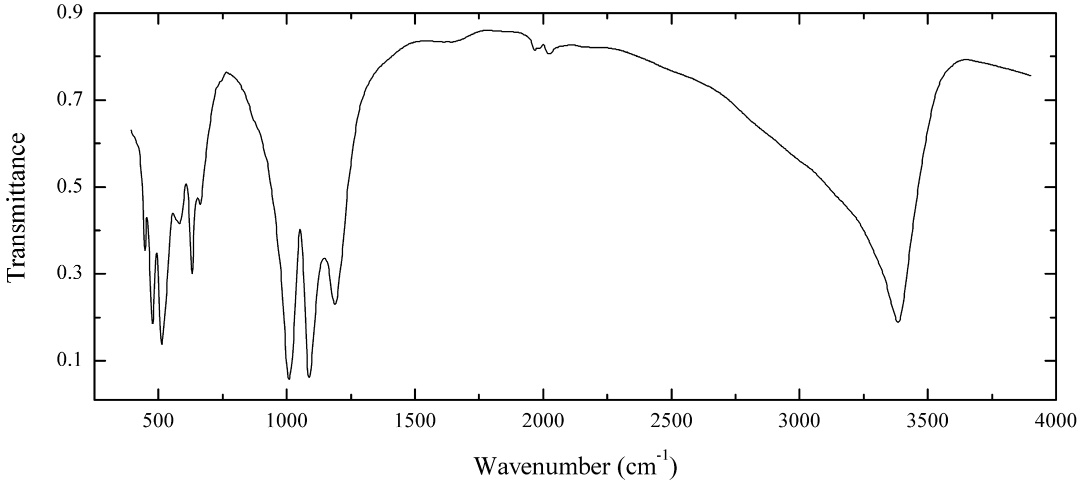


Locality: Queténa Mine, Toki Cu deposit, Calama, El Loa province, Antofagasta region, Chile.

Description: Orange-red crystals. The empirical formula is (electron microprobe) $Mg_{0.9}Fe_{1.0}Al_{0.05}(SO_4)_{2.0}(OH)\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3574s, 3435s, 3330s, 3250s, 2250w, 1690sh, 1650, 1625sh, 1212s, 1165sh, 1137s, 1107s, 1070s, 1024s, 1004s, 721, 670, 651, 605, 538, 492, 446.

S175 Jarosite $KFe^{3+}_3(SO_4)_2(OH)_6$

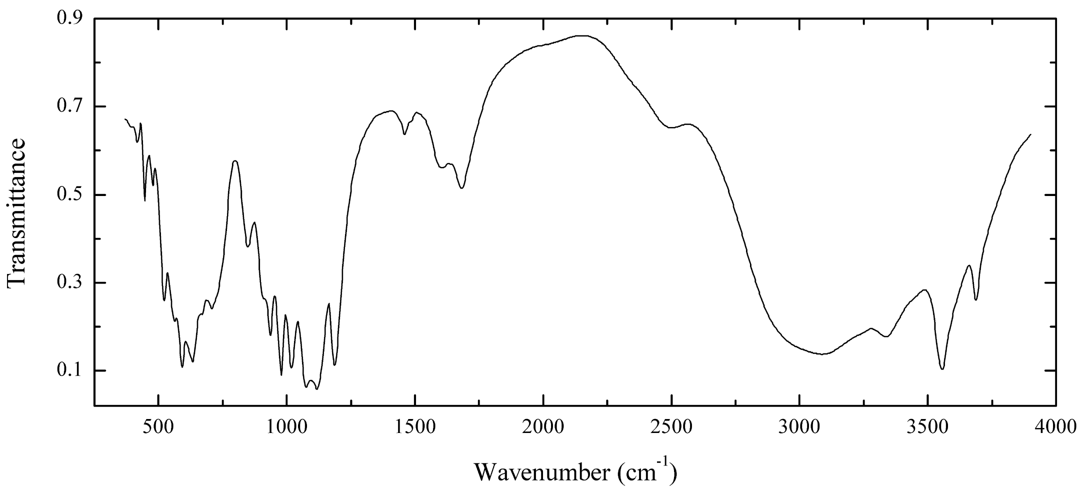


Locality: Caracoles, Sierra Gorda district, Antofagasta province, Chile.

Description: Yellow fine-grained aggregate. The empirical formula is (electron microprobe) $(K_{0.87}Na_{0.09})(Fe_{2.94}Al_{0.04})(SO_4)_{2.00}(OH,H_2O)_6$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3375s, 3000sh, 2011w, 1953w, 1645w, 1615sh, 1187, 1085s, 1005s, 662, 629, 585, 570sh, 511s, 475s, 446.

S177 Mangazeite $Al_2(SO_4)(OH)_4{\cdot}3H_2O$

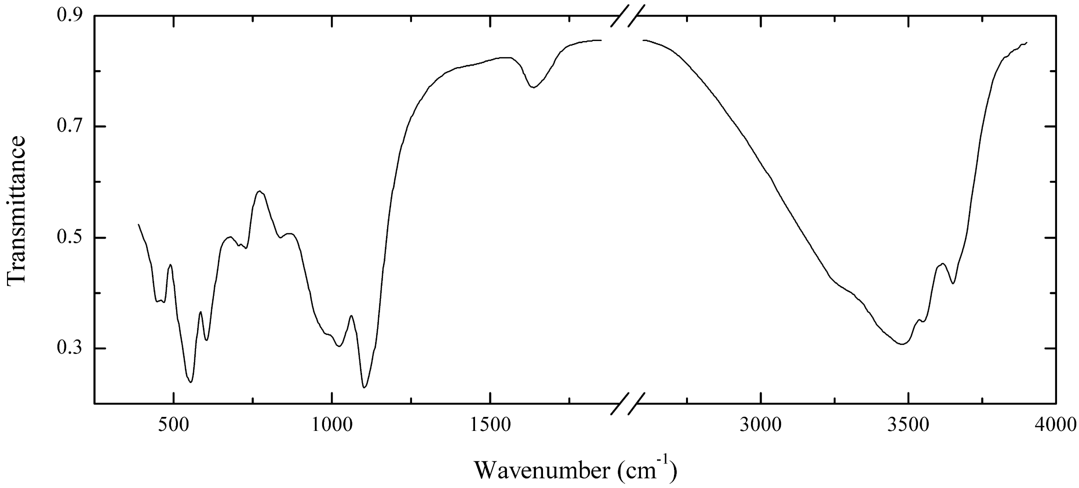


Locality: Mangazeiskoe silver deposit, eastern Sakha Republic (Yakutia), Siberia, Russia (type locality).

Description: White radial aggregates from the association with gypsum, pyrite, arsenopyrite and clinochlore. Material from the authors of the first description of mangazeite, confirmed by powder X-ray diffraction pattern. However IR spectrum differs from the published spectrum of mangazeite holotype.

Wavenumbers (cm^{-1}): 3675, 3547s, 3325, 3075, 2950sh, 2485w, 1685, 1610, 1463w, 1186s, 1117s, 1076s, 1019s, 979s, 935, 915sh, 849, 709, 660sh, 630s, 590s, 562, 520, 475w, 443, 415w.

S179 Chalcoalumite $Cu^{2+}Al_4(SO_4)(OH)_{12}\cdot 3H_2O$

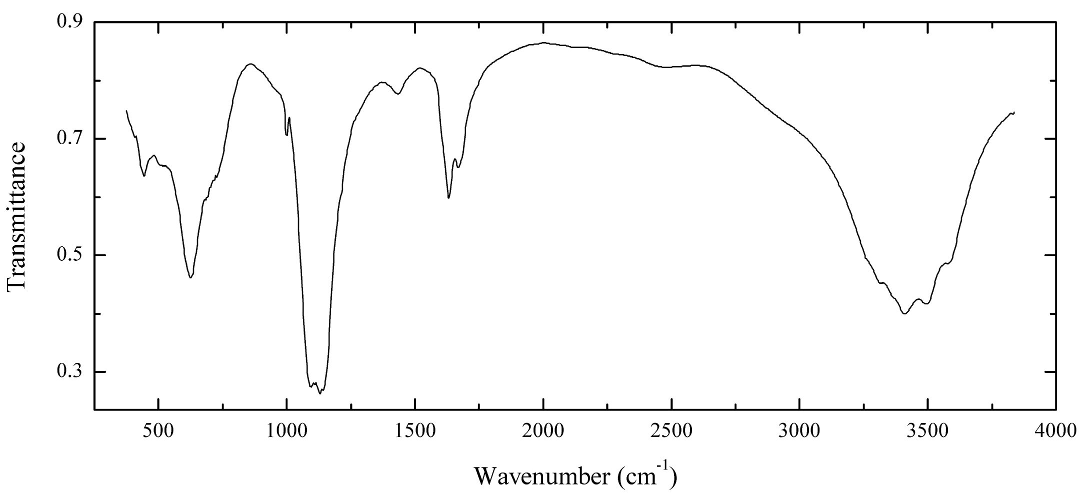


Locality: Grand Reef (Aravaipa) mine, Laurel canyon, Grand Reef Mt., Klondyke, Santa Teresa Mts., Aravaipa district, Graham Co., Arizona, USA.

Description: Light blue botryoidal aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3630, 3520s, 3455s, 3270sh, 1635, 1101s, 1022s, 980sh, 840, 726, 707, 600, 548s, 469, 452.

S180 Starkeyite $Mg(SO_4)\cdot 4H_2O$

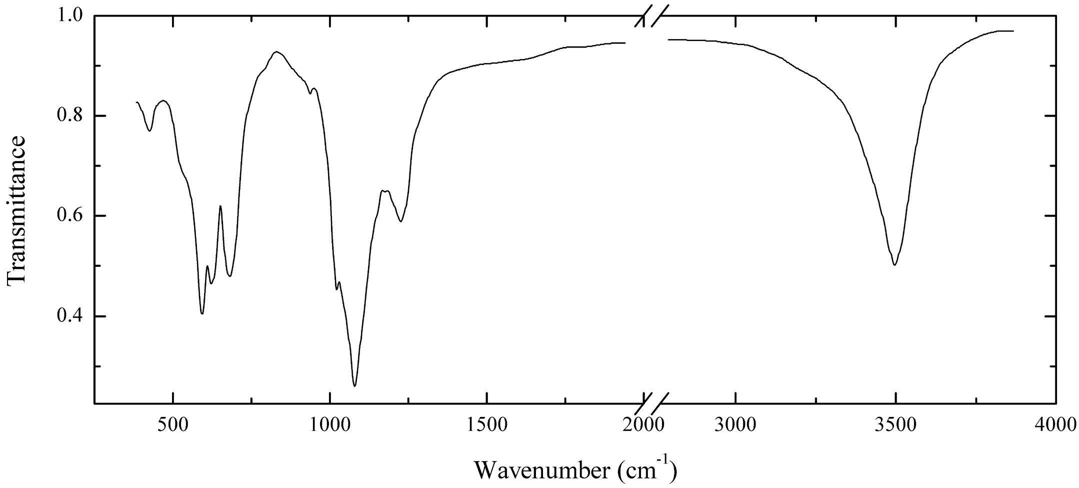


Locality: Smolník (Szomolnok) mine, Smolník mining district, Gelnica Co., Košice region, Slovakia.

Description: Beige fine-grained aggregate forming concretion. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 6.74 (32), 5.38 (59), 6.68 (28), 4.43 (100), 3.93 (62), 3.38 (51), 3.20 (33), 2.93 (47).

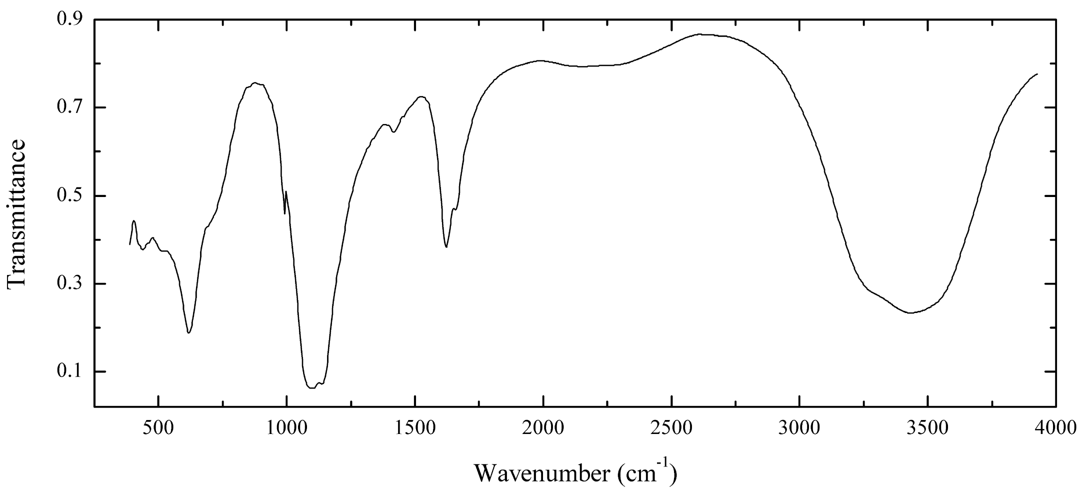
Wavenumbers (cm^{-1}): 3570, 3480, 3395s, 3290, 2900sh, 2480w, 1670, 1635, 1430w, 1130s, 1095s, 997, 720sh, 685sh, 624, 510sh, 445.

S181 Alunite $KAl_3(SO_4)_2(OH)_6$



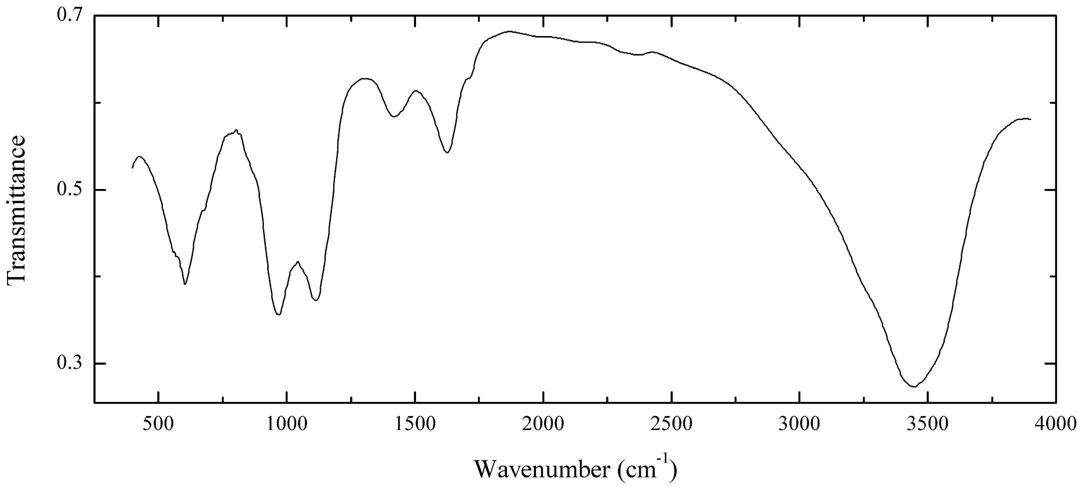
Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.
Description: Cream-coloured crusts from the association with kaolinite, kingite and variscite. The empirical formula is (electron microprobe) $(K_{0.79}Na_{0.08}Ca_{0.06})(Al_{2.96}Fe_{0.06})(SO_4)_{2.00}(OH)_6$.
Wavenumbers (cm^{-1}): 3485, 1225, 1160w, 1078s, 1024s, 938w, 680, 625, 596s, 530sh, 424w.

S182 Boyleite $Zn(SO_4)\cdot 4H_2O$



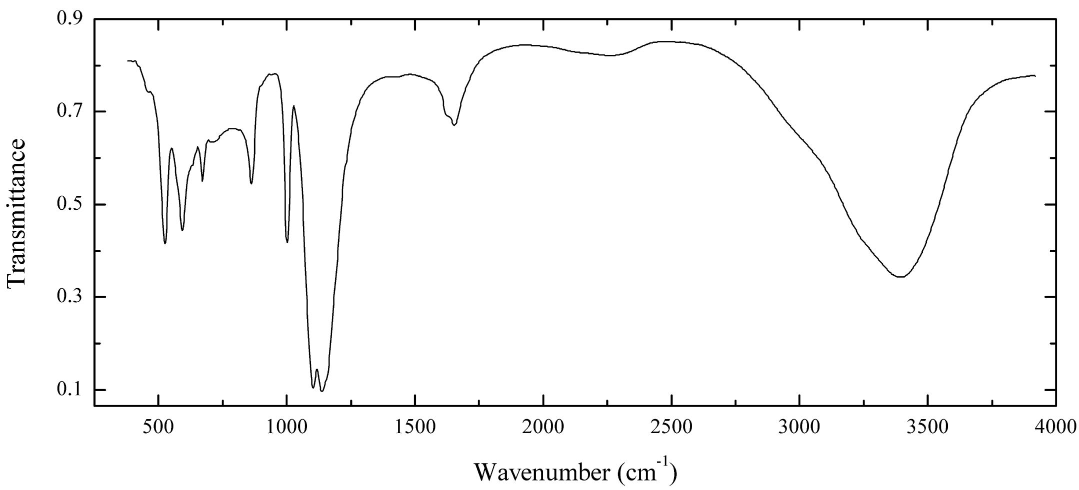
Locality: Kropbach quarry, Münstertal, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany (type locality).
Description: White crusts from the association with dietrichite. The empirical formula is (electron microprobe) $(Zn_{0.47}Mg_{0.30}Mn_{0.13}Fe_{0.10})(SO_4)_{1.00}\cdot nH_2O$. Confirmed by IR spectrum
Wavenumbers (cm^{-1}): 3550sh, 3420s, 3300sh, 2300w, 2140sh, 1665, 1620, 1425w, 1140s, 1102s, 995w, 985sh, 700sh, 616, 520, 440.

S183 Zincowoodwardite $Zn_{1-x}Al_x(SO_4)_{x/2}(OH)_2 \cdot nH_2O$



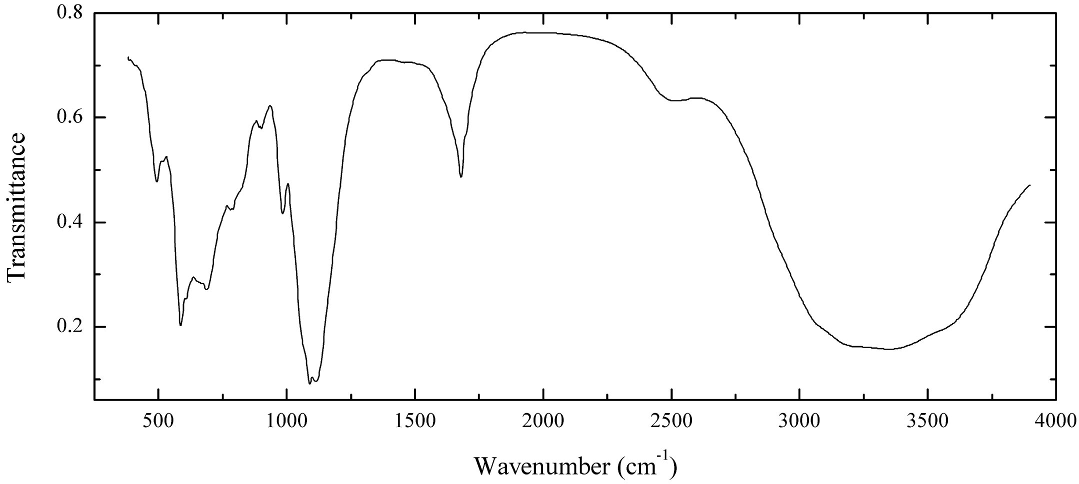
Locality: Baccu Locci mine, Villaputzu, Cagliari province, Sardinia, Italy.
Description: Green botryoidal aggregate. Identified by powder X-ray diffraction pattern, IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3430s, 2370w, 1715sh, 1625, 1425w, 1115, 968s, 675sh, 603s, 565sh.

S184 Ardealite $Ca_2(SO_4)(HPO_4) \cdot 4H_2O$



Locality: Cioclovina cave, Hateg Co., Transylvania, Romania (type locality).
Description: White powdery from the association with gypsum and newberyite. The empirical formula is (electron microprobe) $H_xCa_{1.88}Na_{0.07}(SO_4)_{1.03}(PO_4)_{0.97} \cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3375s, 3260sh, 3020sh, 2250w, 1660, 1640sh, 1398w, 1160sh, 1140s, 1103s, 1002, 863, 720w, 670, 593, 525, 460sh.

S185 Aluminite $Al_2(SO_4)(OH)_4{\cdot}7H_2O$

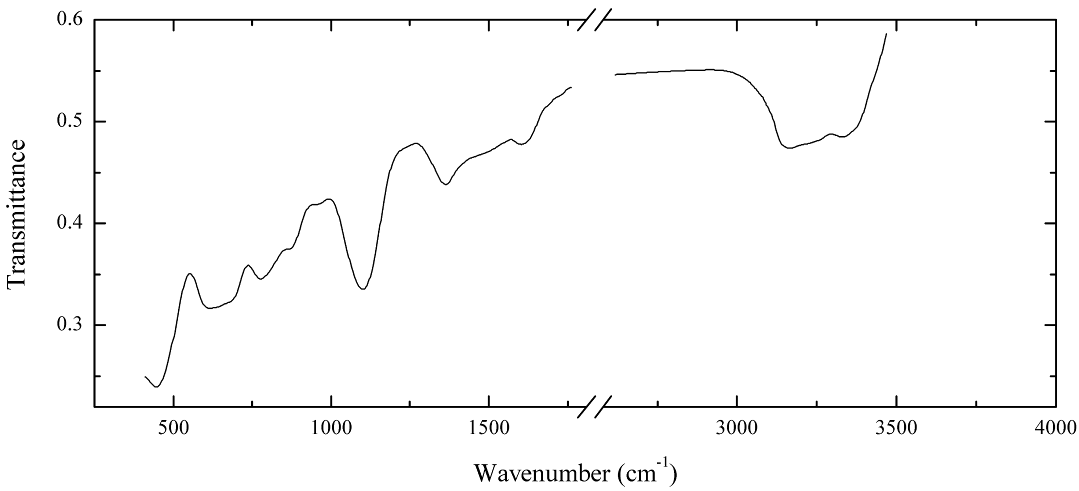


Locality: Bagoly Hill, Gánt, Vértes Mts., Hungary.

Description: White fine-grained aggregate from the association with gypsum and meta-aluminite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3550sh, 3330s, 3220s, 3100sh, 2010w, 1700sh, 1685, 1112s, 1089s, 1065sh, 983, 898w, 820sh, 784, 687, 660sh, 585s, 508w, 490.

S186 Honessite $Ni_6Fe^{3+}{}_2(SO_4)(OH)_{16}{\cdot}4H_2O$

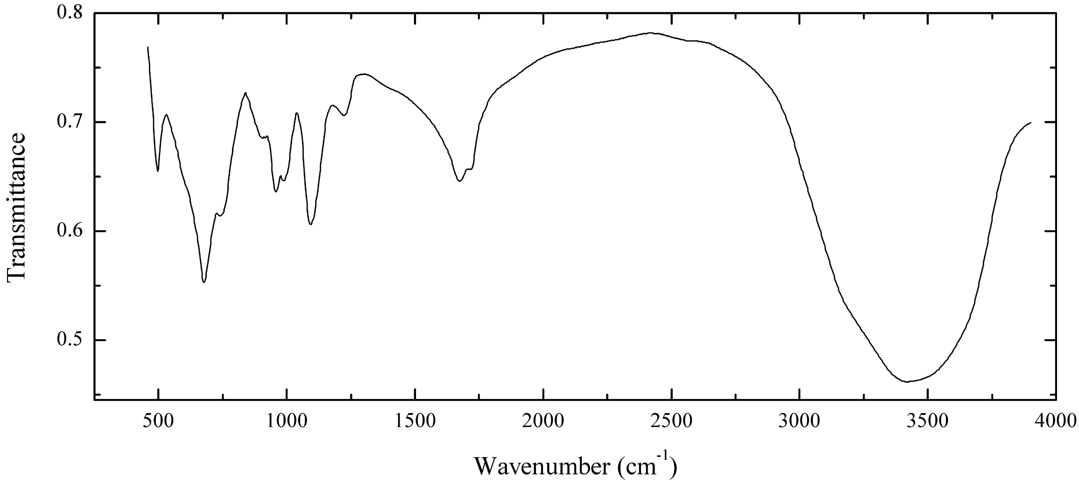


Locality: Dronino ataxite iron meteorite, Dronino village, Kasimov District, Ryazan' region, Russia.

Description: Yellow powdery pseudomorph after violarite from the association with taenite, troilite, chromite, goethite and nickelbischofite. The empirical formula is (electron microprobe) $Ni_{5.1}Fe_{2.9}[(SO_4)_{0.7}(CO_3)_xCl_{0.2}](OH)_{16}{\cdot}nH_2O$.

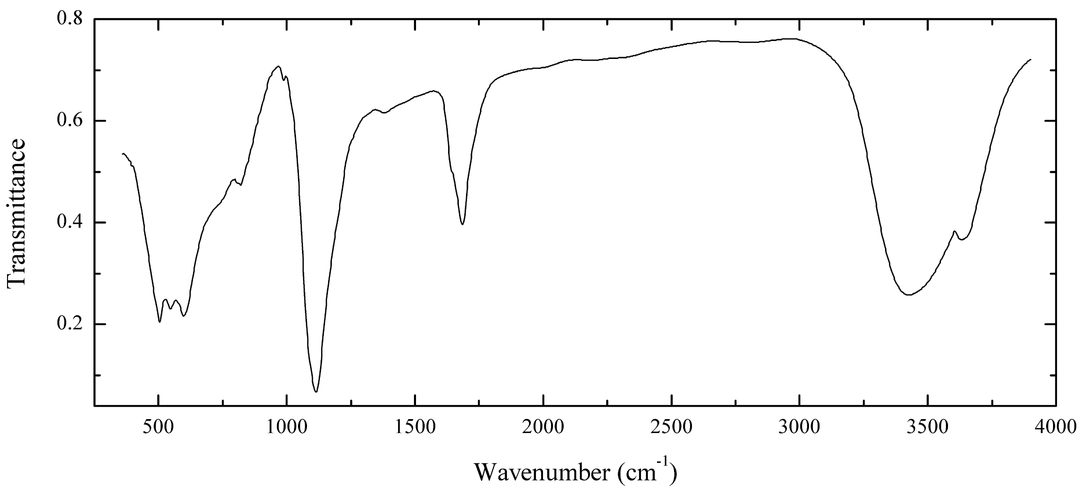
Wavenumbers (cm^{-1}): 3320, 3150s, 1610w, 1365, 1100s, 875, 773, 690sh, 610, 448s.

S187 Buryatite $Ca_3(Si,Fe^{3+},Al)(SO_4)[B(OH)_4](OH)_5O\cdot 12H_2O$



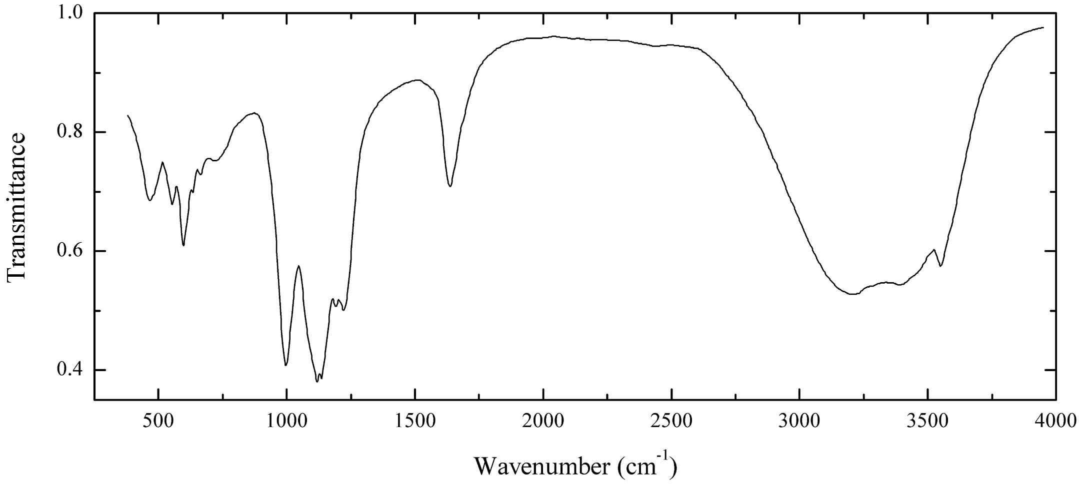
Locality: Fuka mine, Bicchu-cho, near Takahashi city, Okayama prefecture, Honshu Island, Japan.
Description: Pink crystals from the association with calcite and henmilite. Investigated by I.V. Pekov. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 9.24 (100), 5.42 (62), 4.62 (33), 3.79 (77), 3.44 (39), 2.519 (57), 2.160 (53). The empirical formula is (electron microprobe) $Ca_{6.00}(Si_{1.17}Al_{0.88}Mn_{0.04}Mg_{0.02})(SO_4)_{1.28}[B(OH)_4]_x(OH,O)_6\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3600sh, 3400s, 3160sh, 1720, 1680, 1230, 1093s, 992, 858, 910, 740, 674s, 600sh, 496.

S188 Bentorite $Ca_6(Cr,Al)_2(SO_4)_3(OH)_{12}\cdot 26H_2O$



Locality: Hatrurim Formation, southern Israel (type locality).
Description: Violet veins from the association with jennite and portlandite. The empirical formula is (electron microprobe) $Ca_{6.0}(Cr_{1.2}Al_{0.4}Si_{0.4})[(SO_4)_{2.8}(CrO_4)_{0.2}](OH,O)_{12}\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3610, 3395s, 1685, 1645sh, 1390w, 1190sh, 1112s, 986w, 818, 730sh, 598s, 548s, 504s.

S190 Zincocopiapite $ZnFe^{3+}{}_4(SO_4)_6(OH)_2 \cdot 20H_2O$

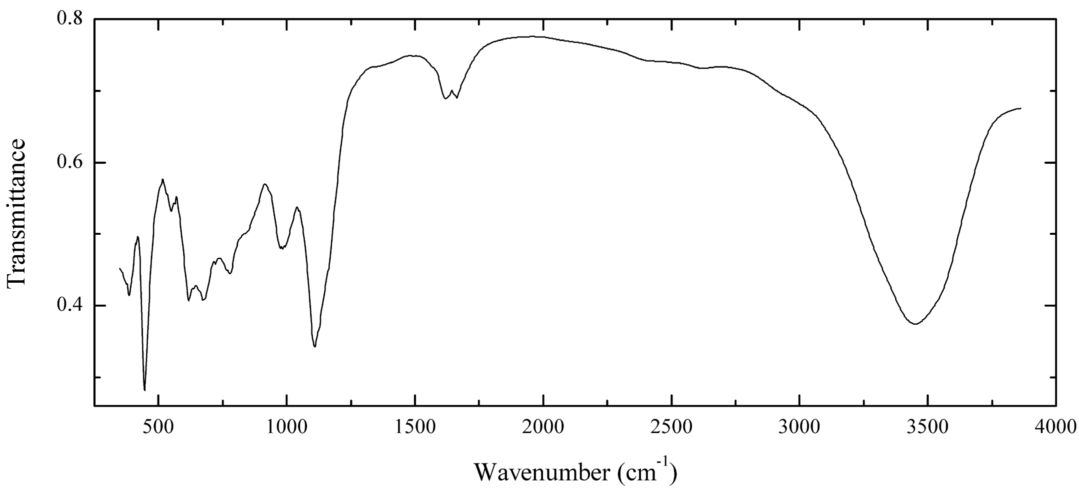


Locality: Parou deposit, Kyzyl-Arvat district, near Krasnovodsk, Mangyshlak, Turkmenistan.

Description: Yellow powdery. The empirical formula is (electron microprobe) $(Zn_{0.71}Fe_{0.24}Mg_{0.05})Fe_{4.00}(SO_4)_{6.00}(OH)_2 \cdot nH_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 9.1 (92), 6.1 (87), 5.61 (64), 4.21 (24), 3.56 (100), 3.35 (81), 3.07 (28). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3400, 3190s, 1640, 1225, 1195, 1134s, 1120s, 997s, 725w, 665w, 632, 596, 552, 480sh, 460.

S191 Hydroxysulfate S191 $[(Mg,Al)_9(OH)_{18}][Na_x(SO_4)_2(H_2O)_{12}]$



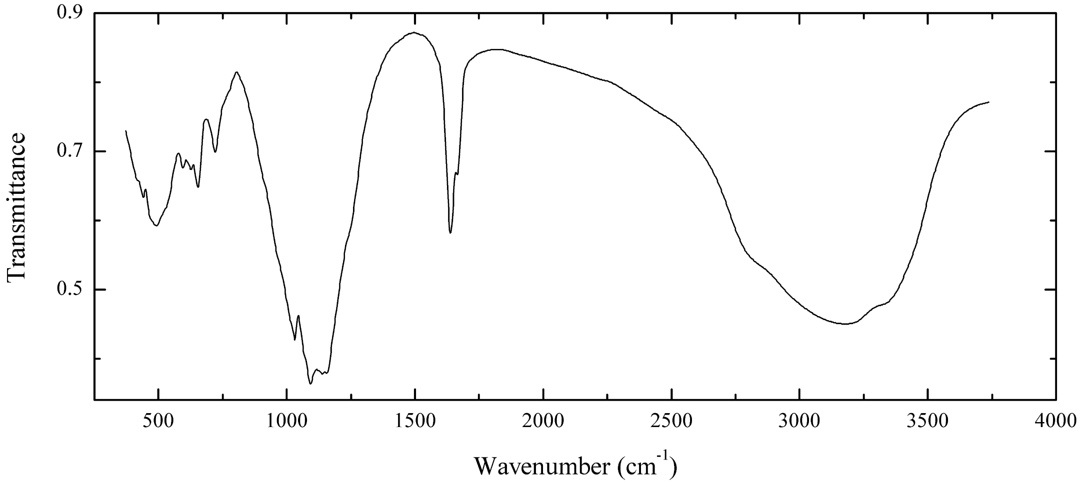
Locality: Stradner Kogel, Wilhelmsdorf, Bad Gleichenberg, Styria, Austria.

Description: White spherulites consisting of thin platelets. Associated minerals are quintinite, gismondine, calcite, gismondine, lizardite, clinochlore, amesite, fluorapatite and diopside. Related to motukoreaite. Not approved by the IMA CNMNC. The crystal structure is solved. Trigonal, space group *R*-3, $a = 9.172(1)$, $c = 33.51(2)$ Å. The empirical formula is (electron microprobe) $[Mg_{5.78}Al_{3.19}Fe_{0.06}(OH)_{18}][Na_{1.13}(SO_4)_{1.86}(H_2O)_x]$. $D_{calc} = 1.971$ g/cm^3. Optically uniaxial (+),

$\omega = 1.486(2)$, $\varepsilon = 1.546(5)$. The lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 11.17 (100), 5.59 (28), 4.58 (11), 3.73 (29), 2.59 (9), 2.39 (8), 2.36 (5), 2.16 (5).

Wavenumbers (cm^{-1}): 3520sh, 3440s, 2610w, 2420w, 1660w, 1625w, 1165sh, 1111s, 982, 830sh, 780, 677, 618, 549w, 444s, 385.

S192 Zircosulfate $Zr(SO_4)_2 \cdot 4H_2O$

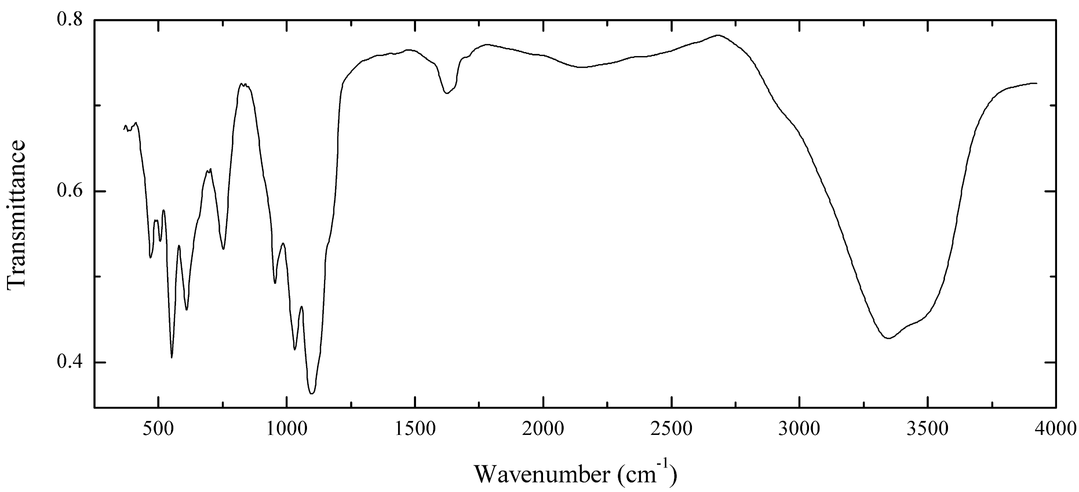


Locality: Korgeredaba alkaline massif, Sangilen Upland, Tuva Republic, Eastern Siberia, Russia (type locality).

Description: White crust from the association with hisingerite, smithsonite and goethite. Holotype sample. The crystal structure is solved. Orthorhombic, space group *Fddd*, $a = 25.92$, $b = 11.62$, $c = 5.532$ Å, $Z = 8$. The empirical formula is $H_{0.12}Zr_{0.97}(SO_4)_{2.00} \cdot 3.8H_2O$. $D_{meas} = 2.85$ g/cm^3, $D_{calc} = 2.833$ g/cm^3. Optically biaxial (+), $\alpha = 1.620$, $\beta \approx 1.644$, $\gamma = 1.674$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 6.50 (50), 4.33 (100), 3.46 (40), 2.98 (90), 2.33 (60), 1.97 (40), 1.62 (40).

Wavenumbers (cm^{-1}): 3300sh, 3160s, 2800sh, 1665, 1635, 1240sh, 1167s, 1137s, 1090s, 1029, 1000sh, 970sh, 720, 654, 625, 595, 530sh, 492, 440, 420sh.

S193 Felsőbányaite $Al_4(SO_4)(OH)_{10} \cdot 4H_2O$

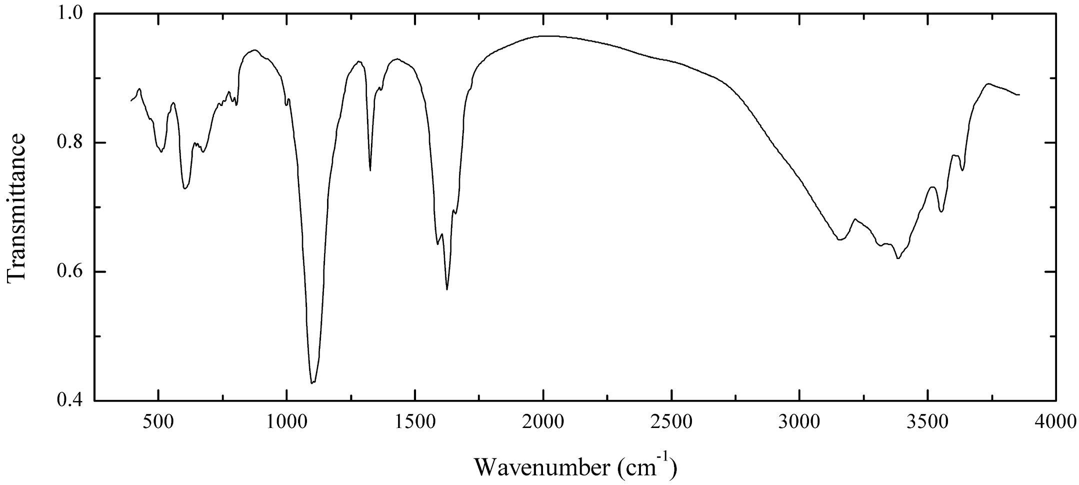


Locality: Dorset, England, UK.

Description: White concretion from the association with gypsum. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3450sh, 3325s, 2450sh, 2150w, 1636w, 1165sh, 1025sh, 1100s, 1035s, 955, 752, 650sh, 610, 550s, 506, 470, 380w.

S194 Coskrenite-(Ce) $(Ce,Nd,La)_2(SO_4)_2(C_2O_4)\cdot 8H_2O$

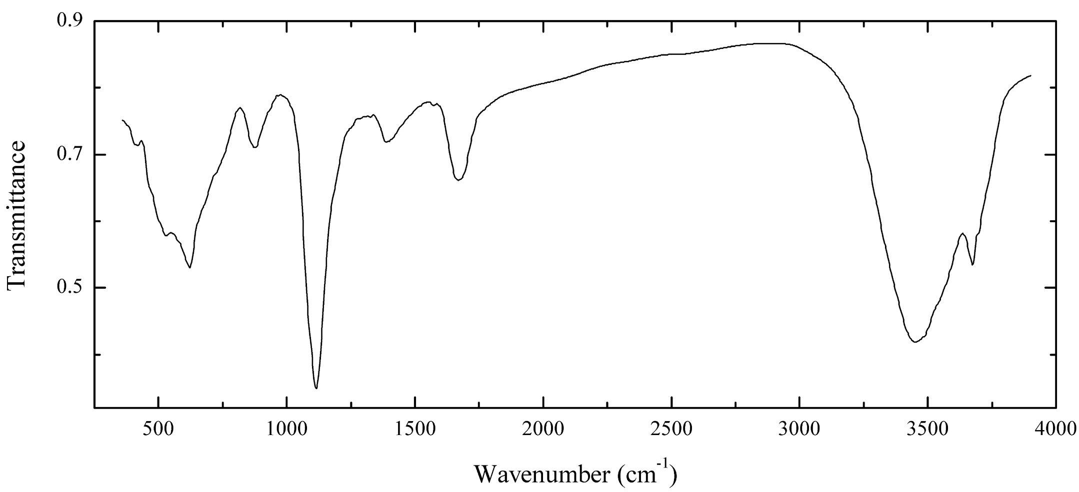


Locality: Alum Cave Bluff, Great Smoky Mountains National Park, Tennessee, USA (type locality).

Description: Pale pink crystals from the association with epsomite and apjohnite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3640, 3555, 3390s, 3320, 3165, 1665, 1631s, 1594, 1365w, 1327, 1125sh, 1103s, 1001w, 808w, 795w, 665, 608, 507, 465sh.

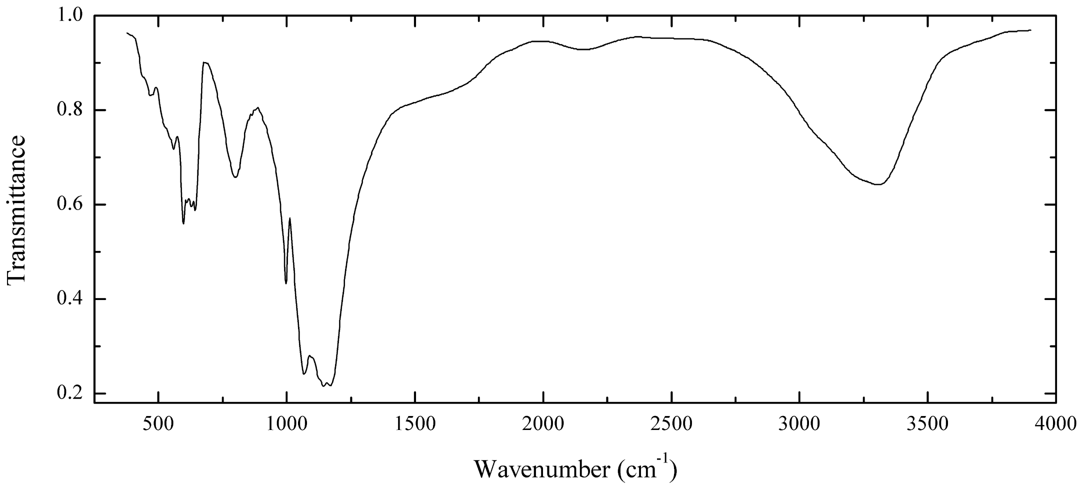
S195 Ettringite $Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$



Locality: Nickenicher Sattel (Eicher Sattel), Eifel paleovolcanic area, Rheinland-Pfalz (Rhineland-Palatinate), Germany.

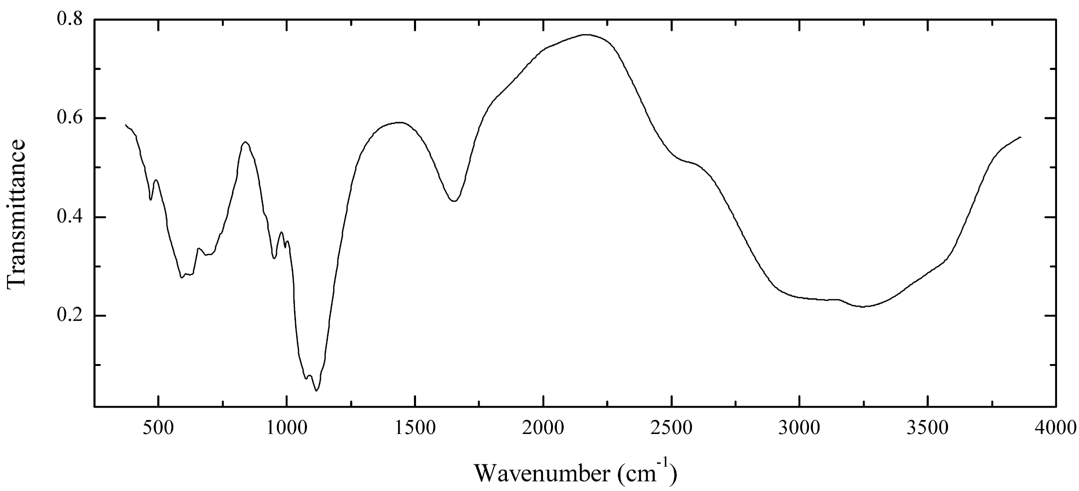
Description: Colourless prismatic crystals. The empirical formula is (electron microprobe) $Ca_6(Al_{1.88}Si_{0.08})(OH,O)_{12}(SO_4)_{2.77}(CO_3)_x·nH_2O$.
Wavenumbers (cm^{-1}): 3660sh, 3635, 3510sh, 3410s, 1670, 1390w, 1114s, 871, 745sh, 617, 547, 500sh, 468sh, 416.

S196 Leightonite $K_2Ca_2Cu^{2+}(SO_4)_4·2H_2O$



Locality: Salvadora mine, Caracoles, Sierra Gorda district, Antofagasta region, Chile.
Description: Light green crystals. The empirical formula is (electron microprobe) $K_{1.6}Ca_{2.1}Cu_{0.9}Mg_{0.1}Zn_{0.1}(SO_4)_{4.0}·nH_2O$.
Wavenumbers (cm^{-1}): 3285, 3050sh, 2150w, 1620sh, 1167s, 1145s, 1125sh, 1067s, 997, 797, 660sh, 643, 629, 607, 595, 559, 520sh, 472w, 440sh.

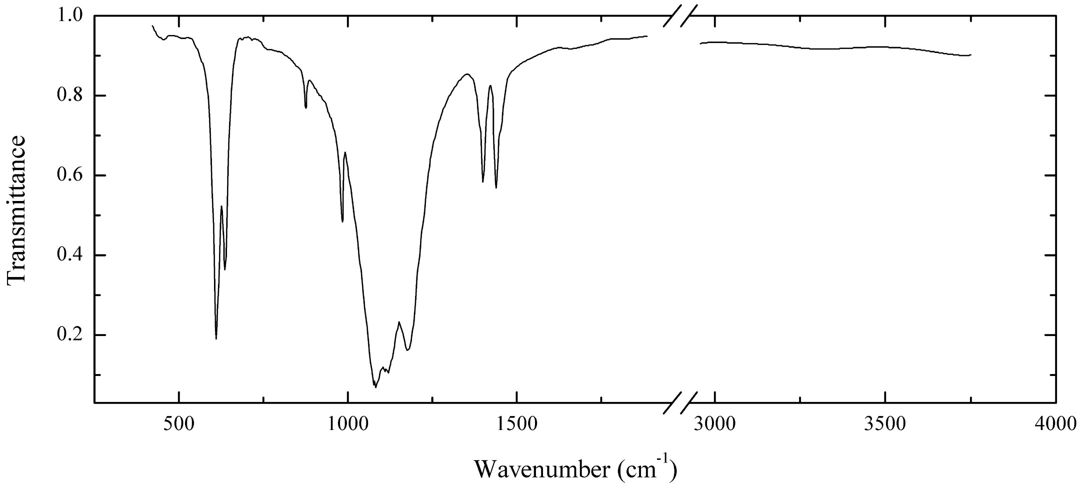
S197 Wupatkiite $(Co,Mg,Ni)Al_2(SO_4)_4·22H_2O$



Locality: Near Cameron, Cameron uranium district, Coconino Co., Arizona, USA (type locality).
Description: Pink acicular crystals. The empirical formula is (electron microprobe) $(Co_{0.55}Mg_{0.40}Ni_{0.05})Al_{2.00}(SO_4)_{4.00}·nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3520sh, 3340s, 3040s, 2470sh, 1663, 1140sh 1114s, 1073s, 994, 952, 740, 624, 588, 469.

S199 Baryte $Ba(SO_4)$

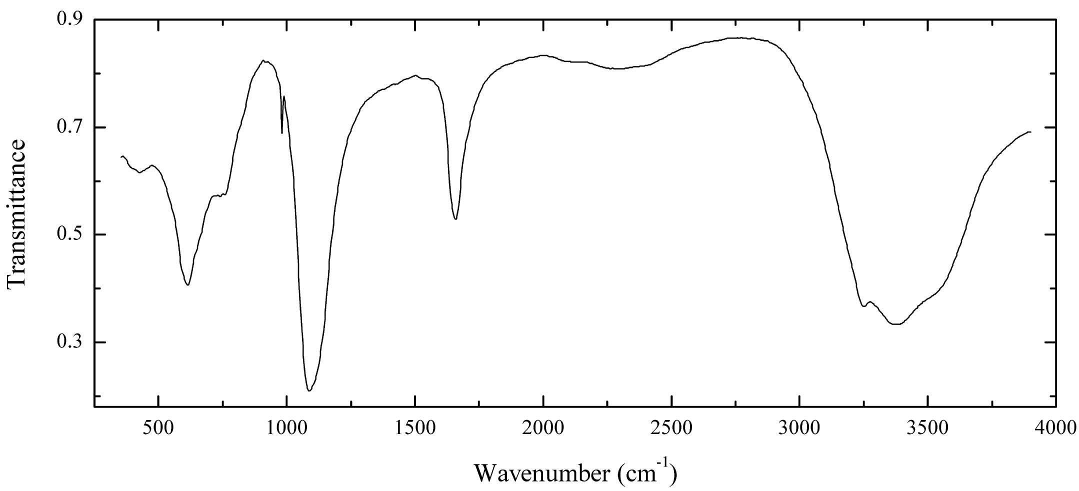


Locality: Kremikovtsi, near Sofia, Bulgaria.

Description: Aggregate of curved platy crystals from the association with rhodochrosite and romanèchite. A very unusual CO_3-rich variety. The homogeneity was checked by electron microscopy and powder X-ray diffraction data. The empirical formula is $Ba_{1.00}(SO_4)_{0.91}(CO_3)_{0.09}$. The bands at 1,450, 1,438, 1,400, 1,390, 875, 717 and 686 cm^{-1} correspond to vibrations of CO_3^{2-} groups.

Wavenumbers (cm^{-1}): 1450sh, 1438, 1400, 1390sh, 1176s, 1116s, 1082s, 983, 875, 760sh, 717w, 686w, 636, 610s, 510w, 452w.

S200 Hexahydrite $Mg(SO_4)\cdot 6H_2O$

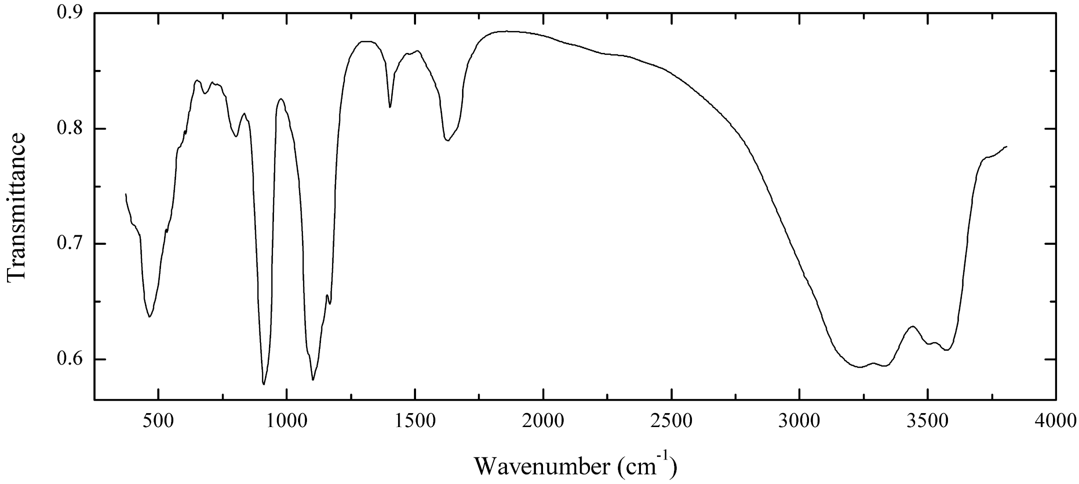


Locality: Great Konya Basin, Turkey.

Description: White powdery aggregate. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3500sh, 3360s, 3250, 2310w, 1665, 1087s, 981w, 735sh, 613, 430.

S201 Metauranopilite $(UO_2)_6(SO_4)(OH)_{10}·5H_2O$

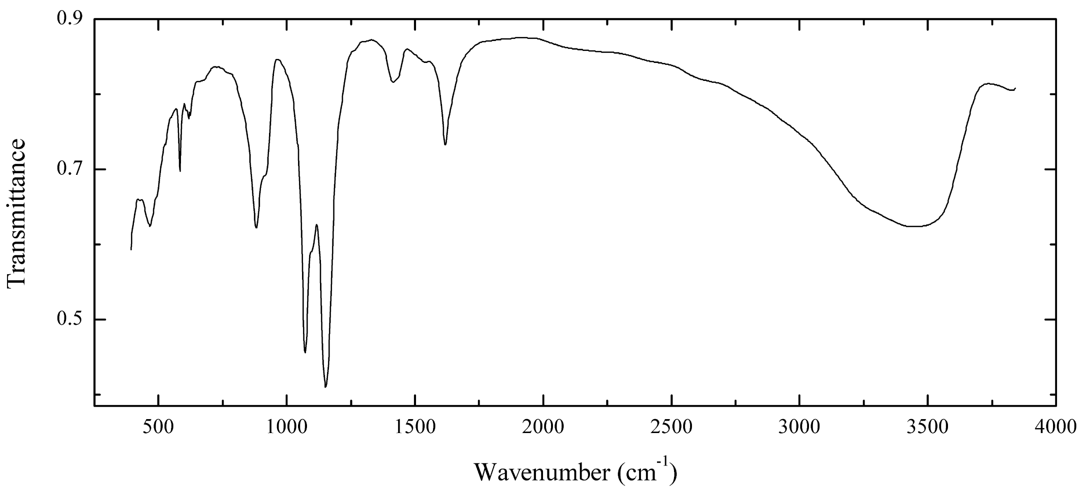


Locality: Menzenschwand U deposit, near Menzenschwand, Kunkelbach valley, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Yellow bortyoidal aggregates from the association with arsenuranospathite. The empirical formula is (electron microprobe) $(UO_2)_{5.91}(SO_4)_{1.09}(OH,H_2O)_{10}·5H_2O$.

Wavenumbers (cm^{-1}): 3545s, 3470, 3315s, 3210s, 1660sh, 1630, 1403, 1167, 1120sh, 1105s, 1080sh, 909s, 798, 675w, 580sh, 535sh, 467, 380sh.

S202 Nickelzippeite $Ni_2(UO_2)_6(SO_4)_3(OH)_{10}·16H_2O$

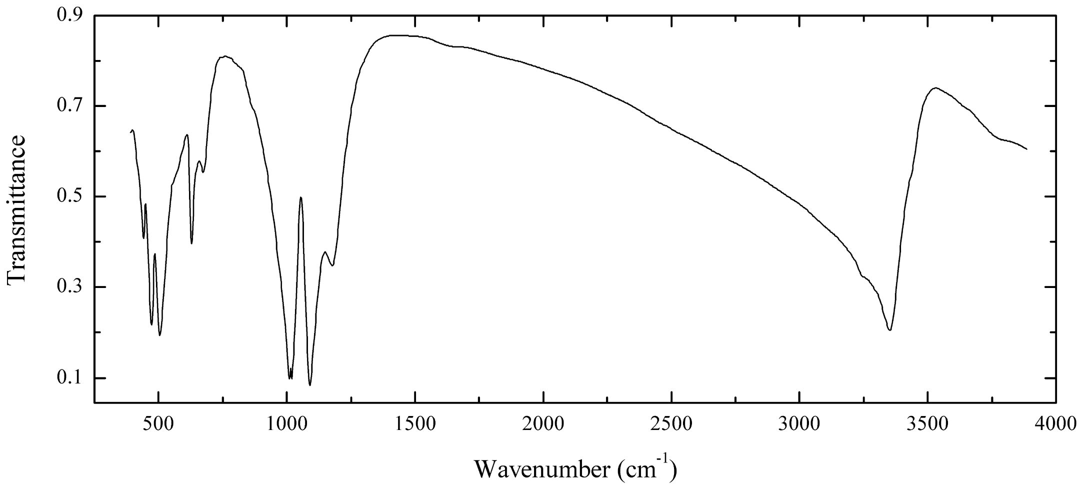


Locality: Happy Jack mine, Copper Point, White Canyon district, San Juan Co., Utah, USA.

Description: Orange massive from the association with natrozippeite and johannite. The empirical formula is (electron microprobe) $(Ni_{1.17}Ca_{0.57}Zn_{0.16}Na_{0.12})(UO_2)_{6.11}[(SO_4)_{2.84}(CO_3)_x](OH)_{10}·nH_2O$.

Wavenumbers (cm^{-1}): 3400, 3260, 1622, 1543w, 1415, 1154s, 1097, 1074s, 910sh, 881, 670w, 617, 582, 467.

S203 Argentojarosite $AgFe^{3+}_3(SO_4)_2(OH)_6$

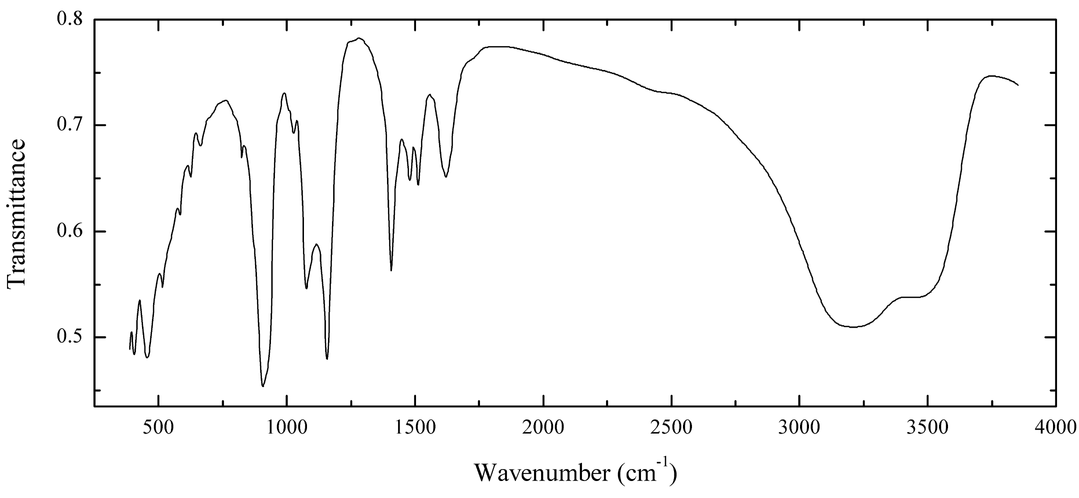


Locality: Tintic Standard mine, Tintic district, Juab Co., Utah, USA (type locality).

Description: Brown fine-grained aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3340s, 3240sh, 1620w, 1175, 1090s, 1019s, 1010s, 676, 629, 560sh, 504s, 473s, 439.

S205 Jáchymovite $(UO_2)_8(SO_4)(OH)_{14}{\cdot}14H_2O$

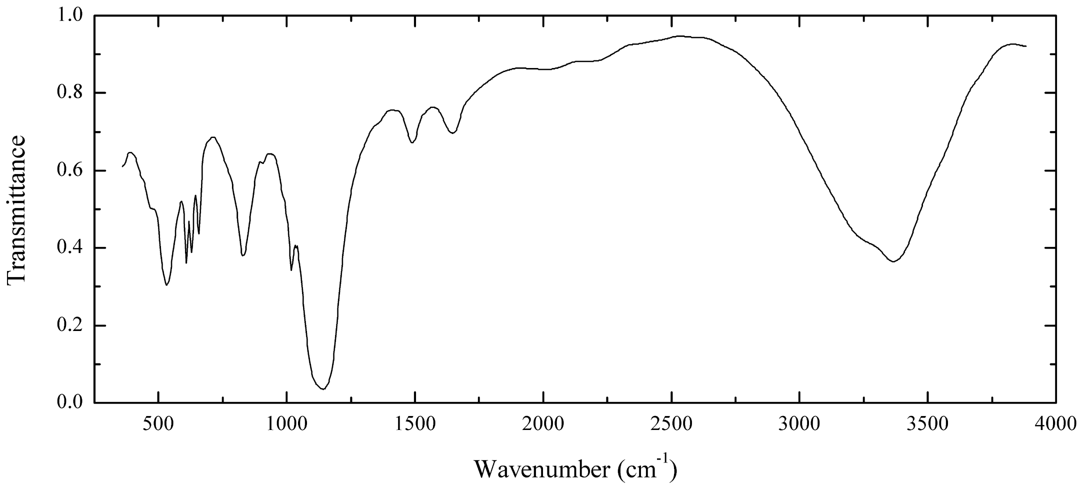


Locality: Jáchymov U deposit, Krušné Hory (Ore Mts.), Western Bohemia, Czech Republic (type locality).

Description: Yellow powdery aggregate. Confirmed by semiquantitative electron microprobe analysis. Contains admixture of a carbonate.

Wavenumbers (cm^{-1}): 3465, 3200s, 1625, 1515, 1482, 1407, 1158s, 1077, 1030w, 907s, 870sh, 824w, 660w, 627, 582, 550sh, 515, 455s, 407s.

S206 Szmikite $Mn(SO_4){\cdot}H_2O$

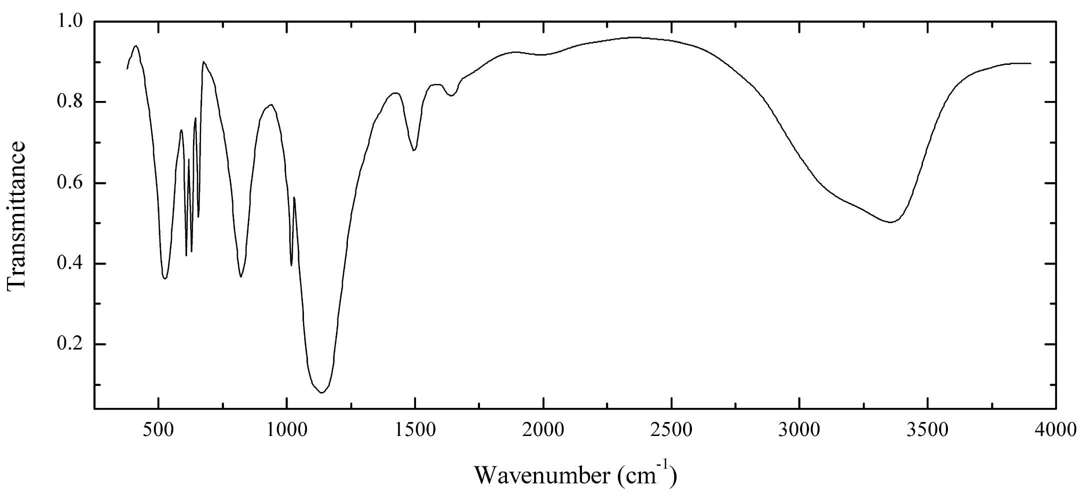


Locality: Chvaletice, Pardubice region, Bohemia, Czech Republic.

Description: White powdery aggregate from the association with goethite. The empirical formula is (electron microprobe) $(Mn_{0.83}Mg_{0.14}Fe_{0.02}Al_{0.01})(SO_4)_{1.00}{\cdot}nH_2O$. The strongest lines of the powder X-ray diffraction pattern are observed at 4.88, 3.49, 3.12 and 2.59 Å.

Wavenumbers (cm^{-1}): 3350s, 3250sh, 2170w, 1990w, 1640, 1500, 1149s, 1120sh, 1019, 905w, 828, 656, 627, 608, 530s, 470sh.

S207 Szmikite $Mn(SO_4){\cdot}H_2O$

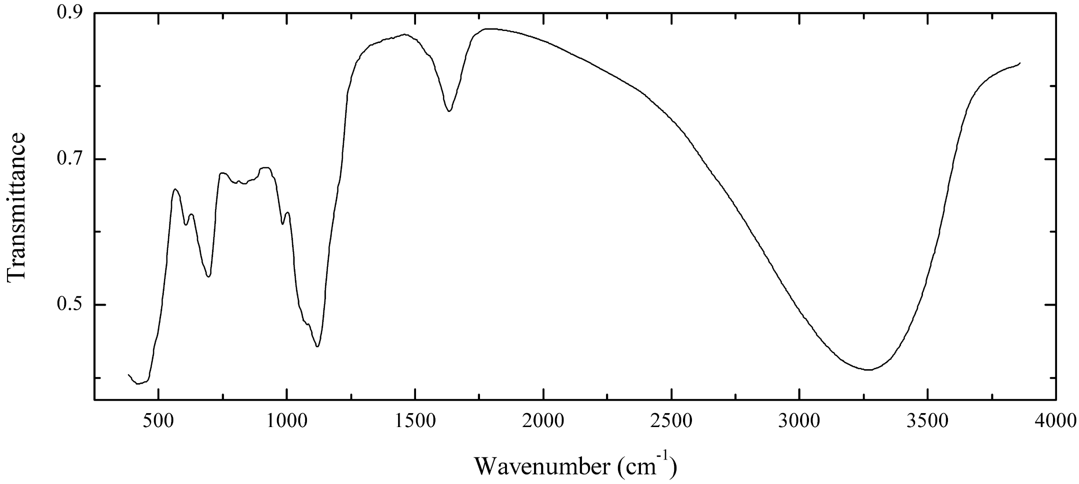


Locality: Toyoha mine, Sapporo, Hokkaido, Japan.

Description: White powdery aggregate. The empirical formula is (electron microprobe) $(Mn_{0.75}Fe_{0.2}Mg_{0.05})(SO_4)_{1.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3360s, 3170sh, 1990w, 1640w, 1507, 1165sh, 1136sh, 1110sh, 1017, 821s, 657, 627, 607, 523s.

S208 Schwertmannite $Fe^{3+}_8(SO_4)O_8(OH)_6$

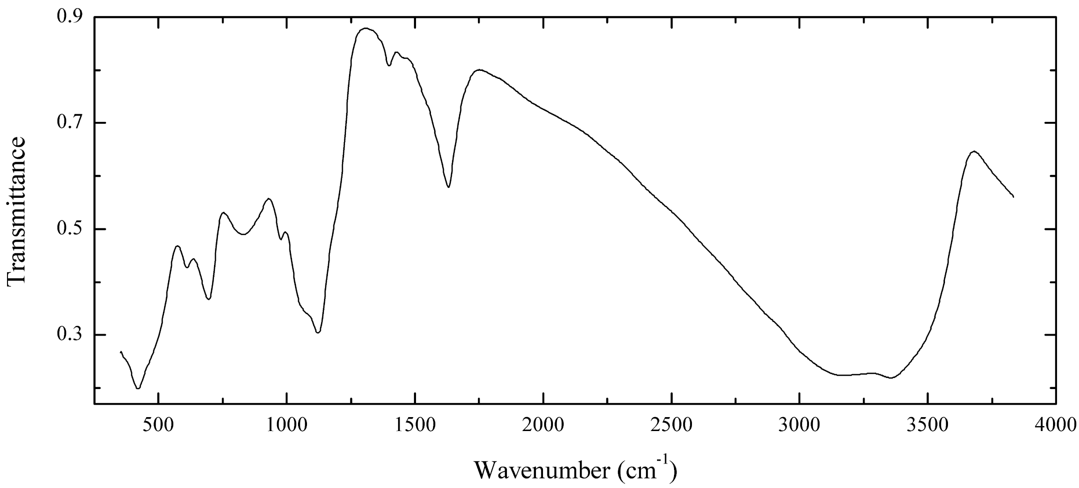


Locality: St. Johannes mine, Wolkenstein, Marienberg district, Erzgebirge (Ore Mts.), Saxony, Germany.

Description: Brown powdery aggregate. Confirmed by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3250s, 1625, 1121s, 1071, 1050sh, 983, 843w, 803w, 697, 608, 500sh, 423s.

S209 Sulfate S209 $Fe^{3+}_4(SO_4)O_4(OH)_2{\cdot}nH_2O$ (?)

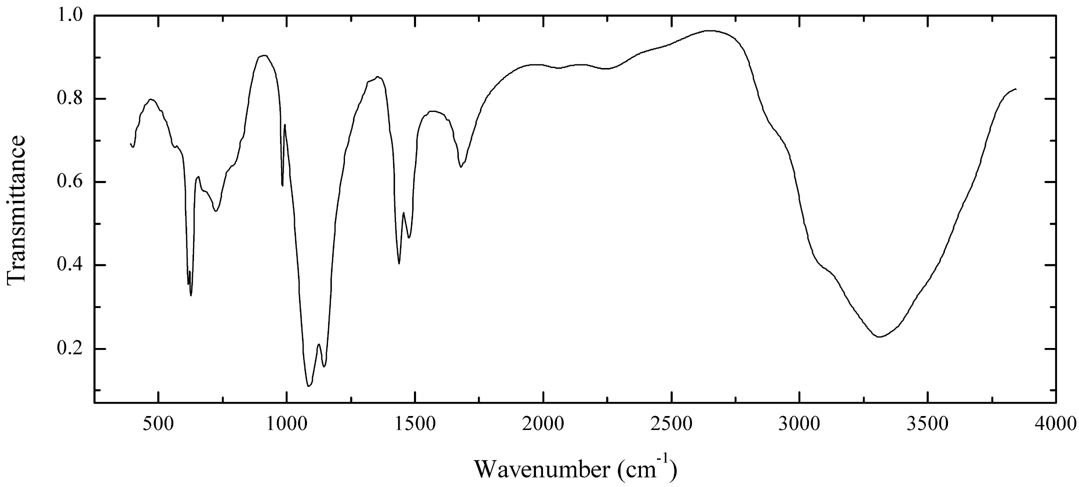


Locality: Schneeberg, Erzgebirge (Ore Mts.), Saxony, Germany.

Description: Brown colloform. X-ray amorphous. Fe:S = 4:1 (by electron microprobe data).

Wavenumbers (cm^{-1}): 3350s, 3150s, 1637, 1400w, 1120s, 1075sh, 975, 825, 697, 607, 460sh, 423s, 390sh.

S210 Boussingaultite $(NH_4)_2Mg(SO_4)_2 \cdot 6H_2O$

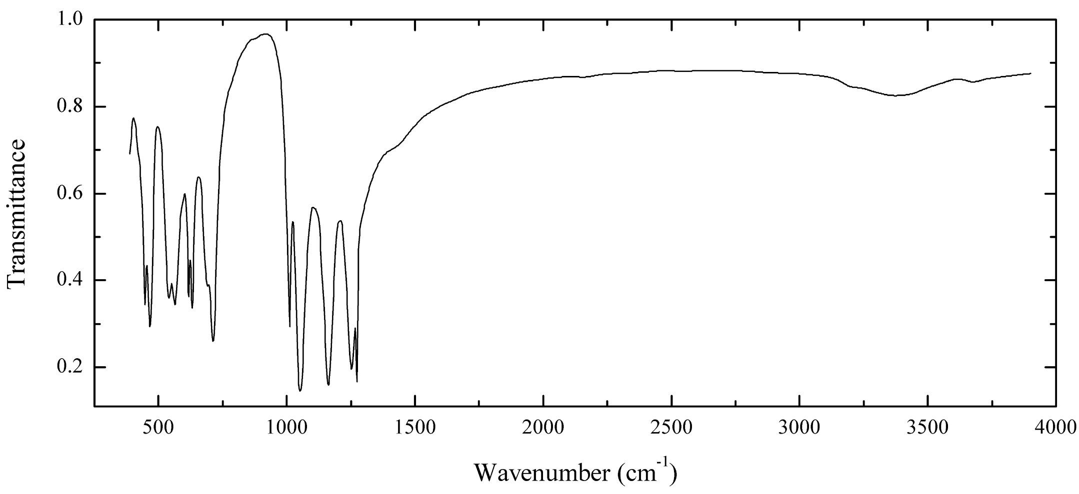


Locality: Larderello, Pomarance, Pisa province, Tuscany, Italy.

Description: Grey granular aggregate. The empirical formula is $(NH_4)_xK_{0.04}(Mg_{0.95}Fe_{0.02})(SO_4)_{2.00} \cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3450sh, 3360sh, 3280s, 3200sh, 3075sh, 2870sh, 2230w, 2040w, 1685, 1475, 1437, 1145s, 1086s, 983, 790sh, 724, 675sh, 627, 616, 563, 400.

S211 Thermessaite $K_2Al(SO_4)F_3$

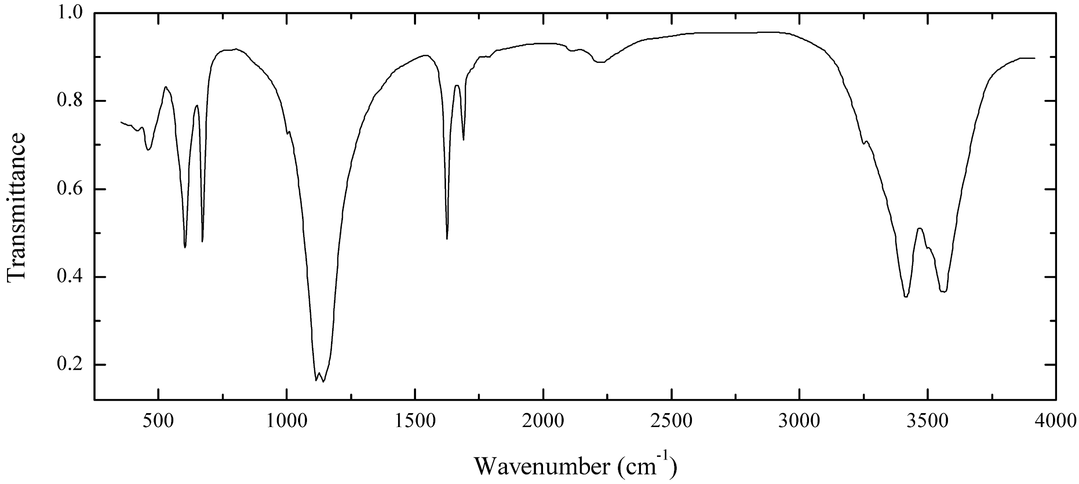


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy (type locality).

Description: Colourless crystals from the association with alunite, anhydrite and metavoltine. The empirical formula is $[K_{1.7}Na_{0.2}(NH_4)_{0.1}]Al_{1.0}(SO_4)_{1.0}F_{2.8}(OH)_{0.2}$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3360w, 1410sh, 1273s, 1252s, 1163s, 1055s, 1011, 711s, 690, 680sh, 631, 618, 561, 537, 463s, 445.

S212 Gypsum $Ca(SO_4)\cdot 2H_2O$

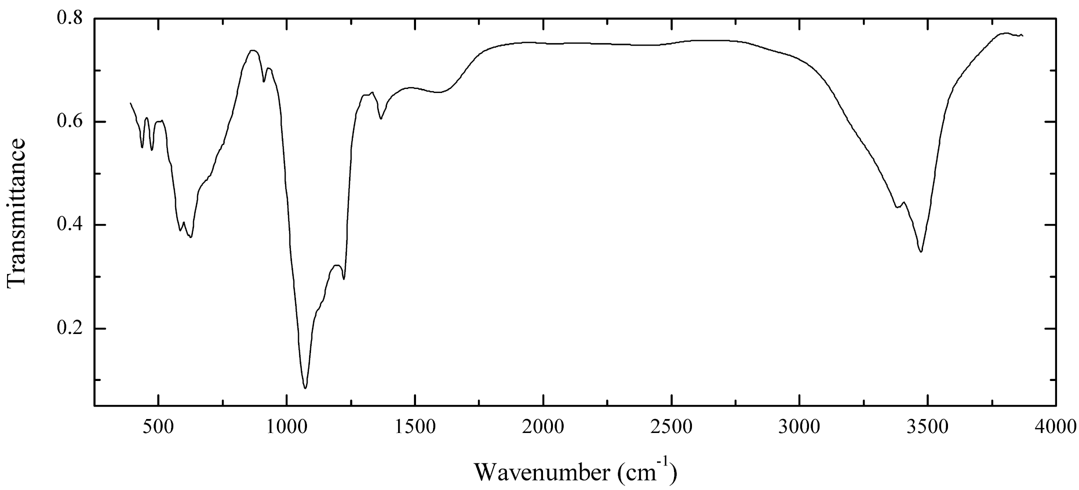


Locality: Belorechenskoe deposit, Adygea (Adygeya) Republic, Northern Caucasus, Russia.

Description: Colourless acicular crystals from the association with melanterite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3542, 3485sh, 3396, 3233, 2223w, 2110w, 1689, 1625, 1160sh, 1142s, 1115s, 1005w, 777w, 670, 601, 461, 418w.

S214 Osarizawaite $PbAl_2Cu(SO_4)_2(OH)_6$

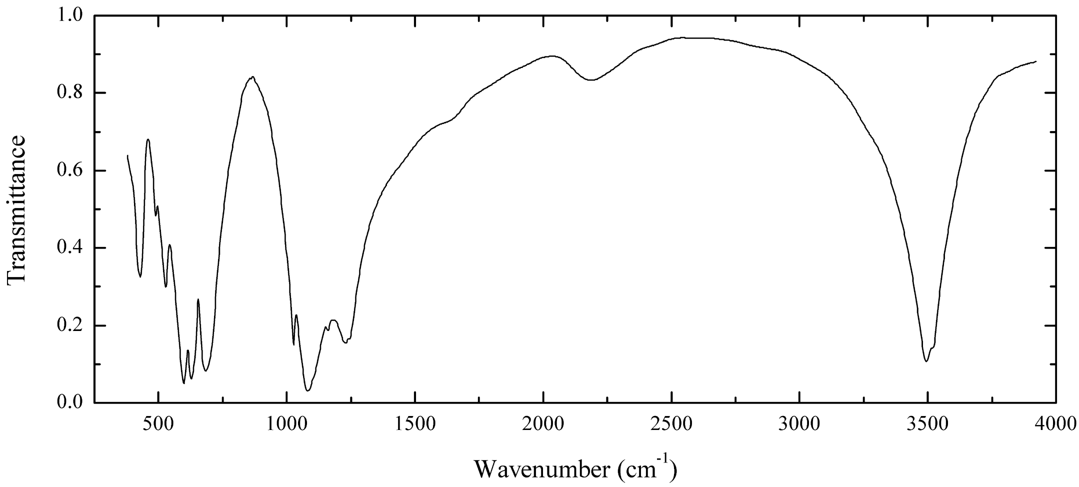


Locality: Rubtsovskoe base-metal deposit, Rubtsovsk ore district, northwest Altai Mts., Siberia, Russia.

Description: Greenish-blue powdery aggregate from the association with kaolinite. The empirical formula is $H_x(Pb_{0.96}K_{0.02}Ca_{0.01})(Al_{1.86}Cu_{0.98}Fe_{0.20})[(SO_4)_{1.80}(SiO_4)_{0.16}(AsO_4)_{0.04}](OH,H_2O)_6$. Confirmed by IR spectrum. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 5.79 (100), 3.534 (41), 3.013 (78), 2.885 (67), 2.290 (53).

Wavenumbers (cm^{-1}): 3453s, 3365, 1600w, 1370w, 1225s, 1130sh, 1070s, 909w, 740sh, 680sh, 620, 583, 550sh, 474, 437.

S215 Alunite $KAl_3(SO_4)_2(OH)_6$

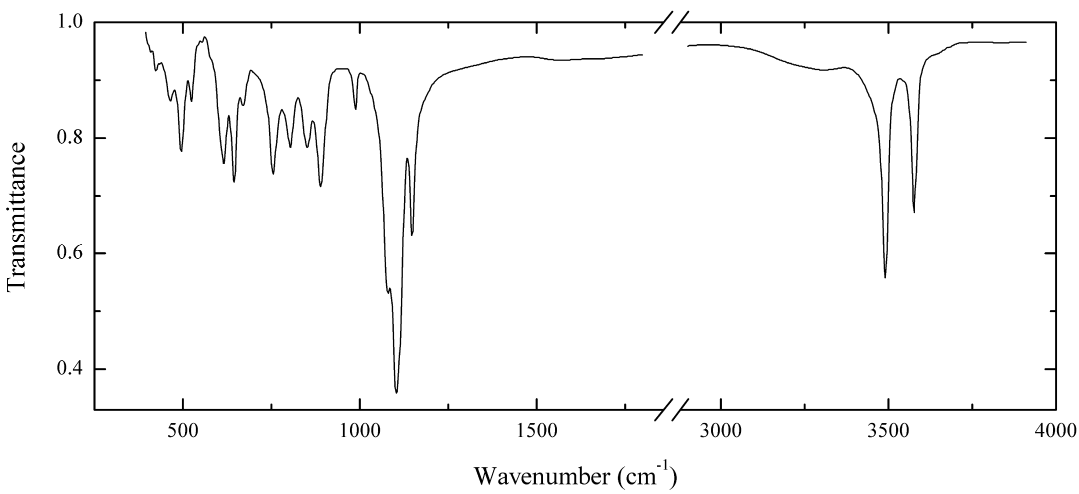


Locality: Beregovo, Transcarpathian region, Ukraine.

Description: Yellow massive. Confirmed by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3505sh, 3480s, 3270sh, 2200w, 1640sh, 1226s, 1159, 1081s, 1026s, 683s, 625s, 598s, 526, 488, 428.

S216 Antlerite $Cu^{2+}{}_3(SO_4)(OH)_4$

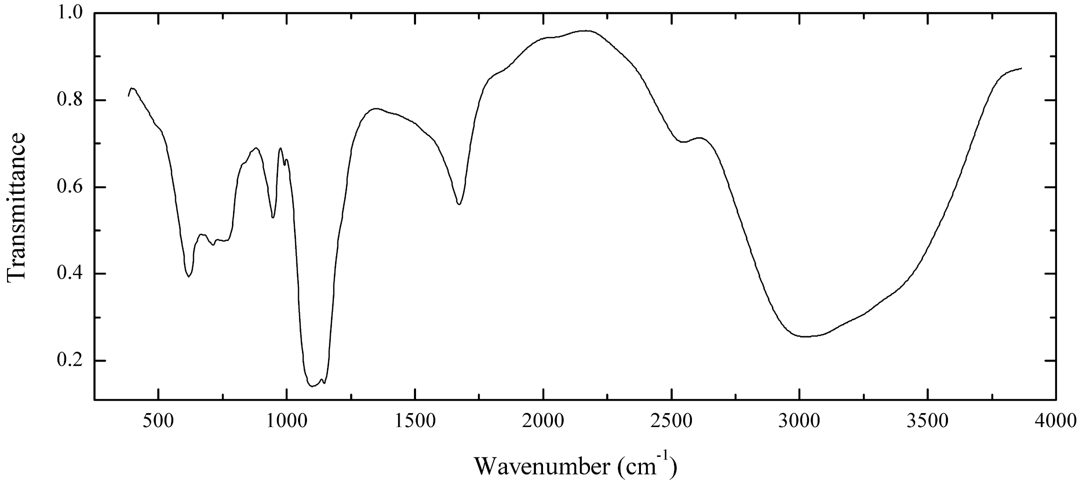


Locality: Belorechenskoe deposit, Adygea (Adygeya) Republic, Northern Caucasus, Russia.

Description: Green crust on galenite. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3570, 3485s, 1150s, 1107s, 1082s, 988w, 890, 852, 803, 754, 667w, 644, 615, 605sh, 520w, 494, 460w, 417w.

S217 Alum-(Na) $NaAl(SO_4)_2·12H_2O$

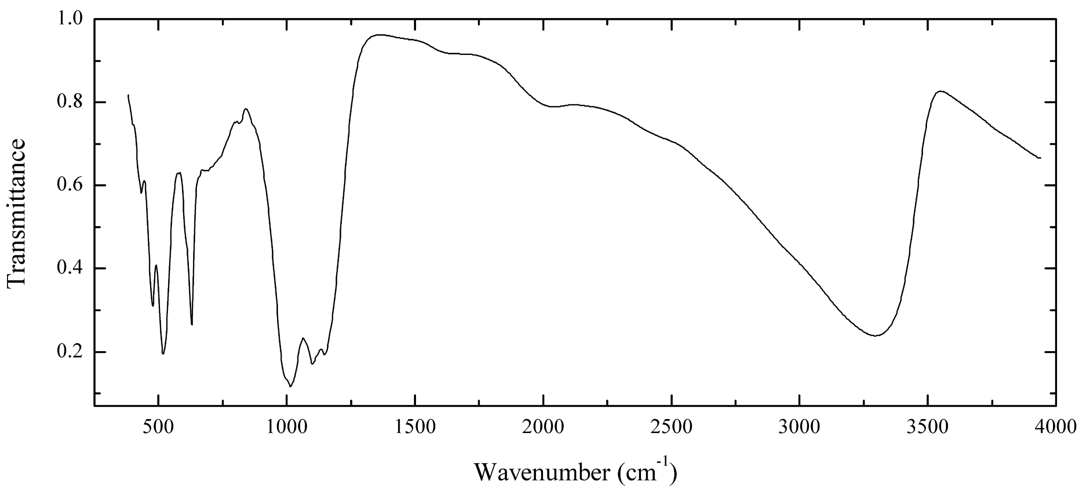


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Yellow crust. The empirical formula is $H_x(Na_{0.82}Tl_{0.06}Ca_{0.02}K_{0.02})Al_{1.01}(SO_4)_{2.00}·nH_2O$.

Wavenumbers (cm^{-1}): 3350sh, 2985, 2530, 1800sh, 1670, 1145s, 1095s, 988w, 946, 750, 708, 616.

S218 Beaverite-(Cu) $Pb(Fe,Cu^{2+})_3(SO_4)_2(OH,H_2O)_6$

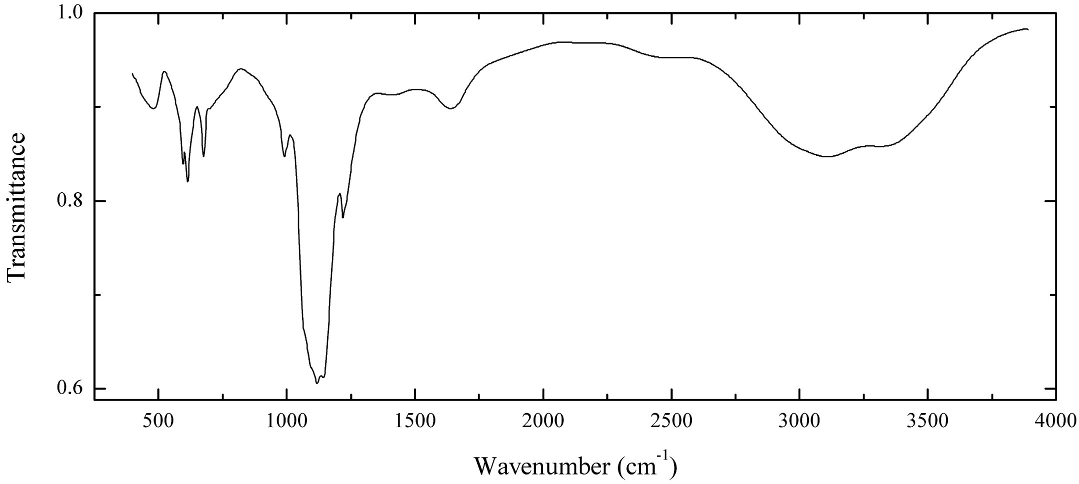


Locality: Rubtsovskoe base-metal deposit, Rubtsovsk ore district, northwest Altai Mts., Siberia, Russia.

Description: Yellow powdery aggregate from the association with cerussite, goethite, kaolinite and quartz. The empirical formula is $H_x(Pb_{0.79}K_{0.01})(Fe_{2.42}Cu_{0.73})[(SO_4)_{1.99}(PO_4)_{0.01}]$ $(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3290s, 2040w, 1620w, 1158s, 1100s, 1013s, 995sh, 814w, 690w, 628, 605sh, 516s, 474, 431w.

S219 Goldichite $KFe^{3+}(SO_4)_2 \cdot 4H_2O$

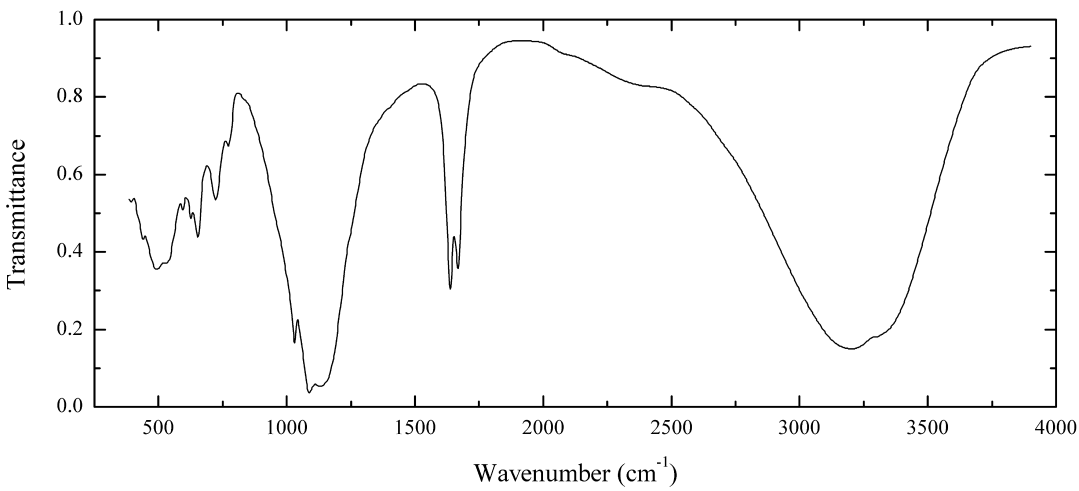


Locality: Kudriavy (Kudryavyi) volcano, Iturup island, Kuril islands, Sakhalinskaya Oblast', Russia.

Description: Yellow massive. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis. Contaminated by another sulfate.

Wavenumbers (cm^{-1}): 3340, 3120, 1640w, 1420w, 1223, 1142s, 1119s, 1095sh, 1065sh, 990, 676, 614, 594, 475w.

S220 Zircosulfate $Zr(SO_4)_2 \cdot 4H_2O$

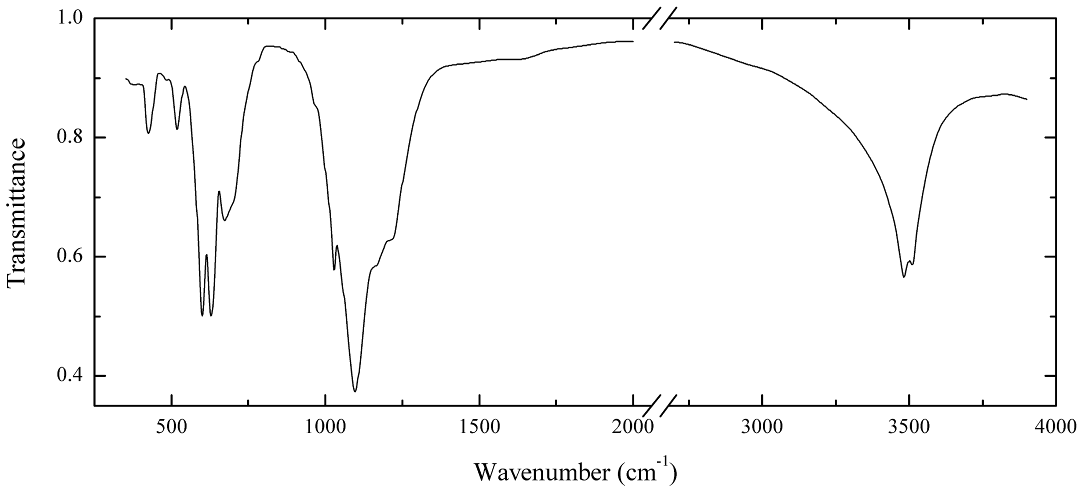


Locality: Korgeredaba alkaline massif, Sangilen Upland, Tuva Republic, Eastern Siberia, Russia (type locality).

Description: White crust from the association with hisingerite, smithsonite and goethite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3300s, 3175s, 2410sh, 1667, 1635, 1132s, 1087s, 1030s, 772w, 722, 654, 625sh, 595sh, 527, 493, 410.

S221 Natroalunite $NaAl_3(SO_4)_2(OH)_6$

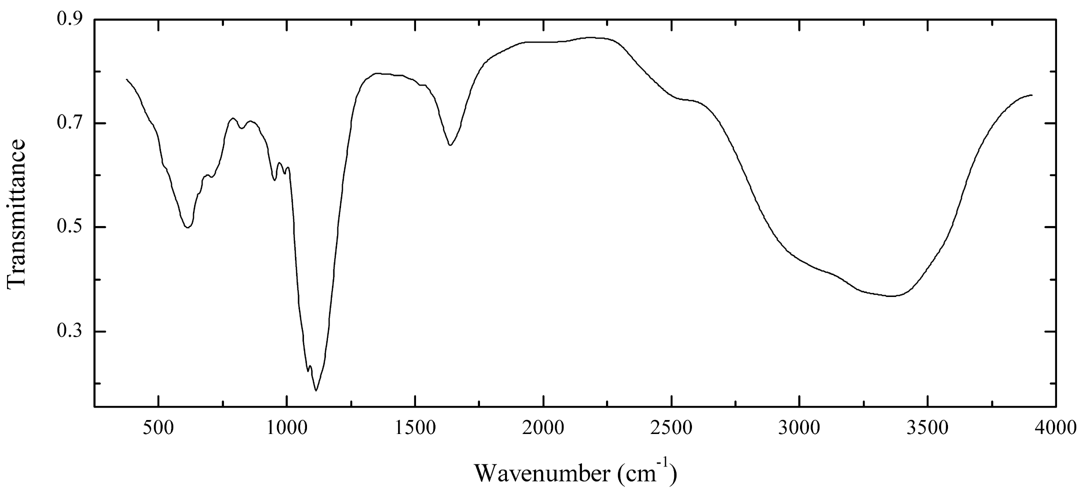


Locality: Barranco Jarosa, Sierra Almagrera, Spain.

Description: Brownish massive from the association with zincosite. The empirical formula is (electron microprobe) $(Na_{0.71}K_{0.17})(Al_{3.02}Fe_{0.06})(SO_4)_{2.00}(OH)_6$.

Wavenumbers (cm^{-1}): 3485, 3455, 1645w, 1220sh, 1160sh, 1095s, 1027s, 960sh, 690sh, 675, 629s, 600s, 519, 427, 385w.

S222 Apjohnite $Mn^{2+}Al_2(SO_4)_4{\cdot}22H_2O$

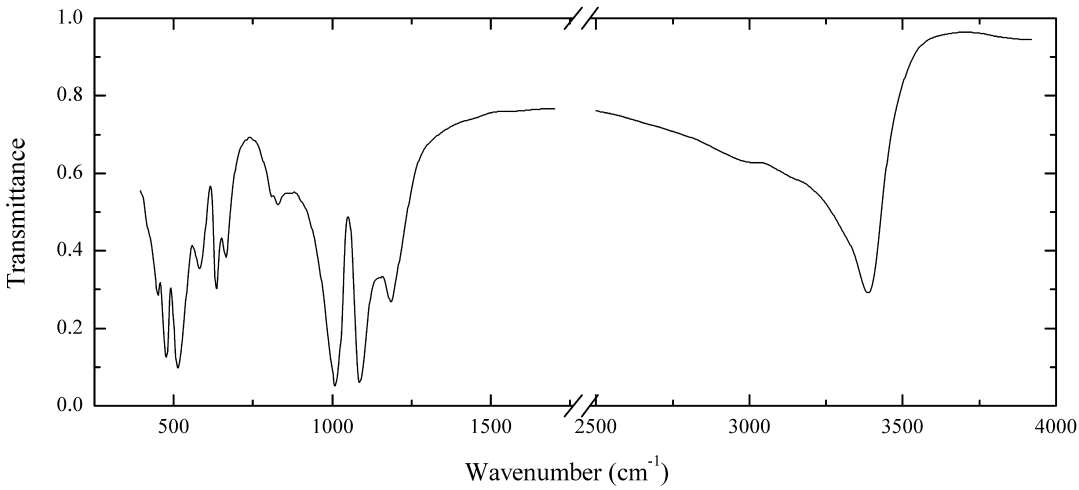


Locality: Chvaletice, Pardubice region, Bohemia, Czech Republic.

Description: Beige fibrous aggregate from the association with szmikite. The empirical formula is (electron mictoprobe) $(Mn_{0.66}Mg_{0.17}Fe_{0.15}Ni_{0.02})(Al_{1.96}Fe_{0.04})(SO_4)_{4.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3340s, 3070sh, 3000sh, 2540w, 1640, 1114s, 1082s, 992, 953, 823w, 708, 655sh, 616, 512sh, 470sh.

S223 Jarosite $KFe^{3+}_3(SO_4)_2(OH)_6$

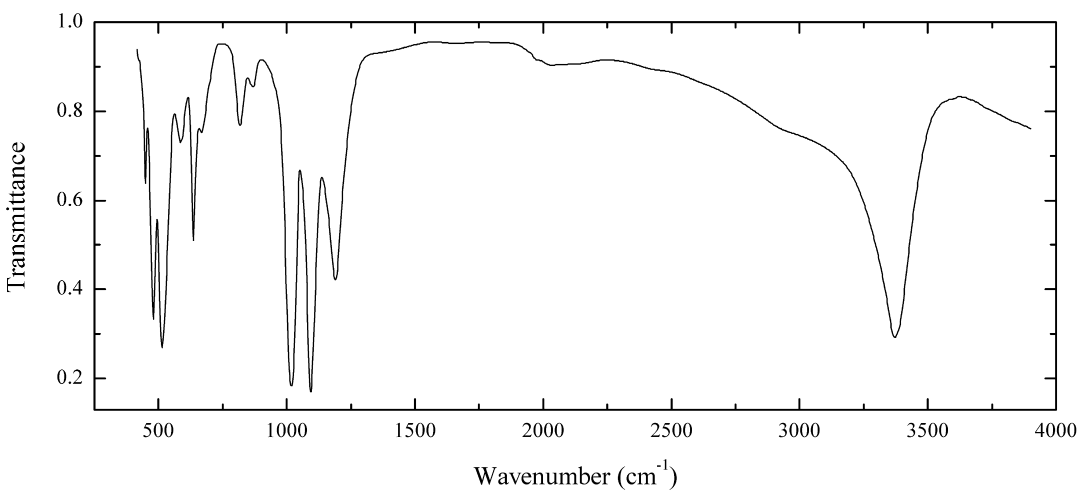


Locality: Large dump of the Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Yellow fine-grained aggregate from the association with scorodite. The empirical formula is (electron microprobe) $H_x(K_{0.93}Na_{0.04}Ca_{0.02}Pb_{0.01})(Fe_{2.94}Al_{0.02}Zn_{0.02})(SO_4)_{2.00}(OH)_6$. Confirmed by IR spectrum. Weak bands at 2,990, 826 and 810 cm^{-1} are due to the admixture of scorodite.

Wavenumbers (cm^{-1}): 3375s, 2990w, 1205sh, 1185, 1085s, 1105s, 826w, 810w, 665, 634, 580, 510s, 476s, 448.

S224 Natrojarosite $NaFe^{3+}_3(SO_4)_2(OH)_6$

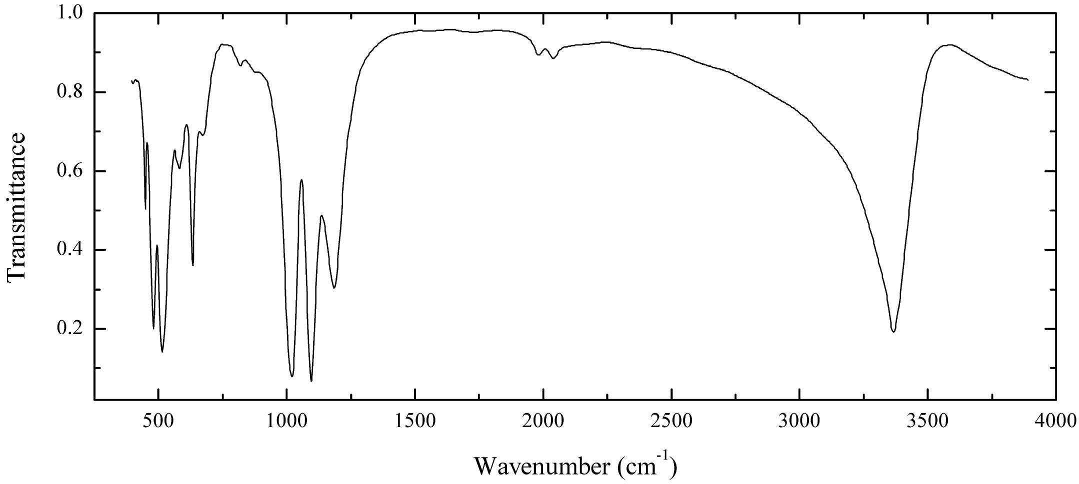


Locality: Large dump of the Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Yellow massive from the association with kamarizaite. The empirical formula is (electron microprobe) $(Na_{0.78}K_{0.20}Ca_{0.04}Pb_{0.03})(Fe_{2.84}Al_{0.10}Zn_{0.03}Mg_{0.03})[(SO_4)_{1.97}(AsO_4)_{0.03}](OH)_6$.

Wavenumbers (cm^{-1}): 3355s, 3000sh, 2035w, 1980sh, 1650w, 1190, 1095s, 1021s, 865w, 815, 667, 634, 584, 514s, 479s, 448.

S225 Natrojarosite $NaFe^{3+}{}_3(SO_4)_2(OH)_6$

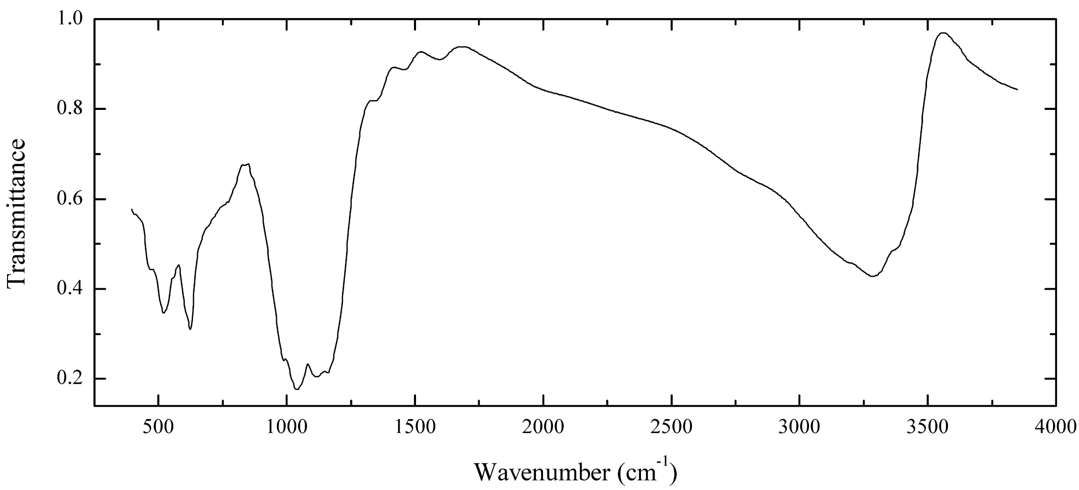


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Yellow massive from the association with goethite. The empirical formula is (electron microprobe) $(Na_{0.5}K_{0.3}Pb_{0.2})(Fe_{2.9}Al_{0.1})[(SO_4)_{1.8}(AsO_4)_{0.1}(SiO_4)_{0.1}](OH)_6$.

Wavenumbers (cm^{-1}): 3348s, 2040w, 1980w, 1186, 1095s, 1022s, 880w, 820w, 667, 632, 569, 513s, 480s, 449.

S226 Beaverite-(Cu) $Pb(Fe,Cu^{2+})_3(SO_4)_2(OH,H_2O)_6$

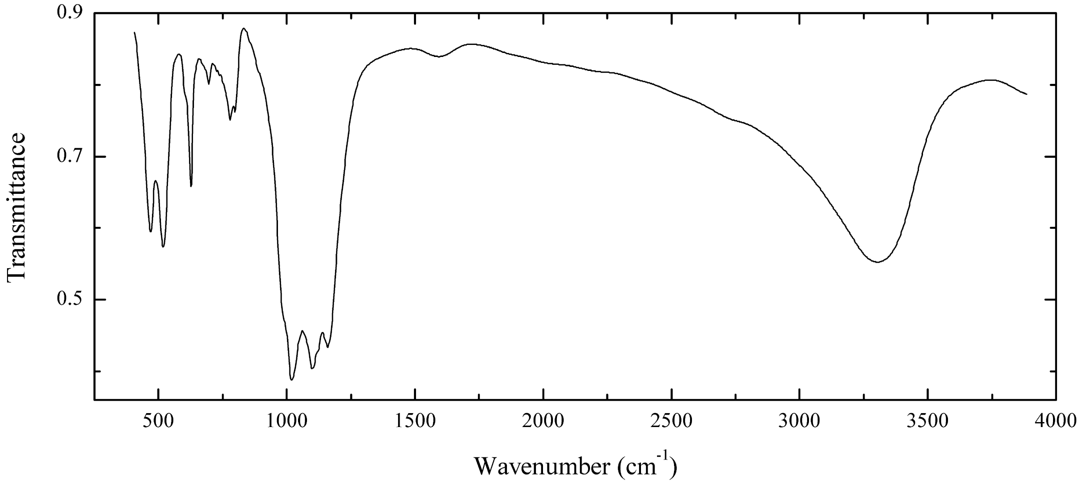


Locality: Stepnoe base-metal deposit, Rubtsovsk ore district, northwest Altai Mts., Siberia, Russia.

Description: Green granular aggregate from the association with quartz, barite, galena and pyrite. The empirical formula is $H_xPb_{1.03}(Cu_{1.05}Fe_{1.02}Al_{0.83})(SO_4)_{2.00}(OH,H_2O)_6$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 5.89 (100), 3.611 (17), 3.043 (42), 2.940 (9), 2.250 (9), 1.956 (9).

Wavenumbers (cm^{-1}): 3370sh, 3275, 3165, 2800sh, 2010sh, 1600w, 1465w, 1350w, 1162s, 1118s, 1046s, 987s, 760sh, 623, 520, 470sh.

S227 Beaverite-(Cu) $Pb(Fe,Cu^{2+})_3(SO_4)_2(OH,H_2O)_6$

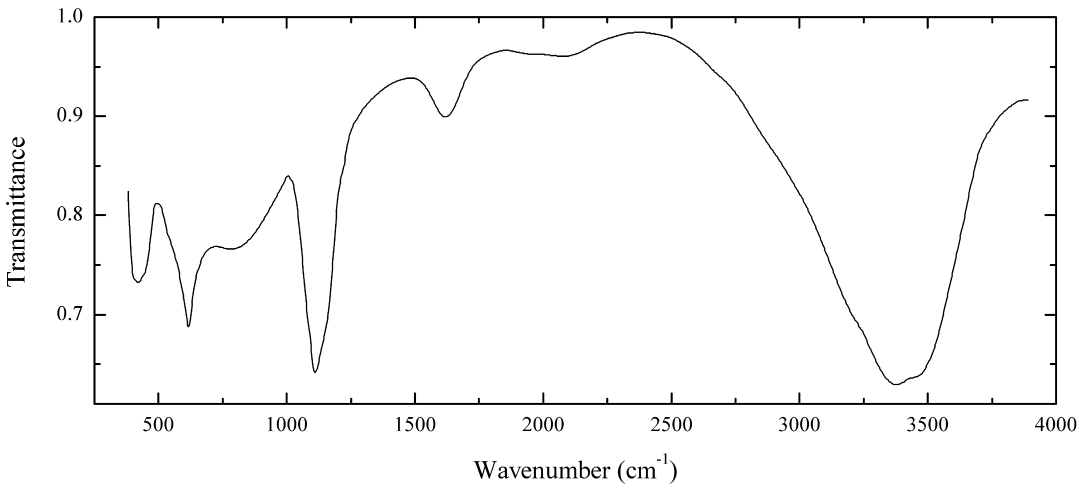


Locality: Stepnoe base-metal deposit, Rubtsovsk ore district, northwest Altai Mts., Siberia, Russia.

Description: Yellow fine-grained aggregate. Identified by IR spectrum and qualitative electron microprobe analysis. Contaminated by quartz.

Wavenumbers (cm^{-1}): 3290, 1618w, 1160s, 1120sh, 1101s, 1021s, 990sh, 797, 777, 694w, 650sh, 650sh, 516, 467.

S228 Glaucocerinite $(Zn,Cu^{2+})_{10}Al_6(SO_4)_3(OH)_{32}\cdot 18H_2O$

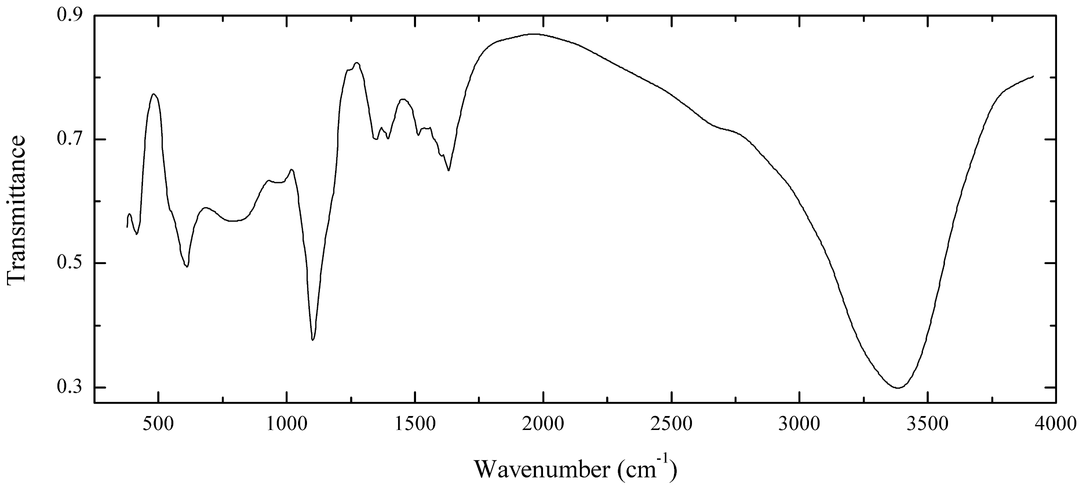


Locality: Christiana mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light green spherulitic crust. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3450sh, 3380s, 3200sh, 2920sh, 2100w, 1630, 1160sh, 1112s, 780, 617, 560sh, 410.

S229 Glaucocerinite $(Zn,Cu^{2+})_{10}Al_6(SO_4)_3(OH)_{32}\cdot18H_2O$

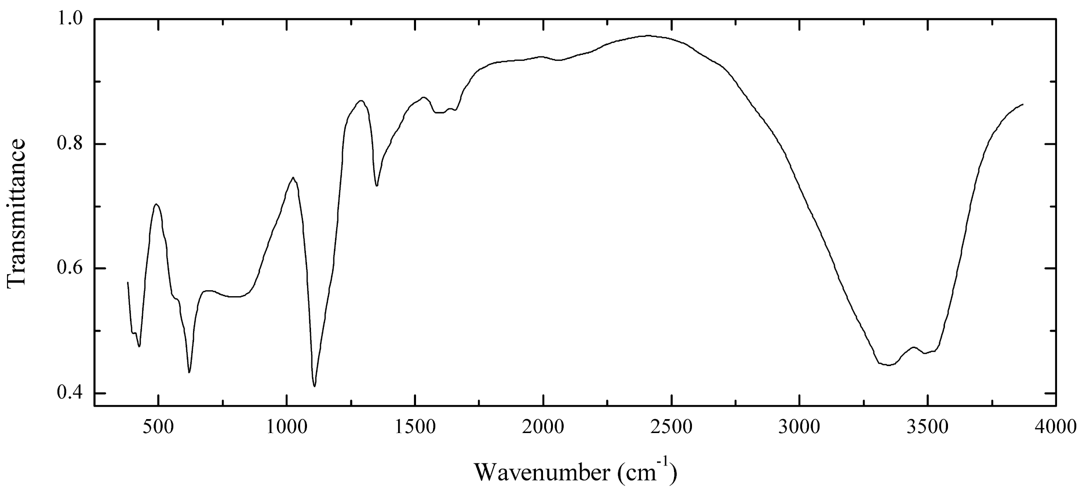


Locality: Christiana mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light blue spherulitic crust. The empirical formula is $(Zn_{6.6}Cu_{2.5}Al_{0.8}Fe_{0.1})Al_{6.0}[(SO_4)_{2.2}(SiO_4)_{0.1}(CO_3)_{0.7}](OH)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3375s, 2720sh, 1635, 1605sh, 1520w, 1397w, 1350w, 1180sh, 1105s, 965w, 790, 610, 550sh, 416.

S230 Glaucocerinite $(Zn,Cu^{2+})_{10}Al_6(SO_4)_3(OH)_{32}\cdot18H_2O$

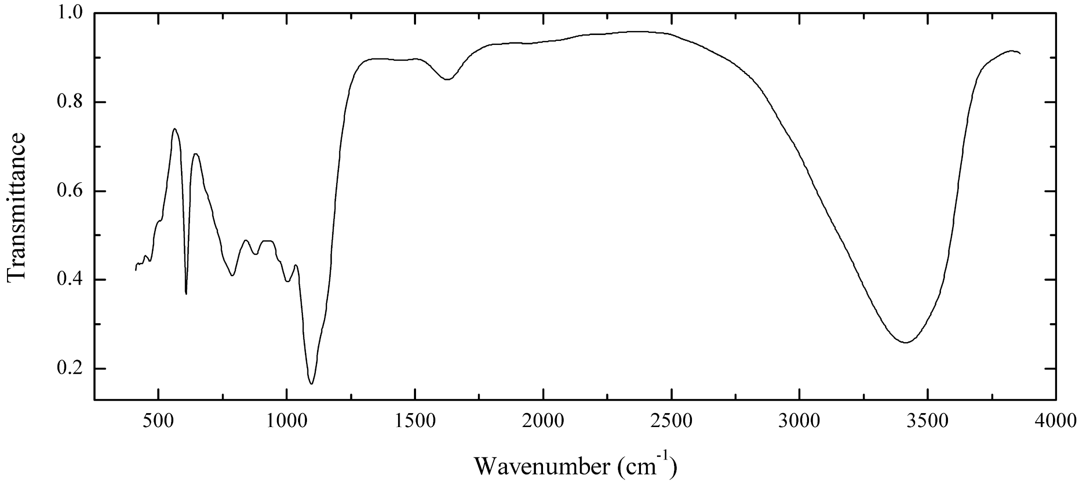


Locality: Serpieri mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light blue spherulitic crust. CO_3-bearing variety. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3460s, 3360s, 2060w, 1645, 1590sh, 1400sh, 1353, 1170sh, 1107s, 800, 617s, 570sh, 423, 402.

S231 Namuwite $(Zn,Cu^{2+})_4(SO_4)(OH)_6 \cdot 4H_2O$

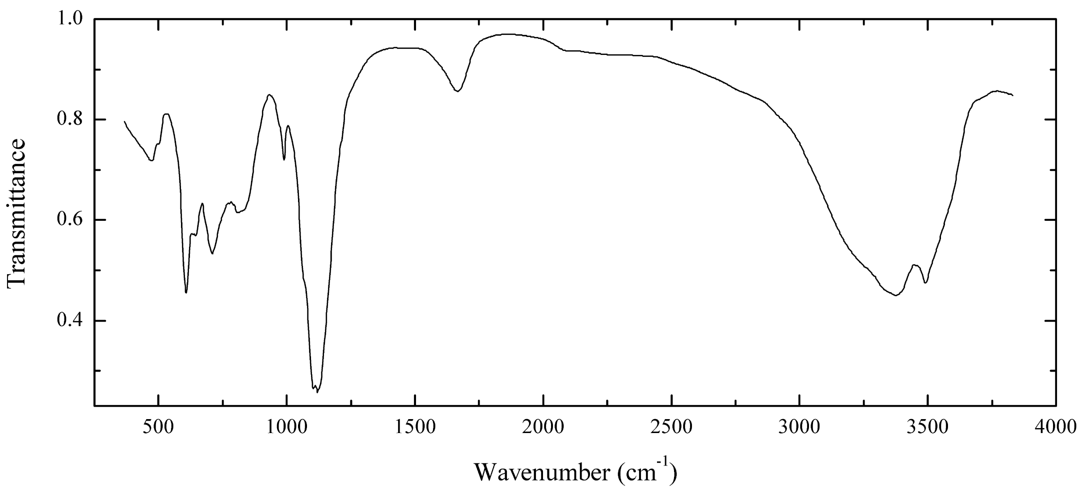


Locality: Jean Baptiste Mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light blue scaly aggregate from the association with serpierite. The empirical formula is $(Zn_{2.8}Cu_{1.0}Fe_{0.2})[(SO_4)_{0.8}(SiO_4)_{0.2}](OH)_6 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3390s, 1635w, 1430w, 1140sh, 1095s, 1005, 968, 877, 786, 606, 509, 468, 430, 410.

S232 Serpierite $Ca(Cu^{2+},Zn)_4(SO_4)_2(OH)_6 \cdot 3H_2O$

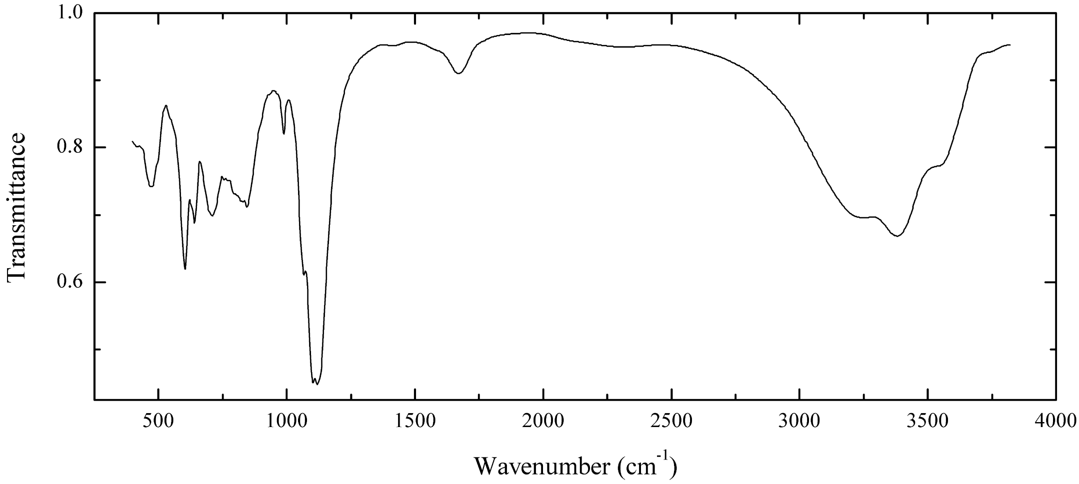


Locality: Jean Baptiste Mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Blue crystals from the association with namuwite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3580sh, 3495, 3375, 3225sh, 2080w, 1665w, 1121s, 1103s, 1070sh, 988, 835sh, 808, 707, 644, 606, 500w, 472, 430sh.

S233 Serpierite $Ca(Cu^{2+},Zn)_4(SO_4)_2(OH)_6{\cdot}3H_2O$

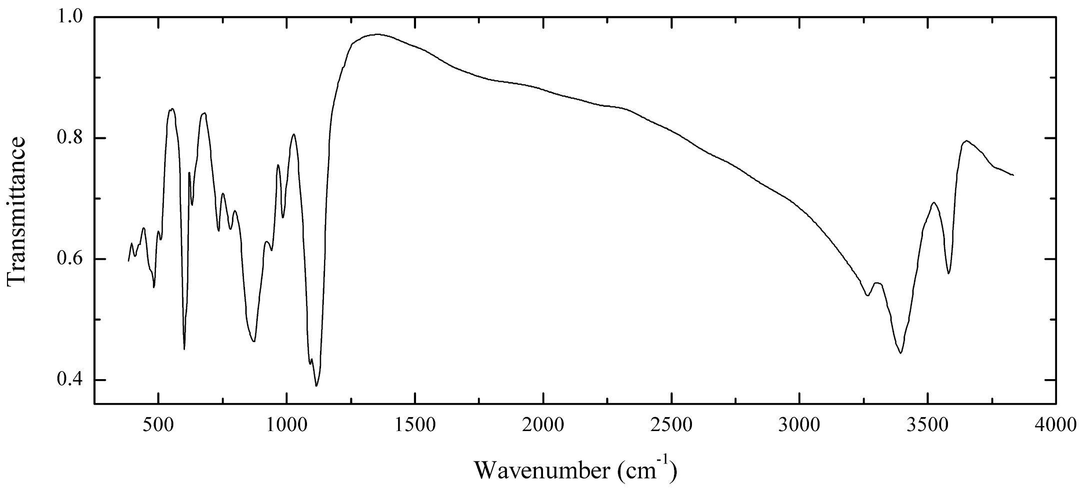


Locality: Large dump of the Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Bluish-green cellular aggregates. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3540, 3360, 3250, 2300w, 1605w, 1120s, 1105s, 1064, 988w, 844, 800sh, 709, 640, 604, 500sh, 472.

S234 Brochantite $Cu^{2+}{}_4(SO_4)(OH)_6$

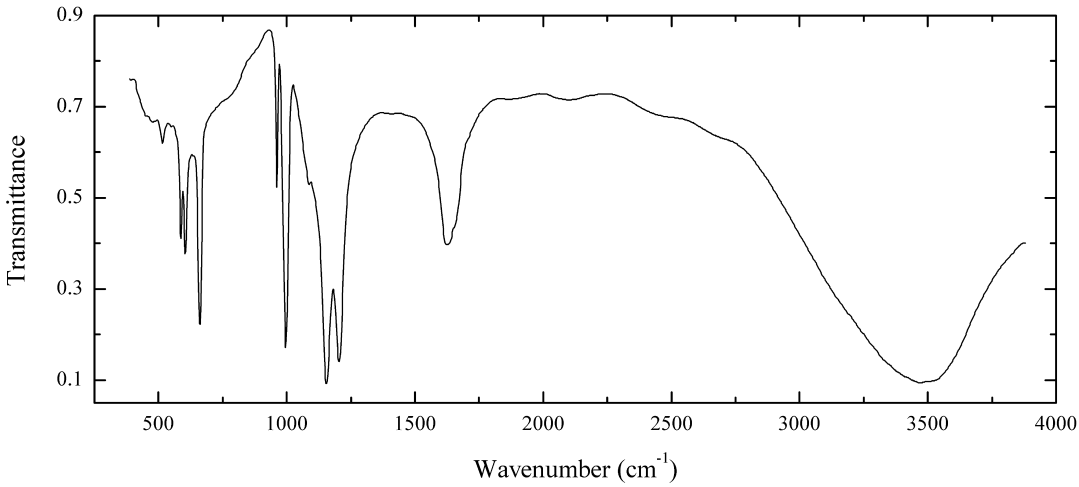


Locality: Large dump of the Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Bright green crystals from the association with serpierite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3565, 3400sh, 3377s, 3250, 1115s, 1088s, 984, 942, 871s, 780, 734, 627, 605sh, 599s, 507, 484, 465sh, 425sh, 409.

S235 Chalcanthite $Cu^{2+}(SO_4)\cdot 5H_2O$

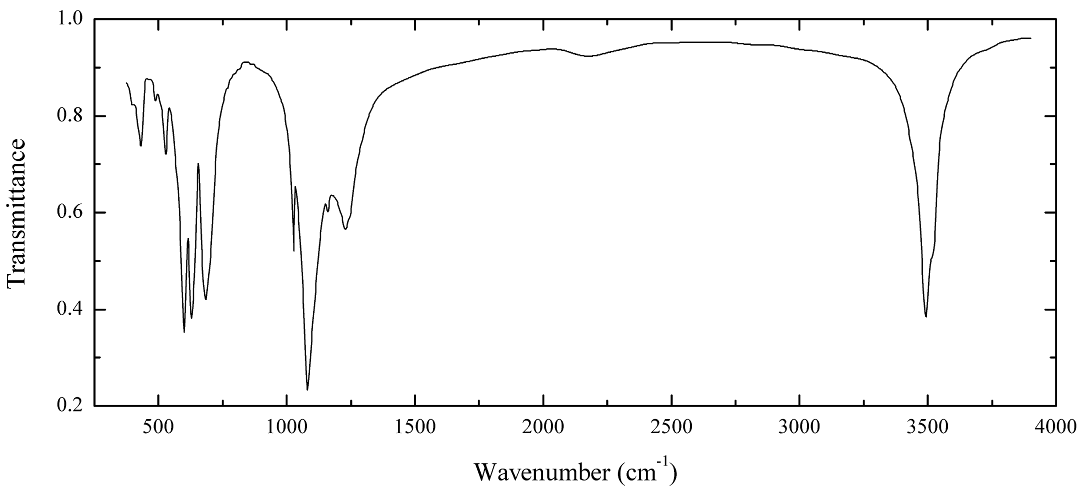


Locality: Hilarion mine, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Bluish-green platy crystals. Identified by IR spectrum and single-crystal X-ray diffraction pattern. Single-crystal unit-cell parameters are $a = 5.97$, $b = 6.12$, $c = 10.72$ Å, $\alpha = 102.7°$, $\beta = 82.2°$, $\gamma = 107.55°$.

Wavenumbers (cm^{-1}): 3470s, 2700sh, 2490w, 2100w, 1900w, 1627, 1204s, 1155s, 1087, 995s, 963, 770sh, 660, 604, 587, 517, 475sh.

S236 Alunite $KAl_3(SO_4)_2(OH)_6$

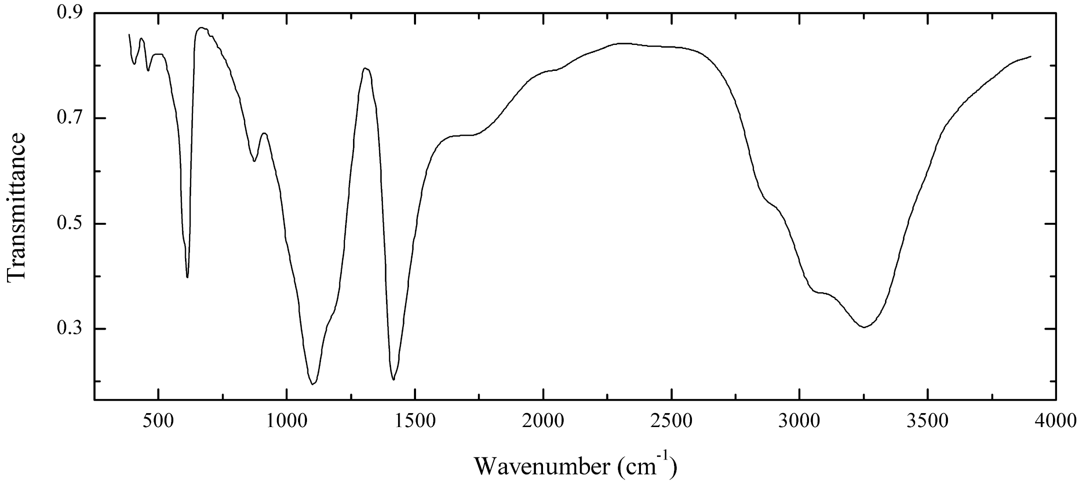


Locality: Sapes area, northern Greece.

Description: Beige crystals. The empirical formula is (electron microprobe) $(K_{0.87}Na_{0.05})(Al_{3.03}Fe_{0.03})[(SO_4)_{1.99}(PO_4)_{0.01}](OH)_6$.

Wavenumbers (cm^{-1}): 3500sh, 3475s, 2175w, 1230, 1162, 1082s, 682, 626, 600s, 575sh, 527, 485w, 430, 420sh, 400w.

S237 **Letovicite** $(NH_4)_3H(SO_4)_2$

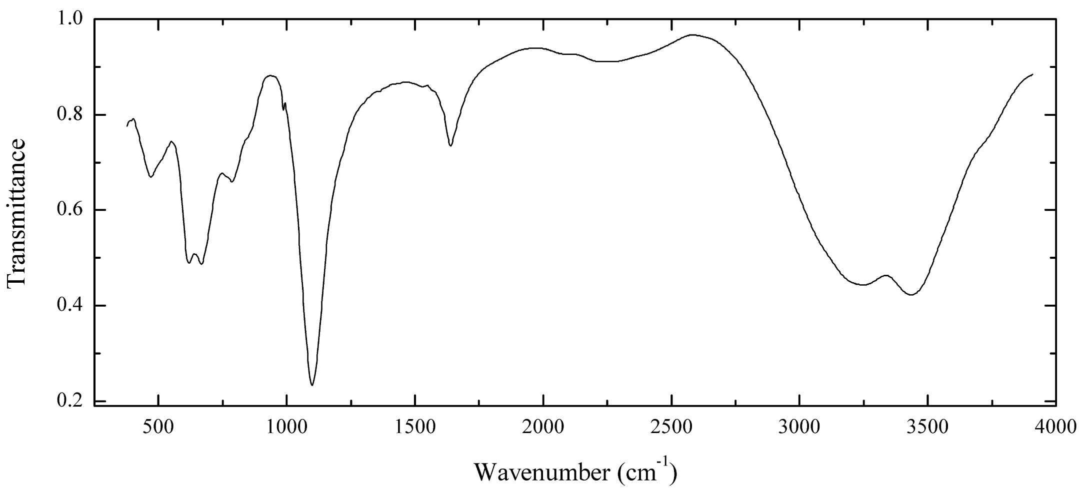


Locality: Near the former settlement of Ravat, about 3 km east of the confluence of the rivers Jagnob and Iskanderdar'ya, Tajikistan.

Description: Coarse-grained aggregate. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3230s, 3037, 2860, 2030sh, 1700, 1416s, 1180sh, 1103s, 1010sh, 875, 613, 600, 458w, 404w.

S238 **Retgersite** $Ni(SO_4)\cdot 6H_2O$

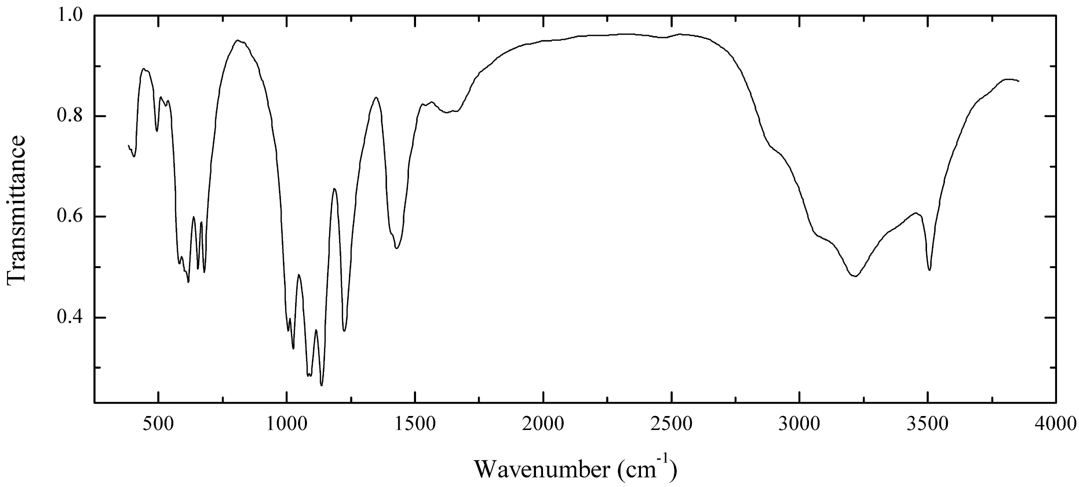


Locality: Pechenga Ni–Cu ore field, Pechengskiy district, Kola peninsula, Murnansk region, Russia.

Description: Bluish-green massive. Identified by IR spectrum, powder X-ray diffraction pattern and semiquantitative electron microprobe analysis (Ni $\gg$ Mg).

Wavenumbers (cm^{-1}): 3440s, 3245s, 2250w, 2070w, 1645, 1096s, 986w, 845sh, 785, 665, 617, 470.

S239 Adranosite $(NH_4)_4NaAl_2(SO_4)_4Cl(OH)_2$

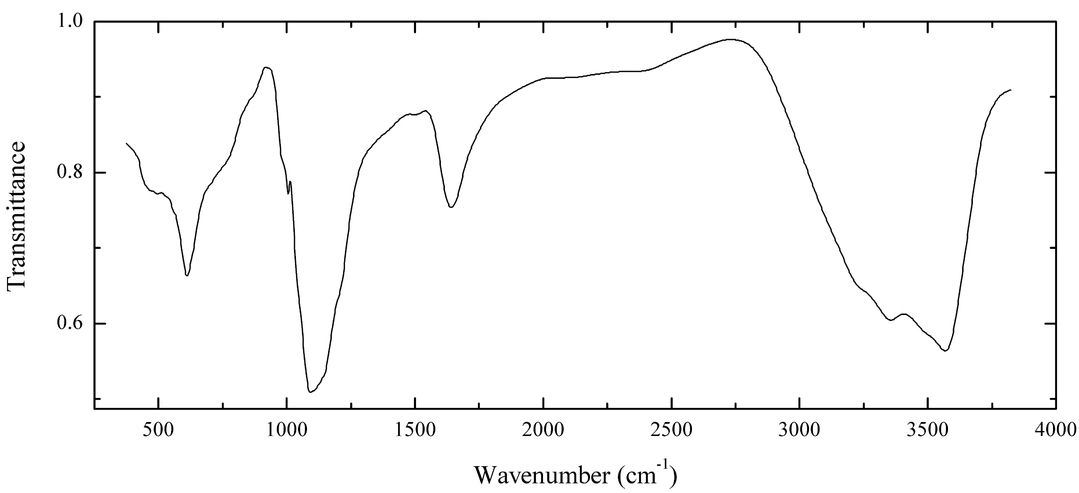


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy (type locality).

Description: White columnar aggregate from the association with alunite. Identified by IR spectrum. The empirical formula is (electron microprobe) $[(NH_4)_xK_{0.2}]Na_{0.8}Al_{2.0}(SO_4)_{4.0}Cl_{1.0}(OH)_2$.

Wavenumbers (cm^{-1}): 3495, 3410sh, 3200, 3060sh, 2890sh, 1665w, 1620w, 1424, 1405sh, 1226s, 1134s, 1090s, 1080s, 1023s, 1002s, 675, 651, 612, 600sh, 577, 488w, 395.

S240 Melanterite $Fe^{2+}(SO_4)\cdot 7H_2O$

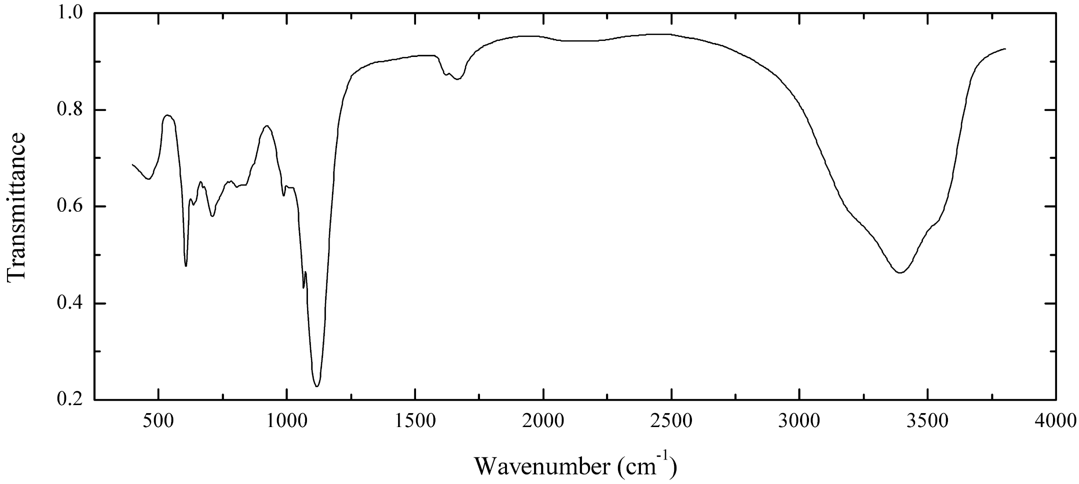


Locality: Abandoned Third Factory mine, Seimchan river, Srednekanskiy district, Magadan region, Russia.

Description: Greenish-blue semitransparent, massive. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3545s, 3330s, 3220sh, 1637, 1200sh, 1135sh, 1094s, 1005, 980sh, 855sh, 740sh, 611, 500sh.

S241 Serpierite $Ca(Cu^{2+},Zn)_4(SO_4)_2(OH)_6{\cdot}3H_2O$

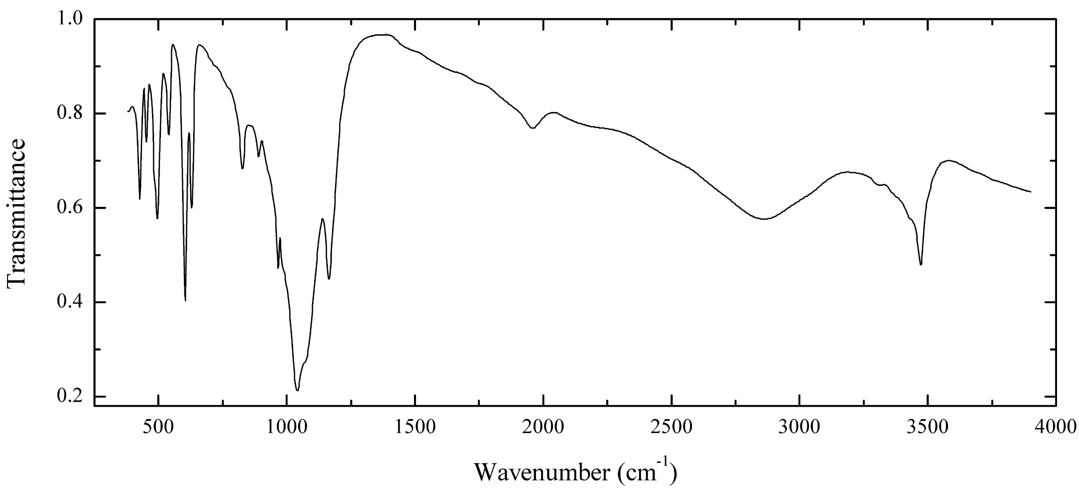


Locality: Serpieri mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Greenish-blue crystals. Identified by IR spectrum. The empirical formula is (electron microprobe) $Ca_{0.9}(Cu_{3.4}Zn_{0.8})(SO_4)_{2.0}(OH,O)_6{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3380s, 3200sh, 1665w, 1617w, 1121s, 1105sh, 1065, 1014, 987, 835, 804, 710, 645sh, 635, 607, 490sh, 458.

S242 Linarite $PbCu^{2+}(SO_4)(OH)_2$

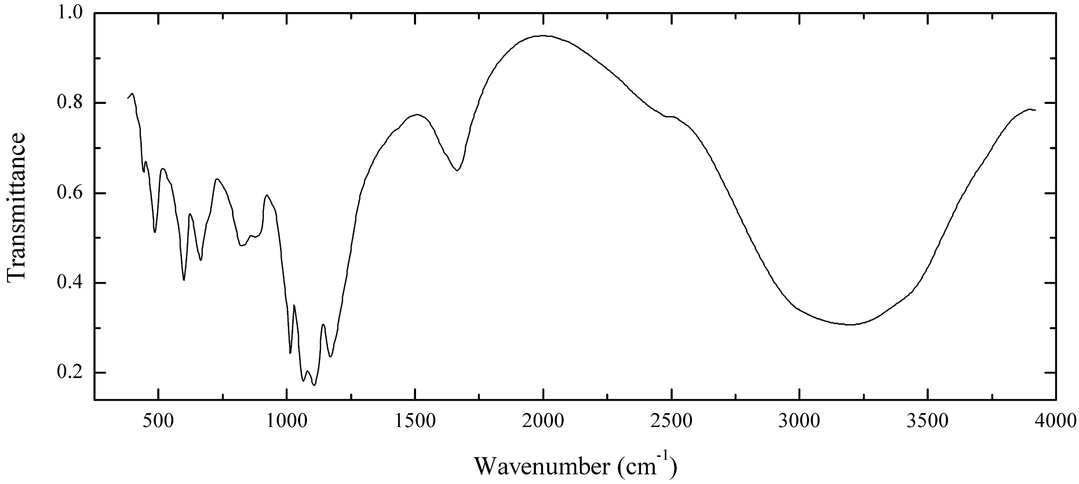


Locality: Goulmina mine, Er Rachidia, Er Rachidia province, Meknès-Tafilalet region, Morocco.

Description: Blue massive from the association with brochantite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3442, 3400sh, 3360sh, 3310w, 2840, 2200sh, 1948w, 1166s, 1070sh, 1040s, 985sh, 966, 888, 826, 629, 603s, 538, 497, 485sh, 450, 425.

S243 Coquimbite $Fe^{3+}{}_2(SO_4)_3{\cdot}9H_2O$

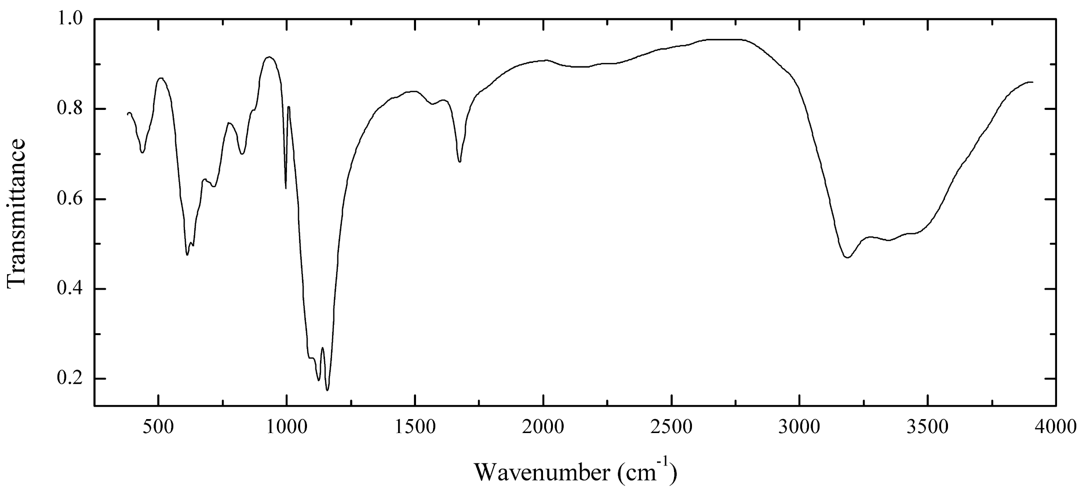


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: White granular aggregate. As-bearing variety. The empirical formula is (electron microprobe) $(Fe_{1.96}Al_{0.12}Cr_{0.01})[(SO_4)_{2.88}(AsO_4)_{0.12}]{\cdot}nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3425sh, 3190s, 3000sh, 2485w, 1660, 1170s, 1109s, 1065s, 1013s, 995sh, 875, 822, 665, 595, 484, 442w.

S244 Blödite $Na_2Mg(SO_4)_2{\cdot}4H_2O$

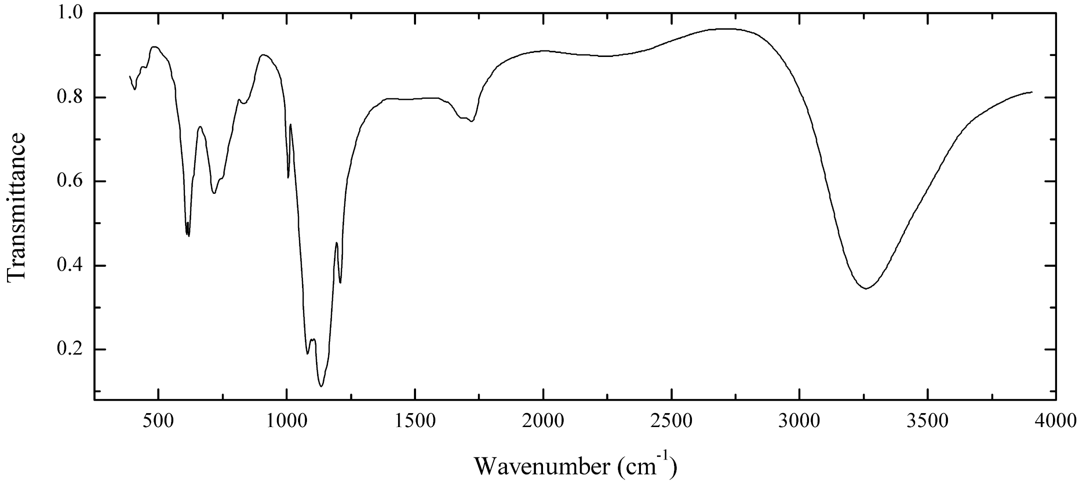


Locality: Strip mine, Soda Lake deposit, Carrizo Plain, San Luis Obispo Co., California, USA.

Description: Grey crystal. Identified by IR spectrum.

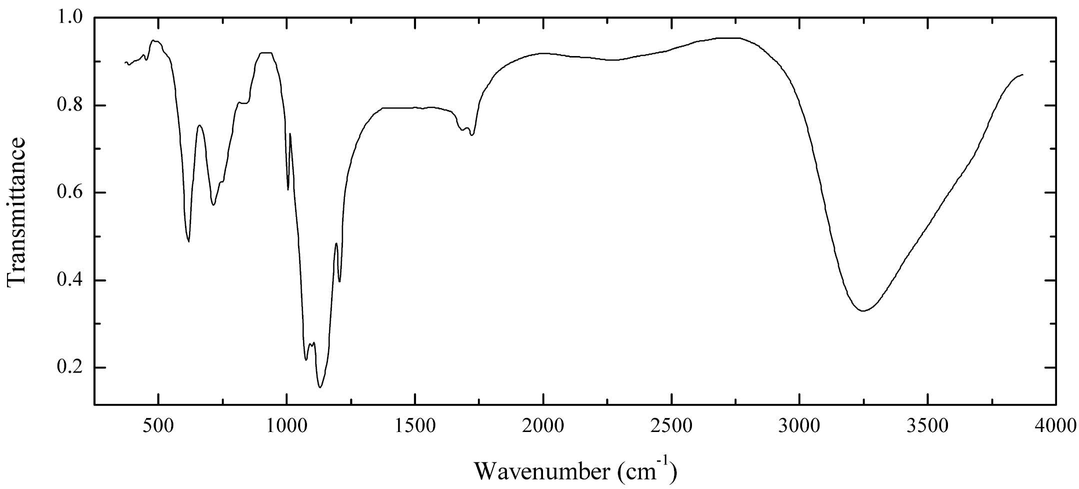
Wavenumbers (cm^{-1}): 3435, 3330, 3170s, 2250w, 2150w, 1675, 1570w, 1161s, 1127s, 1090s, 997, 870sh, 825, 716, 655sh, 637, 614, 465sh, 439.

S245 Leonite $K_2Mg(SO_4)_2 \cdot 4H_2O$



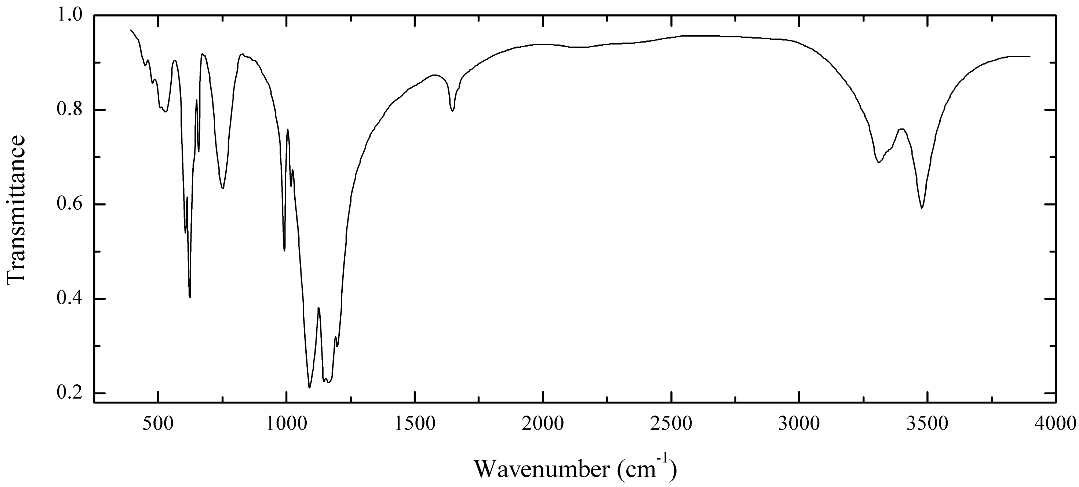
Locality: Adolfsglück Hope mine, Lower Saxony, Germany.
Description: Colourless crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3237s, 2250w, 1723, 1682, 1208, 1155sh, 1136s, 1103s, 1082s, 1005, 830w, 745sh, 716, 635sh, 618, 610, 450w, 405w.

S246 Leonite $K_2Mg(SO_4)_2 \cdot 4H_2O$



Locality: Wintershall Potash Works, Heringen, Werra valley, Hesse, Germany.
Description: White fine-grained aggregate forming pseudomorph after picromerite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3600sh, 3235s, 2250w, 1723, 1685, 1207s, 1150sh, 1133s, 1103s, 1078s, 1005, 835, 747, 715, 635sh, 619, 610, 453w, 402w.

S247 Polyhalite $K_2Ca_2Mg(SO_4)_4·2H_2O$

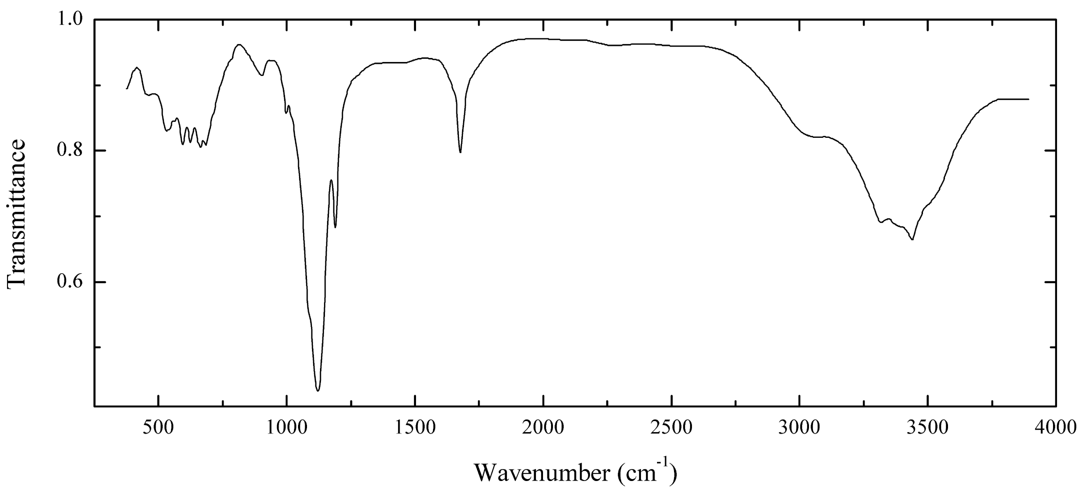


Locality: Inder boron deposit, Atyrau region, Kazakhstan.

Description: Grey massive. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3435, 3310sh, 3270, 1642w, 1197s, 1160s, 1142s, 1087s, 1017w, 991, 751, 657w, 640sh, 622, 606, 530w, 505w, 477w, 450w, 440sh.

S248 Lannonite $HCa_4Mg_2Al_4(SO_4)_8F_9·32H_2O$

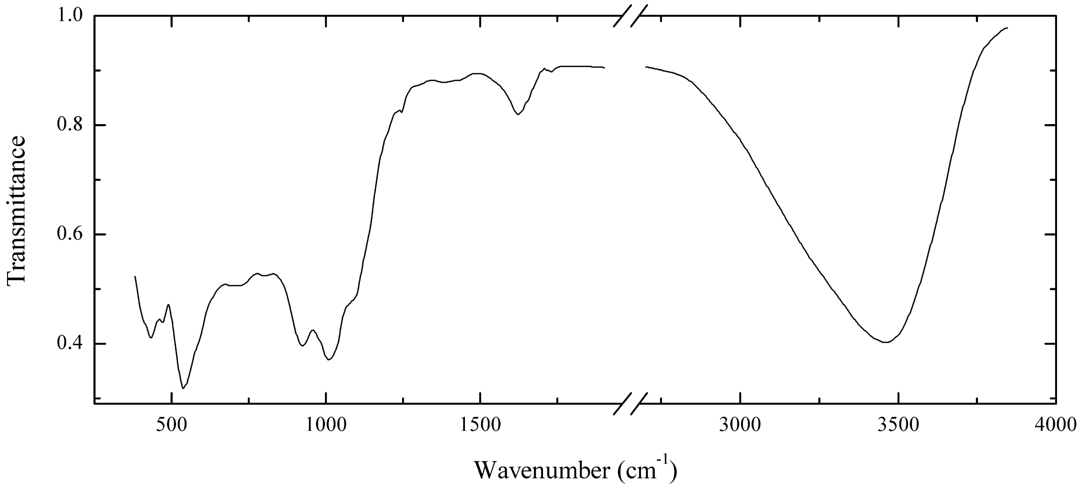


Locality: Lone Pine mine, Catron Co., New Mexico, USA (type locality).

Description: White granular aggregate from the association with gypsum. The empirical formula is (electron microprobe) $H_xCa_{3.7}Mg_{2.1}Al_{4.0}(SO_4)_{8.0}F_{8.1}(OH)_y·nH_2O$.

Wavenumbers (cm^{-1}): 3480sh, 3420, 3375sh, 3300, 3020, 1673, 1190, 1122s, 1090sh, 996, 902w, 683, 663, 623, 584, 530, 460w.

S249 Nickelalumite $NiAl_4(SO_4)(OH)_{12}{\cdot}3H_2O$

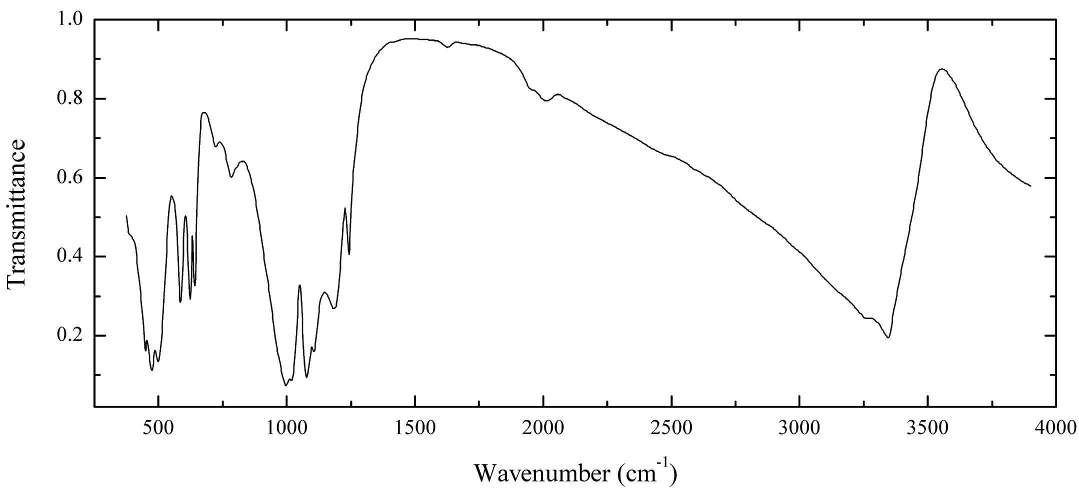


Locality: Kara-Chagyr Mt., Alai range, Osh region, Kyrgyzstan.

Description: Pale blue crust. The empirical formula is (electron microprobe) $Ni_{0.56}Mg_{0.14}Fe_{0.08}Cu_{0.05}Zn_{0.04}Al_{3.23}[(SO_4)_{0.73}(VO_4)_{0.27}](OH)_x{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3475s, 1720w, 1625, 1435sh, 1380w, 1245w, 1095sh, 1016s, 925, 805, 725, 580sh, 541s, 470, 425.

S250 Plumbojarosite $PbFe^{3+}{}_6(SO_4)_4(OH)_{12}$

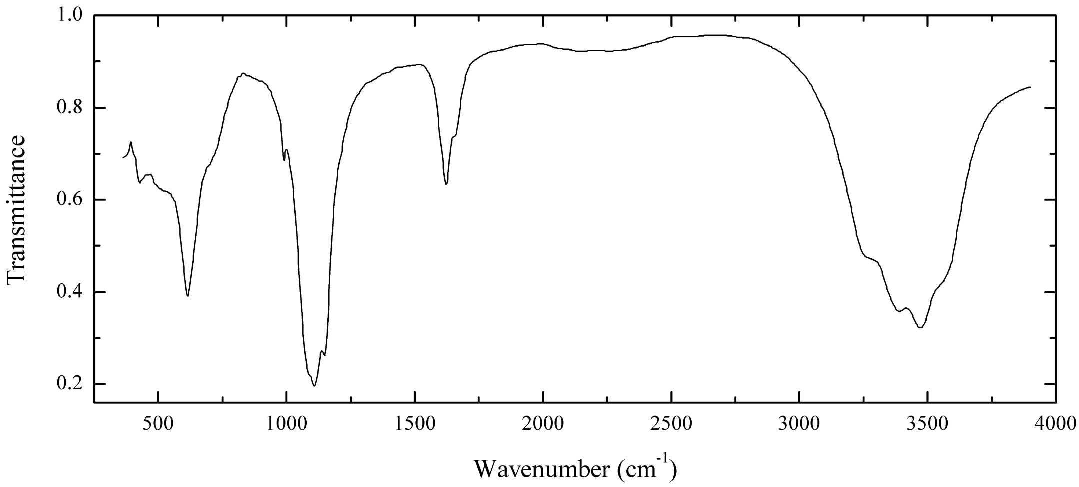


Locality: Akatui Pb–Zn deposit, Akatui, Chita region, Transbaikal area, Eastern Siberia, Russia.

Description: Brown fine-grained aggregate from the association with galena and quartz. Investigated by V.I. Stepanov. The splitting of some bands as compared with most of other samples of jarosite-group minerals can be raised by the ordering of Pb and vacancies.

Wavenumbers (cm^{-1}): 3345s, 3250, 2015w, 1960w, 1635w, 1248, 1188, 1108s, 1078s, 1019s, 1000s, 765, 724w, 640, 626, 585, 499s, 475s, 448s, 390sh.

S251 Rozenite $Fe(SO_4)\cdot 4H_2O$

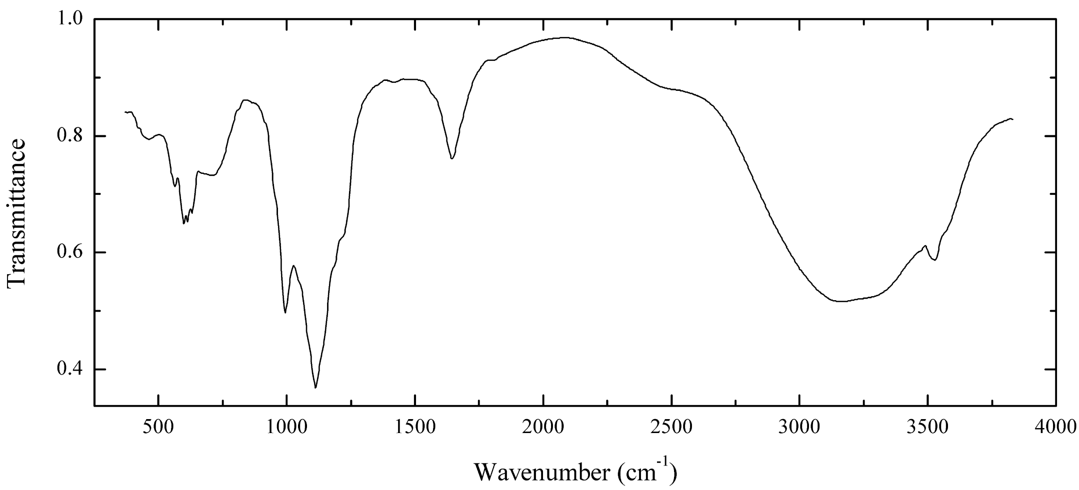


Locality: Plaka mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: White earthy aggregate from the association with magnesiocopiapite and halotrichite. The empirical formula is (electron microprobe) $(Fe_{0.78}Mg_{0.19}Zn_{0.01}Al_{0.01})(SO_4)_{1.00}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3525sh, 3453s, 3370s, 3240sh, 2150w, 1655sh, 1620, 1150s, 1111s, 1090sh, 990w, 700sh, 613, 525, 430w.

S252 Magnesiocopiapite $MgFe^{3+}_4(SO_4)_6(OH)_2\cdot 20H_2O$

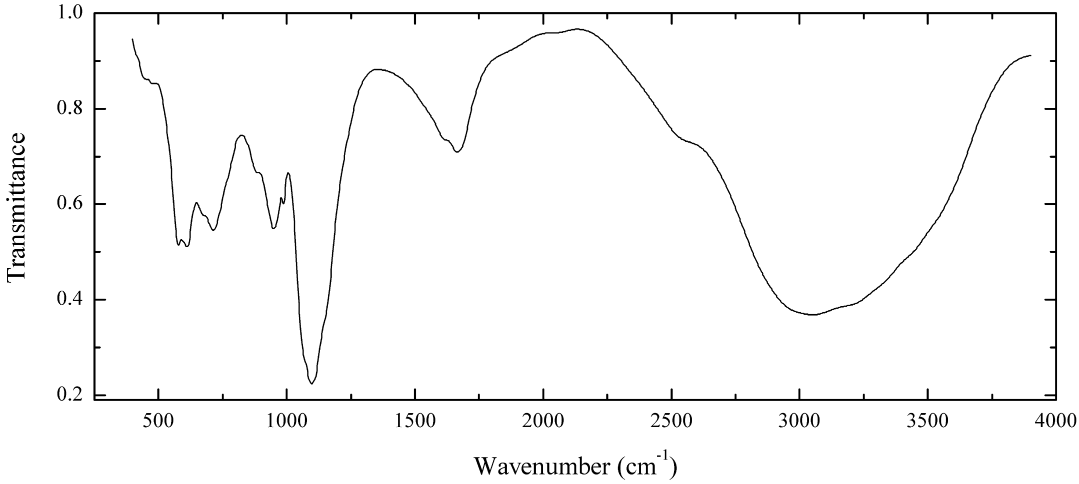


Locality: Plaka mine, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Yellow-brown globular aggregate from the association with rozenite and halotrichite. The empirical formula is (electron microprobe) $Mg_{1.01}(Fe_{4.02}Al_{0.04})(SO_4)_{6.00}(OH)_2\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3522, 3260sh, 3155s, 2500w, 1648, 1220sh, 1185sh, 1114s, 995s, 702, 630, 612, 598, 563, 455w.

S253 Alunogen $Al_2(SO_4)_3{\cdot}17H_2O$

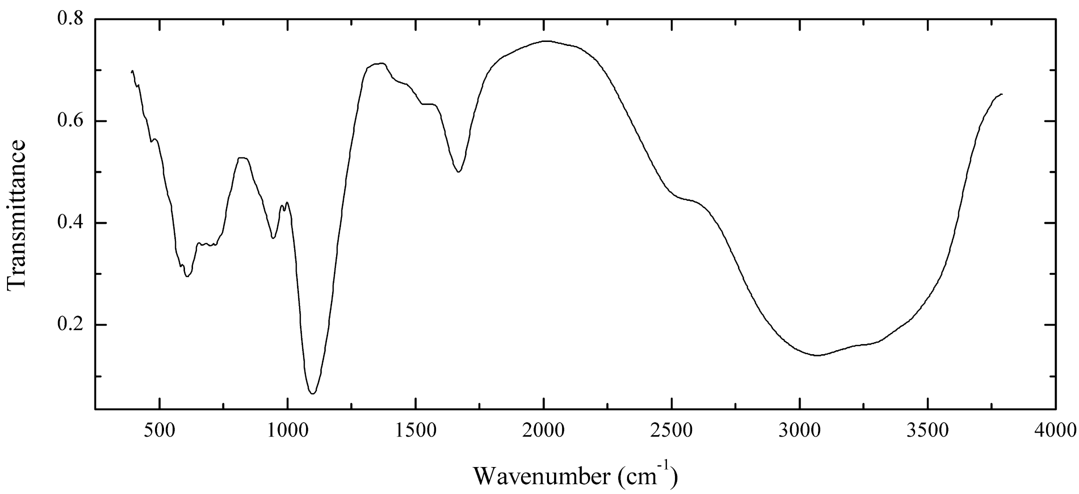


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: White platelets. The empirical formula is (electron microprobe) $(Al_{1.93}Fe_{0.06}Zn_{0.01}Mn_{0.01})(SO_4)_{3.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3400sh, 3200sh, 3010s, 2565sh, 1660, 1620w, 1098s, 1075sh, 985, 947, 885sh, 713, 611, 576, 485sh, 465w.

S254 Alunogen $Al_2(SO_4)_3{\cdot}17H_2O$

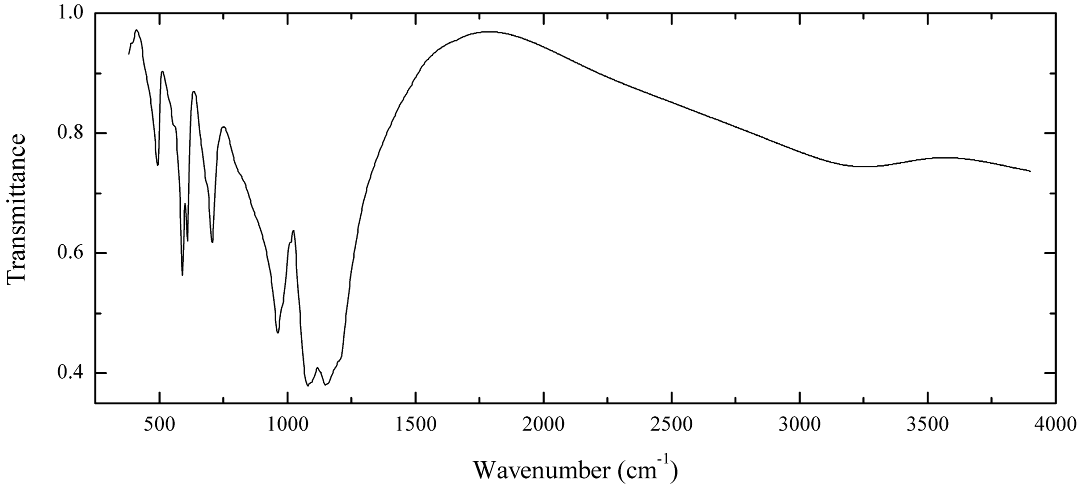


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: White massive. The empirical formula is (electron microprobe) $(Al_{1.93}Fe_{0.06}Mn_{0.02})(SO_4)_{3.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3410sh, 3250s, 3050s, 2550sh, 1670, 1570sh, 1460sh, 1104s, 1090sh, 988, 947, 700, 610, 580sh, 465w.

S255 Chalcocyanite $Cu^{2+}(SO_4)$

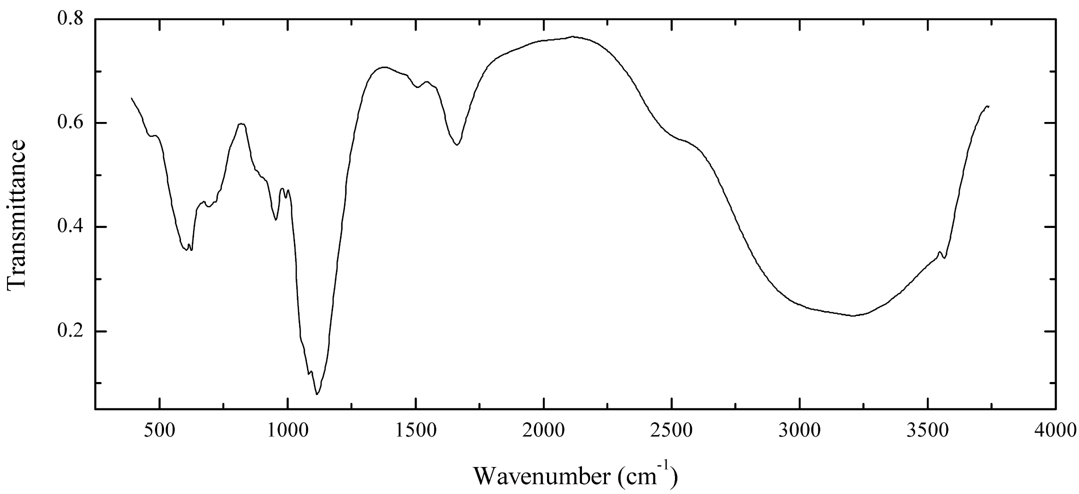


Locality: Fumarole Yadovitaya, Tolbachik volcano, Kamchatka, Russia.

Description: Grey semitransparent from the association with dolerophanite and euchlorine. Identified by IR spectrum and powder X-ray diffraction pattern. Slightly hydrated.

Wavenumbers (cm^{-1}): 3260w, 1200sh, 1152s, 1090sh, 1079s, 1016, 985sh, 964s, 705, 680sh, 608, 589, 565sh, 491.

S256 Dietrichite $ZnAl_2(SO_4)_4{\cdot}22H_2O$

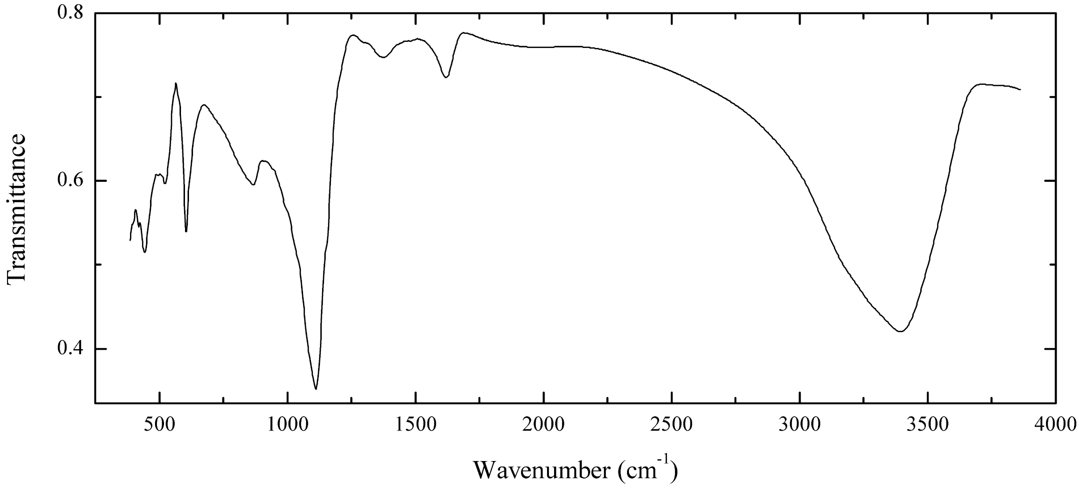


Locality: Agios Philippos Pb–Zn deposit, Kirki district, Thraki (Thrace) department, Greece.

Description: Beige fibrous aggregate from the association with gypsum. The empirical formula is (electron microprobe) $Zn_{1.17}Mg_{0.04}(Al_{1.64}Fe_{0.14})(SO_4)_{4.00}{\cdot}nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3560, 3210s, 3050sh, 2550sh, 1660, 1505w, 1115s, 1079s, 994, 954, 900sh, 690, 625, 600, 466.

S257 Ramsbeckite $(Cu^{2+},Zn)_{15}(SO_4)_4(OH)_{22}\cdot 6H_2O$

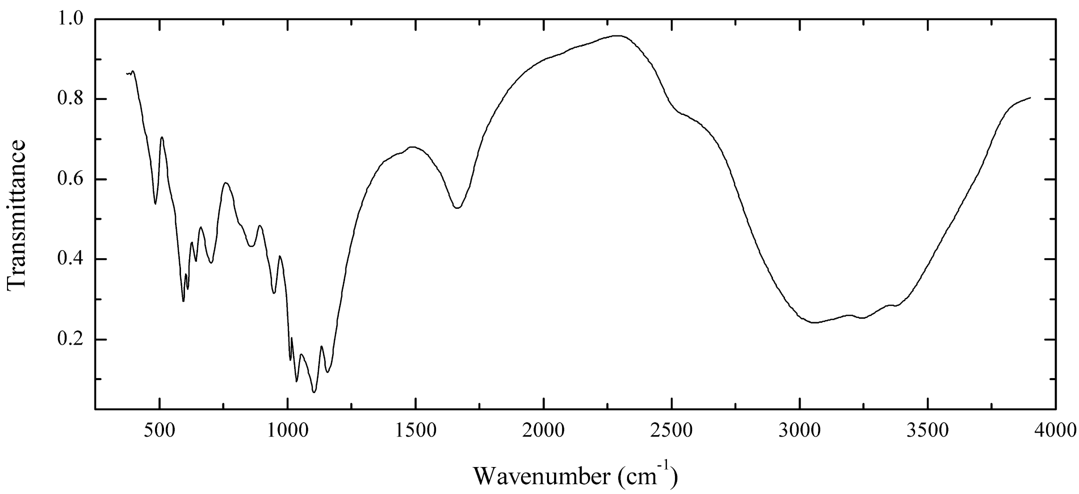


Locality: Ochsenhütte, Goslar, Harz, Germany.

Description: Emerald-green crystals. Single-crystal unit-cell parameters are $a = 16.090(11)$, $b = 15.572(9)$, $c = 7.085(5)$ Å, $\beta = 90.04(6)°$. Confirmed by semiquantitative electron microprobe analysis (Cu:Zn:S ≈ 3:1:1).

Wavenumbers (cm^{-1}): 3370s, 3180sh, 1630, 1375w, 1155sh, 1113s, 1000sh, 867, 620sh, 605, 525, 444, 422.

S258 Aluminocoquimbite $(Fe^{3+},Al)_3Al(SO_4)_6\cdot 18H_2O$

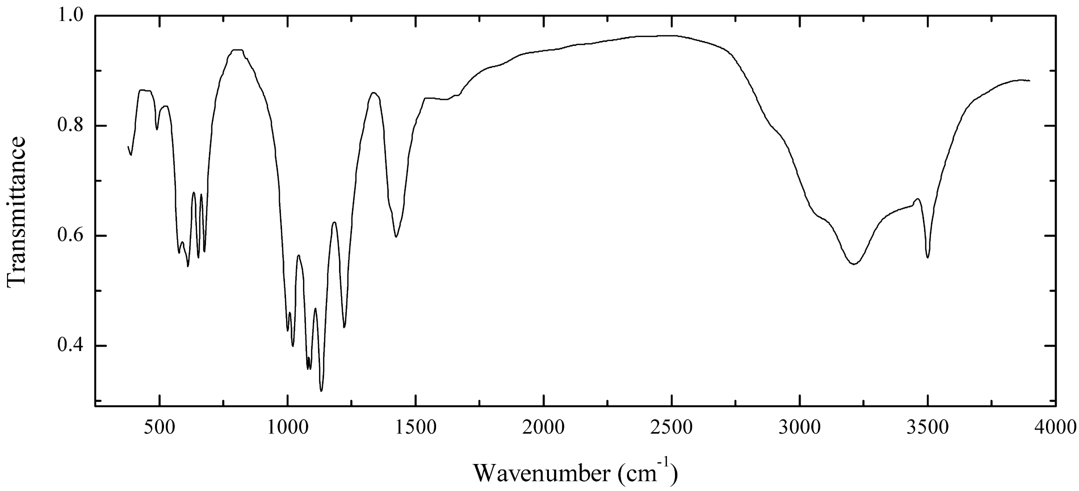


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Pink crystals. The empirical formula is (electron microprobe) $(Fe_{2.1}Al_{0.9})Al_{1.0}(SO_4)_{6.0}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3375, 3235s, 3050s, 2525sh, 1662, 1159s, 1104s, 1038s, 1012s, 949, 860, 815sh, 704, 645, 611, 596, 485.

S259 Adranosite $(NH_4)_4NaAl_2(SO_4)_4Cl(OH)_2$

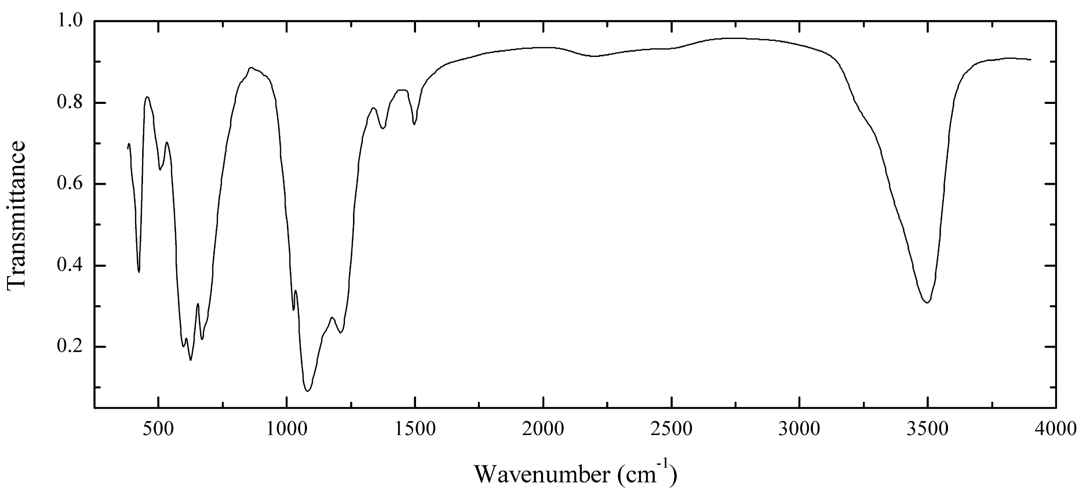


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy (type locality).

Description: White crust from the association with NH_4-rich alunite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3492, 3350sh, 3197, 3075sh, 2880sh, 1820sh, 1670sh, 1622w, 1428, 1410sh, 1225s, 1137s, 1093s, 1081s, 1025s, 1003s, 677, 653, 616, 602, 581, 525w, 492, 402.

S260 "Plumboalunite" $PbAl(SO_4)_4(OH)_{12}$

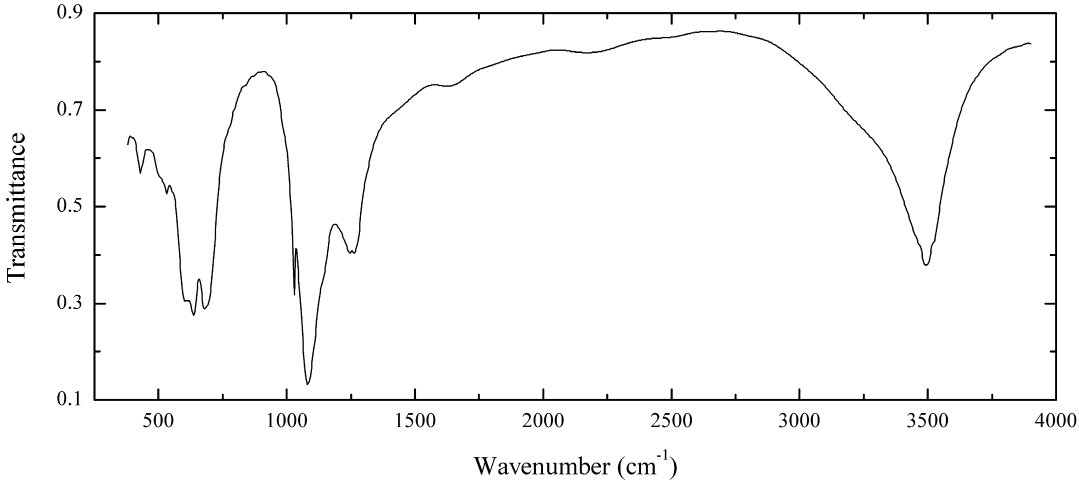


Locality: Rubtsovskoe base-metal deposit, Rubtsovsk ore district, northwest Altai Mts., Siberia, Russia.

Description: Brownish-green earthy aggregate. Al-dominant analogue of plumbojarosite. Not approved by the IMA CNMNC. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $(Pb_{0.9}K_{0.8})(Al_{5.3}Cu_{0.5}Fe_{0.1}Zn_{0.1})(SO_4)_{4.0}(OH)_{12}$. Weak bands at 1,497 and 1,375 cm^{-1} are caused by the admixture of rosasite.

Wavenumbers (cm^{-1}): 3475s, 3340sh, 3220sh, 2505w, 2200w, 1497w, 1375w, 1209s, 1081s, 1027, 680sh, 667s, 625s, 595s, 510sh, 503, 420.

S261 **Alunite** $KAl_3(SO_4)_2(OH)_6$

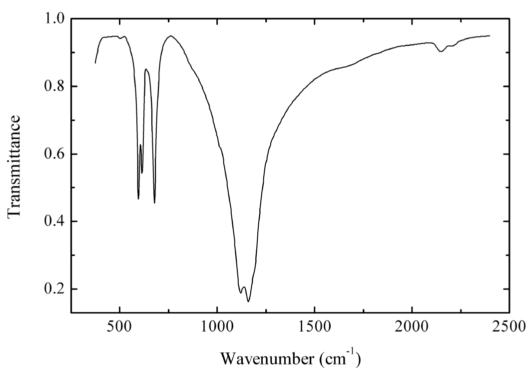


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Yellow porcelain-like fine-grained aggregate. F-bearing variety. The empirical formula is (electron microprobe) $(K_{0.96}Na_{0.06})(Al_{2.97}Fe_{0.01})(SO_4)_{2.00}(OH,H_2O)_{5.0}F_{1.0}$.

Wavenumbers (cm^{-1}): 3475, 3270sh, 2280w, 1635w, 1420sh, 1262, 1244, 1080s, 1029, 685sh, 675s, 634s, 602s, 532w, 429w.

S262 **Anhydrite** $Ca(SO_4)$

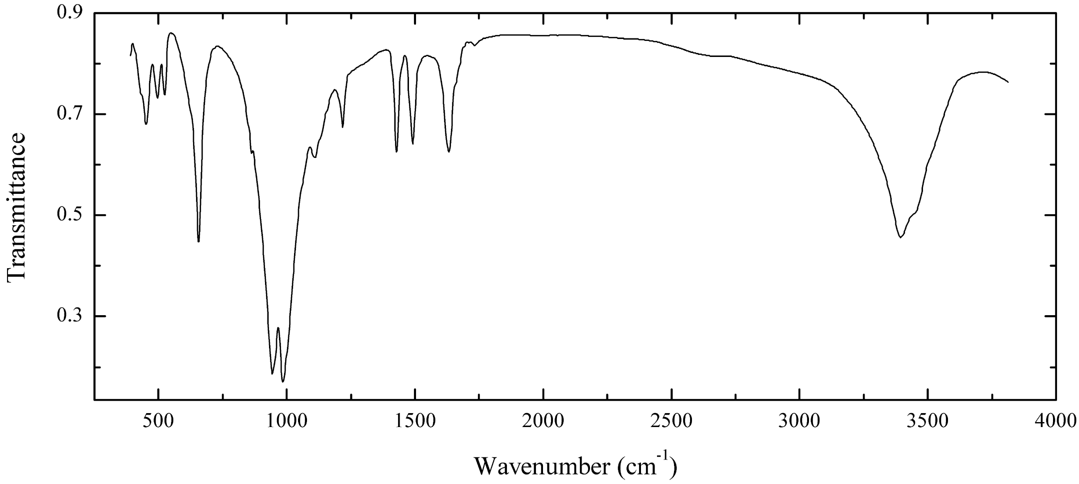


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Colourless crystals. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 2180w, 2125w, 1175sh, 1156s, 1118s, 1010w, 677, 616, 595, 509w.

S263 Hannebachite $Ca(SO_3)·0.5H_2O$

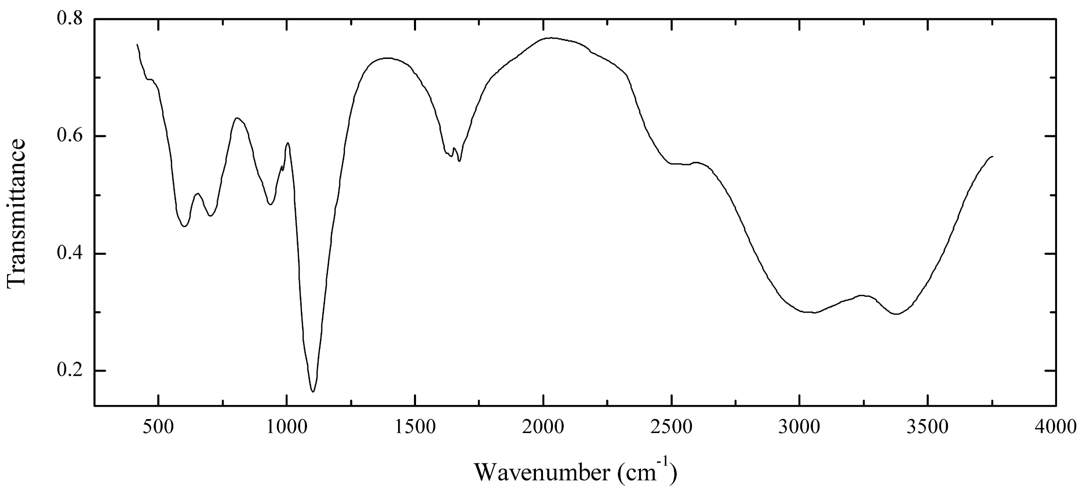


Locality: Hannebacher Ley, near Hannebach, Eifel volcanic area, Germany (type locality).

Description: Colourless platy crystals from the association with calcite, aragonite, gypsum and gismondine. The empirical formula is (electron microprobe, CO_3 calculated) $Ca_{1.00}[(SO_3, SO_4)_{0.95}(CO_3)_{0.05}]·nH_2O$. The bands at 1,492 + 1,430 and 1,217 + 1,108 cm^{-1} correspond to vibrations of CO_3^{2-} and SO_4^{2-} groups, respectively.

Wavenumbers (cm^{-1}): 3425sh, 3380, 1633, 1492, 1430, 1217, 1108, 984s, 944s, 861, 654, 625sh, 525, 495, 453, 430sh.

S264 Mendozite $NaAl(SO_4)_2·11H_2O$

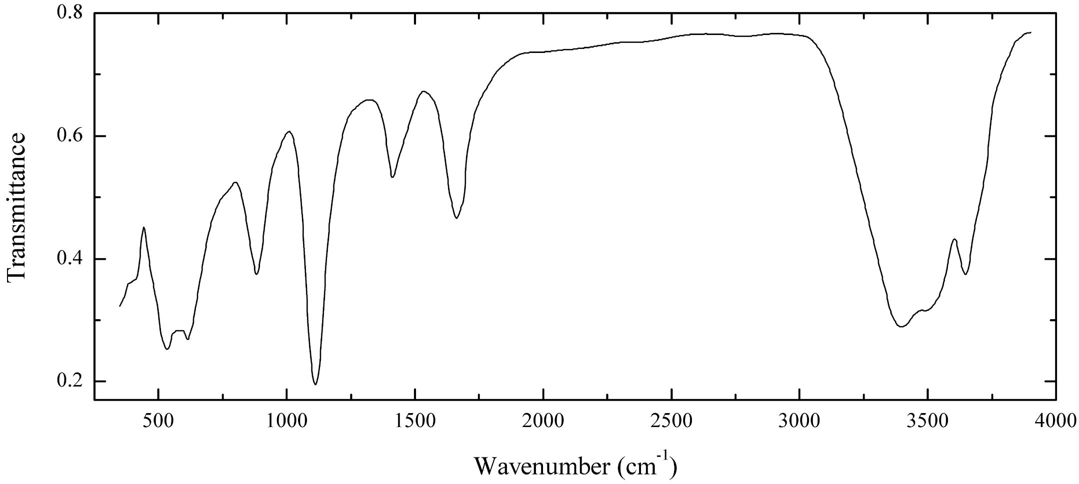


Locality: Cerros Pintados (Cerro Pintados), Pampa del Tamagural, Iquique province, Tarapacá region, Chile.

Description: Colourless grains. Confirmed by semiquantitative electron microprobe analysis (Na:Al:S ≈ 1:1:2).

Wavenumbers (cm^{-1}): 3350s, 3020s, 2565, 2500, 1670, 1635, 1090s, 985sh, 934, 885sh, 700, 600, 460w.

S265 Ettringite $Ca_6Al_2(SO_4)_3(OH)_{12}·26H_2O$

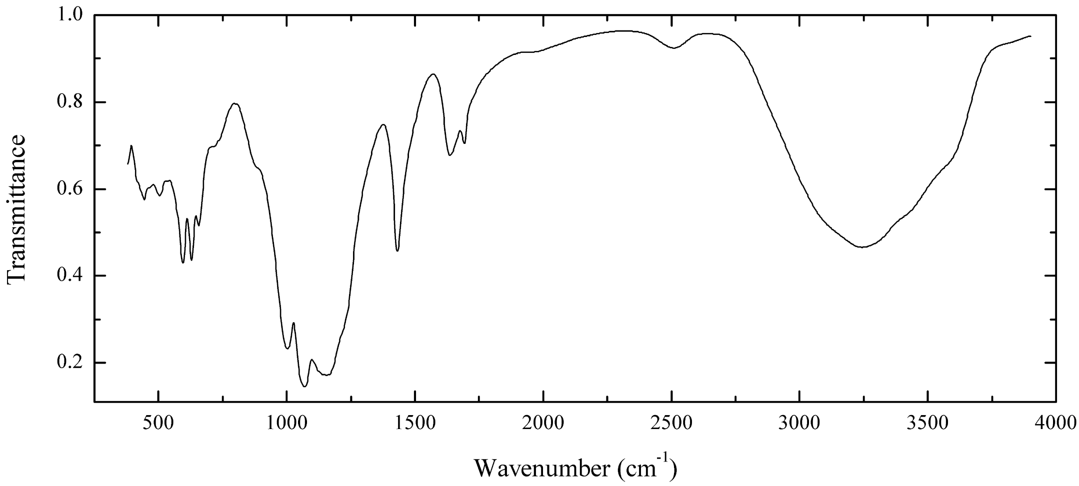


Locality: Hatrurim Formation, Israel.

Description: Yellow transparent crystals. CO_3^{2-} and CrO_4^{2-}-bearing variety.

Wavenumbers (cm^{-1}): 3635, 3480s, 3400s, 1760sh, 1665, 1415, 1110s, 880, 770sh, 615s, 532s, 400sh.

S266 Ammoniomagnesiovoltaite $(NH_4)_2Mg_5Fe^{3+}{}_3Al(SO_4)_{12}·18H_2O$

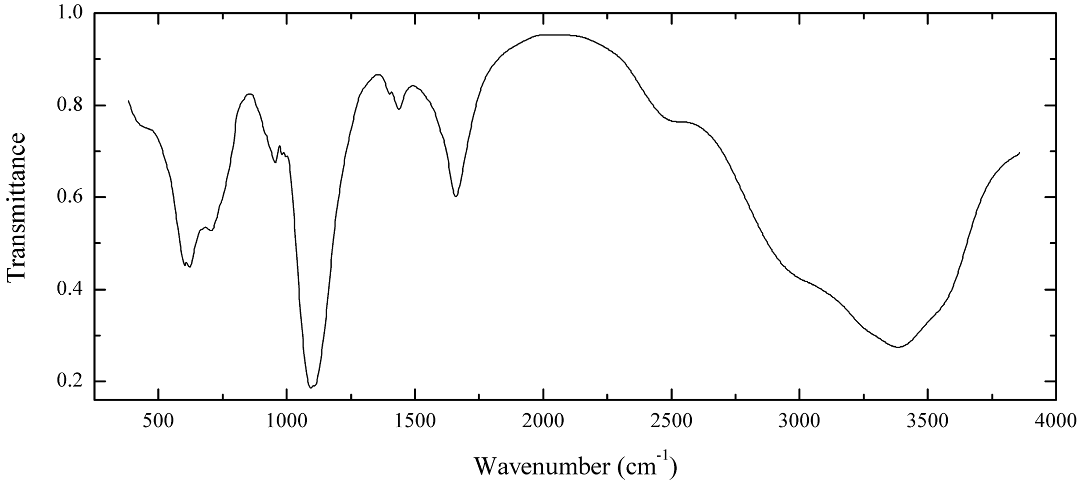


Locality: Pécs-Vasas, Pécs, Mecsek Mts., Baranya Co., Hungary (type locality).

Description: Black crystals from the association with tschermigite, sabieite, kieserite, pickeringite, and hexahydrite. The empirical formula is (electron microprobe) $(NH_4)_2(Mg_{3.72}Fe_{0.76}Mn_{0.52})Fe_{3.00}(Al_{0.70}Fe_{0.30})(SO_4)_{12.00}·nH_2O$.

Wavenumbers (cm^{-1}): 3550sh, 3380sh, 3215, 3120sh, 2500w, 1975w, 1693, 1635, 1430, 1215sh, 1152s, 1068s, 1002s, 885sh, 710sh, 656, 629, 595, 505, 465sh, 445.

S267 Wilcoxite $MgAl(SO_4)_2F{\cdot}18H_2O$

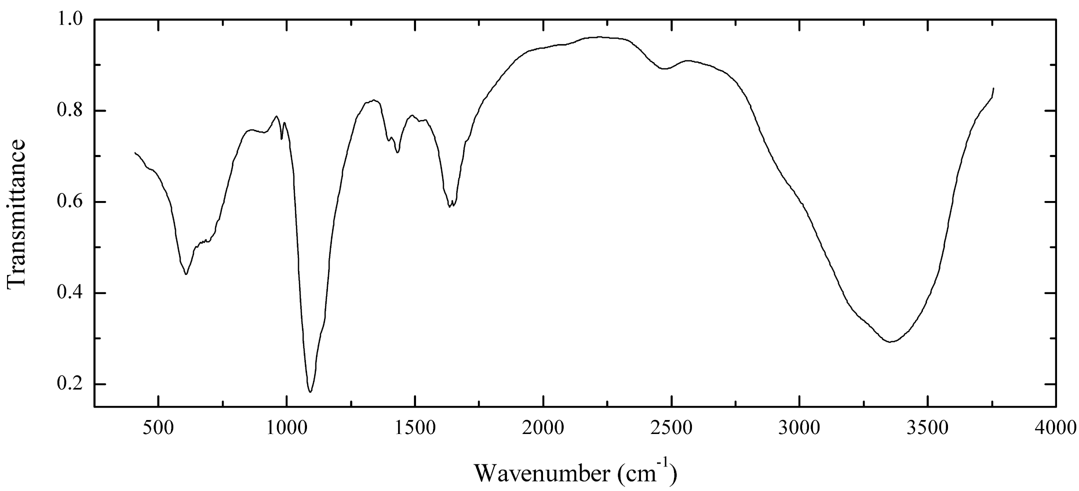


Locality: Gold Bottom mine, Inyo Co., California, USA.

Description: White massive. The empirical formula is (electron microprobe; qualitative electron microprobe analysis for F) $Mg_{1.01}Al_{0.97}(SO_4)_{2.00}(F,OH)_x{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3530sh, 3350s, 3240sh, 2995sh, 2490, 1650, 1433w, 1400w, 1110sh, 1094s, 995w, 983w, 966, 700, 622, 605sh, 475sh, 425sh.

S268 Wilcoxite $MgAl(SO_4)_2F{\cdot}18H_2O$

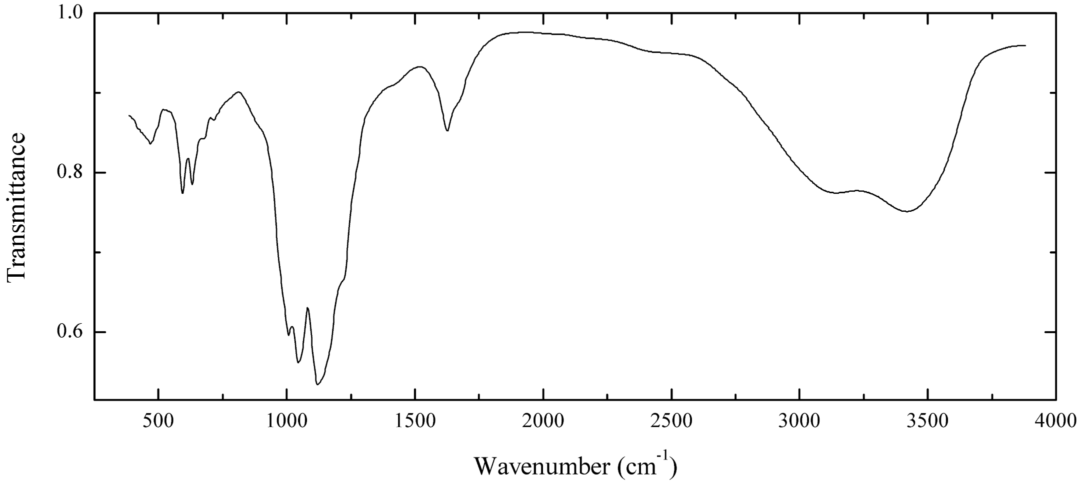


Locality: Silver City, Grand Co., New Mexico, USA.

Description: White massive. The empirical formula is (electron microprobe; qualitative electron microprobe analysis for F) $Mg_{1.0}Al_{1.2}(SO_4)_{2.0}(F,OH)_x{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3600sh, 3340s, 3220sh, 2990sh, 2480w, 1650, 1440, 1405w, 1140sh, 1094s, 979w, 914w, 698, 608, 475w.

S269 Pertlikite $K_2(Fe^{3+},Mg)_2(Mg,Fe^{3+})_4Fe^{3+}{}_2Al(SO_4)_{12}\cdot18H_2O$

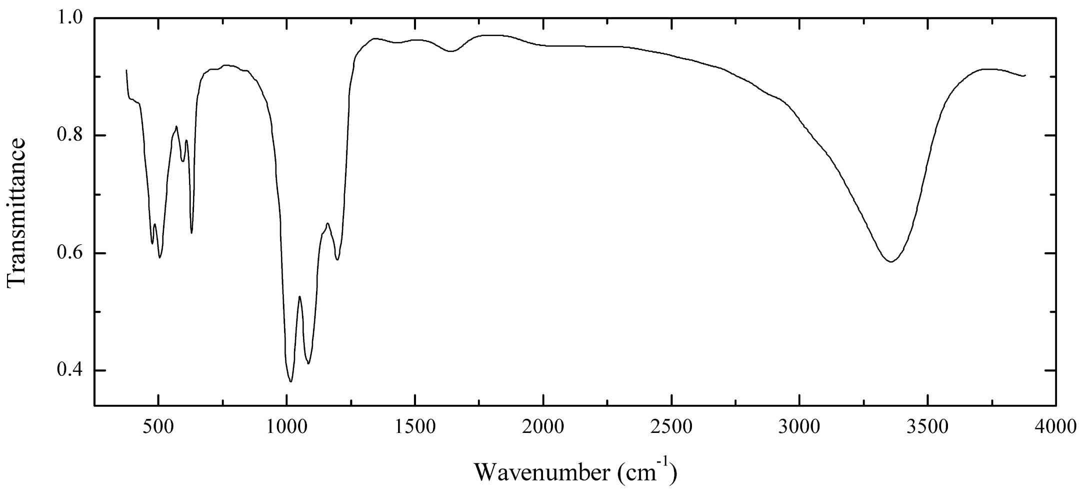


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Dark Green crystals from the association with metavoltine. The empirical formula is (electron microprobe) $K_{1.9}Tl_{0.3}Na_{0.2}Fe_{3.9}Mg_{2.7}Al_{1.0}Cu_{0.3}[(SO_4)_{11.7}(PO_4)_{0.3}]\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3418. 3150, 1675sh, 1634, 1220sh, 1150sh, 1125s, 1048s, 1008s, 890sh, 723w, 665w, 629, 593, 476.

S270 Plumbojarosite $PbFe^{3+}{}_6(SO_4)_4(OH)_{12}$

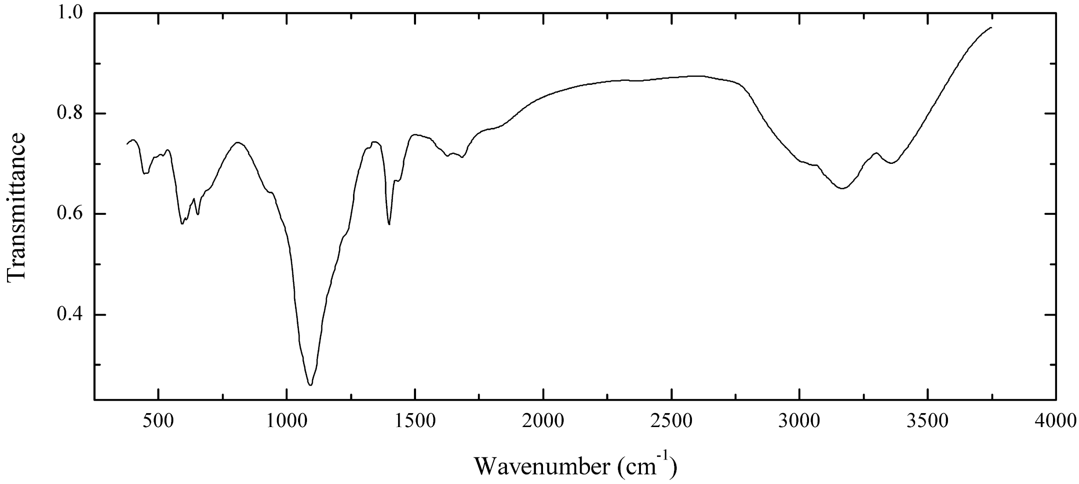


Locality: Reiche Zeche mine, Freiberg, Erzgebirge (Ore Mts.), Saxony, Germany.

Description: Yellow powdery pseudomorph after galena. The empirical formula is (electron microprobe) $(Pb_{0.75}Na_{0.04}Ca_{0.03})Fe_{6.00}(SO_4)_{4.00}(OH,H_2O)_{12}$.

Wavenumbers (cm^{-1}): 3353s, 1634w, 1434w, 1199s, 1085s, 1015s, 629, 596, 506s, 476, 430sh.

S271 Sulfate S271 $(NH_4)Al(SO_4)_2(OH)_{12}\cdot 4H_2O$ (?)

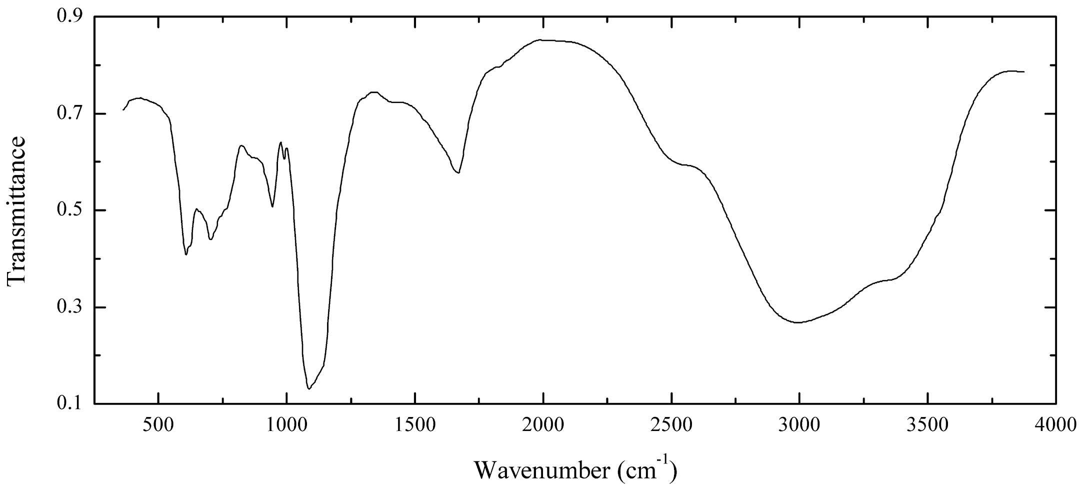


Locality: Anna 2 mine, Alsdorf, Aachen, North Rhine-Westphalia, Germany.

Description: Colourless acicular crystals. Needs further investigation.

Wavenumbers (cm^{-1}): 3350, 3150, 3000, 1825w, 1690w, 1628w, 1433w, 1497, 1226sh, 1095s, 940sh, 690sh, 652, 608, 594, 450.

S272 Alunogen $Al_2(SO_4)_3\cdot 17H_2O$

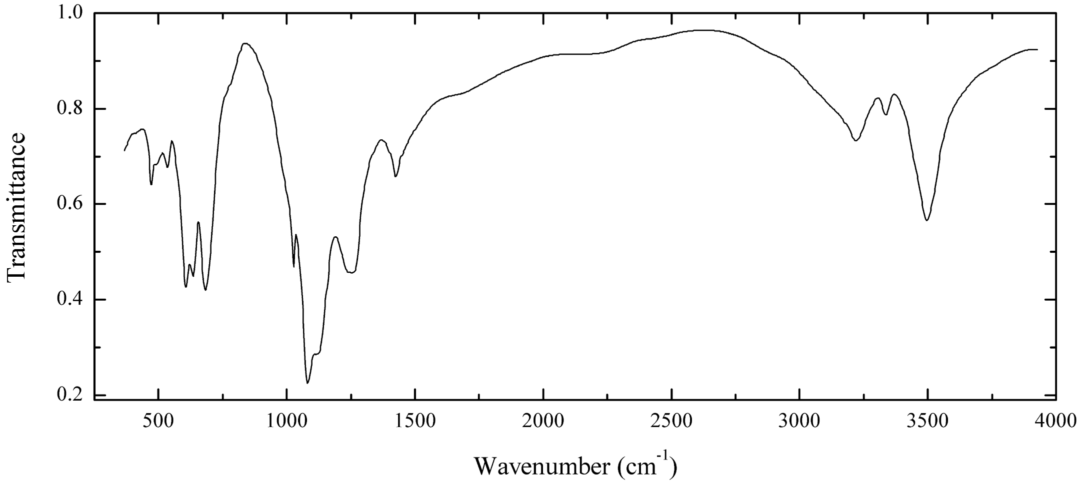


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Colourless platy crystals. The empirical formula is (electron microprobe) $(Al_{1.89}Fe_{0.11})(SO_4)_{3.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3540sh, 3385, 2995s, 2525, 1830w, 1675, 1415w, 1145sh, 1130sh, 1089s, 992w, 947, 875sh, 760sh, 703, 620sh, 607.

S273 Alunite $KAl_3(SO_4)_2(OH)_6$

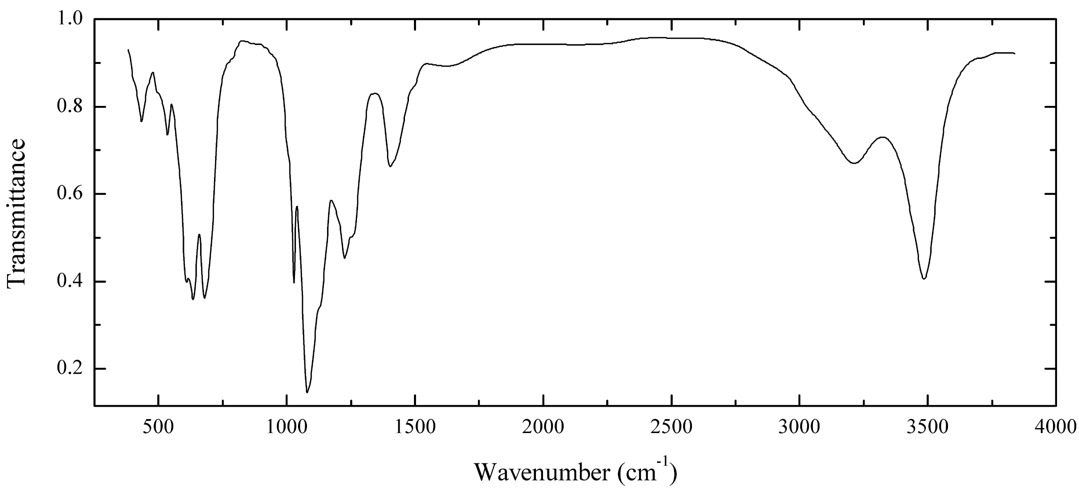


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Grey porcelain-like fine-grained aggregate. NH_4-bearing variety. The empirical formula is (electron microprobe) $[K_{0.76}Tl_{0.05}(NH_4)_x](Al_{2.95}Fe_{0.02})(SO_4)_{2.00}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3485, 3323, 3205, 3150sh, 3075w, 2210w, 1655sh, 1428, 1250, 1155sh, 1120sh, 1082s, 1028, 682s, 635, 605s, 535, 490sh, 472.

S274 Alunite $KAl_3(SO_4)_2(OH)_6$

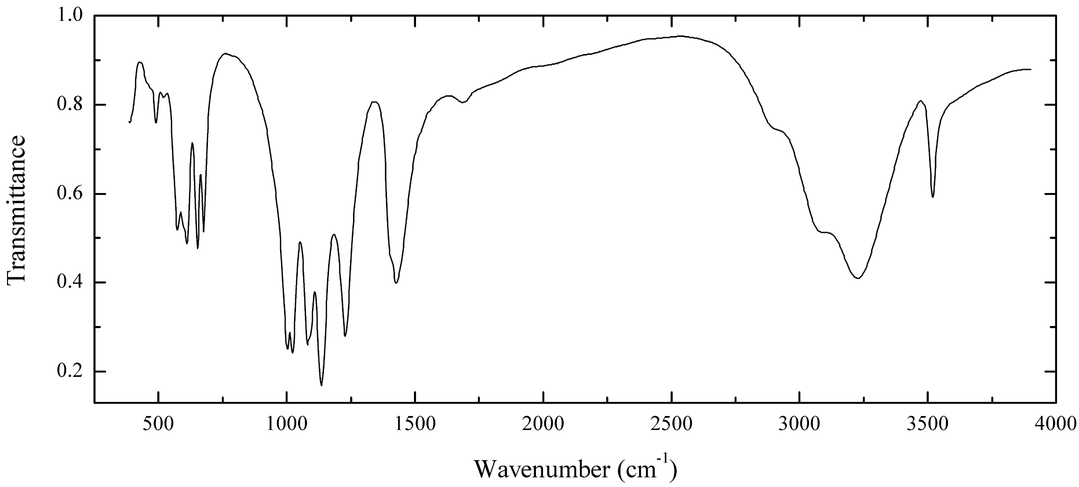


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Grey fine-grained aggregate. NH_4-bearing variety. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3485, 3215, 1640w, 1405, 1260sh, 1230, 1135sh, 1082s, 1031, 1005sh, 680s, 635s, 608, 535, 495sh, 432.

S275 Adranosite $(NH_4)_4NaAl_2(SO_4)_4Cl(OH)_2$

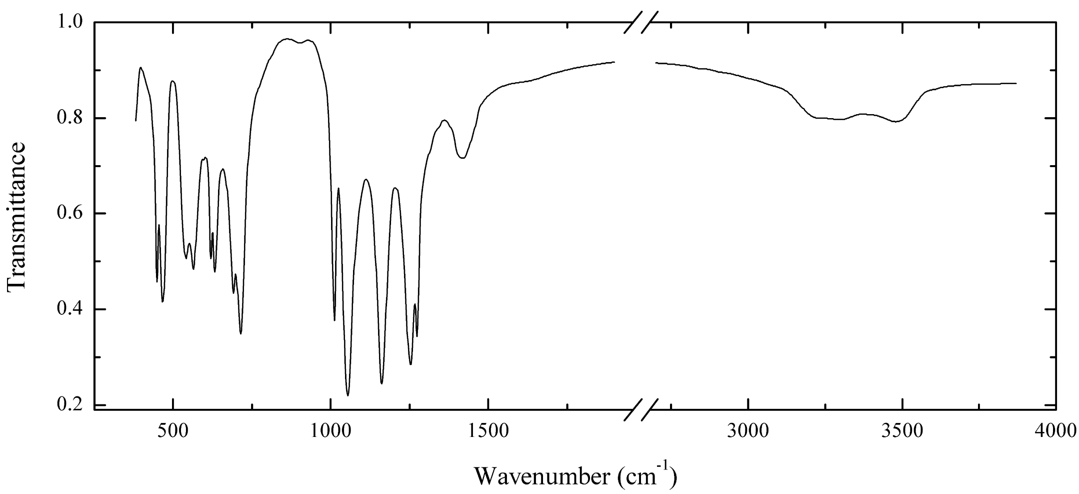


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy (type locality).

Description: Beige spherulites from the association with ammonioalunite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3493, 3200, 3060sh, 2880sh, 1680w, 1424, 1405sh, 1227s, 1135s, 1090sh, 1081s, 1024s, 1003s, 676, 652, 612, 605sh, 574, 522w, 491, (390).

S276 Thermessaite $K_2Al(SO_4)F_3$

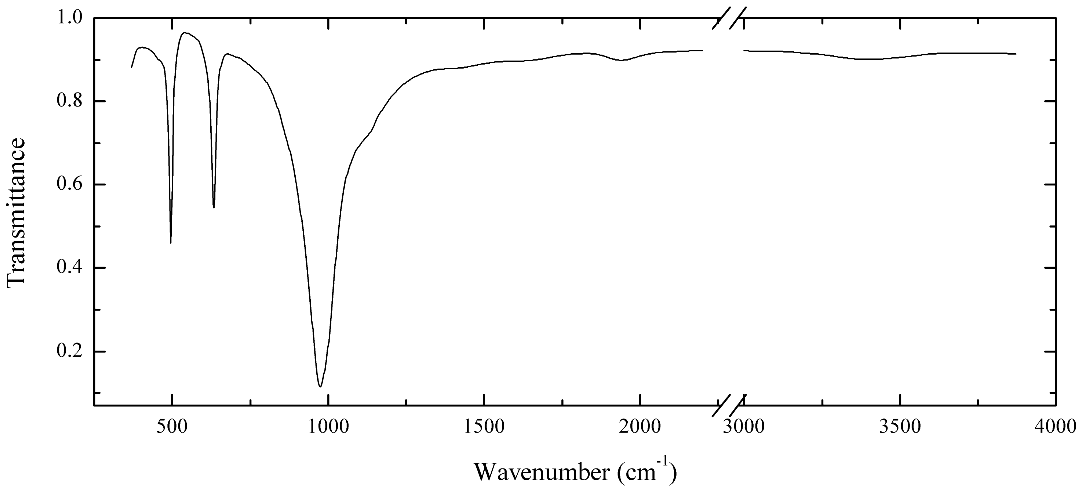


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy (type locality).

Description: Colourless crystals from the association with metavoltine. NH_4-rich variety. The empirical formula is $[K_{1.07}(NH_4)_{0.91}Na_{0.02}]Al_{1.00}Fe_{0.02}(SO_4)_{1.00}(F,OH)_3$. Confirmed by IR spectrum.

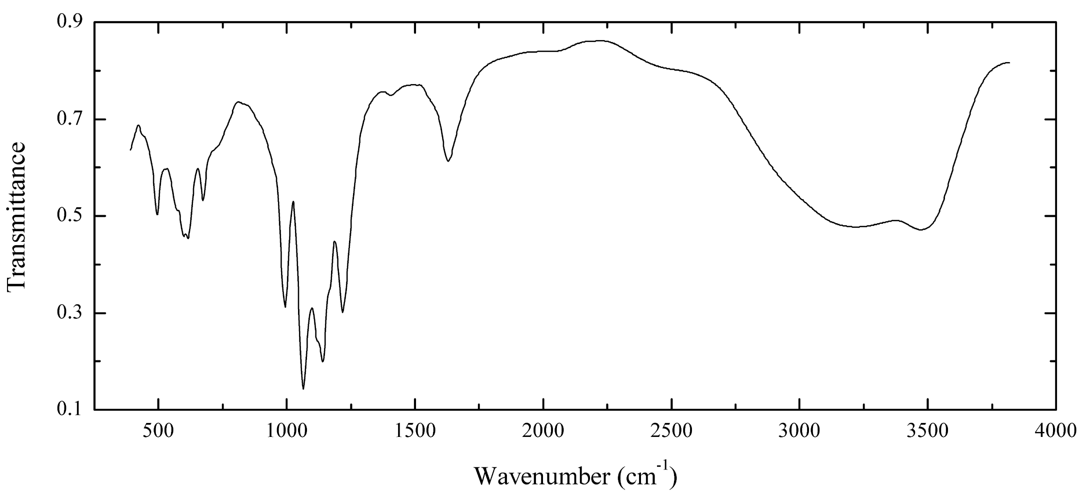
Wavenumbers (cm^{-1}): 3370, 3280, 3210, 1420, 1275s, 1253s, 1165s, 1056s, 1011, 904w, 715s, 692, 634, 620, 565, 537, 465, 448.

S277 Sodium sulfite $Na_2(SO_3)$



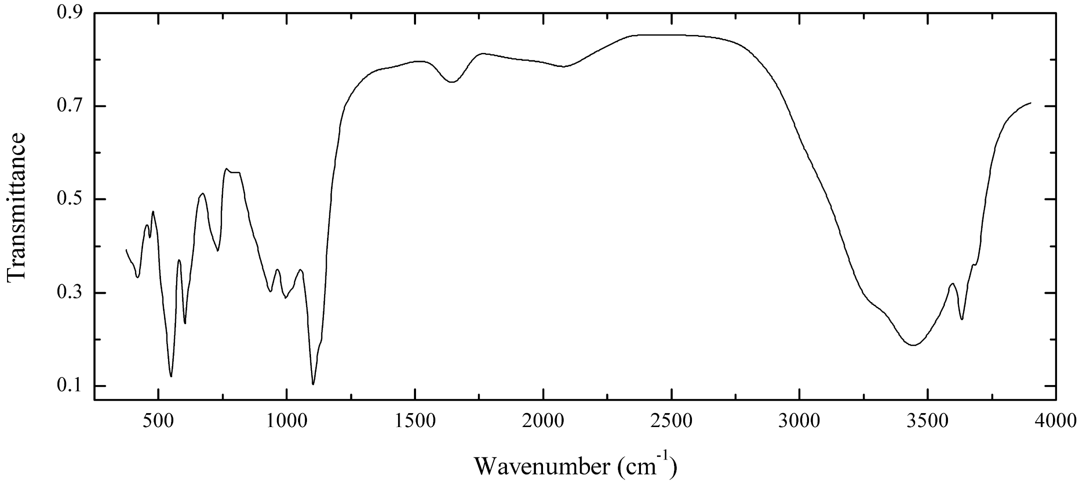
Locality: Synthetic.
Description: Colourless crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): (3375w), 1925w, 1415w, 1130sh, 970s, 634, 499.

S278 Metavoltine $Na_6K_2Fe^{2+}Fe^{3+}{}_6(SO_4)_{12}O_2{\cdot}18H_2O$



Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.
Description: Yellow crystals from the association with pertlikite. The empirical formula is (electron microprobe) $Na_{5.7}K_{2.2}(NH_4)_xFe_{6.9}Mg_{0.1}(SO_4)_{12.0}O_2{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3460, 3200, 2530sh, 2055w, 1635, 1408w, 1223s, 1170sh, 1143s, 1120sh, 1066s, 998s, 720sh, 674, 616, 598, 570sh, 495.

S279 Kyrgyzstanite $ZnAl_4(SO_4)(OH)_{12}·3H_2O$

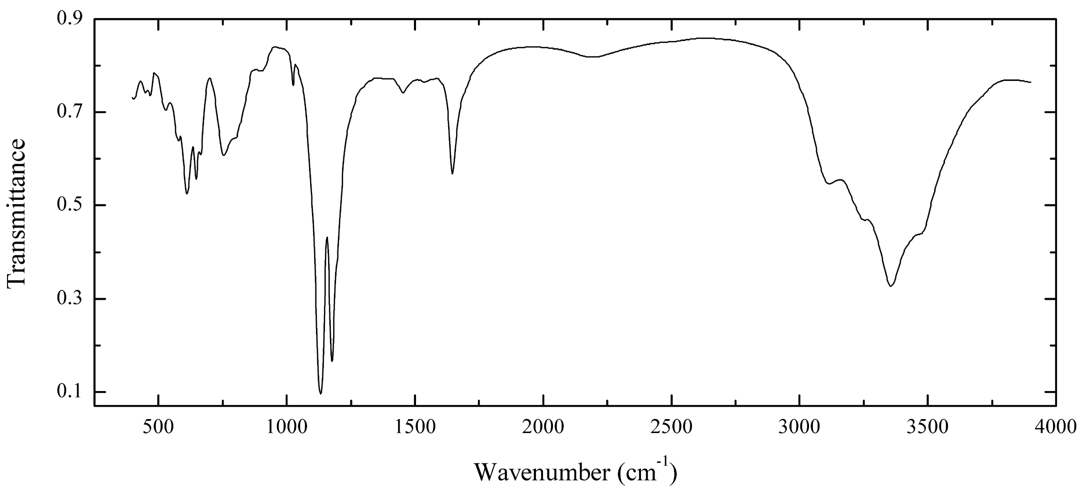


Locality: Christiana mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: White powdery aggregate from the association with serpierite. Confirmed by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $(Zn_{0.84}Cu_{0.10}Mg_{0.07}Ni_{0.02})(Al_{3.81}Fe_{0.10})(SO_4)_{1.00}(OH,H_2O)_{12}·nH_2O$.

Wavenumbers (cm^{-1}): 3660, 3605s, 3425s, 3270sh, 2070w, 1620w, 1130sh, 1102s, 1015sh, 997, 935, 890w, 730, 710sh, 620sh, 603s, 547s, 567w, 417.

S280 Kainite $KMg(SO_4)Cl·3H_2O$

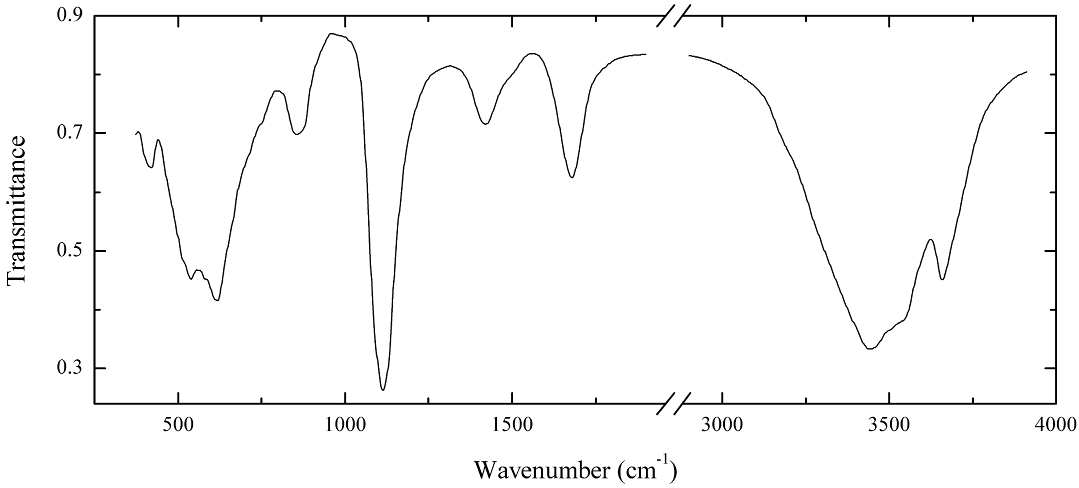


Locality: Brefeld, Tarthun, Stassfurt potash deposit, Saxony-Anhalt, Germany (type locality).

Description: Yellowish-brown granular aggregate. Confirmed by IR spectrum.

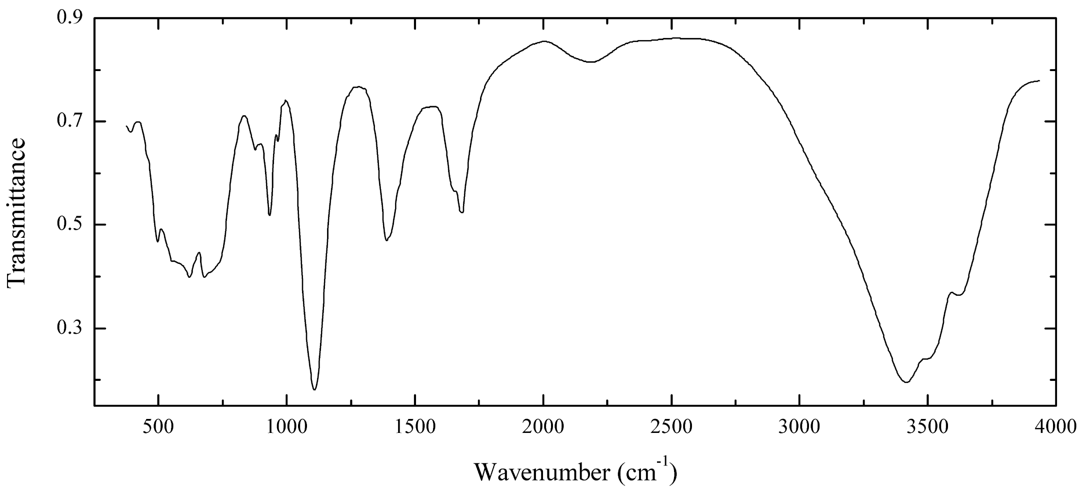
Wavenumbers (cm^{-1}): 3460, 3345s, 3240, 3105, 2185w, 1645, 1538w, 1455w, 1195sh, 1177s, 1134s, 1127s, 1023w, 902w, 800sh, 755, 662, 645, 609, 577, 525w, 468w, 454w.

S281 Ettringite $Ca_6Al_2(SO_4)_3(OH)_{12}{\cdot}26H_2O$



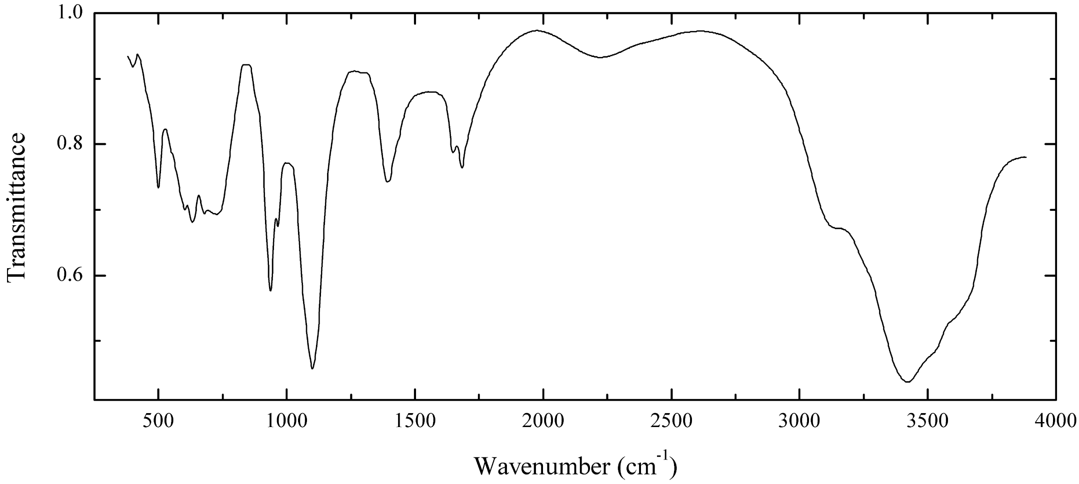
Locality: Maali Adumim, Hatrurim formation ("Mottled Zone"), Israel.
Description: Violet veinlet from the association with afwillite. Cr-bearing variety. The empirical formula is $Ca_{6.0}(Al_{1.6}Cr_{0.2}Si_{0.1})[(SO_4)_{2.65}(CO_3)_x](OH)_{12}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3630, 3480sh, 3420s, 1678, 1485sh, 1413, 1111s, 857, 617s, 539, 420.

S282 Thaumasite $Ca_6Si_2(CO_3)_2(SO_4)_2(OH)_{12}{\cdot}24H_2O$



Locality: Schellkopf, Brenk, Niederzissen, Eifel Mts., Rhineland-Palatinate, Germany.
Description: White radial fibrous aggregate from the association with phillipsite-K. Identified by IR spectrum and semiquantitative electron microprobe analysis. Si-deficient SO_3-rich variety (the bands at 967 and 935 cm^{-1} indicate the presence of sulfite anions).
Wavenumbers (cm^{-1}): 3619, 3500sh, 3423s, 3150sh, 2247w, 1685, 1650sh, 1396, 1112s, 967w, 935, 877w, 715sh, 683, 626, 578, 497, 416w.

S283 Hielscherite $Ca_3Si(OH)_6(SO_4)(SO_3,CO_3)\cdot11\text{-}12H_2O$

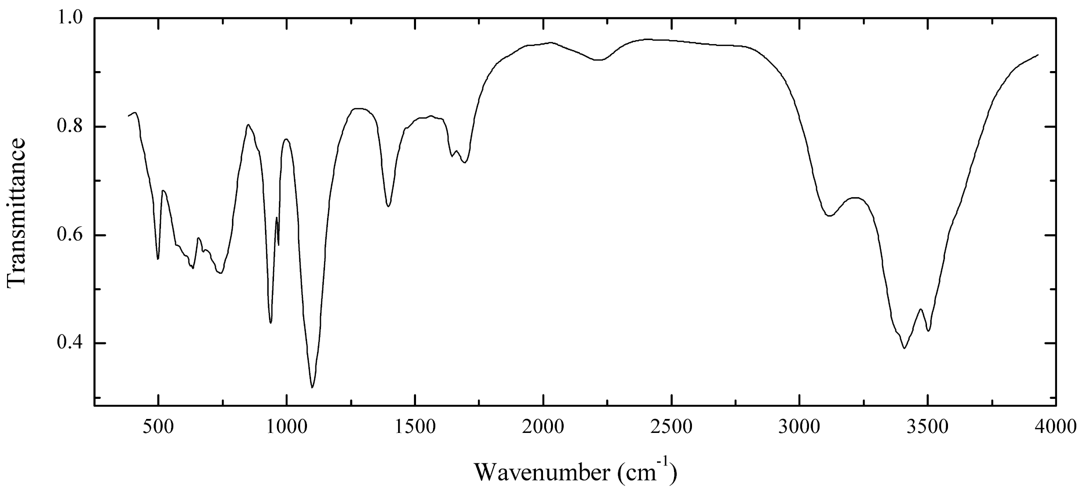


Locality: Graulay, near Hillesheim, western part of Eifel Mts., Rhineland-Palatinate, Germany (type locality).

Description: White fibrous aggregate from the association with gismondine, phillipsite-K, chabazite-Ca and gypsum. Identified by IR spectrum and semiquantitative electron microprobe analysis. The bands at 967 and 935 cm^{-1} correspond to stretching vibrations of sulfite anions.

Wavenumbers (cm^{-1}): 3600sh, 3500sh, 3420s, 3135, 2240w, 1684, 1637, 1397, 1103s, 967, 937s, 720, 678, 633, 596, 497, 408w.

S284 Hielscherite $Ca_3Si(OH)_6(SO_4)(SO_3,CO_3)\cdot11\text{-}12H_2O$

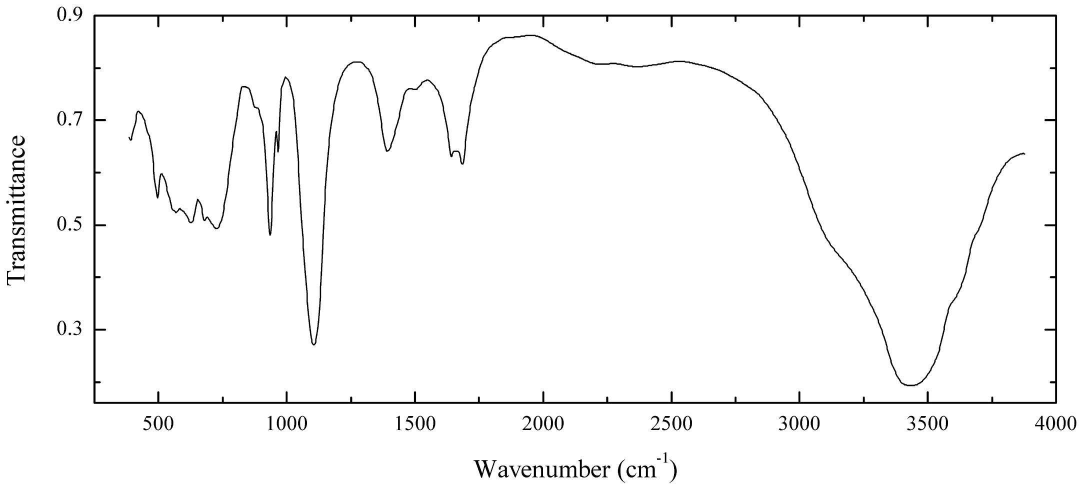


Locality: Graulay, near Hillesheim, western part of Eifel Mts., Rhineland-Palatinate, Germany (type locality).

Description: White fibrous aggregate from the association with phillipsite-K and gypsum. Identified by IR spectrum. The bands at 967 and 937 cm^{-1} correspond to stretching vibrations of sulfite anions.

Wavenumbers (cm^{-1}): 3580sh, 3486s, 3392s, 3360sh, 3106, 2215w, 1694, 1648, 1395, 1101s, 967, 937s, 740, 676, 633, 605sh, 575, 497.

S285 Hielscherite $Ca_3Si(OH)_6(SO_4)(SO_3,CO_3)\cdot 11\text{-}12H_2O$

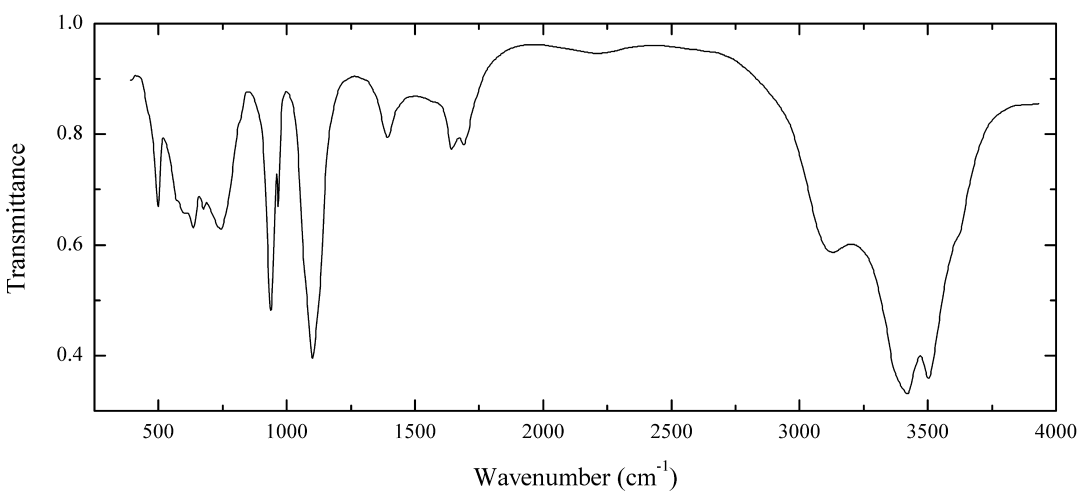


Locality: Graulay, near Hillesheim, western part of Eifel Mts., Rhineland-Palatinate, Germany (type locality).

Description: White matted fibrous aggregates from the association with phillipsite-K, chabazite-Ca and gypsum. Holotype sample. The crystal structure is solved by the Rietveld method. Hexagonal, space group $P6_3$, $a = 11.1178(2)$, $c = 10.5381(2)$ Å, $Z = 2$. $D_{meas} = 1.82(3)$ g/cm^3, $D_{calc} = 1.791$ g/cm^3. Optically uniaxial (−), $\omega = 1.494(2)$, $\varepsilon = 1.476(2)$. The empirical formula is $Ca_{3.00}(Si_{0.73}Al_{0.28})(OH)_{5.71}(SO_4)_{1.00}(SO_3)_{0.62}(CO_3)_{0.38}(NO_3)_{0.05}\cdot 10.63H_2O$. The strongest reflections of the powder X-ray diffraction pattern [(*d*,Å (*I*, %) (*hkl*)] are 9.62 (100) (100); 5.551 (50) (110); 4.616 (37) (102); 3.823 (64) (112); 3.436 (25) (211), 2.742 (38) (302), 2.528 (37) (213), 2.180 (35) (402, 223).

Wavenumbers (cm^{-1}): 3675sh, 3580sh, 3420s, 3100sh, 2350w, 2210w, 1687, 1645, 1503w, 1395, 1107s, 967, 937s, 895sh, 740s, 677, 629, 572, 499.

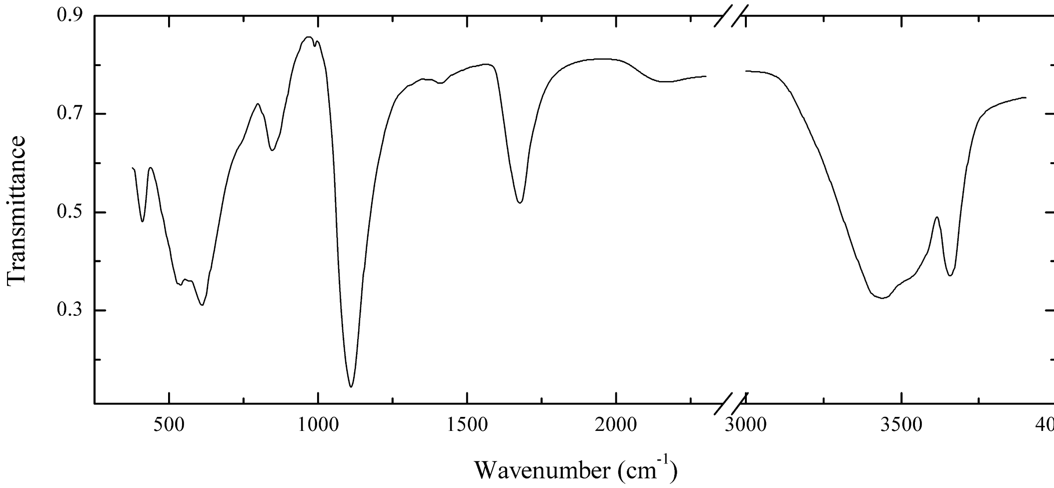
S286 Hielscherite $Ca_3Si(OH)_6(SO_4)(SO_3,CO_3)\cdot 11\text{-}12H_2O$



Locality: Graulay, near Hillesheim, western part of Eifel Mts., Rhineland-Palatinate, Germany (type locality).

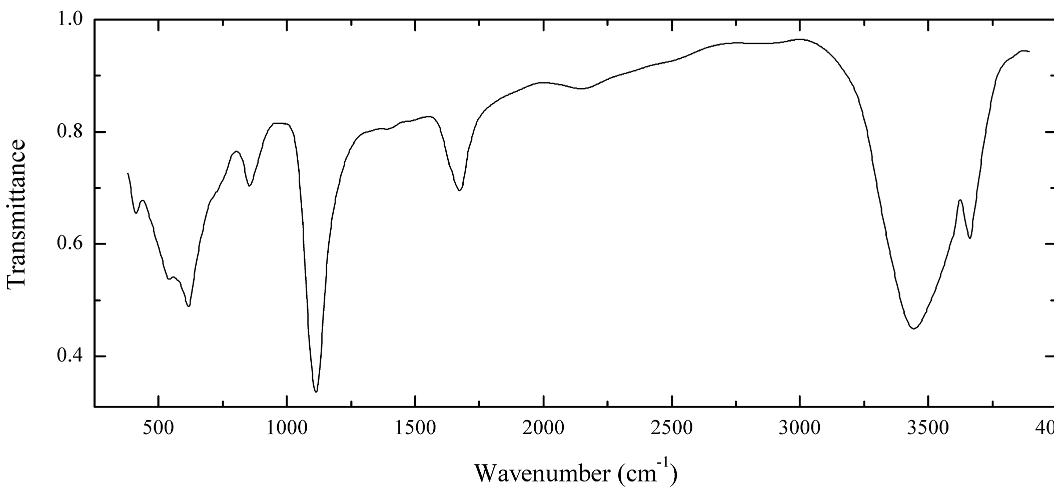
Description: White fine-grained aggregate. The empirical formula is $Ca_{3.00}(Si_{0.88}Al_{0.13})(OH)_6(SO_4)_{1.00}[(SO_3)_{0.77}(CO_3)_{0.23}]\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3600sh, 3484s, 3410s, 3385sh, 3115, 2235w, 1693w, 1647, 1101s, 967, 937s, 739, 674, 632, 605sh, 580sh, 497.

S287 Ettringite $Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$



Locality: Bellerberg, Eifel paleovolcanic area, Rheinland-Pfalz (Rhineland-Palatinate), Germany (type locality).
Description: Colourless long-prismatic crystals from the association with flörkeite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3640, 3520sh, 3430s, 2160w, 1678, 1418w, 1113s, 990w, 616s, 543s, 420.

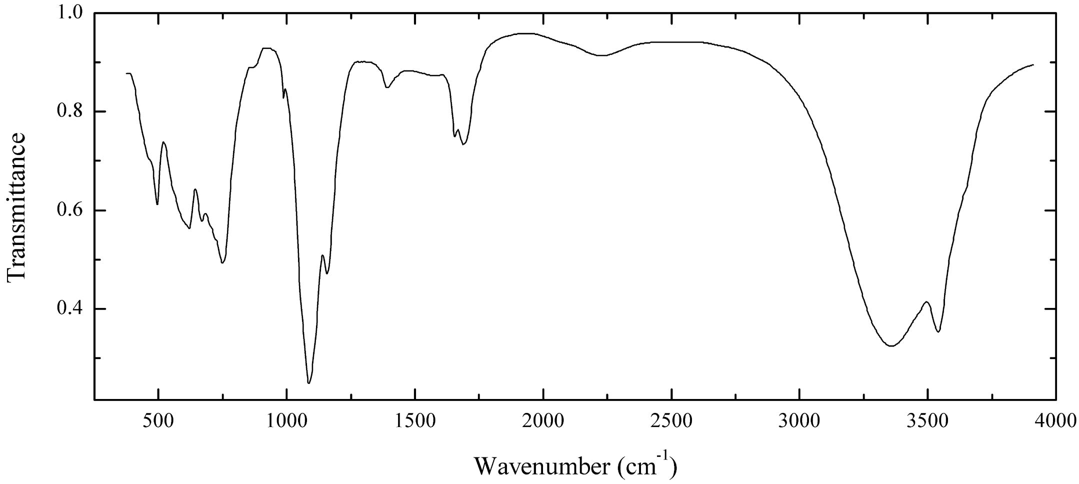
S288 Ettringite $Ca_6Al_2(SO_4)_3(OH)_{12}\cdot 26H_2O$



Locality: Bellerberg, Eifel paleovolcanic area, Rheinland-Pfalz (Rhineland-Palatinate), Germany (type locality).
Description: Colourless long-prismatic crystals from the association with gypsum and zeolites. The empirical formula is (electron microprobe) $Ca_{6.00}(Al_{1.92}Si_{0.06})(OH)_{12}(SO_4)_{2.88}(CO_3)_x\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3638, 3500sh, 3430s, 2470w, 2150w, 1673, 1390w, 1114s, 857, 710sh, 617, 550, 422.

S289 Kottenheimite $Ca_3Si(SO_4)_2(OH)_6{\cdot}12H_2O$

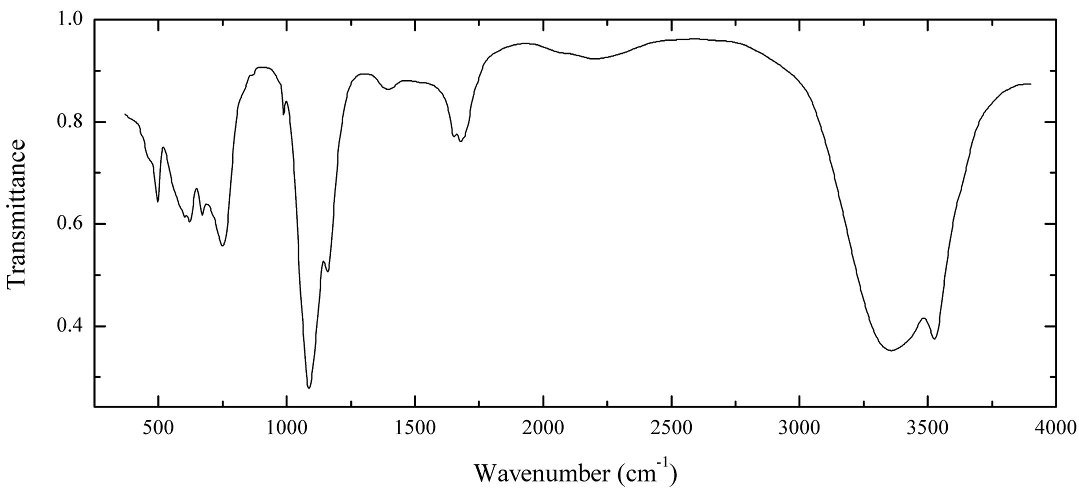


Locality: Bellerberg, Eifel paleovolcanic area, Rheinland-Pfalz (Rhineland-Palatinate), Germany (type locality).

Description: White radiated aggregates of hair-like subparallel clusters of minute crystals from the association with wollastonite, clinochlore, ellestadite, melilite and cuspidine. Holotype sample. The crystal structure is solved by the Rietveld method. Hexagonal, space group $P6_3/m$, a = 11.1548(3), c = 10.5702(3) Å, Z = 2. D_{meas} = 1.92(2) g/cm^3, D_{calc} = 1.926 g/cm^3. Optically uniaxial (−), ω = 1.490(2), ε = 1.477(2). The empirical formula is $Ca_{3.015}Mg_{0.03}Fe_{0.02}Al_{0.03}Si_{0.97}(OH)_{5.94}(SO_4)_{1.97}(CO_3)_{0.09}{\cdot}11.91H_2O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 9.72 (100) (100), 5.590 (60) (110), 4.645 (26) (102), 3.840 (54) (112), 2.751 (34) (302), 2.536 (27) (213), 2.185 (30) (223).

Wavenumbers (cm^{-1}): 3512s, 3350s, 2200w, 2060sh, 1683, 1650, 1392w, 1158s, 1086s, 987w, 870w, 752s, 725sh, 670, 621, 600sh, 496, 460sh.

S290 Kottenheimite $Ca_3Si(SO_4)_2(OH)_6{\cdot}12H_2O$

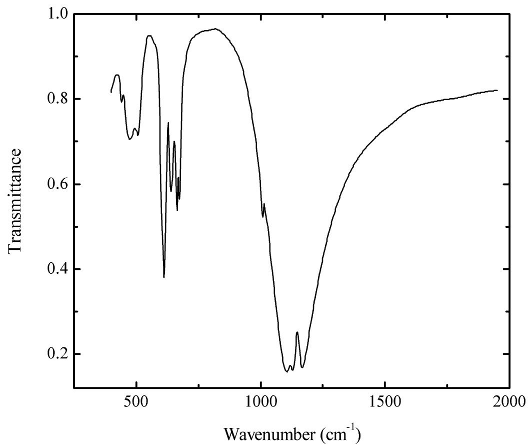


Locality: Bellerberg, Eifel paleovolcanic area, Rheinland-Pfalz (Rhineland-Palatinate), Germany (type locality).

Description: White random aggregates of hair-like subparallel clusters of minute crystals from the association with wollastonite, clinochlore, ellestadite, melilite and cuspidine. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3512s, 3345s, 2200w, 2070sh, 1680, 1650, 1398w, 1160s, 1087s, 987w, 752s, 671, 621, 604, 590sh, 496, 460sh.

S291 Krasheninnikovite $KNa_2CaMg(SO_4)_3F$

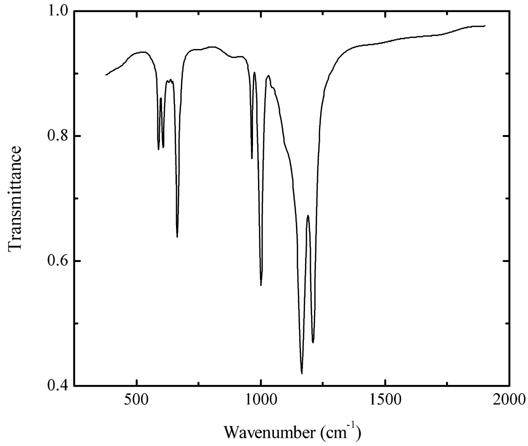


Locality: Second Scoria cone, Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia (type locality).

Description: Sheaf-like, radiating aggregates of colourless acicular crystals from the association with tenorite, thenardite, hematite, euchlorine, blödite, vergasovaite and fluorophlogopite. Holotype sample. The crystal structure is solved for a single crystal and refined for a powdery sample by the Rietveld method. Hexagonal, space group $P6_3/mcm$, a = 16.6753(3), c = 6.9045(1) Å, Z = 6. D_{meas} = 2.68(1) g/cm^3, D_{calc} = 2.67 g/cm^3. Optically uniaxial (−), ω = 1.500(2), ε = 1.492(2). The empirical formula is $K_{0.67}Na_{2.27}Ca_{0.93}Mn_{0.01}Mg_{1.04}Al_{0.02}(SO_4)_{3.04}F_{0.76}Cl_{0.02}O_{0.06}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 4.284 (23) (121); 3.610 (23) (040); 3.566 (17) (221); 3.459 (41) (131, 002); 3.153 (100) (140), 3.117 (21) (022), 2.660 (39) (222], 2.085 (19) (440).

Wavenumbers (cm^{-1}): 1169s, 1130s, 1107s, 1008, 673, 662, 645sh, 638, 612s, 605sh, 508, 470, 442w.

S292 Chlorothionite $K_2Cu^{2+}(SO_4)Cl_2$

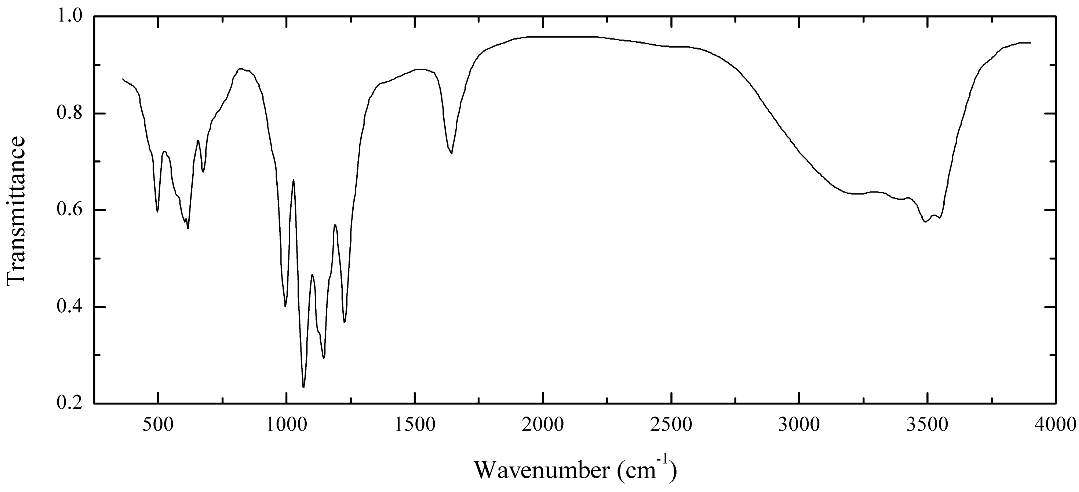


Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: Green crystals. Confirmed by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 1209s, 1165s, 1000s, 963, 885w, 663, 606, 589.

S293 Sulfate S293 $Na_4K_2MgFe^{3+}{}_6(SO_4)_{12}(OH)_2 \cdot 18H_2O$ (?)

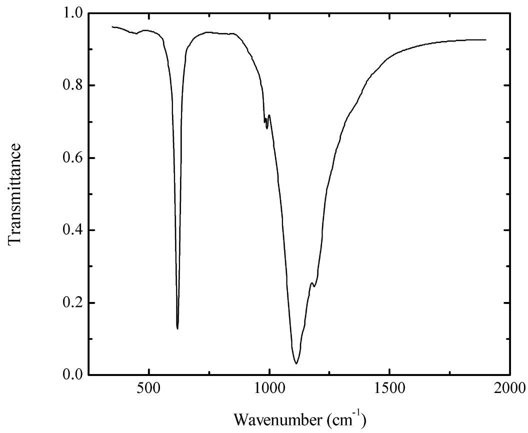


Locality: La Fossa crater, Vulcano island, Lipari, Eolie (Aeolian) islands, Messina province, Sicily, Italy.

Description: Yellow platy crystals. The empirical formula is (electron microprobe) $H_xNa_{3.5}K_{1.9}Mg_{1.2}Fe_{6.0}(SO_4)_{12.0}(OH)_2 \cdot nH_2O$. Related to metavoltine. Needs further investigation.

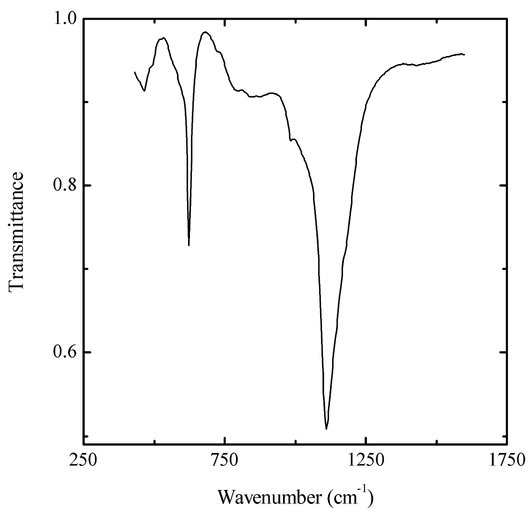
Wavenumbers (cm^{-1}): 3530, 3475, 3380, 3205, 1645, 1225s, 1170sh, 1146s, 1125sh, 1066s, 998s, 750sh, 675, 617, 604, 575sh, 495.

S294 Arcanite $K_2(SO_4)$



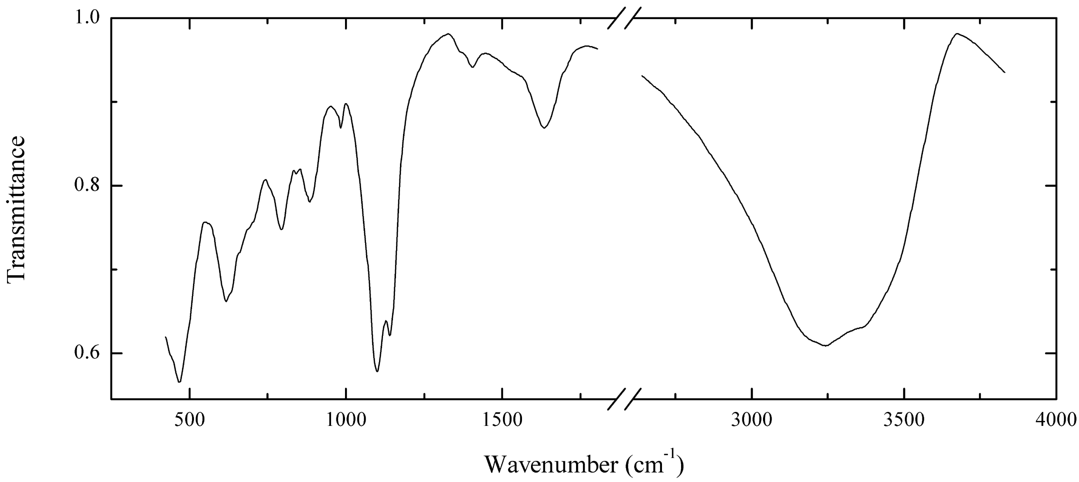
Locality: Synthetic.
Description: Colourless crystals.
Wavenumbers (cm^{-1}): 1134, 1113s, 990w, 981w, 618s.

S295 Arcanite $K_2(SO_4)$



Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.
Description: White grains. Na-bearing variety. The empirical formula is (electron microprobe) $K_{1.64}Na_{0.34}Pb_{0.01}(SO_4)_{1.00}$.
Wavenumbers (cm^{-1}): 1175sh, 1110s, 986w, 870w, 782w, 621s, 465w.

S296 Sulfate S296 $Fe^{2+}_6Fe^{3+}_2(SO_4)(OH)_{16}\cdot 4H_2O$

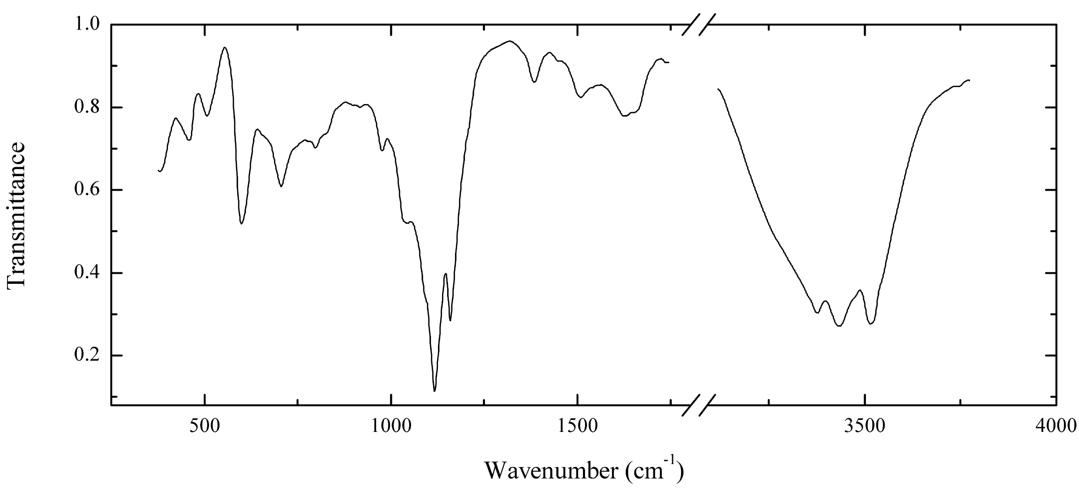


Locality: Weathered Dronino ataxite iron meteorite, near Dronino village, Kasimov District, Ryazan' region, Russia.

Description: Brown platy crystals in cavities, in the association with goethite, akaganéite, hematite, hibbingite, reevesite and chukanovite. Investigated by I.V. Pekov. Fe^{2+}-analogue of honessite. The empirical formula is (electron microprobe) $(Fe_{5.97}Ni_{0.03})(Fe_{1.91}Co_{0.09})[(SO_4)_{0.84}(CO_3,2OH)_{0.16}](OH)_{16}\cdot nH_2O$. Needs further investigation.

Wavenumbers (cm^{-1}): 3350sh, 3240s, 1627, 1402w, 1370sh, 1141s, 1100s, 984w, 883, 790, 690sh, 616s, 457s.

S297 Namuwite $(Zn,Cu^{2+})_4(SO_4)(OH)_6\cdot 4H_2O$

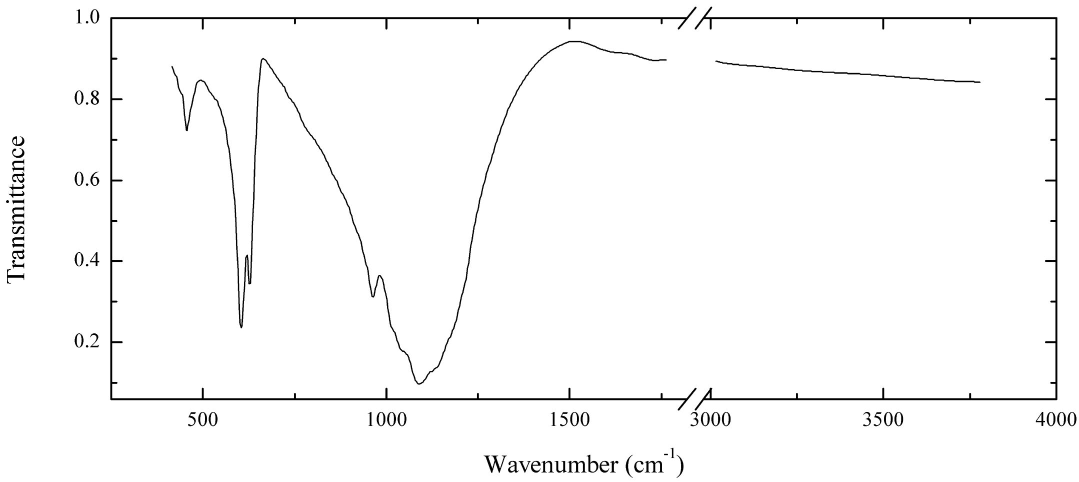


Locality: Herzog Julius smelter (slag locality), Astfeld, Goslar, Harz, Lower Saxony, Germany.

Description: Light blue platelets. The empirical formula is (electron microprobe) $(Zn_{3.8}Cu_{0.2})(SO_4)(OH)_6\cdot nH_2O$.

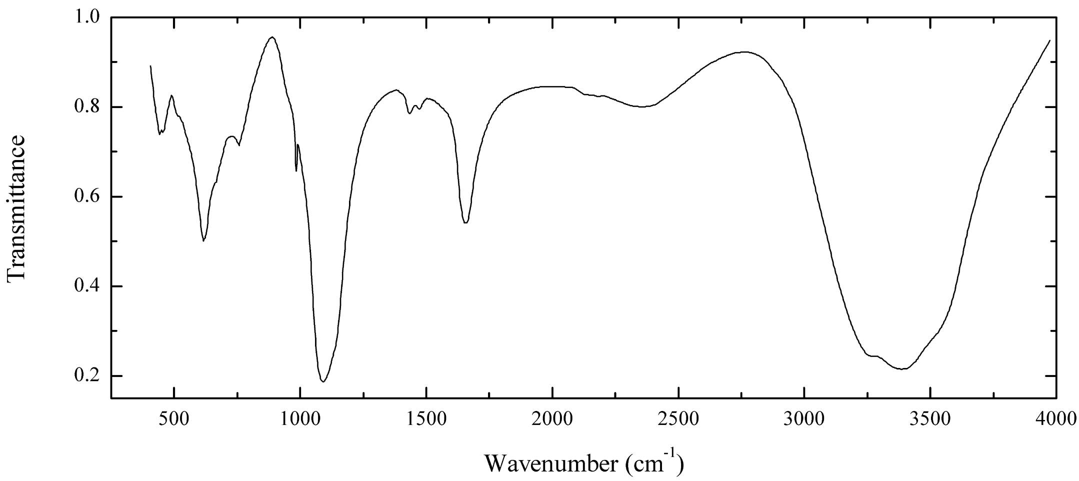
Wavenumbers (cm^{-1}): 3515s, 3435s, 3375s, 3250sh, 1660, 1626, 1505w, 1387w, 1158s, 1118s, 1090sh, 1036, 972w, 815sh, 795w, 705, 596, 509, 460, 390.

S298 Caracolite $Na_3Pb_2(SO_4)_3Cl$



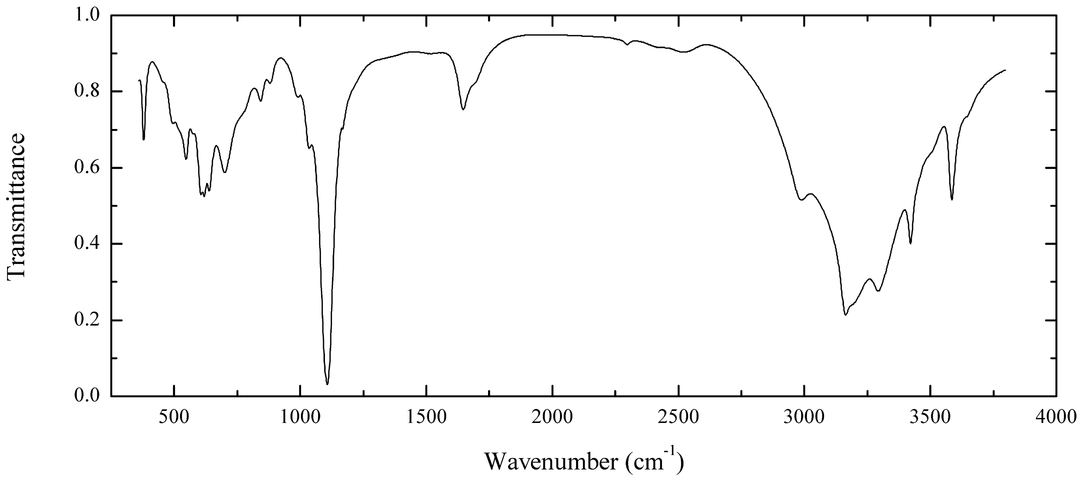
Locality: Mina Beatriz, near Caracoles, Sierra Gorda, Atacama, Chile (type locality).
Description: Colourless pseudohaxagonal crystals. The empirical formula is (electron microprobe) $Na_{2.79}K_{0.04}Pb_{2.16}(SO_4)_{2.97}Cl_{1.12}$.
Wavenumbers (cm^{-1}): 1135sh, 1091s, 1040sh, 1010sh, 968, 694, 615sh, 607s, 454.

S299 Epsomite $Mg(SO_4)\cdot 7H_2O$



Locality: Ronneburg U deposit, Thuringia, Germany.
Description: White massive. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3530sh, 3384s, 3256, 2356, 2110sh, 1657, 1472w, 1433w, 1135sh, 1094s, 983, 756, 617, 505sh, 442.

S300 Vendidaite $Al_2(SO_4)(OH)_3Cl{\cdot}6H_2O$

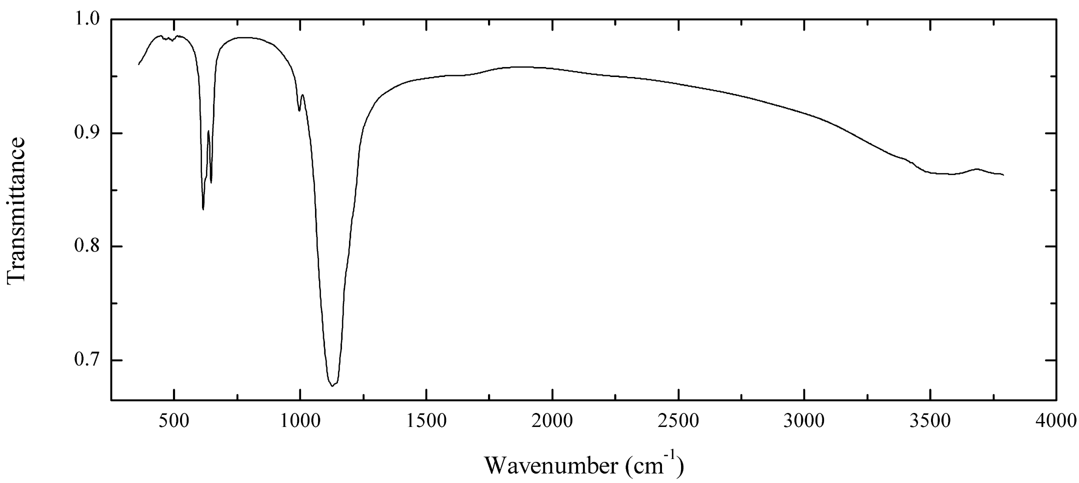


Locality: La Vendida copper mine (Mina La Vendida), Sierra Gorda, Antofagasta Region, Atacama desert, Chile (type locality).

Description: White platy crystals from the association with eriochalcite, Mg-rich aubertite, magnesioaubertite, belloite and clay minerals. Holotype sample. The crystal structure is solved on a single crystal. Monoclinic, space group *C*2/*c*, $a = 11.9246(16)$, $b = 16.134(2)$, $c = 7.4573(9)$ Å, $\beta = 125.815(2)°$, $Z = 4$. $D_{meas} = 1.97$ g/cm^3, $D_{calc} = 1.974$ g/cm^3. Optically biaxial (+), $\alpha = 1.522(2)$, $\beta = 1.524(2)$, $\gamma = 1.527(2)$. The empirical formula is $Al_{1.96}Fe^{3+}_{0.06}(SO_4)_{0.98}Cl_{0.98}(OH)_{3.12}{\cdot}5.98H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.78 (59) (11-1); 4.849 (94) (021); 4.366 (80) (13-1); 4.030 (75) (040, 111); 3.855 (100) (31-1); 3.745 (43) (20-2), 3.285 (59) (131); 2.764 (45) (330); 2.435 (52) (26-1).

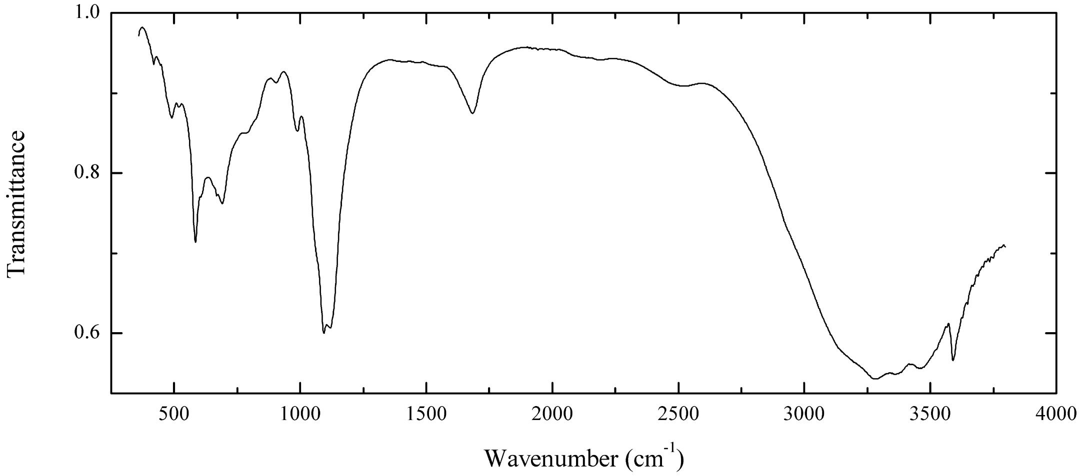
Wavenumbers (cm^{-1}): 3460sh, 3585, 3490sh, 3421, 3293, 3190sh, 3164s, 2989, 2521w, 2445w, 2299w, 1685sh, 1646, 1168, 1107s, 1040, 993w, 882w, 843, 760sh, 700, 639, 620, 609, 575sh, 547, 497, 460sh, 379.

S301 Cesanite $Na_3Ca_2(SO_4)_3(OH)$



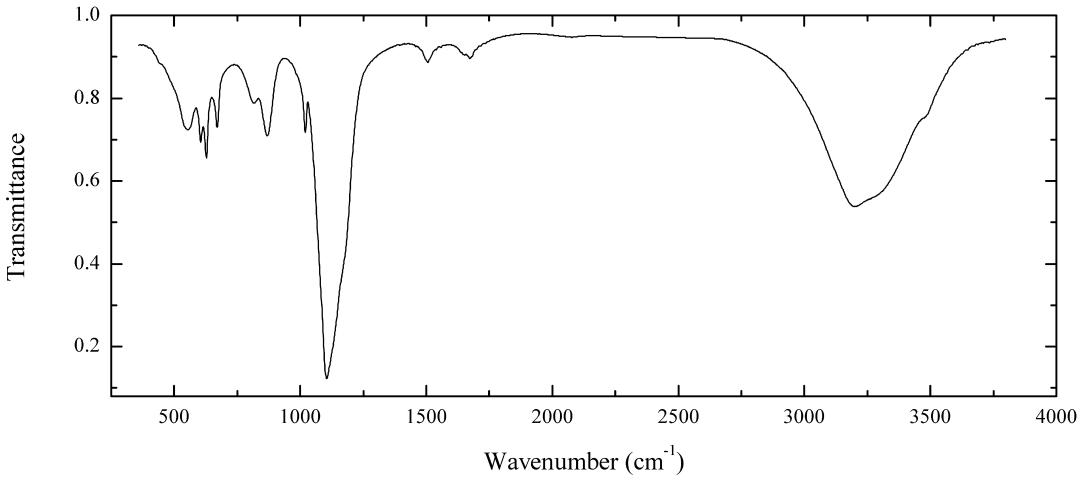
Locality: Cesano I geothermal well, Cesano, Latium, Italy (type locality).
Description: Colourless prismatic crystals from the association with gypsum. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3566, 1654w, 1190sh, 1145sh, 1128s, 996, 646, 625sh, 615, 492w, 467w.

S302 Aluminite $Al_2(SO_4)(OH)_4{\cdot}7H_2O$



Locality: Waisenhausgarten, Halle, Saxony-Anhalt, Germany (type locality).
Description: White concretion. Identified by IR spectrum and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3589s, 3460s, 3364s, 3281s, 3200sh, 2520w, 2188w, 2125w, 1684, 1120s, 1094s, 1065sh, 990, 905w, 820sh, 784, 691, 584, 522, 419.

S303 Cobaltkieserite $Co(SO_4){\cdot}H_2O$

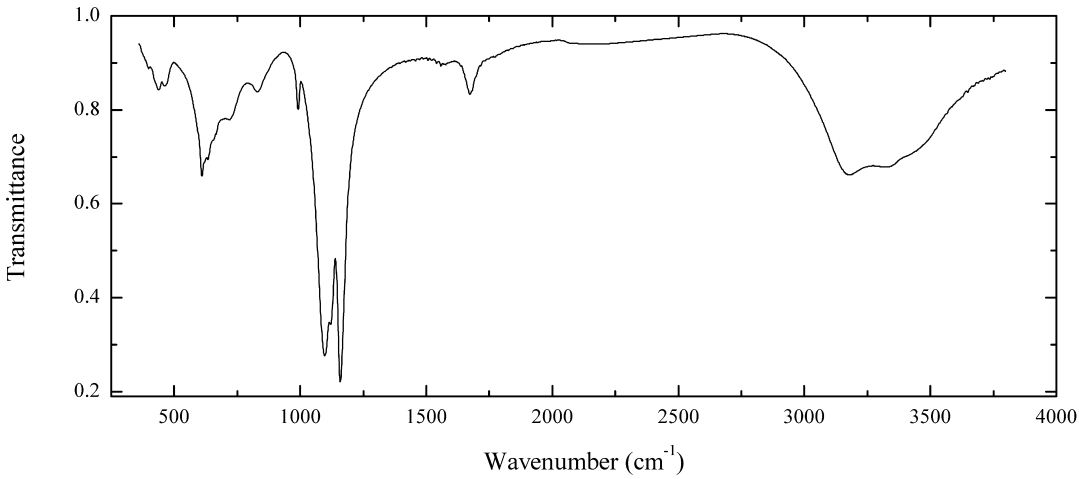


Locality: N'Kana mine, Kitwe district, Zambia.

Description: Pink powdery. Investigated by A.V. Kasatkin. Possibly contains admixture of bonattite. The empirical formula is $(Co_{0.46}Cu_{0.44}Zn_{0.02}Ni_{0.01})(SO_4)_{1.05}\cdot nH_2O$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %)] are 3.409 (100), 3.061 (90), 4.826 (48), 2.509 (40), 3.334 (35), 2.563 (20).

Wavenumbers (cm^{-1}): 3475sh, 3270sh, 3202s, 2475w, 2077w, 1673, 1657w, 1506, 1170sh, 1105s, 1020, 990sh, 869, 818, 670, 628, 605, 555, 450sh.

S304 Cobaltoblödite $Na_2Co(SO_4)_2\cdot 4H_2O$

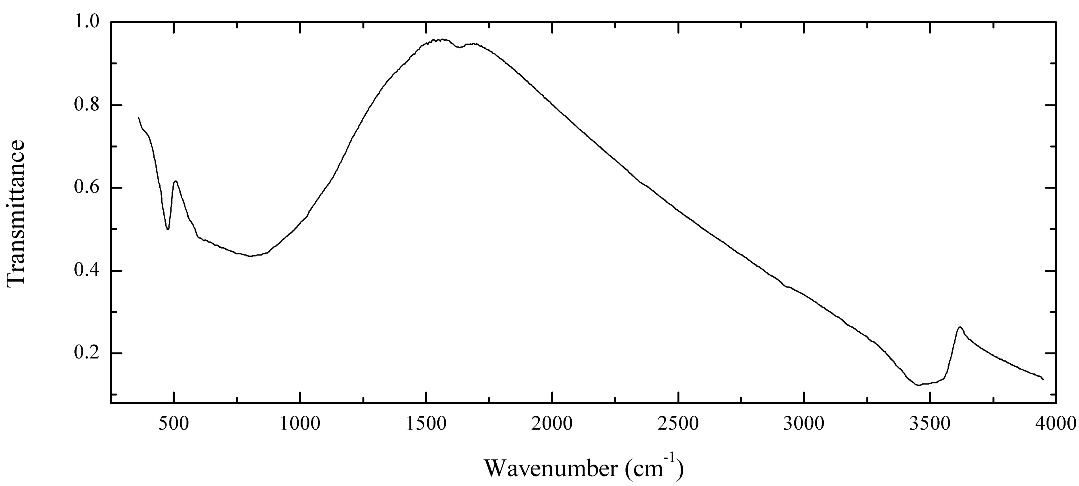


Locality: Blue Lizard mine, Red Canyon, White Canyon district, San Juan Co., Utah, USA.

Description: Pink crust. Cotype specimen. Investigated by A.V. Kasatkin.

Wavenumbers (cm^{-1}): 3410sh, 3325, 3179, 2170w, 1673, 1567, 1159s, 1123s, 1098s, 992, 830, 718, 660sh, 632, 610, 466, 438, 399w.

S305 Ferrotochilinite $6FeS\cdot 5Fe(OH)_2$

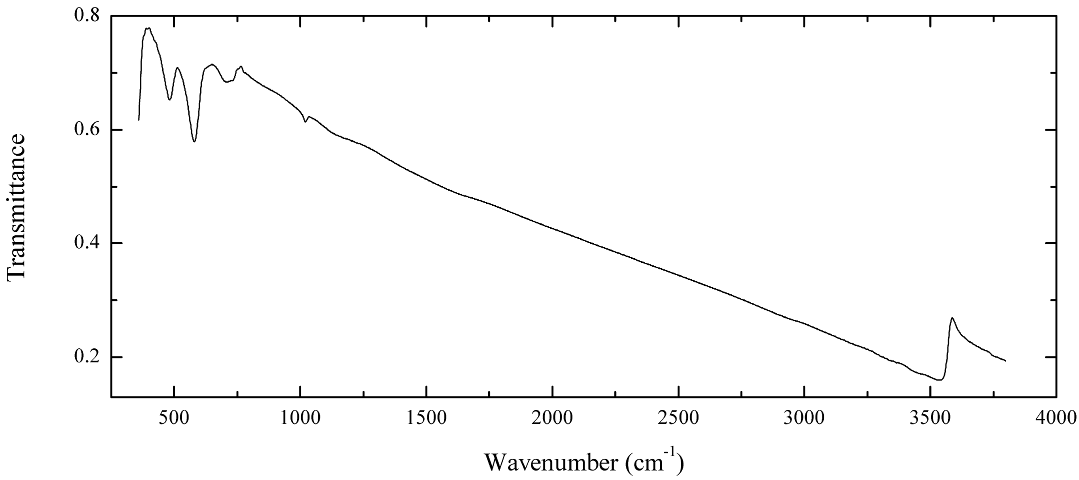


Locality: Oktyabr'skoe Cu–Ni deposit, Norilsk, Krasnoyarsk Krai, Siberia, Russia (type locality).

Description: Dark bronze-coloured elongate lamellar crystals from a cavity of the pentlandite-mooihoekite-cubanite ore, from the association with ferrovalleriite, magnetite and Fe-rich chlorite-like phyllosilicate. Holotype sample. Monoclinic, space group is *C*2/*m*, *Cm* or *C*2, unit-cell parameters are $a = 5.463(5)$, $b = 15.865(17)$, $c = 10.825(12)$ Å, $\beta = 93.7(1)^o$, $V = 936(3)$ Å^3, $Z = 2$. $D_{calc} = 3.467$ g/cm^3. The empirical formula is $Mg_{0.01}Fe_{10.96}Ni_{0.005}Cu_{0.015}S_6(OH)_{10.07}$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 10.83 (13) (001); 5.392 (100) (002); 3.281 (7) (023); 2.777 (7) (150); 2.696 (12) (004, 20-1), 2.524 (12) (22-1, 20-2), 2.152 (8) (134, 153), 1.837 (11) (135, 17-3).

Wavenumbers (cm^{-1}): 3525sh, 3457, 1635w, 801s, 650sh, 477.

S306 Ferrovalleriite $2(Fe,Cu)S{\cdot}1.5Fe(OH)_2$

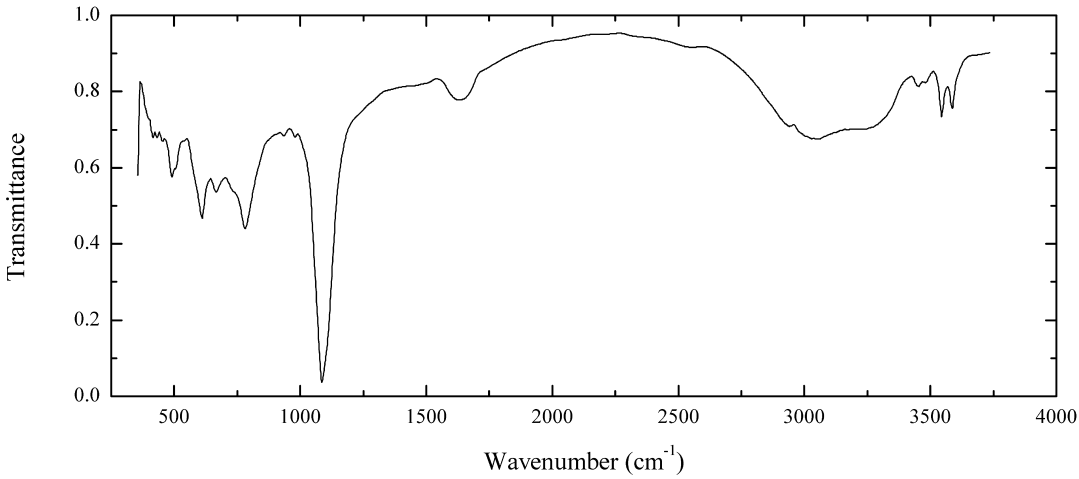


Locality: Oktyabr'skoe Cu–Ni deposit, Norilsk, Krasnoyarsk Krai, Siberia, Russia (type locality).

Description: Black scaly crystals from a cavity of the mooihoekite-cubanite ore. Holotype sample. Two sub-lattices are present in the structure of ferrovalleriite: (1) sulfide sub-lattice, space group *R*-3*m*, *R*3*m* or *R*32, unit-cell parameters ($a = 3.792(2)$, $c = 34.06(3)$ Å, $V = 424(1)$ Å^3); (2) hydroxide sub-lattice, space group is *P*-3*m*1, *P*3*m*1 or *P*321, unit-cell parameters ($a = 3.202(3)$, $c = 11.35(2)$ Å, $V = 100.8(3)$ Å^3. $D_{calc} = 3.72$ g/cm^3). The empirical formula is $Al_{0.01}Fe_{2.55}Cu_{0.91}S_2(OH)_{3.07}$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 5.69 (100); 3.268 (58); 3.163 (36); 1.894 (34); 1.871 (45).

Wavenumbers (cm^{-1}): 3537s, 1022w, 708, 580s, 481.

S307 Kobyashevite $Cu_5(SO_4)_2(OH)_6·4H_2O$

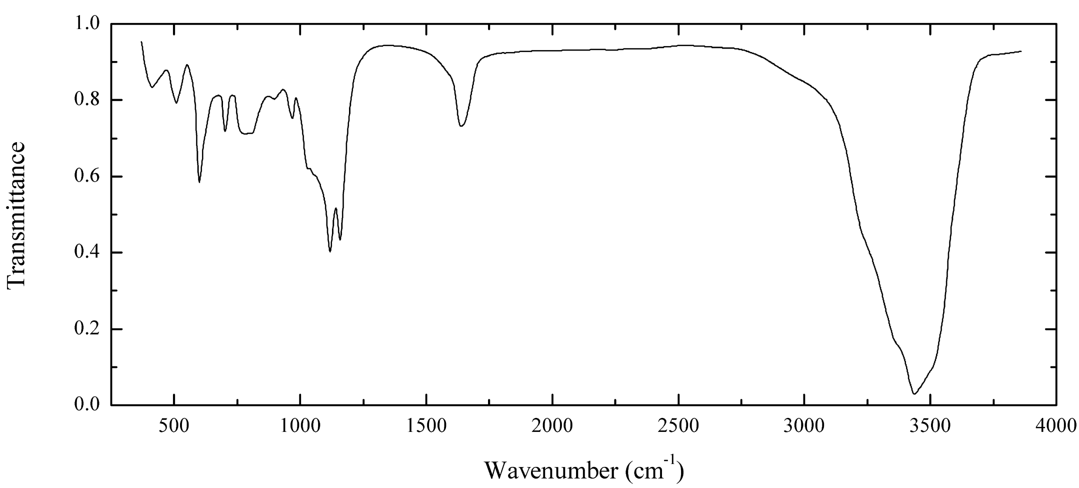


Locality: Kapital'naya mine, Vishnevye Mountains, South Urals, Russia (type locality).

Description: Bluish-green crystals from the association with calcite, quartz, pyrite and chalcopyrite. Holotype sample. The crystal structure is solved on a single crystal. Triclinic, space group *P*-1, $a = 6.0731(6)$, $b = 11.0597(13)$, $c = 5.5094(6)$ Å, $\alpha = 102.883(9)°$, β $9 = 2.348(8)°$, $\gamma = 92.597(9)°$, $V = 359.87(7)$ Å^3, $Z = 1$. $D_{calc} = 3.155$ g/cm^3. Optically biaxial (–), $\alpha = 1.602(4)$, $\beta = 1.666(5)$, $\gamma = 1.679(5)$, $2V_{meas} = 50(10)°$. The empirical formula is $Cu_{4.96}Fe_{0.03}Zn_{0.01}S_{2.01}O_{8.04}(OH)_{5.96}·4H_2O$. The strongest lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 10.84 (100) (010); 5.399 (40) (020); 5.178 (12) (110); 3.590 (16) (030); 2.691 (16) (20-1, 040, 002), 2.653 (12) (04-1, 02-2), 2.583 (12) (2-11, 201, 2-1-1), 2.425 (12) (03-2, 211, 131).

Wavenumbers (cm^{-1}): 3588, 3546, 3480w, 3455w, 3230sh, 3049, 2945sh, 2540w, 1630, 1090s, 989w, 945w, 785, 750sh, 669, 616, 512, 495, 458w, 436w, 419w.

S308 Lahnsteinite $Zn_4(SO_4)(OH)_6·3H_2O$

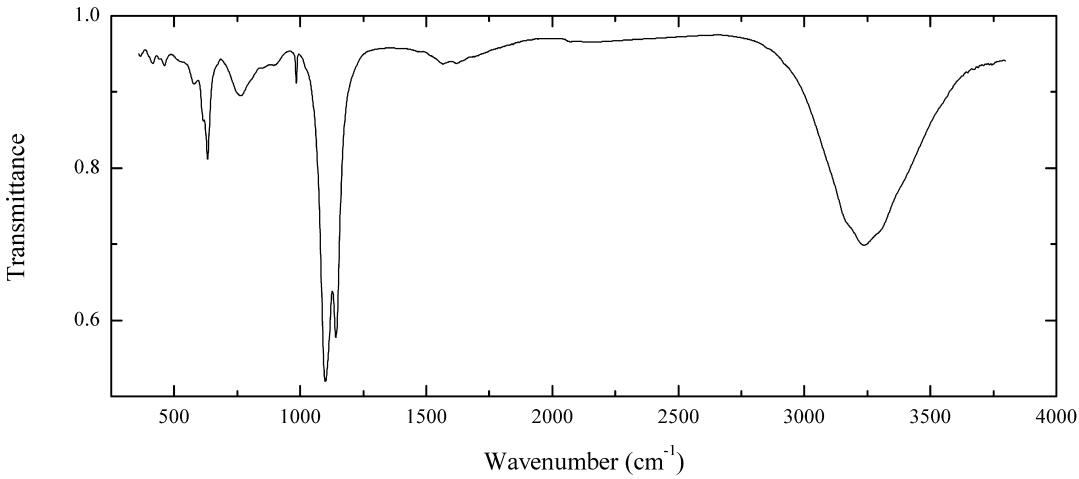


Locality: Friedrichssegen mine, Lahn valley, Bad Ems district, Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Colourless tabular crystals from the association with goethite, hydrozincite, pyromorphite and native copper. Holotype sample. The crystal structure is solved on a single crystal. Triclinic, space group $P1$, $a = 8.3125(6)$, $b = 14.545(1)$, $c = 18.504(2)$ Å, $\alpha = 89.71(1)°$, $\beta = 90.05(1)°$, $\gamma = 90.13(1)°$, $V = 2237.2(3)$ Å^3, $Z = 8$. $D_{meas} = 2.98(2)$ g/cm^3, $D_{calc} = 2.995$ g/cm^3. Optically biaxial (−), $\alpha = 1.568(2)$, $\beta = 1.612(2)$, $\gamma = 1.613(2)$, $2V_{meas} = 18(3)°$. The empirical formula is $(Zn_{3.53}Fe_{0.27}Cu_{0.11})(S_{0.98}O_4)$ $(OH)_6{\cdot}3H_{2.10}O$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 9.30 (100), 4.175 (18), 3.476 (19), 3.290 (19), 2.723 (57), 2.624 (36), 2.503 (35), 1.574 (23).

Wavenumbers (cm^{-1}): 3500sh, 3445s, 3375sh, 3250sh, 1637, 1158s, 1118s, 1060sh, 1032, 971, 901w, 810sh, 780, 701, 600, 516, 415.

S309 Nickelpicromerite $K_2Ni(SO_4)_2{\cdot}6H_2O$

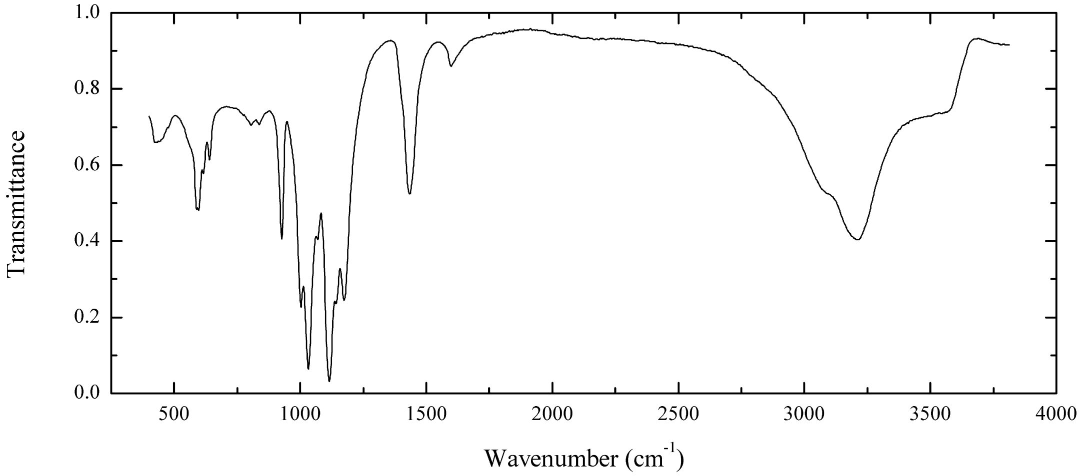


Locality: Slyudorudnik, Kyshtym District, Chelyabinsk Oblast, South Urals, Russia (type locality).

Description: Light greenish-blue equant crystals from the association with gypsum, talc, actinolite, biotite, Ni-enriched vermiculite, pyrite and pyrrhotite. Holotype sample. The crystal structure is solved on a single crystal. Monoclinic, space group $P2_1/c$, $a = 6.1310(7)$, $b = 12.1863(14)$, $c = 9.0076(10)$ Å, $\beta = 105.045(2)°$, $V = 649.9(1)$ Å^3, $Z = 2$. $D_{meas} = 2.20(2)$ g/cm^3, $D_{calc} = 2.22$ g/cm^3. Optically biaxial (−), $\alpha = 1.486(2)$, $\beta = 1.489(2)$, $\gamma = 1.494(2)$, $2V_{meas} = 75(10)°$. The empirical formula is $K_{1.93}Mg_{0.04}Ni_{0.98}S_{2.02}O_{8.05}(H_2O)_{5.95}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 5.386 (34), 4.312 (46), 4.240 (33), 4.085 (100), 3.685 (85), 3.041 (45), 2.808 (31), 2.368 (34).

Wavenumbers (cm^{-1}): 3365sh, 3290sh, 3237s, 3180sh, 2208w, 1622, 1560, 1142s, 1100s, 985, 894w, 850sh, 763, 632, 620sh, 581, 445w, 416w, 366w.

S310 Beshtauite $(NH_4)_2(UO_2)(SO_4)_2·2H_2O$

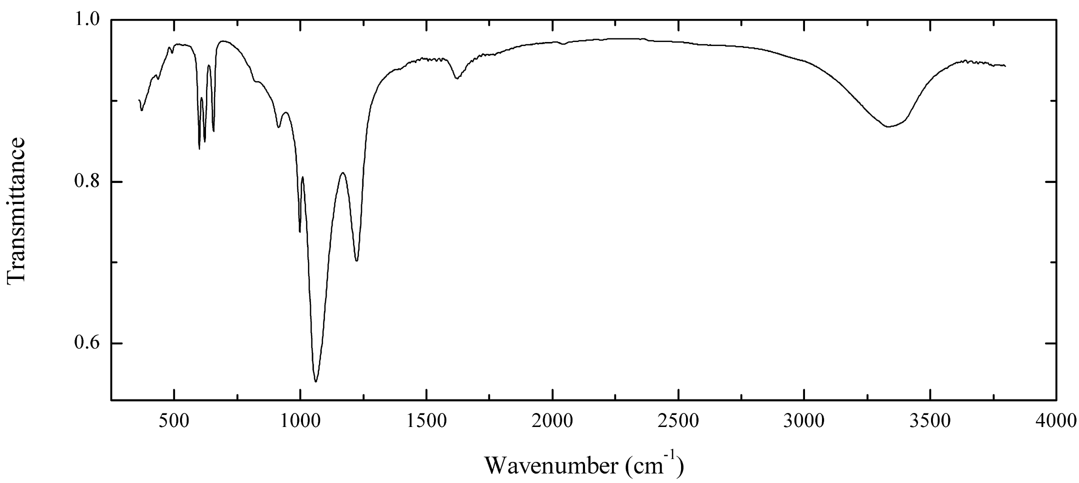


Locality: Gremuchka ore zone, Beshtau U deposit, Mt. Beshtau, near the city of Pyatigorsk, Stavropol Krai, Northern Caucasus, Russia (type locality).

Description: Light green short-prismatic crystals from the association with rozenite, gypsum, marcasite, pyrite, lermontovite, uraninite, halloysite and opal. Holotype sample. The crystal structure is solved on a single crystal. Monoclinic, space group $P2_1/c$, $a = 7.7360(8)$, $b = 7.3712(5)$, $c = 20.856(2)$ Å, $\beta = 102.123(8)°$, $V = 1162.75(19)$ Å^3, $Z = 4$. $D_{calc} = 3.05$ g/cm^3. Optically biaxial (+), $\alpha = 1.566(3)$, $\beta = 1.566(3)$, $\gamma = 1.592(3)$. The empirical formula is $(NH_4)_{2.12}U_{0.99}S_{1.96}O_{9.91}(H_2O)_{2.09}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 6.86 (100), 5.997 (19), 5.307 (36), 5.005 (35), 3.410 (38), 3.081 (24), 2.884 (20).

Wavenumbers (cm^{-1}): 3550, 3233s, 3105, 1603, 1438, 1175s, 1143s, 1117s, 1071, 1033s, 1003s, 928, 840w, 806w, 642, 617, 598, 591, 421.

S311 Kaliochalcite (IMA No. 2013-037) $KCu_2(SO_4)_2[(OH)(H_2O)]$

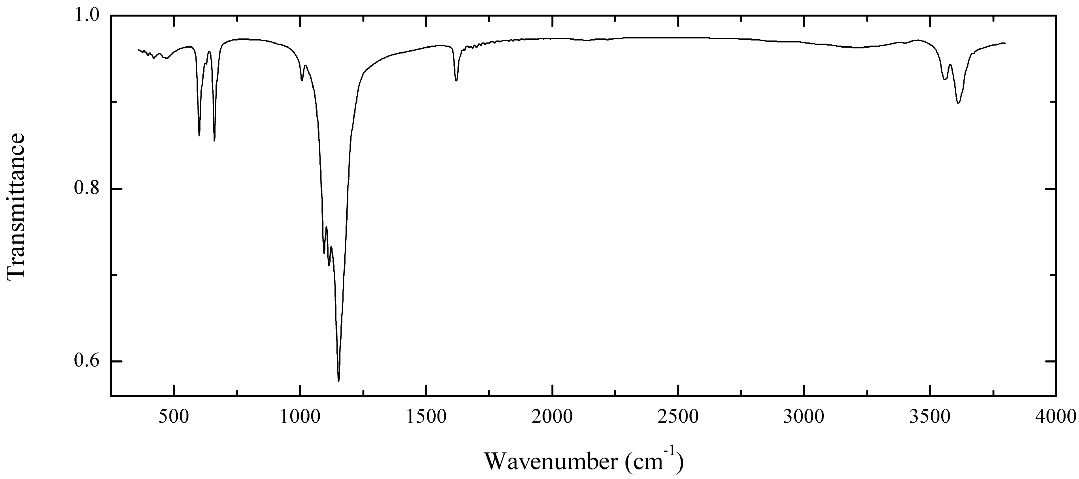


Locality: Yadovitaya fumarole, the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka peninsula, Far-Eastern Region, Russia (type locality).

Description: Green incrustations from the association with euchlorine, fedotovite, piypite, chalcocyanite, alumoklyuchevskite, langbeinite, steklite, aphthitalite, calciolangbeinite, krasheninnikovite, vanthoffite, anhydrite, hematite, tenorite, kamchatkite, lyonsite, *etc*. Holotype sample. The crystal structure is solved on a single crystal. Monoclinic, space group $C2/m$, $a = 8.9352$ (24), $b = 6.2520(18)$, $c = 7.6017(21)$ Å, $\beta = 117.318(5)°$, $Z = 2$. $D_{calc} = 3.49$ g/cm^3. Optically biaxial (+), $\alpha = 1.630(3)$, $\beta = 1.650(3)$, $\gamma = 1.714(3)$, $2V_{meas} = 55(10)°$. The empirical formula is $(K_{0.94}Ca_{0.02}Na_{0.01})_{\Sigma 0.97}(Cu_{2.03}Zn_{0.02}Fe_{0.01})_{\Sigma 2.06}(SO_4)_{2.05}(OH)_{1.01}(H_2O)_{0.79}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 6.78 (100), 4.432 (35), 3.484 (70), 3.249 (63), 2.892 (77), 2.852 (83), 2.554 (72), 2.326 (44).

Wavenumbers (cm^{-1}): 3470sh, 3334, 2044w, 1623, 1390sh, 1224s, 1061s, 998s, 914, 830sh, 655, 621, 599, 492w, 439w, 474.

S312 Bassanite $Ca(SO_4)\cdot 0.5H_2O$

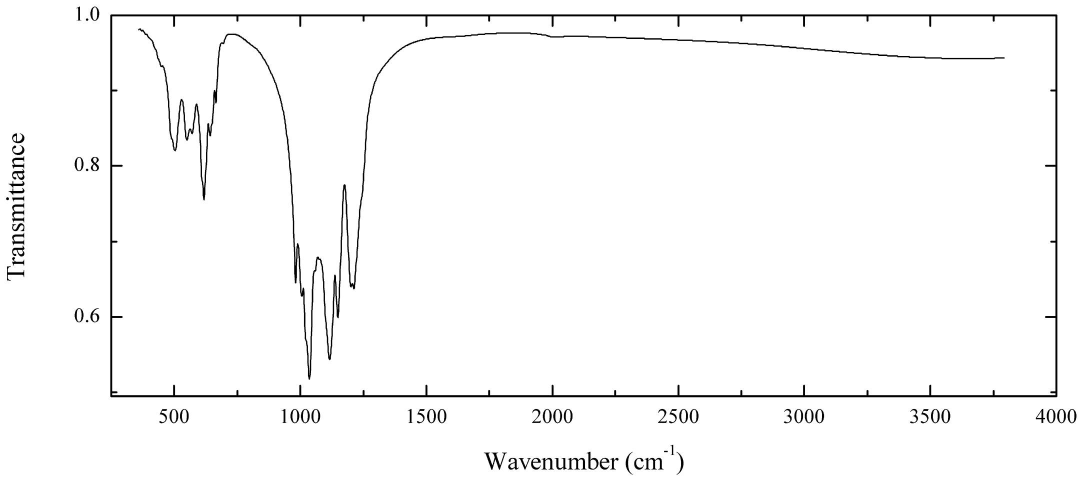


Locality: Kladno (Schöller) mine, Libušin, Kladno, Bohemia, Czech Republic.

Description: White prismatic crystals from the association with tschermigite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3612, 3558, 1619, 1153s, 1115s, 1095s, 1008, 660, 625sh, 600, 472w, 425w.

S313 Parawulffite (IMA No. 2013-036) $K_5Na_3Cu_8O_4(SO_4)_8$

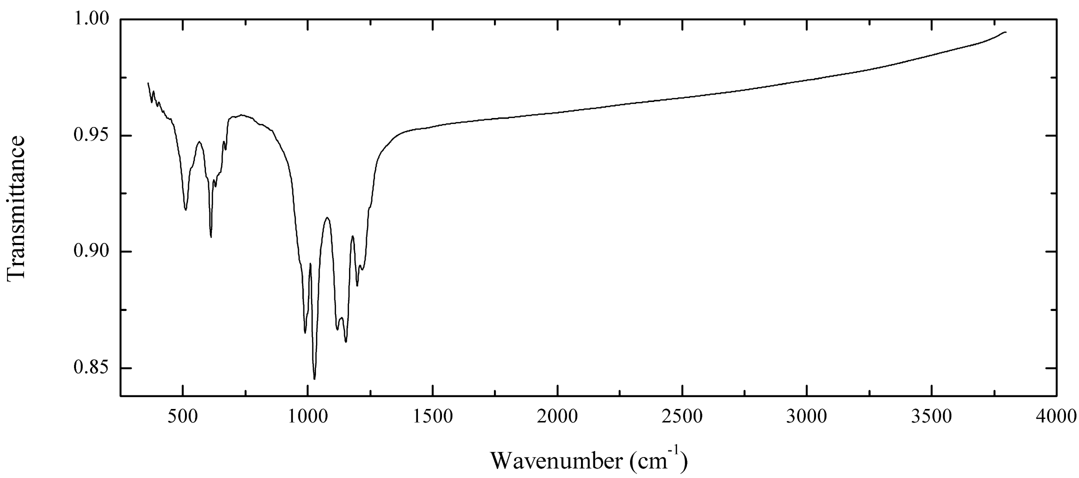


Locality: Yadovitaya fumarole, the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka peninsula, Far-Eastern Region, Russia (type locality).

Description: Dark green incrustations from the association with euchlorine, fedotovite, hematite, tenorite, alumoklyuchevskite, langbeinite, calciolangbeinite, piypite, chalcocyanite, kamchatkite, krasheninnikovite, orthoclase (As-bearing variety), rutile (Fe- and Sb-bearing variety), pseudobrookite, lammerite, lammerite-β, lyonsite, pseudolyonsite, starovaite, *etc*. Holotype sample. The crystal structure is solved on a single crystal. Monoclinic, space group $P2/c$, $a = 13.9043$ (10), $b = 4.9765(3)$, $c = 23.5855(17)$ Å, $\beta = 90.209(6)°$, $Z = 2$. $D_{meas} = 3.35(2)$ g/cm^3, $D_{calc} =$ 3.323 g/cm^3. Optically biaxial (+), $\alpha = 1.585$ (3), $\gamma = 1.717(4)$. The empirical formula is $Na_{2.95}(K_{4.75}Rb_{0.25}Cs_{0.14})_{\Sigma 5.14}(Cu_{7.95}Zn_{0.04})_{\Sigma 7.99}S_{7.99}O_{36}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 9.06 (100), 7.00 (23), 5.903 (12), 3.096 (31), 2.736 (33), 2.492 (24), 2.321 (26).

Wavenumbers (cm^{-1}): 2000w, 1212, 1202, 1149s, 1116s, 1060sh, 1036s, 1025sh, 1006, 981, 690w, 665, 650sh, 642, 618, 572, 550, 503, 490sh, 450sh.

S314 Wulffite (IMA No. 2013-035) $K_3NaCu_4O_2(SO_4)_4$

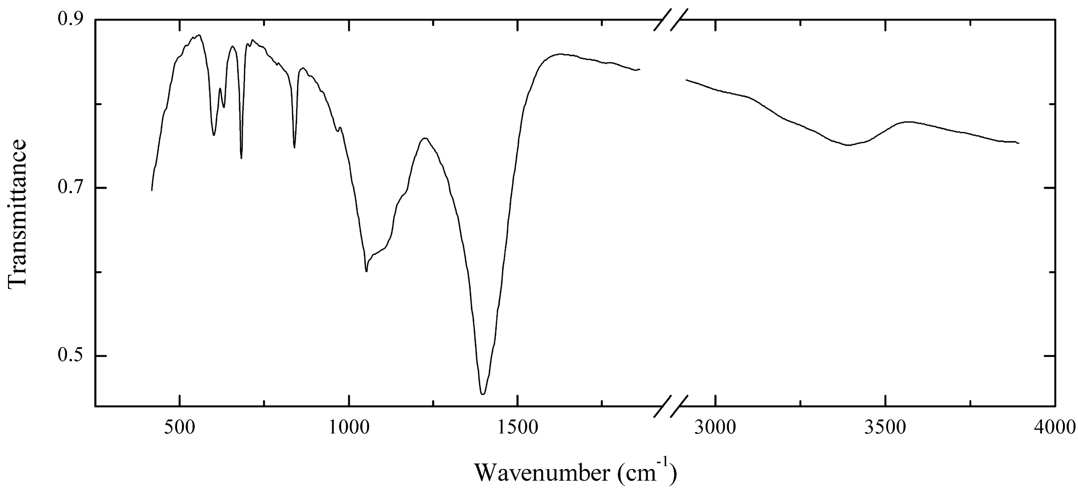


Locality: Arsenatnaya fumarole, the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka peninsula, Far-Eastern Region, Russia (type locality).

Description: Emerald-green incrustations from the association with aphthitalite, euchlorine, tenorite, hematite, lammerite, lammerite-β, johillerite, bradaczekite, urusovite, alarsite, tilasite, svabite, langbeinite, calciolangbeinite, arcanite, palmierite, dolerophanite, *etc*. Holotype sample. The crystal structure is solved on a single crystal. Orthorhombic, space group $Pn2_1a$, $a = 14.2810(6)$, $b = 4.9478(2)$, $c = 24.1127(11)$ Å, $Z = 4$. $D_{meas} = 3.23(2)$ g/cm^3, $D_{calc} = 3.192$ g/cm^3. Optically biaxial (+), $\alpha = 1.582$ (3), $\beta = 1.610(3)$, $\gamma = 1.717(3)$. The empirical formula is $Na_{1.08}(K_{2.85}Rb_{0.08}Cs_{0.04})_{\Sigma 2.97}(Cu_{3.99}Zn_{0.02})_{\Sigma 4.01}S_{3.99}O_{18}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 9.27 (100), 7.16 (22), 3.125 (16), 2.882 (16), 2.780 (33), 2.725 (14), 2.472 (20).

Wavenumbers (cm^{-1}): 1250sh, 1223, 1198, 1153s, 1118s, 1026s, 995sh, 989s, 970sh, 671w, 645sh, 630, 612, 535sh, 511.

SC1 Susannite $Pb_4(SO_4)(CO_3)_2(OH)_2$

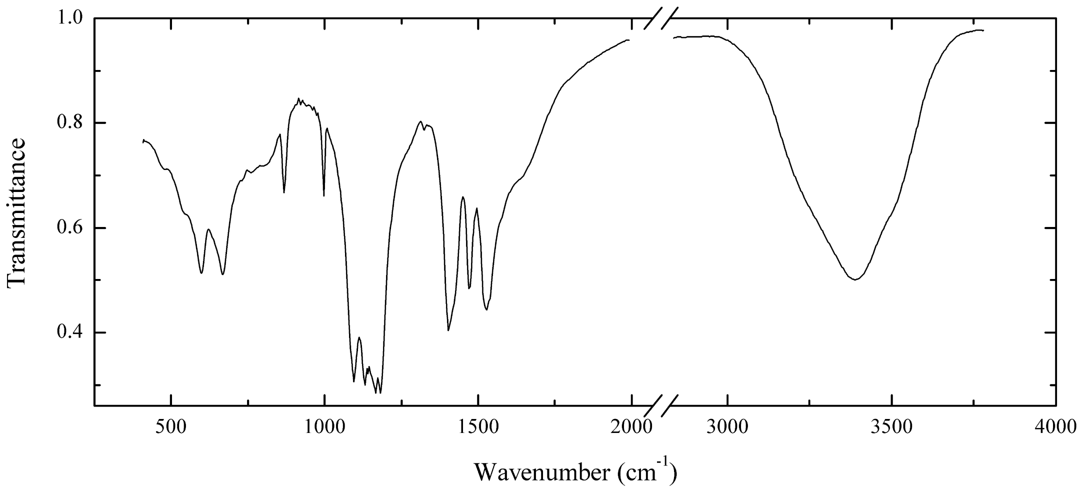


Locality: Boarezzo mine (Pradisci prospect), Boarezzo, Varese province, Lombardy, Italy.

Description: White crust on galena.

Wavenumbers (cm^{-1}): 3375, 1400s, 1160sh, 1100sh, 1050s, 965w, 839, 679, 625w, 600.

SC2 Rapidcreekite $Ca_2(SO_4)(CO_3)\cdot 4H_2O$

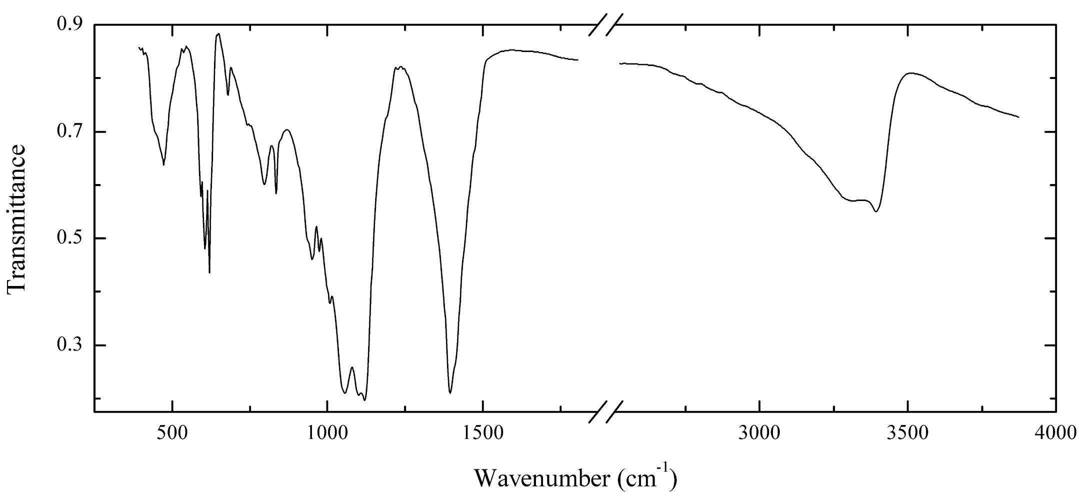


Locality: Rapid Creek area, northern Yukon Territory, Canada (type locality).

Description: Clusters of pale yellow crystals from the association with aragonite. Confirmed by IR spectrum and semiquantitative electron microprobe analysis (S:Ca:O ≈ 1:2:12).

Wavenumbers (cm^{-1}): 3525sh, 3390s, 3240sh, 1675sh, 1625, 1545sh, 1536s, 1480, 1425sh, 1409s, 1184s, 1167s, 1142s, 1096s, 1001, 869, 805sh, 760sh, 732w, 667, 599, 550, 475w.

SC3 Caledonite $Pb_5Cu_2(SO_4)_3(CO_3)(OH)_6$

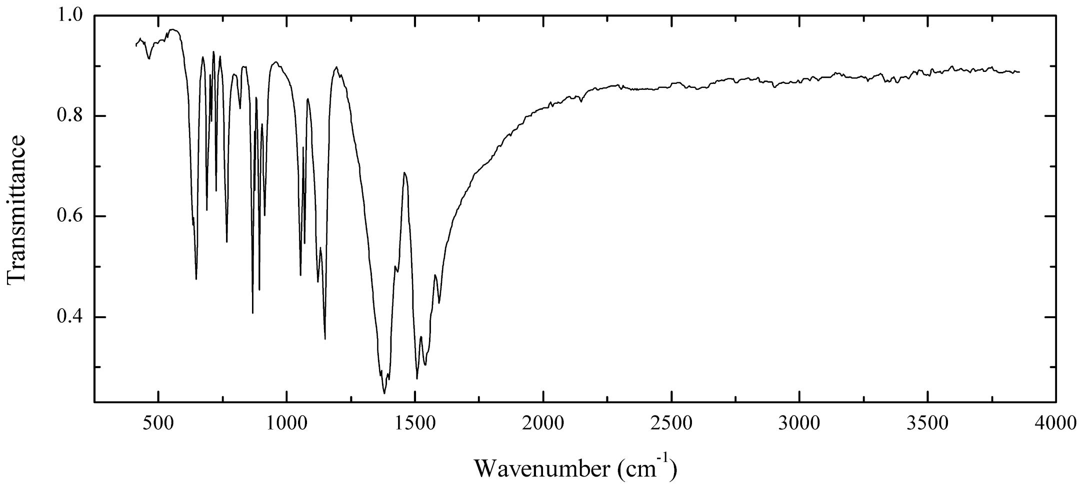


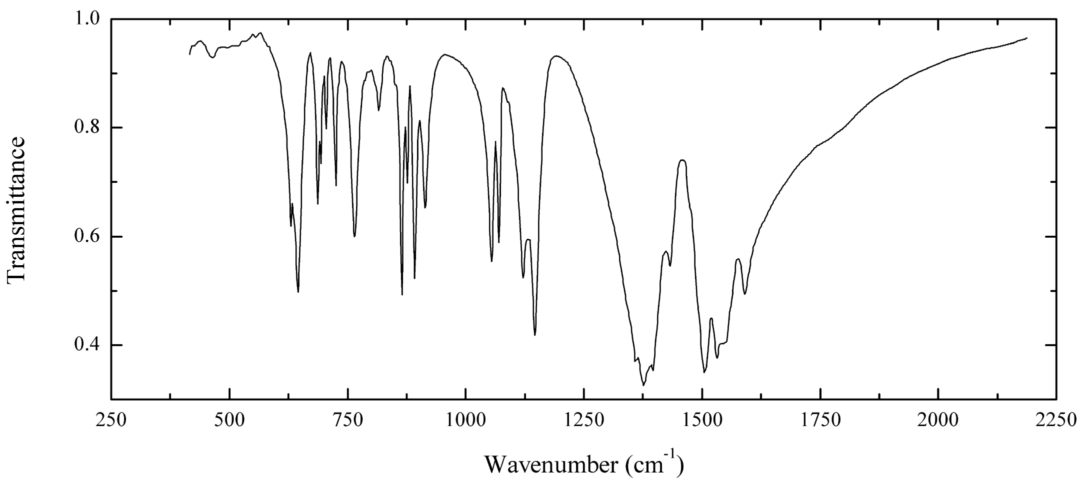
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Bluish-green semitransparent crystals from the association with cerussite and malachite. The empirical formula is $Pb_{5.00}Cu_{2.00}[(SO_4)_{2.98}(AsO_4)_{0.02}](CO_3)(OH)_6$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3395, 3285, 1410sh, 1398s, 1120s, 1102s, 1057s, 1008, 976, 953, 940sh, 837, 800, 745sh, 679w, 620, 605, 590, 470, 445sh.

SC4 Mineevite-(Y) $Na_{25}Ba(Y,Gd,Dy)_2(SO_4)_2(CO_3)_{11}(HCO_3)_4F_2Cl$



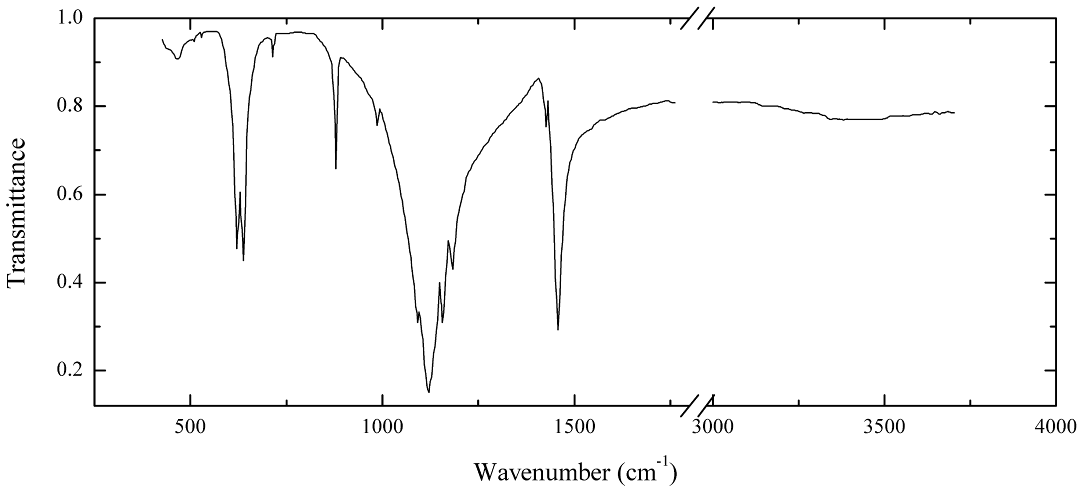


Locality: Alluaiv Mt., Lovozero alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Greenish-yellow transparent grains from the association with nahcolite, trona, thermonatrite, sidorenkite, neighborite, aegirine, albite, sphalerite and manganotychite. Holotype sample. Hexagonal, space group $P6_3/m$. $a = 8.811(7)$, $c = 37.03(3)$ Å, $Z = 2$. $D_{meas} = 2.85(2)$ g/cm^3, $D_{calc} = 2.84$ g/cm^3. Optically uniaxial (−), $\omega = 1.536(2)$, $\varepsilon = 1.510(2)$. The empirical formula is $Na_{25.30}Ba_{1.02}(Y_{1.11}Gd_{0.27}Dy_{0.20}Sm_{0.11}Ce_{0.07}Nd_{0.06}Er_{0.06}Tb_{0.04}La_{0.03}Ho_{0.02}Yb_{0.01})(CO_3)_{10.98}(HCO_3)_{3.92}(SO_4)_{2.03}F_{2.01}Cl_{1.02}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.829 (100), 2.270 (90), 2.531 (71), 2.659 (51), 1.660 (46), 3.32 (40), 7.61 (39).

Wavenumbers (cm^{-1}): 2900w, 2095w, 2140w, 1775sh, 1593, 1545sh, 1535s, 1506s, 1480sh, 1432, 1394s, 1376s, 1361s, 1147s, 1122, 1070, 1055, 914, 892, 877w, 866, 816w, 765, 725, 705w, 694, 687, 645, 630, 600sh, 460w.

SC5 Hanksite $KNa_{22}(SO_4)_9(CO_3)_2Cl$

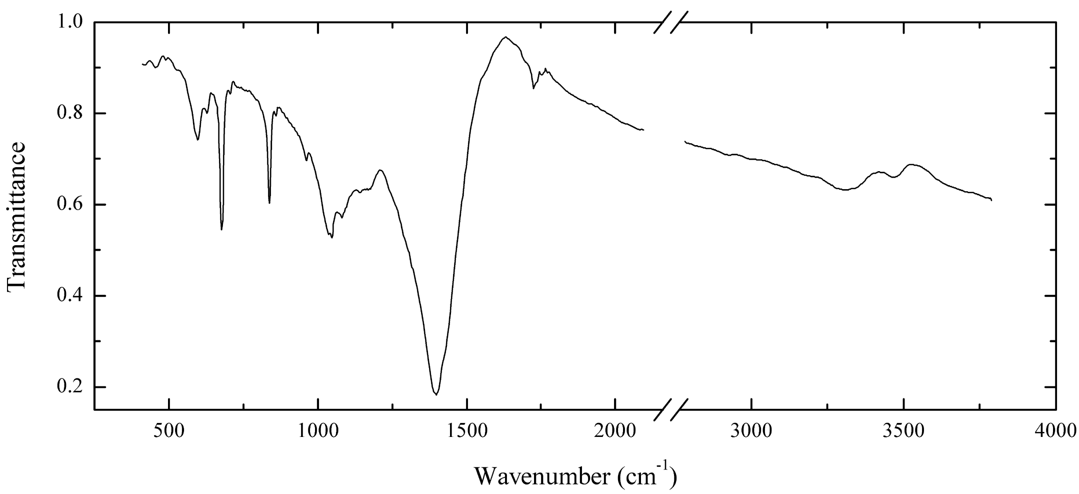


Locality: Searles Lake, San Bernardino Co., California, USA (type locality).

Description: Colourless crystal. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1460s, 1427w, 1185, 1159s, 1123s, 1095s, 987w, 878, 711w, 625, 609, 455w.

SC6 Leadhillite $Pb_4(SO_4)(CO_3)_2(OH)_2$

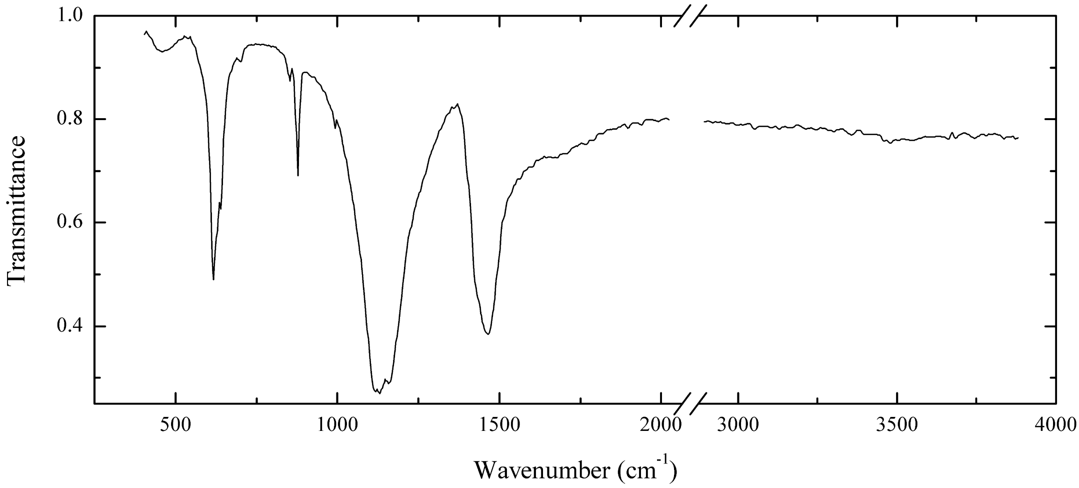


Locality: Kremikovtsi, near Sofia, Bulgaria.

Description: Colourless platy grains with perfect mica-lake cleavage. Partly substituted by cerussite (?). Associated minerals are galena and linarite.

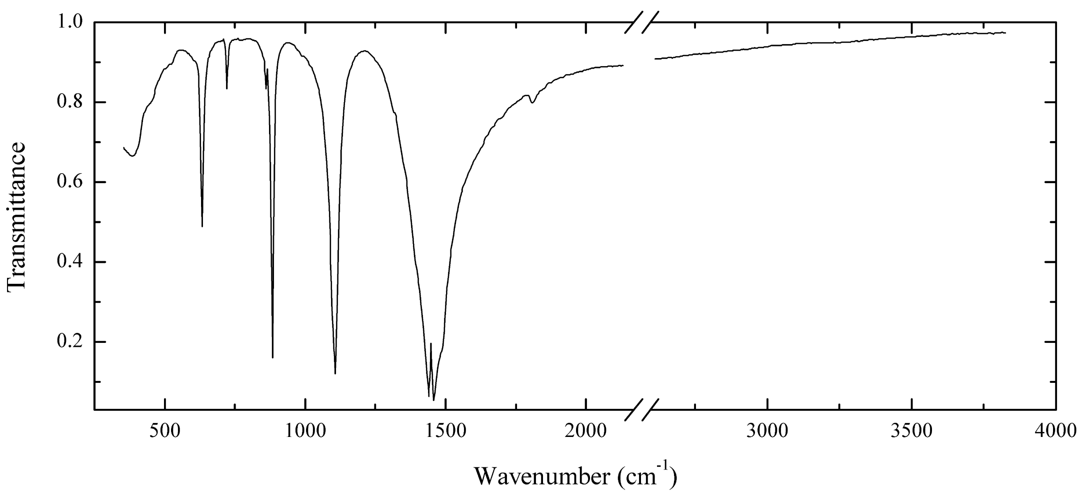
Wavenumbers (cm^{-1}): 3460w, 3300w, 1730w, 1402s, 1155w, 1085, 1035, 962, 860w, 840, 707w, 680, 625w, 600.

SC7 Burkeite $Na_4(SO_4)(CO_3,SO_4)_2$



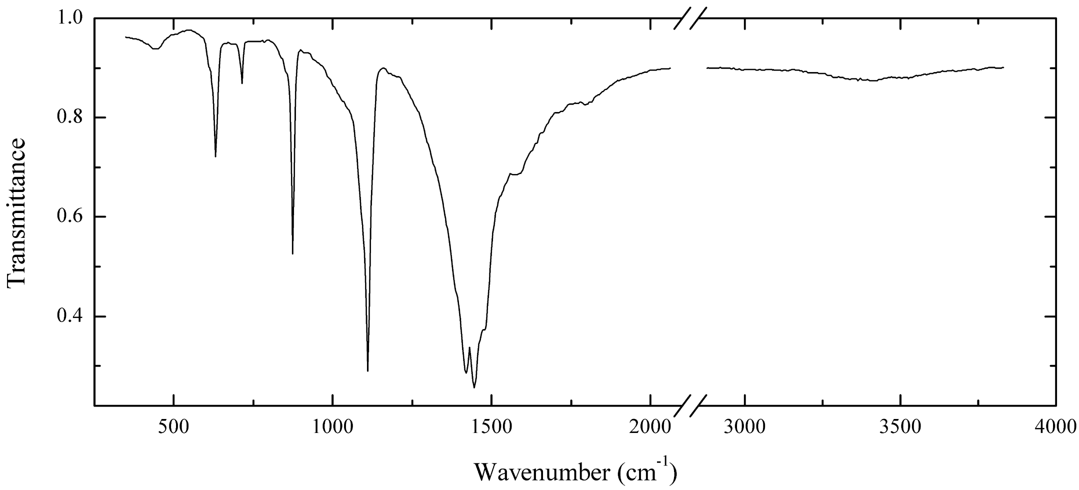
Locality: Natrum depression, Western Desert, Sahara, Egypt.
Description: White globular aggregates from the association with trona and halite. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1463s, 1158s, 1129s, 1117s, 992w, 880sh, 875, 850w, 701w, 641, 625sh, 615, 460w.

SC10 Tychite $Na_6Mg_2(SO_4)(CO_3)_4$



Locality: Searles Lake, San Bernardino Co., California, USA (type locality).
Description: Colourless octahedral crystal. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 1814w, 1490sh, 1463s, 1445s, 1109s, 1104s, 883s, 859w, 717w, 630, 510sh, 400sh, 388.

SC11 Ferrotychite $Na_6Fe^{2+}{}_2(SO_4)(CO_3)_4$

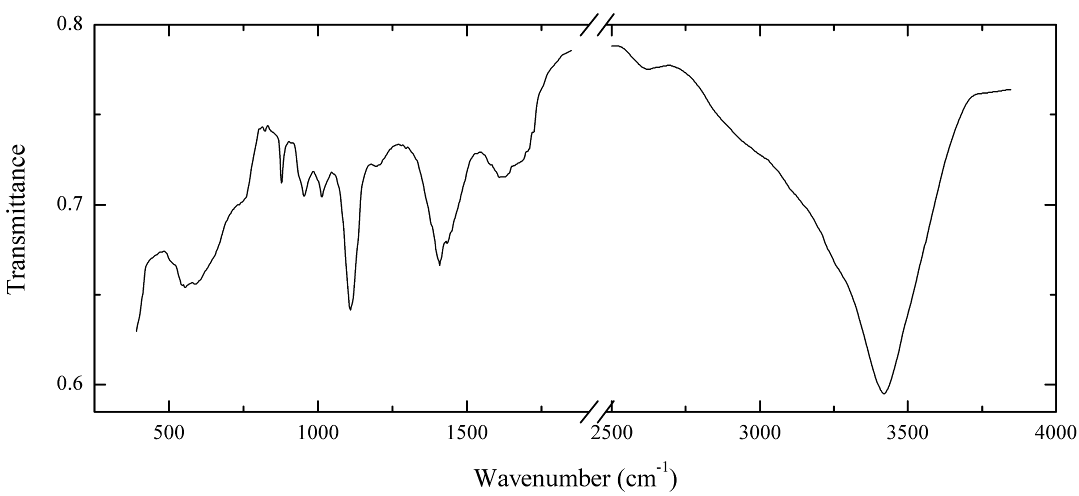


Locality: Olenii Ruchei (Reindeer's Stream), Khibiny alkaline complex, Kola peninsula, Murnansk region, Russia (type locality).

Description: Yellow grains from the association with shortite, bonshtedtite and analcime. Holotype sample. Cubic, space group $Fd3$, $a = 13.962(5)$, $Z = 8$. $D_{meas} = 2.79$ g/cm^3, $D_{calc} = 2.78$ g/cm^3. Optically isotropic, $n = 1.550(2)$. The empirical formula is $Na_{6.01}(Fe_{1.23}Mg_{0.40}Mn_{0.35})S_{0.98}C_{4.04}O_{16}$. The strongest lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 2.68 (100), 4.18 (90), 2.47 (80), 1.614 (60), 2.36 (40), 1.958 (40), 1.428 (30).

Wavenumbers (cm^{-1}): 1807w, (1595), 1475sh, 1445s, 1417s, 1385sh, 1110s, 874, 850sh, 712, 630, 605sh, 457w.

SC13 Jouravskite $Ca_2Mn^{4+}{}_2(SO_4,CO_3)_4(OH)_{12}\cdot 26H_2O$

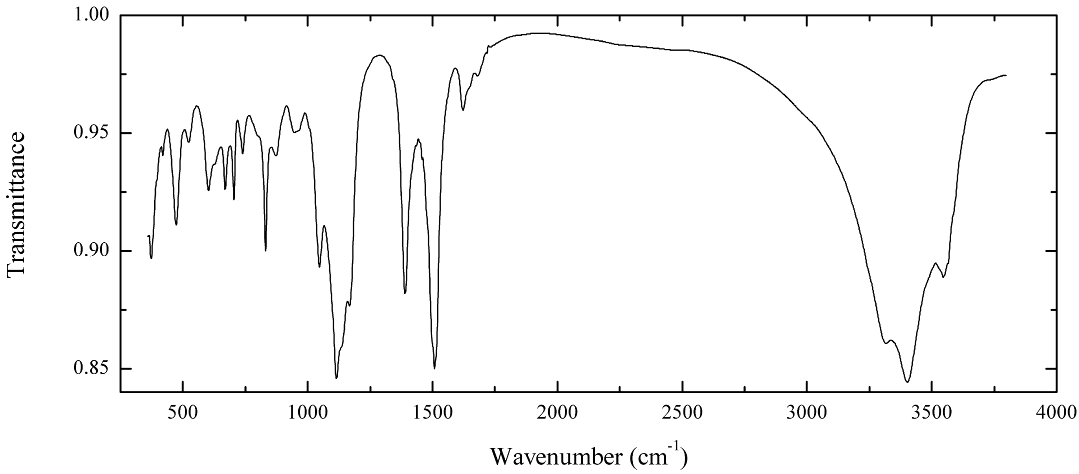


Locality: Tachgagalt mine, Anti-Atlas, Morocco (type locality).

Description: Yellow crystals on gaudefroyite. The empirical formula is (electron microprobe) $Ca_{6.00}(Mn_{1.51}Al_{0.44})[(SO_4)_{1.29}(CO_3)_x](OH)_{12}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3400s, 2610w, 1680sh, 1620, 1430, 1405s, 1200w, 1130sh, 1108s, 1009, 950, 870, 710sh, 630sh, 613s, 580s.

SC14 Brianyoungite $Zn_3(CO_3,SO_4)(OH)_4$

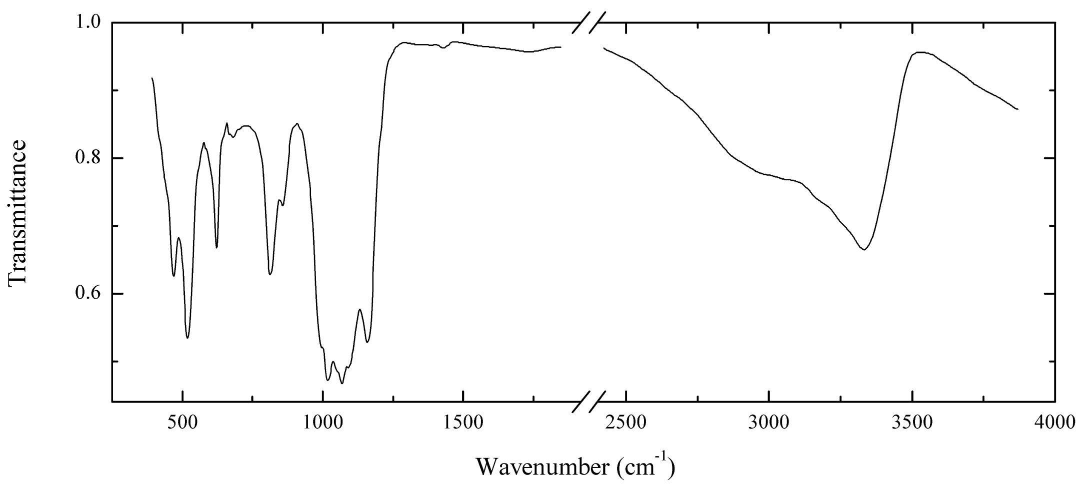


Locality: Esperanza mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: White scaly aggregate from the association with sphalerite and smithsonite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3546, 3403s, 3319, 1680w, 1650sh, 1622, 1508s, 1390, 1168, 1135sh, 1115s, 1047, 960sh, 947, 873, 831, 805sh, 739, 704, 669, 625sh, 603, 523, 473, 419, 374.

SP1 Corkite $PbFe^{3+}{}_3(SO_4)(PO_4)(OH)_6$

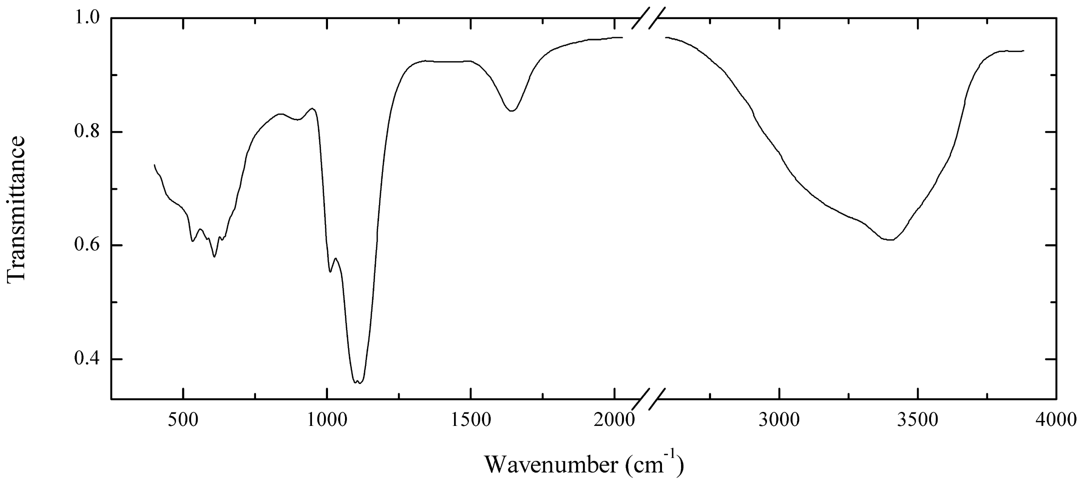


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Brown crystals. The empirical formula is (electron microprobe) $Pb_{0.97}Fe_{2.91}Cu_{0.08}Al_{0.04}[(SO_4)_{1.01}(PO_4)_{0.94}(AsO_4)_{0.05}](OH)_6$.

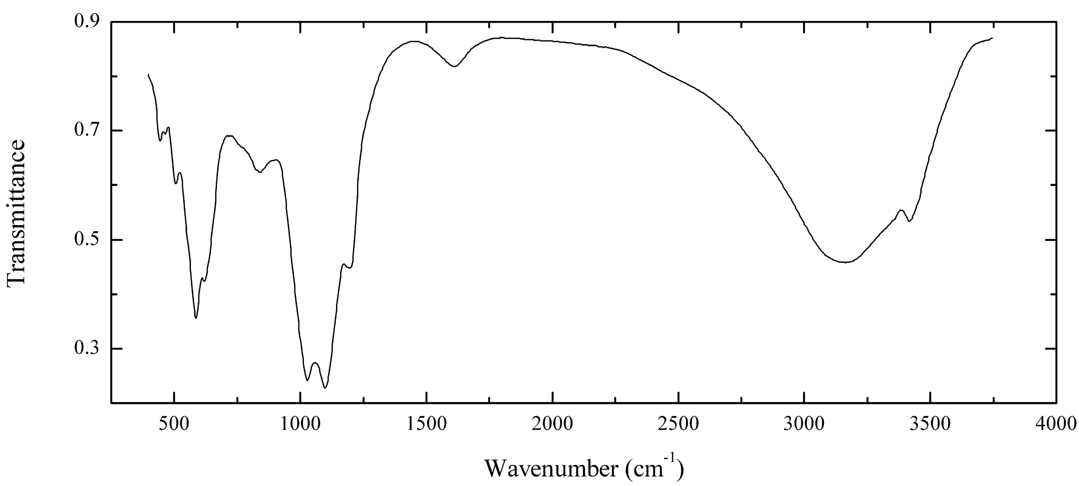
Wavenumbers (cm^{-1}): 3325, 3000sh, 1420w, 1160, 1085sh, 1067s, 1014s, 995sh, 857, 812, 683w, 633, 520, 468.

SP2 Peisleyite $Na_3Al_{16}(SO_4)_2(PO_4)_{10}(OH)_{17}\cdot20H_2O$



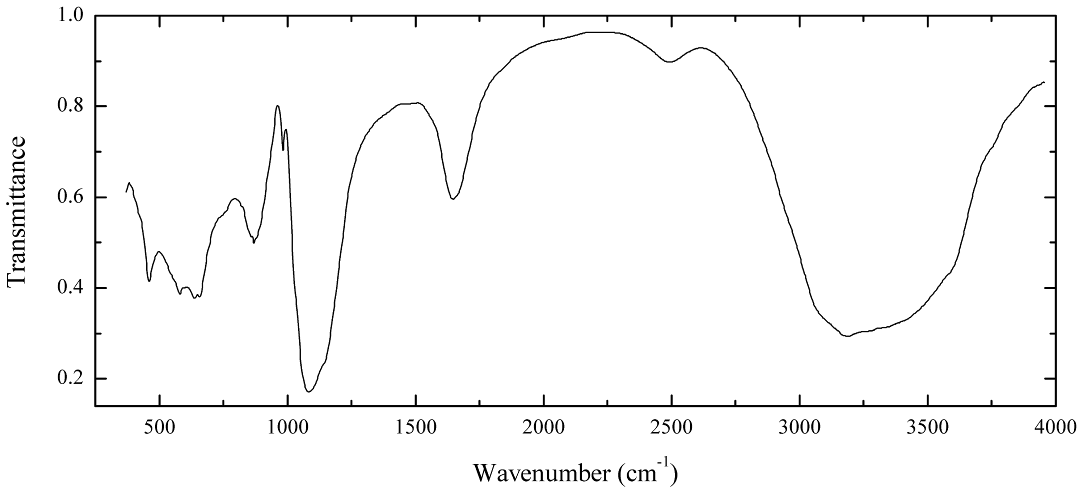
Locality: Tom's phosphate quarry, near Kapunda, South Australia, Australia (type locality).
Description: White fine-grained (porcelain-like) aggregate from the association with wavellite.
Wavenumbers (cm^{-1}): 3600sh, 3405, 3250sh, 1640, 1123s, 1101s, 1016, 895w, 680sh, 638, 608, 531, 470sh.

SP3 Hinsdalite $PbAl_3(PO_4,SO_4)_2(OH,H_2O)_6$



Locality: Madjarovo (Madzharovo) deposit, Rhodope Mts., Haskovo Oblast, Bulgaria.
Description: Light green, from the association with pyromorphite. Material of original description of "orpheite". The latter mineral species was subsequently discredited because it was shown to be identical to hinsdalite.
Wavenumbers (cm^{-1}): 3420, 3165, 1612w, 1190, 1098s, 1026s, 835, 620, 581s, 505, 465w, 446.

SP4 Sanjuanite $Al_2(SO_4)(PO_4)(OH){\cdot}9H_2O$

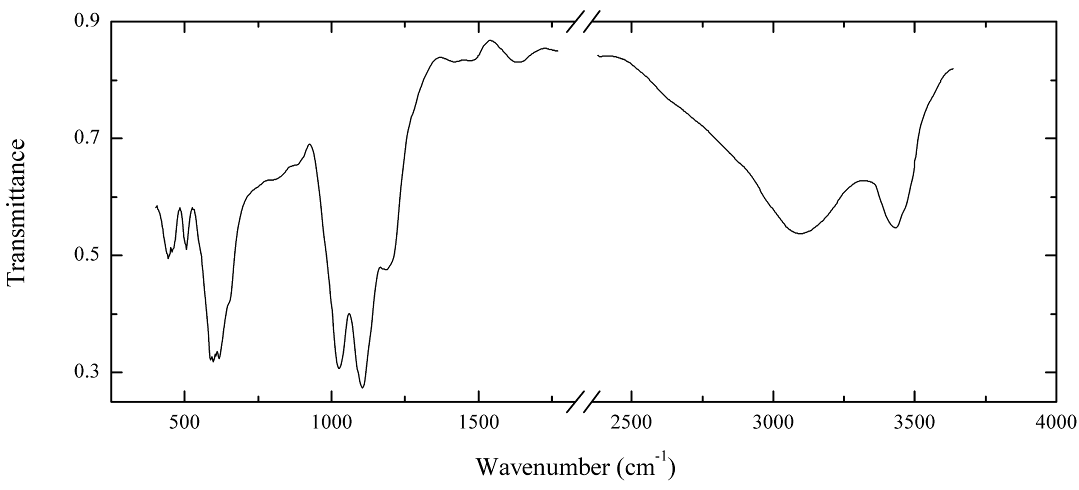


Locality: Eastern slope of Sierra Chica de Zonda, near San Juan City, department of Pocito, San Juan province, Argentina (type locality).

Description: White massive. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3570sh, 3380sh, 3160s, 3080sh, 2475w, 1650, 1135sh, 1083s, 983, 872, 655, 635, 583, 463.

SP5 Svanbergite $SrAl_3(PO_4,SO_4)_2(OH,H_2O)_6$

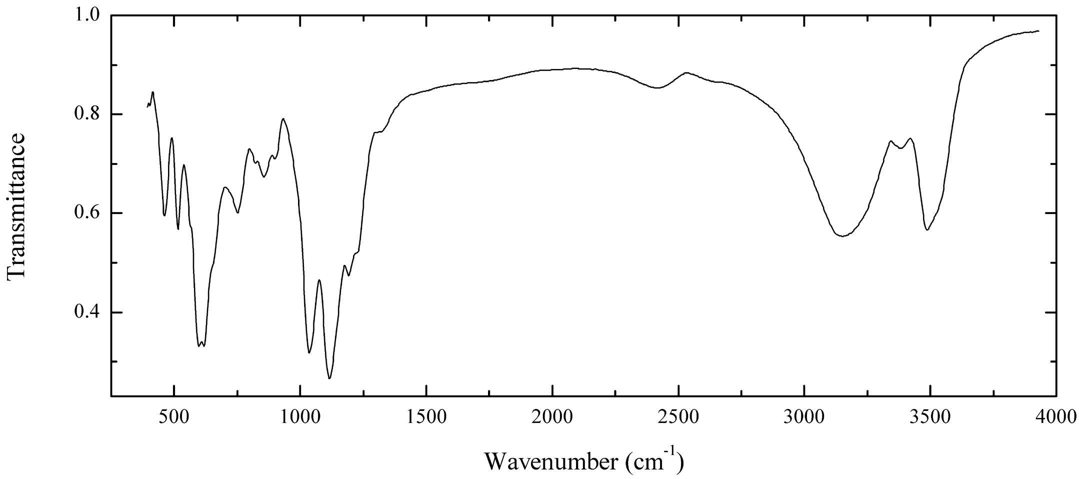


Locality: Novokarantinnyi mine, Kerch iron-ore basin, Crimea, Ukraine.

Description: Light brown crust on limonite. The empirical formula is (electron microprobe) $(Sr_{0.45}Ca_{0.35}Ba_{0.1})(Al_{2.7}Fe_{0.4})[(PO_4)_{1.3}(SO_4)_{0.7}](OH,H_2O)_6$.

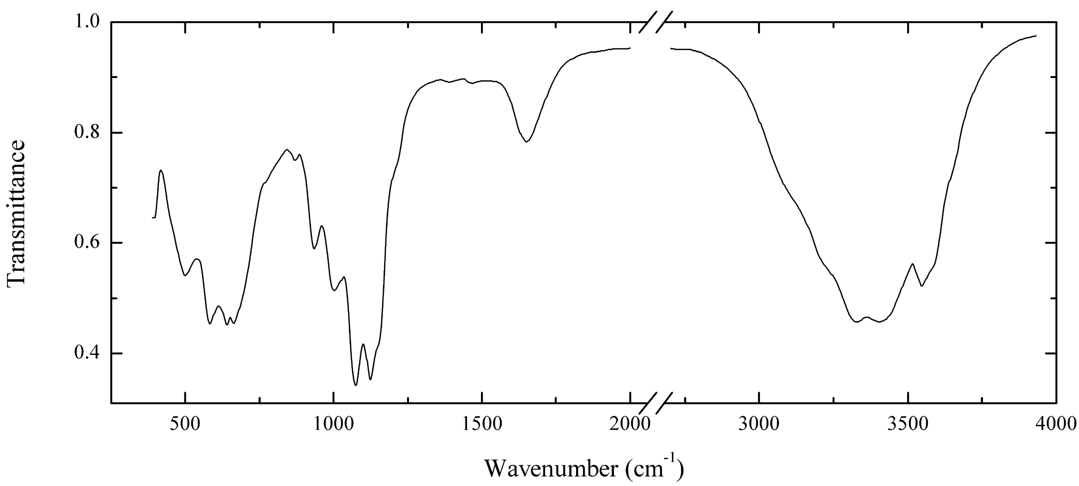
Wavenumbers (cm^{-1}): 3425, 3090, 1635w, 1475w, 1415w, 1185, 1106s, 1030s, 875w, 795w, 655, 612, 594s, 503, 447.

SP6 Svanbergite $SrAl_3(PO_4,SO_4)_2(OH,H_2O)_6$



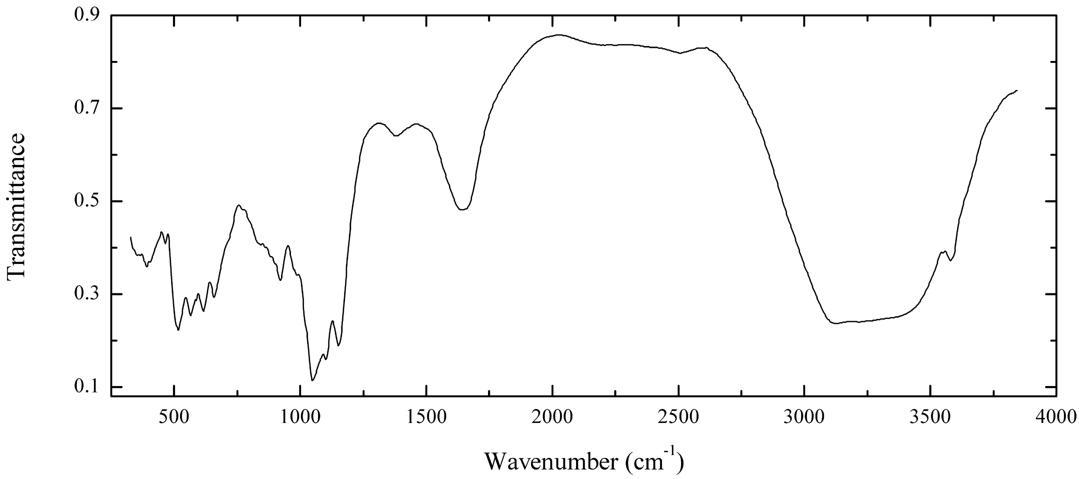
Locality: Starukha Mt., Subpolar Urals, Russia.
Description: Investigated by V.I. Popova and V.A. Popov.
Wavenumbers (cm^{-1}): 3425, 3320w, 3090, 2360w, 1310w, 1215sh, 1182, 1107s, 1031s, 888w, 844, 805w, 746, 650sh, 611s, 599s, 560sh, 512, 458.

SP7 Hotsonite $Al_{11}(SO_4)_3(PO_4)_2(OH)_{21}\cdot 16H_2O$



Locality: Blyava Cu deposit, Sakmara zone, Mednogorsk district, South Urals, Russia.
Description: White concretion from the association with gypsum and aluminite. Investigated by O.K. Ivanov. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3640sh, 3580sh, 3545, 3410, 3320, 3220sh, 3100sh, 1650, 1460w, 1390w, 1210sh, 1150sh, 1123s, 1073s, 1001, 930, 867w, 658, 638, 582, 500.

SP8 Mitryaevaite $Al_5(PO_4)_2[(P,S)O_3(OH,O)]_2F_2(OH)_2{\cdot}8H_2O$

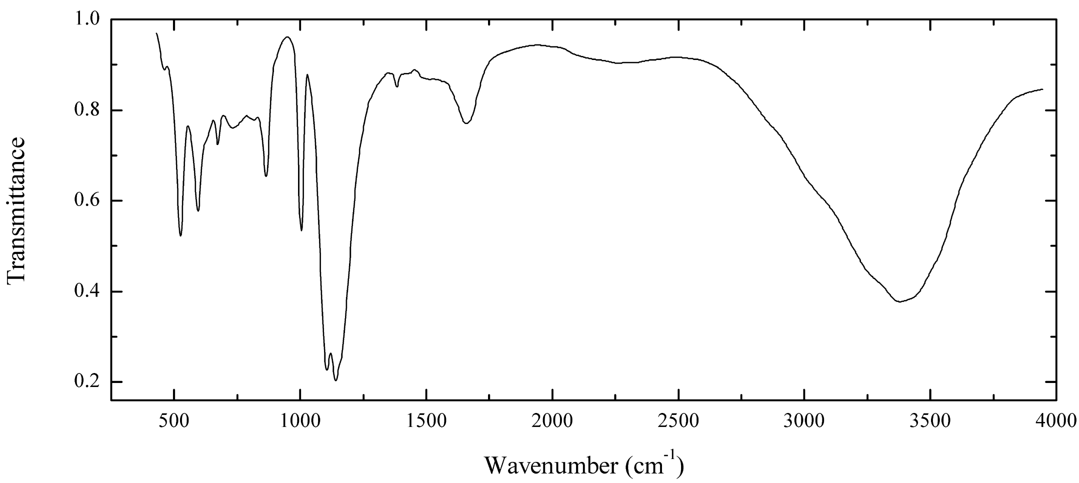


Locality: Balasauskandyk V deposit, Karatau range (Kara-Tau Mts.), southern Kazakhstan.

Description: White massive. Investigated by the author (E.A. Ankinovich). Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3565, 3330sh, 3190sh, 3105s, 2500w, 2200w, 1648, 1385w, 1153s, 1101s, 1005sh, 1047s, 1025sh, 990sh, 920, 850sh, 705sh, 657, 613, 565, 512s, 461, 395, 370sh.

SP9 Ardealite $Ca_2(SO_4)(HPO_4){\cdot}4H_2O$

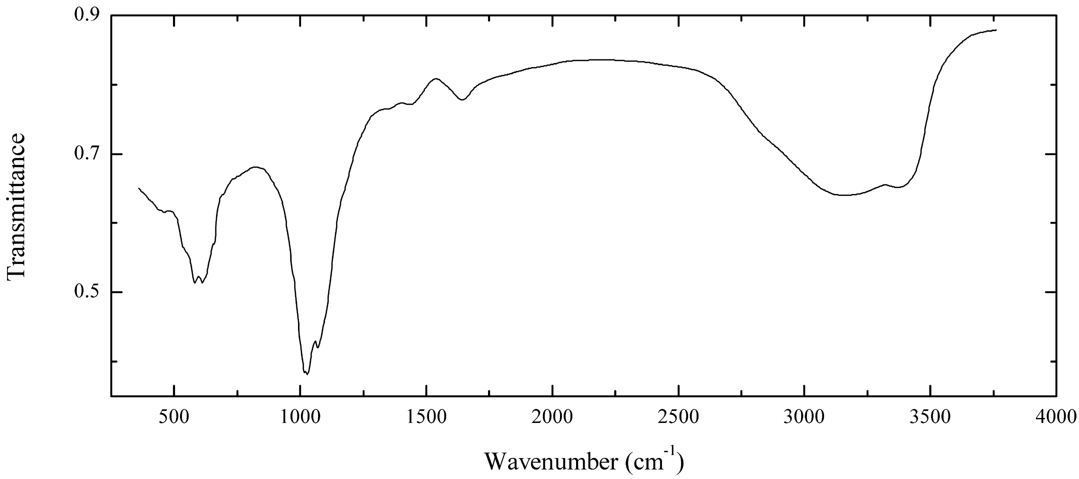


Locality: Cioclovina cave, Hateg Co., Transylvania, Romania (type locality).

Description: White powdery aggregate from the association with newberyite, gypsum and brushite. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3375s, 3260sh, 3020sh, 2250w, 1660, 1640sh, 1398w, 1160sh, 1140s, 1103s, 1002, 863, 720w, 670, 593, 525, 460sh.

SP10 Hinsdalite $PbAl_3(PO_4,SO_4)_2(OH,H_2O)_6$

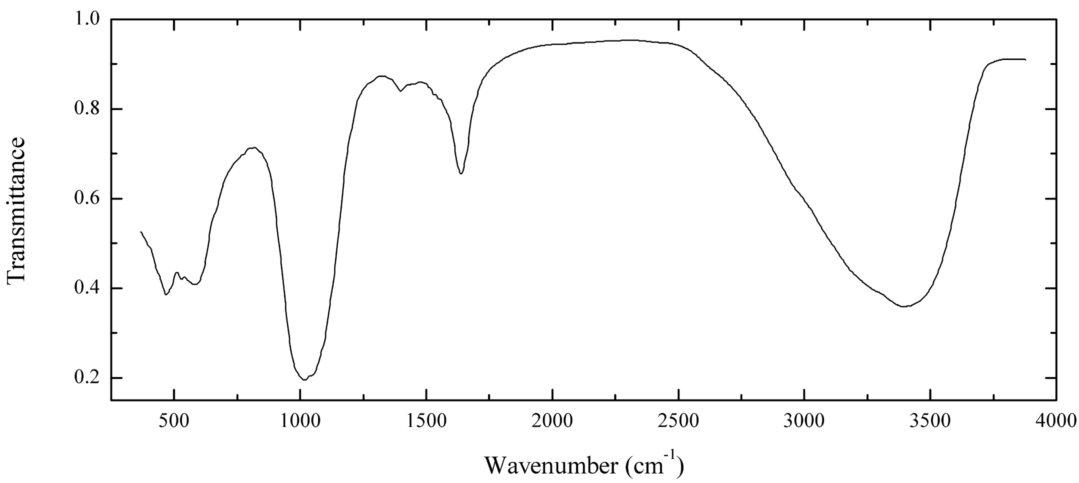


Locality: Pingwu Co., Mianyang prefecture, Sichuan province, China.

Description: Green prismatic crystals from the association with kësterite and "varlamovite". The empirical formula is (electron microprobe) $Pb_{1.0}(Al_{2.6}Cu_{0.4}Al_{0.1})[(PO_4)_{1.1}(SO_4)_{0.8}(SiO_4)_{0.1}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3400, 3160, 2880sh, 1650w, 1445w, 1345w, 1165sh, 1070s, 1028s, 660sh, 614, 581, 545sh, 460w.

SP11 Delvauxite $CaFe^{3+}{}_4(PO_4,SO_4)_2(OH)_8 \cdot nH_2O$ (n = 4–6)

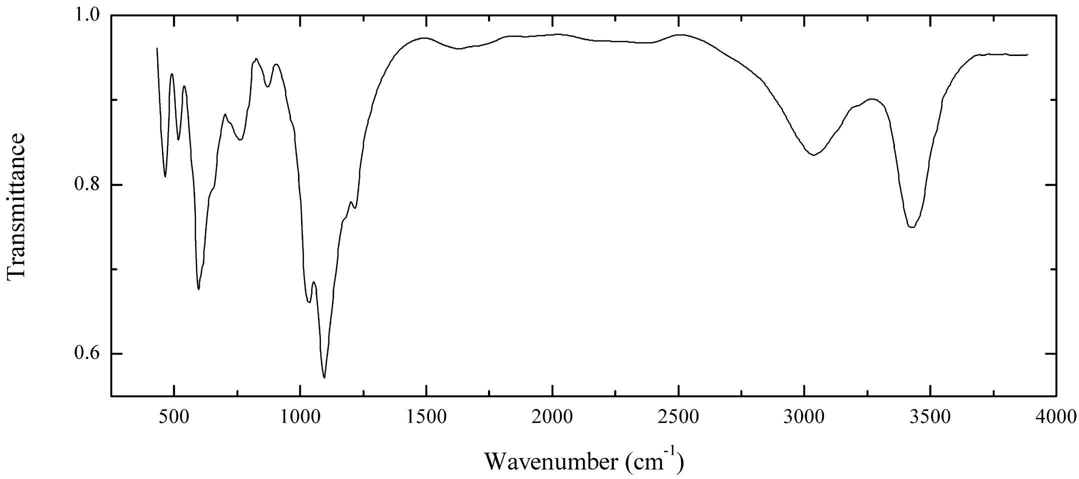


Locality: Berneau, Province of Liège, Belgium (type locality).

Description: Orange-brown, massive. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3380, 3250sh, 2950sh, 1640, 1400w, 1085sh, 1050sh, 1020, 985sh, 580, 530, 472.

SP12 "Strontioalunite" $SrAl_3(SO_4,PO_4)_2(OH,H_2O)_6$

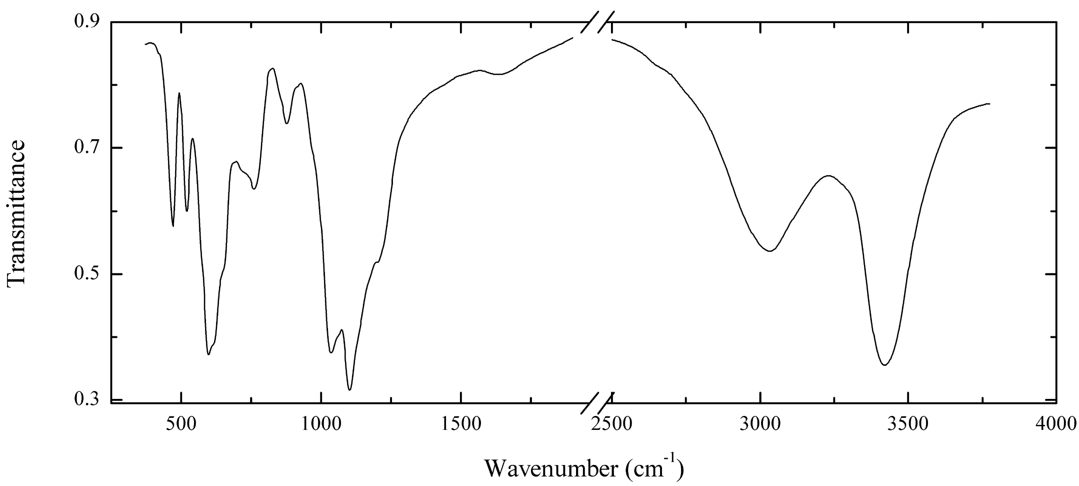


Locality: Novokarantinnyi mine, Kerch iron-ore basin, Crimea, Ukraine.

Description: Beige granular aggregate. SO_4-dominant analogue of svanbergite. The empirical formula is (electron microprobe) $(Sr_{0.47}Ca_{0.30}Na_{0.15}Ce_{0.03})(Al_{2.96}Fe_{0.04})[(SO_4)_{1.12}(PO_4)_{0.88}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3415, 3045, 2360w, 1690w, 1640w, 1223, 1210sh, 1093s, 1035s, 870w, 760, 650sh, 598s, 515, 463.

SP13 Woodhouseite $CaAl_3(PO_4,SO_4)_2(OH,H_2O)_6$

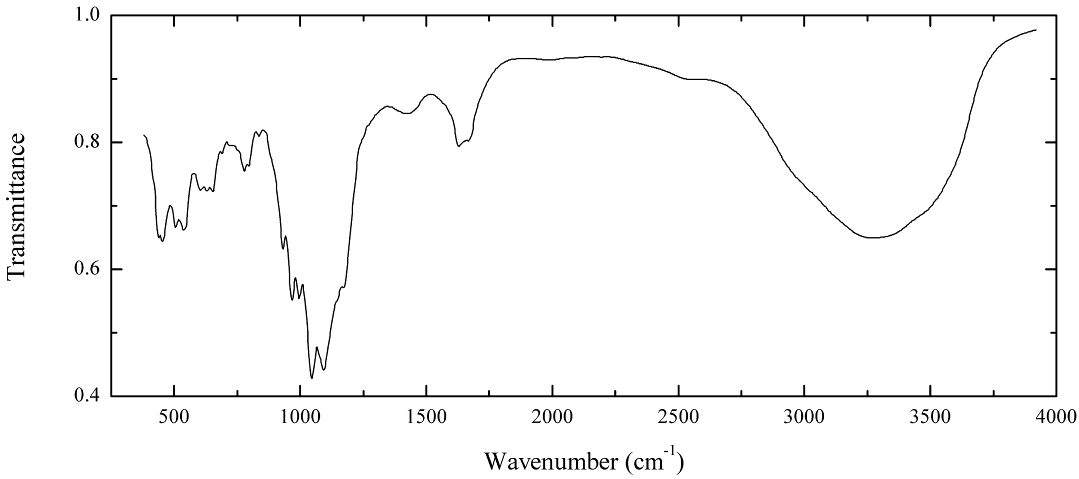


Locality: Champion mine, Champion andalusite deposit, White Mts., Mono Co., California, USA (type locality).

Description: Reddish-brown crystals from the association with lazulite and augelite. The empirical formula is (electron microprobe) $(Ca_{0.87}Na_{0.07}Sr_{0.04})(Al_{2.67}Fe_{0.25}Mg_{0.04}Mn_{0.03})[(PO_4)_{1.10}(SO_4)_{0.90}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3420s, 3030, 1635w, 1210sh, 1104s, 1043s, 975sh, 883, 767, 725sh, 655sh, 615sh, 599s, 570sh, 520, 470.

SP14 Coconinoite $Fe^{3+}{}_2Al_2(UO_2)_2(PO_4)_4(SO_4)(OH)_{20}\cdot20H_2O$

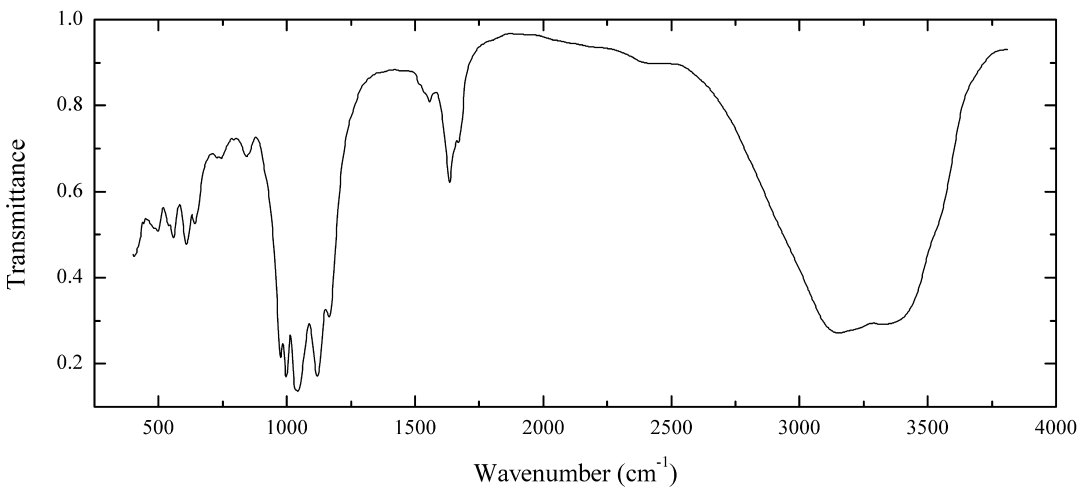


Locality: Koscheka U deposit, Auminzatau Mts., Central Kyzylkum region, Kyzylkum desert, Uzbekistan.

Description: Yellow powdery aggregate. Fe-poor variety. The empirical formula is (electron microprobe) $Al_{3.6}Fe_{0.3}(UO_2)_{2.1}(PO_4)_{4.0}(SO_4)_{1.0}(OH)_{1.9}\cdot nH_2O$. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3580sh, 3450sh, 3240, 2925sh, 2540w, 1665sh, 1625, 1412w, 1170sh, 1145sh, 1095s, 1045s, 996, 966, 931, 836w, 795, 777, 692w, 655, 635, 605, 542, 506, 454, 441, 420sh.

SP15 Diadochite $Fe^{3+}{}_2(SO_4)(PO_4)(OH)\cdot6H_2O$

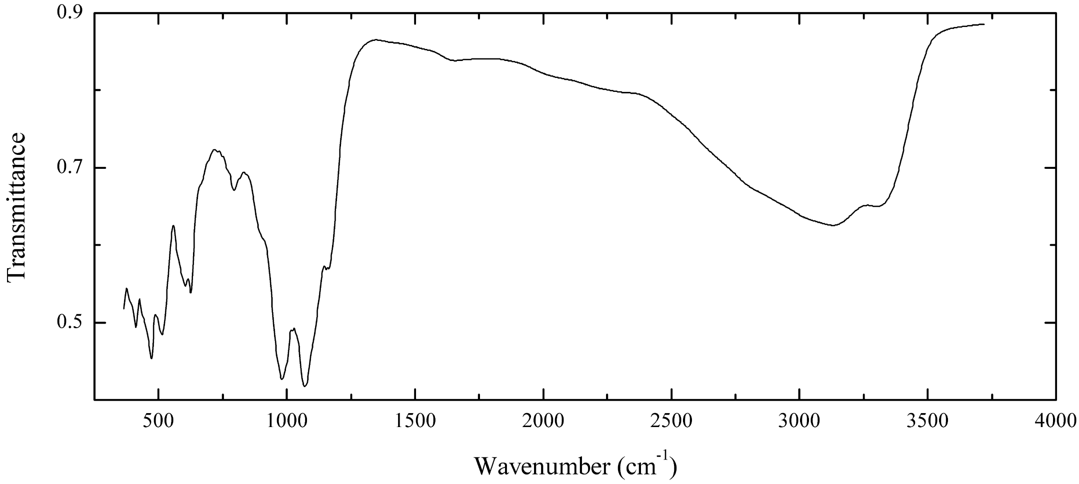


Locality: Kotzebue, Northwest Arctic Borough, Alaska, USA.

Description: Beige granular aggregate. Identified by qualitative electron microprobe analysis and IR spectrum.

Wavenumbers (cm^{-1}): 3530sh, 3330s, 3150s, 2440w, 1675sh, 1645, 1564w, 1168, 1122s, 1043s, 999s, 976s, 843w, 745w, 727w, 640, 609, 555, 495.

SP16 Corkite $PbFe^{3+}{}_3(SO_4)(PO_4)(OH)_6$



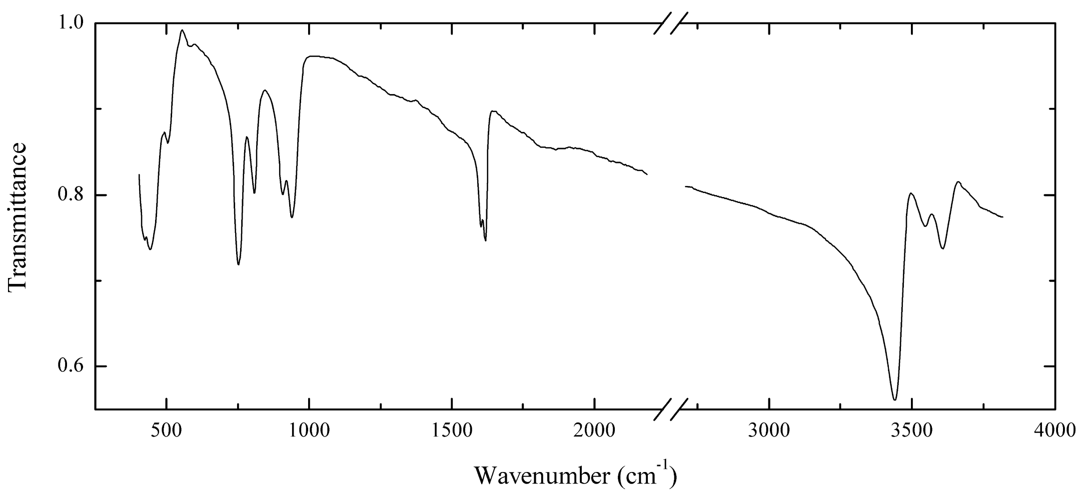
Locality: Schöne Aussicht mine, Burbach, Siegerland, North Rhine-Westphalia, Germany.

Description: Brown crystals from the association with pyromorphite, allophane and quartz. Identified by qualitative electron microprobe analysis and IR spectrum.

Wavenumbers (cm^{-1}): 3295. 3150, 2300sh, 2160sh, 1630w, 1158, 1080sh, 1069s, 982s, 905sh, 794, 775sh, 626, 603, 513, 473s, 418.

2.10 Chlorides

Cl1 Avdoninite $K_2Cu_5Cl_8(OH)_4{\cdot}H_2O$

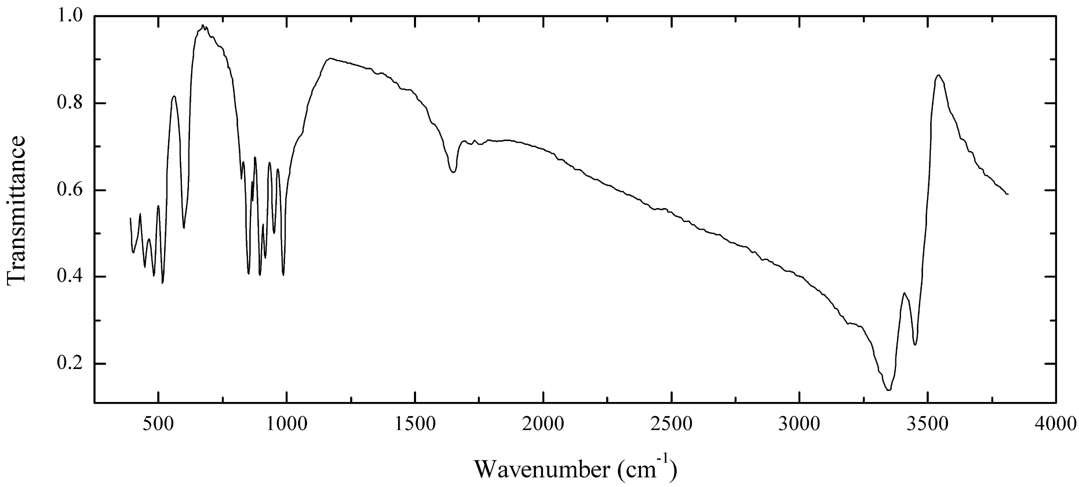


Locality: Fumarole “Yadovitaya” at the Second Cinder Cone, Northern Break of the Large Fissure Tolbachik Eruption, Tolbachik volcano, Kamchatka peninsula, Russia (type locality).

Description: Green imperfect, short-prismatic, partly flattened crystals. Holotype sample. Associated minerals are euchlorine, paratacamite, atacamite, belloite and langbeinite. Monoclinic, space group *P*2/*m*, *P*2 or *Pm*; $a = 24.34$ (2), $b = 5.878$ (4), $c = 11.626$ (5), $\beta = 93.3$ (1)°. Biaxial, optically neutral, $\alpha = 1.669(2)$, $\beta = 1.688(2)$, $\gamma = 1.707(5)$. $D_{meas} = 3.03(3)$ g/cm^3, $D_{calc} =$ 3.066 g/cm^3. The empirical formula is (electron microprobe, H_2O determined by Penfield method) $K_{1.96}Cu_{5.00}Cl_{8.09}(OH)_{3.87}{\cdot}1.03H_2O$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 11.63 (100) (001), 5.88 (20) (010), 5.80 (27) (002), 5.73 (17) (-102), 2.518 (19) (21-4), 2.321 (17) (005).

Wavenumbers (cm^{-1}): 3598, 3540, 3430s, 1616s, 1601, 942s, 913, 808, 758s, 507, 445s, 425sh, 410sh.

Cl2 Atacamite $Cu^{2+}{}_2Cl(OH)_3$

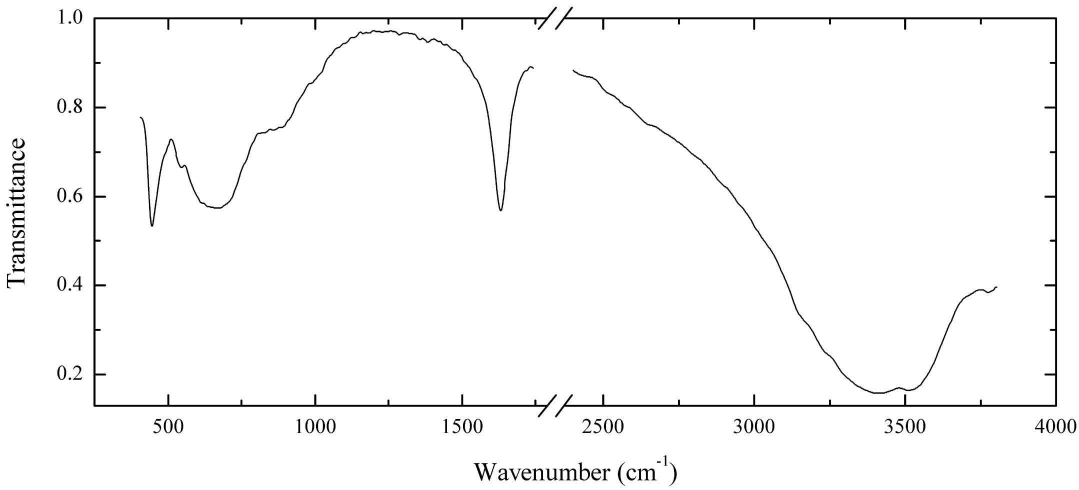


Locality: Northern open pit, Dzhezkazgan copper mine, Karagandy region, Central Kazakhstan.

Description: Green pseudomorph after azurite nodule. Associated minerals are azurite, pseudomalachite and malachite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Cu_{1.99}Fe_{0.01}Cl_{1.03}(OH)_{2.97}$.

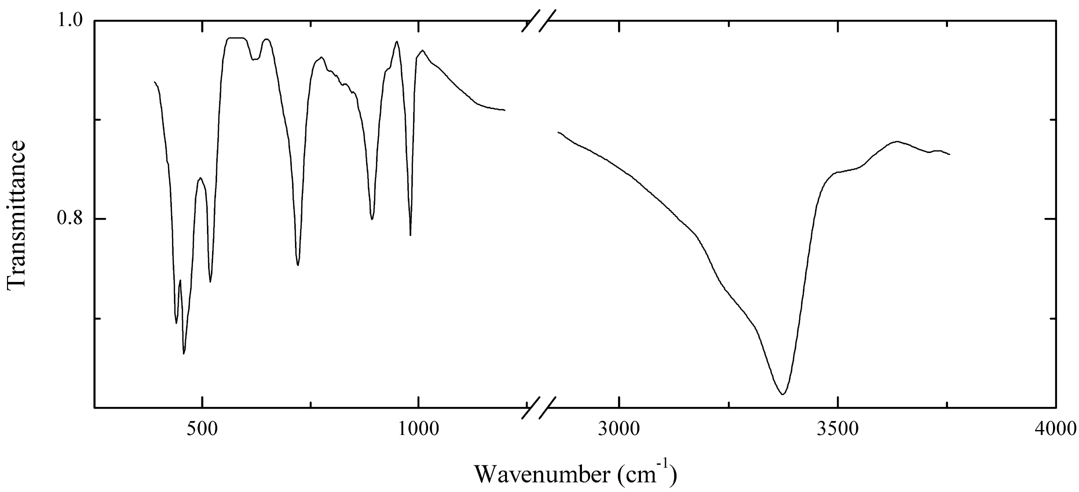
Wavenumbers (cm^{-1}): 3440s, 3340s, 3185sh, 1760w, 1715w, 1650, 1040sh, 985s, 948, 915, 894s, 866w, 849s, 820w, 605sh, 594, 512s, 479s, 441, 400.

Cl4 Koenenite $Na_4Mg_9Al_4Cl_{12}(OH)_{22}$



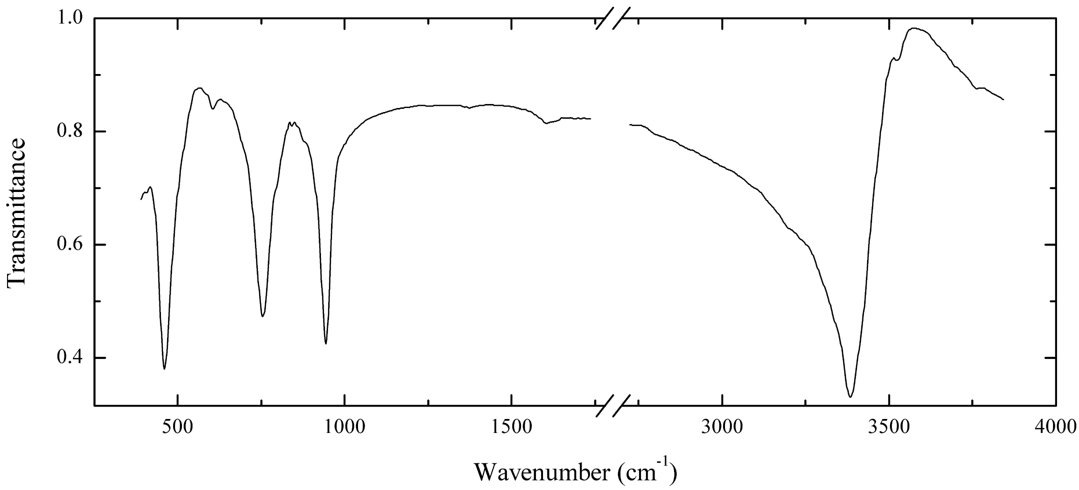
Locality: Potash Justus mine, Solling, Lower Saxony, Germany (type locality).
Description: Orange-yellow scaly crystals from the association with anhydrite, halite, carnallite and sylvite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3505s, 3410s, 1635, 1000sh, 850sh, 670, 630sh, 548, 446s.

Cl5 Boleite $KPb_{26}Ag_9Cu_{24}Cl_{62}(OH)_{48}$



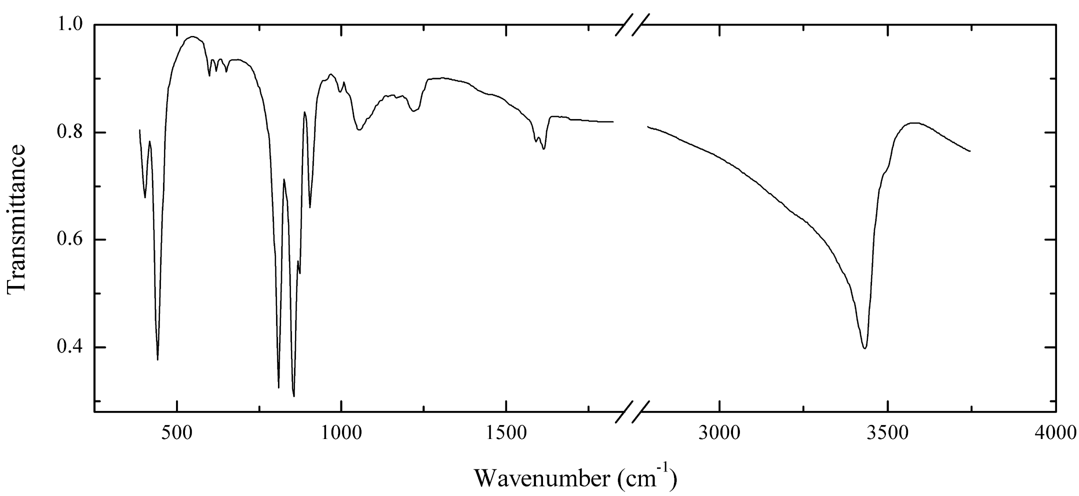
Locality: Amelia mine, Boléo district, Mexico (type locality).
Description: Blue cubic crystals from the association with cumengeite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3355s, 3230sh, 1620w, 973, 885, 716, 633w, 615w, 515, 470sh, 462s, 445.

Cl6 Herbertsmithite $Cu_3Zn(OH)_6Cl_2$



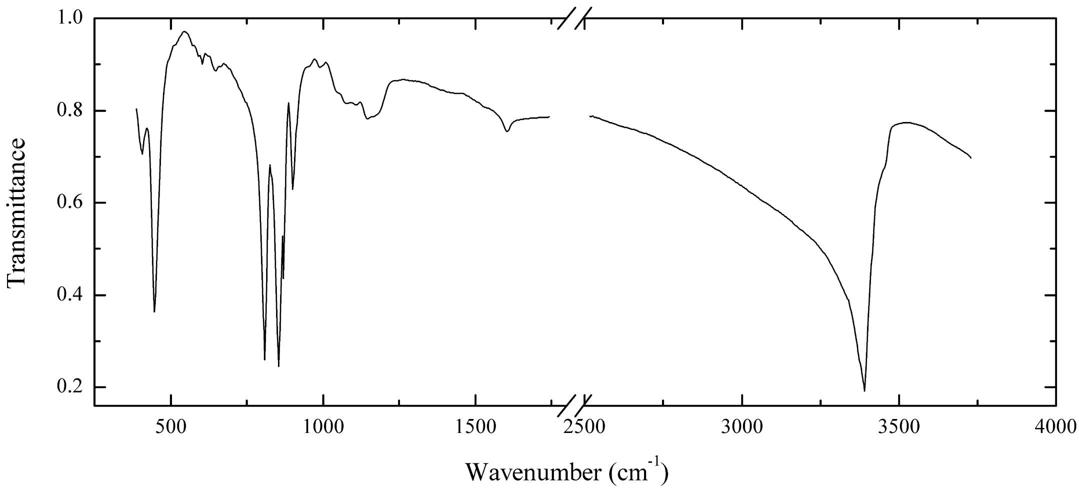
Locality: San Francisco mine, Caracoles, Sierra Gorda district, Antofagasta province, Chile.
Description: Dark green crystals from the association with christelite. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $Cu_{2.98}Zn_{1.02}(OH)_{5.93}Cl_{2.07}$.
Wavenumbers (cm^{-1}): 3383s, 1610w, 946s, 780sh, 755s, 603w, 458s.

Cl7 Belloite Cu(OH)Cl



Locality: Fumarole "Yadovitaya" at the Second Cinder Cone, Northern Break of the Large Fissure Tolbachik Eruption, Tolbachik volcano, Kamchatka peninsula, Russia.
Description: Green crust from the association with atacamite. Identified by IR spectrum and qualitative electron microprobe analysis. Weak bands in the ranges 596–652 and 995–1,217 cm^{-1} are due to the admixture of a sulfate mineral.
Wavenumbers (cm^{-1}): 3400s, 3240sh, 1610w, 1585w, 1217w, 1052w, 995w, 904, 872, 854s, 809s, 652w, 621w, 596w, 440s, 404.

Cl8 Belloite $Cu(OH)Cl$

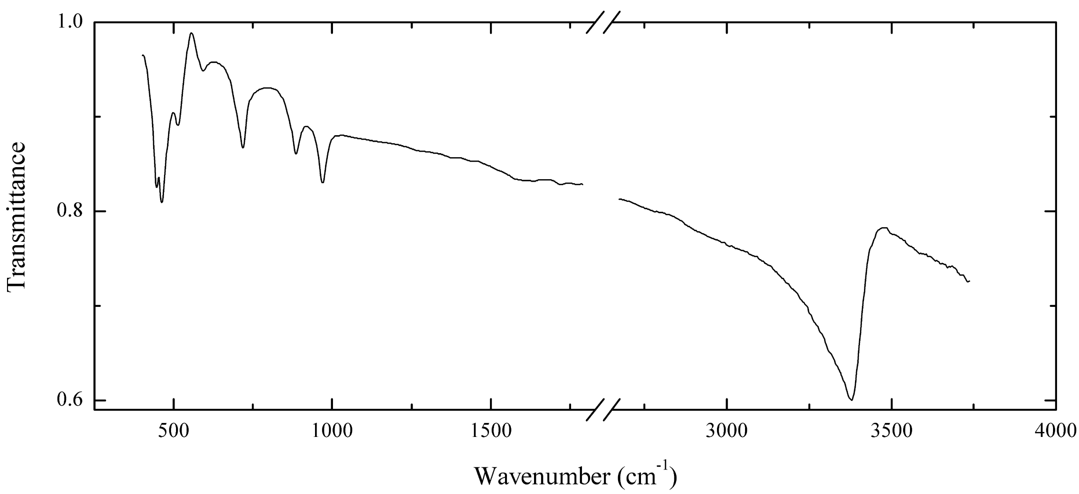


Locality: Fumarole "Yadovitaya" at the Second Cinder Cone, Northern Break of the Large Fissure Tolbachik Eruption, Tolbachik volcano, Kamchatka peninsula, Russia.

Description: Green crust from the association with atacamite and avdoninite. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $Cu_{0.99}Zn_{0.01}(OH)Cl_{1.00}$. Weak bands in the ranges 590–660 and 990–1,650 cm^{-1} are due to the admixture of a sulfate mineral.

Wavenumbers (cm^{-1}): 3400s, 904, 873, 856s, 810s, 442s, 405.

Cl9 Boleite $Pb_{26}Ag_9Cu_{24}Cl_{62}(OH)_{48}$

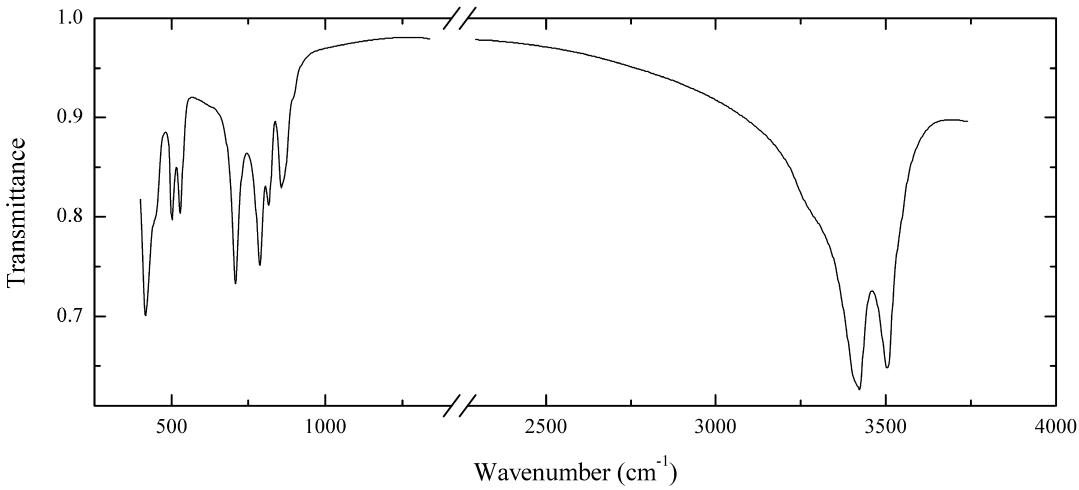


Locality: Rowley (Rawley) copper mine, San Carlos patented claim #4524, Theba, Painted Rock Mts., Maricopa Co., Arizona, USA.

Description: Light blue crystals from the association with pseudoboleite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3360s, 974, 888, 716, 600, 512, 475sh, 463s, 445.

Cl10 Botallackite $Cu^{2+}{}_2Cl(OH)_3$

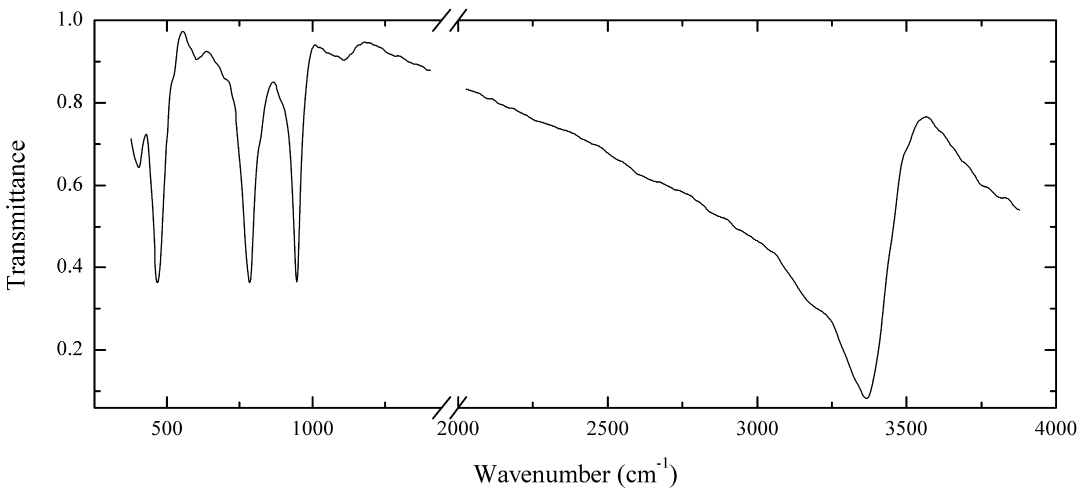


Locality: Levant mine, Trewellard, St. Just district, Cornwall, England, UK.

Description: Bluish-green crystals. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3505s, 3415s, 3405sh, 895sh, 870sh, 860, 818, 785, 706s, 534, 505, 450sh, 419s.

Cl11 Gillardite $Cu_3Ni(OH)_6Cl_2$

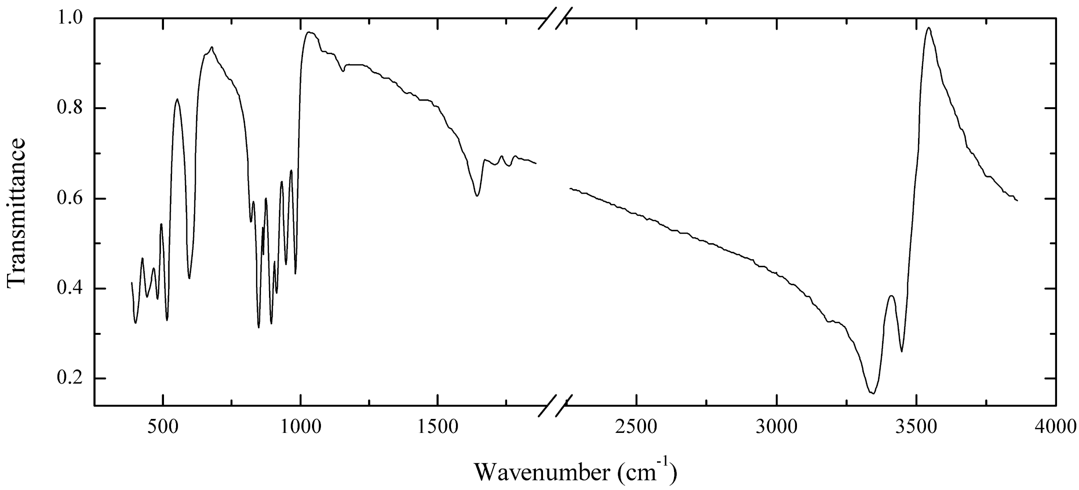


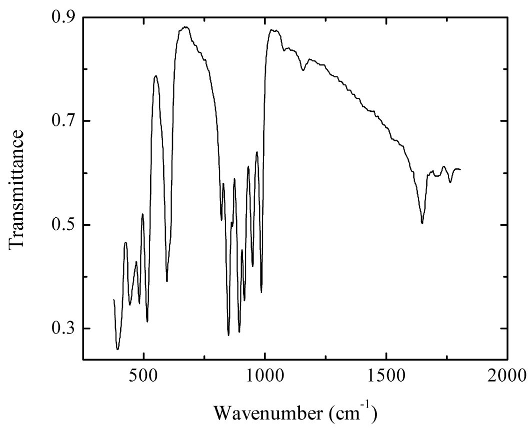
Locality: Paris mine, Widgiemooltha, Western Australia.

Description: Green crystals on rock. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $Cu_{3.0}Ni_{0.9}Mg_{0.1}(OH)_{6.1}Cl_{1.9}$.

Wavenumbers (cm^{-1}): 3360s, 3200sh, 1090w, 950s, 784s, 604w, 467s, 403w.

Cl12 Atacamite $Cu^{2+}{}_2Cl(OH)_3$



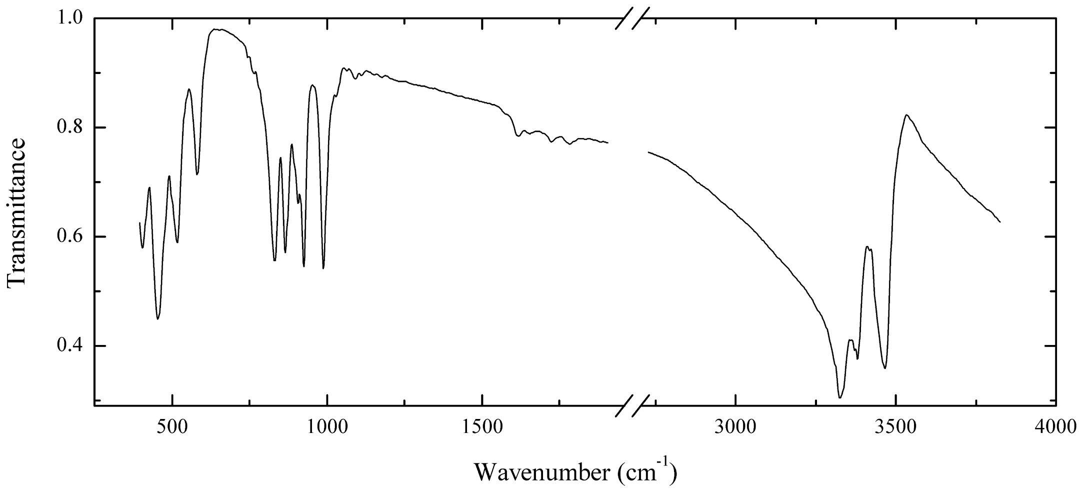


Locality: Atacama desert, Chile (type locality).

Description: Green long-prismatic crystals from the association with malachite, chrysocolla and brochantite. Identified by IR spectrum and qualitative electron microprobe analysis.

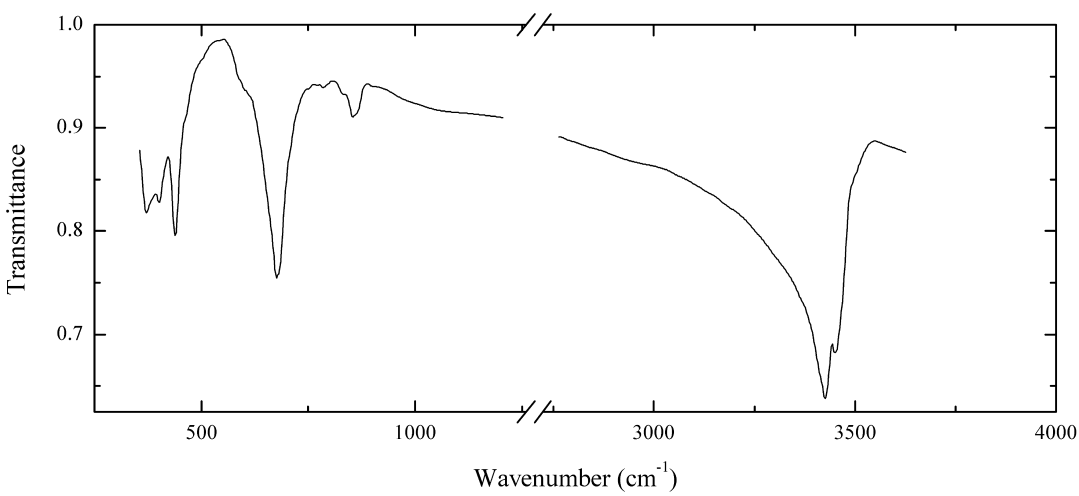
Wavenumbers (cm^{-1}): 3438s, 3337s, 3180, 1762w, 1712w, 1647, 1162w, 1090w, 985, 949, 915, 894s, 866, 849s, 819, 605sh, 595, 514s, 480, 441, 400s.

Cl13 Clinoatacamite $Cu^{2+}{}_2Cl(OH)_3$



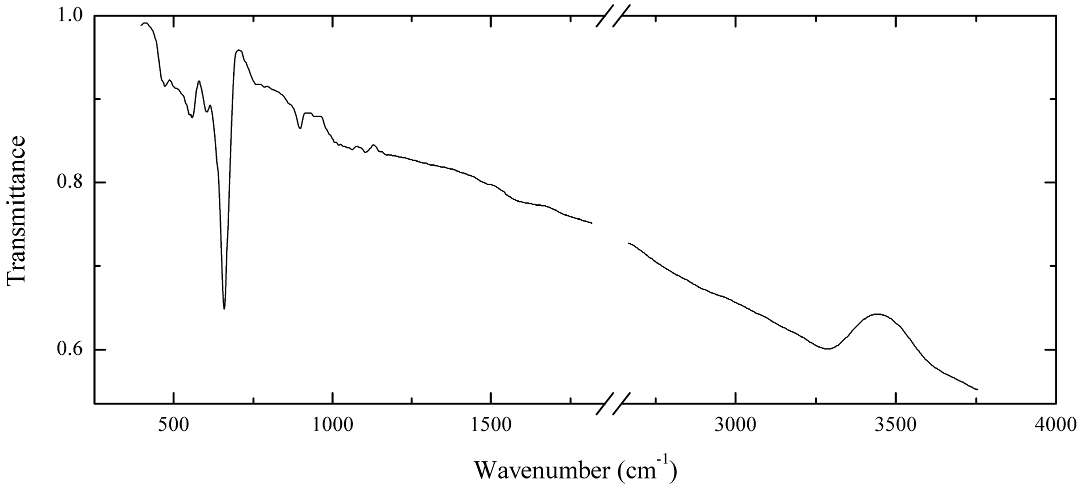
Locality: Northern open pit, Dzhezkazgan copper mine, Karagandy region, Central Kazakhstan.
Description: Green pseudomorph after azurite nodule. Associated minerals chrysocolla and malachite. Identified by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Cu_{1.97}Zn_{0.02}Fe_{0.01}Cl_{0.95}(OH)_{3.05}$.
Wavenumbers (cm^{-1}): 3443s, 3357s, 3306s, 1770w, 1725w, 1655w, 1615w, 1090w, 1040sh, 987, 925, 908, 865, 830, 582, 513, 455s, 405.

Cl14 Diaboleite $Pb_2Cu^{2+}Cl_2(OH)_4$



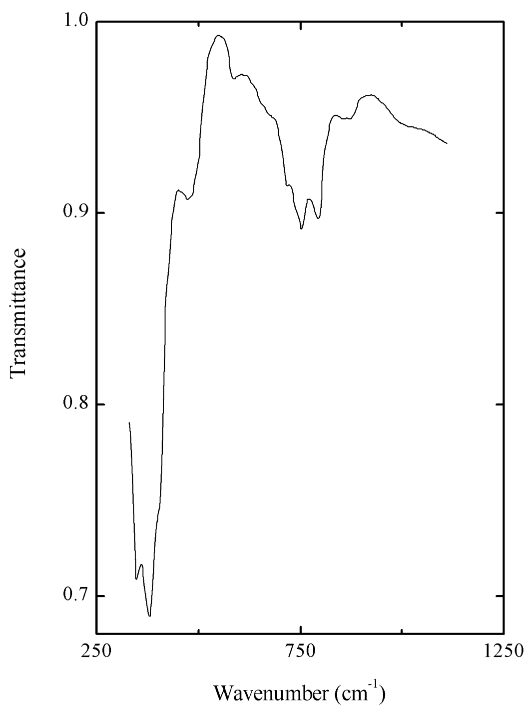
Locality: Mammoth mine, Tiger, Mammoth district, Pinal Co., Arizona, USA.
Description: Blue crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3450s, 3425s, 856, 780w, 680s, 605sh, 441s, 405, 387.

Cl15 Kleinite 4(Hg_2NCl)·Hg(SO_4,Cl)·H_2O



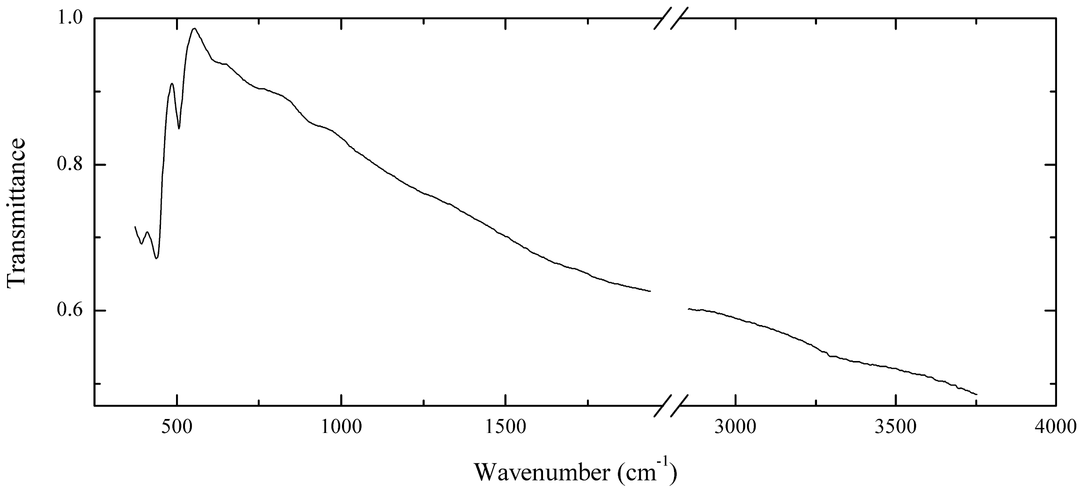
Locality: Cordero mine, Opalite district, Humboldt Co., Nevada, USA.
Description: Imperfect yellow crystals. The empirical formula is (electron microprobe) $Hg_9Cl_{3.9}S_{0.9}O_xN_y{\cdot}nH_2O$. Probably contains mainly S^{2-} instead of SO_4^{2-}. The presence of N is confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3275, 1600w, 1105w, 1065w, 1030sh, 903w, 770sh, 658s, 600w, 555, 470w.

Cl16 Sahlinite $Pb_{14}(AsO_4)_2O_9Cl_4$



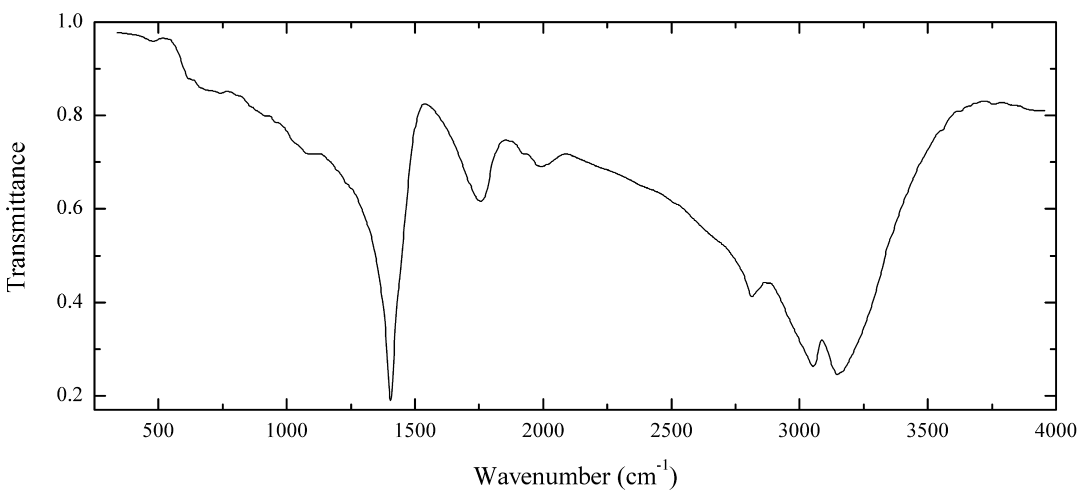
Locality: Kombat mine, Kombat, Grootfontein district, Otjozondjupa region, Namibia.
Description: Orange-red grains in rock. The empirical formula is (electron microprobe) $(Pb_{13.7}Ca_{0.2}Sr_{0.1})[(AsO_4)_{0.9}(SiO_4)_{0.5}(VO_4)_{0.4}(SO_4)_{0.1}]O_9Cl_{4.0}$.
Wavenumbers (cm^{-1}): 865w, 794, 751, 720, 575w, 470, 380s, 350s.

Cl17 Mendipite $Pb_3Cl_2O_2$



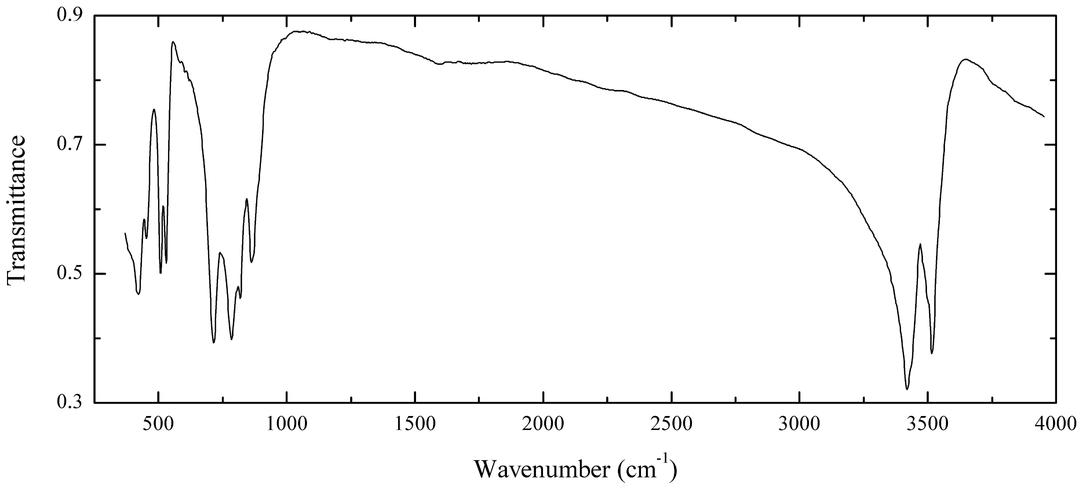
Locality: Merehead quarry, near Shepton Mallet, Somerset, England, UK.
Description: Pink single-crystal grain with perfect cleavage from the association with cerussite. Confirmed by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 505, 437s, 400s.

Cl18 Salammoniac NH_4Cl



Locality: Burning coal bed at the Ravat village, near the confluence of the rivers Yagnob and Iskanderdar'ja, Viloyati Khodzhent, Tajikistan.
Description: White dendrite from the association with mascagnite, gwihabaite, ravatite and sulphur. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3130s, 3032s, 2792, 1990w, 1940sh, 1740, 1445sh, 1404s, 1100sh, 730w, 680sh, 625sh, 435w.

Cl19 Botallackite $Cu^{2+}{}_2Cl(OH)_3$

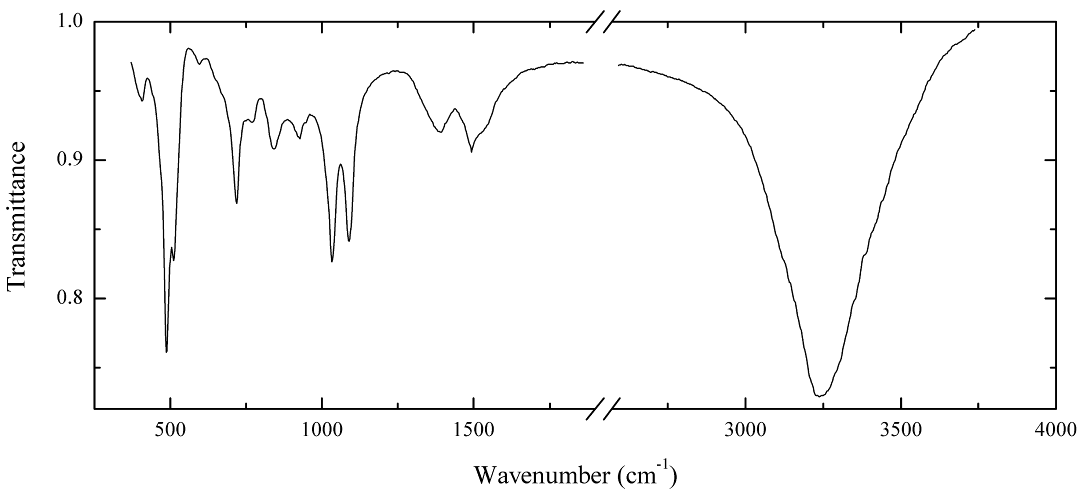


Locality: Needle's Eye, Kirkcudbrightshire, Scotland, UK.

Description: Green elongated platelets in quartz. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500s, 3405s, 1595w, 868, 861, 820, 784s, 713s, 529, 506, 452, 422, 390sh.

Cl20 Simonkolleite $Zn_5(OH)_8Cl_2{\cdot}H_2O$

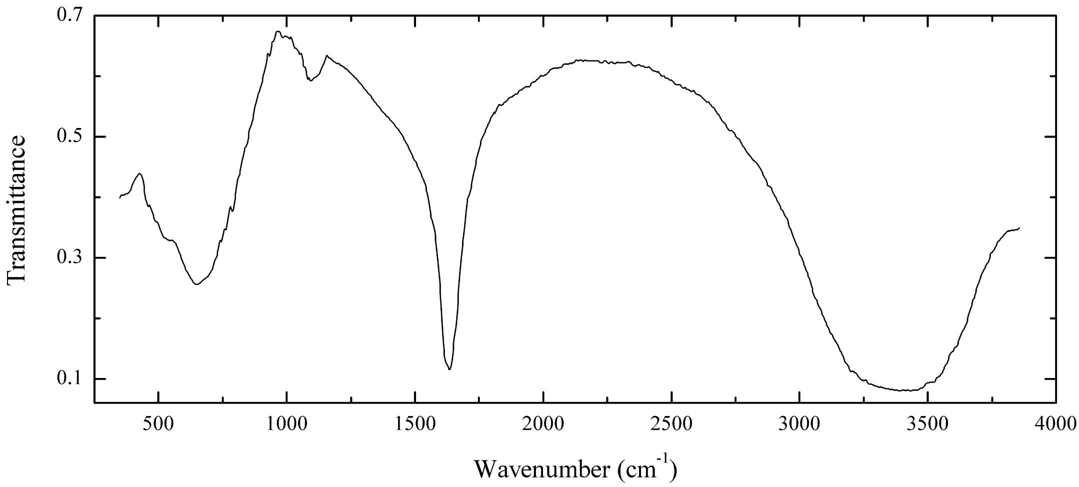


Locality: Richelsdorf foundry, Hesse, Germany (type locality).

Description: Colourless platelets intergrown with hydrozincite. Technogenetic, from slag. The bands in the range 1,385–1,540 cm^{-1} are due to the admixture of hydrozincite.

Wavenumbers (cm^{-1}): 3230s, 1540sh, 1495, 1385, 1088, 1033, 926w, 844, 773w, 718, 610w, 507, 483s, 402.

Cl21 Nickelbischofite $NiCl_2 \cdot 6H_2O$

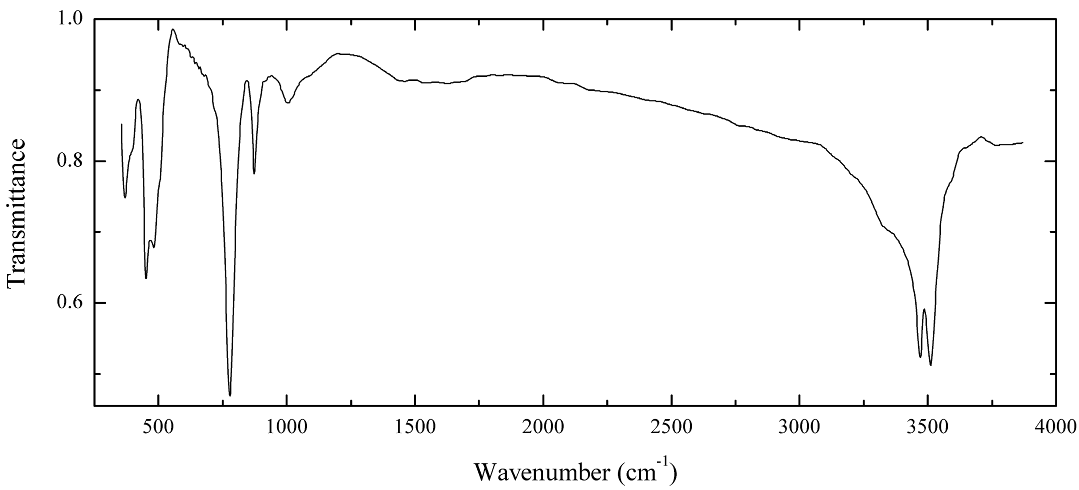


Locality: Weathered Dronino ataxite iron meteorite, near Dronino village, Kasimov District, Ryazan' region, Russia.

Description: Green spherulites from the association with taenite, violarite, troilite, chromite, goethite, lepidocrocite, droninoite and amorphous Fe^{3+} hydroxides. The empirical formula is (electron microprobe) $(Ni_{0.82}Fe_{0.18})Cl_{1.84}(OH)_{0.16} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3380s, 1633s, 1095w, 648, 530sh.

Cl22 Haydeeite $Cu_3Mg(OH)_6Cl_2$

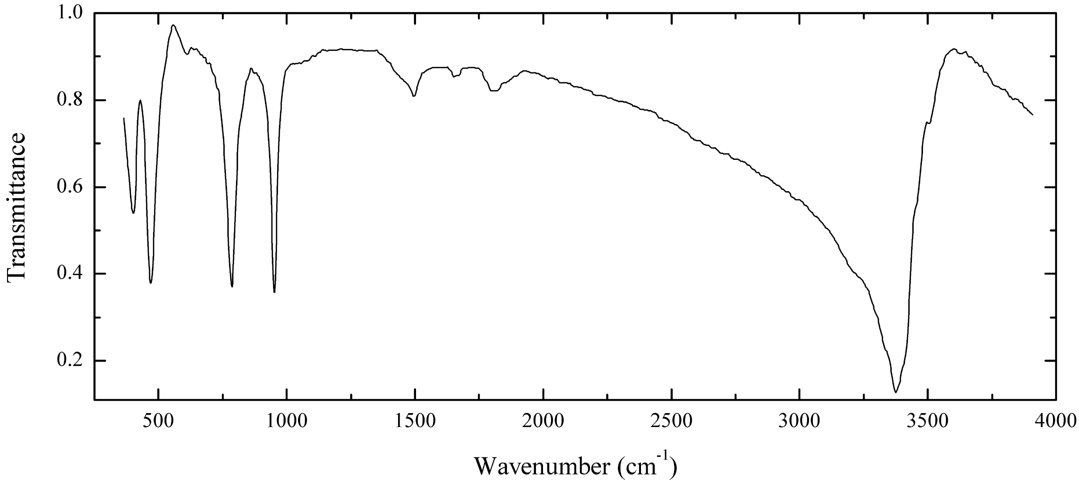


Locality: Haydee mine, western border of the southern end of Salar Grande, 110 km SE of Iquique, Atacama Desert, Tarapacá Province, northern Chile (type locality).

Description: Blue crystals from the association with atacamite. The empirical formula is (electron microprobe) $Cu_{2.99}Mg_{0.97}Zn_{0.04}(OH)_{6.13}Cl_{1.87}$.

Wavenumbers (cm^{-1}): 3485s, 3445s, 3310, 1010w, 872, 777s, 482, 450s, 390sh, 367.

Cl23 Gillardite $Cu_3Ni(OH)_6Cl_2$

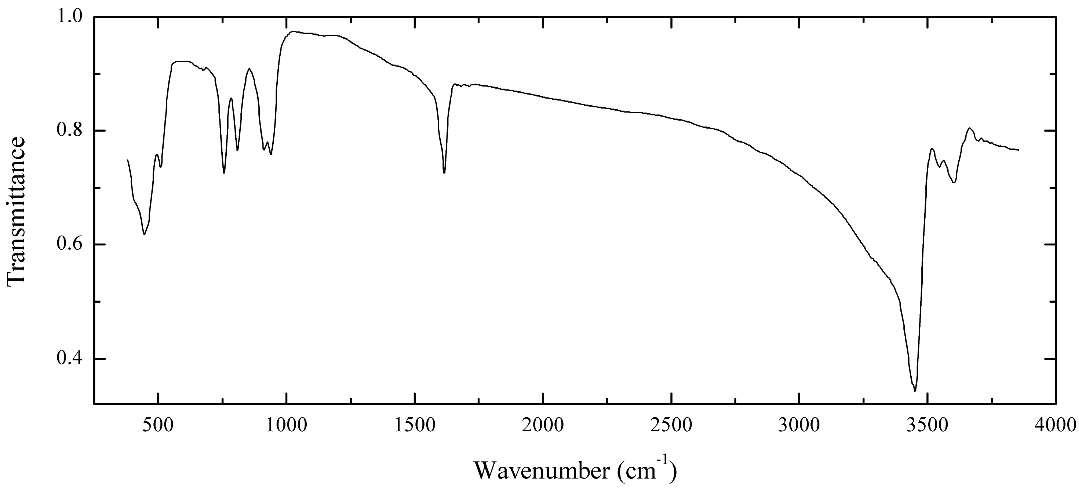


Locality: 132 North Mine, Widgiemooltha, Western Australia.

Description: Dark green crystals on gaspeite. Identified by IR spectrum and chemical composition. The empirical formula is (electron microprobe) $Cu_{2.86}Ni_{1.00}Zn_{0.12}Fe_{0.02}(OH)_{5.92}Cl_{2.08}$.

Wavenumbers (cm^{-1}): 3495w, 3395sh, 3365s, 3210sh, 1812w, 1660w, 1500, 951s, 820sh, 784s, 608w, 468s, 402.

Cl24 Avdoninite $K_2Cu_5Cl_8(OH)_4·1-2H_2O$

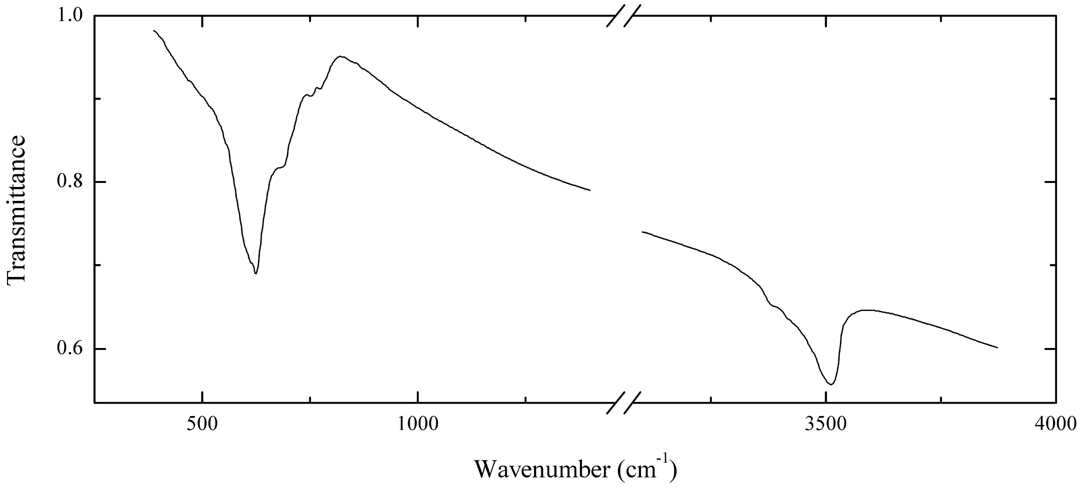


Locality: Blyava Cu deposit, Mednogorsk district, South Urals, Russia.

Description: Green granular aggregate from the association with atacamite, mitscherlichite and nantokite. Identified by IR spectrum and powder X-ray diffraction pattern. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 11.54 (100), 5.85 (13), 5.77 (14), 5.104 (11), 3.210 (12), 3.046 (11), 2.511 (10), 2.310 (15).

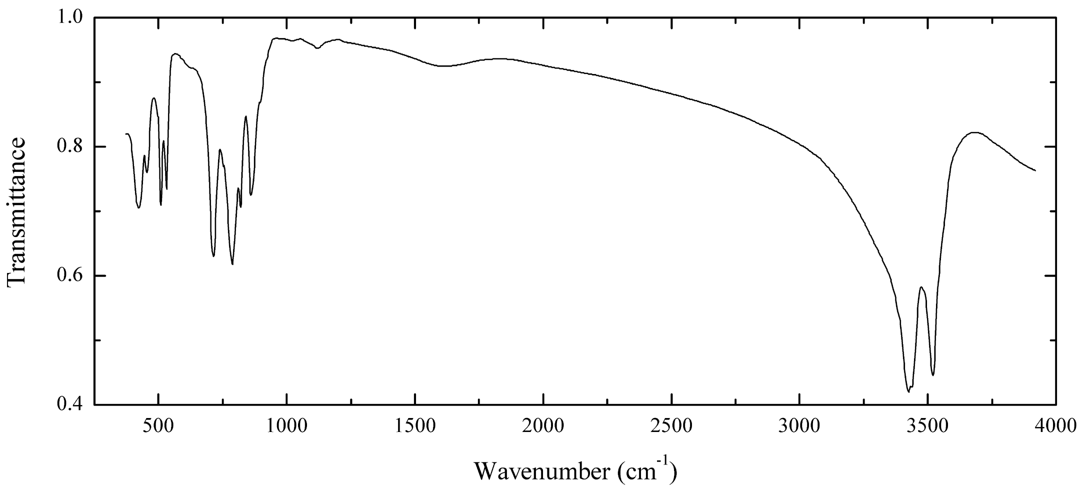
Wavenumbers (cm^{-1}): 3597, 3545, 3445s, 3310sh, 1618, 1605sh, 939, 914, 806, 754, 670w, 508, 441s, 400sh.

Cl25 Paralaurionite PbCl(OH)



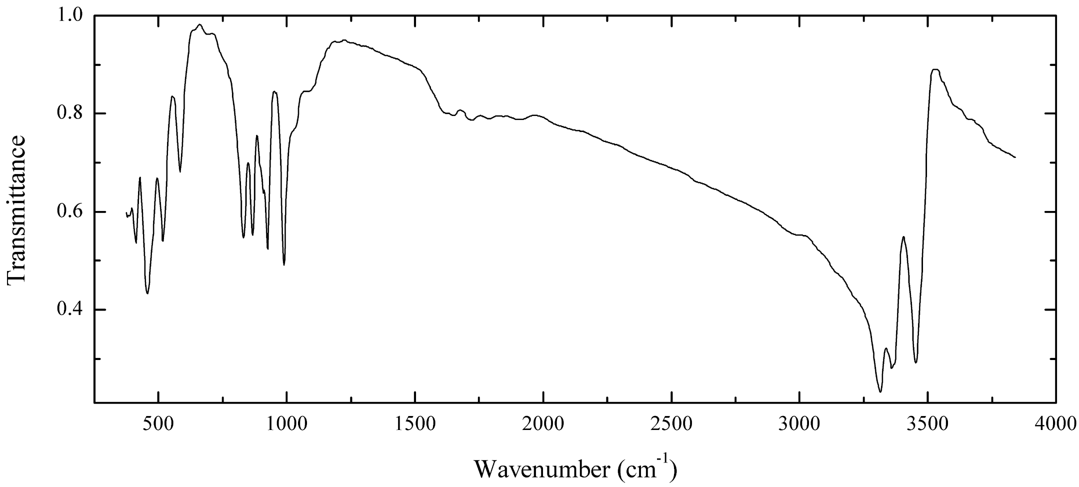
Locality: Mina Margarita, Sierra Gorda, Atacama desert, Chile.
Description: Colourless crystals from the association with clinoatacamite, boleite, bingheimite and anhydrite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $Pb_{0.96}Ca_{0.04}Cl_{0.99}(OH)_{1.01}$.
Wavenumbers (cm^{-1}): 3480, 3370sh, 775w, 750w, 680sh, 624s, 600sh.

Cl26 Botallackite $Cu^{2+}{}_2Cl(OH)_3$



Locality: Cligga Head, Perranzabuloe, Cornwall, England, UK.
Description: Bluish-green crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3505s, 3410s, 1615w, 1115w, 895sh, 870sh, 860, 820, 786s, 709s, 528, 505, 451, 421.

Cl27 Clinoatacamite $Cu^{2+}{}_2Cl(OH)_3$

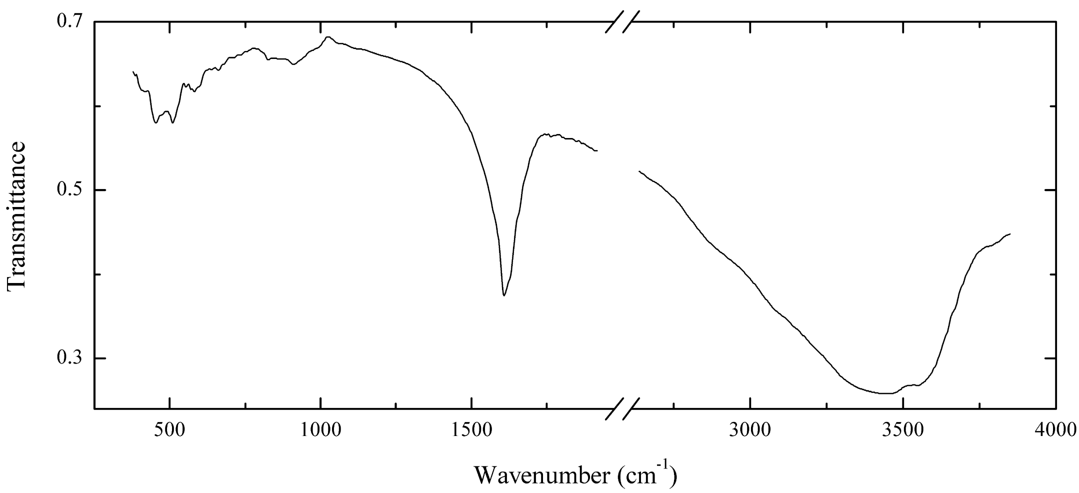


Locality: Northern open pit, Dzhezkazgan copper mine, Karagandy region, Central Kazakhstan.

Description: Green pseudomorph after azurite nodule. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3445s, 3355s, 3305s, 3125sh, 3000sh, 1900w, 1780w, 1720w, 1655w, 1612w, 1080w, 1025sh, 988, 925, 907, 867, 830, 582, 515, 455s, 407.

Cl28 Eriochalcite $CuCl_2{\cdot}2H_2O$

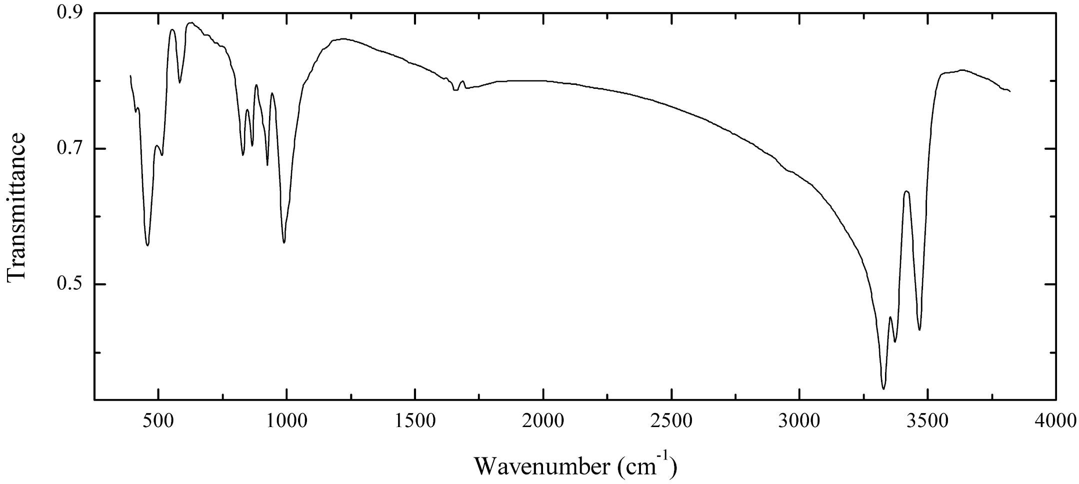


Locality: Fumarole "Yadovitaya" at the Second Cinder Cone, Northern Break of the Large Fissure Tolbachik Eruption, Tolbachik volcano, Kamchatka peninsula, Russia.

Description: Bluish-green prismatic crystals from the association with atacamite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is (electron microprobe) $K_{0.02}Cu_{0.97}Fe_{0.02}Cl_{1.00}{\cdot}nH_2O$.

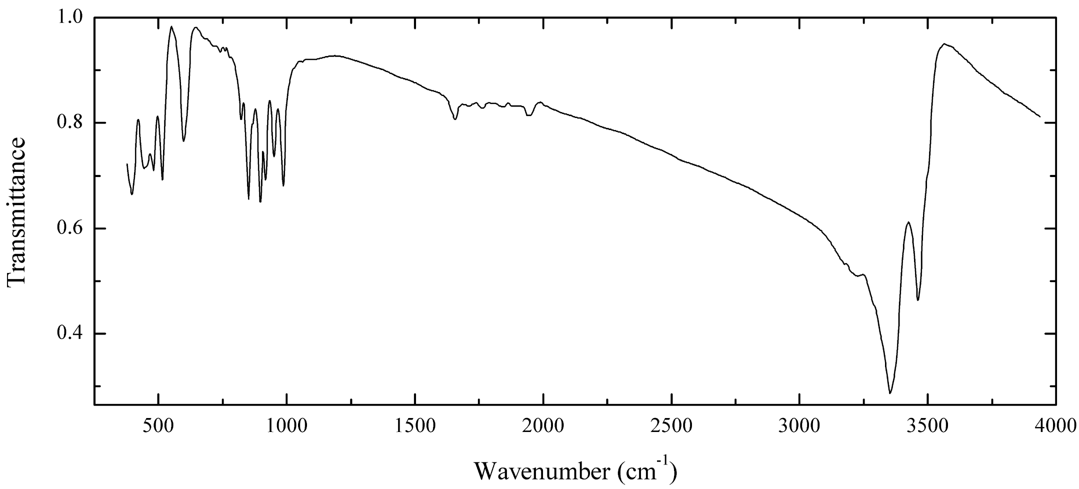
Wavenumbers (cm^{-1}): 3540s, 3440s, 3100sh, 2900sh, 1610s, 910w, 830w, 664w, 580w, 509, 452, 415w.

Cl29 Clinoatacamite $Cu^{2+}{}_2Cl(OH)_3$



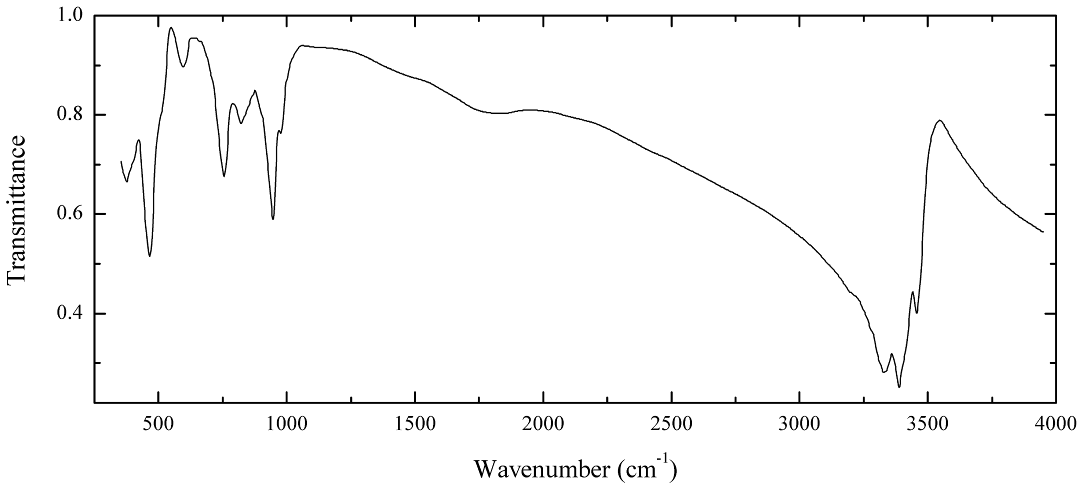
Locality: Mason Pass, Yerington, Yerington district, Lyon Co., Nevada, USA.
Description: Green crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3445s, 3352s, 3305s, 1725w, 1655w, 989, 923, 910sh, 865, 829, 583, 512, 457s, 408.

Cl30 Atacamite $Cu^{2+}{}_2Cl(OH)_3$



Locality: Capo Calamita mine, Capoliveri, Elba Island, Livorno province, Tuscany, Italy.
Description: Green crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3440s, 3330s, 3200, 1940w, 1760w, 1715w, 1655w, 986, 950, 916, 895, 867w, 850, 820w, 595, 513, 479, 443, 400.

Cl31 Paratacamite $Cu^{2+}{}_2Cl(OH)_3$

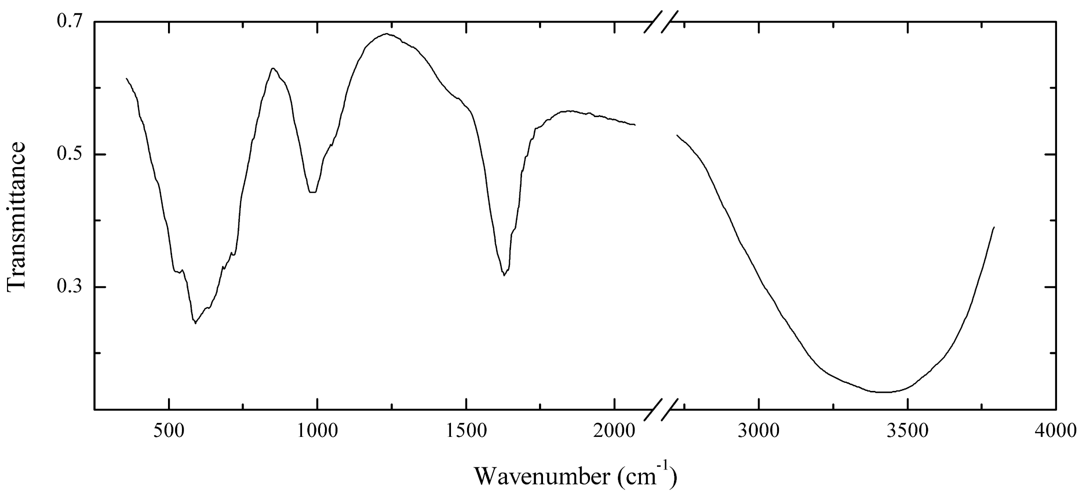


Locality: Nangeroo mine, Murrin Murrin, Western Australia.

Description: Green crystals. Identified by IR spectrum. The empirical formula is (electron microprobe) $Cu_{1.84}Zn_{0.14}Fe_{0.02}Cl_{0.99}(OH)_{3.01}$. The paratacamite-type crystal structure is stabilized by Zn^{2+} cations.

Wavenumbers (cm^{-1}): 3445s, 3375s, 3320s, 3200sh, 1800w, 1450sh, 975, 947s, 823, 755, 594, 510sh, 464s, 376.

Cl32 Cadwaladerite $AlCl(OH)_2{\cdot}4H_2O$

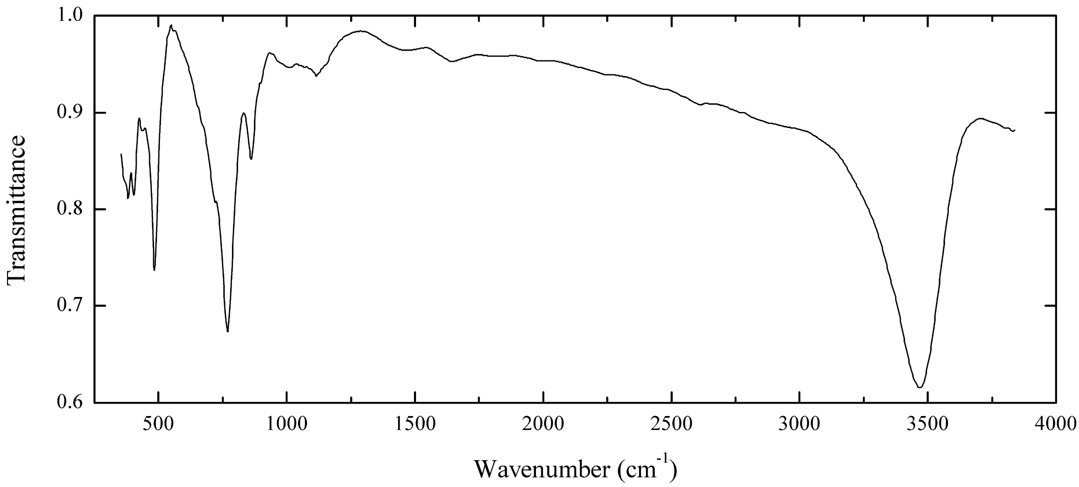


Locality: Tolbachik volcano, Kamchatka peninsula, Russia.

Description: Yellow, soft, colloform. The empirical formula is (electron microprobe) $(Al_{0.76}Mg_{0.12}Fe_{0.09}Mn_{0.02})Cl_{0.94}F_{0.06}(OH)_{1.9}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3420s, 3250sh, 1655sh, 1628s, 1480sh, 1035sh, 985, 715, 635sh, 590s, 533s.

Cl33 Kapellasite $Cu_3Zn(OH)_6Cl_2$

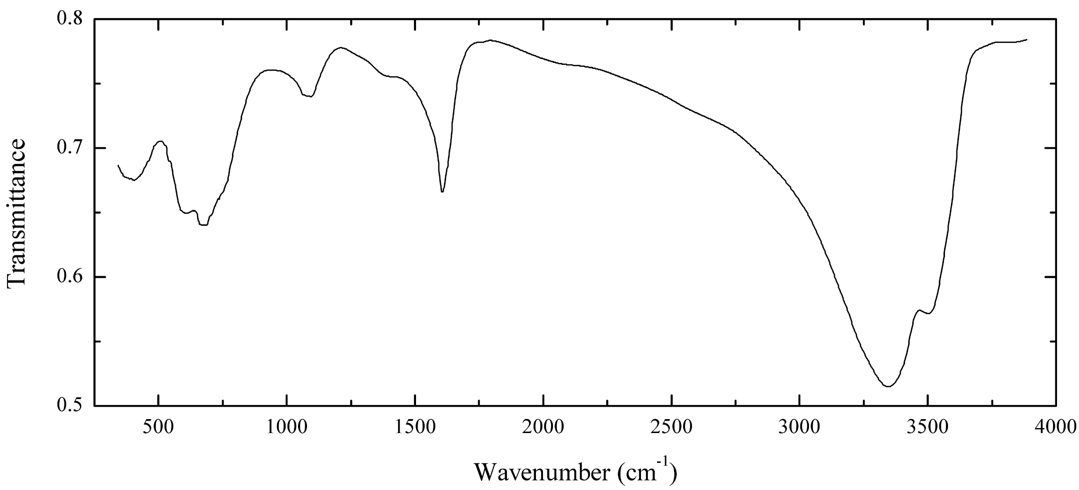


Locality: Hilarion mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Green powdery aggregate. The empirical formula is (electron microprobe) $Cu_{2.75}Zn_{1.20}Mg_{0.05}Cl_{1.99}(OH)_{6.01}$.

Wavenumbers (cm^{-1}): 3450s, 2610w, 1625w, 1470w, 1115w, 1012w, 860, 767s, 720sh, 484s, 404, 383.

Cl34 Chloride Cl34 $NiCl(OH){\cdot}nH_2O$

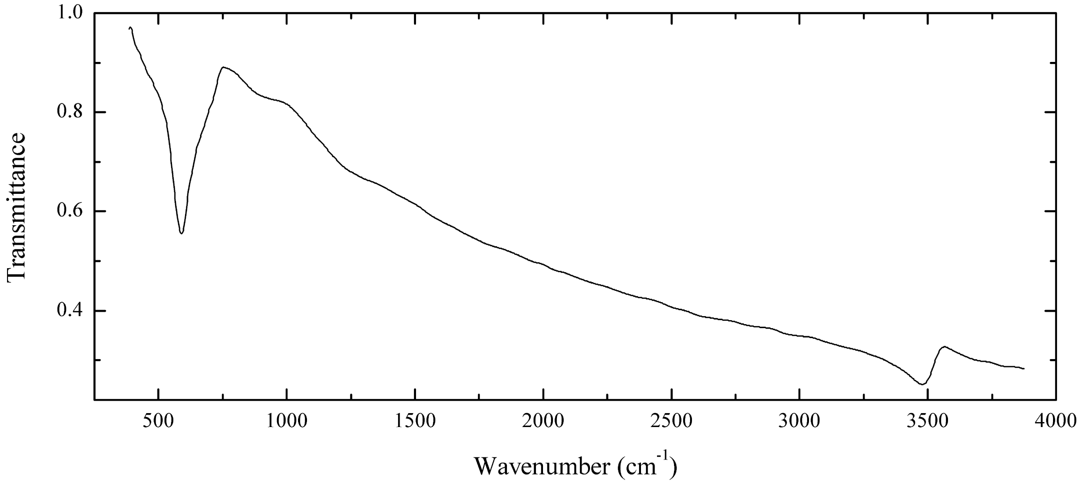


Locality: Weathered Dronino ataxite iron meteorite, near Dronino village, Kasimov District, Ryazan' region, Russia.

Description: Green efflorescence. Associated minerals are violarite, troilite, chromite, goethite, lepidocrocite, droninoite and reevesite. The empirical formula is (electron microprobe) $Ni_{0.96}Fe_{0.04}Cl_{0.94}(SO_4)_{0.04}(OH)_{0.99}){\cdot}nH_2O$. Amorphous. Needs further investigation.

Wavenumbers (cm^{-1}): 3490s, 3320s, 1608, 1480w, 1093, 730sh, 675, 600, 395.

Cl35 Laurionite $PbCl(OH)$

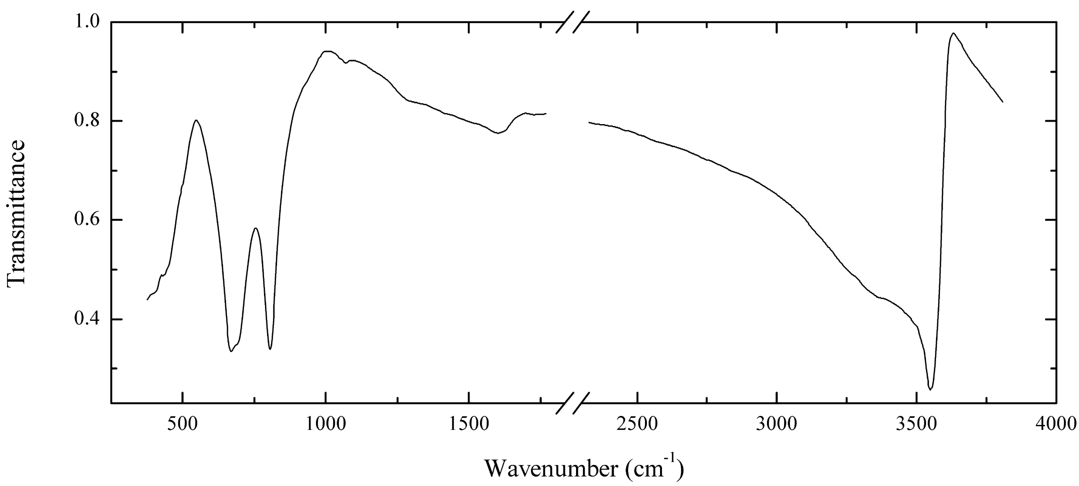


Locality: Ancient slags of the Lavrion mining district, Attikí Prefecture, Greece (type locality).

Description: Colourless long-prismatic crystals. Identified by single-crystal X-ray diffraction pattern and qualitative electron microprobe analysis. Single-crystal unit-cell parameters are $a = 4.01$, $b = 7.11$, $c = 9.67$ Å.

Wavenumbers (cm^{-1}): 3495, 950sh, 584s.

Cl36 Chloride Cl36 $Fe^{2+}{}_2(OH)_3Cl$

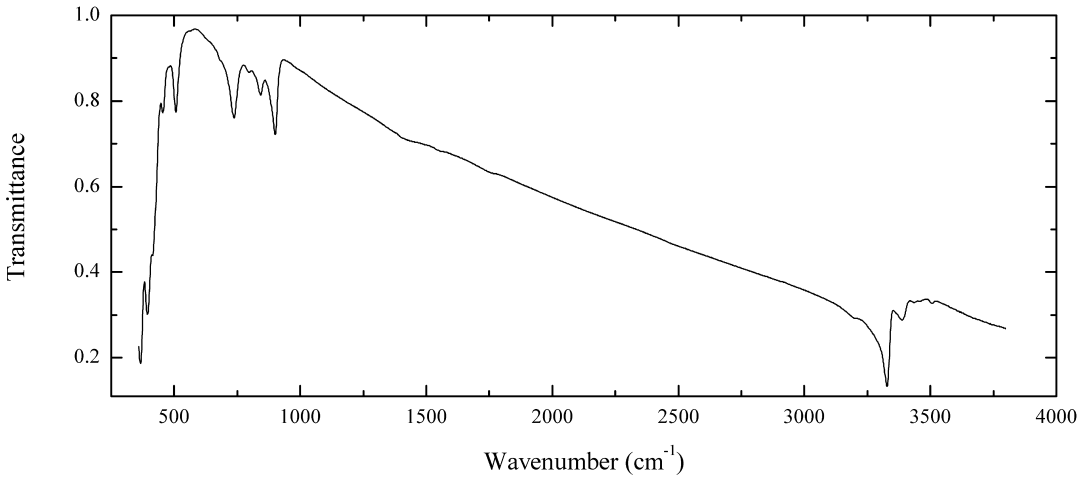


Locality: Weathered Dronino ataxite iron meteorite, near Dronino village, Kasimov District, Ryazan' Oblast, Russia.

Description: Green transparent split crystals from the association with goethite, honessite and chukanovite. Structurally related to paratacamite and dimorphous with hibbingite. Investigated by I.V. Pekov.

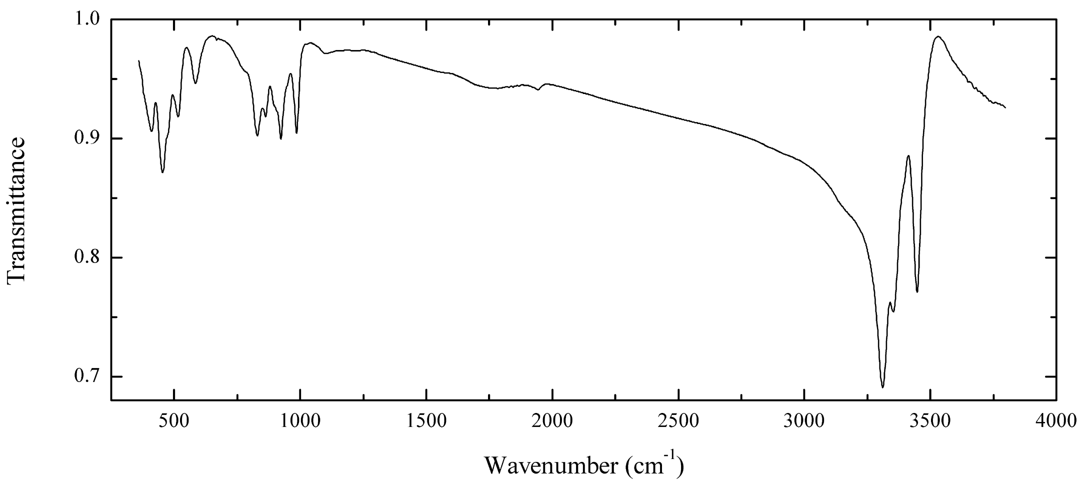
Wavenumbers (cm^{-1}): 3550s, 3380sh, 1624, 1320sh, 1070w, 803s, 685sh, 667s, 430sh, 400sh.

Cl37 Chloroxiphite $Pb_3Cu^{2+}Cl_2(OH)_2O_2$



Locality: Higher Pitts mine, Mendip Hills, Somerset, England, UK (type locality).
Description: Dark green grains. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3510w, 3460w, 3435w, 3388, 3328, 3205sh, 1760w, 1560w, 1440sh, 901, 843, 800w, 737, 506, 455, 415sh, 396s, 369s.

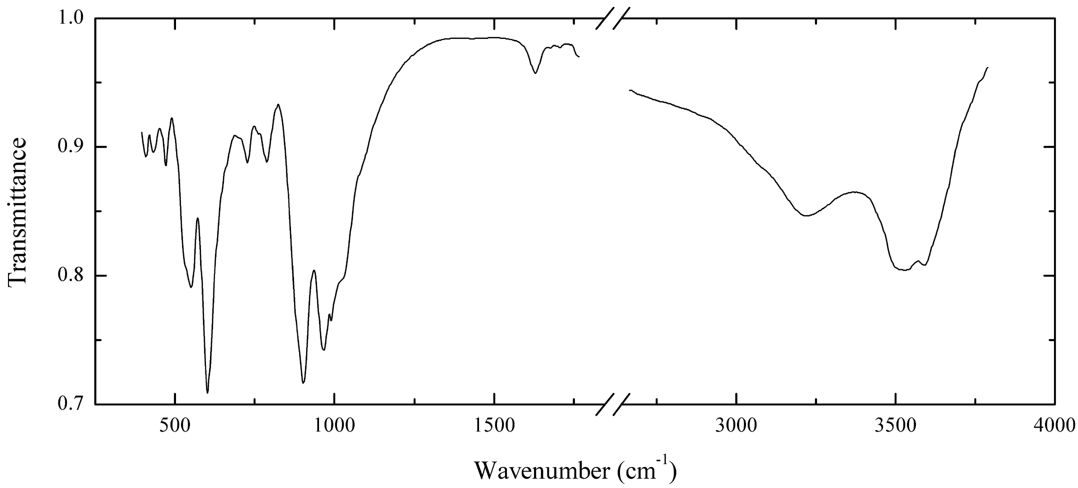
Cl38 Anatacamite $Cu^{2+}{}_2Cl(OH)_3$



Locality: La Vendida copper mine (Mina La Vendida), about 5 km WNW of Sierra Gorda, Antofagasta Region, Atacama desert, Chile (type locality).
Description: Green twinned triangular, tabular crystals from the association with atacamite, alunite, clinoatacamite, chalcanthite, coquimbite, eriochalcite, jarosite, kröhnkite, magnesioaubertite, tamarugite and voltaite. The similarity with IR spectrum of clinoatacamite reflects close structural relationship between these polymorphs of $Cu^{2+}{}_2Cl(OH)_3$.
Wavenumbers (cm^{-1}): 3448s, 3353s, 3311s, 3175sh, 1943w, 1750, 1660sh, 1104w, 986, 923, 905sh, 863, 830, 780sh, 584, 516, 470sh, 454, 410.

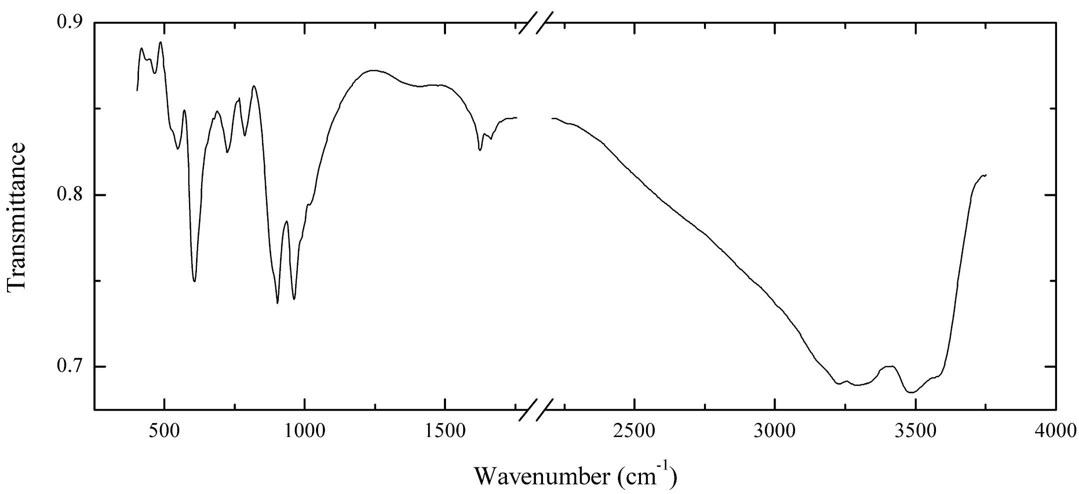
2.11 Vanadates and Vanadium Oxides

V1 Ankinovichite $(Ni,Zn)Al_4(VO_3)_2(OH)_{12}·2H_2O$



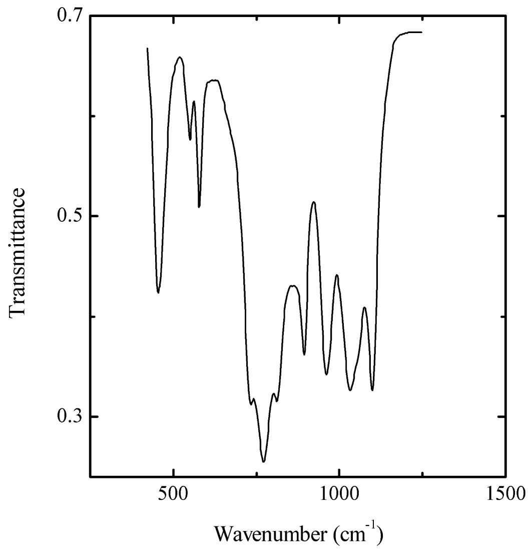
Locality: Kara-Chagyr Mt., Osh region, Kara-Tau range, Kazakhstan (type locality).
Description: Light green crystalline crust from the association with volborthite. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3560, 3500, 3200, 1622w, 1025, 987, 964s, 903s, 787, 728, 601s, 545, 530sh, 468w, 427w, 399w.

V2 Alvanite $(Zn,Ni)Al_4(VO_3)_2(OH)_{12}·2H_2O$



Locality: Kara-Tau range, Kazakhstan (type locality).
Description: Light green crystals from the oxidation zone of a vanadiferous clay-anthraxolite horizon. Investigated by V.Yu. Karpenko.
Wavenumbers (cm^{-1}): 3560sh, 3470, 3300, 3190, 1662w, 1624w, 1400w, 1015sh, 962s, 901s, 885sh, 786, 725, 605s, 542, 525. 465w, 430w.

V4 Bushmakinite $Pb_2Al(PO_4)(VO_4)(OH)$

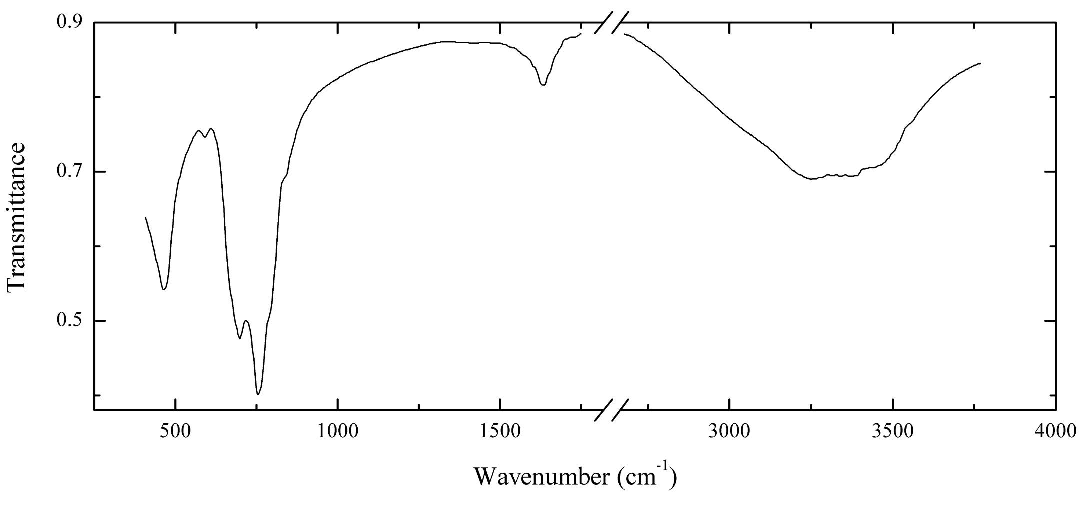


Locality: Berezovskoye gold deposit, Middle Urals, Russia (type locality).

Description: Bright yellow lamellar crystals from the association with cerussite, bindheimite, vauquelinite, mottramite and pyromorphite. Holotype sample. Monoclinic, space group $P2_1/m$, $a = 7.734(9)$, $b = 5.814(6)$, $c = 8.69(1)$ Å, $\beta = 112.1(1)°$. The empirical formula is $Pb_{2.02}(Al_{0.77}Cu^{2+}_{0.21}Zn_{0.01})(PO_4)[(V^{5+}_{0.74}Cr^{6+}_{0.14}P_{0.12}S_{0.01})O_4](OH)$. Optically biaxial (–), $\alpha = 1.99$, $\beta = 2.03$, $\gamma = 2.06$; $2V_{calc} = 80°$. $D_{calc} = 6.21$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 4.68 (80) (011), 3.57 (50) (111), 3.21 (100) (21-1), 2.91 (80) (21-2, 020, 10-3), 2.71 (70) (021, 112), 2.27 (40) (220), 2.05 (50) (12-3, 11-4).

Wavenumbers (cm^{-1}): 1100, 1031, 959, 894, 816, 771s, 732, 579, 550w, 457.

V5 Bokite $KAl_3Fe_6V^{4+}{}_6V^{5+}{}_{20}O_{76}\cdot15H_2O$

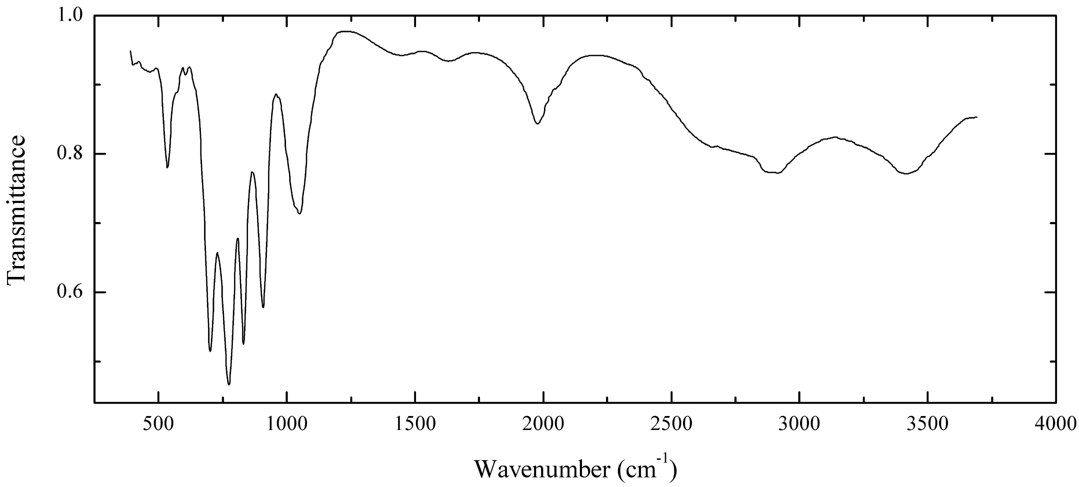


Locality: Monument #2 mine, Apache Co., Arizona, USA.

Description: Orange-brown massive.

Wavenumbers (cm^{-1}): 3425sh, 3360, 3230, 1635, 840sh, 790sh, 756s, 700, 600w, 469.

V6 Vésigniéite $BaCu^{2+}_3(VO_4)_2(OH)_2$

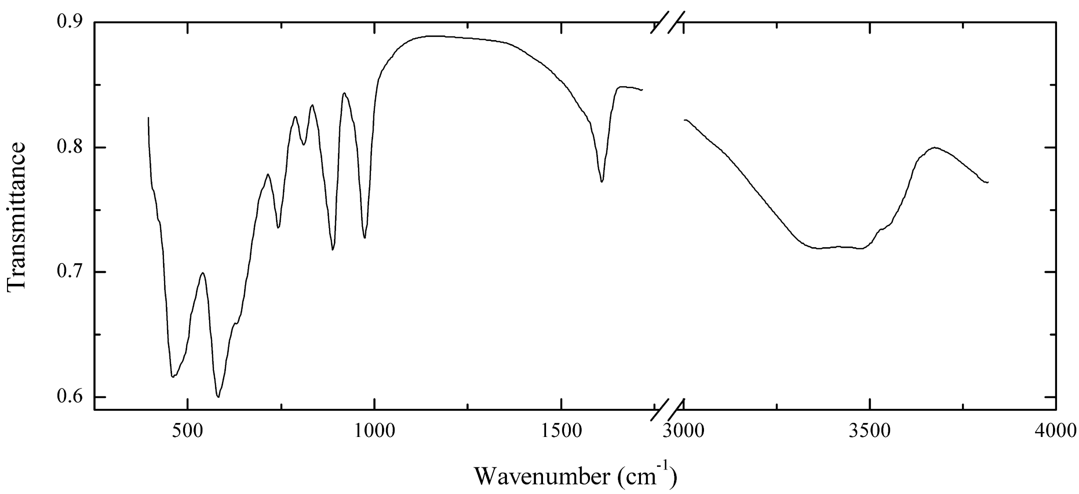


Locality: Kara-Chagyr Mt., Osh region, Kara-Tau range, Kyrgyzstan.

Description: Light green radial aggregate. The empirical formula is (electron microprobe) $(Ba_{0.91}Ca_{0.08})Cu^{2+}_{0.96}[(VO_4)_{1.90}(AsO_4)_{0.10}](OH,H_2O)_2$.

Wavenumbers (cm^{-1}): 3425, 2910, 2870sh, 2700sh, 2060sh, 1985, 1630w, 1450w, 1052, 1035sh, 911, 834s, 777s, 704s, 604w, 565sh, 536, 463w, 402w.

V7 Vanuralite $Al(UO_2)_2(VO_4)_2(OH)\cdot 11H_2O$

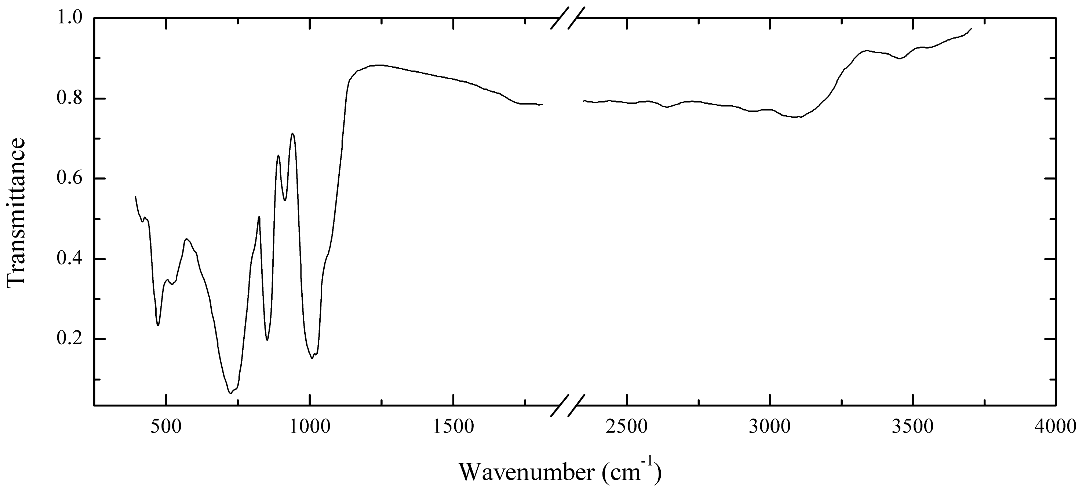


Locality: Mounana mine, Franceville, Gabon (type locality).

Description: Yellow crusts. Specimen No. 76654 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.

Wavenumbers (cm^{-1}): 3540sh, 3465, 3350, 1612, 975, 892, 811w, 744, 635sh, 583s, 480sh, 465s, 415sh.

V8 Descloizite $PbZn(VO_4)(OH)_2$

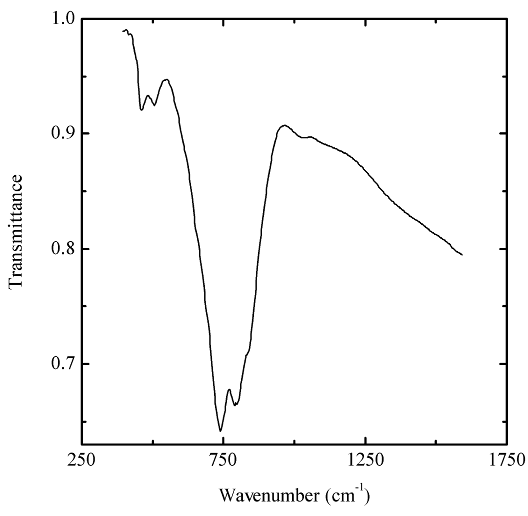


Locality: Suleiman-Sai deposit, Karatau range (Kara-Tau Mts.), southern Kazakhstan.

Description: Black massive from the association with vanadinite. The empirical formula is (electron microprobe) $Pb_{1.01}(Zn_{0.76}Cu_{0.23})(VO_4)_{1.00}(OH)$.

Wavenumbers (cm^{-1}): 3450w, 3375w, 3080, 2930w, 2650w, 1060sh, 1025sh, 1013s, 918, 854, 740sh, 727s, 524, 472, 410.

V9 Vanadinite $Pb_5(VO_4)_3Cl$

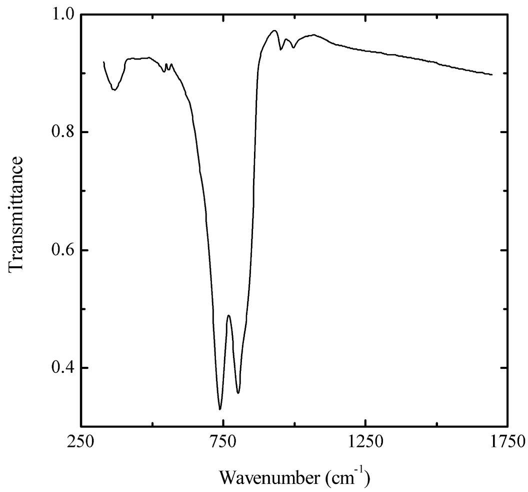


Locality: Hackman valley, Khibiny alkaline complex, Kola peninsula, Murmansk region, Russia.

Description: Yellow prismatic crystals from the association with microcline, natrolite, aegirine, catapleiite, apatite, edingtonite, strontianite, ancylite, cerite-(Ce), clinobarylite and chabazite-Ca. Investigated by I.V. Pekov. The chemical composition is (wt. %) PbO 79.85, CaO 0.11, P_2O_5 0.83, As_2O_5 0.22, V_2O_5 16.03, Cl 2.07, -O = Cl −0.47, total 98.64.

Wavenumbers (cm^{-1}): 1018w, 835sh, 802s, 741s, 506w, 465.

V12 Vanadinite $Pb_5(VO_4)_3Cl$

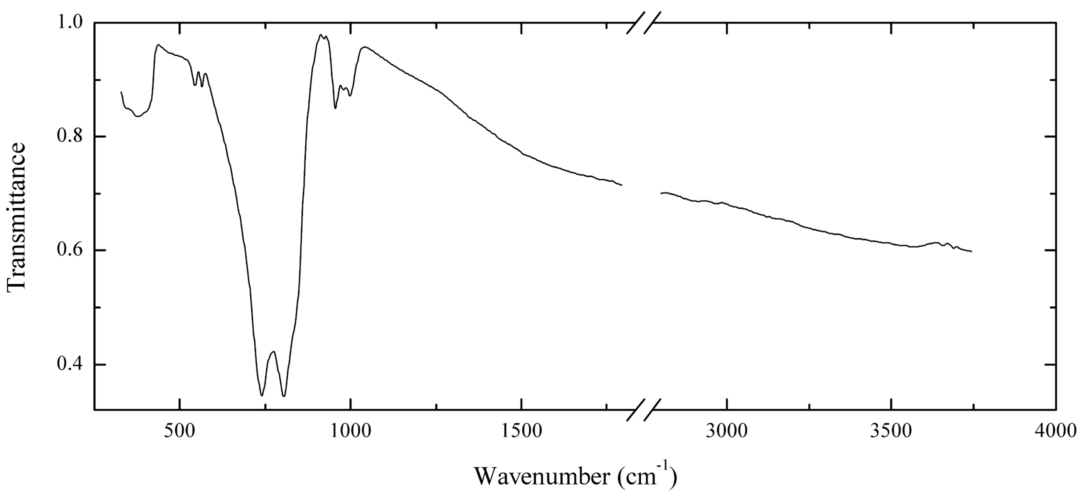


Locality: Mibladen mining district, Midelt, Khénifra province, Morocco.

Description: Red short-prismatic crystal from the association with coronadite. The empirical formula is (electron microprobe) $Pb_{5.01}[(VO_4)_{2.96}(PO_4)_{0.04}]Cl_{0.95}(OH,O,F)_{0.05}$.

Wavenumbers (cm^{-1}): 1000w, 960w, 830sh, 805s, 741s, 560w, 537w, (390).

V13 Vanadinite $Pb_5(VO_4)_3Cl$

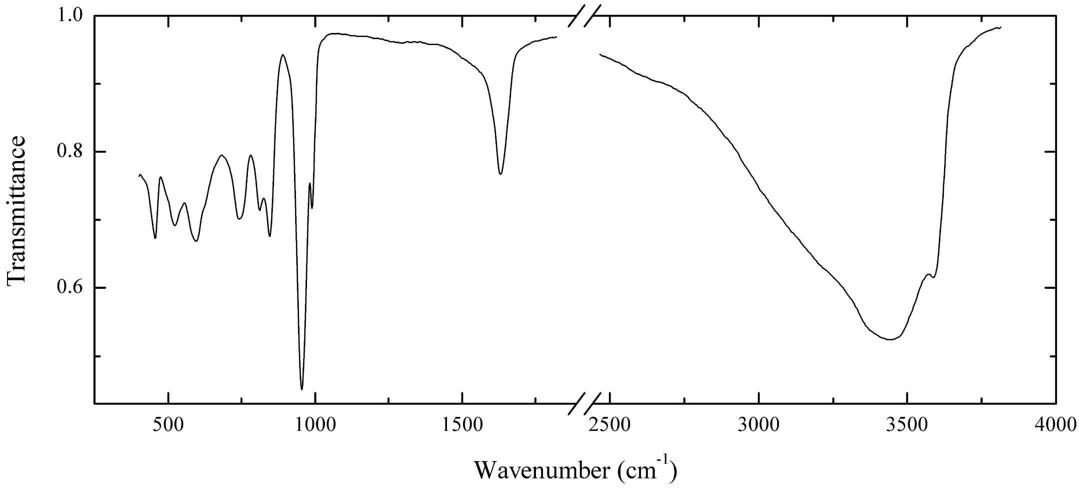


Locality: Mibladen mining district, Midelt, Khénifra province, Morocco.

Description: Brown short-prismatic crystal. The empirical formula is (electron microprobe) $Pb_{4.98}Ca_{0.02}[(VO_4)_{2.81}(PO_4)_{0.19}]Cl_{0.97}(OH,O,F)_{0.03}$.

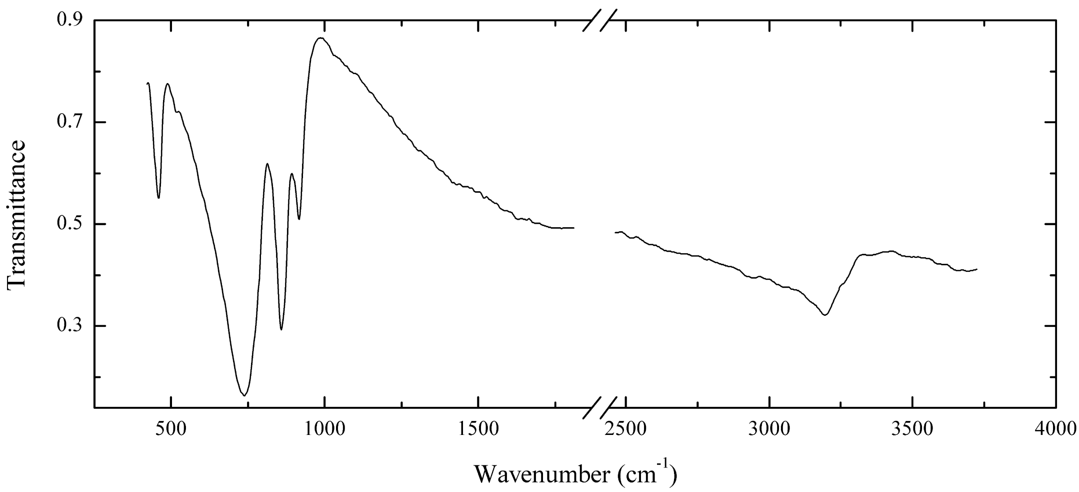
Wavenumbers (cm^{-1}): 1000, 983w, 957, 920w, 835sh, 802s, 837s, 595sh, 561w, 541w, 400.

V14 Grantsite $(Na,Ca)_x(V^{5+},V^{4+})_6O_{16}{\cdot}4H_2O$ ($x = 2$–3)



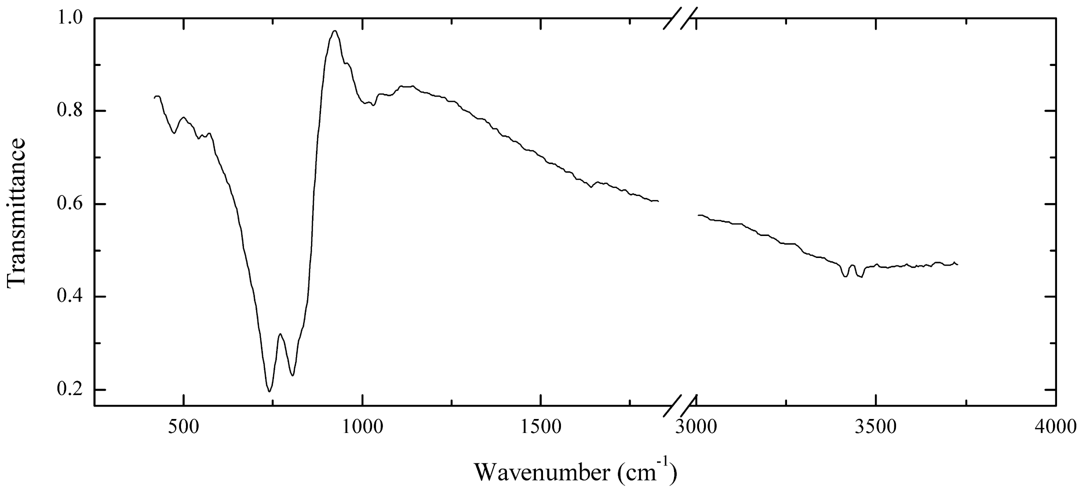
Locality: Sunday # 2 mine, Slick Rock District, San Miguel Co., Colorado, USA.
Description: Orange-yellow powdery aggregate from the association with gypsum and huemulite. The empirical formula is (electron microprobe) $Na_{1.13}Ca_{0.89}V_{5.97}O_{16}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3560, 3425, 3380sh, 3220sh, 1627, 989, 955s, 846, 812, 747, 630sh, 599, 522, 453.

V15 Descloizite $PbZn(VO_4)(OH)_2$



Locality: Black Butte prospect, Yavapai Co., Arizona, USA.
Description: Dark brown split crystals from the association with calcite and Mn oxides. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3185, 918, 859s, 740s, 458.

V16 Vanadinite $Pb_5(VO_4)_3Cl$

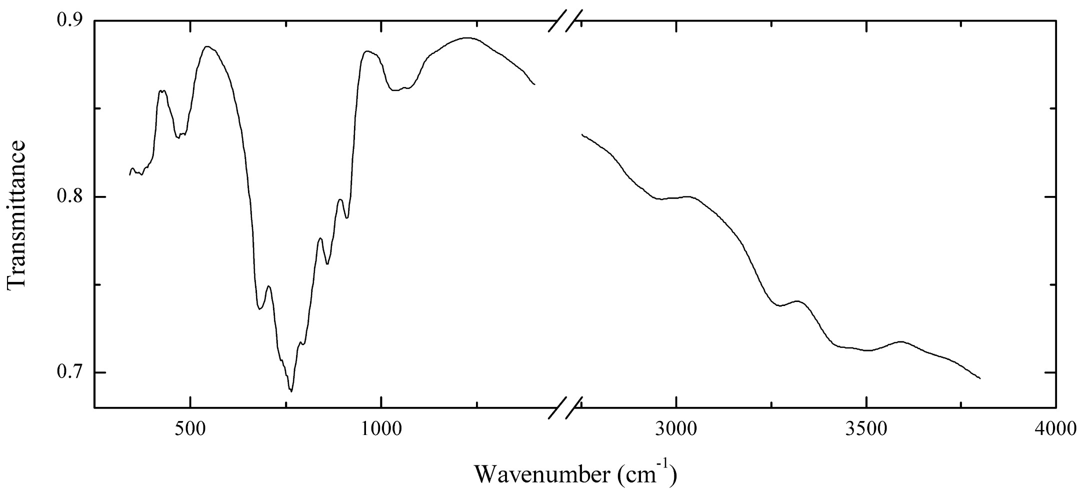


Locality: Domino mine, Cumero canyon, Palmetto district, Patagonia Mts., Santa Cruz Co., Arizona, USA.

Description: Orange crystals from the association with cerussite. OH-bearing variety. The empirical formula is (electron microprobe) $Pb_{4.77}[(VO_4)_{2.84}(PO_4)_{0.16}]Cl_{0.76}(OH,O,F,H_2O)_{0.24}$.

Wavenumbers (cm^{-1}): 3450w, 3410w, 1648w, 1075, 1032, 1006, 952w, 830sh, 804s, 739s, 563w, 541w, 475.

V17 Tokyoite $Ba_2Mn^{3+}(VO_4)_2(OH)$

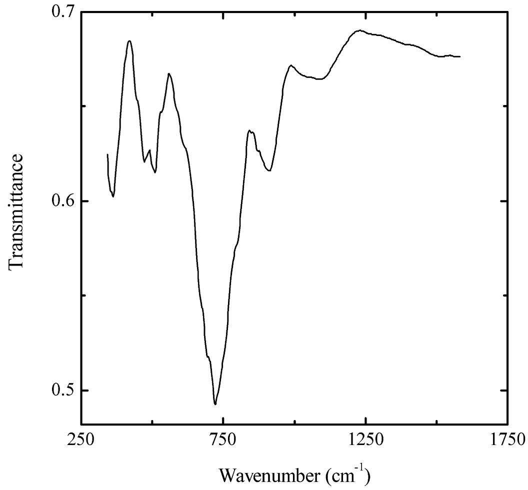


Locality: Krettnich, Wadern, Saarland, Germany.

Description: Dark brown crystals from the association with krettnichite, mottramite and brackebuschite. Pb-rich variety. The empirical formula is (electron microprobe) $(Ba_{1.08}Pb_{0.87}Ca_{0.03})(Mn_{0.75}Fe_{0.25})[(VO_4)_{1.90}(SiO_4)_{0.10}](OH,H_2O)$.

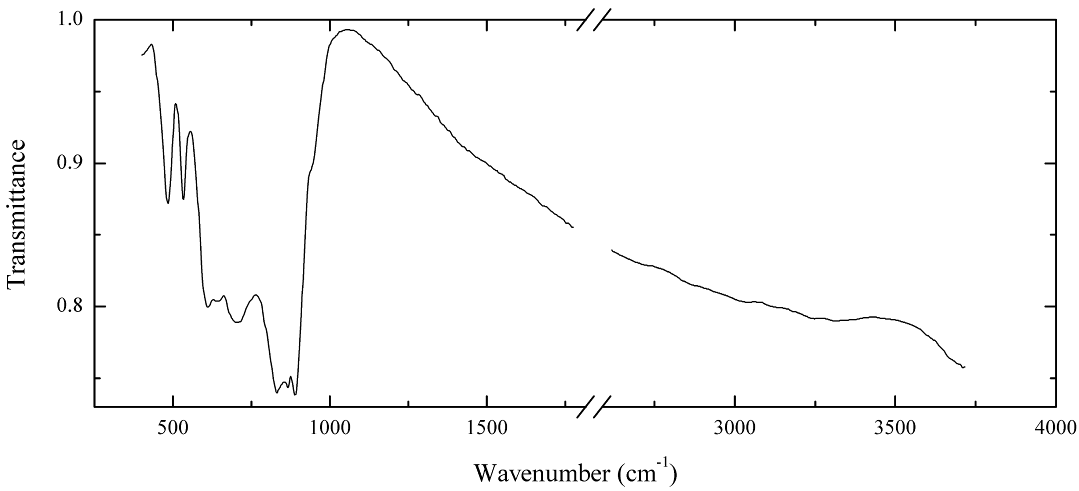
Wavenumbers (cm^{-1}): 3460, 3390, 3230, 2930w, 1060w, 1030w, 911, 858, 795s, 760s, 740sh, 683, 683, 479, 370.

V18 Krettnichite $PbMn^{3+}{}_2(VO_4)_2(OH)_2$



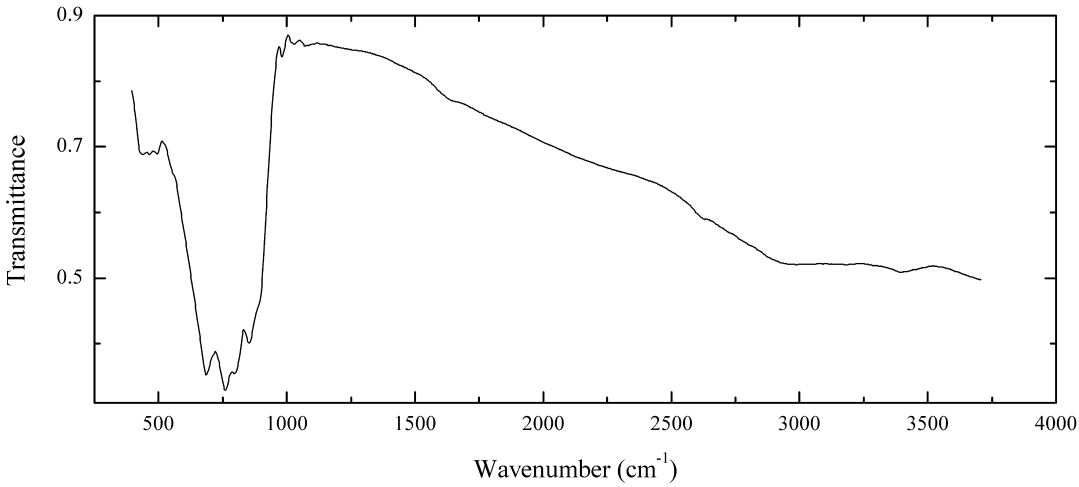
Locality: Krettnich, Wadern, Saarland, Germany.
Description: Dark brown crystals from the association with tokyoite, mottramite and brackebuschite. The empirical formula is (electron microprobe) $(Pb_{0.80}Sr_{0.13}Ca_{0.09})(Mn_{1.64}Co_{0.14}Fe_{0.10}Mg_{0.06})[(VO_4)_{1.83}(AsO_4)_{0.16}(PO_4)_{0.01}](OH)_2$.
Wavenumbers (cm^{-1}): 1100w, 910, 790sh, 718s, 700sh, 530sh, 506, 470, 440sh, 400w, 360.

V21 Dreyerite $Bi(VO_4)$



Locality: Catherine mine, Riverside Co., California, USA.
Description: Yellow, massive. Confirmed by electron microprobe analysis.
Wavenumbers (cm^{-1}): 885s, 861s, 827s, 707, 635, 609, 534, 481.

V22 Calderónite $Pb_2Fe^{3+}(VO_4)_2(OH)$

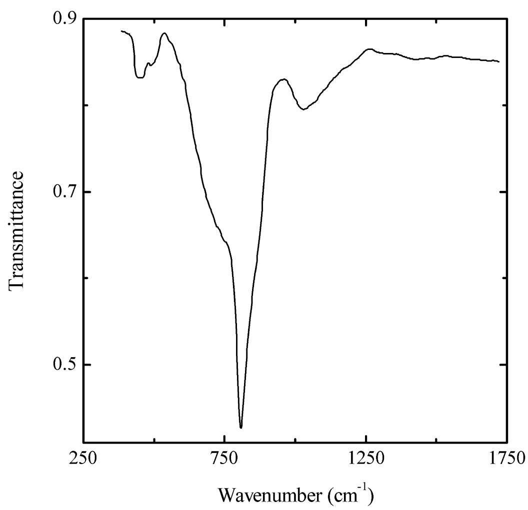


Locality: Venus mine, El Guaico district, Punilla department, Córdoba, Argentina.

Description: Dark brown crystals from the association with pyromorphite, descloisite and brackebuschite. The crystal structure is solved. Monoclinic, space group $P2_1/m$, $a = 8.782(3)$, $b = 6.148(3)$, $c = 7.628(3)$ Å, $\beta = 111.1(1)°$. The empirical formula is (electron microprobe) $Pb_{1.9}Fe_{0.75}Mn_{0.15}Al_{0.1}Zn_{0.1}(VO_4)_{2.0}(OH)$. Weak bands at 975, 1,025 and 1,050 cm^{-1} correspond to trace amount of PO_4^{3-} groups.

Wavenumbers (cm^{-1}): 3370w, 2940, 2610w, 1640w, 1050w, 1025w, 975w, 885sh, 853s, 800s, 763s, 688s, 550sh, 500, 480, 440.

V23 Clinobisvanite $Bi(VO_4)$

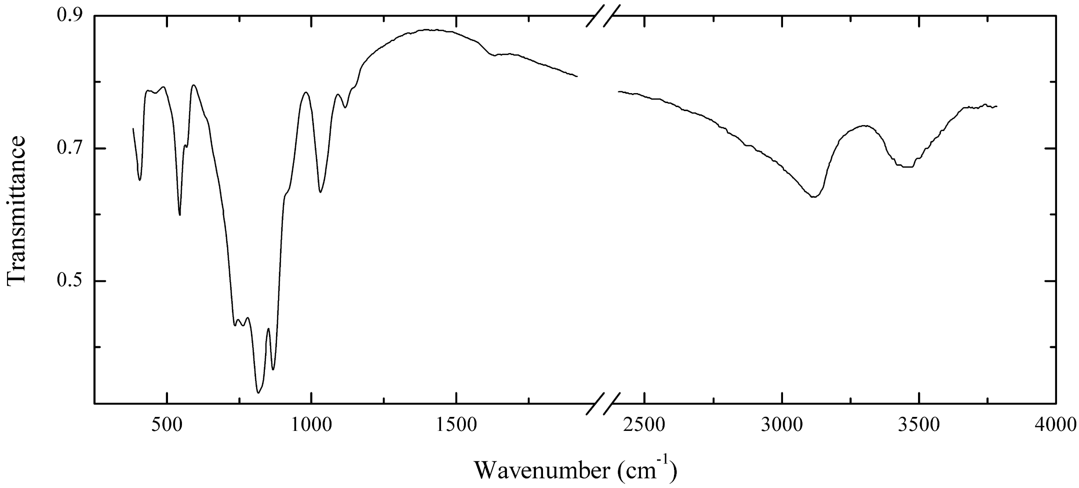


Locality: Linka (Garnetite) mine, Spencer Hot Springs district, Lander Co., Nevada, USA.

Description: Yellow, powdery, from the association with bismuthite and calcite. The empirical formula is (electron microprobe) $(Bi_{0.95}Ca_{0.05}Fe_{0.05})[(VO_4)_{0.9}(PO_4)_{0.1}]$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 4.70 (60), 3.10 (100), 2.597 (50), 2.279 (50), 1.934 (80), 1.723 (50), 1.589 (70), 1.553 (50), 1.254 (60).

Wavenumbers (cm^{-1}): 1025, 870sh, 806s, 730sh, 486w, 445.

V24 Tangeite $CaCu(VO_4)(OH)$

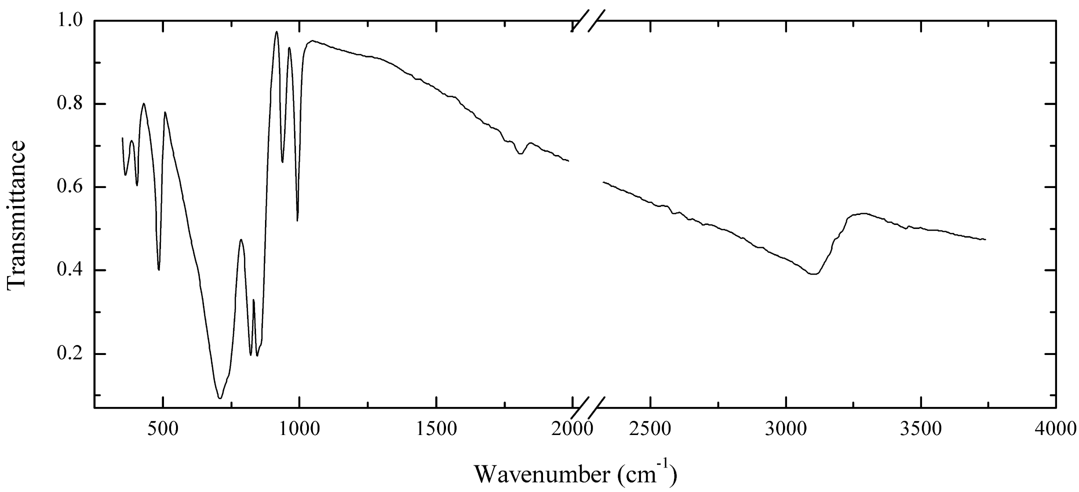


Locality: Range Gorge, Tyuya-Muyun Cu–V–U deposit, Fergana valley, Alai range, Kyrgyzstan (type locality).

Description: Dark green massive from the association with chrysocolla, malachite and calcite. The empirical formula is (electron microprobe) $(Ca_{0.97}Sr_{0.03}Mn_{0.01})(Cu_{0.98}Fe_{0.01})[(VO_4)_{0.96}(SO_4)_{0.04}](OH)$.

Wavenumbers (cm^{-1}): 3425, 3090, 1627w, 1150sh, 1117, 1034, 920sh, 868s, 830sh, 814s, 764, 734, 680sh, 630sh, 567, 543, 467w, 407.

V25 Mottramite $PbCu(VO_4)(OH)_2$

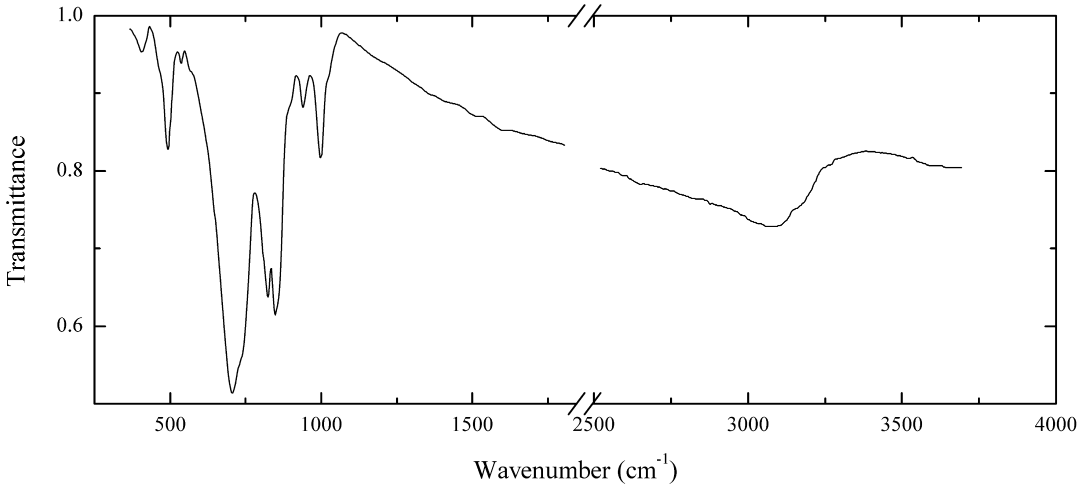


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Dark greenish-brown split crystals. Zn-rich variety. The empirical formula is (electron microprobe) $(Pb_{0.98}Ca_{0.04})(Cu_{0.57}Zn_{0.40}Fe_{0.01})[(VO_4)_{0.94}(AsO_4)_{0.03}(PO_4)_{0.03}](OH)$.

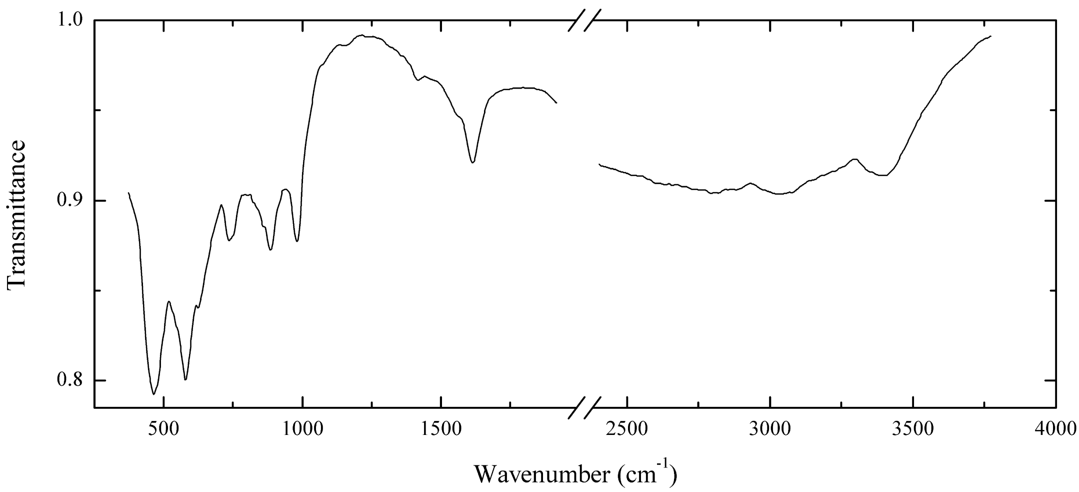
Wavenumbers (cm^{-1}): 3080, 1805w, 1755w, 995, 938, 860sh, 847s, 824s, 740sh, 712s, 490, 412, 387.

V26 Mottramite $PbCu(VO_4)(OH)_2$



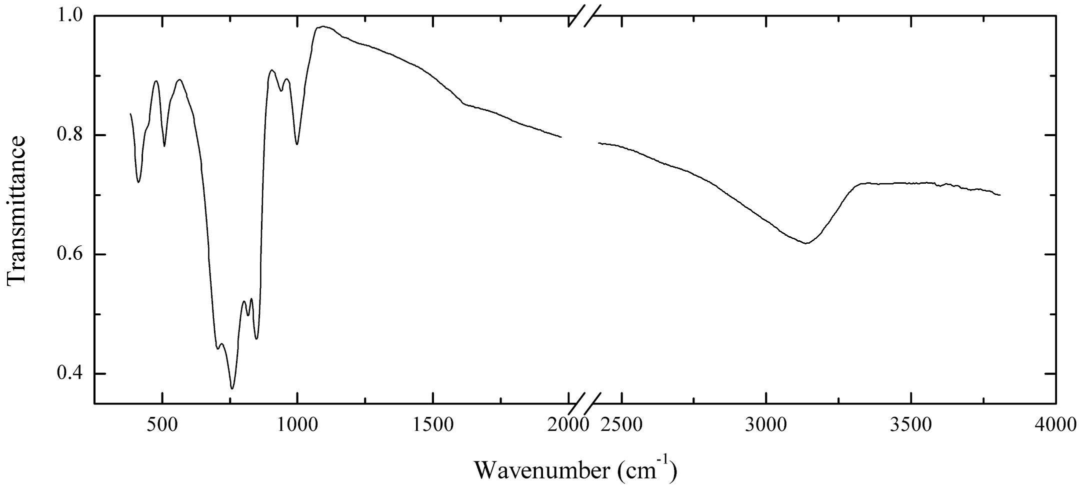
Locality: Crocoite pit, Uspenskaya Mt., near Berezovsk, Middle Urals, Russia.
Description: Brown crystals. Investigated by D.A. Kleimenov. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3130sh, 3050, 1020sh, 995, 940, 890sh, 855sh, 846s, 823s, 735sh, 705s, 560sh, 534w, 489, 410.

V27 Metavanuralite $Al(UO_2)_2(VO_4)_2(OH)\cdot 8H_2O$



Locality: Mounana mine, Franceville, Gabon (type locality).
Description: Yellow massive.
Wavenumbers (cm^{-1}): 3360, 3040, 2780, 1618, 1415w, 983, 890, 742, 628, 581s, 470s

V28 Mottramite $PbCu(VO_4)(OH)_2$

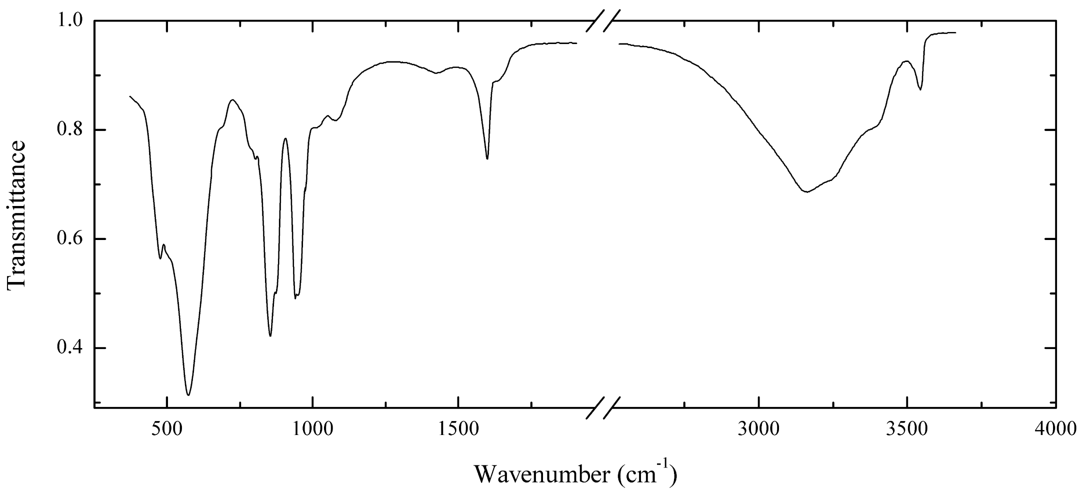


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Olive green spherulites on calcite. Zn-rich variety. Identified by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3125, 1615w, 995, 939w, 842s, 813s, 751s, 699s, 530sh, 502, 440sh, 410.

V29 Metarossite $CaV^{5+}{}_2O_6{\cdot}2H_2O$

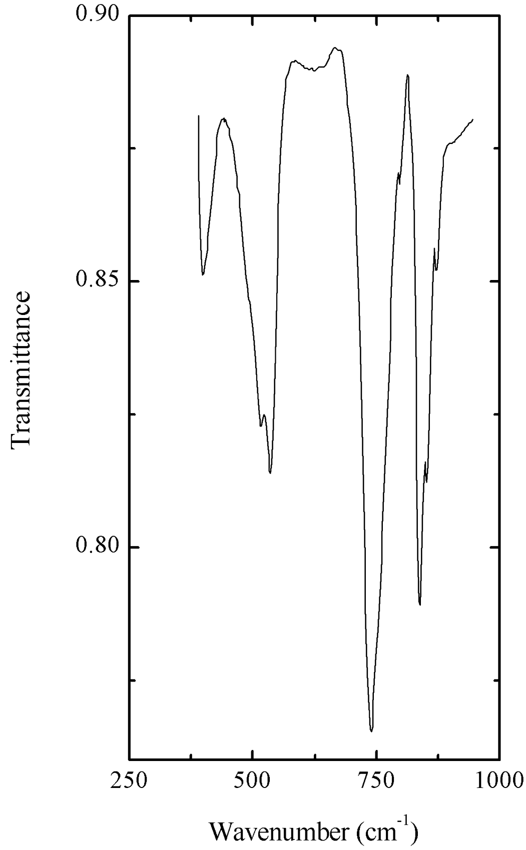


Locality: Slick Rock District, San Miguel Co., Colorado, USA.

Description: Yellow, powdery crust. The empirical formula is (electron microprobe) $Ca_{1.00}V_{2.00}O_6{\cdot}nH_2O$. Confirmed by IR spectrum.

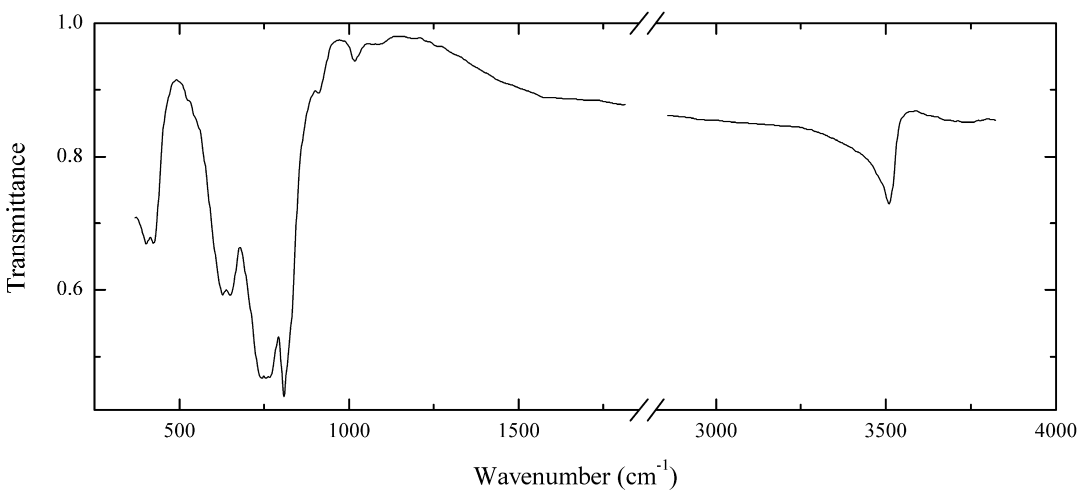
Wavenumbers (cm^{-1}): 3530, 3360sh, 3230sh, 3160, 1625sh, 1602, 1433w, 1082w, 1020w, 978, 951s, 940s, 875s, 854s, 794, 775sh, 680sh, 570s, 505sh, 475.

V31 Namibite $Cu(BiO)_2(VO_4)(OH)$



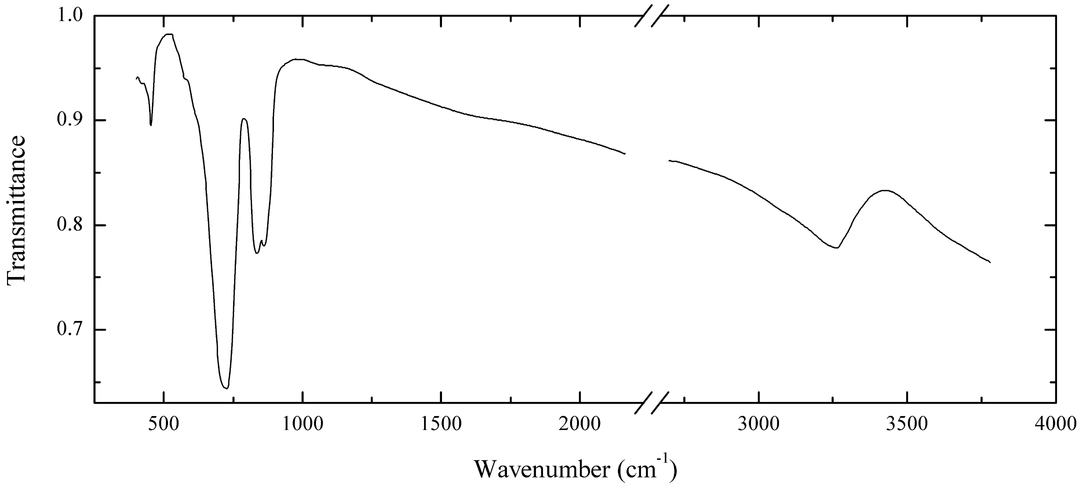
Locality: Stewart mine, California, USA.
Description: Green granular aggregate. Identified by electron microprobe analysis.
Wavenumbers (cm^{-1}): 879, 857, 842, 760sh, 743, 534, 518, 410.

V32 Nabiasite $BaMn_9[(V,As)O_4]_6(OH)_2$



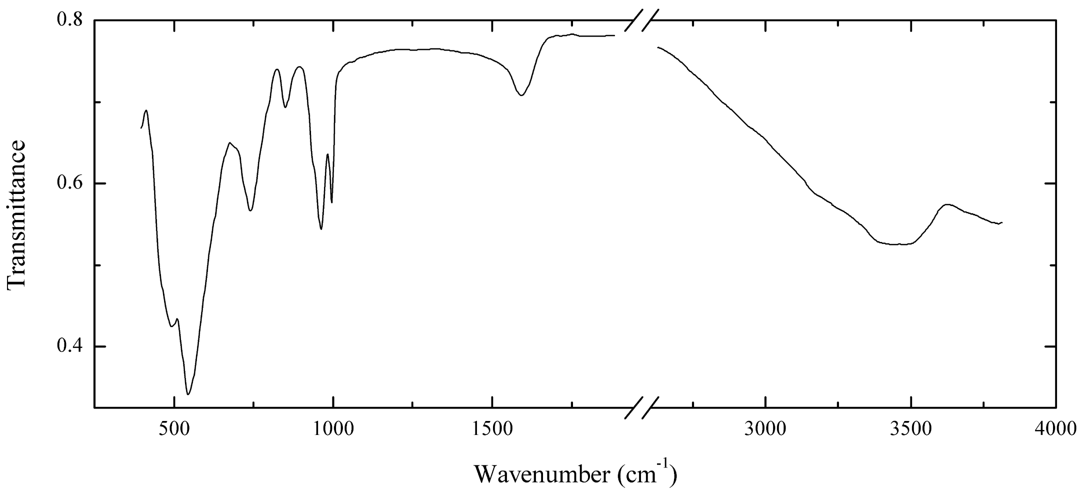
Locality: Gambatesa mine, Val Graveglia, Genova, Italy.
Description: Dark red grains.
Wavenumbers (cm^{-1}): 3510, 1090w, 1015w, 905w, 825sh, 806s, 766s, 742s, 648, 627, 418, 400.

V33 Pyrobelonite $PbMn(VO_4)(OH)_2$



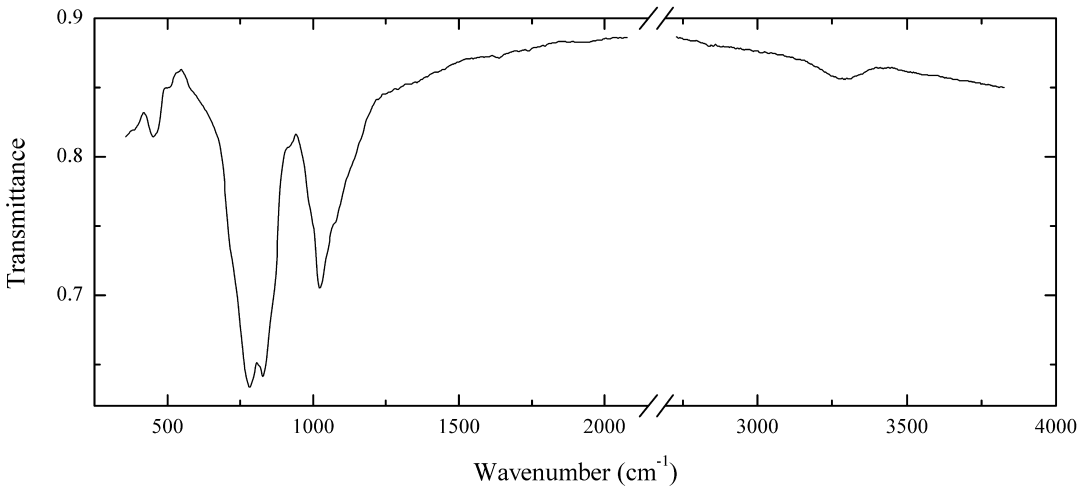
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: Reddish-brown grains from the association with hausmannite and calcite. Confirmed by IR spectrum and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3240, 865s, 840s, 721s, 575sh, 455.

V34 Metahewettite $CaV^{5+}{}_6O_{16}\cdot 3H_2O$



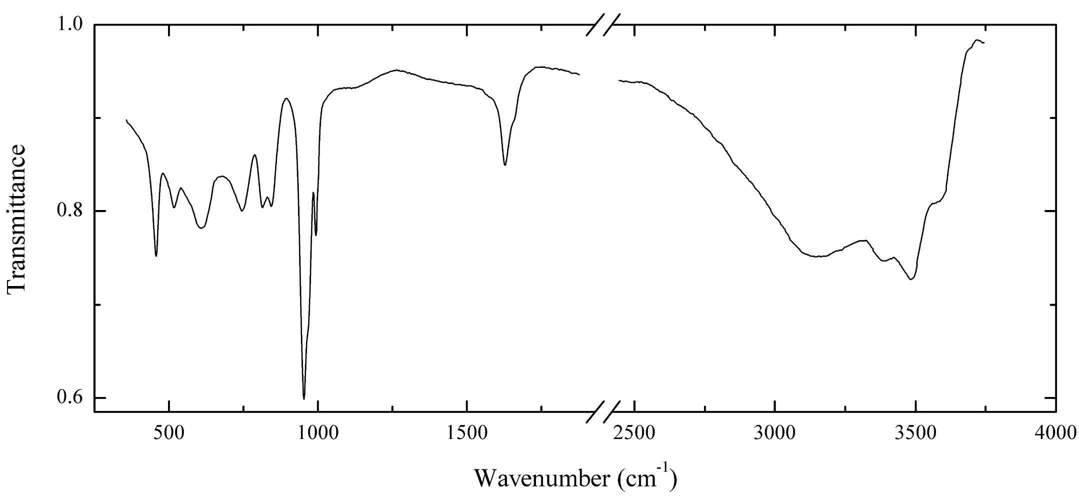
Locality: Anaconda mine, Grants, New Mexico, USA.
Description: Reddish-brown massive. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3440, 3270sh, 1602, 996, 962, 935sh, 850, 737, 715sh, 545s, 494s.

V35 Palenzonaite $(Ca_2Na)Mn^{2+}{}_2(VO_4)_3$



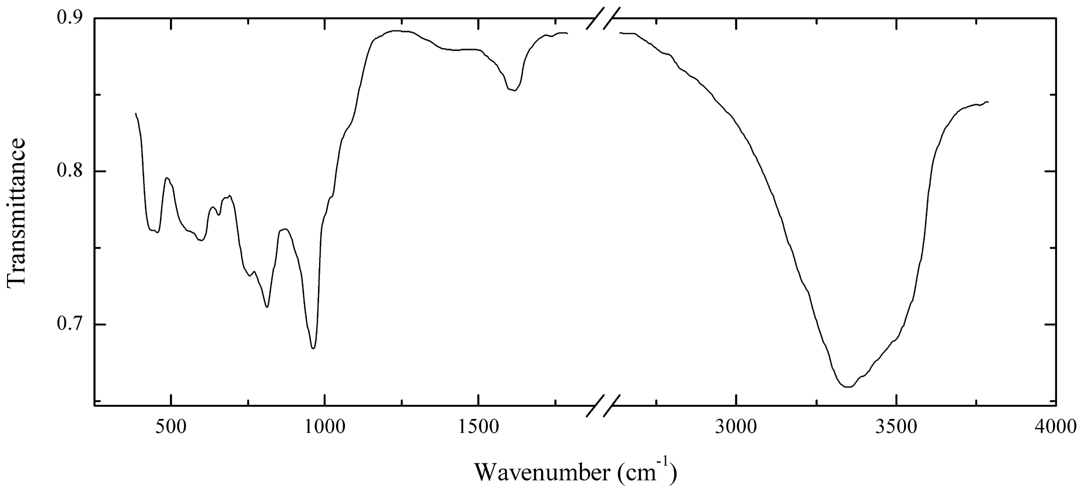
Locality: Molinello mine, Graveglia valley, Genova, eastern Liguria region, Italy (type locality).
Description: Dark red veinlet from the association with calcite, saneroite and ganophyllite. The empirical formula is (electron microprobe) $Ca_{2.2}Na_{0.7}Mn_{2.0}V_{2.5}Si_{0.4}As_{0.1}(O,OH)_{12}$.
Wavenumbers (cm^{-1}): 3280w, 1155sh, 1105sh, 1027, 900sh, 870sh, 831s, 789s, 720sh, 507w, 460.

V36 Pascoite $Ca_3V^{5+}{}_{10}O_{28}\cdot 17H_2O$



Locality: Sunday #2 mine, Slick Rock District, San Miguel Co., Colorado, USA.
Description: Orange crust. The empirical formula is (electron microprobe) $Ca_{2.96}V_{10.02}O_{28}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3550sh, 3460, 3365, 3130, 1655sh, 1625, 992, 966s, 952, 846, 818, 747, 608, 520, 456.

V37 Satpaevite $Al_{12}V^{4+}{}_2V^{5+}{}_6O_{37}\cdot 30H_2O$ (?)

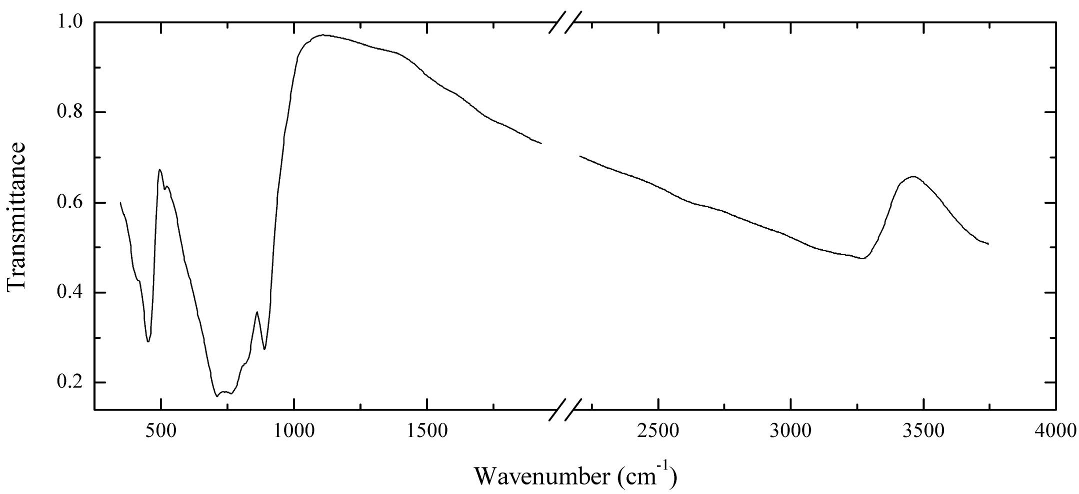


Locality: Kurumsak V deposit, Aksumbe, Karatau range (Kara-Tau Mts.), southern Kazakhstan (type locality).

Description: Yellow fine-grained aggregate from the association with steigerite, vanalite, hewettite, delvauxite and gypsum. Holotype sample. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 5.86 (60), 4.425 (40), 3.905 (70), 2.330 (90), 1.918 (100), 1.554 (50), 1.471 (80).

Wavenumbers (cm^{-1}): 3485sh, 3325, 1620, 1410w, 1090sh, 1020sh, 968s, 810, 760, 655, 598, 530sh, 460, 430.

V38 Turanite $Cu_5(VO_4)_2(OH)_4$

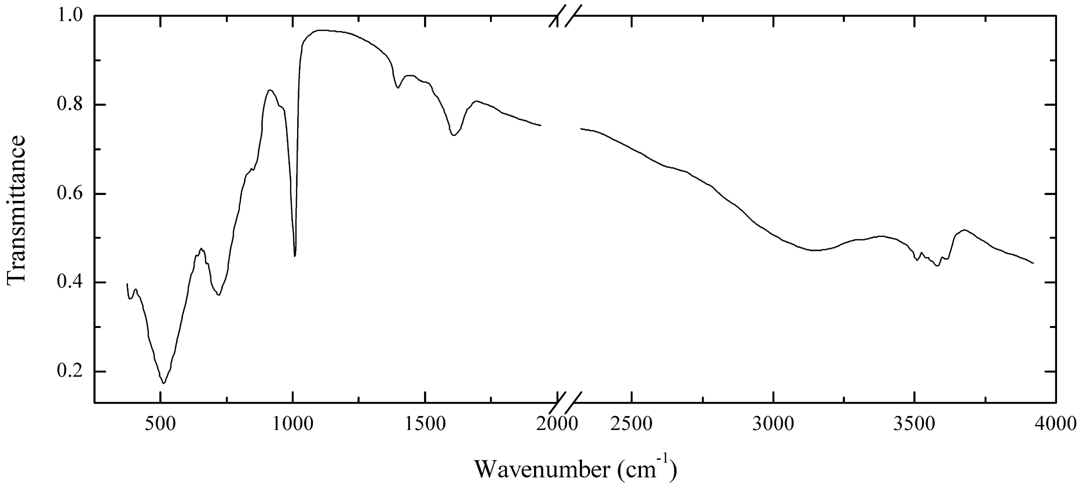


Locality: Tyuya Muyun, Fergana valley, Turan region, Kyrgyzstan (type locality).

Description: Dark green radial aggregate from the association with malachite and calcite. The empirical formula is (electron microprobe) $Cu_{5.00}(VO_4)_{2.00}(OH)_4$.

Wavenumbers (cm^{-1}): 3550sh, 3285, 3200sh, 3110sh, 886, 825sh, 755s, 709s, 630sh, 511w, 477, 405sh.

V39 Kazakhstanite $Fe^{3+}_5V^{4+}_3V^{5+}_{12}O_{38}(OH)_9 \cdot 9H_2O$ (?)

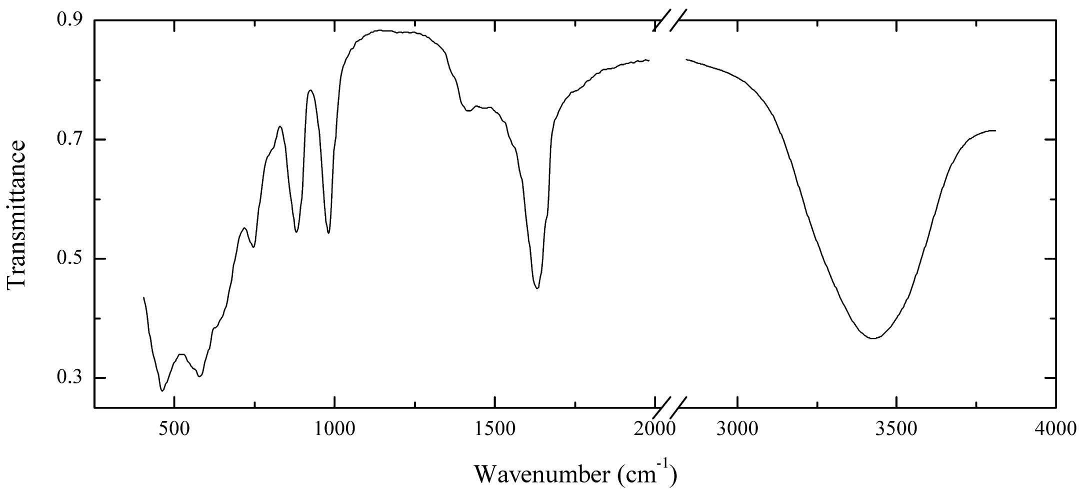


Locality: North Wilson pit, Potash Sulfur Springs, Arkansas, USA.

Description: Dark red-brown scaly aggregate from the association with bokite. Confirmed by IR spectrum. K-bearing variety. The empirical formula is (electron microprobe) $K_{0.64}Fe_{4.27}V_{15,73}O_{39}(OH)_9 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3595, 3560, 3495, 3120, 1610, 1400, 1007, 840sh, 717s, 508s, 388s.

V40 Tyuyamunite $Ca(UO_2)_2(V_2O_8) \cdot 5–8H_2O$

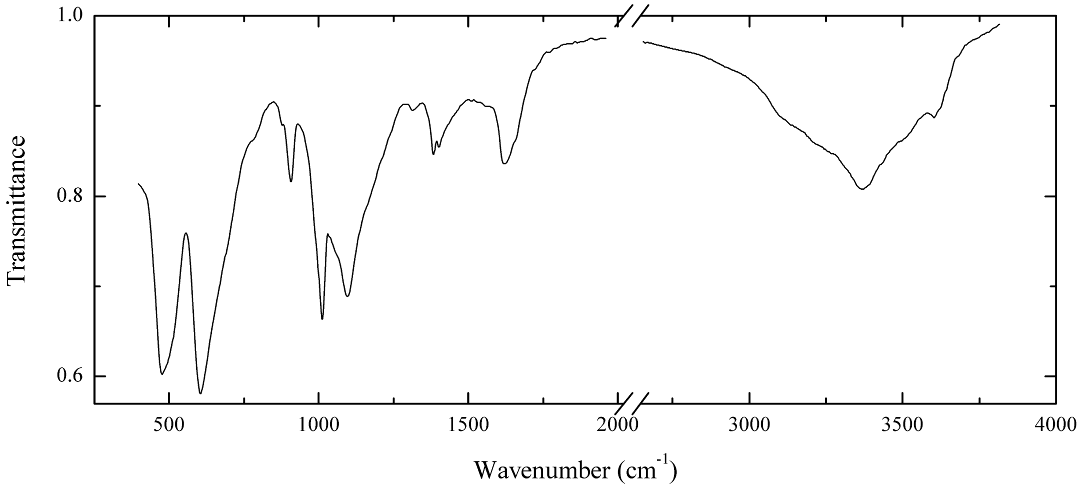


Locality: Tyuya-Muyun Cu–V–U deposit, Fergana valley, Alai range, Kyrgyzstan (type locality).

Description: Yellow platy crystals from the association with carnotite, corvusite, uranophane, volborthite and gypsum. Investigated by A.A. Chernikov.

Wavenumbers (cm^{-1}): 3400s, 1630, 1420w, 981, 883, 746, 650sh, 630sh, 582s, 466s, 420sh.

V41 Rauvite $Ca(UO_2)_2V^{5+}{}_{10}O_{28}{\cdot}16H_2O$

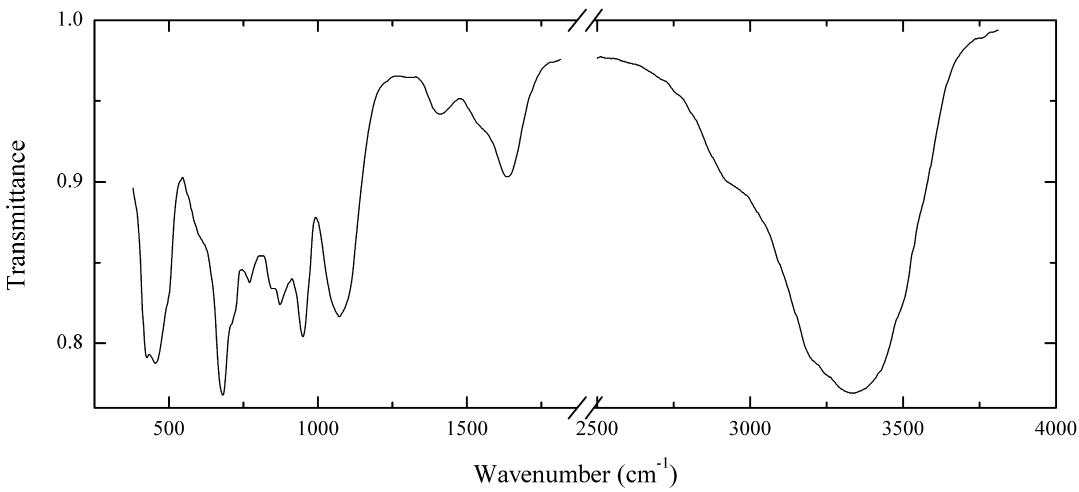


Locality: Fergana valley, Alai range, Kyrgyzstan.

Description: Brown massive from the association with tyuyamunite, gypsum and quartz. Investigated by G.A. Sidorenko.

Wavenumbers (cm^{-1}): 3575w, 3470sh, 3350, 3260sh, 3200sh, 3140sh, 1655sh, 1620, 1400w, 1382, 1316w, 1101, 1013s, 907, 870w, 598s, 500sh, 470s.

V42 Rusakovite $(Fe^{3+},Al)_2(VO_4,PO_4)_2(OH)_9{\cdot}3H_2O$

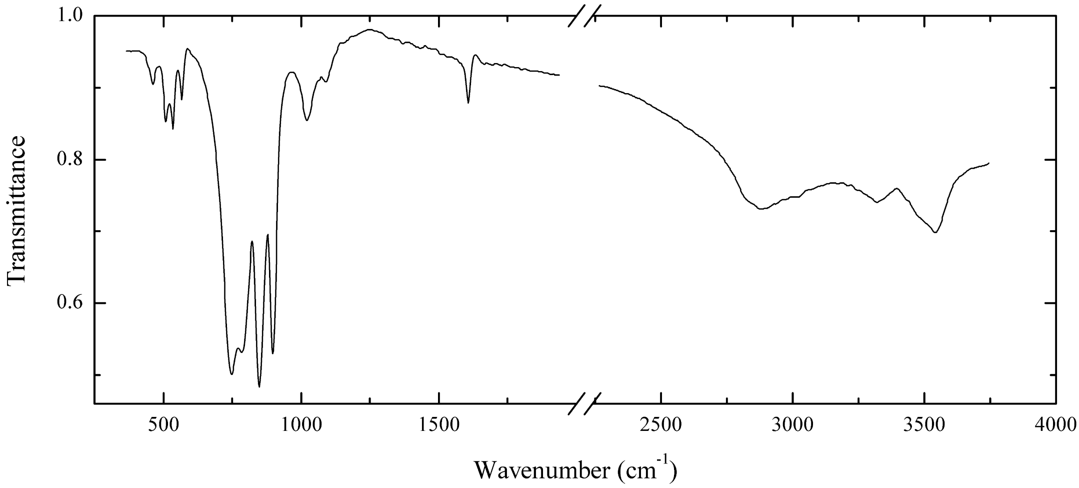


Locality: Kurumsak V deposit, Aksumbe, Karatau range (Kara-Tau Mts.), southern Kazakhstan.

Description: Brownish-yellow powdery. The empirical formula is (electron microprobe) $(Fe_{3.94}Al_{1.01})[(VO_4)_{1.11}(PO_4)_{0.89}](OH,H_2O)_{12}$. Confirmed by powder X-ray diffraction pattern.

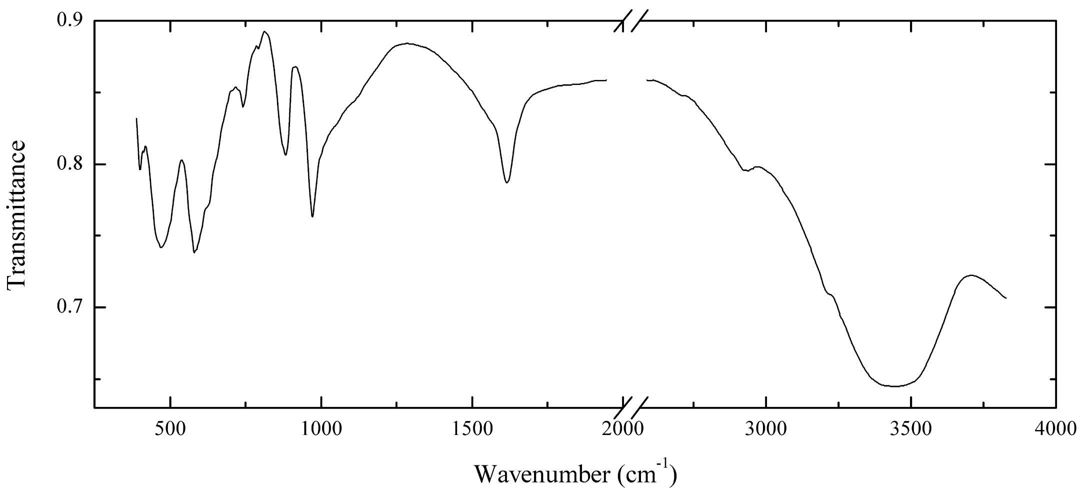
Wavenumbers (cm^{-1}): 3335s, 3220sh, 2925sh, 1635, 1550sh, 1400w, 1078, 951, 879, 852, 775, 720sh, 681s, 610sh, 490sh, 463s, 426s.

V43 Volborthite $Cu^{2+}{}_3V^{5+}{}_2O_7(OH)_2\cdot2H_2O$



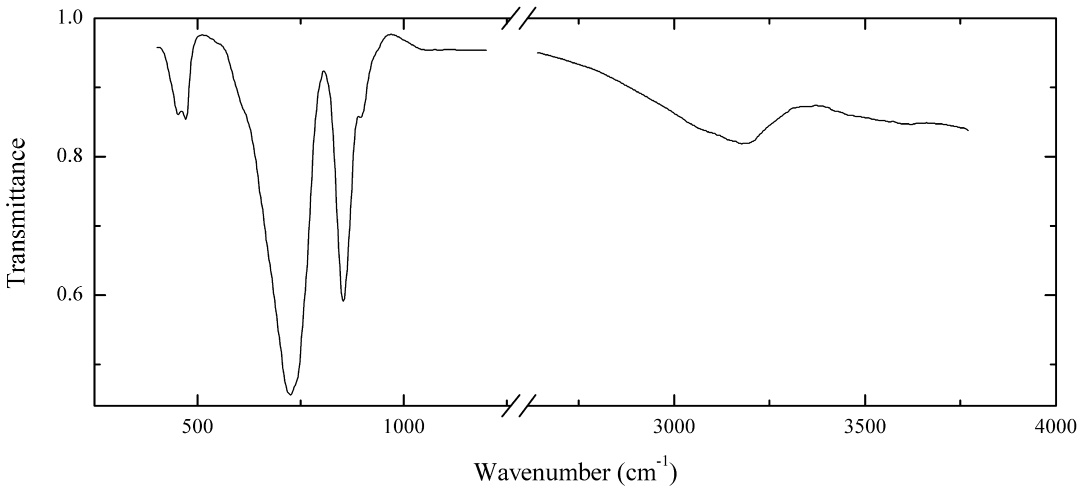
Locality: Uchkuduk area, Kyzylkum desert, Uzbekistan.
Description: Olive green platy crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3532, 3490sh, 3315, 2880, 1612, 1095w, 1022, 897s, 849s, 788s, 749s, 564, 533, 509, 460.

V44 Francevillite $Ba(UO_2)_2(V_2O_8)\cdot5H_2O$



Locality: U deposit Srednyaya Padma, Zaonezhskii peninsula, Onega sea, Karelia, Russia.
Description: Orange fine-grained aggregate from the association with roscoelite and dolomite. The empirical formula is (electron microprobe) $(Ba_{0.7}Sr_{0.2}Ca_{0.1}Na_{0.1})(UO_2)_{1.95}V_{2.00}O_8\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3420s, 3200sh, 2930, 1622, 975, 882, 740, 620sh, 575s, 468s, 390.

V45 Čechite $Pb(Fe^{2+},Mn)(VO_4)(OH)$

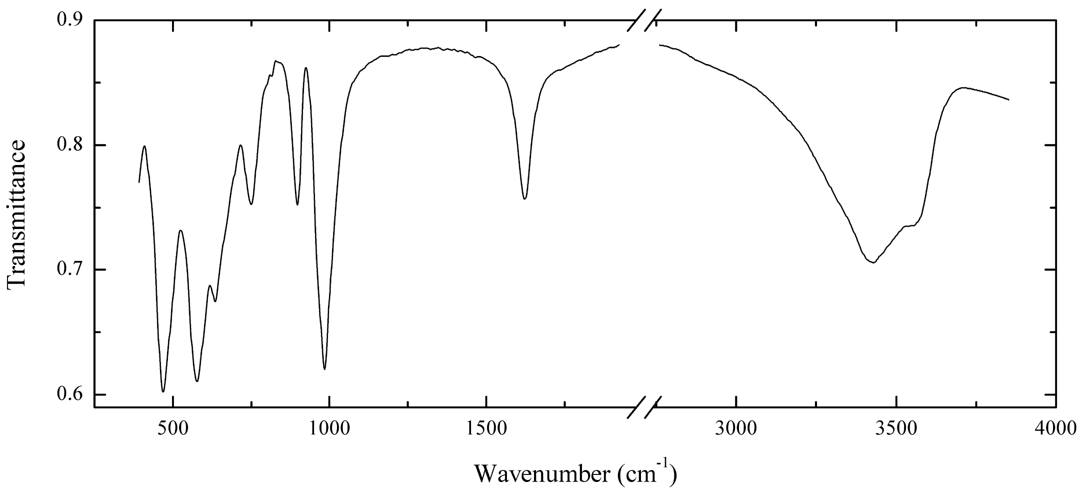


Locality: Pošepný vein, Vrančice deposit, near Přibram, Czech Republic (type locality).

Description: Black veinlets from the association with hedyphane, calcite, hematite, willemite and quartz. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3170, 3050sh, 1032w, 896, 853s, 740sh, 721s, 610sh, 470, 448.

V47 Strelkinite $Na_2(UO_2)_2(V_2O_8)\cdot 6H_2O$

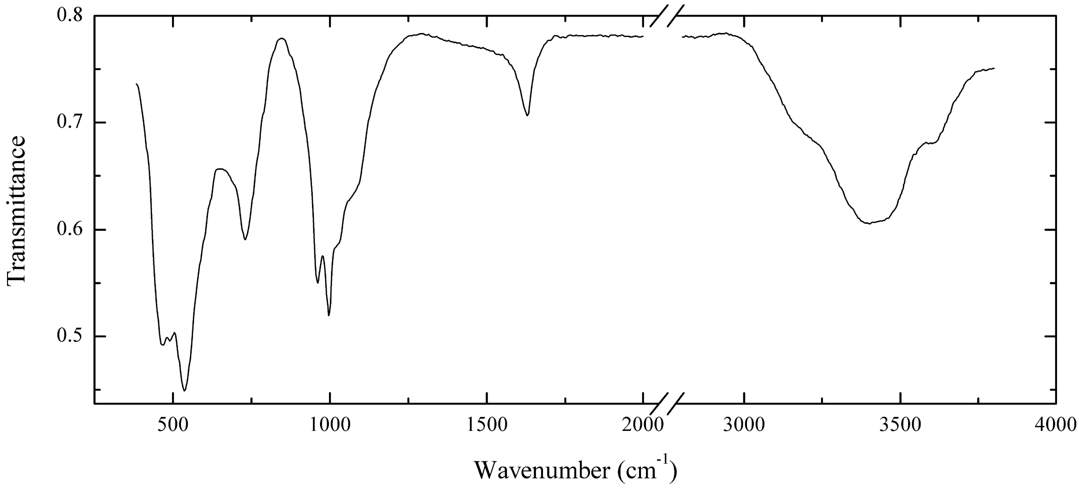


Locality: Zhalgyz ore district, north of Bota-Burum Mo–U deposit, southern Kazakhstan (type locality).

Description: Yellow scaly aggregate from the association with calcite, quartz, iron hydroxides and clay minerals. Investigated by A.A. Chernikov. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3530, 3400, 1625, 982s, 960sh, 897, 817w, 747, 632, 574s, 468s.

V48 Hewettite $CaV^{5+}{}_6O_{16} \cdot 9H_2O$

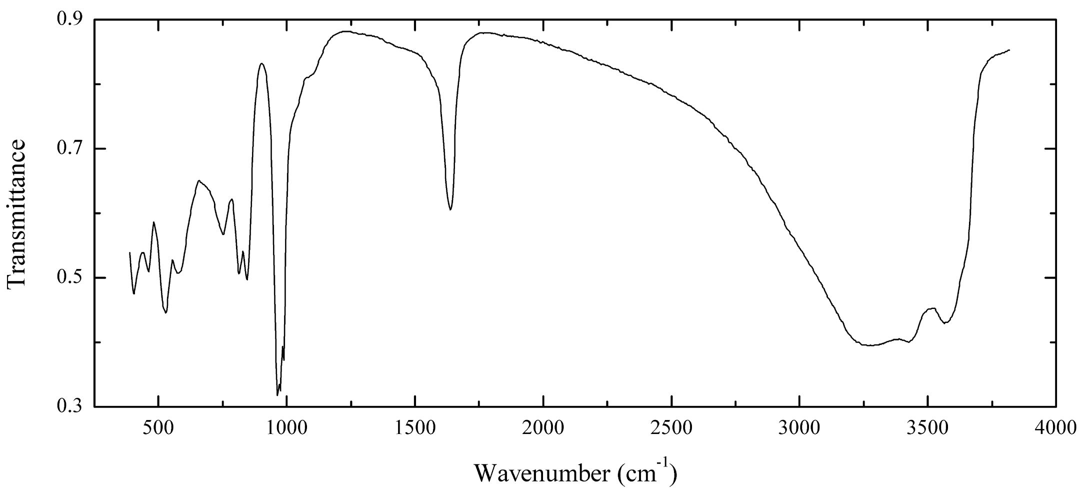


Locality: Sunday #2 mine, Slick Rock District, San Miguel Co., Colorado, USA.

Description: Reddish-brown crust from the association with pascoite and opal. The empirical formula is (electron microprobe) $Ca_{0.99}V_{5.93}Si_{0.09}O_{16} \cdot nH_2O$. The shoulder at 1,080 cm^{-1} and the band at 469 cm^{-1} are due to the admixture of opal.

Wavenumbers (cm^{-1}): 3565, 3370, 3220sh, 1628, 1080sh, 1025sh, 999, 964, 729, 539s, 492, 469.

V49 Hummerite $K_2Mg_2V^{5+}{}_{10}O_{28} \cdot 16H_2O$

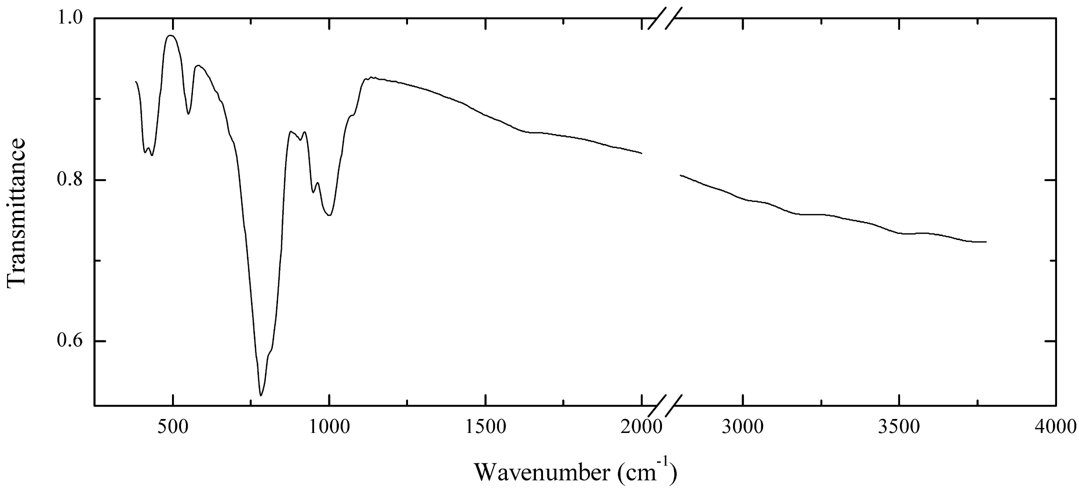


Locality: Hummer mine, Jo Dandy group, Paradox valley, Montrose Co., Colorado, USA (type locality).

Description: Orange fine-grained aggregate from the association with huemulite and gypsum. Specimen No. 1363/3 from the Mining Museum, St. Petersburg Mining Institute.

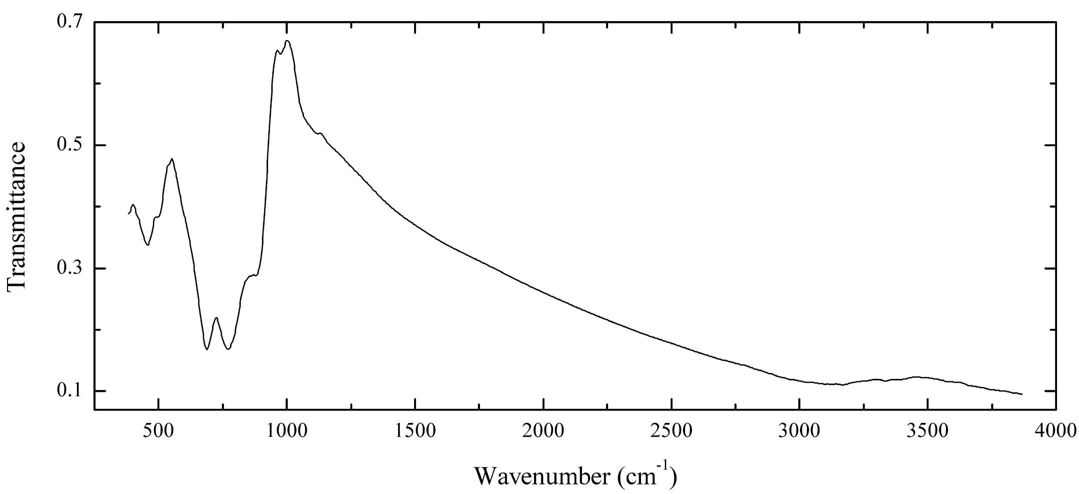
Wavenumbers (cm^{-1}): 3600sh, 3535s, 3390s, 3250s, 1632, 1085sh, 983s, 972s, 963s, 840, 810, 746, 557, 520, 456, 400.

V50 Heyite $Pb_5Fe^{2+}{}_2(VO_4)_2O_4$



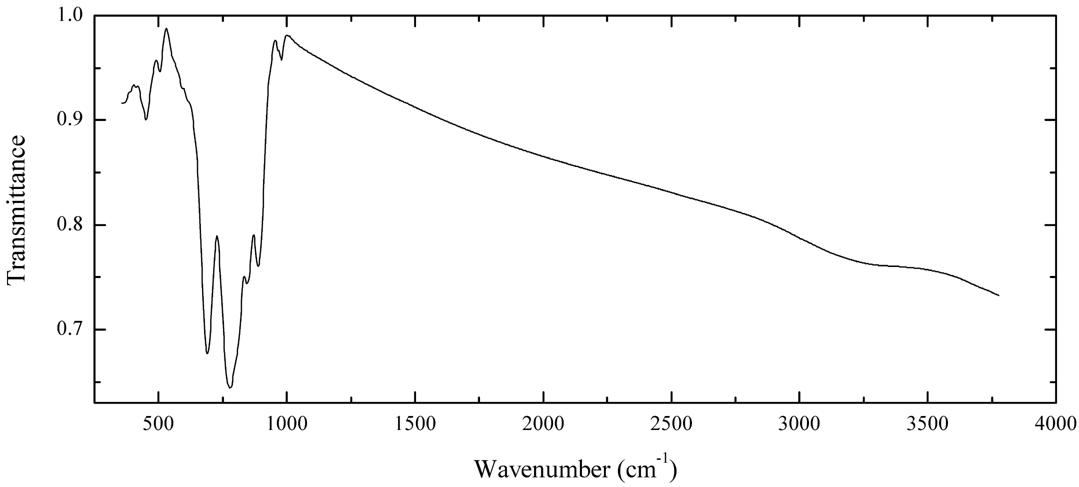
Locality: Betty Jo claim, Ely, White Pine Co., Nevada, USA (type locality).
Description: Yellow granular aggregate. Specimen No. 82076 from the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia.
Wavenumbers (cm^{-1}): 1075sh, 1007, 955, 909w, 825sh, 800sh, 786s, 551, 430, 410.

V51 Calderónite $Pb_2Fe^{3+}(VO_4)_2(OH)$



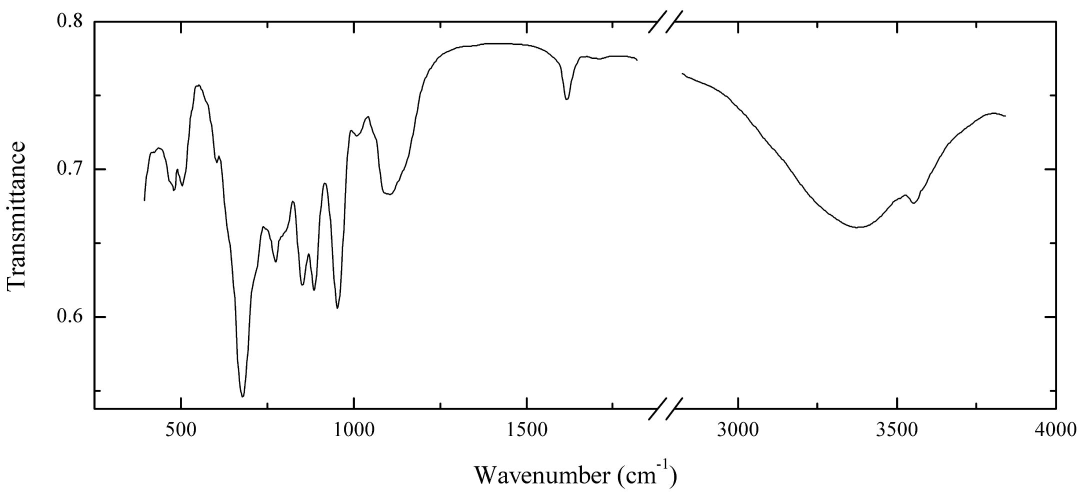
Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.
Description: Dark brown crystals. The empirical formula is (electron microprobe) $(Pb_{1.95}Ca_{0.05})Fe_{1.00}[(VO_4)_{1.86}(AsO_4)_{0.14}](OH)$.
Wavenumbers (cm^{-1}): 3100 (very broad), 1100sh, 970w, 860sh, 771s, 686s, 500sh, 458.

V52 Calderónite $Pb_2Fe^{3+}(VO_4)_2(OH)$



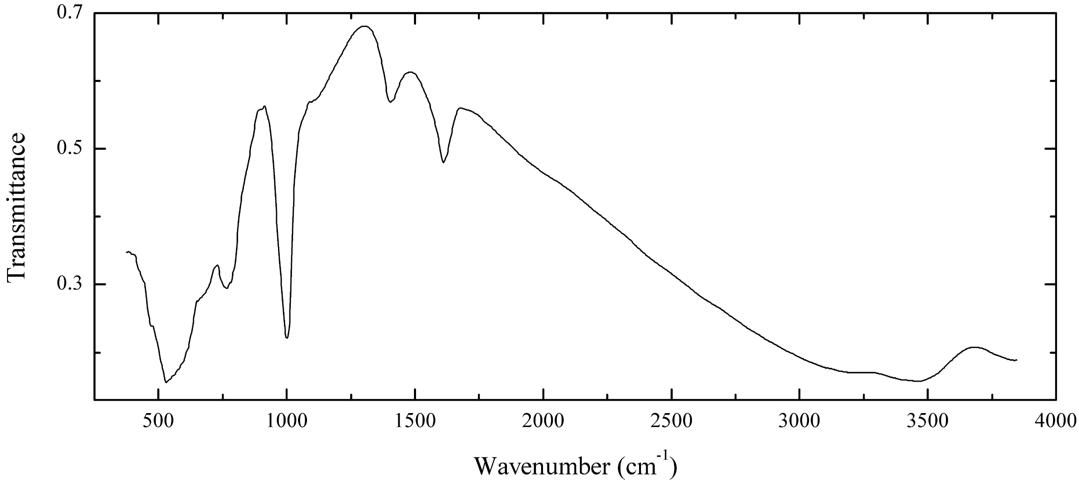
Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.
Description: Dark brown crystals. The empirical formula is (electron microprobe) $(Pb_{1.96}Ca_{0.04})(Fe_{0.95}Al_{0.05})(VO_4)_{2.00}(OH)$.
Wavenumbers (cm^{-1}): 3200 (very broad), 976w, 888, 845, 775s, 688s, 503w, 449.

V53 Rusakovite $(Fe^{3+},Al)_2(VO_4,PO_4)_2(OH)_9{\cdot}3H_2O$



Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.
Description: Brownish massive from the association with calderónite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3547, 3160, 1630, 1140sh, 1090, 1003w, 953, 886, 850, 800sh, 775, 678s, 604w, 505, 480.

V54 Doloresite $V^{4+}{}_3O_4(OH)_4$ (?)

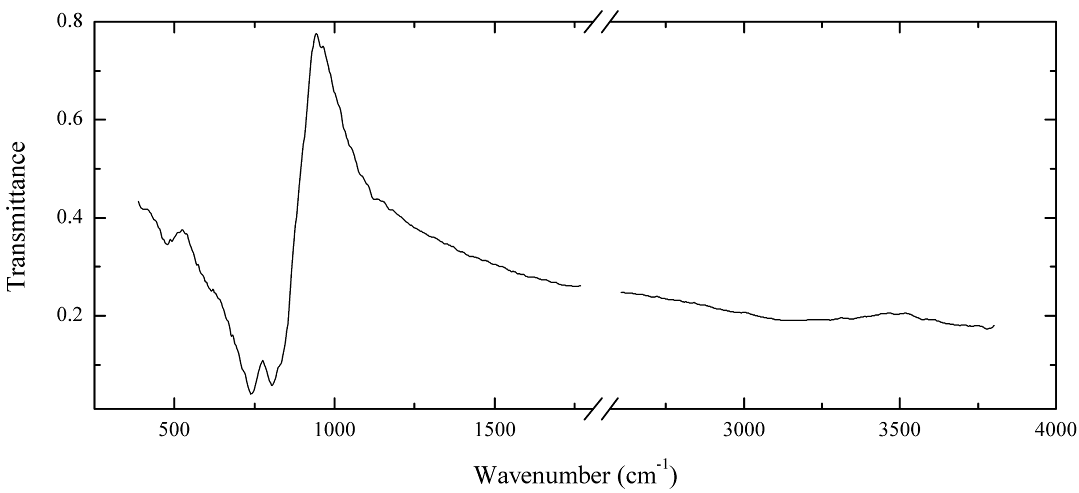


Locality: Dolores river, Colorado plateau, Colorado, USA.

Description: Black powdery aggregate from the association with häggite. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3485s, 3200s, 1615, 1405, 1095sh, 1000s, 765, 675sh, 595sh, 533s, 470sh.

V55 Vanadinite $Pb_5(VO_4)_3Cl$

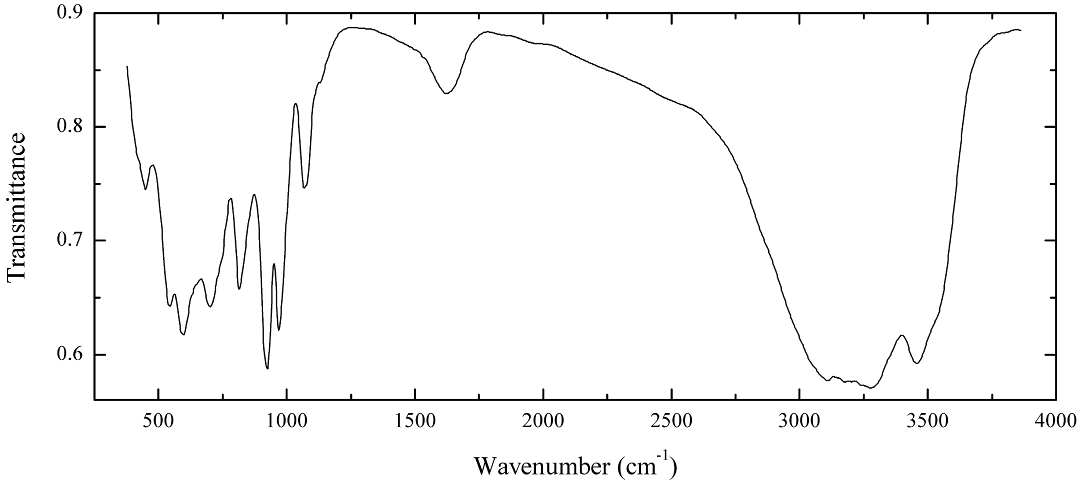


Locality: Gold Quarry mine, Maggie Creek district, Eureka Co., Nevada, USA.

Description: Brown prismatic crystals. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 803s, 737s, 615sh, 475.

V56 Vanalite $NaAl_8V_{10}O_{38}\cdot30H_2O$

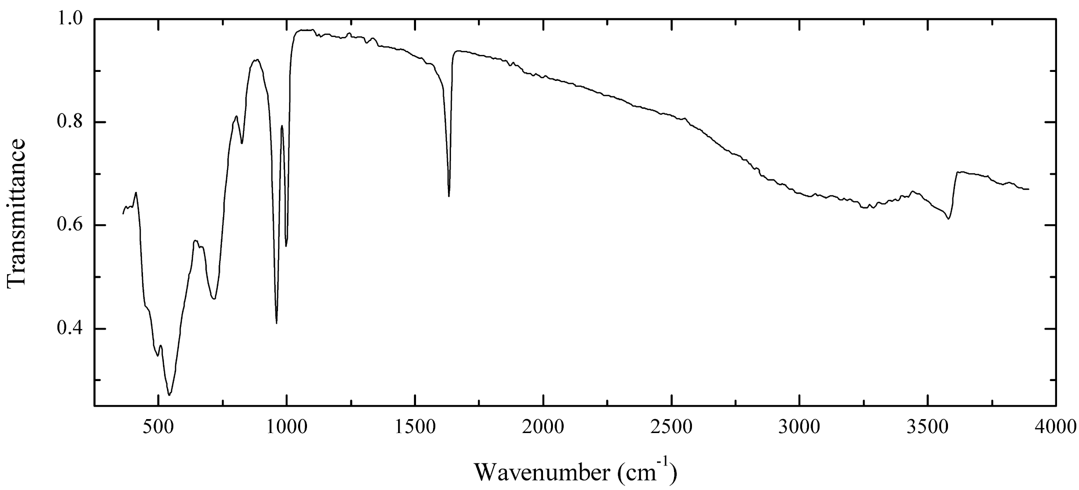


Locality: Kurumsak V deposit, Aksumbe, Karatau range (Kara-Tau Mts.), southern Kazakhstan (type locality).

Description: Orange-yellow massive from the association with steigerite, hewettite, delvauxite, satpaevite, gypsum, halloysite and montmorillonite. Investigated by E.A. Ankinovich and G. Bekenova. Identified by powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3530sh, 3450, 3260sh, 3190, 3120sh, 1635, 1070, 968, 923s, 910sh, 814, 702, 596, 543, 448, 420sh.

V57 Barnesite $Na_2V^{5+}{}_6O_{16}\cdot3H_2O$

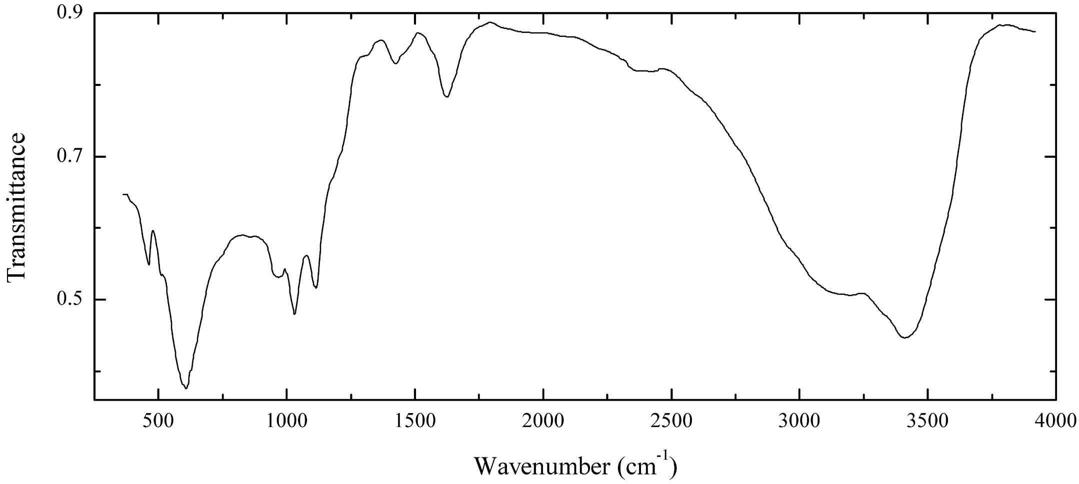


Locality: Kurumsak V deposit, Aksumbe, Kara-Tau Mts., southern Kazakhstan.

Description: Dark brownish-red, massive. Ca-bearing variety. Investigated by E.A. Ankinovich.

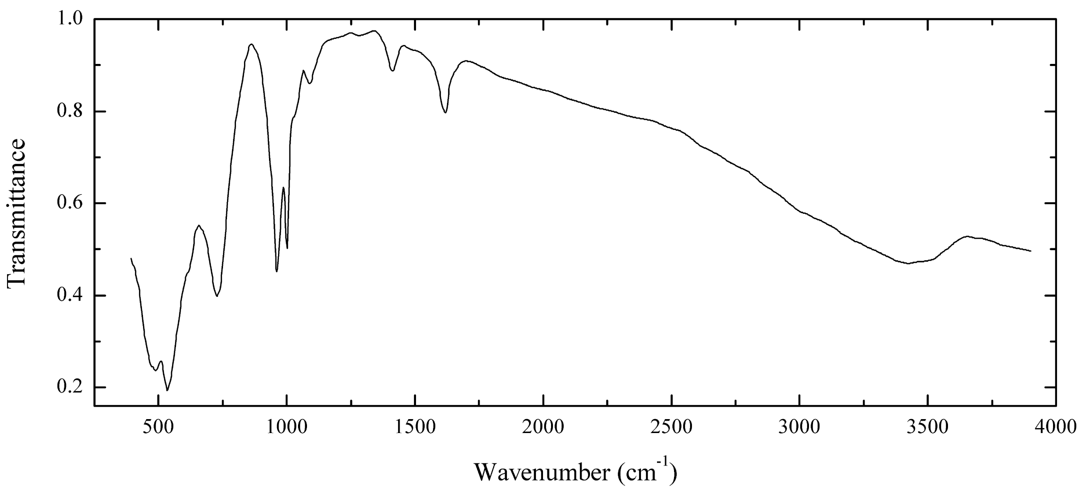
Wavenumbers (cm^{-1}): 3565, 3530sh, 3260, 3050sh, 1638, 999, 960s, 834, 717, 544s, 497s, 450sh.

V58 Steigerite $Al(VO_4)\cdot 3H_2O$



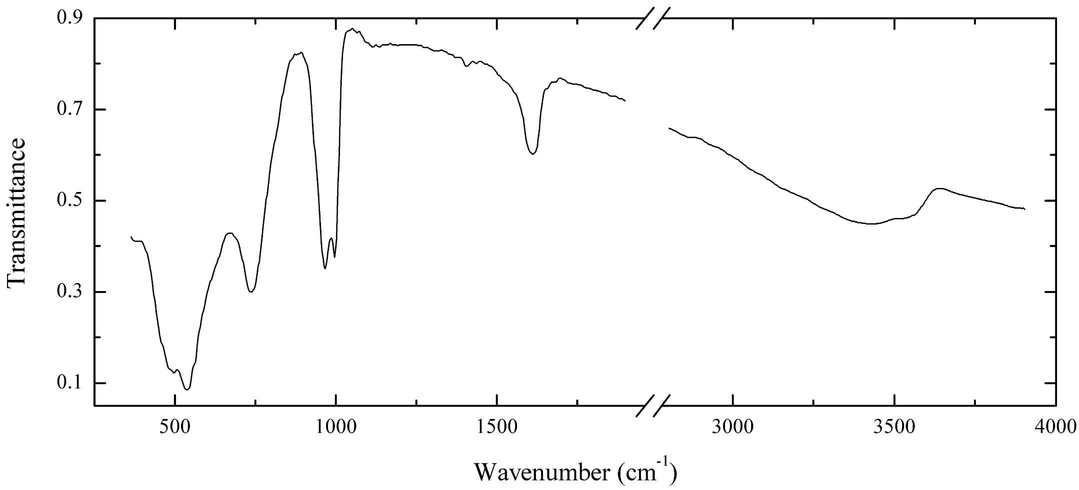
Locality: Kurumsak V deposit, Aksumbe, Karatau range (Kara-Tau Mts.), southern Kazakhstan.
Description: Yellow-green, massive. Investigated by E.A. Ankinovich.
Wavenumbers (cm^{-1}): 3430sh, 3395s, 3170, 2960sh, 2430w, 2360w, 1625, 1470sh, 1428w, 1310sh, 1180sh, 1114, 1031, 972, 603s, 509, 461.

V59 Metahewettite $CaV^{5+}{}_6O_{16}\cdot 3H_2O$



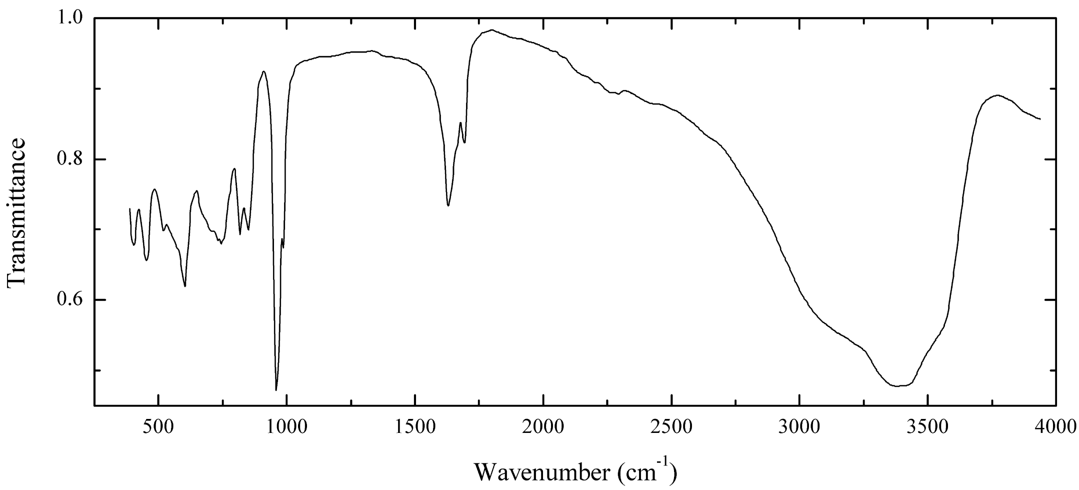
Locality: Balasauskandyk V deposit, Karatau range (Kara-Tau Mts.), southern Kazakhstan.
Description: Reddish-brown massive. Investigated by E.A. Ankinovich. Confirmed by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.
Wavenumbers (cm^{-1}): 3420, 1615, 1410, 1088, 1025, 999, 961, 730, 615sh, 536s, 492s, 475sh.

V60 Metahewettite $CaV^{5+}_6O_{16}·3H_2O$



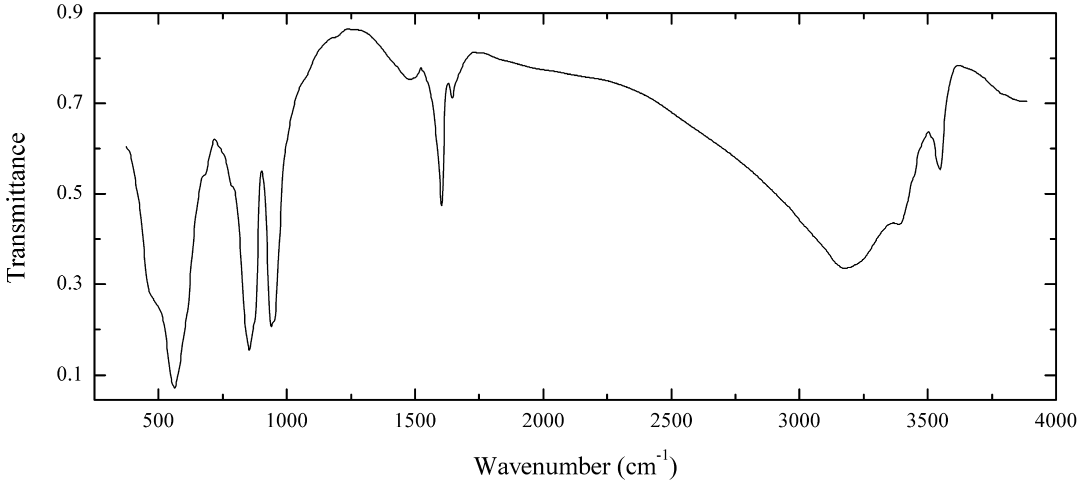
Locality: Balasauskandyk V deposit, Karatau range (Kara-Tau Mts.), southern Kazakhstan.
Description: Reddish-brown massive. Product of dehydration of hewettite investigated by E.A. Ankinovich. Confirmed by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3520sh, 3425, 1615, 1407w, 1025w, 998, 965, 736, 540s, 495s.

V61 Lasalite $Na_2Mg_2V^{5+}_{10}O_{28}·20H_2O$



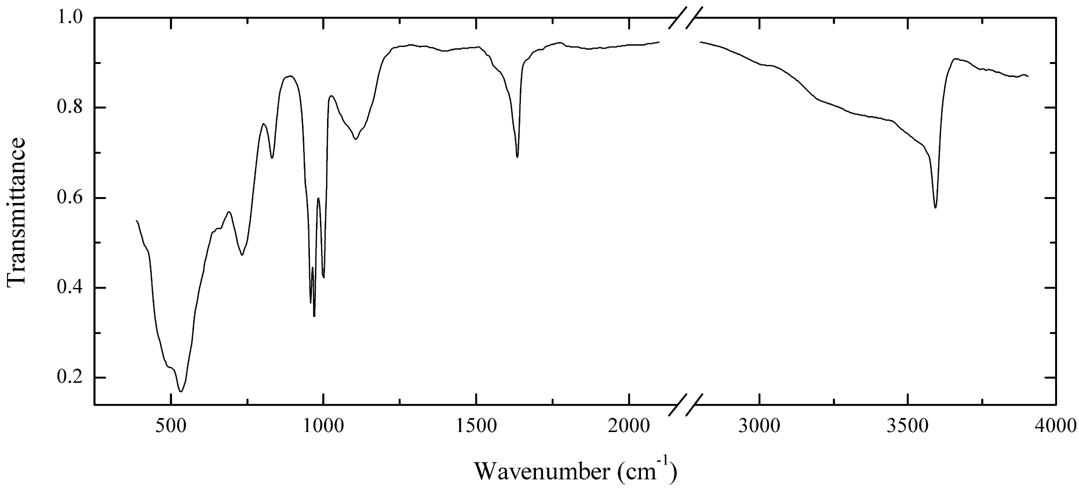
Locality: Vanadium Queen mine, San Juan Co., Utah, USA (type locality).
Description: Orange crust on sandstone in the association with corvusite and carbonates. Confirmed by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3500sh, 3360s, 3150sh, 2280w, 1692, 1628, 985, 956s, 847, 814, 743, 700sh, 600, 560sh, 517, 451, 402.

V62 Metarossite $CaV^{5+}{}_2O_6{\cdot}2H_2O$



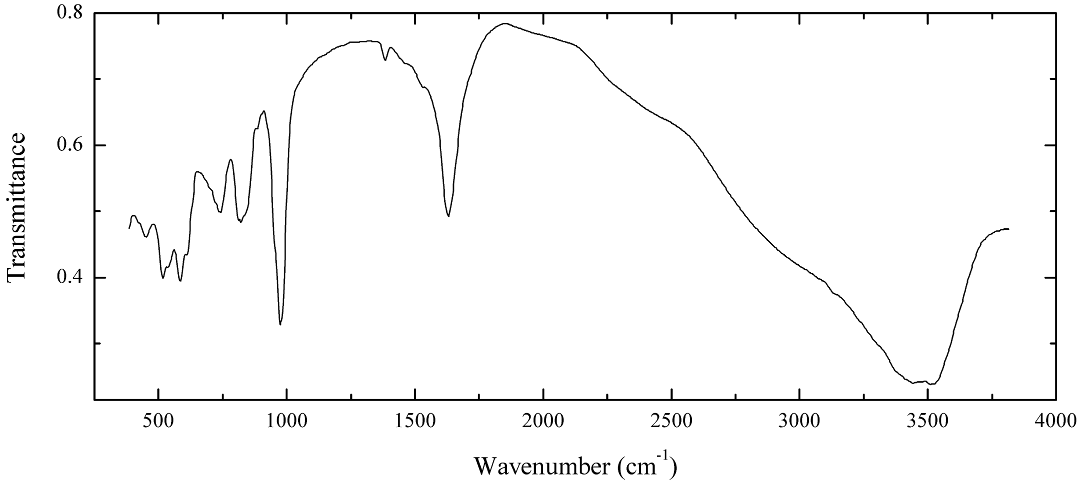
Locality: Sunday #2 mine, Slick Rock District, San Miguel Co., Colorado, USA.
Description: Yellowish crust from the association with metahewettite. The empirical formula is (electron microprobe) $Na_{0.05}Ca_{0.94}Fe_{0.02}V_{2.00}O_6{\cdot}nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3517, 3350, 3160, 1645w, 1603, 1585w, 950sh, 937, 875sh, 855s, 785sh, 680sh, 615sh, 564s, 480sh.

V63 Barnesite $Na_2V^{5+}{}_6O_{16}{\cdot}3H_2O$



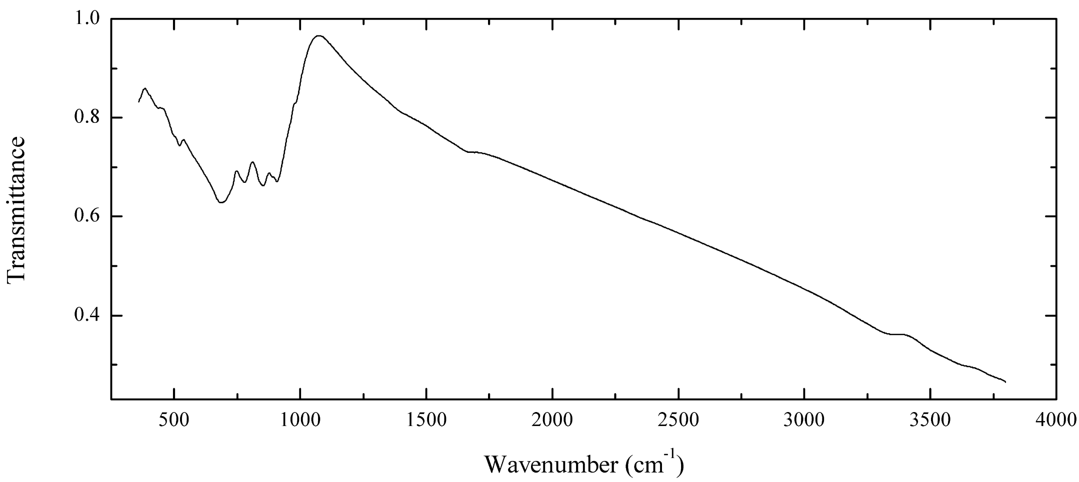
Locality: Van Nav San claims, Fish Creek range, Nevada, USA.
Description: Dark red earthy aggregate. The empirical formula is (electron microprobe) $Na_{2.06}Ca_{0.03}Al_{0.07}(V_{5.86}P_{0.07})O_{16}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3575, 3350sh, 3210sh, 3010sh, 1637, 1135sh, 1105, 1080sh, 999, 970, 957, 828, 732, 655sh, 533s, 495sh.

V64 Hughesite $Na_3Al(V_{10}O_{28})\cdot 22H_2O$



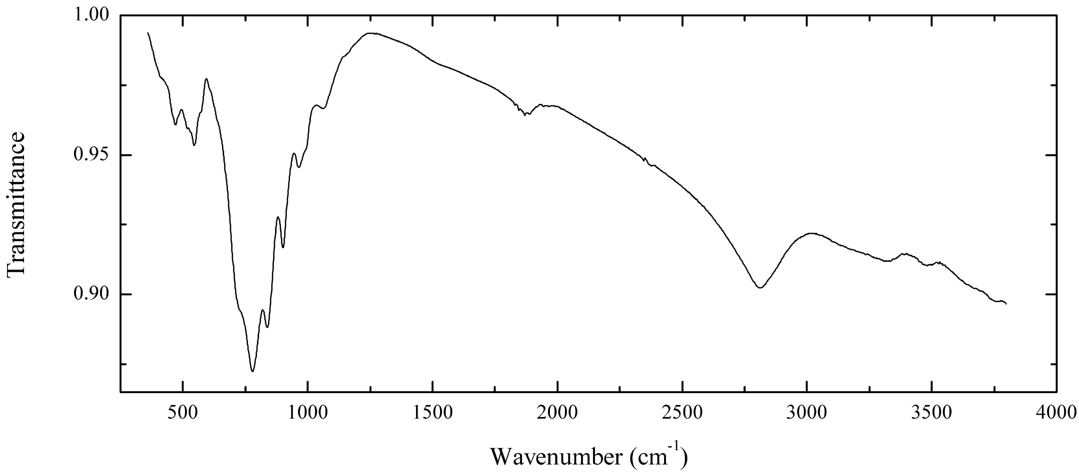
Locality: West Sunday mine, Big Gypsum valley, San Miguel Co., Colorado, USA (type locality).
Description: Orange-yellow crystals from the association with gypsum.
Wavenumbers (cm^{-1}): 3485s, 3410s, 3000sh, 2450sh, 1627, 1530sh, 1480sh, 1373w, 974s, 950sh, 870w, 817, 739, 610, 586, 535sh, 516, 450.

V65 Blossite $Cu^{2+}{}_2V^{5+}{}_2O_7$



Locality: Second cone, Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.
Description: Black crystals with brown streak. Investigated by I.V. Pekov. Orthorhombic, single-crystal unit-cell parameters are $a = 6.457$, $b = 8.397$, $c = 20.659$ Å. The empirical formula is (electron microprobe) $(Cu_{1.87}Al_{0.02}Zn_{0.01}Fe_{0.01})V_{2.03}O_7$.
Wavenumbers (cm^{-1}): 907s, 895sh, 853s, 779s, 700sh, 686s, 522, 510sh, 430sh.

V66 Engelhauptite $KCu_3(V_2O_7)(OH)_2Cl$



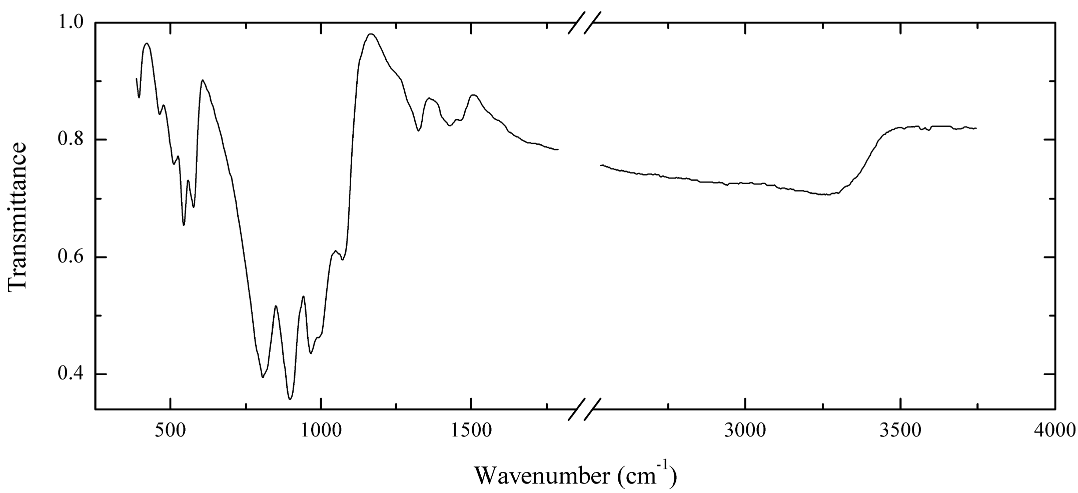
Locality: Kahlenberg (Auf'm Kopp) quarry, Oberstadtfeld municipality, near Daun, Eifel Mts., Rhineland-Palatinate (Rheinland-Pfalz), Germany (type locality).

Description: Greenish-brown radial aggregates from the association with volborthite, allophane and earlier mineral assemblage including augite, mica of the phlogopite–oxyphlogopite series, sanidine, nepheline, leucite, fluorapatite and magnetite. Holotype sample. The crystal structure is solved. Hexagonal, space group $P6_3/mmc$, $a = 5.922(2)$, $c = 14.513(5)$ Å, $V = 440.78(3)$ Å^3, Z = 2. The empirical formula is $K_{1.05}(Cu_{2.97}Al_{0.02}Ni_{0.02})(V_{1.97}S_{0.05})O_{7.23}(OH)_{1.91}Cl_{0.86}$. Optically uniaxial (+), $\omega = 1.978(4)$, $\varepsilon = 2.021(4)$. $D_{calc} = 3.856$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 7.32 (98), 4.224 (17), 2.979 (100), 2.759 (19), 2.565 (18), 2.424 (18), 1.765 (16).

Wavenumbers (cm^{-1}): 3482w, 3312w, 2810, 1869, 1150sh, 1060, 990sh, 964, 901, 838s, 779s, 735sh, 570sh, 545, 520sh, 471, 410sh.

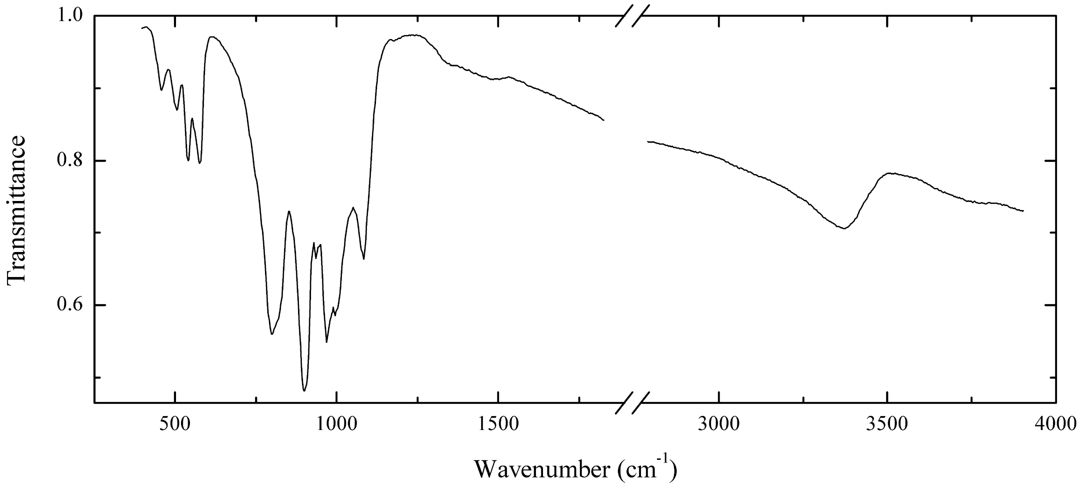
2.12 Chromates

Cr2 Vauquelinite $Pb_2Cu(CrO_4)(PO_4)(OH)$



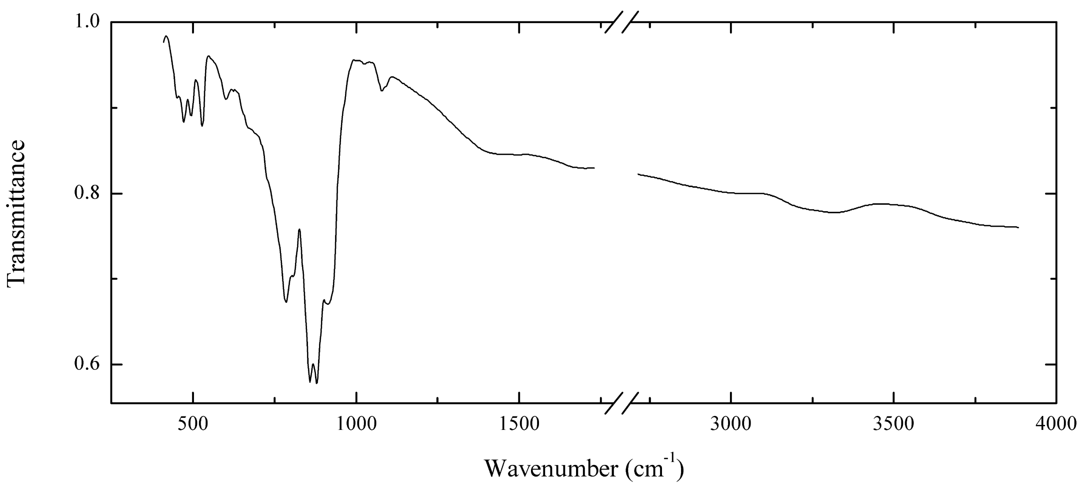
Locality: Crocoite pit, Uspenskaya Mt., near Berezovsk, Middle Urals, Russia (type locality).
Description: Dark green crystals from the association with crocoite. The empirical formula is (electron microprobe) $Pb_{2.05}Cu_{1.03}(CrO_4)_{1.05}(PO_4)_{0.93}(AsO_4)_{0.02}(OH,O)$.
Wavenumbers (cm^{-1}): 3310, 1450w, 1423w, 1320w, 1250sh, 1073, 990sh, 967s, 897s, 815sh, 803s, 579, 565, 544, 508, 460, 390.

Cr3 Vauquelinite $Pb_2Cu(CrO_4)(PO_4)(OH)$



Locality: Crocoite pit, Uspenskaya Mt., near Berezovsk, Middle Urals, Russia (type locality).
Description: Dark green crystals from the association with crocoite and malachite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3305, 1447w, 1330w, 1079, 996s, 966s, 934. 899s, 815sh, 802s, 578, 541, 506, 460.

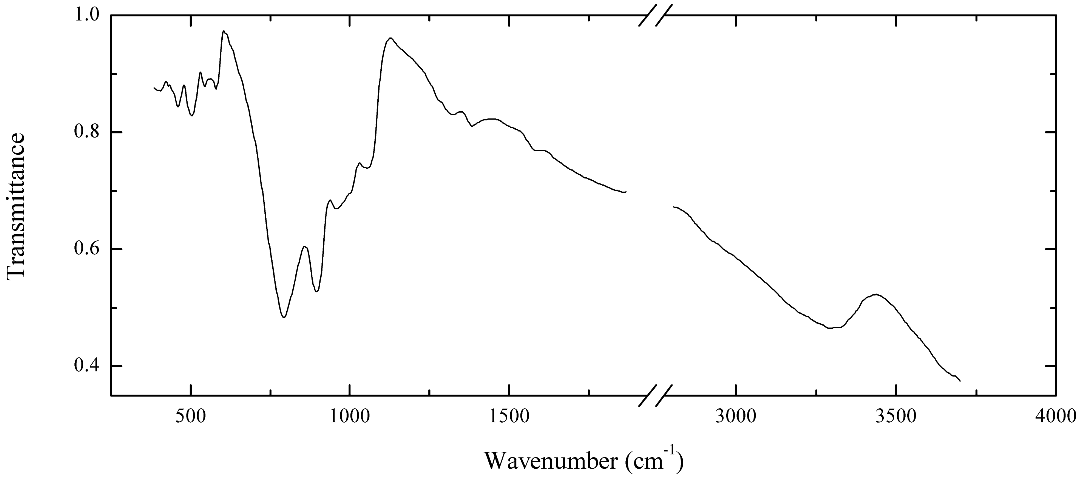
Cr4 Iranite $Pb_{10}Cu(CrO_4)_6(SiO_4)_2(OH,F)$



Locality: Chah Khouni mine, Anarak district, Iran (type locality).
Description: Orange-yellow crystals from the association with hemihedrite. The empirical formula is (electron microprobe) $Pb_{10.00}Cu_{1.00}(CrO_4)_{5.95}(SiO_4)_{2.02}(OH,F)$.

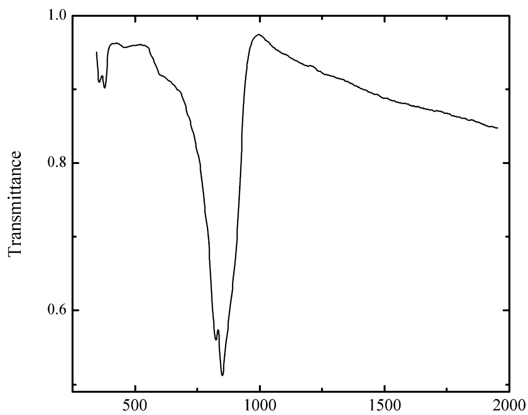
Wavenumbers (cm^{-1}): 3300w, 1410w, 1077w, 920s, 879s, 860s, 810, 786s, 735sh, 680sh, 605w, 527, 494, 470, 451w.

Cr5 Fornacite $Pb_2Cu(CrO_4)(AsO_4)(OH)$



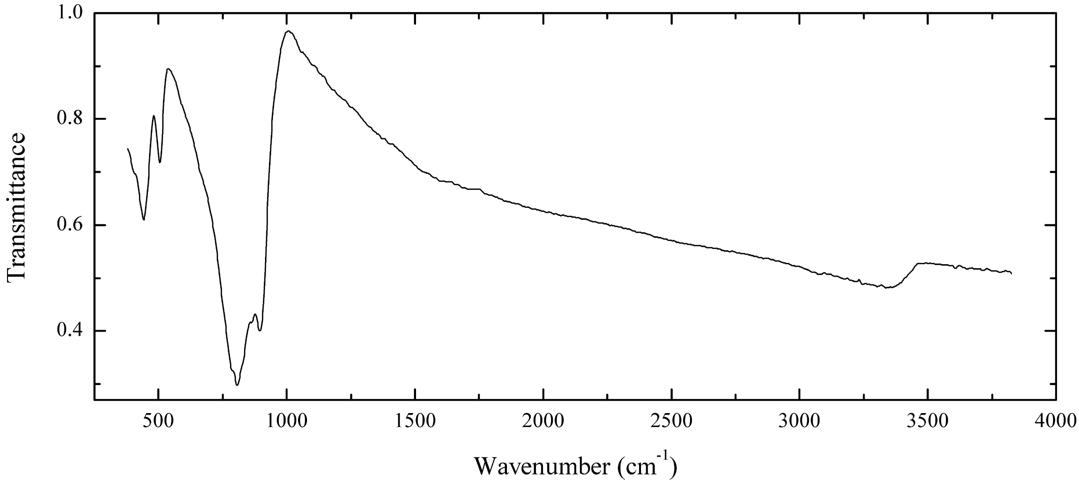
Locality: Crocoite pit, Uspenskaya Mt., near Berezovsk, Middle Urals, Russia.
Description: Dark green spherulites from the association with crocoite. PO_4-bearing variety. The empirical formula is (electron microprobe) $Pb_{2.01}Cu_{1.03}(CrO_4)_{1.03}(AsO_4)_{0.60}(PO_4)_{0.36}(OH,O)$.
Wavenumbers (cm^{-1}): 3290, 1590w, 1390w, 1325w, 1290sh, 1058, 995sh, 960, 897s, 820sh, 791s, 579w, 545w, 503, 458, 420w.

Cr6 Crocoite $Pb(CrO_4)$



Locality: Crocoite pit, Uspenskaya Mt., near Berezovsk, Middle Urals, Russia (type locality).
Description: Orange prismatic crystals from the association with vauquelinite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 890sh, 855s, 831s, 600sh, 385w, 370w.

Cr7 Fornacite $Pb_2Cu(CrO_4)(AsO_4)(OH)$

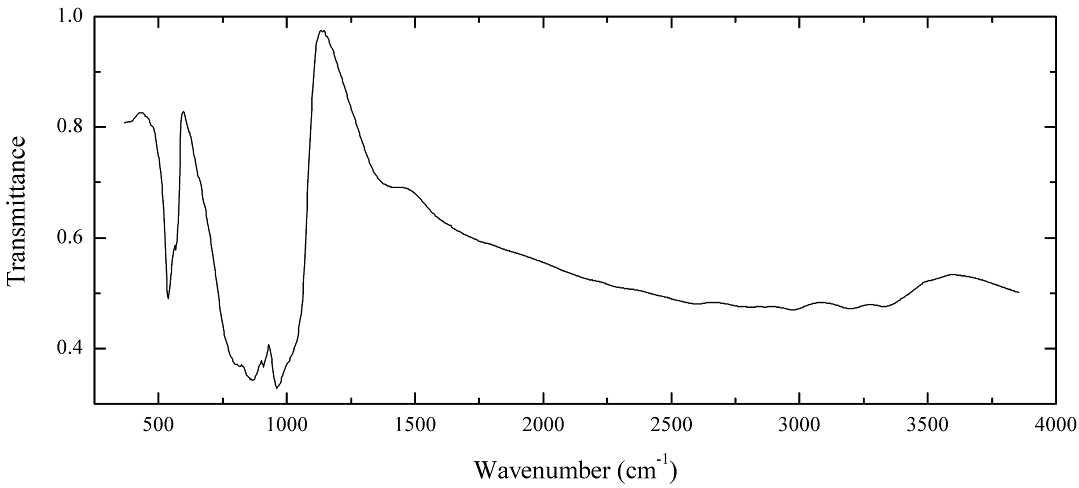


Locality: Crocoite pit, Uspenskaya Mt., near Berezovsk, Middle Urals, Russia.

Description: Dark green crystals from the association with crocoite. The empirical formula is (electron microprobe) $Pb_{2.05}Cu_{0.98}(CrO_4)_{1.01}(AsO_4)_{0.97}(AsO_4)_{0.02}(OH,O)$.

Wavenumbers (cm^{-1}): 3310, 889s, 857s, 820sh, 800s, 780sh, 670sh, 502, 438.

Cr8 Embreyite $Pb_5(CrO_4)_2(PO_4)_2{\cdot}H_2O$

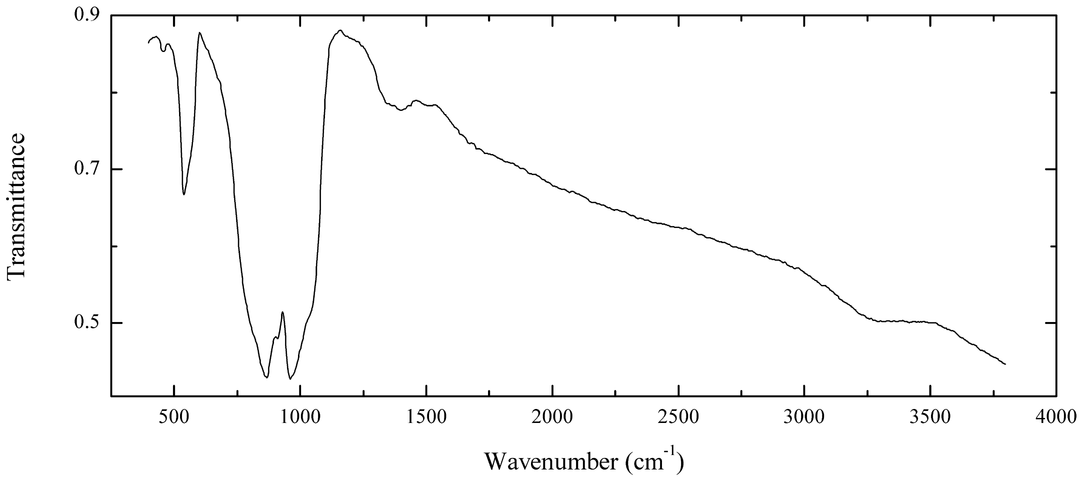


Locality: Berezovskoe gold deposit, near Berezovsk, Middle Urals, Russia (type locality).

Description: Dull orange from the association with crocoite and vauquelinite. The empirical formula is (electron microprobe) $Pb_{5.13}(CrO_4)_{2.04}(PO_4)_{1.94}(AsO_4)_{0.02}(H_2O,OH)$.

Wavenumbers (cm^{-1}): 3340w, 3200w, 2980w, 2800w, 1390w, 1025sh, 964s, 907s, 867s, 820sh, 567, 537.

Cr9 Embreyite $Pb_5(CrO_4)_2(PO_4)_2 \cdot H_2O$

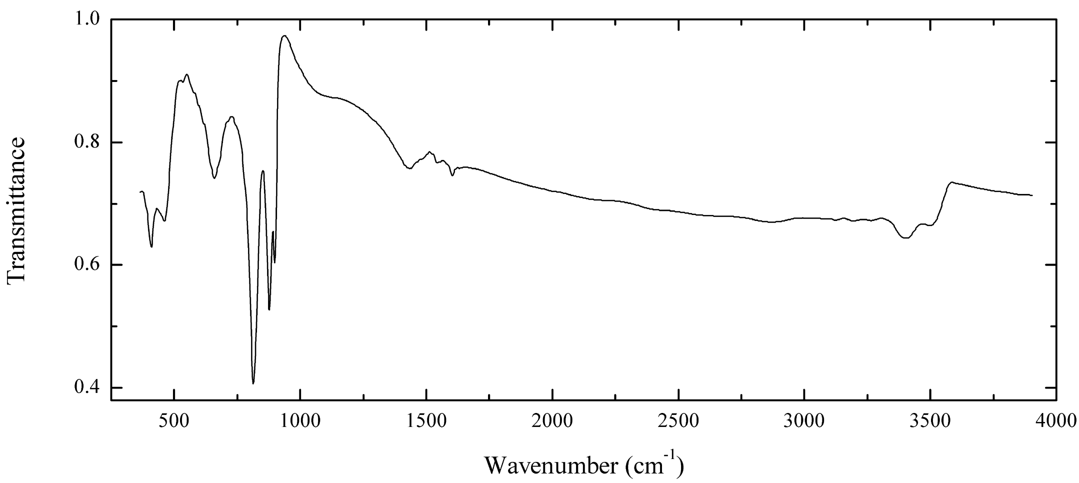


Locality: Bertievaya Mt., near Nizhniy Tagil, Middle Urals, Russia.

Description: Dull orange porcelain-like aggregate from the association with vauquelinite. Identified by IR spectrum and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3320w, 1500w, 1407w, 1355sh, 1040sh, 980sh, 963s, 911, 865s, 810sh, 570sh, 536, 458w.

Cr10 Chromate Cr10 $Pb_4(CrO_4)(O,OH)_x \cdot nH_2O$

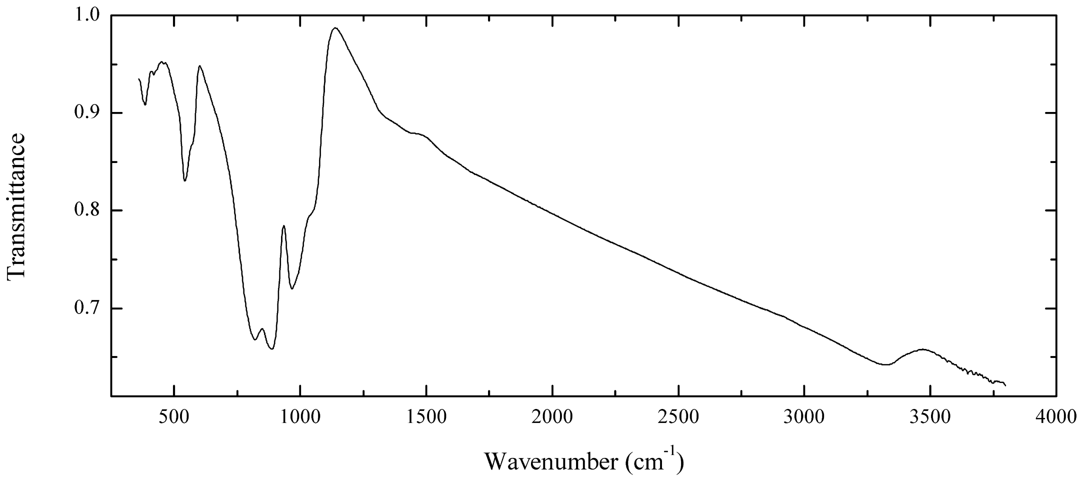


Locality: Grube Clara (Clara mine), Rankach valley, Oberwolfach, Wolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Clusters of red crystals. Pb:Cr = 4:1 in atomic proportion (by electron microprobe data). Needs further investigation.

Wavenumbers (cm^{-1}): 3485w, 3395, 1607w, 1550w, 1438w, 902, 879s, 815s, 660, 460, 411.

Cr11 Embreyite $Pb_5(CrO_4)_2(PO_4)_2{\cdot}H_2O$

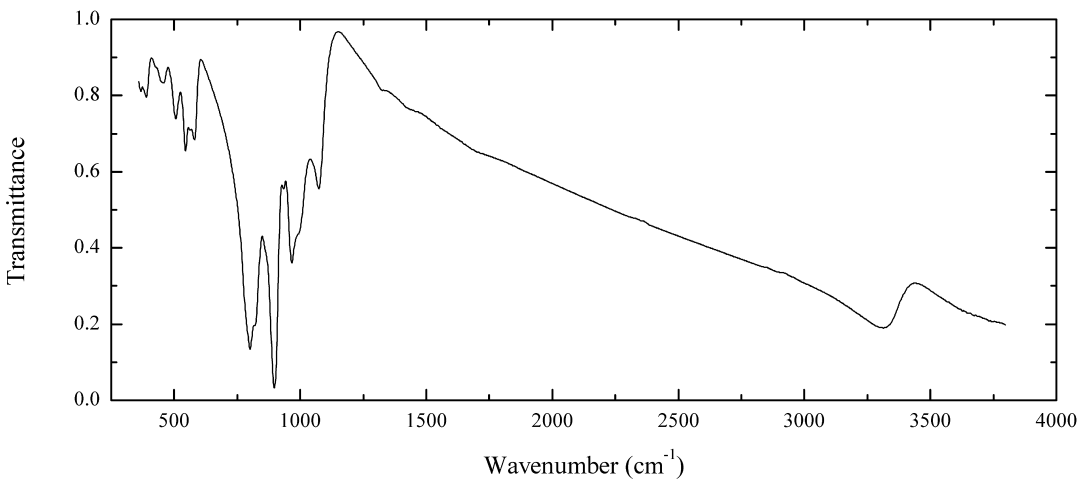


Locality: Crocoite pit, Uspenskaya Mt., Berezovskoe gold deposit, near Berezovsk, Middle Urals, Russia (type locality).

Description: Dull orange from the association with crocoite and vauquelinite. Investigated by I.V. Pekov. Cu-bearing, As-rich variety. The empirical formula is (electron microprobe) $Cu_{0.32}Pb_{5.34}(CrO_4)_{2.10}(PO_4)_{1.46}(AsO_4)_{0.43}(VO_4)_{0.01}(H_2O,OH)$.

Wavenumbers (cm^{-1}): 3317, 1440w, 1365sh, 1045sh, 967, 888s, 821s, 570sh, 543, 420w, 383.

Cr12 Vauquelinite $Pb_2Cu(CrO_4)(PO_4)(OH)$

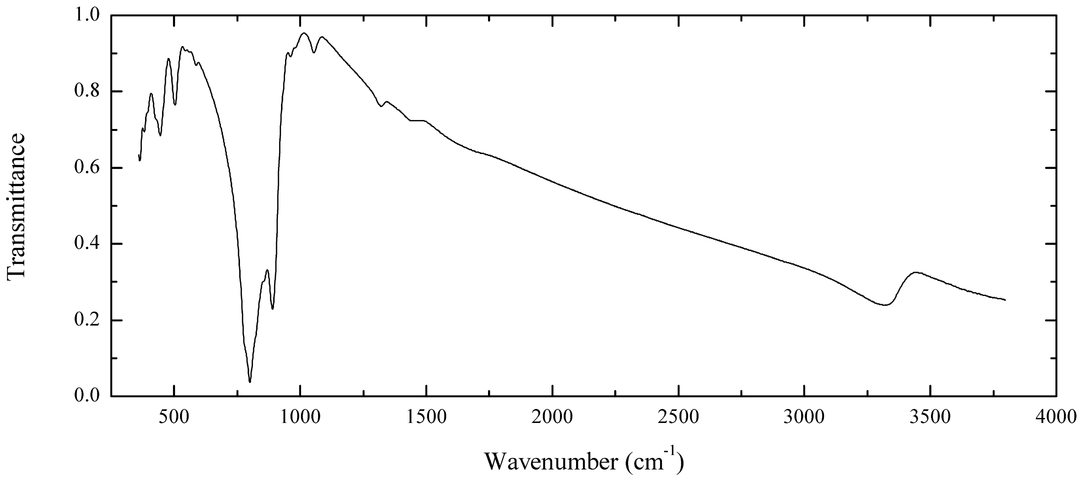


Locality: Crocoite pit, Uspenskaya Mt., Berezovskoe gold deposit, near Berezovsk, Middle Urals, Russia (type locality).

Description: Dark green crystals from the association with crocoite. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $Pb_{1.97}Cu_{1.03}(CrO_4)_{0.99}(PO_4)_{0.84}(AsO_4)_{0.01}(OH,O)$.

Wavenumbers (cm^{-1}): 3314, 1730sh, 1445sh, 1335w, 1074, 985sh, 966, 937w, 897s, 815sh, 801s, 580, 565w, 545, 506, 458w, 430sh, 388, 369w.

Cr13 Fornacite $Pb_2Cu(CrO_4)(AsO_4)(OH)$

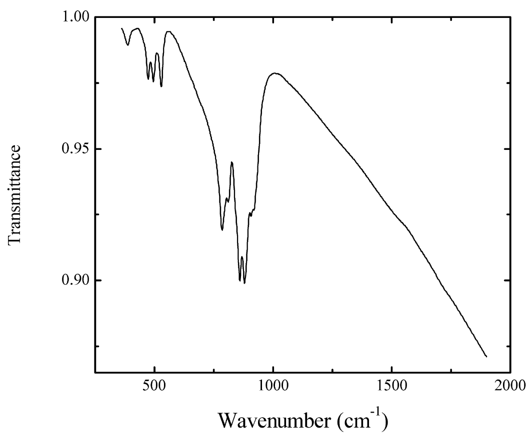


Locality: Crocoite pit, Uspenskaya Mt., Berezovskoe gold deposit, near Berezovsk, Middle Urals, Russia.

Description: Dark green split crystals from the association with crocoite. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $Pb_{2.03}Cu_{1.02}(CrO_4)_{1.07}(AsO_4)_{0.80}(PO_4)_{0.08}(OH,O)$.

Wavenumbers (cm^{-1}): 3318, 1690sh, 1455w, 1320w, 1054w, 985sh, 963w, 890s, 850sh, 800s, 785sh, 588w, 503, 445, 435sh, 365.

Cr14 Hemihedrite $Pb_{10}Zn(CrO_4)_6(SiO_4)_2(OH,F)$



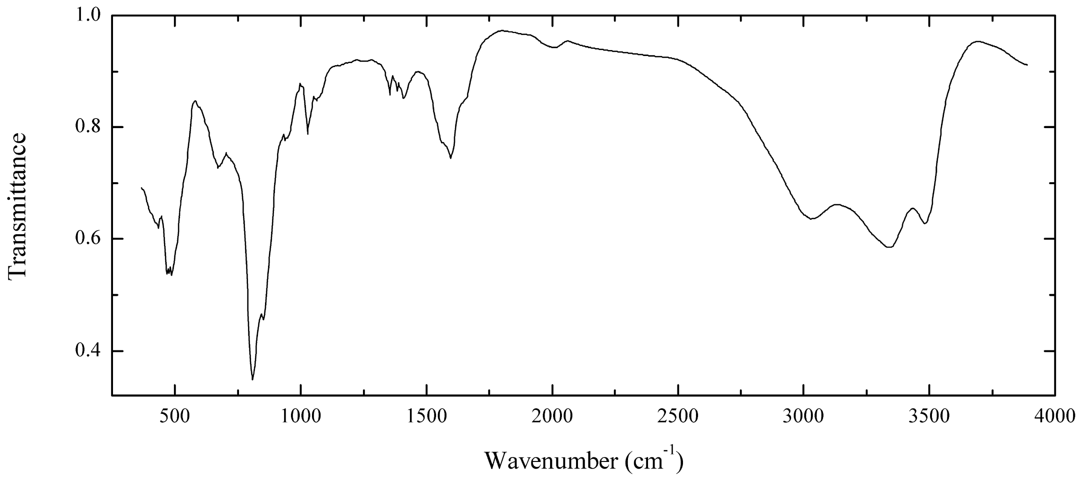
Locality: Adobe Wells Claim, Vulture district, Vulture Mts., Maricopa Co., Arizona, USA.

Description: Orange crystals on quartz.

Wavenumbers (cm^{-1}): 920sh, 910, 880s, 860s, 812, 785, 529, 496, 476, 390.

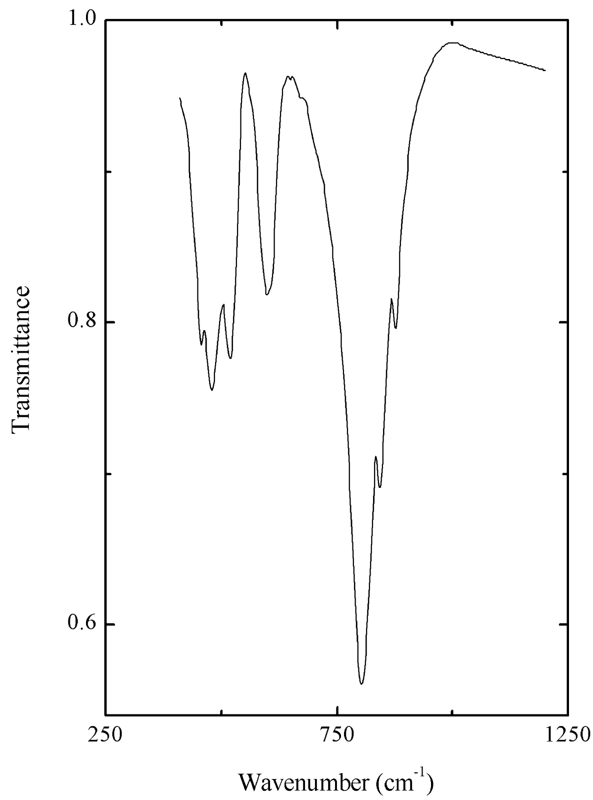
2.13 Arsenates, Arsenites and Sulfato-Arsenates

As1 Tyrolite CO_3-free $Ca_2Cu^{2+}_9(AsO_4)_4(OH)_{10}\cdot 10H_2O$



Locality: Khovu-Aksy deposit, 80 km SW of Kyzyl, Tuva, Middle Siberia, Russia.
Description: Bluish-green split flattened crystals to 0.5 mm. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3490s, 3340s, 3040s, 2020w, 1980w, 1660sh, 1600, 1570sh, 1412w, 1385w, 1355w, 1075w, 1030, 940, 853s, 806s, 661, 500sh, 482s, 466s, 421.

As2 Lammerite $Cu_3(AsO_4)_2$

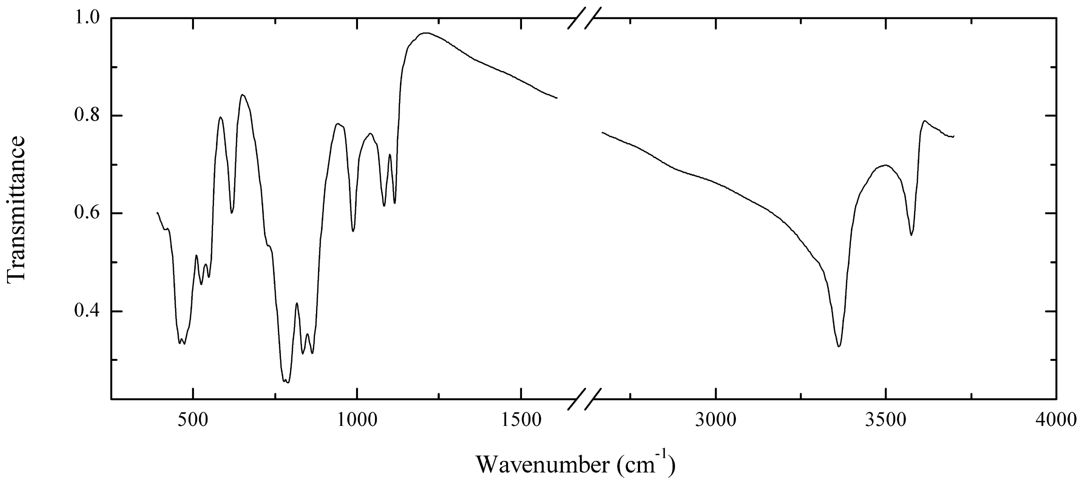


Locality: North Breach of the Great Fissure Tolbachik volcano, Kamchatka peninsula, Russia.

Description: Green crystals to 0.2 mm. The empirical formula is (electron microprobe) $Cu_{2.92}Zn_{0.04}Mg_{0.03}[(AsO_4)_{1.98}(PO_4)_{0.02}]$.

Wavenumbers (cm^{-1}): 876, 842s, 803s, 598, 517, 478s, 456.

As3 Clinoclase $Cu^{2+}{}_3(AsO_4)(OH)_3$

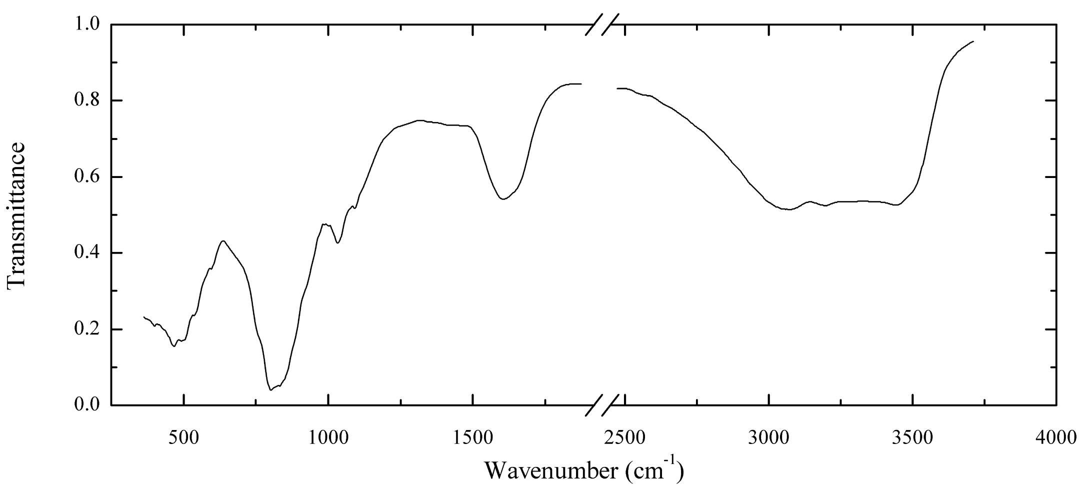


Locality: Novoveská Huta, Spisska Nova Ves, Slovakia.

Description: Aggregates of dark bluish-green short-prismatic crystals to 0.4 mm in the association with cornubite and strashimirite. The empirical formula is (electron microprobe) $Cu_{2.95}Zn_{0.03}Ca_{0.01}[(AsO_4)_{0.93}(PO_4)_{0.07}](OH)_{3.02}$.

Wavenumbers (cm^{-1}): 3560, 3345s, 1116, 1983, 986, 861s, 832s, 789s, 775s, 726, 614, 547, 522, 472, 458, 410w.

As4 Tyrolite CO$_3$-free $Ca_2Cu^{2+}{}_9(AsO_4)_4\,(OH)_{10}\cdot 10H_2O$

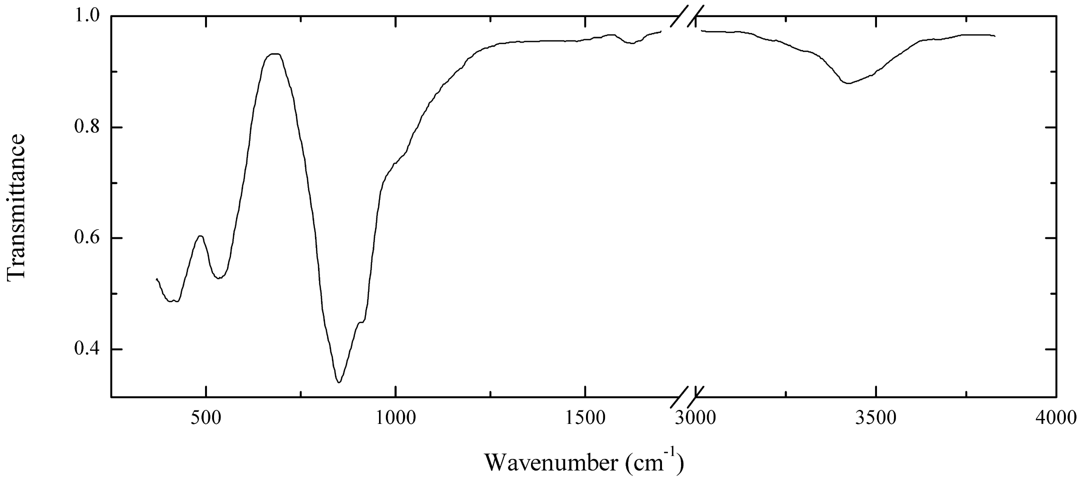


Locality: Khovu-Aksy deposit, 80 km SW of Kyzyl, Tuva, Middle Siberia, Russia.

Description: Bluish-green crusts. Identified by powder X-ray diffraction pattern and semi-qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3480sh, 3815s, 3170s, 3035s, 1600, 1095w, 1030, 824sh, 798s, 760sh, 590sh, 530sh, 487s, 459s, 421.

As5 Durangite $NaAl(SO_4)F$



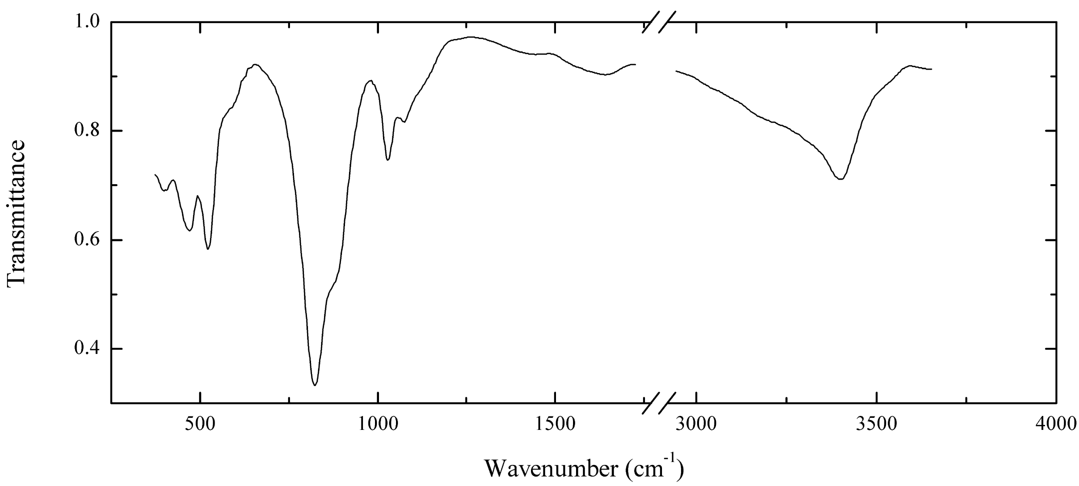
Locality: Thomas Range, Juab Co., Utah, USA.

Description: Orange-red grains in rock. The bands at 3,400 and 1,620 cm^{-1} can be due to water absorbed by the KBr pellet.

The empirical formula is (electron microprobe) $Na_{1.03}(Al_{0.73}Fe_{0.27})[(AsO_4)_{0.90}(SiO_4)_{0.08}]F_{0.94}$.

Wavenumbers (cm^{-1}): (3410), (1620w), 1000sh, 913s, 850s, 820sh, 531, 520sh, 422s, 402s.

As6 Chenevixite $Cu^{2+}{}_2Fe^{3+}{}_2(AsO_4)(OH)_4{\cdot}H_2O$

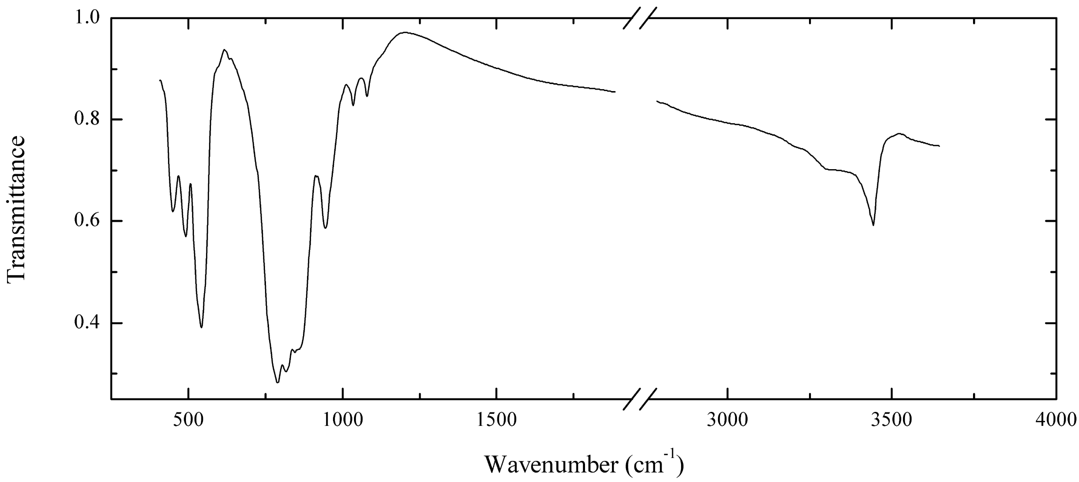


Locality: Mina el Guanaco, Taltal, Atacama, Chile.

Description: Green, powdery. The empirical formula is (electron microprobe) $Ca_{1.97}(Fe_{1.47}Al_{0.57})[(AsO_4)_{1.92}(SO_4)_{0.05}(PO_4)_{0.02}](OH)_4{\cdot}H_2O$.

Wavenumbers (cm^{-1}): 3400, 3260sh, 1645w, 1445w, 1073, 1029, 880sh, 823s, 580sh, 520s, 467, 401.

As7 Olivenite $Cu^{2+}_2(AsO_4)(OH)$

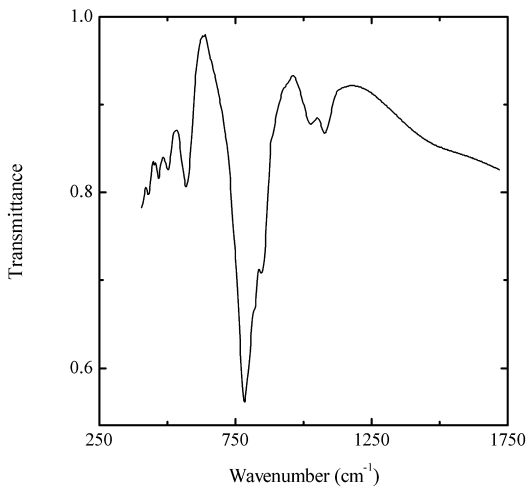


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Transparent, prismatic green crystals in cavities. The empirical formula is (electron microprobe) $Cu_{2.01}[(AsO_4)_{0.97}(PO_4)_{0.08}](OH)$.

Wavenumbers (cm^{-1}): 3425, 3300sh, 1083w, 1034w, 944, 865sh, 859, 845s, 823s, 791s, 780sh, 541s, 489, 449.

As8 Atelestite $Bi_2(AsO_4)O(OH)$



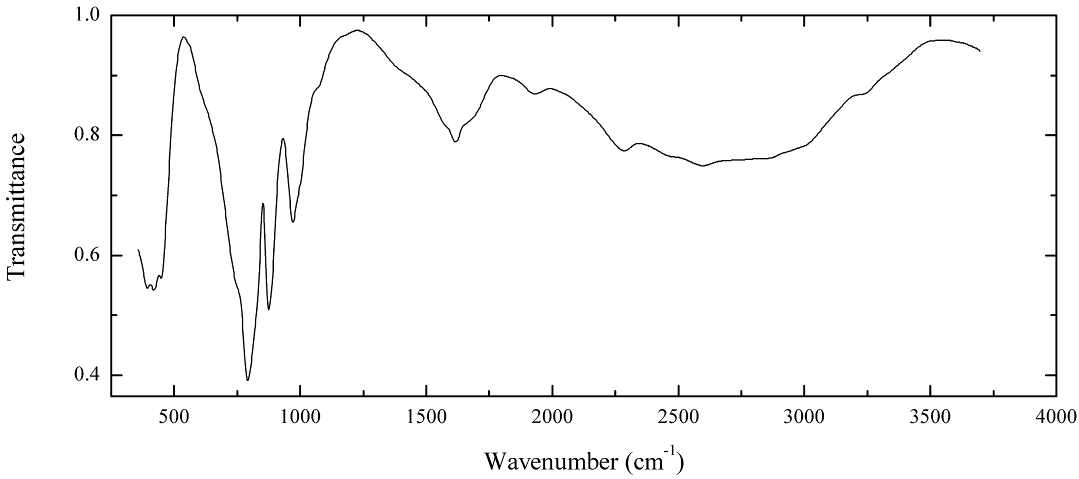
Locality: Smrkovec, Slavkovsky Les Mts., near Mariánské Lázně, Czech Republic.

Description: Greenish-grey transparent crystals in the association with walpurgite. Identified by powder X-ray diffraction pattern.

The empirical formula is (electron microprobe) $Bi_{2.00}[(AsO_4)_{0.96}(PO_4)_{0.04}]O(OH,F)$.

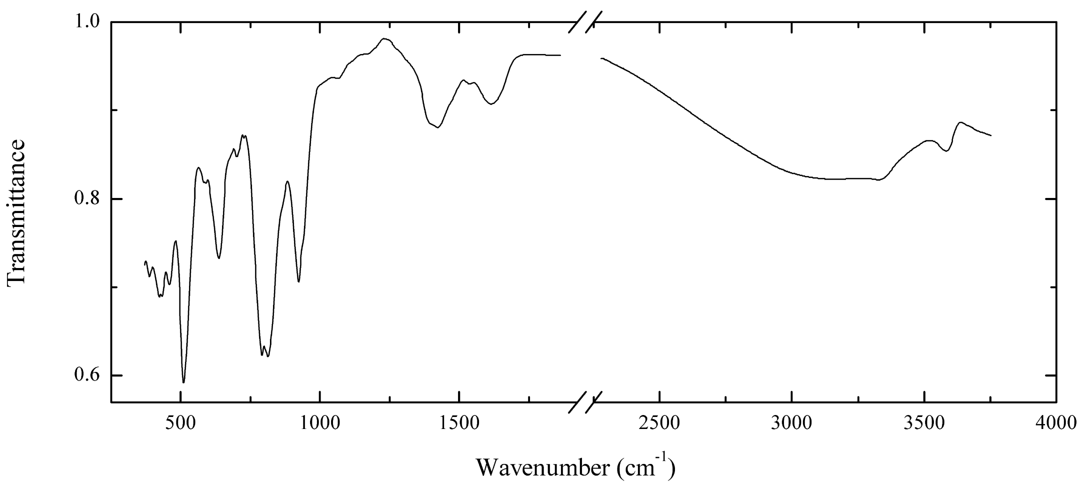
Wavenumbers (cm^{-1}): 1075, 1025, 844s, 820sh, 779s, 570, 501, 467, 421.

As9 Brandtite $Ca_2Mn(AsO_4)_2 \cdot 2H_2O$



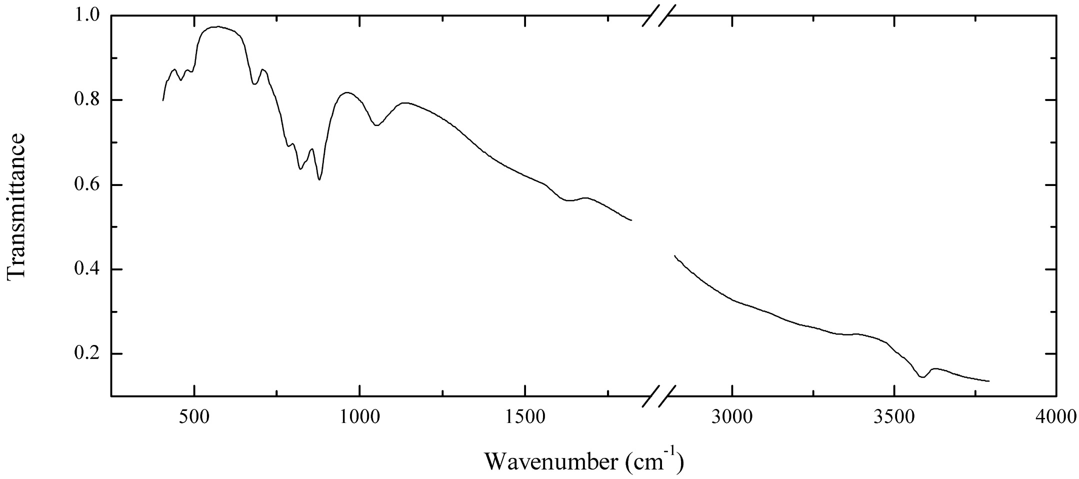
Locality: Harstigen mine, Pajsberg, near Filipstad, Värmland, Sweden (type locality).
Description: White prismatic crystals (to 0.7 mm long) in skarn (in a cavity). Associated minerals are richterite, calcite, svabite.
Wavenumbers (cm^{-1}): 3220w, 2800sh, 2590, 2470sh, 2282, 1940, 1675sh, 1615, 1080sh, 970, 874s, 820sh, 793s, 750sh, 453s, 421s, 398s.

As10 Arseniosiderite $Ca_2Fe^{3+}_3(AsO_4)_3O_2 \cdot 3H_2O$



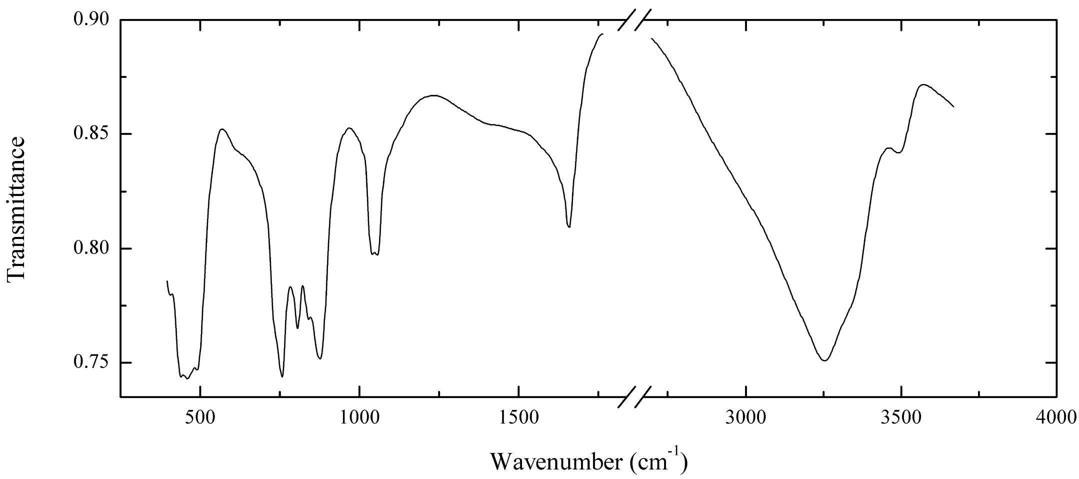
Locality: Sailauf, Spessart Mts., NW Bavaria, Germany.
Description: Black crystals to 0.2 mm. Streak colour is dark brown. The empirical formula is (electron microprobe) $(Ca_{1.83}Na_{0.18})_{\Sigma 2.01}(Fe^{3+}_{2.53}Al_{0.28}Mn_{0.12})_{\Sigma 2.93}(AsO_4)_{3.06}(O,OH)_2 \cdot 3H_2O$.
Wavenumbers (cm^{-1}): 3580, 3325, 3050, 2650sh, 1623, 1432, 1392, 940sh, 924, 810s, 792s, 697w, 637, 579w, 508s, 458, 423, 386.

As11 Guanacoite $Cu^{2+}{}_2Mg_2(Mg_{0.5}Cu_{0.5})(AsO_4)_2(OH)_4 \cdot 4H_2O$



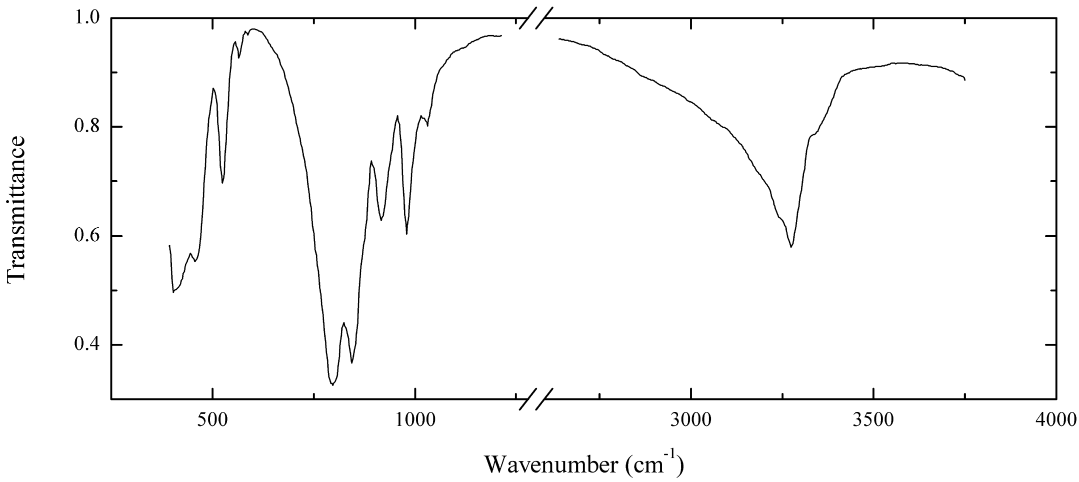
Locality: Mina el Guanaco, Est Catalina, Taltal, II region, Atacama, Chile (type locality).
Description: Light blue long-prismatic crystals in the association with arhbarite, brochantite, chrysocolla and conichalcite.
Wavenumbers (cm^{-1}): 3570, 1640, 1050, 881s, 840sh, 823s, 787s, 690sh, 681, 496, 464.

As12 Arthurite $Cu^{2+}Fe^{3+}{}_2(AsO_4)_2(OH)_2 \cdot 4H_2O$



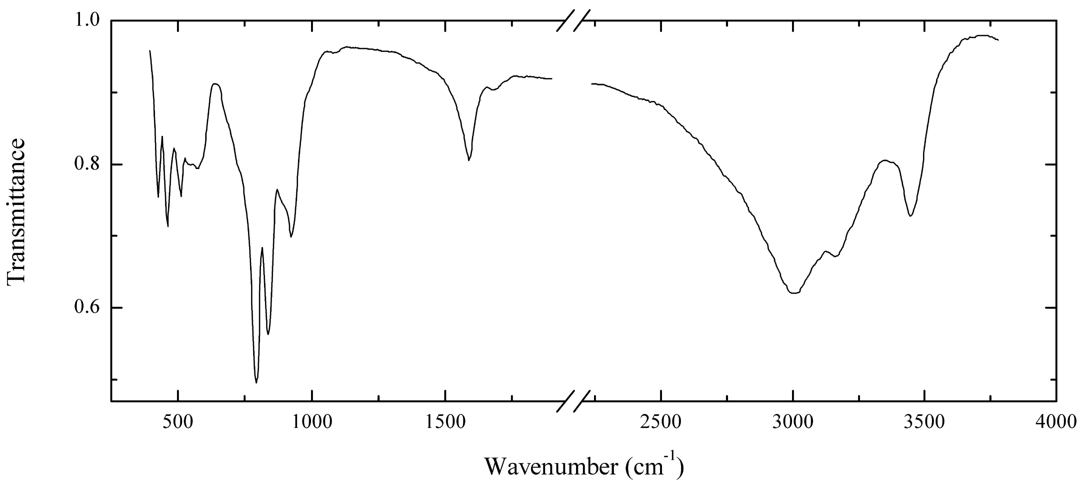
Locality: Majuba Hill mine, Pershing Co., Nevada, USA.
Description: Green. Phosphorous variety (the bands at 1,057 and 1,043 cm^{-1}).
Wavenumbers (cm^{-1}): 3465w, 3350sh, 3235, 1660, 1450sh, 1057, 1043, 881s, 843, 808s, 757s, 735sh, 494s, 465s, 439s.

As13 Austinite $CaZn(AsO_4)(OH)$



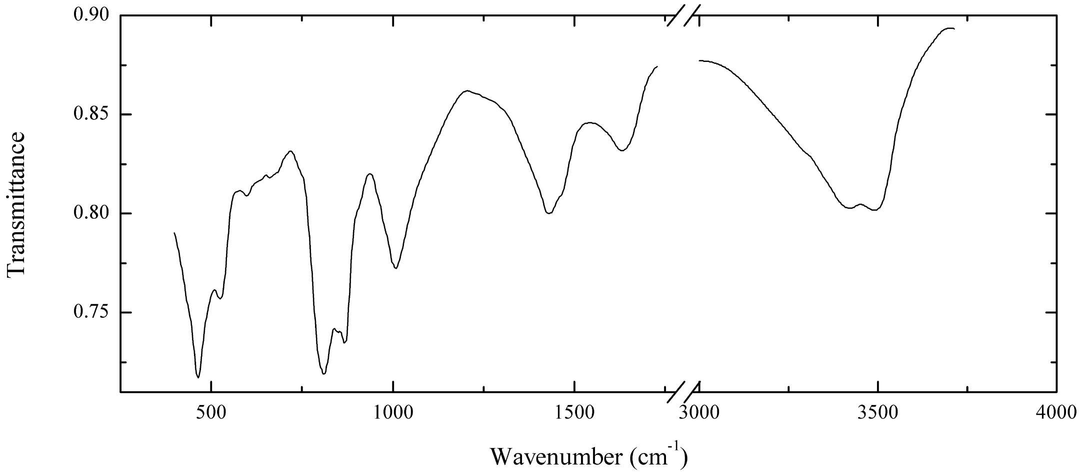
Locality: Lavrion, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.
Description: Light green transparent crystals on ore.
Wavenumbers (cm^{-1}): 3320sh, 3260, 3220sh, 1032, 977, 916, 842s, 795s, 587w, 566w, 523, 455, 402s.

As14 Annabergite $Ni_3(AsO_4)_2{\cdot}8H_2O$



Locality: Km-3 mine, Lavrion, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.
Description: Radial aggregates of bright-green flattened prismatic crystals to 1.5 mm long.
The empirical formula is (electron microprobe) $(Ni_{2.64}Mg_{0.20}Fe_{0.07}Co_{0.03}Ca_{0.02}Al_{0.02})[(AsO_4)_{1.97}(PO_4)_{0.03}]{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3428, 3150, 2995s, 1630w, 1588, 1090w, 924, 895sh, 836s, 791s, 720sh, 586, 570sh, 550sh, 508, 459, 421.

As15 Agardite-(Ce) $CeCu^{2+}_6(AsO_4)_3(OH)_6 \cdot 3H_2O$

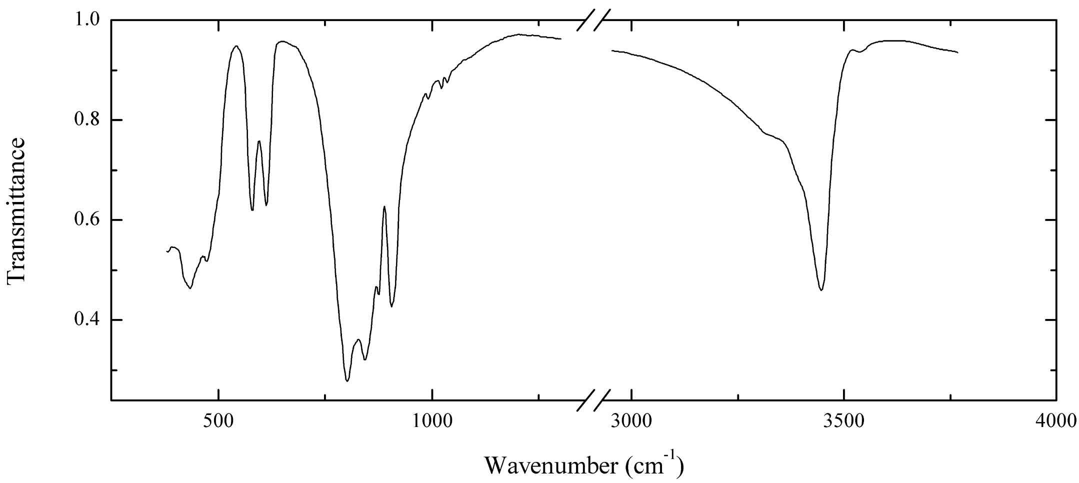


Locality: Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Green, fibrous. Identified by qualitative electron microprobe analysis and powder X-ray diffraction data. Contains admixtures of a carbonate (the band at 1,425 cm^{-1}) and a silicate (the bands at 1,010 and 463 cm^{-1}).

Wavenumbers (cm^{-1}): 3470, 3400, 1640, 1425, 1010, 867s, 848s, 812s, 600w, 525, 463, 450sh.

As16 Adelite $CaMg(AsO_4)(OH)$

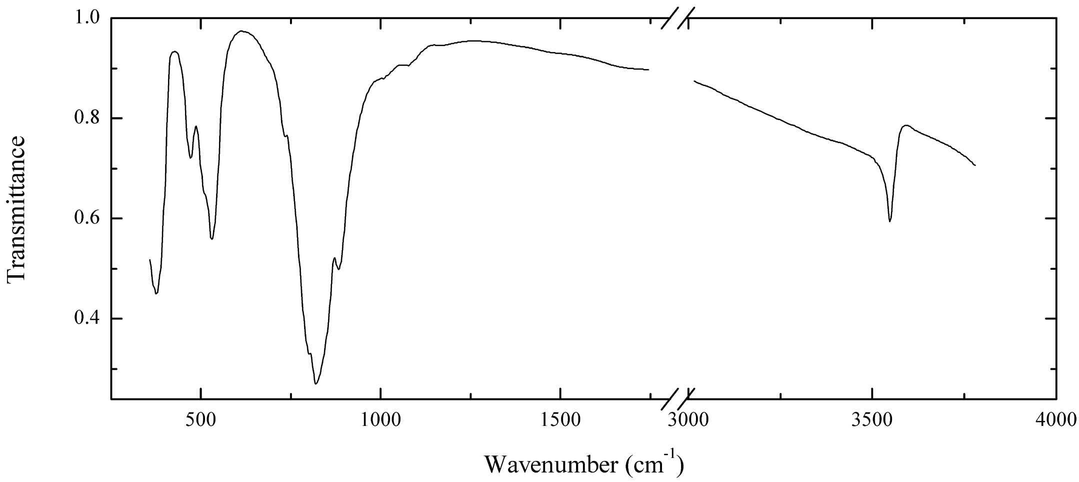


Locality: Jakobsberg, Värmland, Sweden.

Description: Yellow, with greasy lustre.

Wavenumbers (cm^{-1}): 3510w, 3420s, 3370sh, 3300sh, 1035w, 1020w, 990w, 904s, 875, 840s, 801s, 612, 576, 495sh, 469, 425s, (400).

As17 Adamite $Zn_2(AsO_4)(OH)$

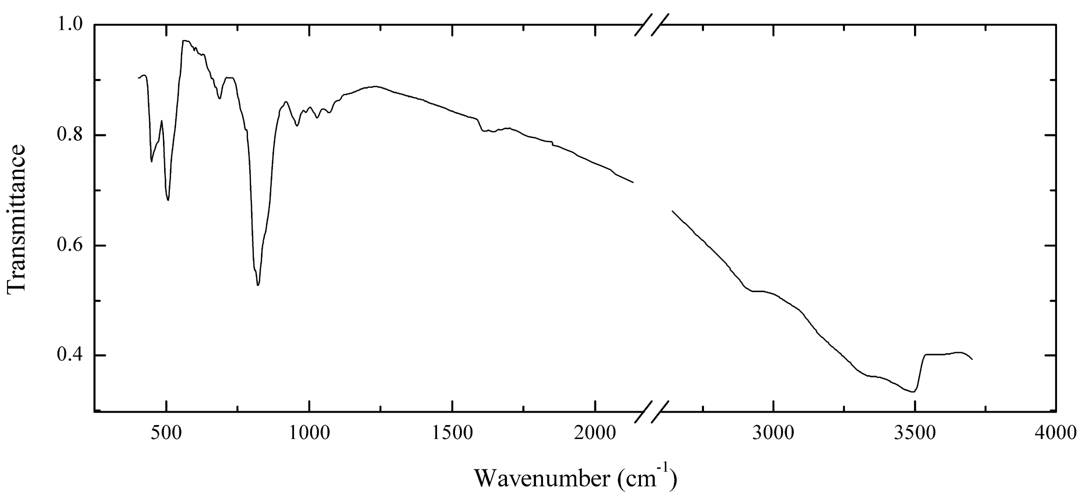


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Yellow crystals. Confirmed by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3540, 1077w, 1009w, 884s, 822s, 800sh, 735, 531, 515sh, 472, 379s.

As18 Arhbarite $Cu^{2+}{}_2Mg(AsO_4)(OH)$

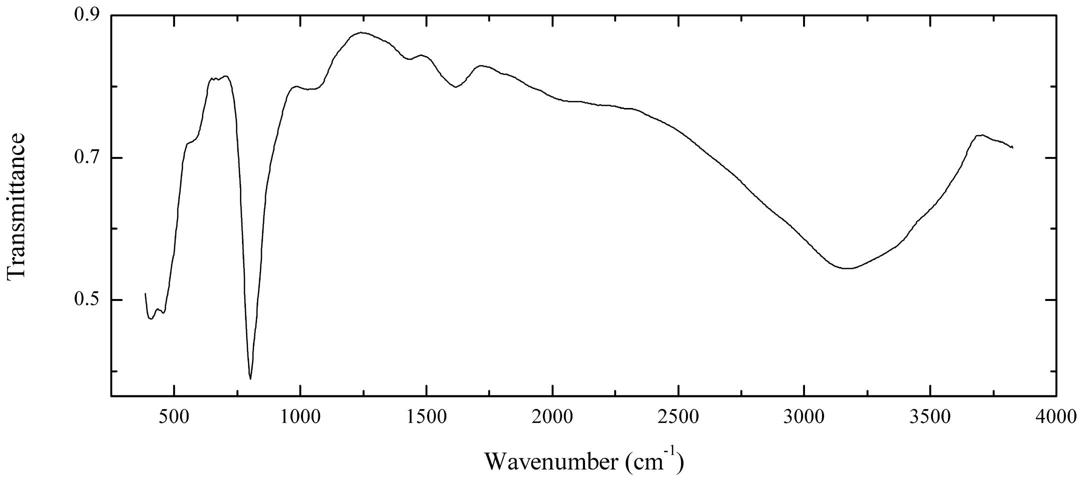


Locality: Mina el Guanaco, Est Catalina, Taltal, II region, Atacama, Chile.

Description: Blue, massive, in the association with guanacoite, brochantite, chrysocolla and conichalcite. Confirmed by semiquantitative electron microprobe analysis and powder X-ray diffraction data.

Wavenumbers (cm^{-1}): 3506, 3335sh, 2935sh, 1655sh, 1623w, 1070w, 1030w, 992w, 958, 850sh, 829s, 820sh, 689, 505s, 453.

As19 Pharmacoalumite $KAl_4(AsO_4)_3(OH)_4{\cdot}6.5H_2O$

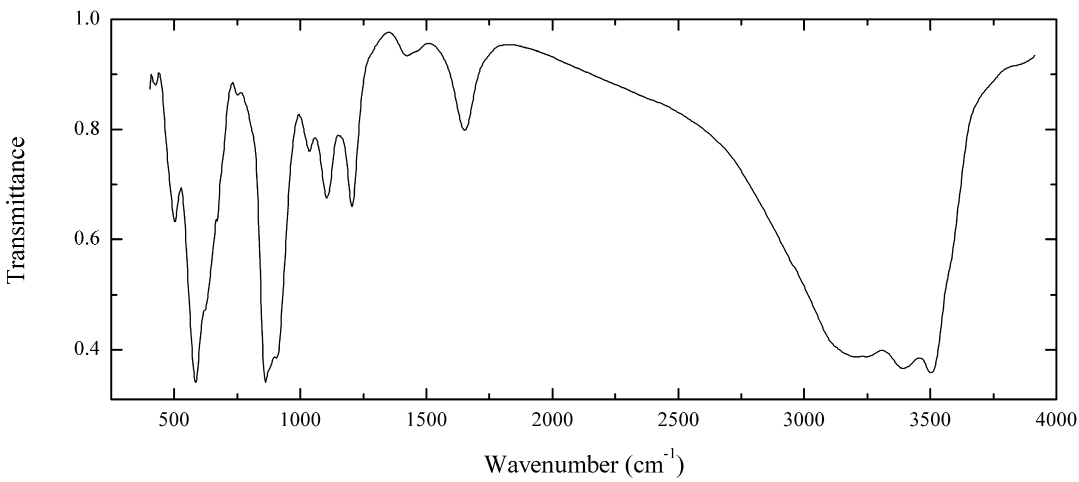


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Brownish cubic crystals to 0.3 mm on ore. The empirical formula is (electron microprobe) $K_{0.9}Na_{0.1}(Al_{3.5}Fe_{0.5})[(AsO_4)_{2.9}(PO_4)_{0.1}](OH)_4{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3490sh, 3160s, 2900sh, 1622, 1430w, 1075, 1040w, 803s, 682w, 595sh, 580, 455s, 417s.

As21 Arsenogorceixite $HBaAl_3(AsO_4)_2(OH)_6$

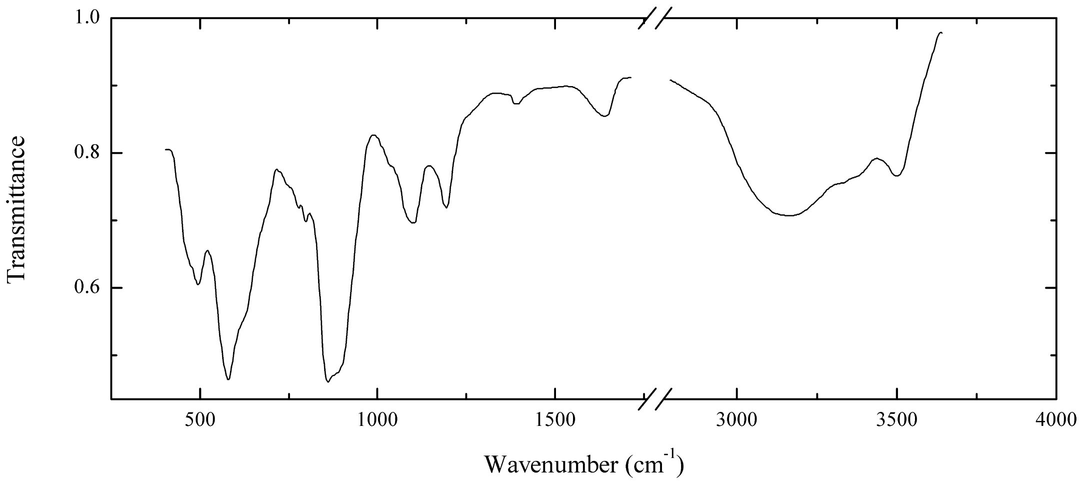


Locality: Grube Clara (Clara mine), Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Blue crust, in the association with barite. The empirical formula is (electron microprobe) $H_x(Ba_{0.6}Sr_{0.5})(Al_{2.7}Fe_{0.3})[(AsO_4)_{1.65}(PO_4)_{0.35}](OH,H_2O)_6$.

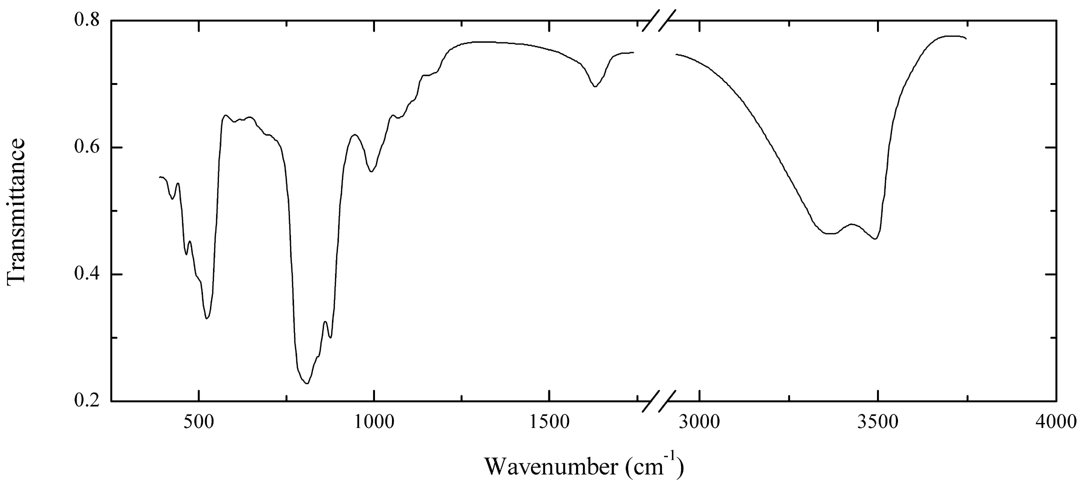
Wavenumbers (cm^{-1}): 3508s, 3389s, 3211s, 1639, 1411w, 1199, 1098, 1028w, 906s, 875sh, 858s, 620sh, 584s, 497, 417w.

As22 Arsenogorceixite $HBaAl_3(AsO_4)_2(OH)_6$



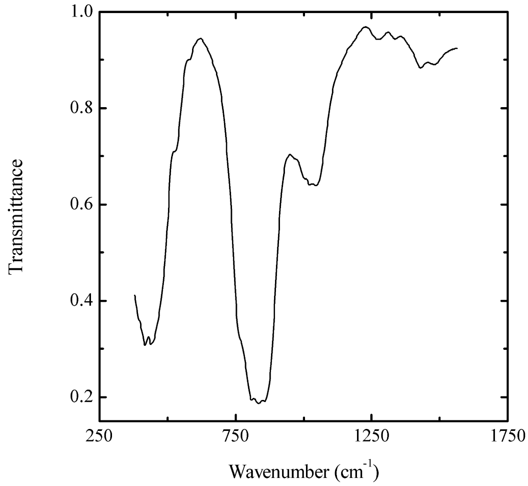
Locality: Grube Clara (Clara mine), Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany (type locality).
Description: Grey crystals. Confirmed by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3495, 3350sh, 3160s. 1650, 1620sh, 1395w, 1200, 1103, 1030sh, 900sh, 860s, 800w, 780w, 625sh, 580s, 497.

As23 Agardite-(Y) $YCu^{2+}{}_6(AsO_4)_3(OH)_6{\cdot}3H_2O$



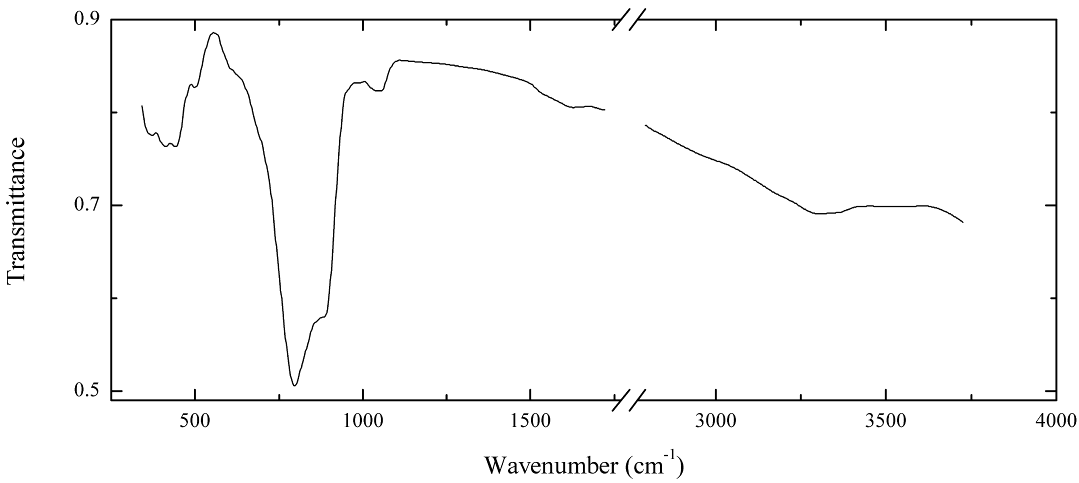
Locality: Grube Clara (Clara mine), Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.
Description: Green, fibrous. Confirmed by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3475s, 3350s, 1630, 1150sh, 1115sh, 1079, 995, 878s, 846s, 809s, 790sh, 695sh, 634w, 610w, 528s, 500, 468, 429.

As24 Arseniopleite $NaCaMn^{2+}(Mn^{2+},Mg)_2(AsO_4)_3$



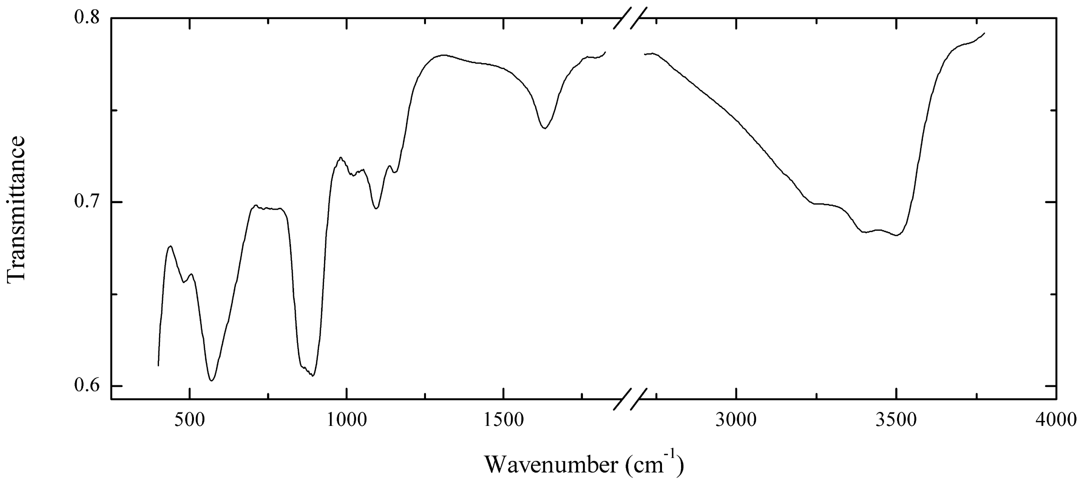
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: Red-brown veinlet in skarn.
Wavenumbers (cm^{-1}): 1480w, 1420w, 1330w, 1270w, 1050, 1025, 1000sh, 857s, 832s, 809s, 765sh, 580sh, 527, 437s, 416s, 395sh.

As25 Arsenbrackebuschite $Pb_2Fe^{3+}(AsO_4)_2(OH)$



Locality: Berezovskoe gold deposit, Middle Urals, Russia.
Description: Brown crystals to 0.2 mm. Confirmed by semiquantitative electron microprobe analysis and powder X-ray diffraction data.
Wavenumbers (cm^{-1}): 3310, 1635w, 1050w, 879s, 799s, 500w, 447, 405, 377.

As26 Arsenogorceixite $HBaAl_3(AsO_4)_2(OH)_6$

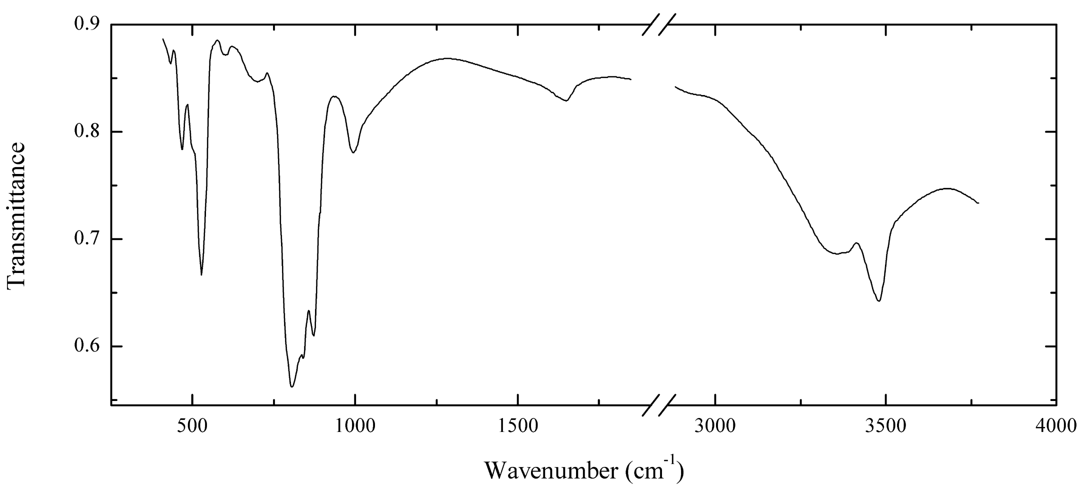


Locality: Grube Clara (Clara mine), Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Crusts consisting of light grey transparent crystals, in the association with barite and quartz. The empirical formula is (electron microprobe) $Ba_{0.8}Sr_{0.2}(Al_{1.8}Fe_{1.0}Zn_{0.2})[(AsO_4)_{1.9}(SiO_4)_{0.1}](OH,H_2O)_5$.

Wavenumbers (cm^{-1}): 3500, 3390, 3250, 1635, 1160, 1095, 1025, 898s, 863s, 635sh, 605sh, 578s, 475.

As28 Zálesíite $CaCu_6(AsO_4)_2(AsO_3OH)(OH)_6{\cdot}3H_2O$

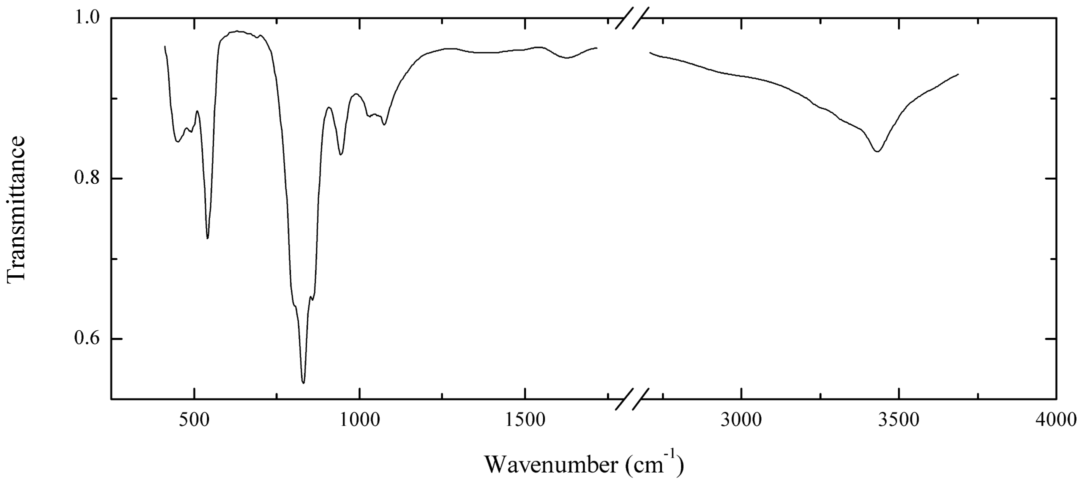


Locality: Grube Clara (Clara mine), Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Green needle-like crystals (to 1 mm long) on rock. The empirical formula is (electron microprobe) $(Ca_{0.65}La_{0.12}Y_{0.07}Zn_{0.14})Cu_{6.05}[(As(O,OH)_4]_{2.95}(SO_4)_{0.05}(OH)_6{\cdot}3H_2O$.

Wavenumbers (cm^{-1}): 3485, 3360, 1650w, 995, 874s, 844s, 812s, 698w, 605w, 529s, 500sh, 467, 430w.

As30 Olivenite $Cu_2(AsO_4)(OH)$



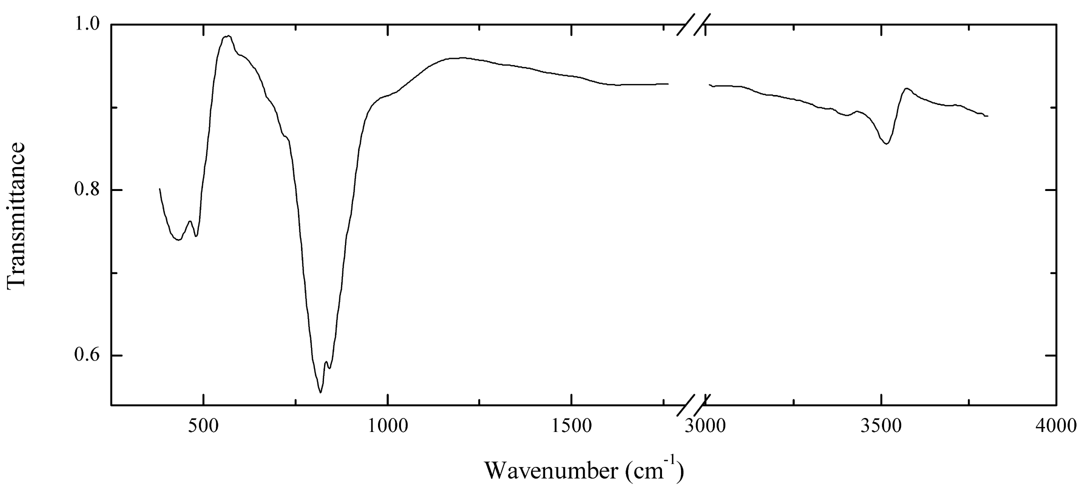
Locality: Novoveská Huta, Spisska Nova Ves, Slovakia.

Description: Light bluish-green fibrous, pseudomorph after strashimirite. Identified by powder X-ray diffraction pattern (the strongest lines are at 6.05, 4.90, 4.25, 3.00, 2.63, 2.49, 2.43, 2.37 Å).

Probably contains isomorphous admixture of PO_4^{3-} (the bands at 1,075 and 1,015 cm^{-1}).

Wavenumbers (cm^{-1}): 3435, 3360sh, 3250sh, 1645w, 1075, 1030, 948, 862s, 832s, 805sh, 541s, 489, 460sh, 446.

As31 Sarkinite $Mn^{2+}{}_2(AsO_4)(OH)$

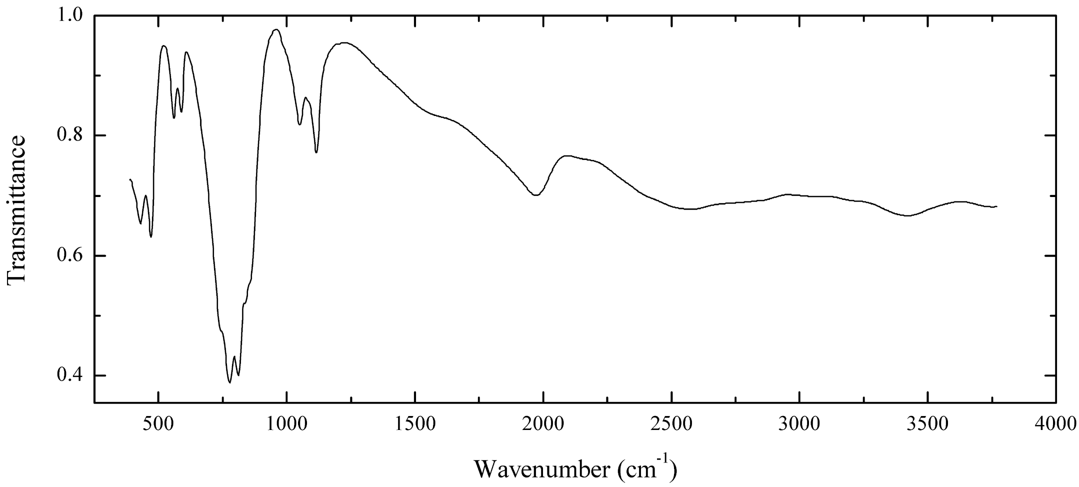


Locality: Gambatesa mine, near Reppia, Val Graveglia, Liguria, Italy.

Description: Orange grains in a veinlet, in the association with reppiaite. The empirical formula is (electron microprobe) $Mn_{1.94}Ca_{0.04}[(AsO_4)_{0.95}(VO_4)_{0.04}(PO_4)_{0.01}](OH)$.

Wavenumbers (cm^{-1}): 3508, 3380w, 3325w, 1000sh, 843s, 821s, 805sh, 720sh, 680sh, 500sh, 478, 432.

As32 Bayldonite $PbCu_3(AsO_4)_2(OH)_2$

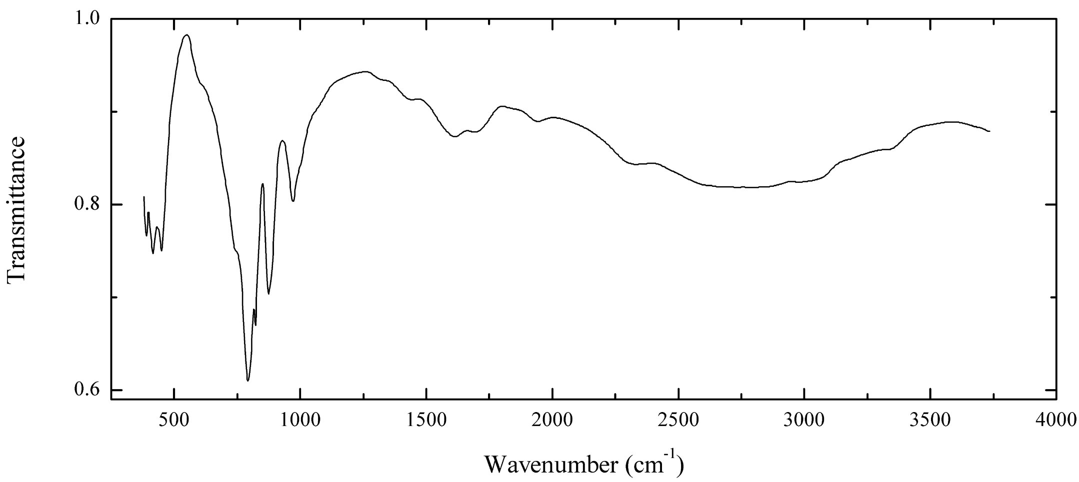


Locality: Berezovskoe gold deposit, near Ekaterinburg, Middle Urals, Russia.

Description: Olive green spherulitic crusts in the association with mimetite, fornacite, duftite, malachite and bindheimite. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3420, 2570, 1980, 1620sh, 1114, 1050, 860, 839s, 811s, 779s, 740sh, 589, 557, 467, 431, 410sh.

As34 Brandtite $Ca_2Mn(AsO_4)_2 \cdot 2H_2O$

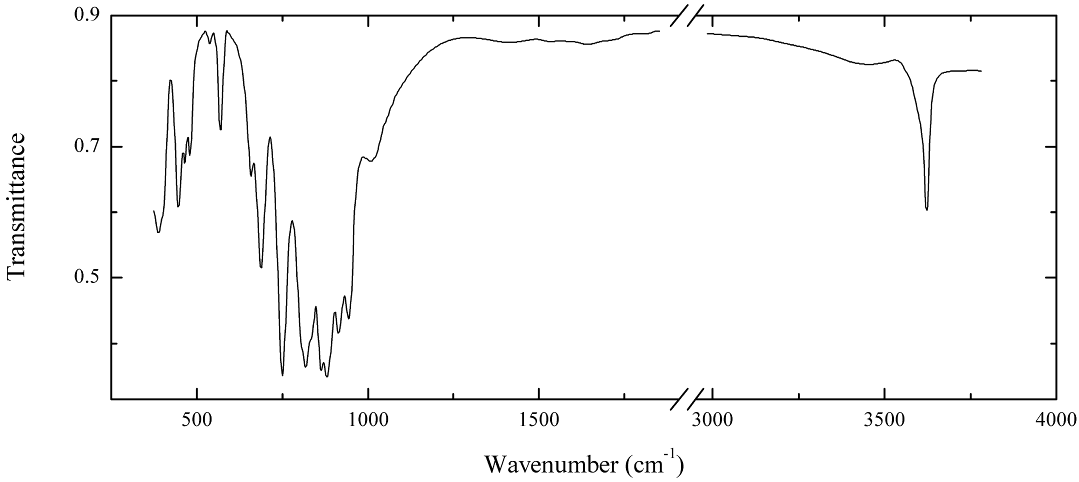


Locality: Harstigen mine, Pajsberg, near Filipstad, Värmland, Sweden.

Description: Short-prismatic split colourless crystals on skarn. Identified visually and by IR spectrum.

Wavenumbers (cm^{-1}): 3320w, 3000sh, 2750, 2320w, 1935w, 1690, 1610, 1430w, 1000sh, 969, 873s, 822s, 791s, 750sh, 610sh, 450, 423, 402.

As35 Bergslagite $CaBe(AsO_4)(OH)$

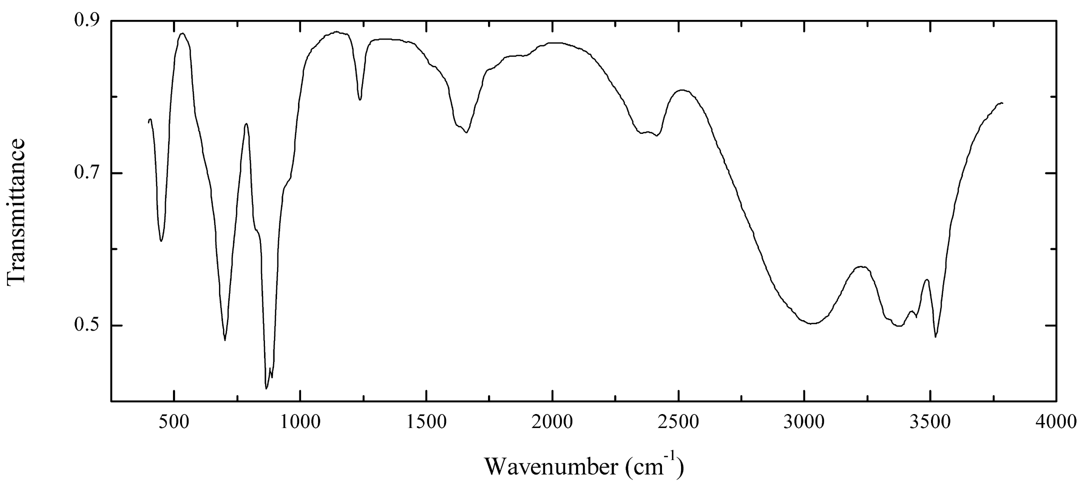


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Light yellowish-grey, with a greasy lustre. Massive. Associating minerals are pyroxene, calcite and svabite. Shows light blue luminescence under short-wave UV irradiation. The strong band at 750 cm^{-1} is assigned to Be–O stretching vibrations. The weak bands given in parentheses are due to admixtures of adsorbed water (3,425 and 1,625 cm^{-1}) and calcite (1,420 cm^{-1}).

Wavenumbers (cm^{-1}): 3572, (3425w), (1625w), (1420w), 1008, 942, 912, 878s, 862s, 833, 819s, 805sh, 750s, 689, 660, 571, 540w, 485, 470, 450, 400.

As36 Brassite $Mg(AsO_3OH)\cdot 4H_2O$

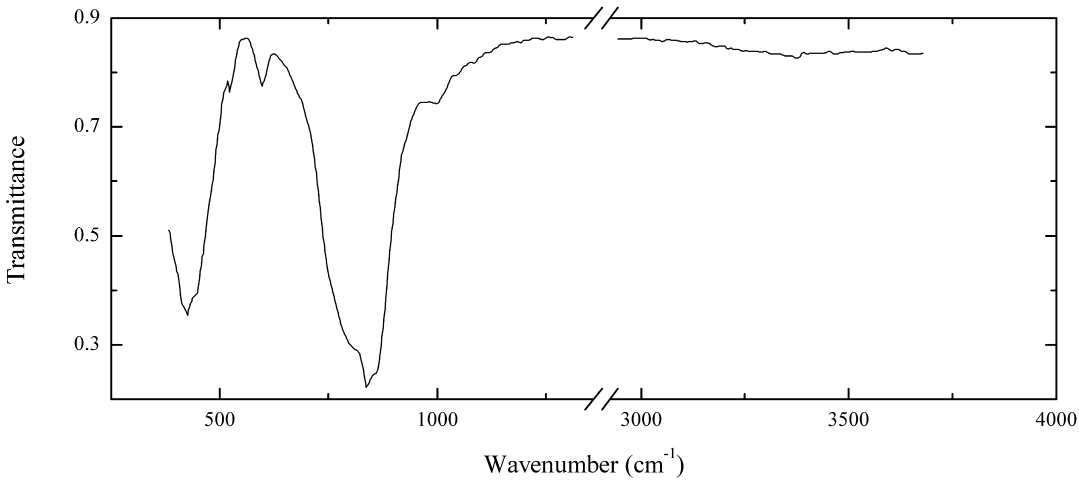


Locality: Jáchymov, Bohemia, Krušné Hory Mts. (Ore Mts.), Czech Republic (type locality).

Description: White, massive.

Wavenumbers (cm^{-1}): 3510s, 3435, 3370, 3320sh, 3025, 2420w, 2360w, 1910w, 1765sh, 1660, 1630sh, 1530sh, 1237w, 950sh, 886s, 867s, 825sh, 700, 640sh, 590sh, 443.

As37 Manganberzeliite $NaCa_2Mn^{2+}{}_2(AsO_4)_3$

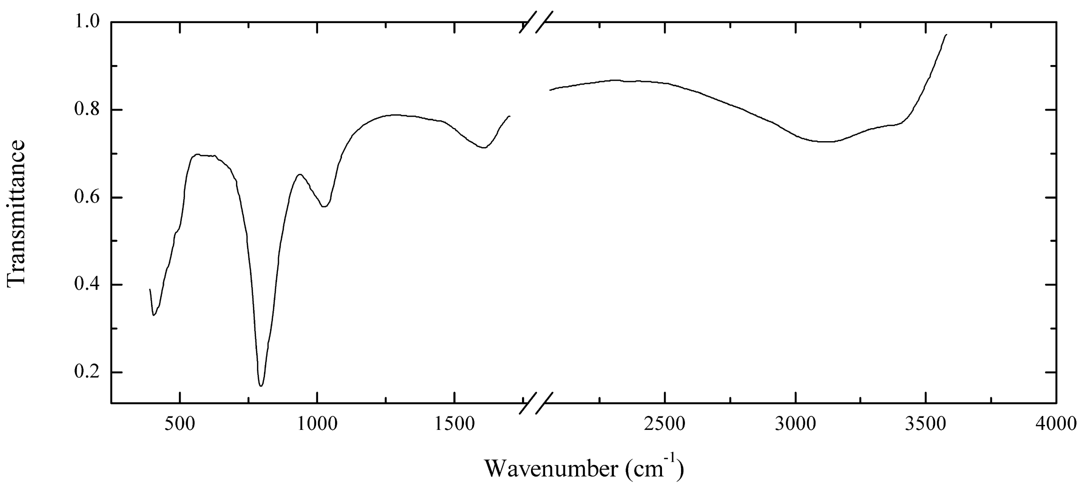


Locality: Sjögruvan, Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Orange-brown massive aggregate in the association with svabite, calcite and pyroxene. The empirical formula is (electron microprobe) $Na_{0.97}Ca_{2.07}Mn_{1.19}Mg_{0.78}(AsO_4)_{3.00}$.

Wavenumbers (cm^{-1}): 991w, 856sh, 837s, 810s, 785sh, 594w, 519w, 475sh, 440sh, 420s.

As38 Bariopharmacosiderite $Ba_{0.5}Fe^{3+}{}_4(AsO_4)_3(OH)_4{\cdot}5H_2O$

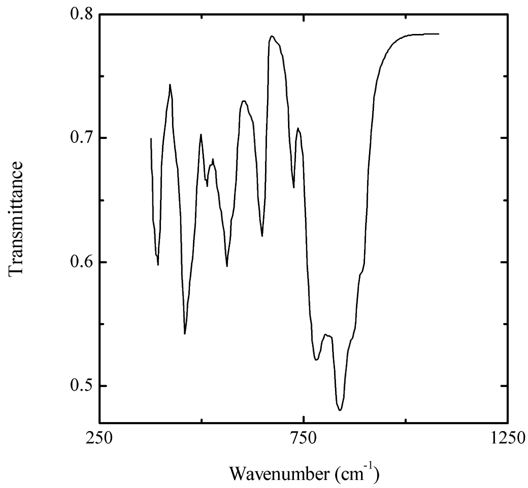


Locality: Grube Clara (Clara mine), Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany (type locality).

Description: Brown pseudo-cubic crystals to 0.3 mm on rock. Confirmed by semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3370, 3120, 1615w, 1031, 830sh, 799s, 590w, 495sh, 403s.

As39 Bradaczekite $NaCu_4(AsO_4)_3$

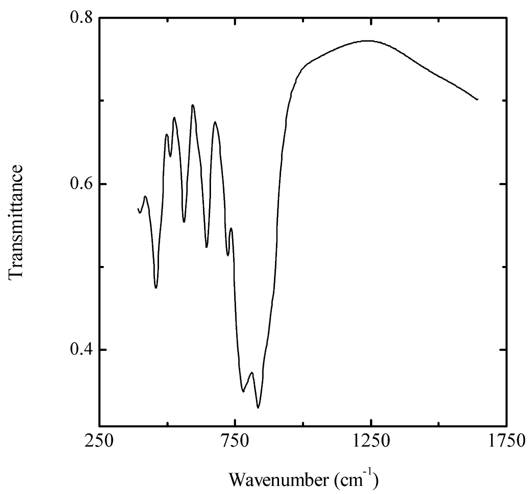


Locality: North Breach of the Great Fissure Tolbachik volcano, Kamchatka peninsula, Russia (type locality).

Description: Blue crystals. Holotype sample.

Wavenumbers (cm^{-1}): (1095), 890sh, 865sh, 838s, 783s, 724, 648, 580sh, 564, 514w, 475sh, 460s, 394.

As40 Bradaczekite $NaCu_4(AsO_4)_3$

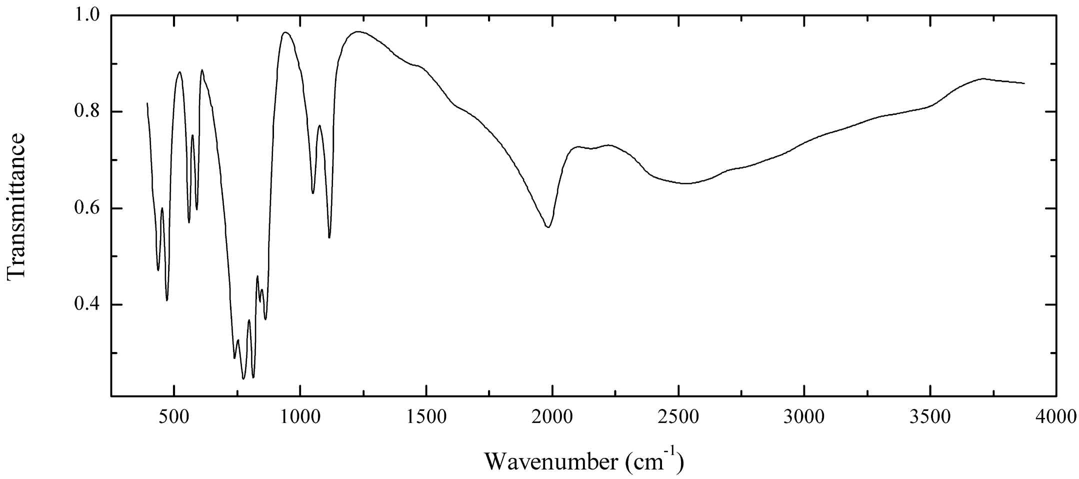


Locality: North Breach of the Great Fissure Tolbachik volcano, Kamchatka peninsula, Russia (type locality).

Description: Blue crystals (to 0.2 mm) in the association with arcanite and tenorite. The empirical formula is (electron microprobe) $(Na_{0.69}K_{0.25}Ca_{0.03}Pb_{0.01})(Cu_{3.81}Zn_{0.15}Fe_{0.01}Al_{0.01})[(AsO_4)_{2.91}(SO_4)_{0.12}]$.

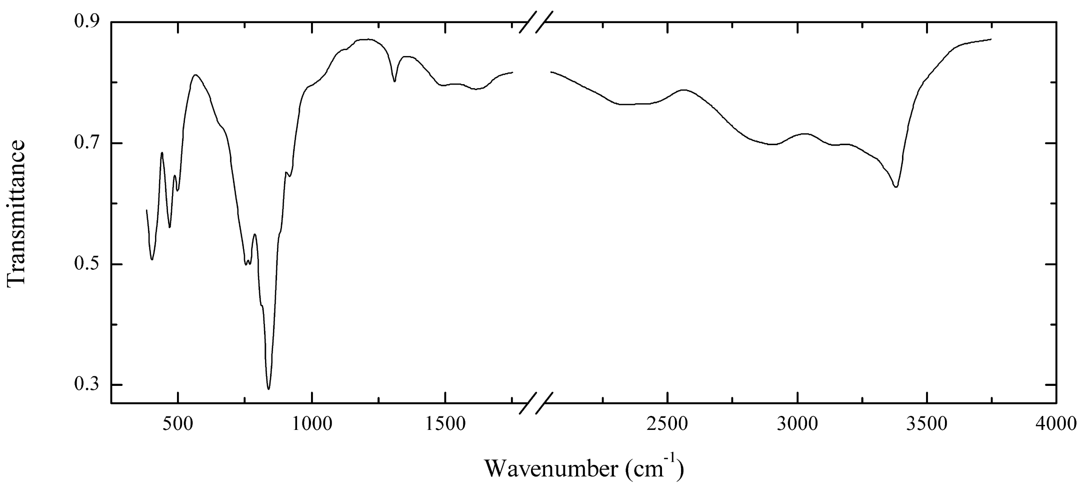
Wavenumbers (cm^{-1}): 895sh, 869, 836s, 782s, 724, 647, 620sh, 562, 511w, 475sh, 458s, 400.

As41 Bayldonite $Cu_3PbO(AsO_3OH)_2(OH)_2$



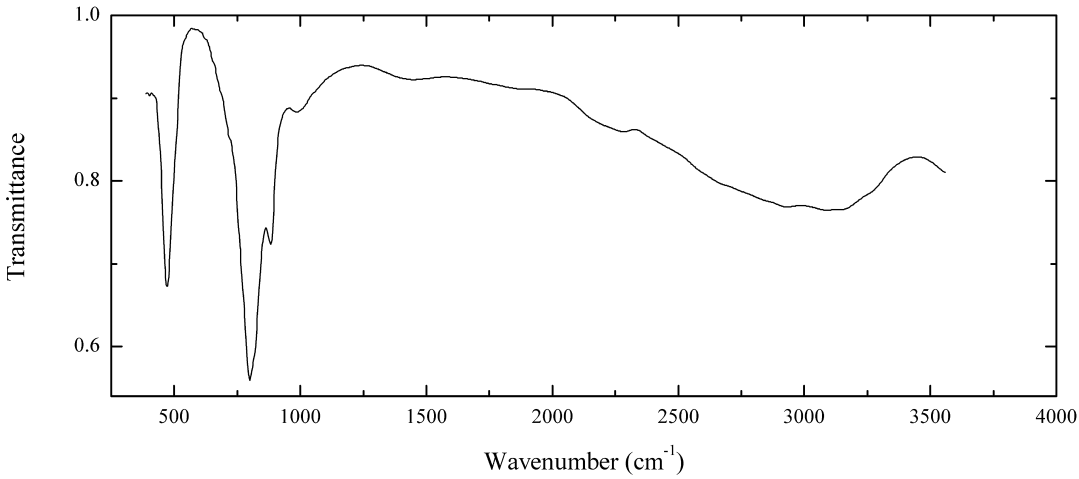
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.
Description: Green, massive. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3450sh, 2720sh, 2520, 2150w, 1980, 1630sh, 1430sh, 1116, 1052, 864, 839, 813s, 776s, 740s, 590, 558, 472, 434.

As43 Villyaellenite $(Mn^{2+},Ca,Zn)_5(AsO_4)_2[AsO_3(OH)]_2 \cdot 4H_2O$



Locality: Veta Negra mine, Pampa Larga, Tierra Amarilla, Chile.
Description: Pink transparent split prismatic crystals (to 0.5 mm) on rock.
Wavenumbers (cm^{-1}): 3390s, 3150, 2910, 2840sh, 2420sh, 2330, 1645w, 1500w, 1314w, 1000sh, 924, 885sh, 841s, 813s, 767, 758, 700sh, 501, 471, 401s.

As44 Gartrellite $PbCuFe^{3+}(AsO_4)_2(OH){\cdot}H_2O$

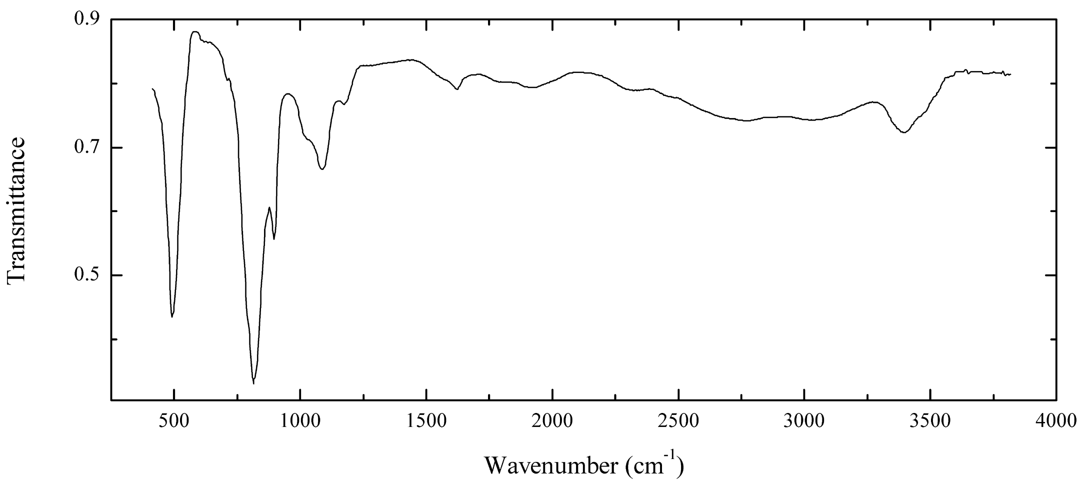


Locality: Berezovskoe gold deposit, near Ekaterinburg, Middle Urals, Russia.

Description: Greenish-yellow, massive, in the association with duftite, carminite and fornacite in oxidized ore. Identified by electron microprobe analysis and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3100, 2950, 2750sh, 2300w, 990, 882, 810sh, 800s, 471s.

As45 Gartrellite $PbCuFe^{3+}(AsO_4)_2(OH){\cdot}H_2O$

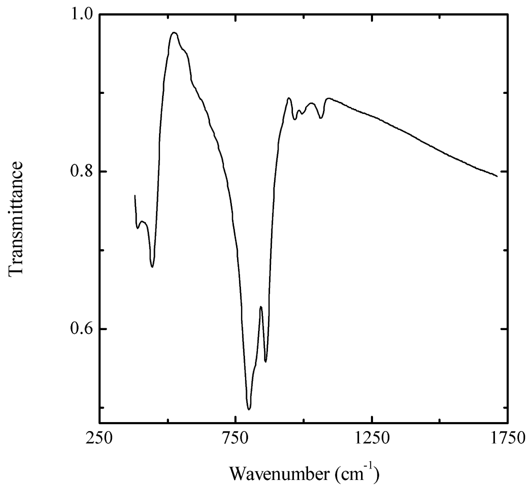


Locality: Anticline deposit, Mineral Claim 84, near Ashburton Downs homestead, Western Australia, Australia (type locality). Contains admixture of hydrous sulphate (the bands at 3,410, 1,620, 1,172, 1,081, 1,015, 632, 618, 599 cm^{-1}).

Description: Yellow, massive, in the association with chenevixite.

Wavenumbers (cm^{-1}): 3390sh, 3400, 3050, 2780, 2340w, 1930w, 1810sh, 1620, 1540sh, 1172, 1081, 1015sh, 887, 801, 770sh, 695w, 632w, 610w, 473s.

As46 Hedyphane $Pb_3Ca_2(AsO_4)_3Cl$

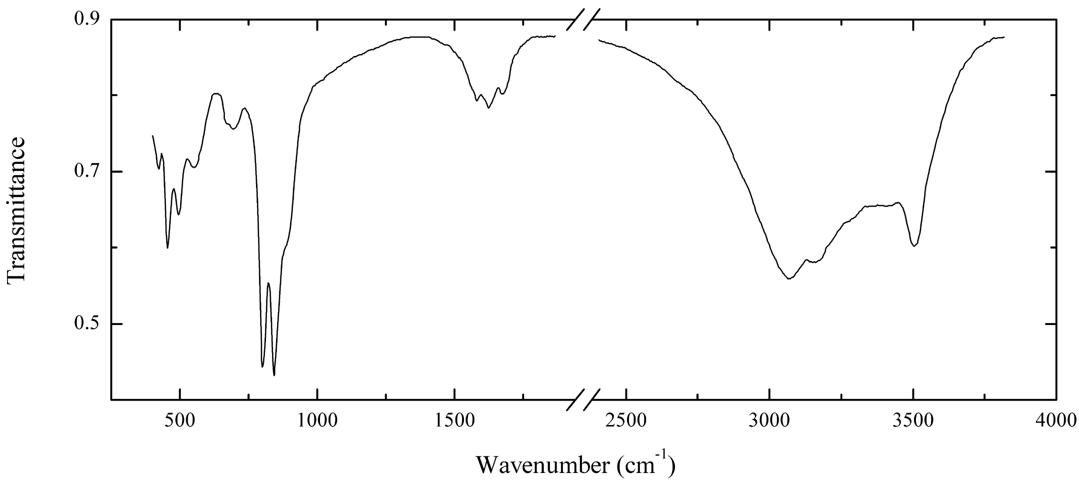


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Yellow, massive, in skarn. The empirical formula is (electron microprobe) $Pb_{3.2}Ca_{1.8}[(AsO_4)_{2.9}(PO_4)_{0.1}]Cl_{0.95}(OH)_{0.05}$.

Wavenumbers (cm^{-1}): 1065w, 988w, 968w, 864s, 825sh, 803s, 600sh, 560sh, 444, 393.

As47 Hörnesite $Mg_3(AsO_4)_2{\cdot}8H_2O$

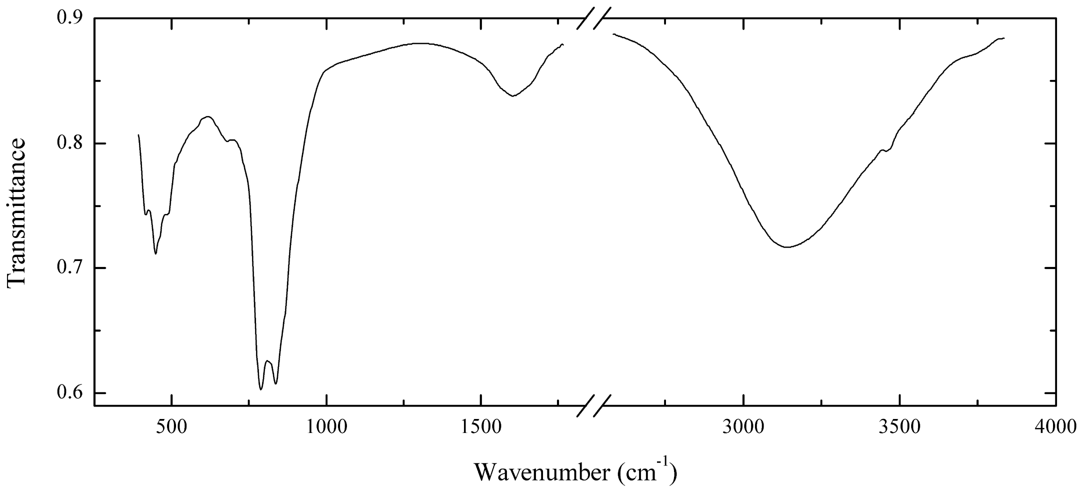


Locality: Belorechenskoe deposit, 70 km S. from Maikop, Northern Caucasus, Russia.

Description: White powdery aggregate. Confirmed by electron microprobe analysis and powder X-ray diffraction pattern.

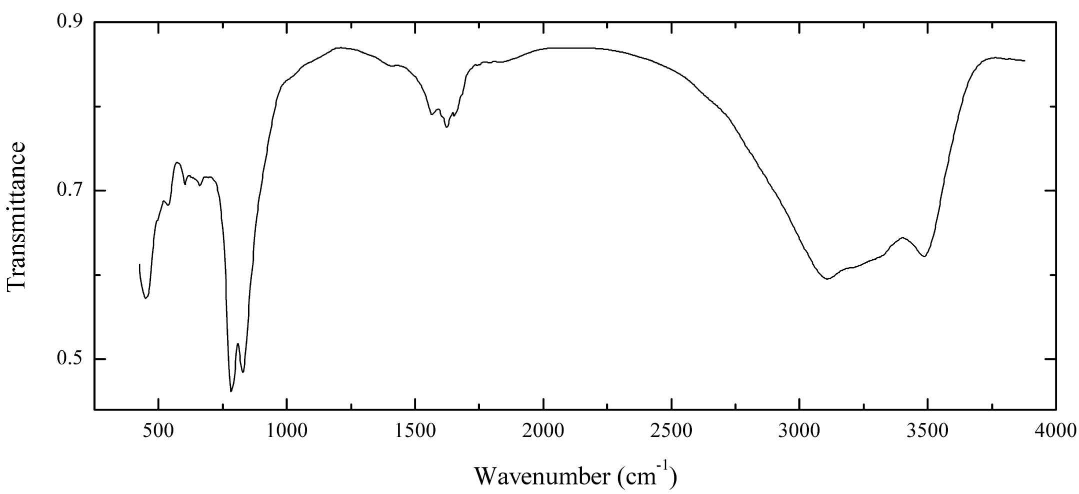
Wavenumbers (cm^{-1}): 3470, (3380), 3135, 3040s, 1675, 1620, 1577, 890sh, 843s, 802s, 698, 675sh, 557, 497, 457s, 420.

As48 Parasymplesite $Fe^{2+}_3(AsO_4)_2{\cdot}8H_2O$



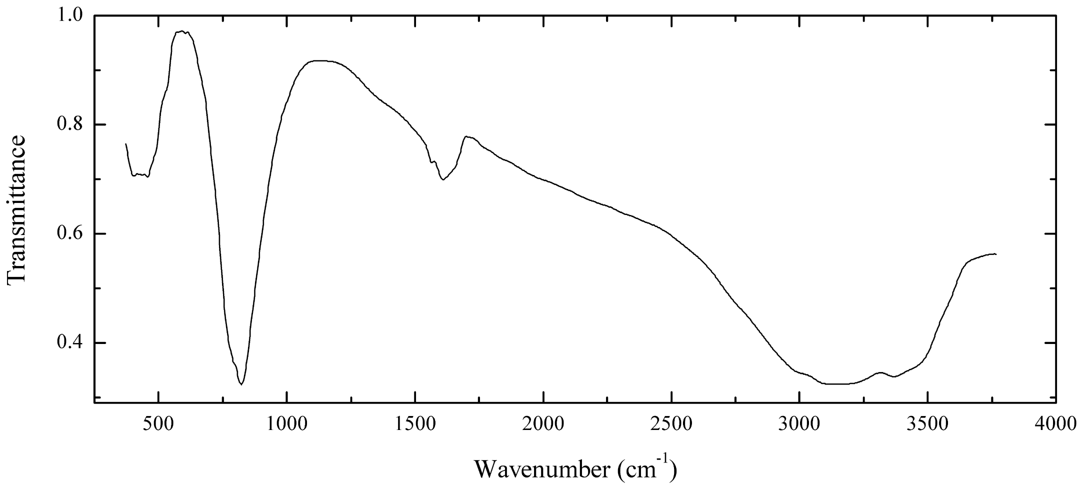
Locality: Belorechenskoe deposit, 70 km S. from Maikop, Northern Caucasus, Russia.
Description: Aggregates of green-brown needle-like crystals. Identified by electron microprobe analysis and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3460, 3110s, 1610, 833s, 783s, (575w), 490, 445, 417.

As49 Symplesite $Fe^{2+}_3(AsO_4)_2{\cdot}8H_2O$



Locality: Khovu-Aksy, Tuva, Russia.
Description: Radiated aggregates of light blue long-prismatic crystals to 0.05 × 0.5 mm. The empirical formula is (electron microprobe) $(Fe_{2.57}Ni_{0.24}Co_{0.17})(AsO_4)_{2.00}{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3470s, 3250sh, 3090s, 1655, 1625, 1575, 1400w, 831s, 781s, 660w, 606w, 540, 452.

As50 Ferrisymplesite $Fe^{3+}{}_3(AsO_4)_2(OH)_3·5H_2O$

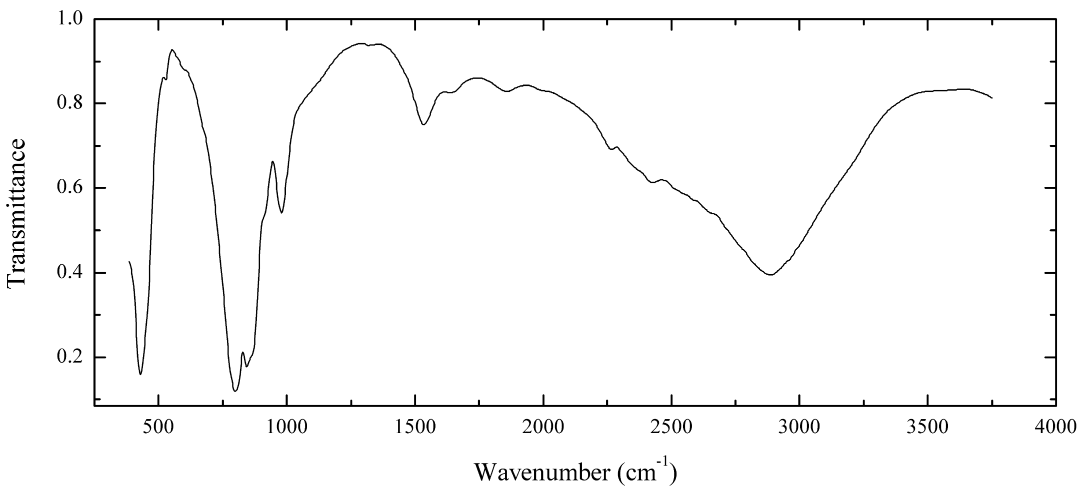


Locality: Khovu-Aksy, Tuva, Russia. The empirical formula is (electron microprobe) $(Fe_{1.8}Co_{0.8}Al_{0.2}Ni_{0.1}Ca_{0.1})(AsO_4)_{2.0}(OH)_x·nH_2O$. Probably contains admixture of erythrine (weak lines at 8.1, 6.79, 4.45, 3.95, 3.26, 3.04, 2.76, 2.49 Å in the powder X-ray diffraction pattern).

Description: Brown spherulites (pseudomorphs after symplesite) to 0.5 mm.

Wavenumbers (cm^{-1}): 3420sh, 3360s, 3140s, 3000sh, 1645sh, 1615, 1575w, 821s, 780sh, 530sh, 475, 405.

As51 Roselite-β $Ca_2Co(AsO_4)_2·2H_2O$

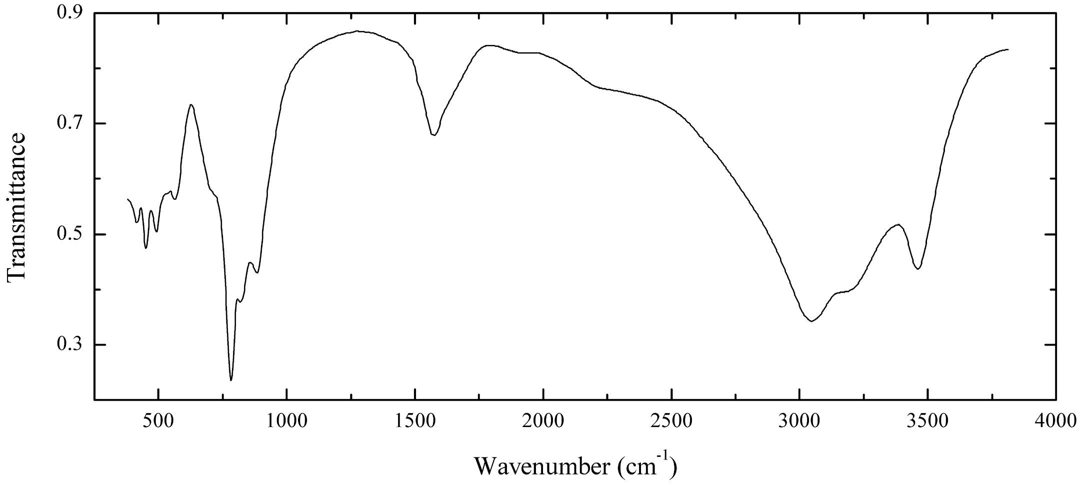


Locality: Bou-Azzer, near Tazenakht, Morocco.

Description: Crimson split crystals to 3 mm in the association with erythrite, wendwilsonite, cobaltaustinite and heterogenite. Identified by morphological features, IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3170sh, 2870s, 2425, 2265, 1860w, 1650w, 1545, 982, 910sh, 860sh, 843s, 800s, 530w, 431s.

As52 **Erythrite** $Co_3(AsO_4)_2 \cdot 8H_2O$

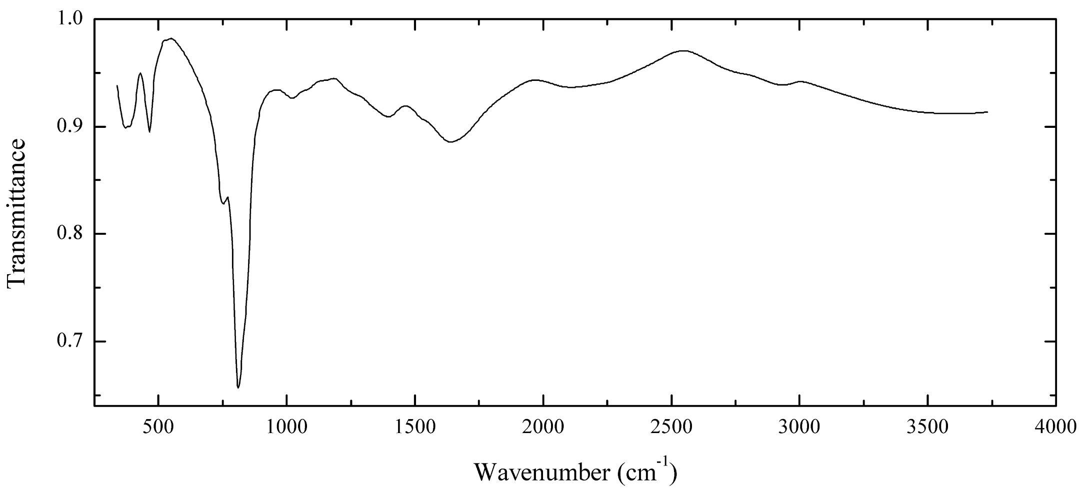


Locality: Bou-Azzer, 30 km of Tazenakht, Morocco.

Description: Crimson prismatic crystals to 1 mm long in the association with roselite-beta, wendwilsonite, cobaltaustinite and heterogenite. The empirical formula is (electron microprobe) $(Co_{2.3}Mg_{0.5}Ni_{0.2})(AsO_4)_{2.0} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3442, 3160s, 3028s, 2280sh, 1900w, 1660sh, 1577, 885, 822s, 782s, 710sh, 566, 494, 454, 417.

As53 **Schultenite** $PbH(AsO_4)$

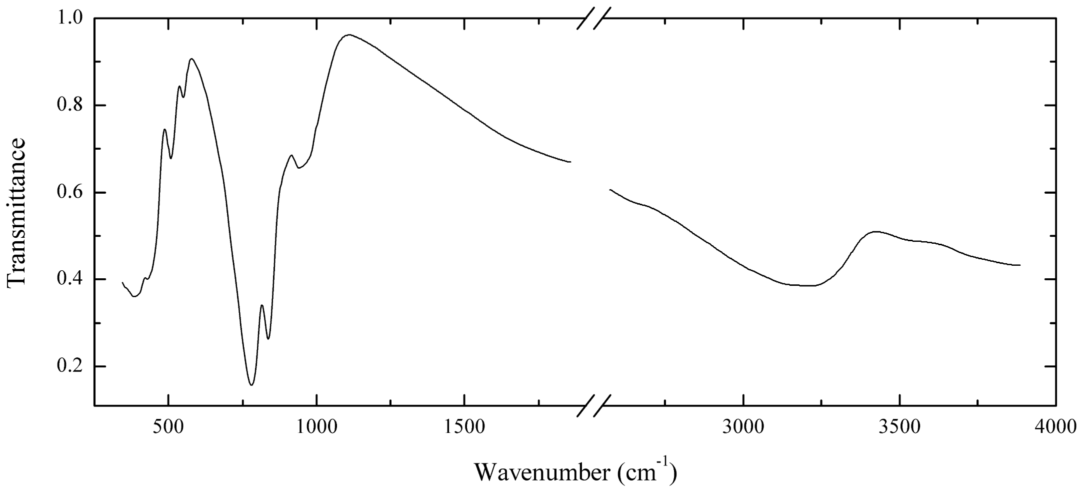


Locality: Eduard mine, Jáchymov, Krušné Hory Mts. (Ore Mts.), Bohemia, Czech Republic.

Description: White, powdery. Confirmed by semiquantitative electron microprobe analysis.

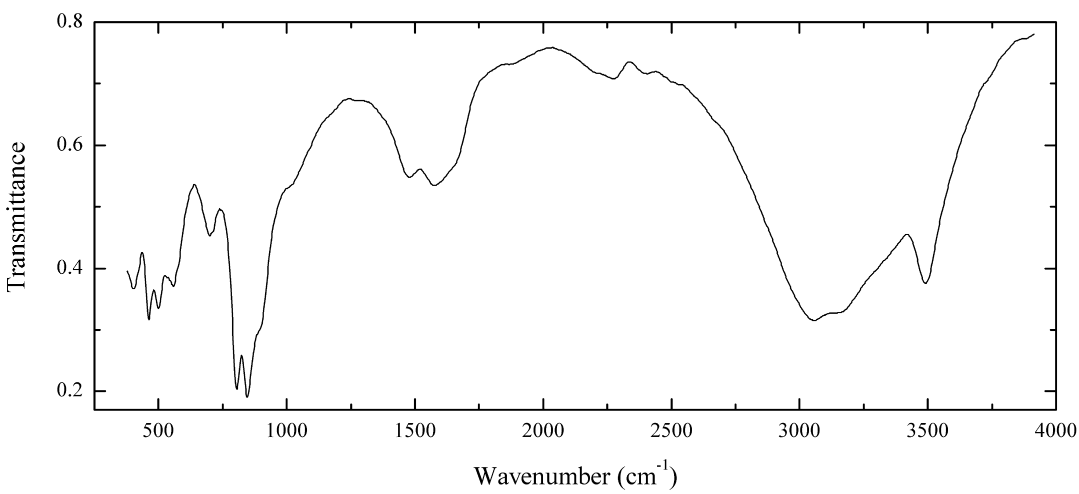
Wavenumbers (cm^{-1}): 2940w, 2750sh, 2130w, 1650, 1390w, 1270sh, 1080sh, 1025w, 810s, 752, 463, ~375.

As54 Arsendescloizite $PbZn(AsO_4)(OH)$



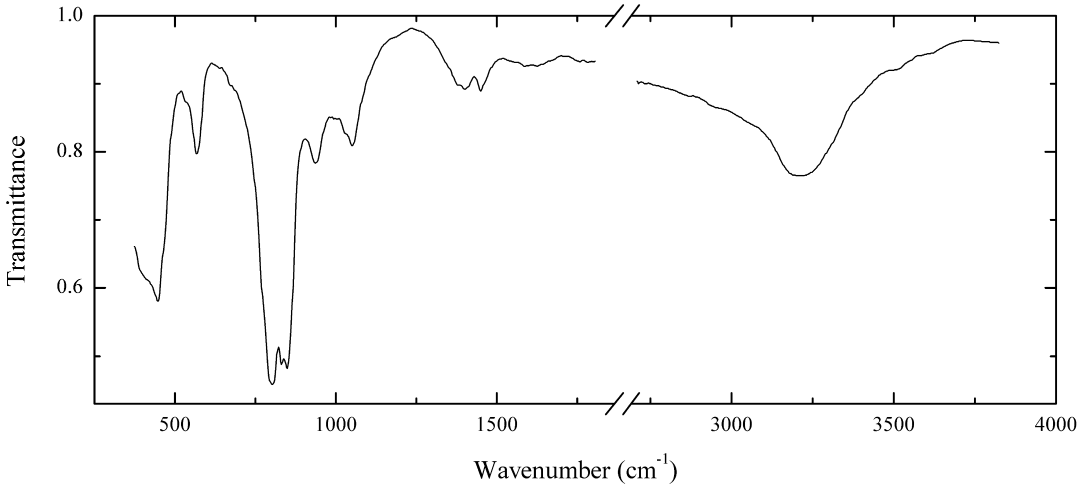
Locality: Mina Ojuela (Ojuela mine), Mapimi, Durango, Mexico.
Description: Grey-green crust on rock. Identified by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3200, 3150sh, 947, 836s, 782s, 551w, 506, 430, 399s.

As55 Hörnesite $Mg_3(AsO_4)_2 \cdot 8H_2O$



Locality: Ste Marie-aux-Mines mining area, Vosges mountains, Alsace, France.
Description: White spherulites in the association with calcite on ore. Identified by semiquantitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3475s, 3130s, 3040s, 2400w, 2270w, 2200sh, 1850sh, 1670sh, 1575, 1475, 1005sh, 890sh, 843s, 804s, 698, 551, 498, 460s, 410.

As56 Conichalcite $CaCu^{2+}(AsO_4)(OH)$

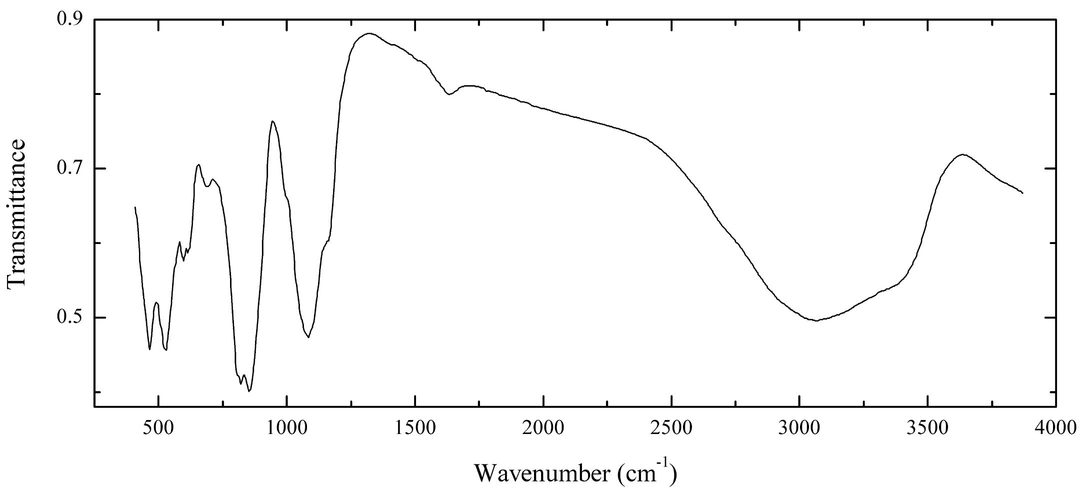


Locality: Hagendorf, Waidhaus, Oberpfalz, Bavaria, Germany.

Description: Grass-green semitransparent crust on rock. Contains admixture of PO_4^{3-} groups (the band at 1,050 cm^{-1}).

Wavenumbers (cm^{-1}): 3200, 1610w, 1450, 1400, 1050, 935, 847s, 831s, 805s, 795sh, 569, 447s, 420sh.

As57 Segnitite $PbFe^{3+}{}_3H(AsO_4)_2(OH)_6$

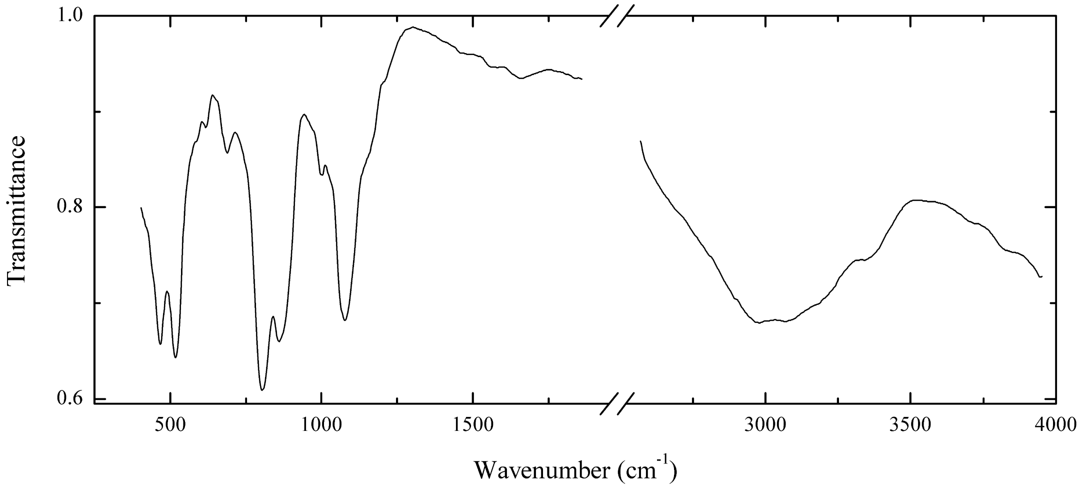


Locality: Baccu Locci, California, USA.

Description: Olive green crust on schist. The empirical formula is (electron microprobe) $Pb_{1.0}Fe_{2.4}Al_{0.4}Cu_{0.3}[(AsO_4)_{1.4}(SO_4)_{0.4}(PO_4)_{0.1}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3320sh, 3030, 1640w, 1155sh, 1085s, 1000sh, 850s, 818s, 805sh, 687w, 610sh, 595, 528s, 467s.

As58 Segnitite $PbFe^{3+}{}_3H(AsO_4)_2(OH)_6$

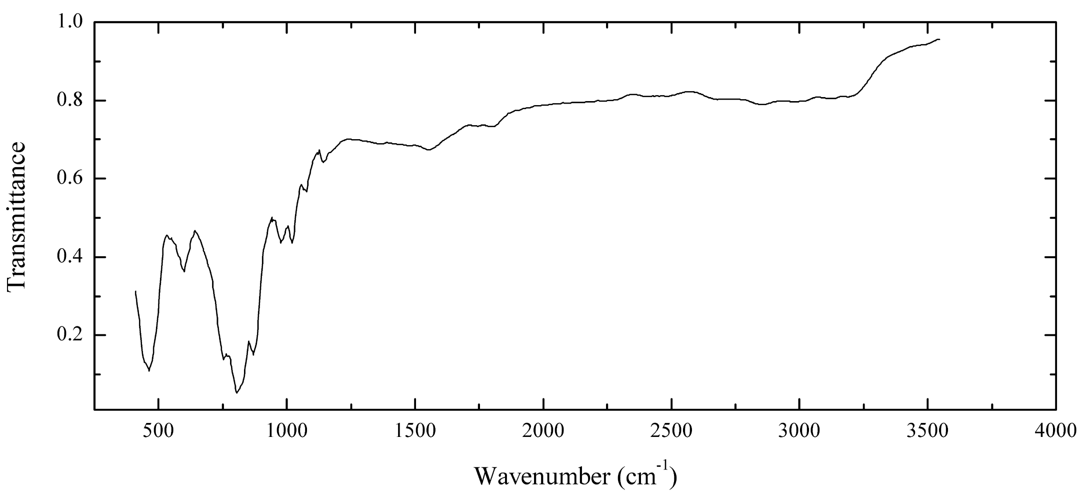


Locality: Gestoso mine, Serra da Freita, Arouca, Aveira district, Portugal.

Description: Brown-green crust on rock in the association with carminite, beudantite and mimetite. The empirical formula is (electron microprobe) $Pb_{1.0}(Fe_{2.5}Al_{0.5})[(AsO_4)_{1.5}(PO_4)_{0.3}(SO_4)_{0.15}(SiO_4)_{0.05}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3300, 3150sh, 3040, 2950, 2750sh, 1645w, 1560w, 1470w, 1150sh, 1075s, 996, 860s, 805s, 685, 612w, 517s, 468s.

As59 Carminite $PbFe^{3+}{}_2(AsO_4)_2(OH)_2$

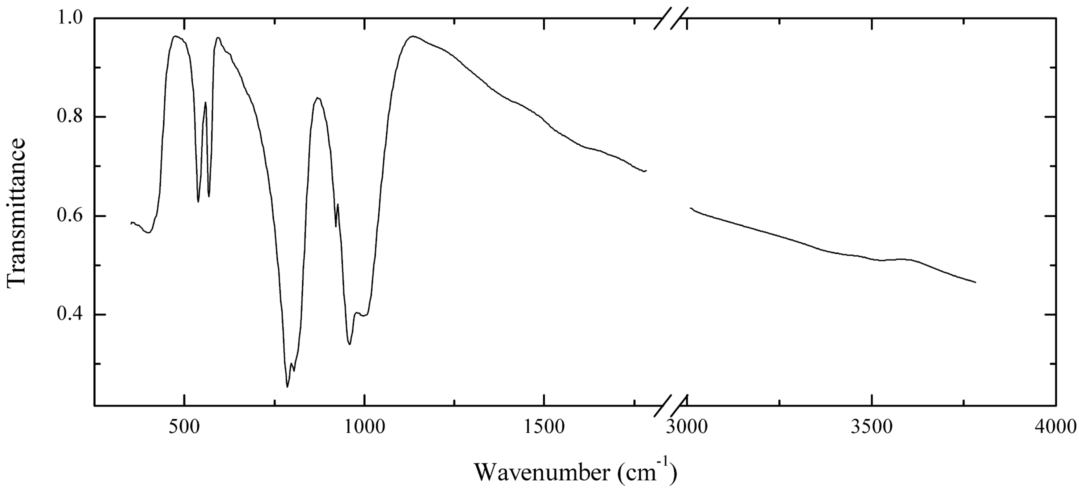


Locality: Gestoso mine, Serra da Freita, Arouca, Aveira district, Portugal.

Description: Red crust on rock in the association with segnitite, beudantite and mimetite. The empirical formula is (electron microprobe) $Pb_{1.08}(Fe_{1.76}Al_{0.12}Cu_{0.08})[(AsO_4)_{1.70}(PO_4)_{0.19}(SiO_4)_{0.04}(SO_4)_{0.02}](OH,H_2O)_2$.

Wavenumbers (cm^{-1}): 3180, 3090, 3000, 2830, 2660. . ., 1800w, 1550w, 1140w, 1068w, 1020, 977, 869s, 820sh, 807s, 756s, 596, 460s, 445sh.

As60 Mimetite $Pb_5(AsO_4)_3Cl$

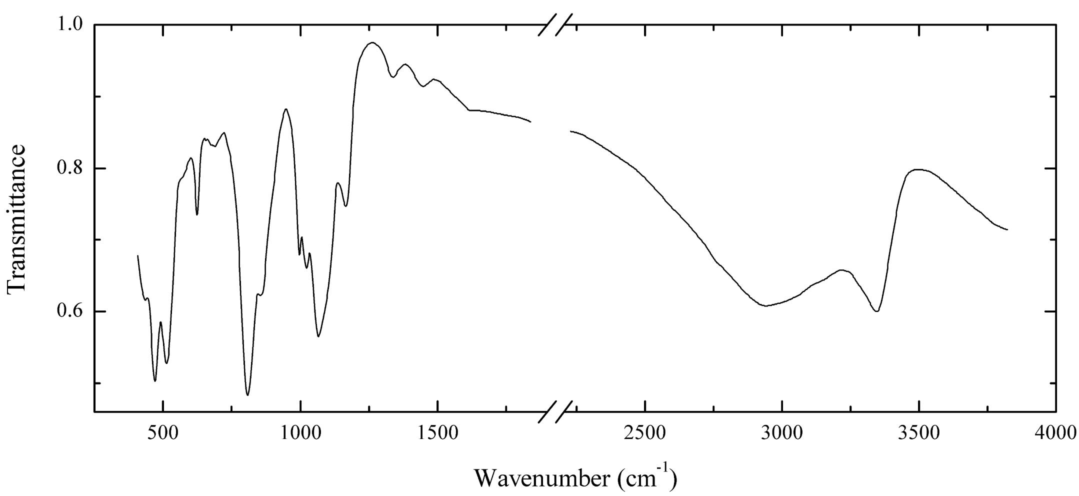


Locality: Dry Gill mine, Caldbeck Fells, Cumbria, England, estoso mine, Serra da Freita, Arouca, Aveira district, Portugal.

Description: Yellow imperfect short-prismatic crystals in the association with hollandite. P-bearing variety. The empirical formula is (electron microprobe) $Pb_{5.0}[(AsO_4)_{2.1}(PO_4)_{0.9}]Cl_{1.0}$

Wavenumbers (cm^{-1}): 998s, 958s, 923, 815sh, 806s, 786s, 568, 539, 420sh, 402.

As61 Beudantite $PbFe^{3+}{}_3(AsO_4)(SO_4)(OH)_6$

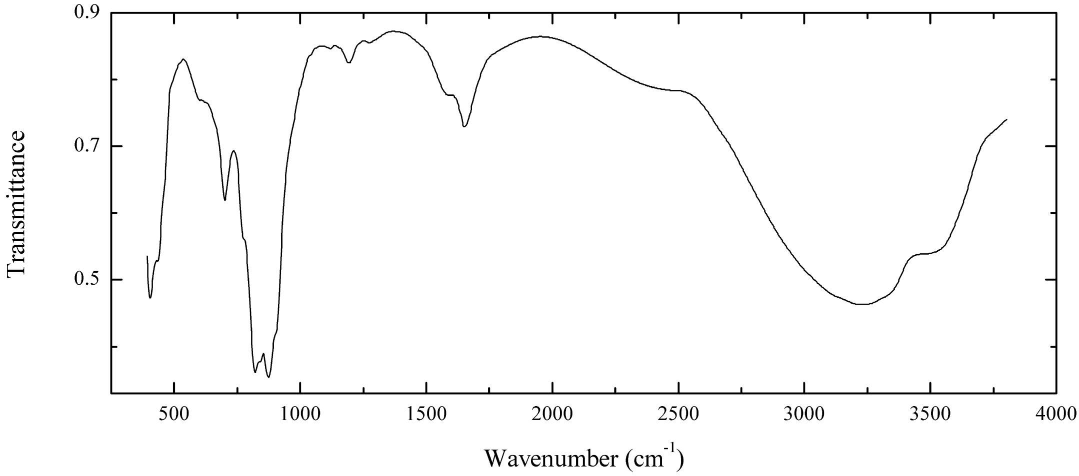


Locality: Gestoso mine, Serra da Freita, Arouca, Aveira district, Portugal.

Description: Brown crust on rock in the association with carminite, segnitite, mimetite and lepidocrocite. The empirical formula is (electron microprobe) $Pb_{1.0}(Fe_{2.7}Al_{0.3})[(AsO_4)_{1.2}(PO_4)_{0.2}(SO_4)_{0.6}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3335, 2930, 1620w, 1452w, 1337w, 1166, 1100sh, 1068s, 1021, 996, 855, 806s, 788w, 625, 513s, 470s, 435.

As62 Guérinite $Ca_5H_2(AsO_4)_4{\cdot}9H_2O$

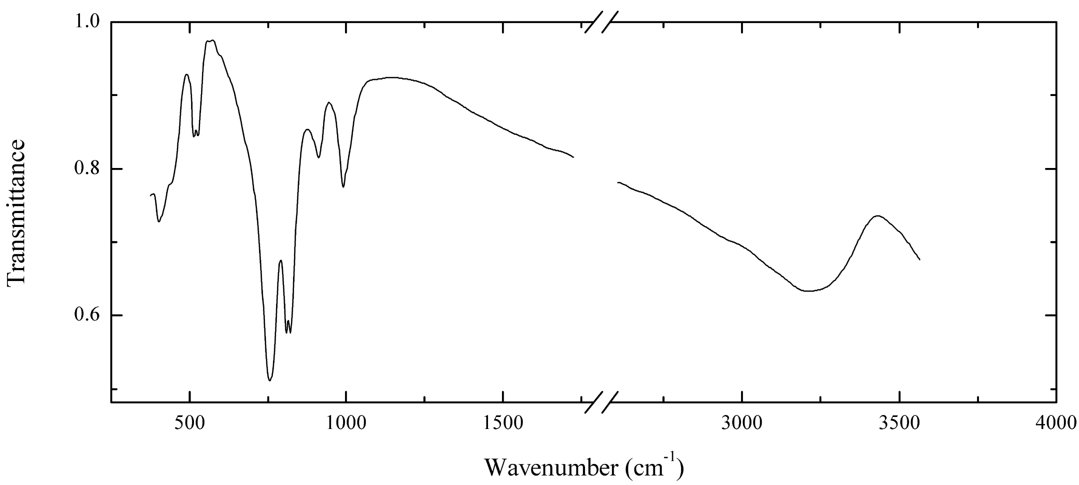


Locality: Wechselschacht, Richelsdorfer Gebiet (Richelsdorf region), 15 km E of Bebra, Hessen, Germany.

Description: White. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3490, 3220s, 1655, 1590, 1270w, 1195w, 1120w, 905sh, 875s, 844s, 822s, 773, 703, 600sh, 435, 407s.

As63 Duftite $PbCu(AsO_4)(OH)$



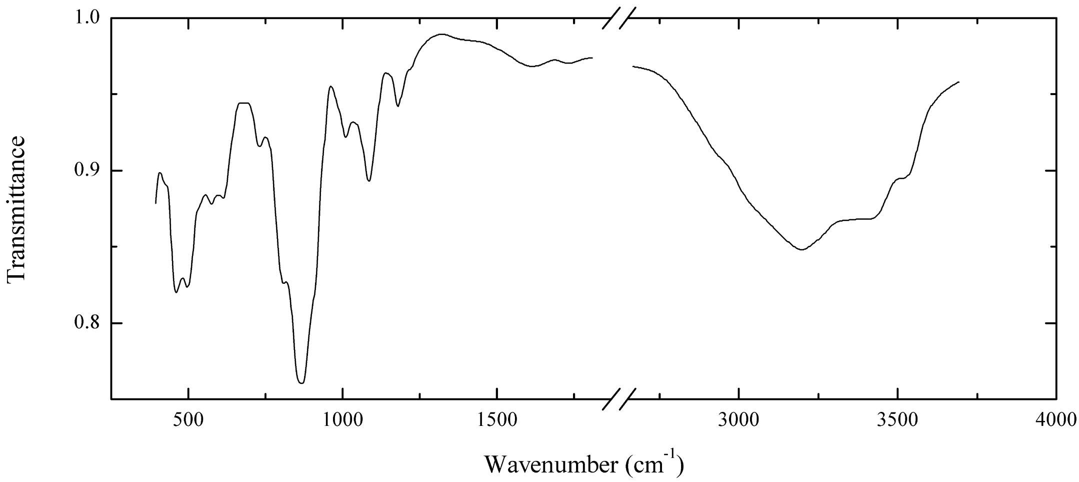
Locality: Berezovskoe gold deposit, near Ekaterinburg, Middle Urals, Russia.

Description: Olive green veinlet.

Description: Identified by powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Pb_{0.94}Ca_{0.04}Cu_{1.03}[(AsO_4)_{0.88}(PO_4)_{0.10}(CrO_4)_{0.02}](OH)$.

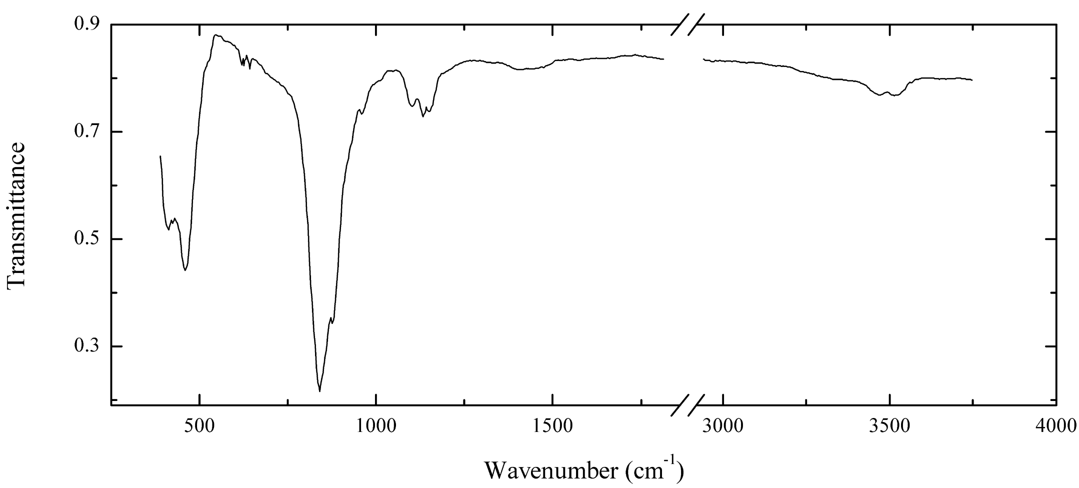
Wavenumbers (cm^{-1}): 3200, 1010sh, 990, 910, 821s, 809s, 756s, 526, 514, 441, 405.

As64 Dussertite $BaFe_3(AsO_4)_2(OH,H_2O)_6$



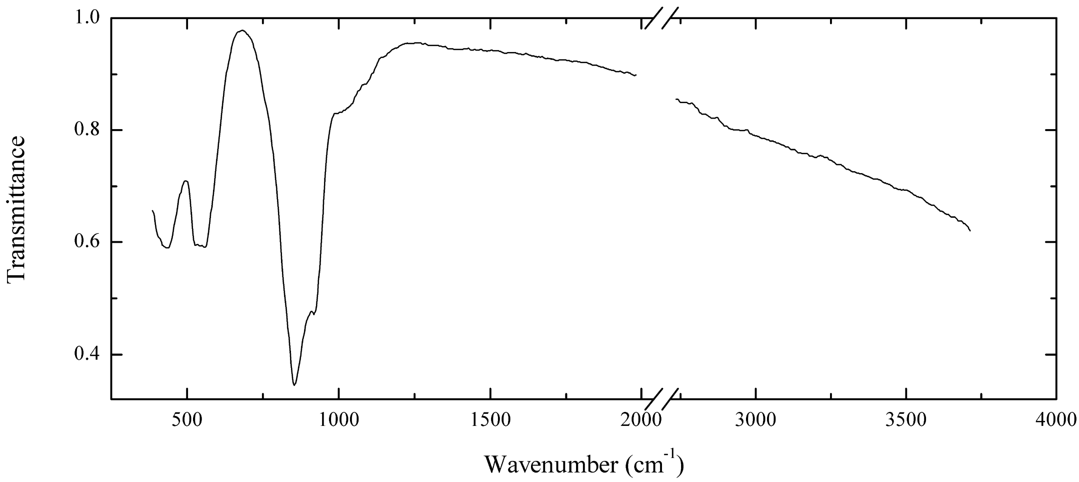
Locality: Grube Clara (Clara mine), Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.
Description: Green spherulites on quartz.
Wavenumbers (cm^{-1}): 3510, 3400, 3180, 1820w, 1600w, 1215sh, 1187, 1091, 1012w, 900sh, 873s, 860s, 810, 739w, 600, 577, 500, 467.

As65 Johnbaumite $Ca_5(AsO_4)_3(OH)$



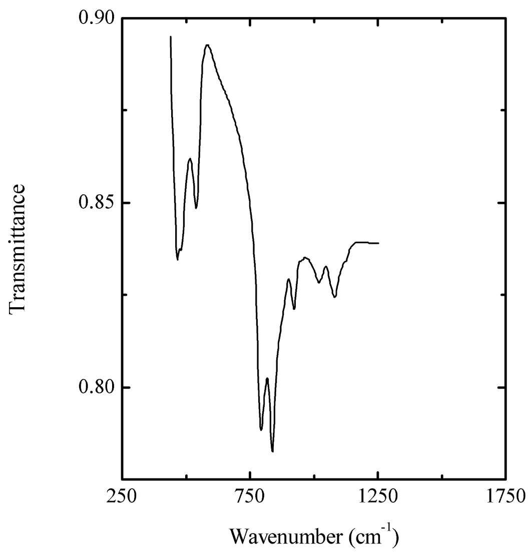
Locality: Solongo deposit, Transbaikal Region, Buryatia, Russia (core of a borehole).
Description: Light-pink massive, in the association with kurchatovite, fedorovskite, frolovite and ludwigite. Identified by electron microprobe analysis and powder X-ray diffraction pattern.
The empirical formula is (electron microprobe, the content of H_2O by TGA data, $Z = 1$) $Ca_{10.16}Mn_{0.05}[(AsO_4)_{5.89}(PO_4)_{0.04}(SiO_4)_{0.04}(SO_4)_{0.03}](OH)_{0.82}Cl_{0.77}O_{0.32}F_{0.18}\cdot 0.12H_2O$.
Wavenumbers (cm^{-1}): 3496w, 3445w, 1465w, 1415w, 1150, 1131, 1102, 1015sh, 955, 875s, 850sh, 837s, 638w, 624w, 616w, 520sh, 458s, 410.

As66 Durangite $NaAl(AsO_4)F$



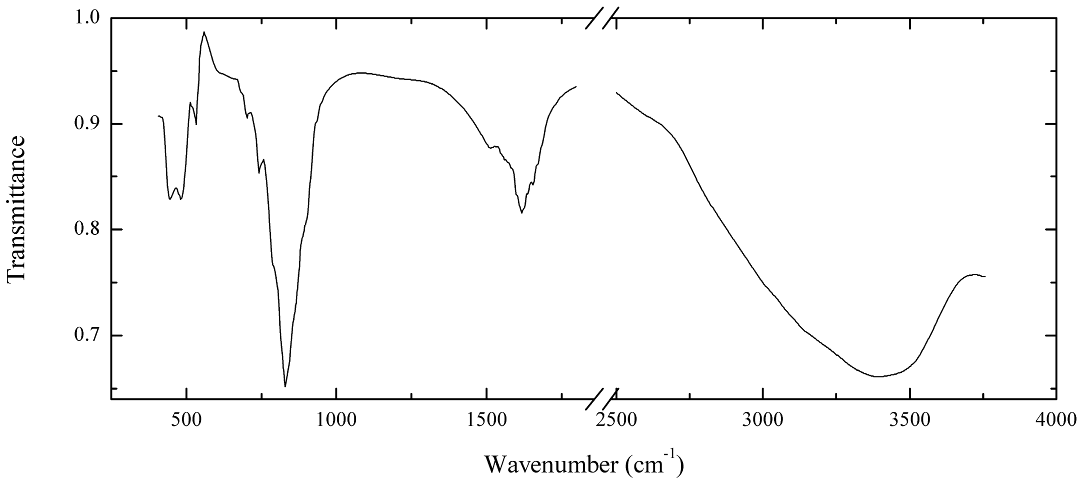
Locality: Barranca tin mine (near Coneto), Durango, Mexico (type locality).
Description: Orange crystals.
Wavenumbers (cm^{-1}): 1080sh, 1010sh, 920s, 854s, 755sh, 558, 546, 532, 427.

As67 Zdeněkite $NaPbCu_5(AsO_4)_4Cl{\cdot}5H_2O$



Locality: Cap Garonne mine, near Le Pradet, Var, France (type locality).
Description: Light blue spherulites.
Wavenumbers (cm^{-1}): 1092, 1022, 925, 870sh, 837s, 792s, 537, 475, 440s.

As69 Yvonite $Cu(AsO_3OH)·2H_2O$

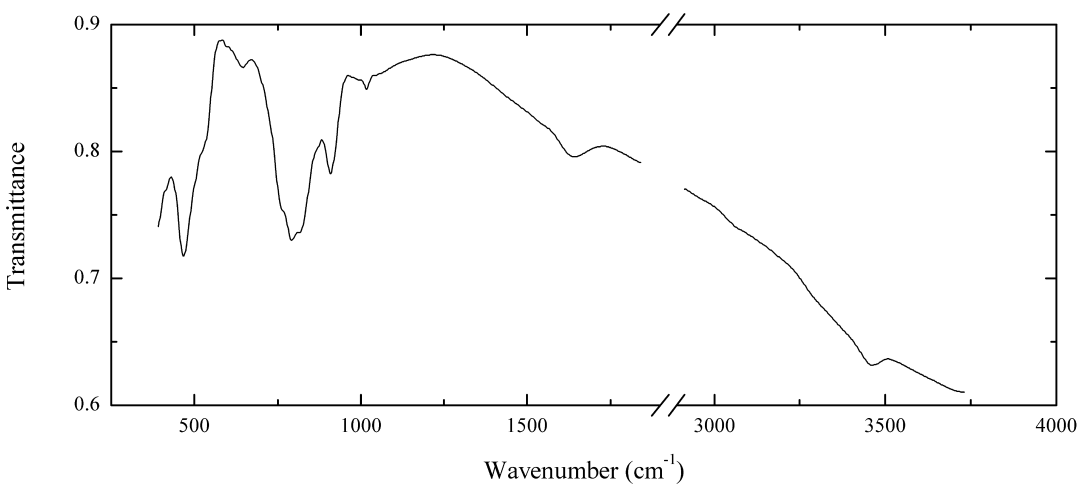


Locality: Salsigne mine, Montagne Noire, 15 km north of Carcassonne, Aude department, France (type locality).

Description: Light blue spherulites (to 0.25 mm) in the association with pushcharovskite and geminite.

Wavenumbers (cm^{-1}): 3380s, 3100sh, 1622, 1560sh, 1520w, 900sh, 870sh, 832s, 800sh, 755, 710w, 537, 489, ~435.

As70 Cobaltlotharmeyerite $Ca(Co,Fe^{3+},Ni)_2(AsO_4)_2(OH,H_2O)_2$

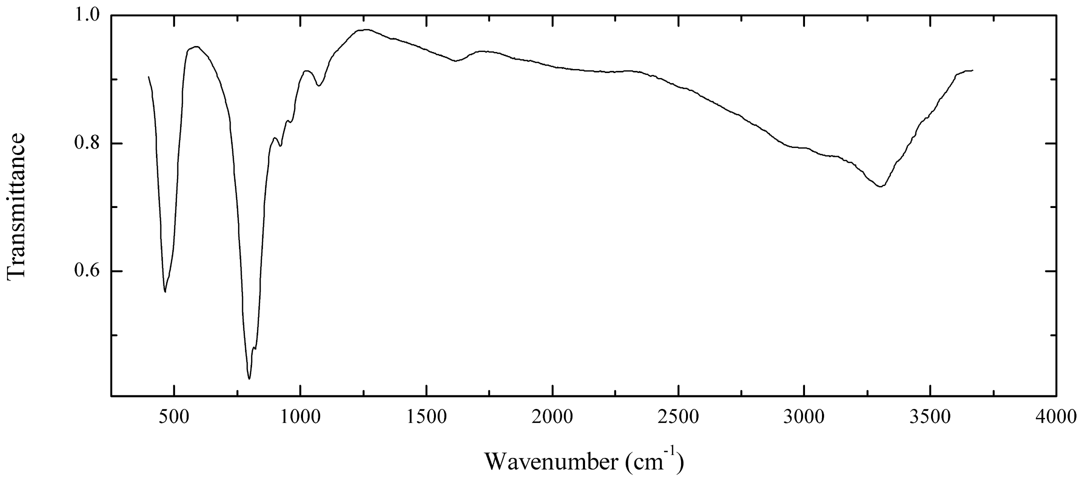


Locality: Roter Berg mining area, near Schneeberg, Saxony, Germany (type locality).

Description: Brown crystal with red streak. The empirical formula is (electron microprobe) $Ca_{1.00}(Co_{0.63}Fe_{0.56}Ni_{0.46}Al_{0.29}Zn_{0.02}Mn_{0.01})(AsO_4)_{2.00}(OH,H_2O)_2$.

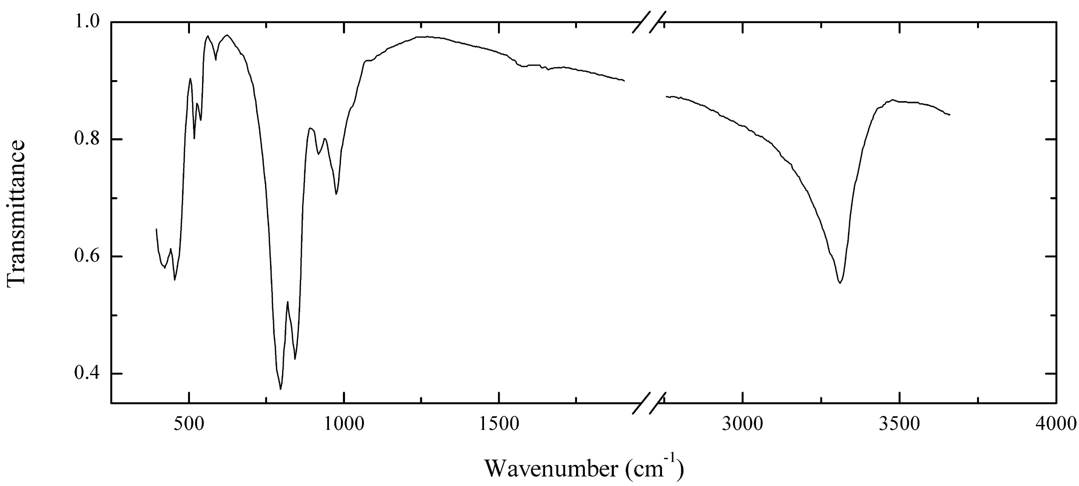
Wavenumbers (cm^{-1}): 3450, 1645, 1014w, 911, 822s, 793s, 765sh, 647w, 525sh, 466s.

As71 Cornubite $Cu_5(AsO_4)_2(OH)_4$



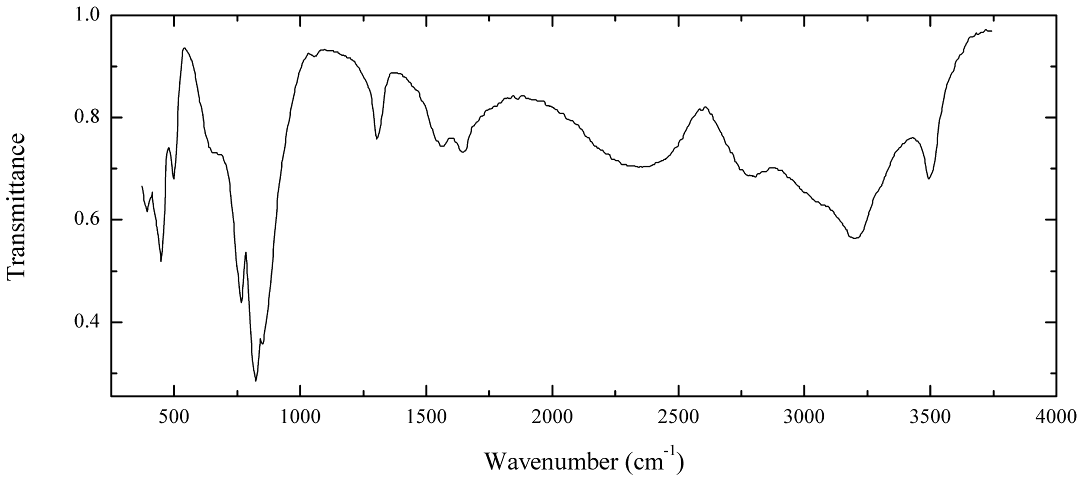
Locality: Tarot, Zeravshan range, Tajikistan.
Description: Dark green spherulites.
Wavenumbers (cm^{-1}): 3290, 3100sh, 2980sh, 1620w, 1083w, 964, 919, 822s, 797s, 480sh, 460s.

As72 Cobaltaustinite $CaCo(AsO_4)(OH)$



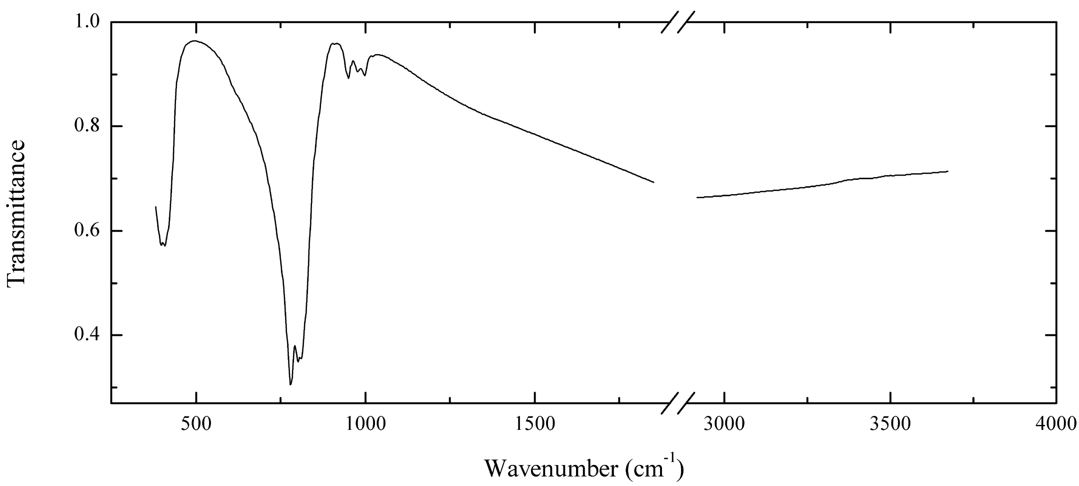
Locality: Dome Rock copper deposit, 42 km N of Mingray, South Australia, Australia (type locality).
Description: Dark green crusts. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3285, 1655w, 1575w, 1075w, 1030sh, 974, 918, 842s, 830sh, 797s, 775sh, 650sh, 587w, 535, 516, 455s, 418.

As73 Koritnigite $ZnH(AsO_4)\cdot H_2O$



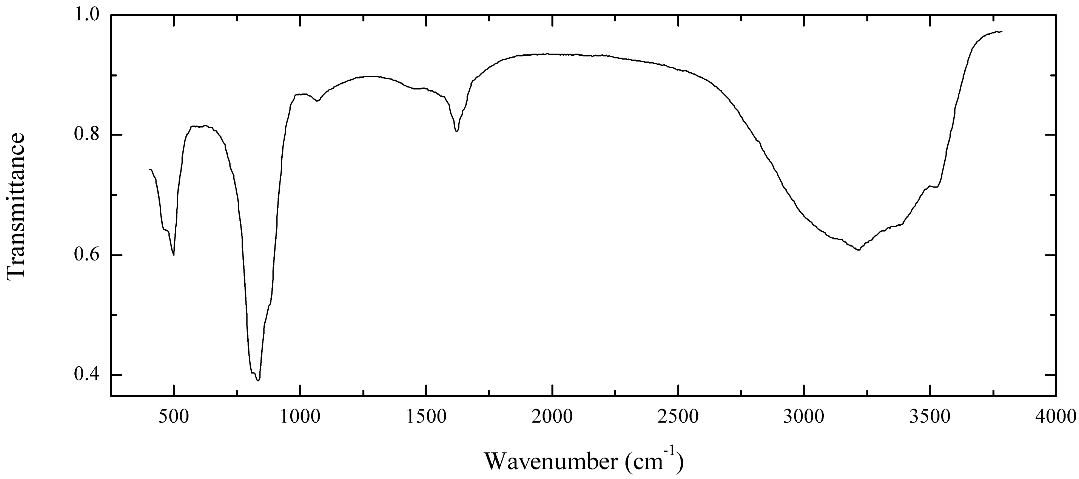
Locality: Jáchymov, Bohemia, Krušné Hory Mts. (Ore Mts.), Czech Republic.
Description: Pink spherulites. The empirical formula is (electron microprobe) $(Zn_{0.86}Co_{0.15}Mn_{0.01})H_{0.96}(AsO_4)_{1.00}\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3480, 3270sh, 3175s, 3060sh, 2780, 2350, 1647, 1565, 1308, 1053w, 880sh, 853s, 825s, 767s, 650sh, 497, 425sh, 447, 395.

As75 Clinomimetite $Pb_5(AsO_4)_3Cl$



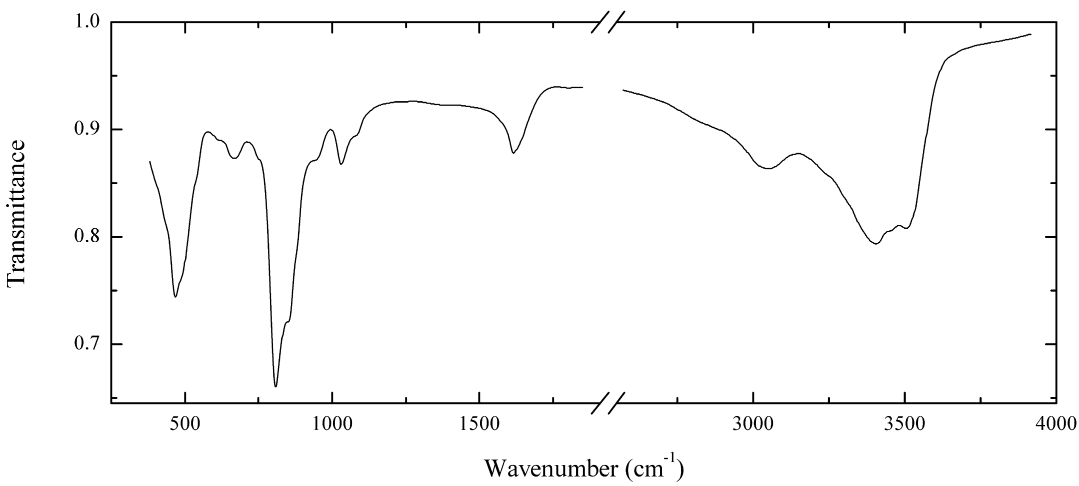
Locality: Johanngeorgenstadt, Erzgebirge, Sachsen, Germany (type locality).
Description: Yellow prismatic crystal. The empirical formula is (electron microprobe) $Pb_{5.03}[(AsO_4)_{2.98}(PO_4)_{0.02}]Cl_{0.95}O_{0.05}$.
Wavenumbers (cm^{-1}): 1002w, 985w, 954w, 816s, 806s, 784s, 620sh, 408, 398.

As76 Kaňkite $Fe^{3+}(AsO_4)\cdot3.5H_2O$



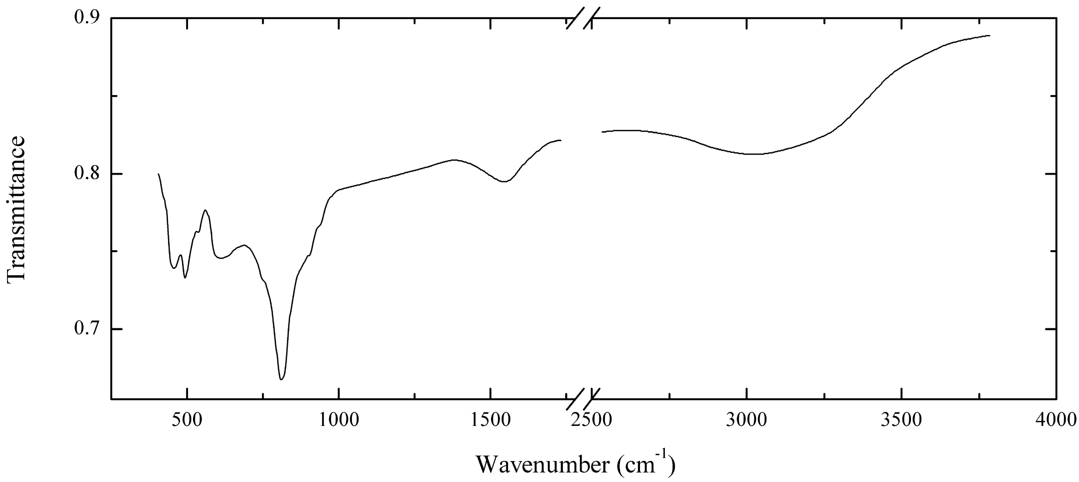
Locality: Kaňk, 5 km N of Kutná Hora, Bohemia, Czech Republic (type locality).
Description: Green-yellow spherulites. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3515, 3370sh, 3207s, 3110sh, 1622, 1455w, 1074w, 885sh, 833s, 808s, 755sh, 491, 460sh.

As77 Tyrolite CO_3-free $Ca_2Cu^{2+}{}_9(AsO_4)_4\,(OH)_{10}\cdot10H_2O$



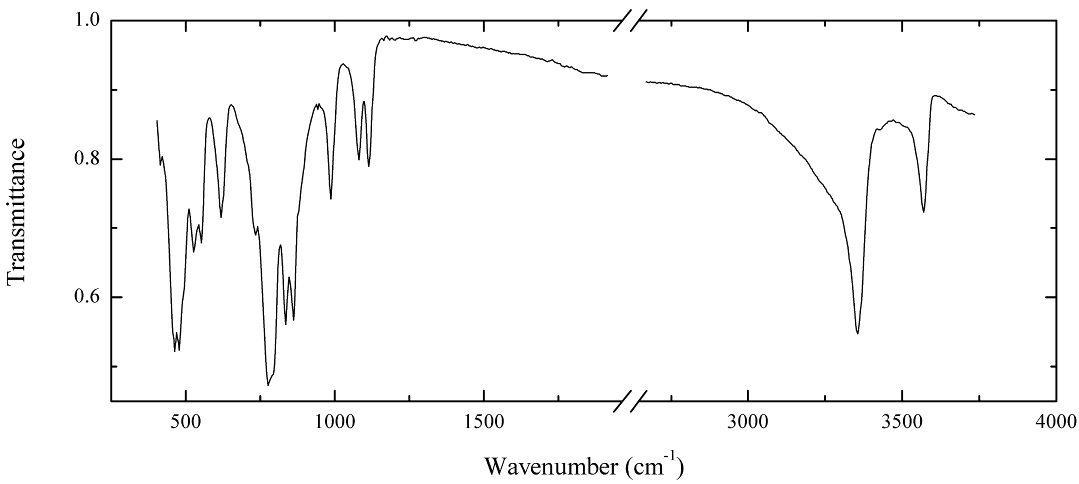
Locality: Bolivia mine, Nevada, USA.
Description: Green radial aggregates of prismatic crystals.
Wavenumbers (cm^{-1}): 3480, 3425, 3380, 3020, 1613, 1080sh, 1030, 940sh, 875sh, 853s, 806s, 667, 603w, 535sh, 500sh, 467, 430sh.

As78 Karibibite $Fe^{3+}{}_2As^{3+}{}_4(O,OH)_9$



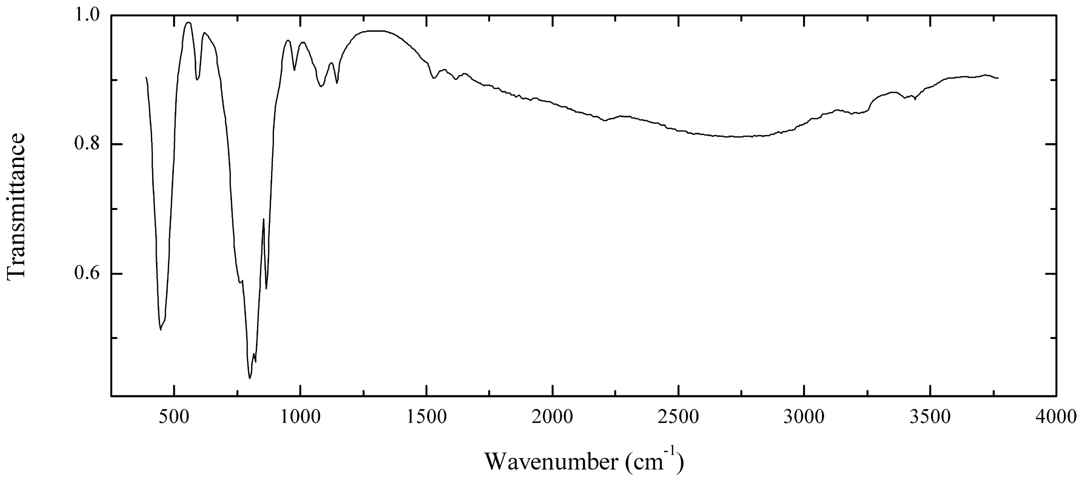
Locality: Belaya Gora, Kalba Range, Kazakhstan. Investigated by A.V. Voloshin.
Description: Yellow powdery in the association with schneiderhöhnite; pseudomorph after löllingite.
Wavenumbers (cm^{-1}): 3200sh, 3010, 1555w, 940sh, 900sh, 840sh, 808s, 760sh, 591, 544w, 492, 460.

As79 Clinoclase $Cu^{2+}{}_3(AsO_4)(OH)_3$



Locality: Wheal Gorland, Gwennap, Cornwall, England, UK (type locality).
Description: Green radial axial aggregates of prismatic crystals. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3550, 3335s, 1115, 1082, 986, 862s, 833s, 790sh, 776s, 727, 615, 549, 525, 490sh, 473s, 460s, 409w.

As80 Carminite $PbFe^{3+}_2(AsO_4)_2(OH)_2$

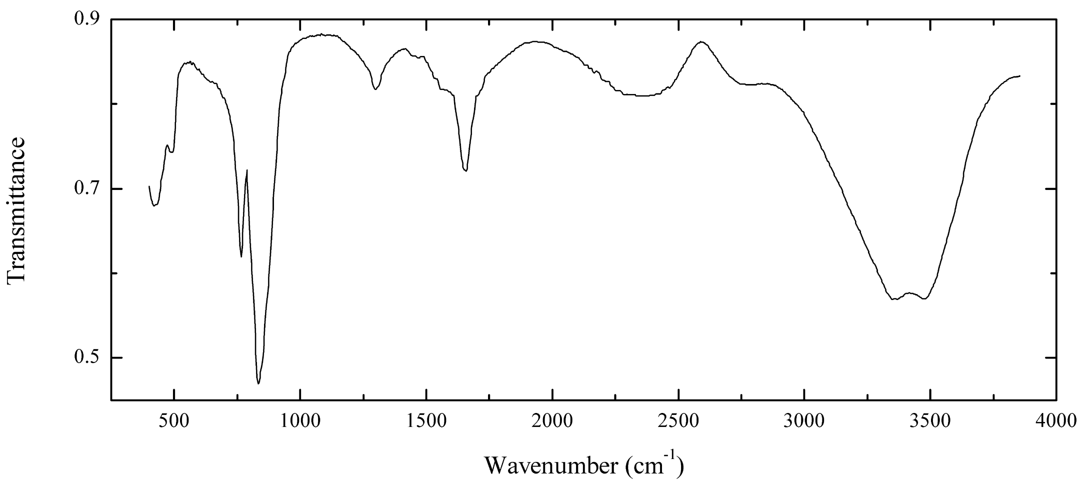


Locality: Benjamin Hill, Sonora, Mexico.

Description: Red crystals. Investigated by A.F. Bushmakin.

Wavenumbers (cm^{-1}): 3420w, 3375w, 3200w, 2700 (broad), 2210w, 1620w, 1532w, 1146, 1083, 979, 864s, 821s, 799s, 761s, 590, 460sh, 447s.

As81 Krautite $Mn^{2+}[(AsO_3(OH)]\cdot H_2O$

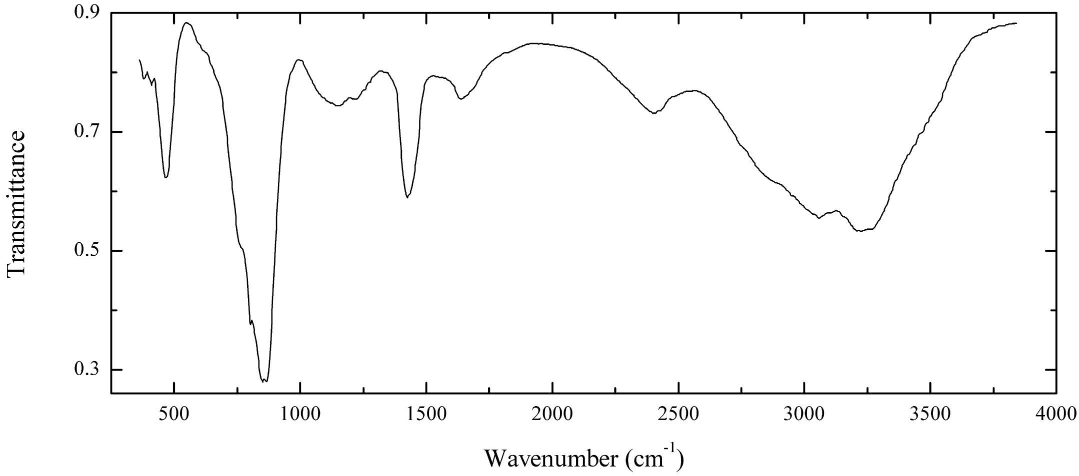


Locality: Jáchymov, Bohemia, Krušné Hory Mts. (Ore Mts.), Czech Republic.

Description: Pink, massive. The empirical formula is (electron microprobe) $(Mn_{0.48}Ni_{0.20}Zn_{0.16}Co_{0.08}Mg_{0.05}Fe_{0.02})[AsO_3(OH)]\cdot nH_2O$.

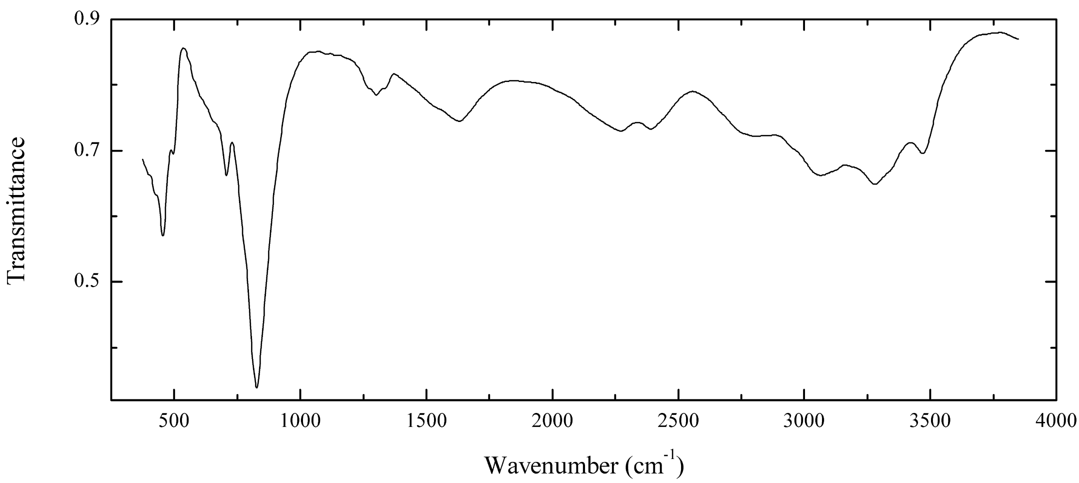
Wavenumbers (cm^{-1}): 3455s, 3340s, 2760sh, 2350 (broad), 1655, 1575sh, 1460w, 1300, 850sh, 835s, 810sh, 766s, 490, 423.

As82 Kaatialaite $Fe^{3+}(H_2AsO_4)_3{\cdot}5H_2O$



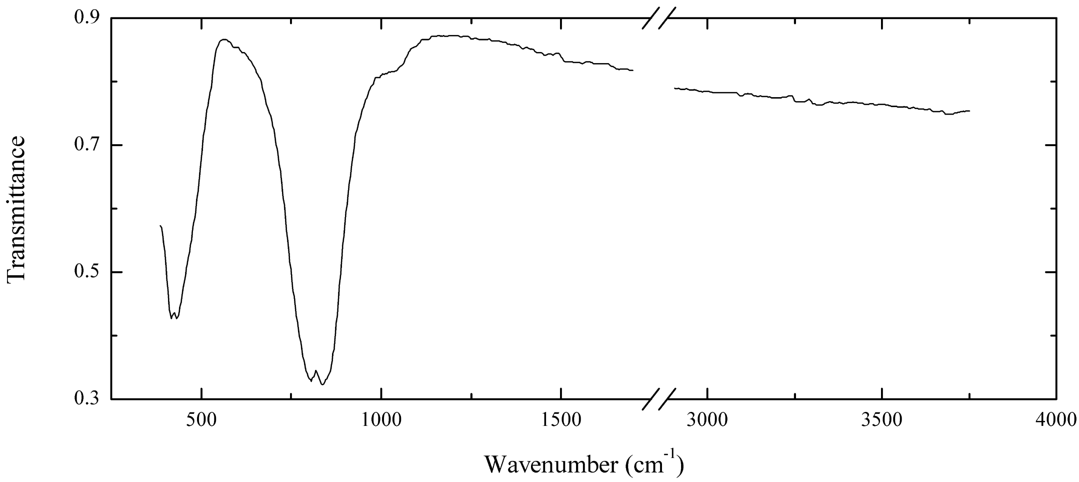
Locality: Jáchymov, Bohemia, Krušné Hory Mts. (Ore Mts.), Czech Republic.
Description: White, powdery.
Wavenumbers (cm^{-1}): 3210, 3035, 2850sh, 2400, 1685sh, 1640, 1427, 1215w, 1145, 864s, 850s, 801, 760sh, 468, 406w, 376w.

As83 Cobaltkoritnigite $Co[AsO_3(OH)]{\cdot}H_2O$



Locality: Tunaberg, 14 km southwest of Nykoping, Sweden.
Description: Pink spherulites forming crusts on cobaltite crystals, in the association with aplowite. The empirical formula is (electron microprobe) $(Co_{0.87}Mg_{0.07}Ni_{0.04}Zn_{0.03})_{\Sigma 1.01}[AsO_3(OH)]{\cdot}H_2O$.
Wavenumbers (cm^{-1}): 3460, 3265, 3050, 2800, 2390, 2275, 1630, 1540sh, 1335w, 1304w, 1270sh, 830s, 815sh, 780sh, 709, 660sh, 610sh, 495, 453s, 425sh, 400sh.

As84 Caryinite $NaCa_2Mn_2(AsO_4)_3$

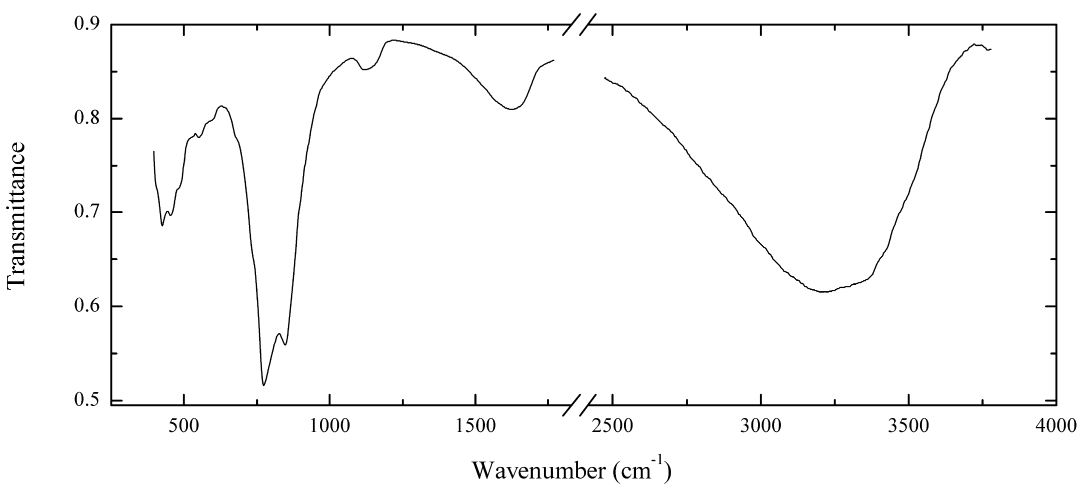


Locality: Trädgårdsvarpen, Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Brownish-red, massive, in the association with pyroxene, Mn-bearing phlogopite and calcite.

Wavenumbers (cm^{-1}): 1020sh, 860sh, 834s, 800s, 440sh, 421s, 412s.

As85 Köttigite $Zn_3(AsO_4)_2{\cdot}8H_2O$

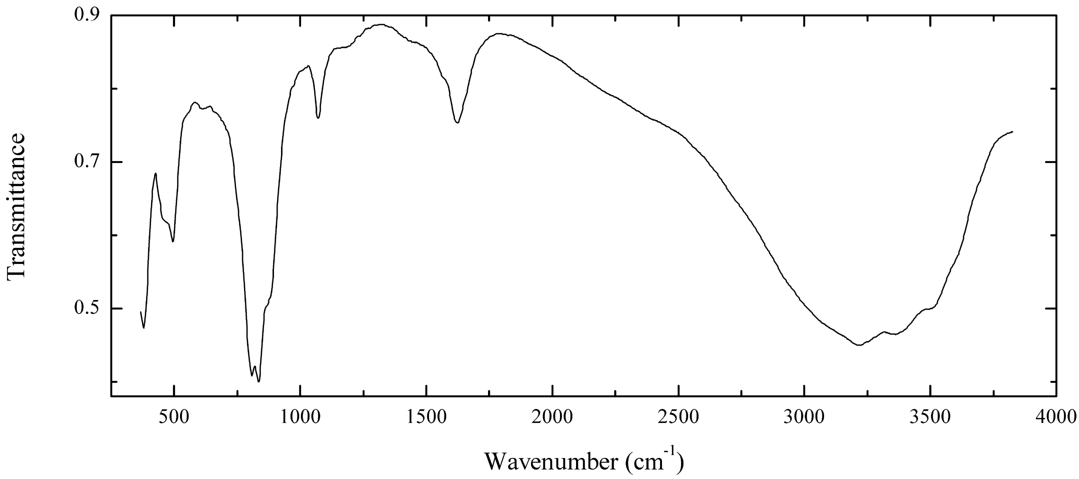


Locality: Mina Ojuela (Ojuela mine), Mapimi, Durango, Mexico.

Description: Dark green crystals to 2 mm. Identified by semiquantitative electron microprobe analysis and IR spectrum.

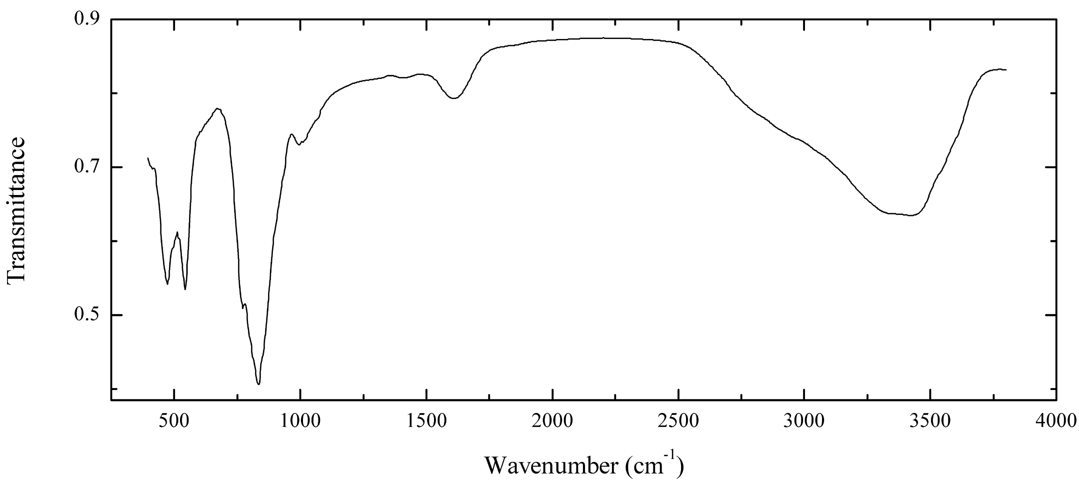
Wavenumbers (cm^{-1}): 3340sh, 3210, 1630, 847s, 775s, 543, 485, 460, 429s.

As86 Kaňkite $Fe^{3+}(AsO_4)·3.5H_2O$



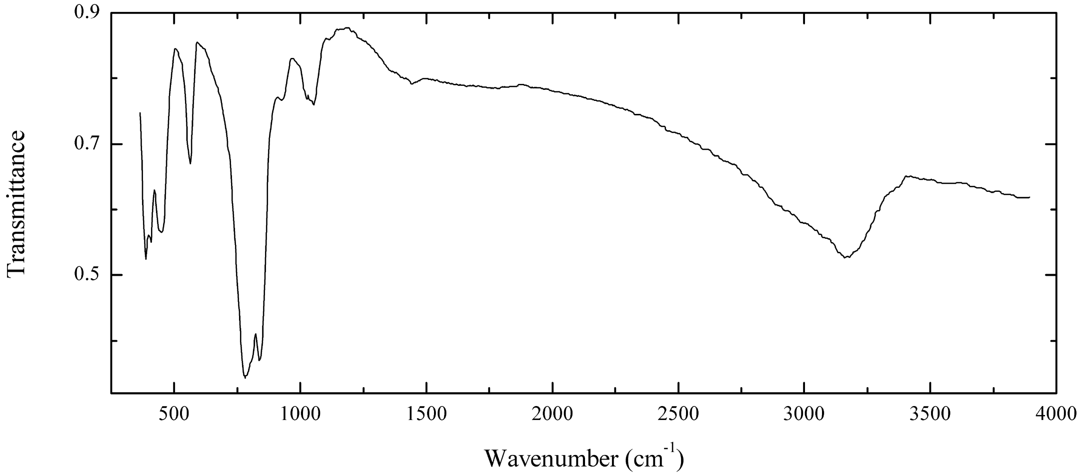
Locality: Munzig, Saxony, Germany.
Description: Greenish crusts, in the association with scorodite and zýkaite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3500, 3340, 3210, 1625, 1570sh, 1460sh, 1180w, 1076, 880sh, 835s, 808s, 612w, 492, 460sh, 365s.

As87 Cornwallite $Cu^{2+}{}_5(AsO_4)_2(OH)_4$



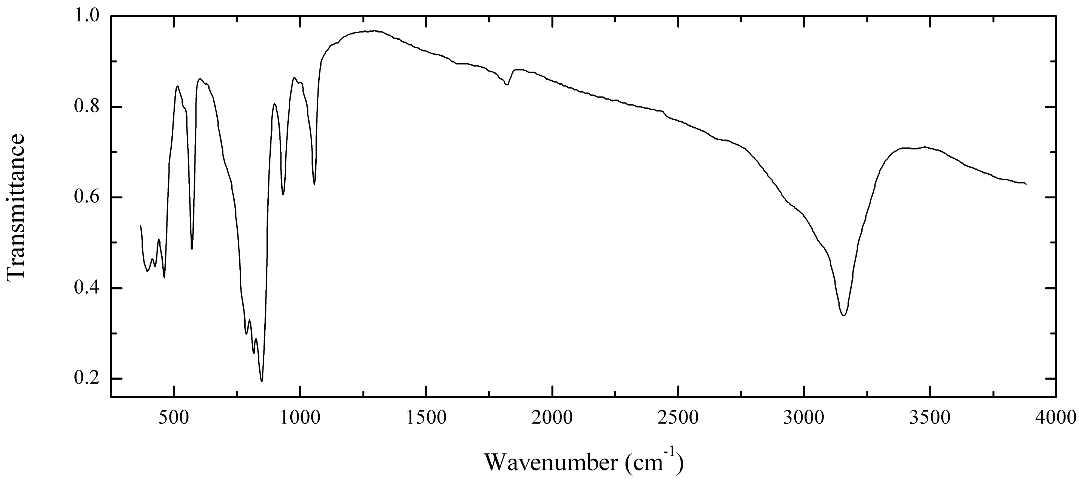
Locality: Horný Bartolomei hallery, Novoveská Huta, Spisska Nova Ves, Slovakia.
Description: Green colloform crust, in the association with other copper arsenates. Poor-crystallized H_2O-bearing variety.
Wavenumbers (cm^{-1}): 3570sh, 3520sh, 3410, 3320sh, 2900sh, 1615, 1075sh, 997, 900sh, 835s, 778s, 546s, 471s.

As88 Duftite $PbCu(AsO_4)(OH)$



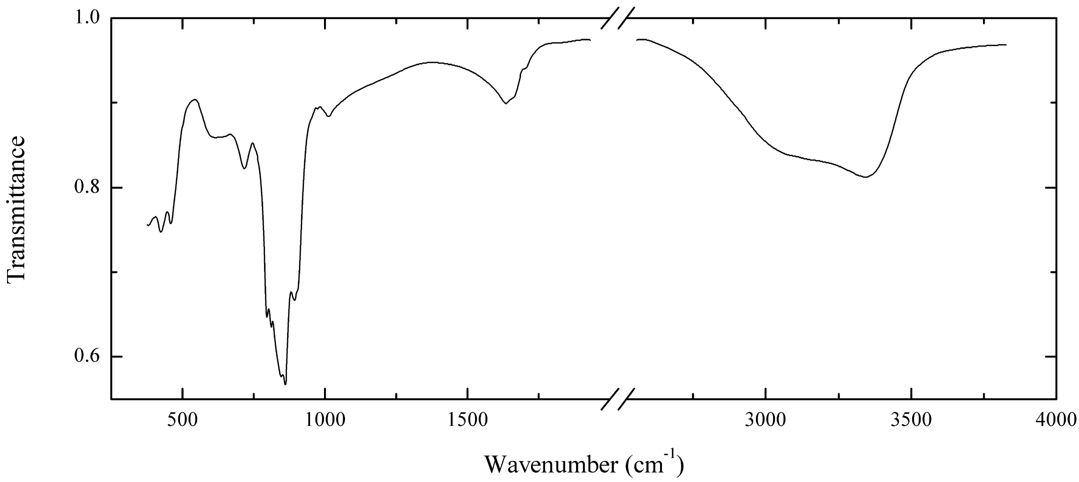
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: Olive green, massive. The empirical formula is (electron microprobe) $(Pb_{0.61}Ca_{0.39})Cu_{1.00}[(AsO_4)_{0.96}(PO_4)_{0.04}](OH)$.
Wavenumbers (cm^{-1}): 3145, 2980sh, 1445w, 1405sh, 1360sh, 1052, 1025w, 925w, 839s, 800sh, 780s, 561, 448, 407, 389s.

As89 Conichalcite $CaCu^{2+}(AsO_4)(OH)$



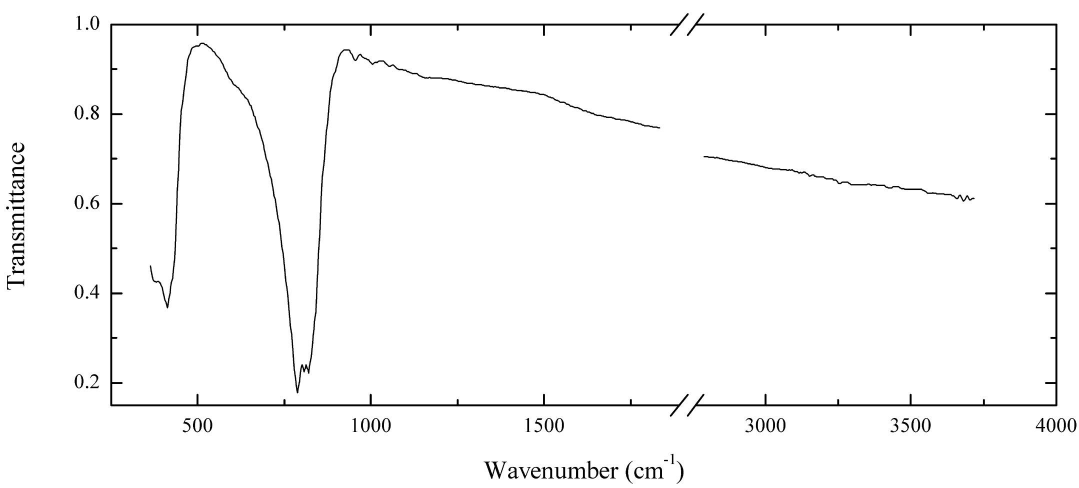
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.
Description: Green crystals to 1 mm. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3140s, 3050sh, 2940sh, 1815w, 1616w, 1060, 933, 848s, 816s, 789s, 775sh, 710sh, 571, 542w, 462, 450sh, 425, 400.

As90 Mcnearite $NaCa_5H_4(AsO_4)_5 \cdot 4H_2O$



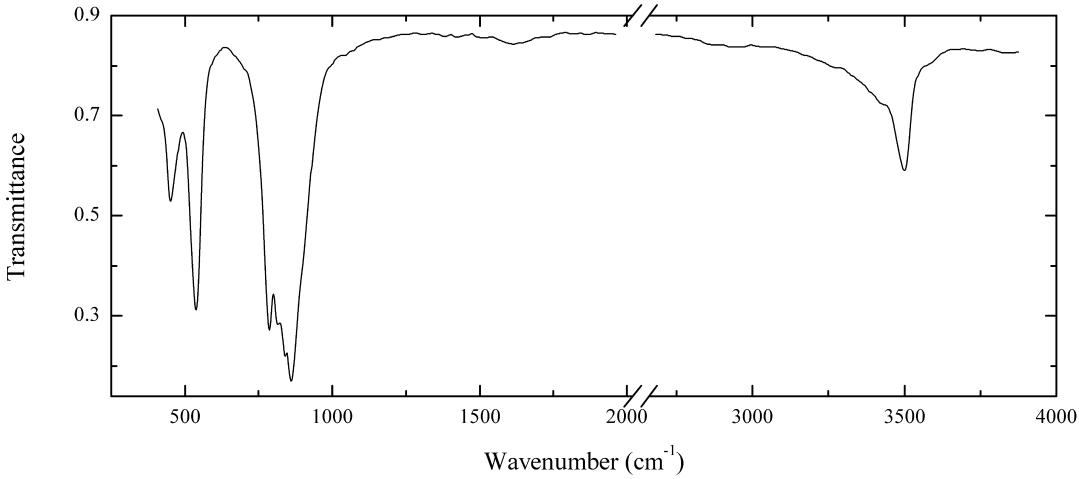
Locality: Grube Gottes, Sainte-Marie-aux-Mines, Vosges, France (type locality).
Description: White spherule with radiated constitution.
Wavenumbers (cm^{-1}): 3360, 3180sh, 1700sh, 1660sh, 1640, 1013w, 905sh, 891, 861s, 846s, 811, 796, 717, 616w, 454, 420.

As91 Mimetite $Pb_5(AsO_4)_3Cl$



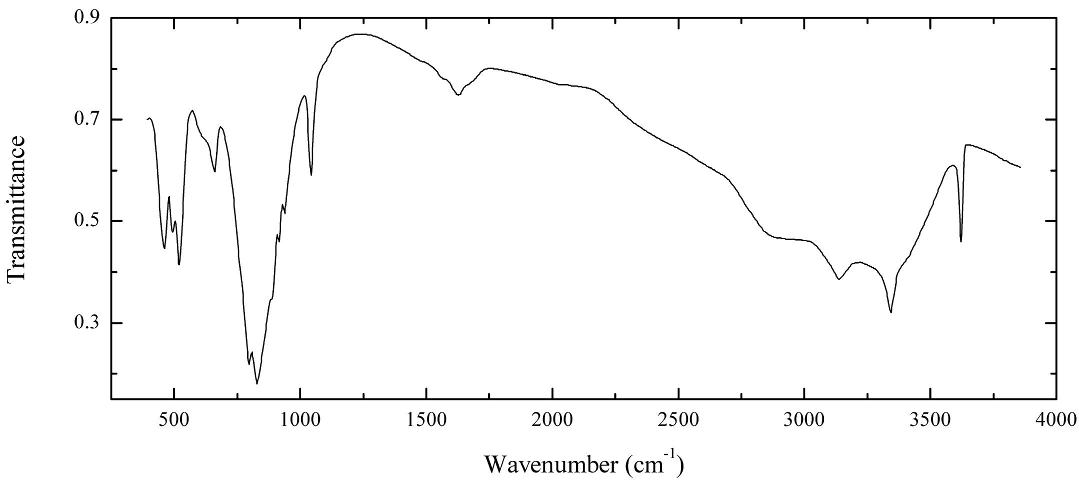
Locality: M'Fouati, Reneville, Congo.
Description: Yellow split crystals to 0.5 mm in the association with wulfenite. Identified by semiquantitative electron microprobe analysis (contains only Pb, As, Al and trace amounts of P).
Wavenumbers (cm^{-1}): 1003w, 960w, 817s, 805s, 784s, 418, 410s, 373.

As94 Zincolivenite $CuZn(AsO_4)(OH)$



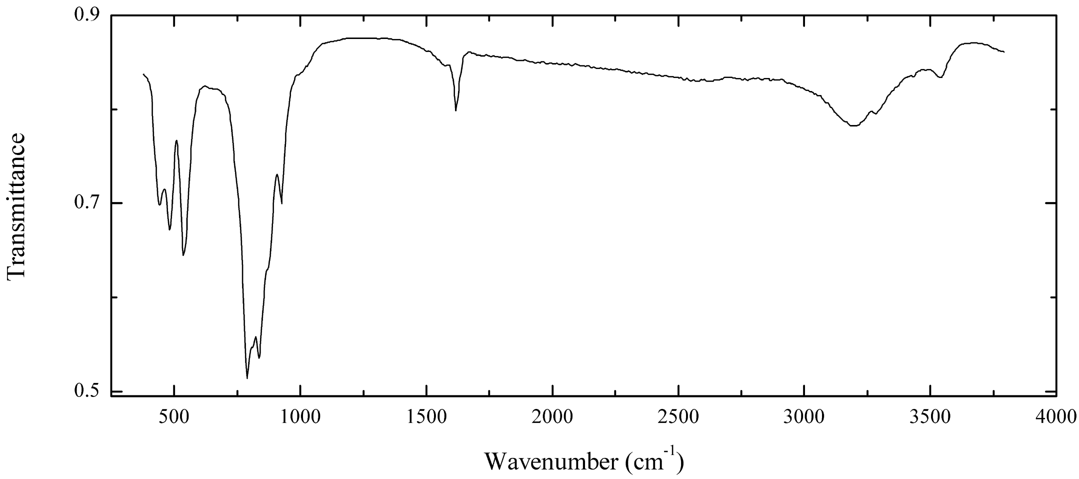
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.
Description: Olive green. The empirical formula is (electron microprobe) $(Cu_{1.2}Zn_{0.8})(AsO_4)(OH)$.
Wavenumbers (cm^{-1}): 3482, 3420sh, 1610w, 860s, 840s, 815, 788, 537, 454.

As95 Legrandite $Zn_2(AsO_4)(OH)\cdot H_2O$



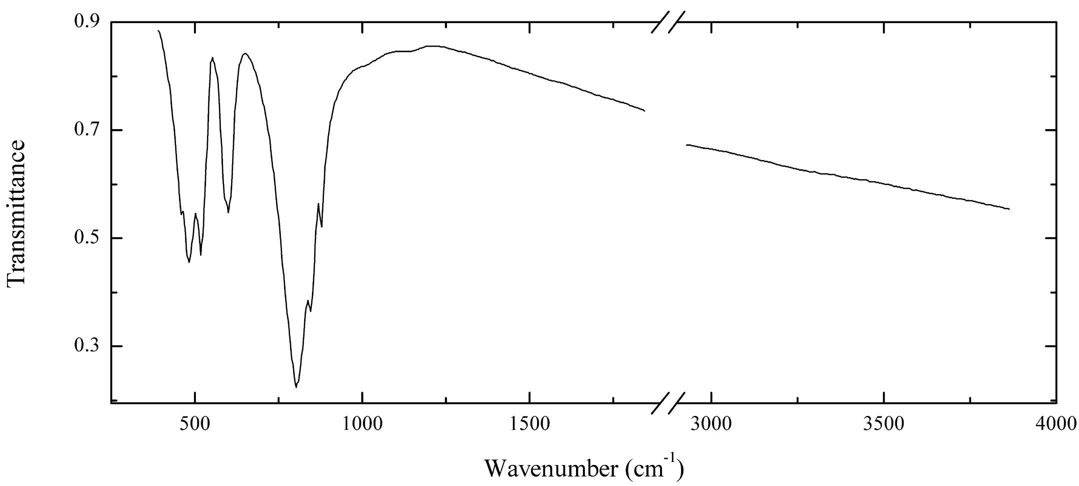
Locality: Mina Ojuela (Ojuela mine), Mapimi, Durango, Mexico.
Description: Yellow transparent long-prismatic crystal (2 cm in length) in the association with adamite.
Wavenumbers (cm^{-1}): 3570, 3350sh, 3297s, 3100, 2900sh, 2600sh, 2400sh, 1680sh, 1614w, 1560sh, 1035, 923, 907, 878s, 860sh, 821s, 790s, 760sh, 655, 615sh, 512s, 485, 454.

As96 Lavendulan $NaCaCu^{2+}_5(AsO_4)_4Cl{\cdot}5H_2O$



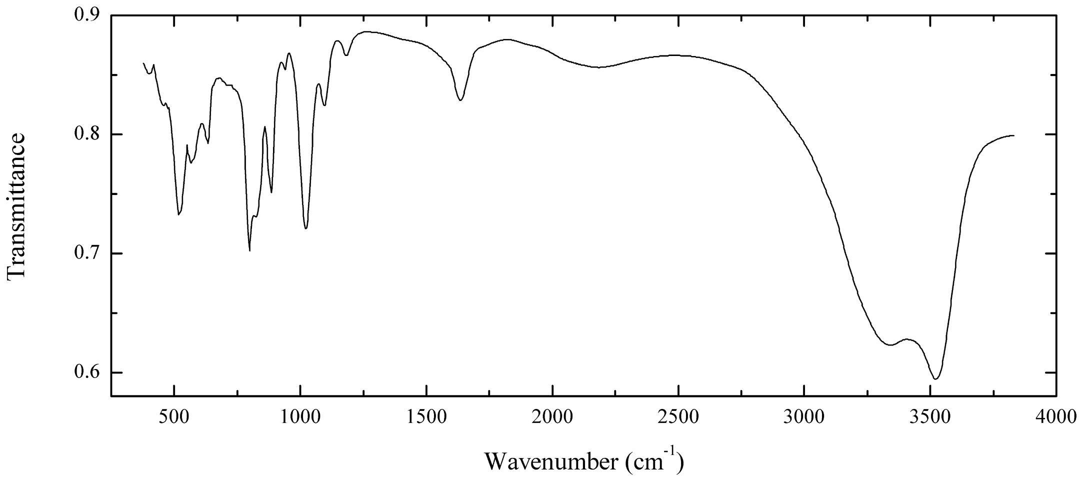
Locality: Pastrana Murcia, Spain.
Description: Blue-green crust. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3530w, 3425w, 3275, 3195, 1622, 1580w, 1000sh, 927, 875sh, 838s, 815sh, 790s, 760sh, 538, 482, 440.

As97 Lammerite $Cu_3(AsO_4)_2$



Locality: North Breach of the Great Fissure Tolbachik volcano, Kamchatka peninsula, Russia.
Description: Green crystals. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 1148w, 1000sh, 877, 843s, 800s, 599, 590sh, 516s, 479s, 456.

As98 Liroconite $Cu^{2+}{}_2Al(AsO_4)(OH)_4 \cdot 4H_2O$

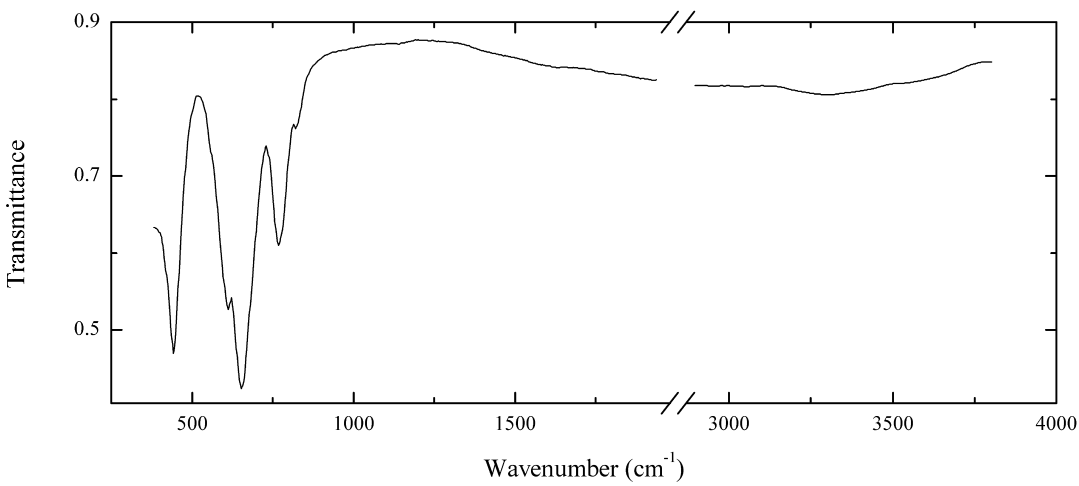


Locality: Wheal Gorland, Cornwall, England, UK (type locality).

Description: Blue-green crystal. PO_4-rich variety.

Wavenumbers (cm^{-1}): 3496s, 3300s, 3240sh, 1633, 1184w, 1097, 1022s, 942w, 885, 825s, 799s, 635, 573, 524s, 466, 410w.

As99 Magnussonite $Mn^{2+}{}_5As^{3+}{}_3O_9(OH,Cl)$

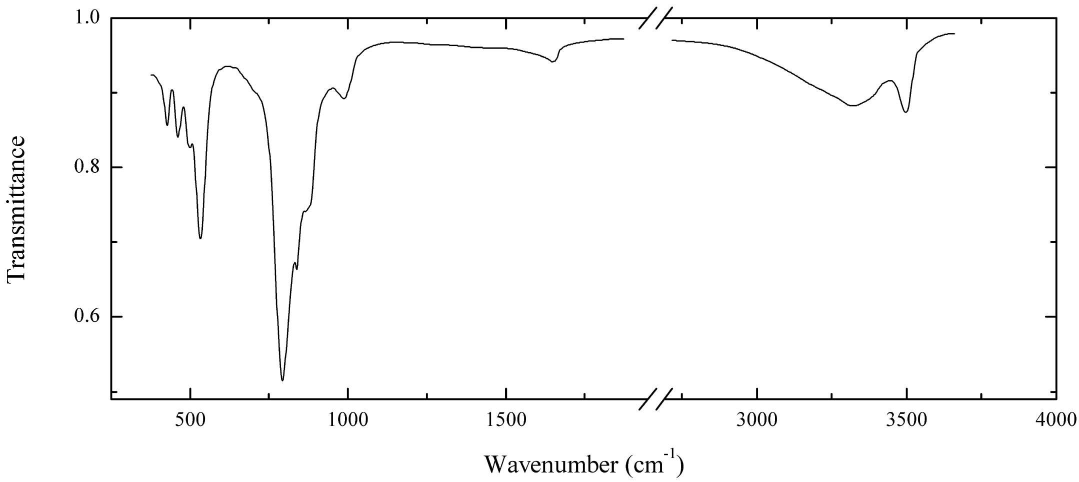


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Green grains in skarn, in the association with hausmannite, dolomite, diopside, serpentine. OH-poor variety. Identified by the powder X-ray diffraction pattern.

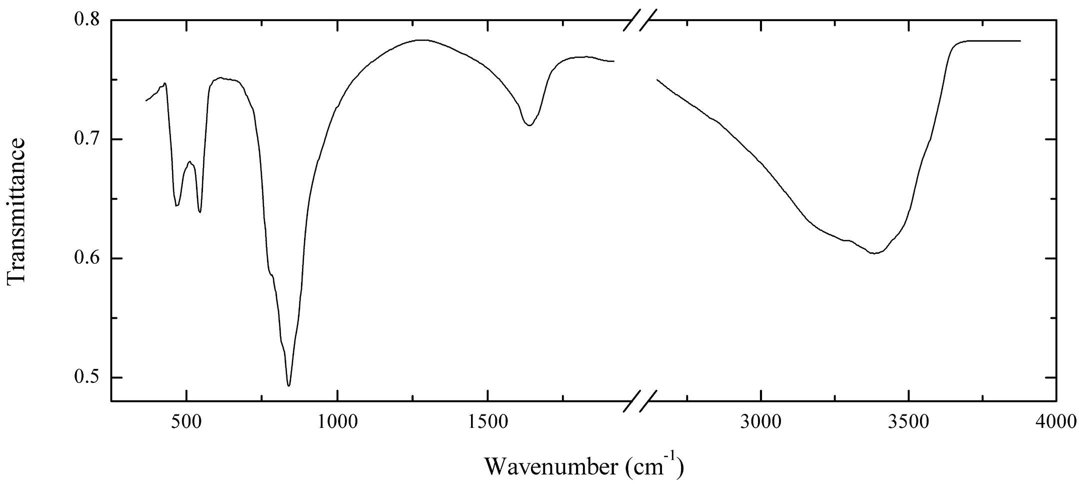
Wavenumbers (cm^{-1}): 3420sh, 3320w, 825, 769, 656s, 609s, 442s.

As100 Mixite $BiCu^{2+}_6(AsO_4)_3(OH)_6{\cdot}3H_2O$



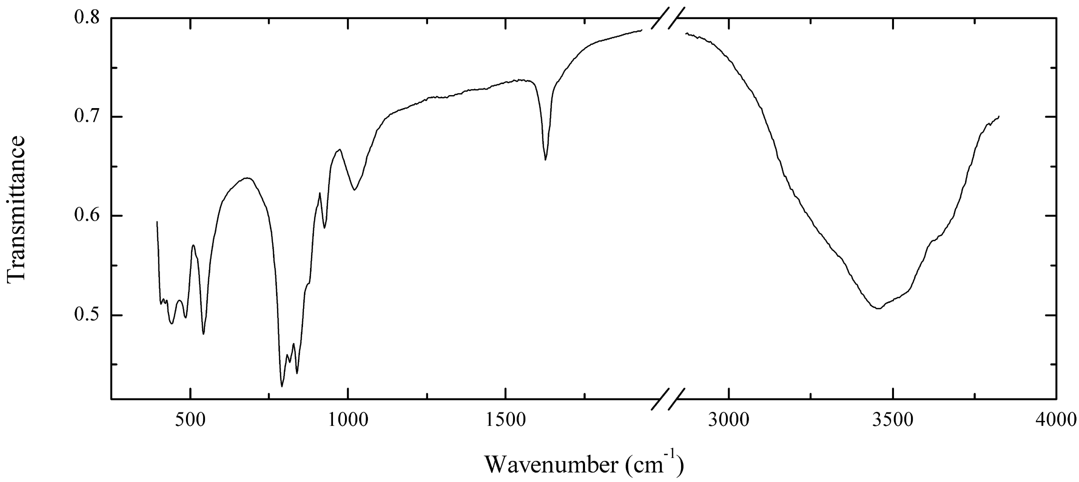
Locality: Schmiedestollen, Wittichen, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.
Description: Green, fibrous. Confirmed by the qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3475, 3305, 1645w, 986w, 880sh, 863, 838s, 793s, 532s, 497, 463, 425.

As101 Lindackerite $Cu_5(AsO_3OH)_2(AsO_4)_2(OH)_4{\cdot}10H_2O$



Locality: Elias mine, Jáchymov, Krušné Hory Mts. (Ore Mts.), Bohemia, Czech Republic (type locality).
Description: Green crusts in the association with lavendulan. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3380s, 3260sh, 1630, 837s, 815sh, 775sh, 539, 463.

As102 Lavendulan $NaCaCu^{2+}{}_5(AsO_4)_4Cl{\cdot}5H_2O$

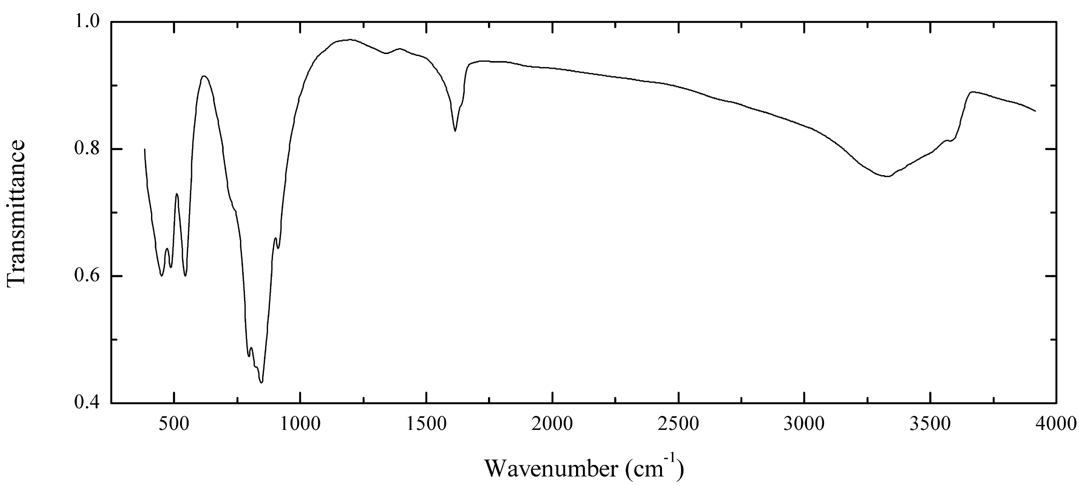


Locality: Serpieri mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Blue crusts, in the association with serpierite. The empirical formula is (electron microprobe) $K_{0.06}Na_{0.74}Ca_{1.05}(Cu_{4.62}Fe_{0.17}Zn_{0.09}Al_{0.07})[(AsO_4)_{3.89}(PO_4)_{0.11}]Cl_{1.10}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3600sh, 3500sh, 3430s, 3300sh, 1623, 1023, 928, 875sh, 839s, 815s, 790s, 541, 484, 441, 398.

As103 Lemanskiite $NaCaCu_5(AsO_4)_4Cl{\cdot}5H_2O$

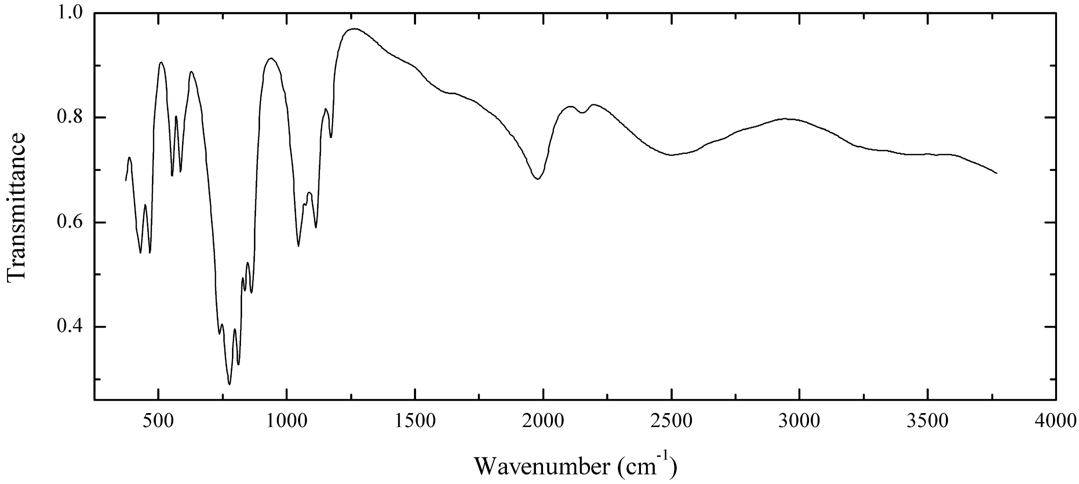


Locality: Abundancia mine, El Guanaco gold province, Antofagasta, Chile (type locality). The empirical formula of the holotype sample is $Na_{1.04}Ca_{1.00}Cu_{5.01}(AsO_4)_{4.00}Cl_{0.96}(OH)_{0.11}{\cdot}4.93\ H_2O$.

Description: Aggregate of bright blue crystals in the association with lammerite and olivenite.

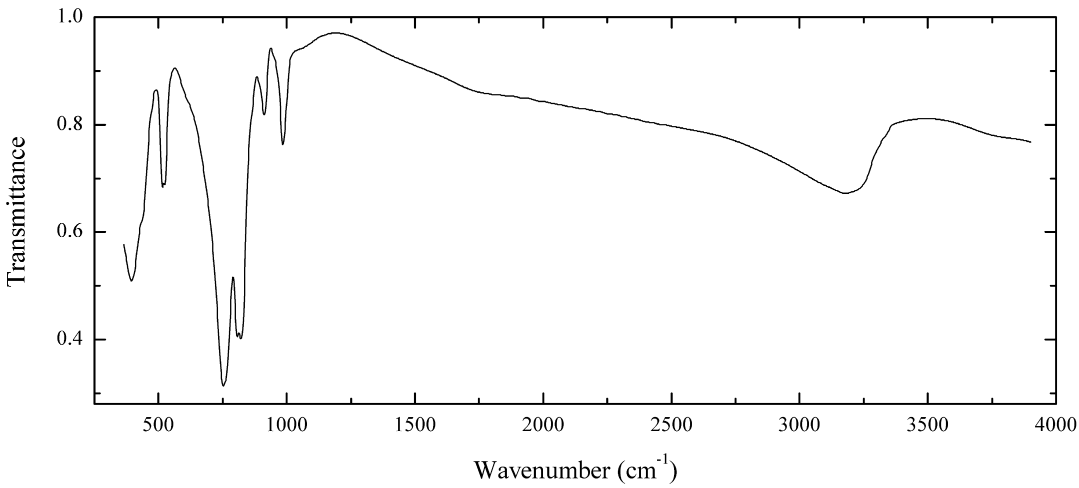
Wavenumbers (cm^{-1}): 3550, 3290, 1640sh, 1615, 1340w, 917, 846s, 820s, 792s, 730sh, 543, 486, 449.

As104 **Bayldonite** $Cu_3PbO(AsO_3OH)_2(OH)_2$



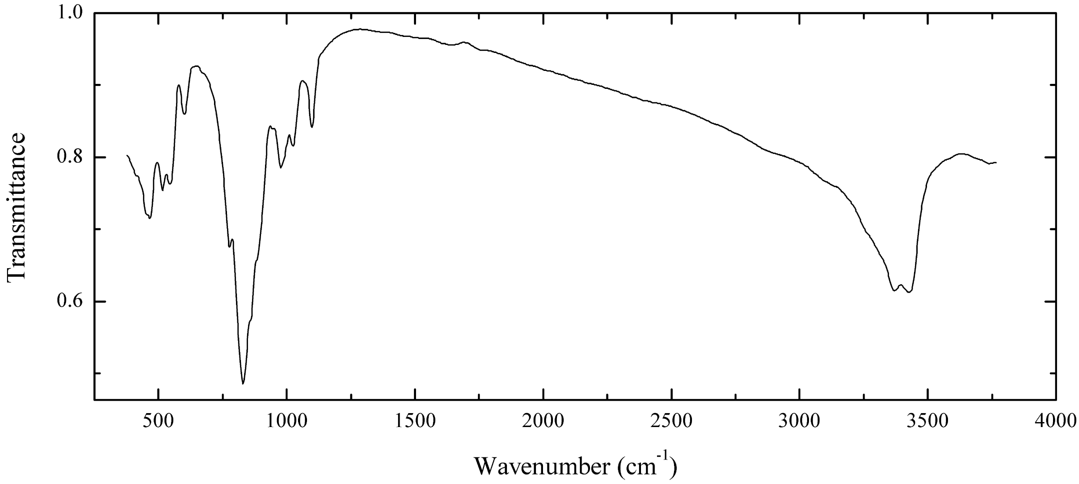
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.
Description: Green, massive. Identified by IR spectrum. The empirical formula is (electron microprobe) $Cu_{2.9}Zn_{0.1}Pb_{0.9}O(AsO_3OH)_2(OH,H_2O)_2$
Wavenumbers (cm^{-1}): 3400w, 3250sh, 2510, 2150w, 1975, 1630sh, 1480sh, 1176, 1116, 1080sh, 1051, 866, 839, 813s, 778s, 741s, 590, 558, 470, 432.

As105 **Duftite** $PbCu(AsO_4)(OH)$



Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: Olive green crusts in the association with mimetite and malachite. The empirical formula is (electron microprobe) $Pb_{0.85}Ca_{0.2}Cu_{1.0}[(AsO_4)_{0.95}(PO_4)_{0.05}](OH,O)$.
Wavenumbers (cm^{-1}): 3160, 983, 911, 818s, 804s, 752s, 525, 509, 435sh, 395.

As106 Cornwallite $Cu^{2+}{}_5(AsO_4)_2(OH)_4$

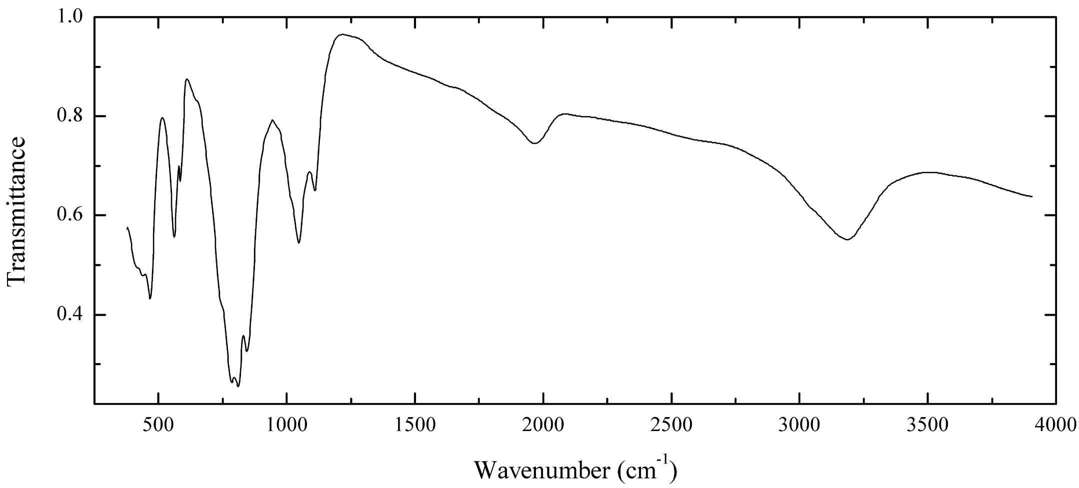


Locality: Saxony, Germany.

Description: Green crusts, in the association with malachite. PO_4-bearing variety. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3390, 3333, 1097, 1024, 978, 947w, 887s, 864s, 832s, 815sh, 779s, 599w, 547, 515, 470, 455.

As107 Conichalcite $CaCu^{2+}(AsO_4)(OH)$

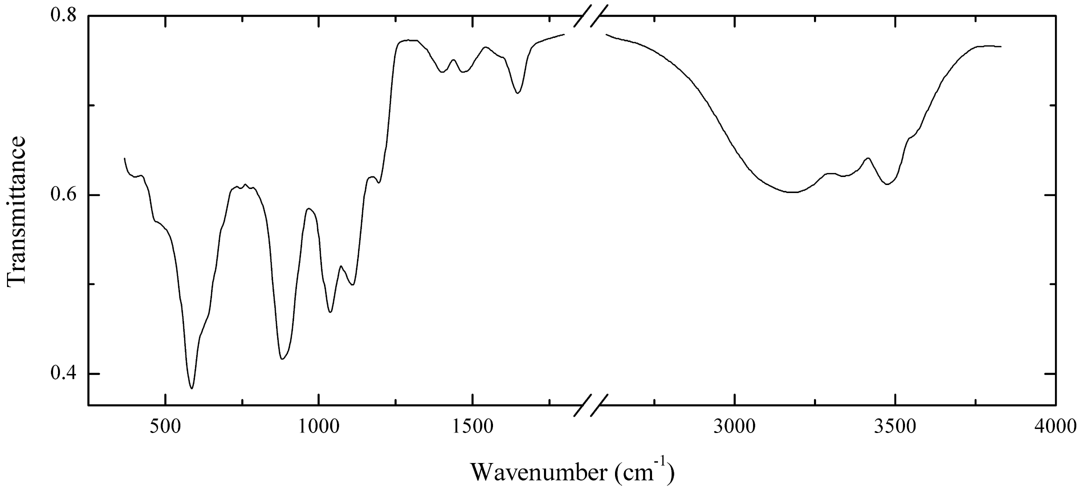


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Green split crystals to 0.5 mm forming crusts. Identified by IR spectrum. Pb-rich variety. The empirical formula is (electron microprobe) $Ca_{0.64}Pb_{0.39}Cu_{0.92}H_{0.10}[(AsO_4)_{0.93}(PO_4)_{0.07}](OH)$.

Wavenumbers (cm^{-1}): 3185, 1970, 1108, 1047, 1010sh, 841s, 808s, 783s, 745sh, 585, 558, 467s, 440, 415.

As108 Arsenocrandallite $CaAl_3(AsO_4)_2(OH,H_2O)_6$

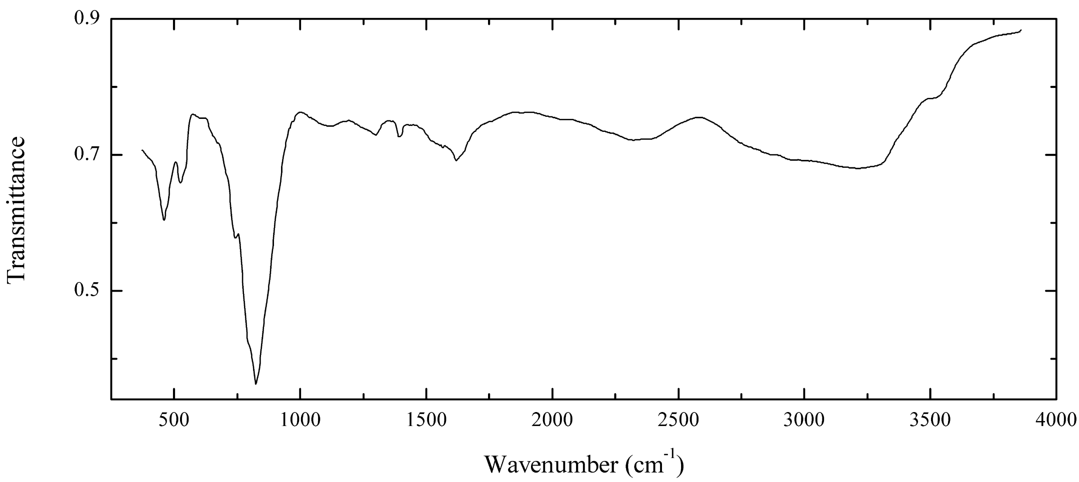


Locality: Christiana mine No. 132, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light grey crusts, in the association with attikaite, olivenite and conichalcite. Sr-rich variety. The empirical formula is (electron microprobe) $(Ca_{0.55}Sr_{0.45})(Al_{2.7}Fe_{0.2}Cu_{0.1})[(AsO_4)_{1.4}(PO_4)_{0.4}(SiO_4)_{0.2}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3540sh, 3465, 3330, 3170, 1650, 1477w, 1407w, 1195, 1109s, 1037s, 880s, 625sh, 585s, 475sh, 402w.

As109 Pushcharovskite $Cu(AsO_3OH)\cdot H_2O$

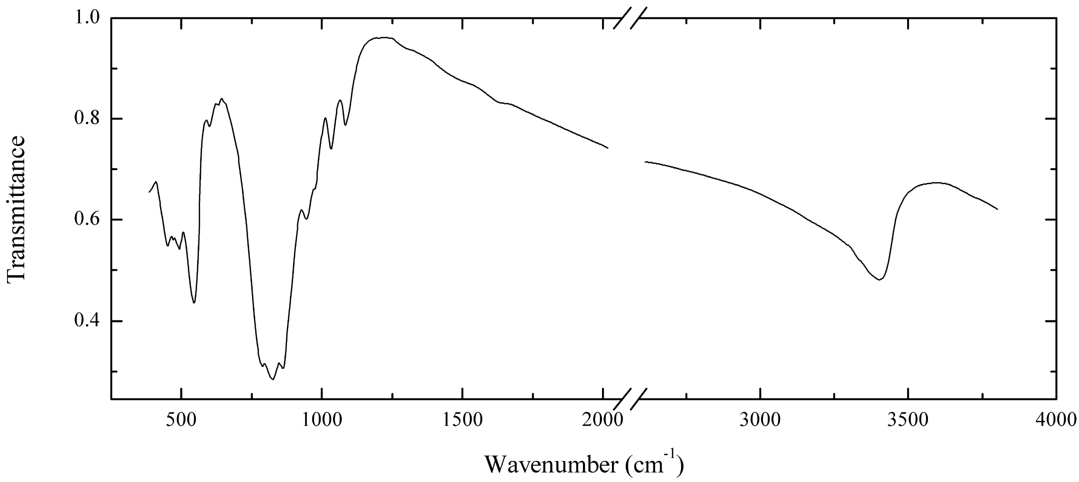


Locality: Salsigne, Aude, France.

Description: Light blue powdery, in the association with yvonite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3515w, 3250, 2950sh, 2850sh, 2360, 1620, 1565sh, 1392w, 1300w, 1120w, 875sh, 830s, 800sh, 741, 533, 465.

As110 Olivenite $Cu_2(AsO_4)(OH)$

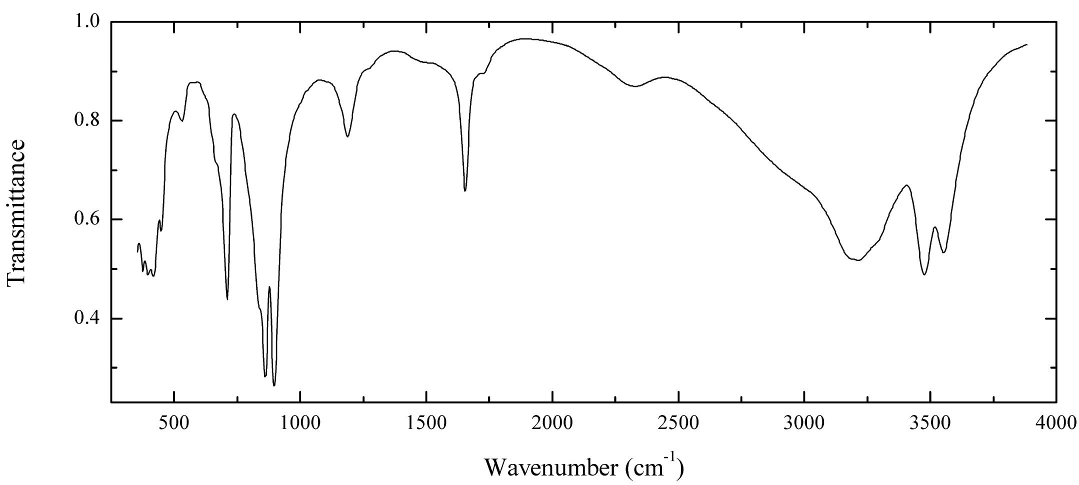


Locality: Ĺubietová-Svätoduška, near Banská Bystrica, Slovakia.

Description: Dark green crystals to 0.5 mm on ore. The empirical formula is (electron microprobe) $Cu_{1.89}Zn_{0.06}Fe_{0.03}[(AsO_4)_{0.95}(PO_4)_{0.05}](OH)$.

Wavenumbers (cm^{-1}): 3400, 1095sh, 1085, 1033, 975sh, 944, 863s, 824s, 791s, 630w, 596w, 542s, 488, 449.

As111 Pharmacolite $CaH(AsO_4)\cdot 2H_2O$

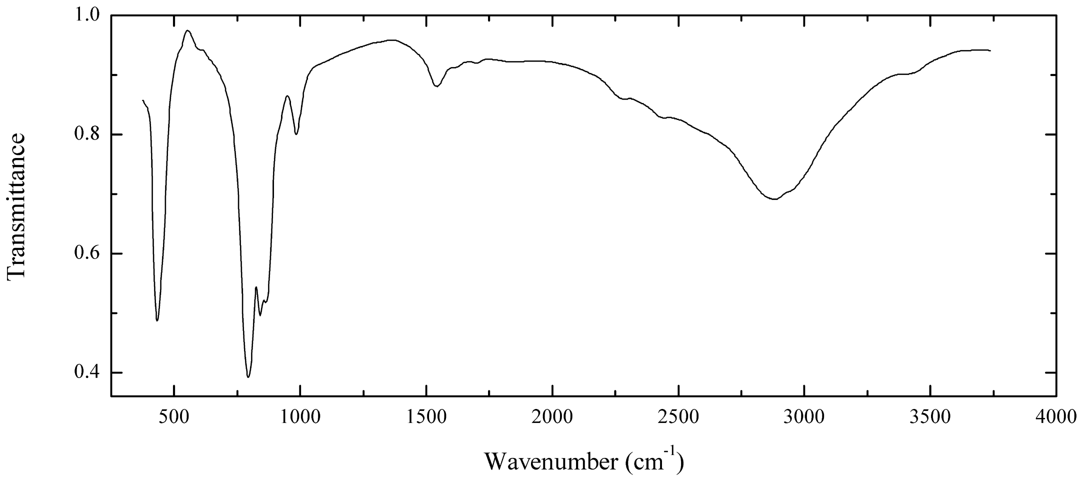


Locality: Hartenstein, Saxony, Germany.

Description: Colourless crystals in the association with rösslerite. Identified by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3528, 3450, 3250sh, 3190, 2950sh, 2305w, 1720sh, 1652, 1490w, 1265sh, 1186, 897s, 862s, 835sh, 710, 670sh, 534w, 445, 415, 395, 377.

As112 Roselite-β $Ca_2Co(AsO_4)_2{\cdot}2H_2O$



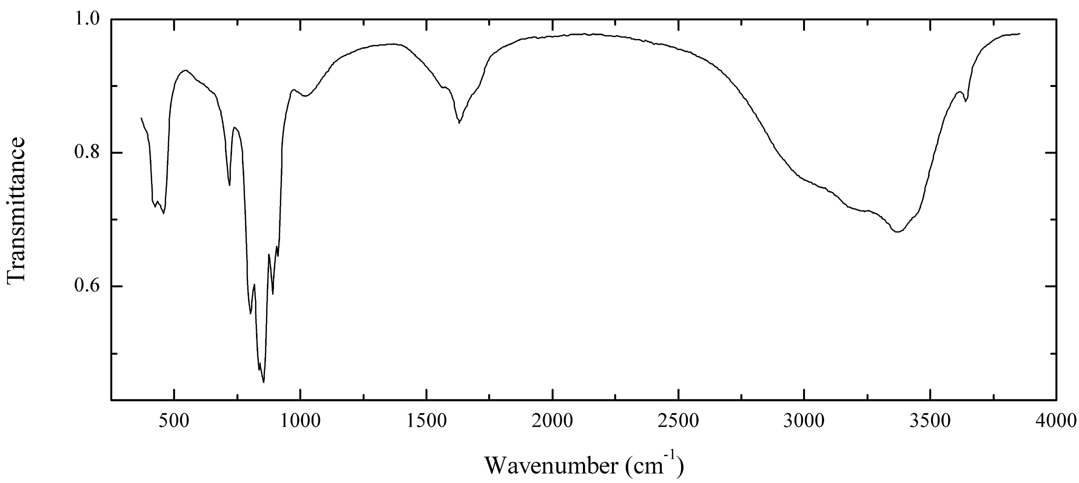
Locality: Ambed-3, Bou-Azzer ore region, Morocco.

Description: Pink split crystals to 2 mm in the association with erythrite. Identified by powder X-ray diffraction pattern and electron microprobe analysis.

The empirical formula is $H_{0.04}Ca_{1.00}(Co_{0.51}Ni_{0.29}Mg_{0.18})(AsO_4)_{2.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3405w, 2870, 2430w, 2270w, 1700w, 1640w, 1540, 986, 868s, 843s, 796s, 600sh, 432s.

As113 Picropharmacolite $Ca_4Mg(AsO_3OH)_2\,(AsO_4)_2{\cdot}11H_2O$

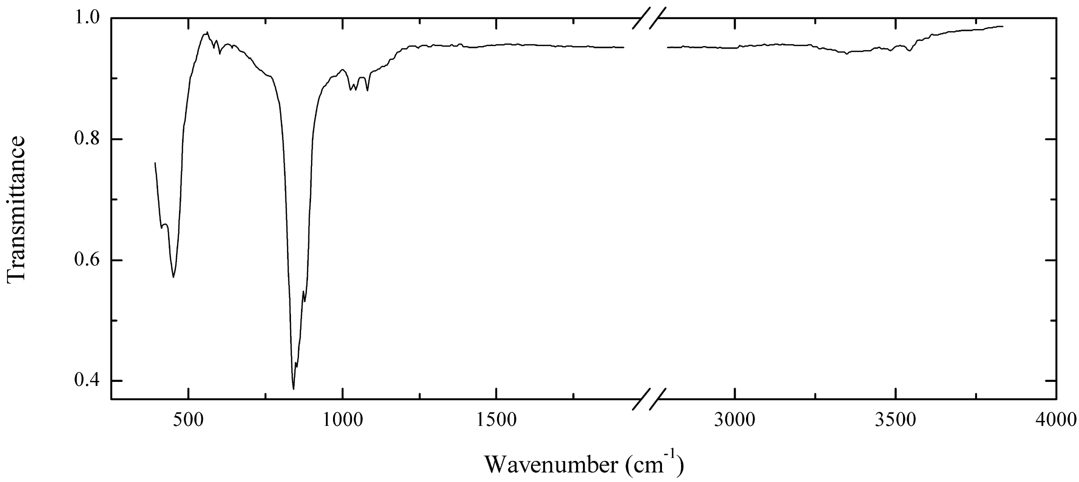


Locality: Belorechenskoye deposit, 70 km south of Maikop, Caucasus, Russia.

Description: White acicular aggregate, in the association with hörnesite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3610w, 3420sh, 3345s, 3200, 3020sh, 1650sh, 1625, 1565w, 1025w, 912, 889s, 851s, 836s, 803s, 718, 458, 423.

As115 Svabite $Ca_5(AsO_4)_3F$

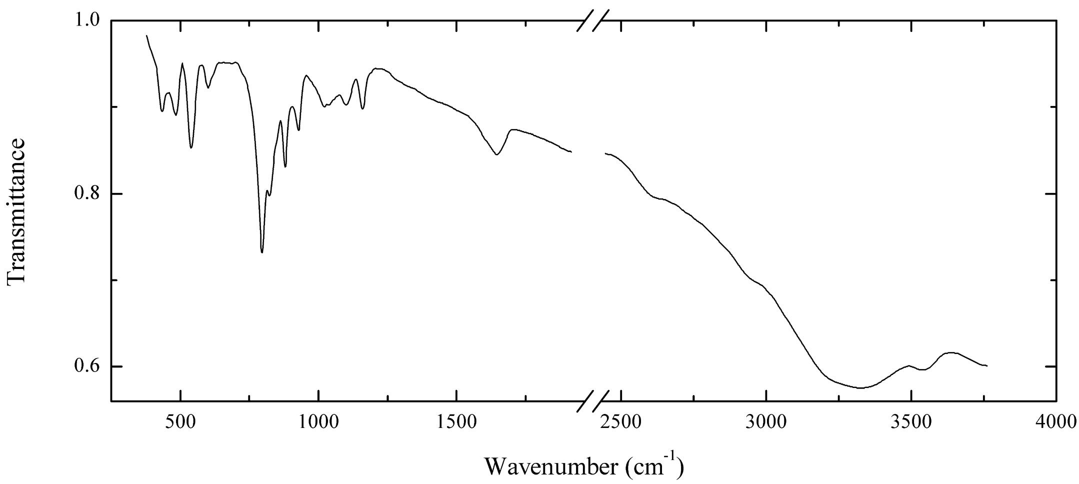


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: White veinlet in tilasite aggregate, in the association with calcite. The empirical formula is (electron microprobe, OH calculated) $(Ca_{4.88}Mn_{0.07}Fe_{0.03})[(AsO_4)_{2.92}(SO_4)_{0.05}(PO_4)_{0.03}]F_{0.44}(OH)_{0.33}Cl_{0.23}$.

Wavenumbers (cm^{-1}): 3510w, 3460w, 1079w, 1043w, 1027w, 877, 852s, 839s, 599w, 580w, 451, 430sh, 412.

As118 Richelsdorfite $Ca_2Cu^{2+}{}_2Sb^{5+}(AsO_4)_4Cl(OH)_6 \cdot 6H_2O$

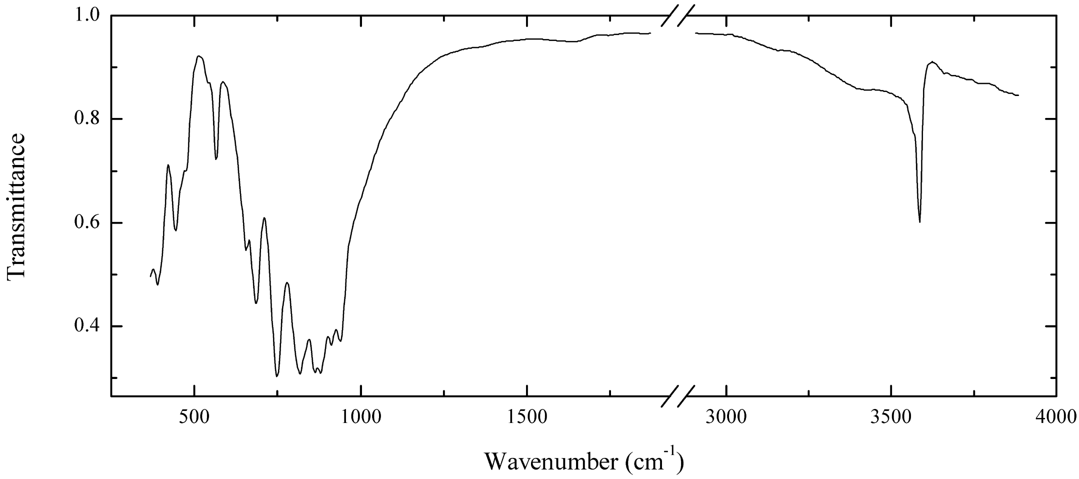


Locality: Richelsdorf, Hessen, Germany (type locality).

Description: Blue radiated aggregate. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3530, 3300, 2940sh, 2640sh, 1660, 1615sh, 1161, 1107, 1031, 931, 881, 850sh, 825s, 797s, 605, 540, 483, 436.

As119 Bergslagite $CaBe(AsO_4)(OH)$

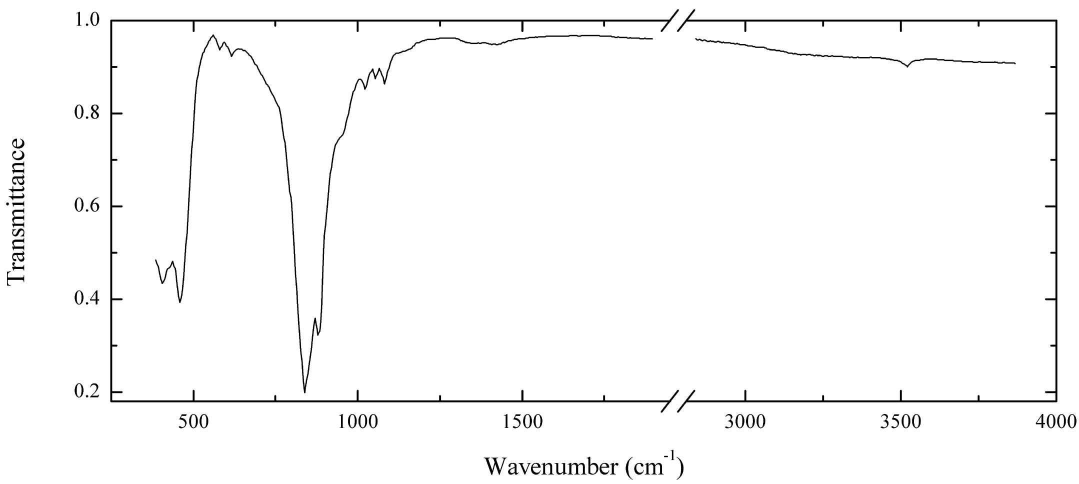


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Light yellowish-grey, with a greasy lustre. Massive. Associating minerals are calcite, svabite. Shows light blue luminescence under short-wave UV irradiation. Identified by IR spectrum. The strong band at 750 cm^{-1} is assigned to Be-O stretching vibrations. The weak bands given in parentheses are due to admixture of adsorbed water (3,420 and 1,630 cm^{-1}).

Wavenumbers (cm^{-1}): 3574, (3420w), (1630w), 941, 911, 878s, 861s, 835sh, 818s, 750s, 688, 659, 570, 540w, 482, 465sh, 447, 395.

As120 Turneaureite $Ca_5(AsO_4)_3Cl$



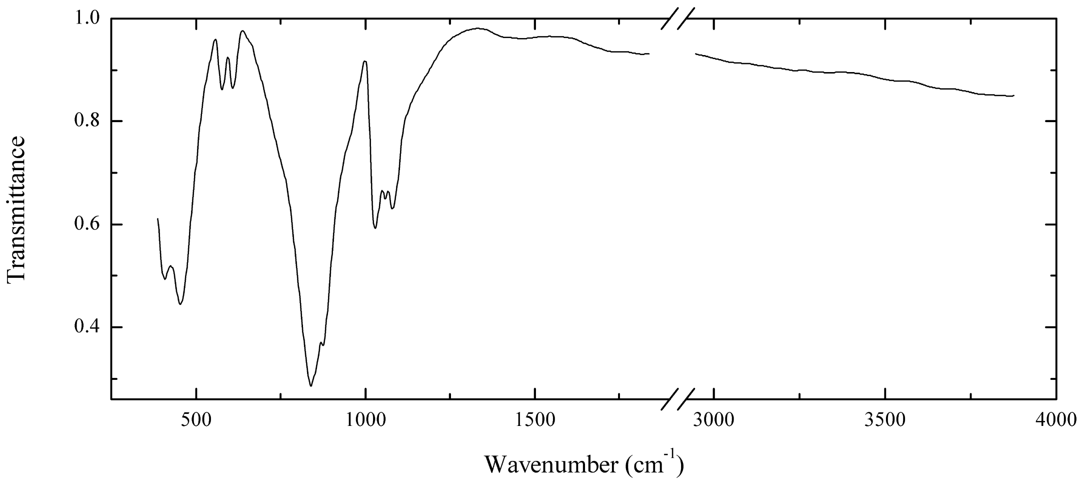
Locality: Solongo boron deposit, Buryatia, Russia.

Description: Lilac vein in boron ore, in the association with kurchatovite, sakhaite, frolovite and calcite. Identified by powder X-ray diffraction pattern and chemical composition.

The empirical formula is (electron microprobe, F and Cl determined by wet chemical analysis, H_2O determined by thermal data) $(Ca_{5.12}Mn_{0.01})_{\Sigma 5.13}[(AsO_4)_{2.79}(PO_4)_{0.03}(SiO_4)_{0.07}(SO_4)_{0.11}]_{\Sigma 3.00}Cl_{0.46}(OH)_{0.16}F_{0.14}O_{0.22}(H_2O)_{0.04}$.

Wavenumbers (cm^{-1}): 3502w, 1081w, 1053w, 1023w, 950sh, 877s, 850sh, 835s, 613w, 579w, 458s, 407s.

As121 Svabite $Ca_5(AsO_4)_3F$

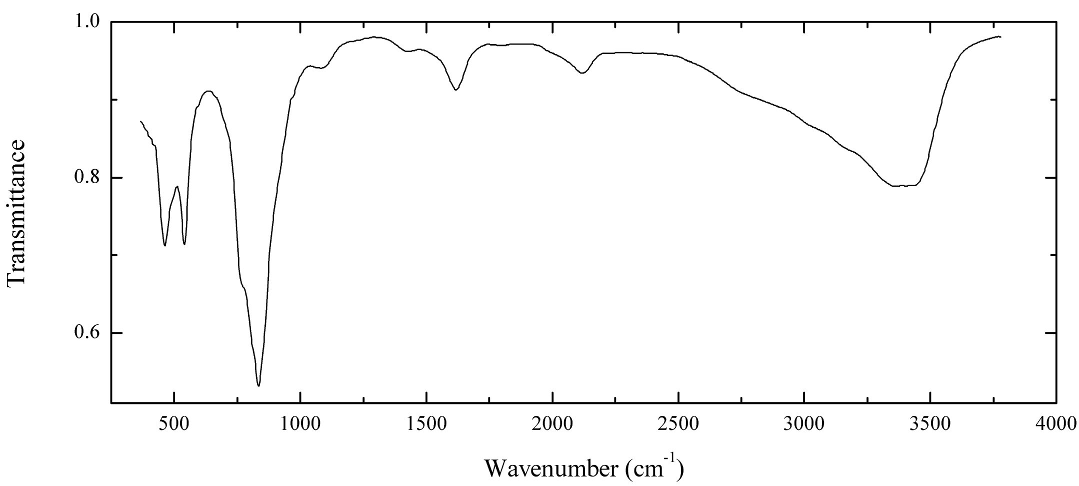


Locality: Rakten, near Ultevis, Norrbotten, Lapland, Sweden.

Description: Light grey vein in rock, in the association with spessartite and piemontite. A P-rich variety; the empirical formula is (electron microprobe, OH calculated) $(Ca_{4.9}Mn_{0.1})[(AsO_4)_{2.5}(PO_4)_{0.4}(SO_4)_{0.05}(SiO_4)_{0.05}]F_{0.6}Cl_{0.3}(OH)_{0.1}$.

Wavenumbers (cm^{-1}): 1080, 1060, 1030, 875s, 850sh, 839s, 603w, 585w, 453s, 411s.

As122 "Trichalcite" $Cu_3(AsO_4)_2·4H_2O$



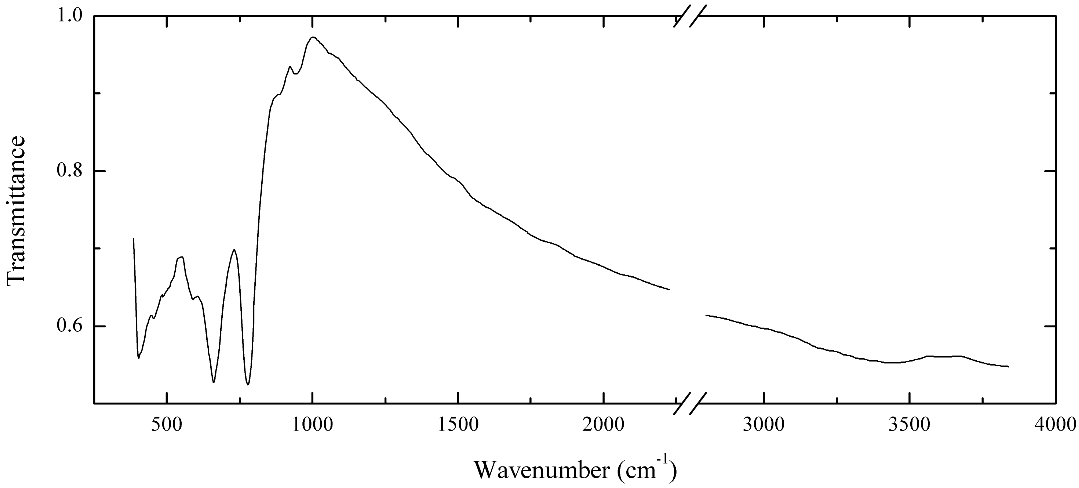
Locality: Khovu-Aksy deposit, 80 km SW of Kyzyl, Tuva, Middle Siberia, Russia.

Description: Blue massive. Original sample investigated by L.K. Yakhontova.

Related to strashimirite?

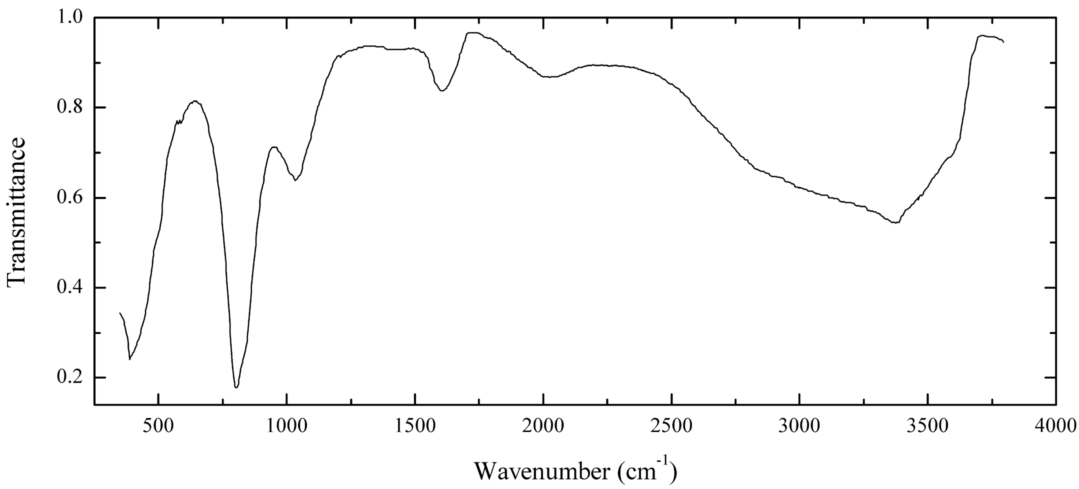
Wavenumbers (cm^{-1}): 3425, 3360, 3160sh, 2770sh, 2122, 1625, 1087w, 860sh, 837s, 815sh, 774s, 540, 463.

As123 Fetiasite $(Fe^{2+},Fe^{3+},Ti)_3O_2As^{3+}O_5$



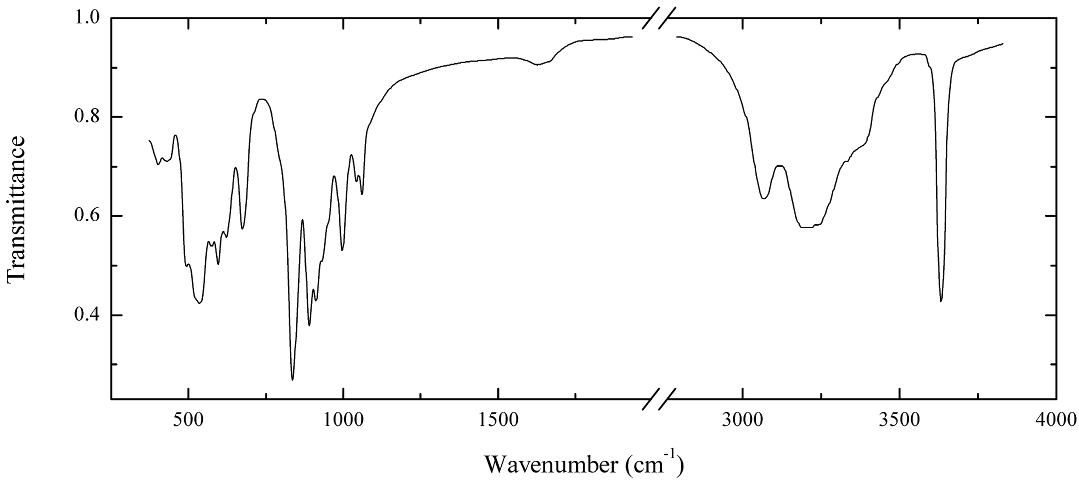
Locality: Gorb, Binntal, Wallis, Switzerland (type locality).
Description: Black, with brown streak.
Wavenumbers (cm^{-1}): 1142w, 1085sh, 776s, 661s, 599, 515sh, 492w, 460, 403.

As124 Pharmacosiderite $KFe^{3+}{}_4(AsO_4)_3(OH)_4·6–7H_2O$



Locality: Horní Slavkov (former Schlaggenwald), Bohemia, Czech Republic.
Description: Brownish cubic crystals. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3570sh, 3365, 3050sh, 2860sh, 2030, 1610, 1039, 830sh, 801s, 580w, 450sh, 415s.

As126 Ceruleite $Cu_2Al_7(AsO_4)_4(OH)_{13}{\cdot}11.5H_2O$

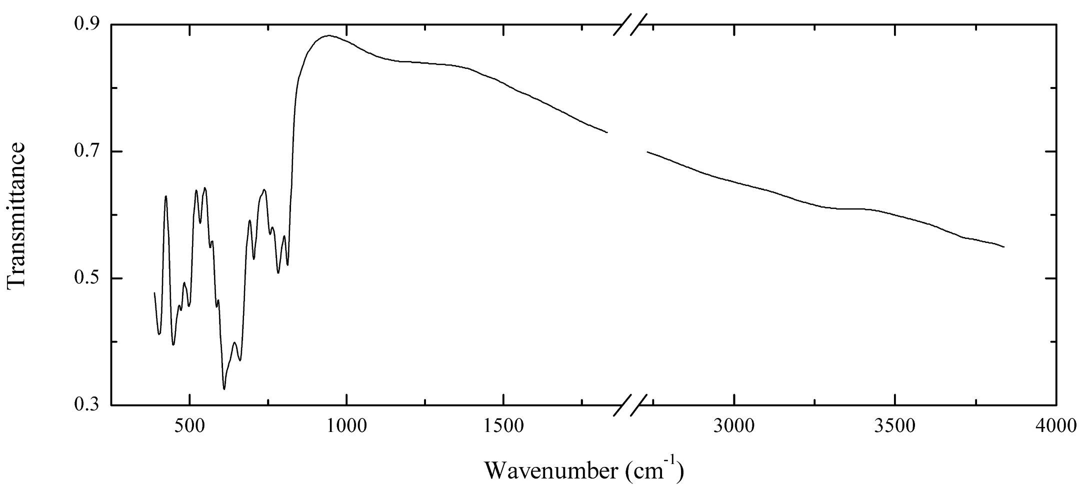


Locality: Huanaco, Taltal, Chile (type locality).

Description: Blue massive in the association with pharmacoalumite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3605s, 3350sh, 3310sh,3210sh, 3185, 3045, 1630w, 1059, 1041, 997, 950sh, 930, 911s, 889s, 836s, 675, 622, 597, 572, 540s, 525sh, 495, 437w, 400w.

As127 Schneiderhöhnite $Fe^{2+}Fe^{3+}{}_2As^{3+}{}_5O_{13}$

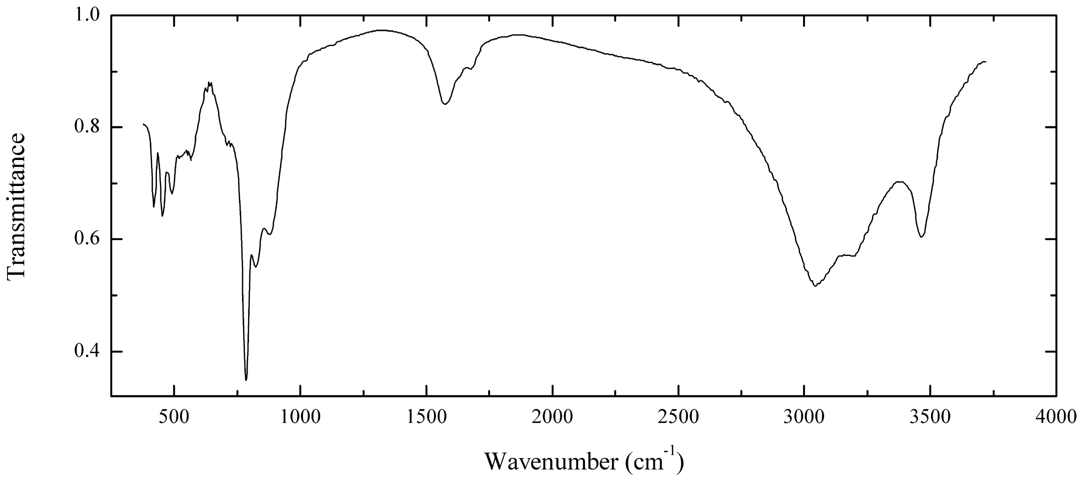


Locality: Urucum mine, Galiléia Co., Minas Gerais, Brazil.

Description: Black massive with brown streak: crust on an arsenide mineral. Identified by IR spectrum. The empirical formula is (electron microprobe) $Fe_{3.2}As_{5.0}O_x$.

Wavenumbers (cm^{-1}): 813, 782, 757, 705, 661s, 625sh, 609s, 585, 565, 534w, 498, 473, 448s, 405.

As128 Erythrite $Co_3(AsO_4)_2 \cdot 8H_2O$

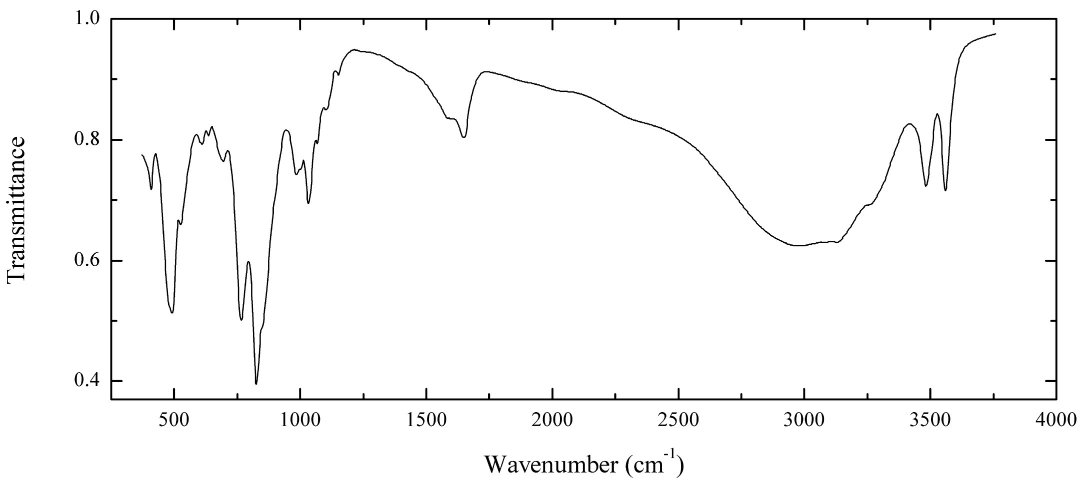


Locality: Richelsdorf, 15 km east of Bebra, Hessen, Germany.

Description: Pink spherulites to 1.5 mm in diameter in the association with cobaltkoritnigite. The empirical formula is (electron microprobe) $(Co_{2.3}Ni_{0.4}Mg_{0.3})(AsO_4)_{2.0} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3447, 3175s, 3030s, 1680, 1575, 881, 828s, 785s, 710sh, 567, (530), 495, 453, 420.

As129 Euchroite $Cu^{2+}{}_2(AsO_4)(OH) \cdot 3H_2O$

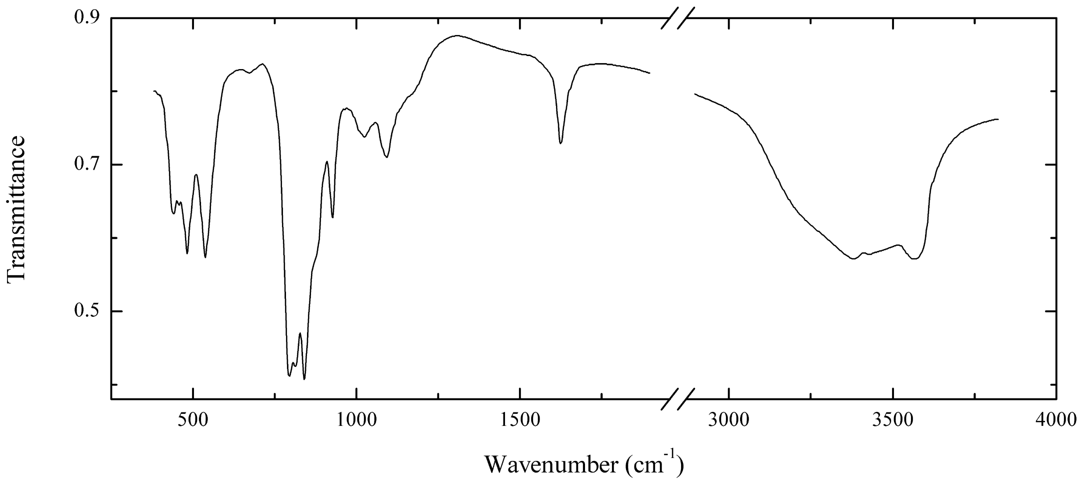


Locality: Ľubietová (former Libethen) ore belt, Western Slovenské Rudohorie Mts., Banská Bystrica Region, Slovakia (type locality).

Description: Deep green semitransparent crystals in the association with malachite. Identified by IR spectrum. PO_4-bearing variety (the bands at 1,156 1,107, 1,072, 1,035, 987, 638 and 610 cm^{-1}).

Wavenumbers (cm^{-1}): 3540, 3460, 3240sh, 3100, 2950, 1650, 1600sh, 1156w, 1107w, 1072, 1035, 987, 848sh, 826s, 767s, 691, 638w, 610w, 527, 495s, 480sh, 409.

As130 Shubnikovite $Ca_2Cu^{2+}{}_8(AsO_4)_6Cl(OH){\cdot}7H_2O$

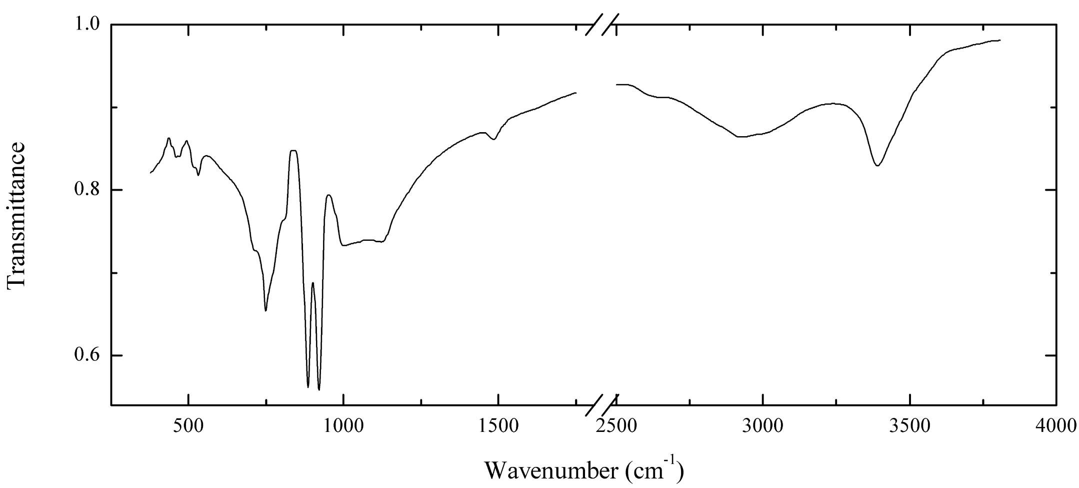


Locality: Khovu-Aksy deposit, 80 km southwest of Kyzyl, Tuva, Middle Siberia, Russia (type locality).

Description: Light blue massive.

Wavenumbers (cm^{-1}): 3550, 3415, 3260sh, 1630, 1125sh, 1070, 1030w, 927w, 875sh, 838s, 817s, 794s, 536, 477, 385.

As131 Švenekite $Ca(H_2AsO_4)_2$

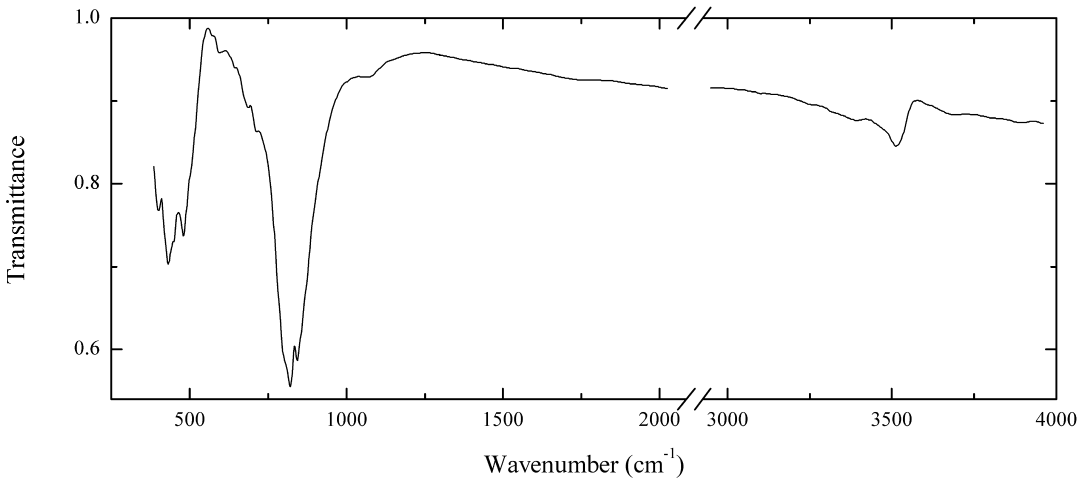


Locality: Geschieber vein, Svornost shaft, 12th level, Jáchymov, Krušné Hory Mts. (Ore Mts.), Czech Republic.

Description: White botryoidal crust.

Wavenumbers (cm^{-1}): 3365, 2930, 2640w, 1485, 1120, 1000, 917s, 882s, 805sh, 765sh, 746, 715sh, 590w, 532, 520sh, 450w.

As132 Sarkinite $Mn^{2+}_2(AsO_4)(OH)$

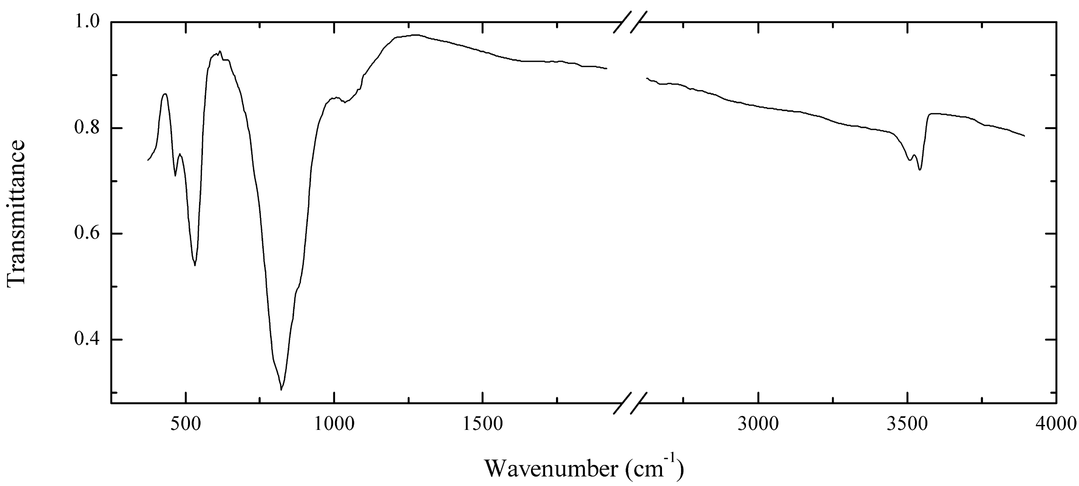


Locality: Sjögruvan mine, Grythyttan, Orebro, Västmanland, Sweden.

Description: Orange-yellow grains in the association with welinite. Strongest lines of the powder X-ray diffraction pattern have d values of 6.06, 3.514, 3.168, 3.060, 2.909 and 2.660 Å.

Wavenumbers (cm^{-1}): 3507, 3380w, 1065w, 845s, 821s, 805sh, 715w, 680w, 655sh, 605w, 480, 432, 400w.

As133 Adamite $Zn_2(AsO_4)(OH)$

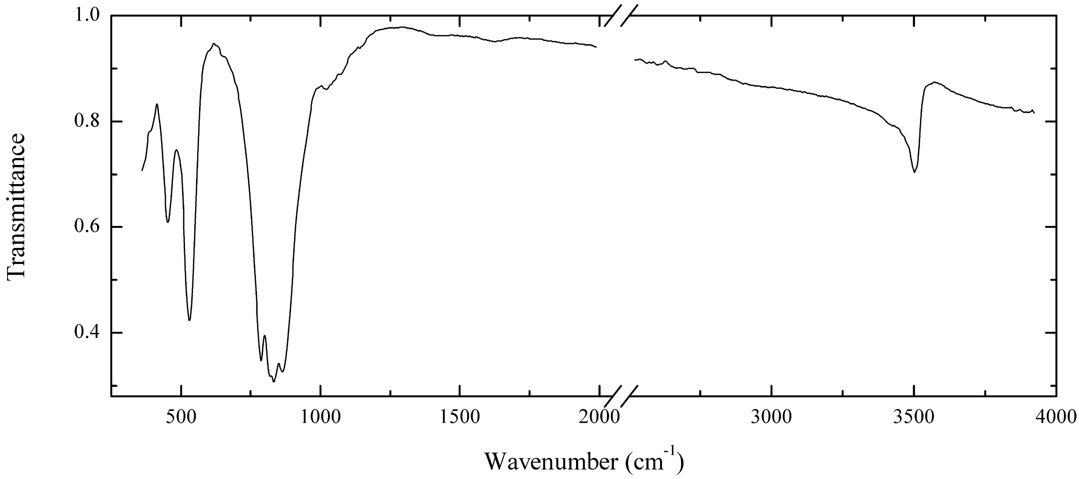


Locality: Verkhnii mine, Dalnegorsk, Far East, Russia.

Description: Green spherulites in the association with goethite and calcite. Cu-bearing variety. The empirical formula is (electron microprobe) $(Zn_{1.60}Cu_{0.35}Fe_{0.04})[(AsO_4)_{0.98}(PO_4)_{0.02}](OH)$.

Wavenumbers (cm^{-1}): 3533, 3496, 1080sh, 1040w, 875sh, 822s, 810sh, 530s, 465, (380).

As134 Zincolivenite $CuZn(AsO_4)(OH)$

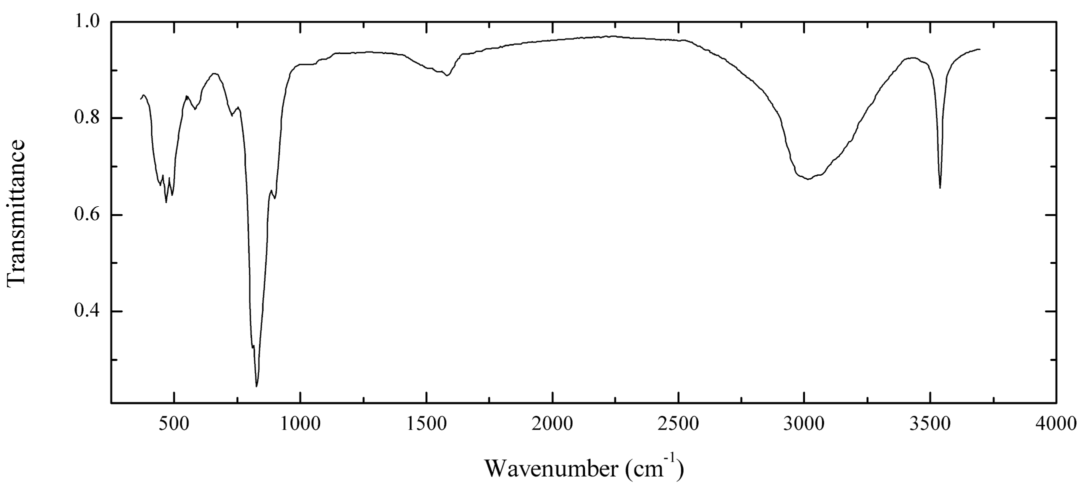


Locality: Large Dump, Kamariza, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece (type locality).

Description: Green-blue prismatic crystals (to 0.7 × 2 mm) growing on the walls of cavities in ore. Associated minerals are goethite, jarosite, conichalcite, pharmacoalumite, arseniosiderite, scorodite. Holotype sample. Orthorhombic, *Pnnm*; $a = 8.5839$, $b = 8.5290$, $c = 5.9696$ Å. Optically biaxial (−): $\alpha = 1.736$, $\beta = 1.784$, $\gamma = 1.788$; $2V = -30°$. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 6.00 (54) (110), 4.860 (64) (101, 011), 3.002 (100) (220), 2.690 (67) (310, 221, 130), 2.662 (53) (112), 2.456 (94) (311, 131), 2.437 (86) (202, 022). The empirical formula is (electron microprobe, H_2O by Penfield method) $Cu_{0.94}Zn_{1.03}Fe_{0.02}$ $[(AsO_4)_{0.98}(PO_4)_{0.02}](OH)_{0.98}(H_2O)_{0.10}$.

Wavenumbers (cm^{-1}): 3480, 3405sh, 1135sh, 1020w, 865s, 833s, 819s, 788s, 529s, 456, 400sh.

As135 Scorodite $Fe^{3+}(AsO_4)\cdot 2H_2O$



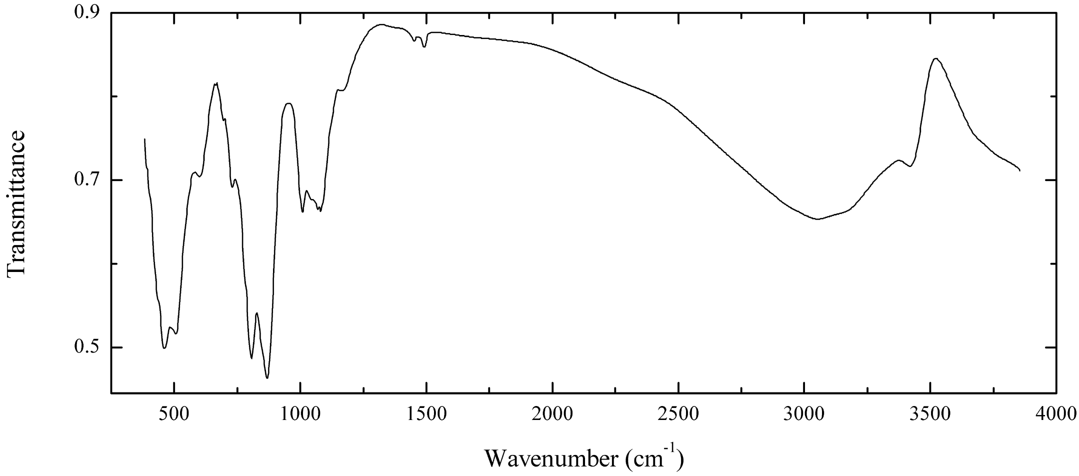
Locality: Svetloye deposit, Iul'tin district, Chukotka Autonomous Area, Russia.

Description: Greenish-grey crusts on quartz. Identified by powder X-ray diffraction pattern.

The empirical formula is (electron microprobe) $(Fe_{0.98}Al_{0.03})[(AsO_4)_{0.96}(SO_4)_{0.02}(SiO_4)_{0.02}]\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3510, 3100sh, 3030sh, 2990, 2960sh, 1580, 1540w, 1500w, 1100w, 1050w, 897, 825s, 808s, 727, 583, 493, 467, 439.

As136 Dussertite $BaFe^{3+}{}_3(AsO_4)_2(OH,H_2O)_6$

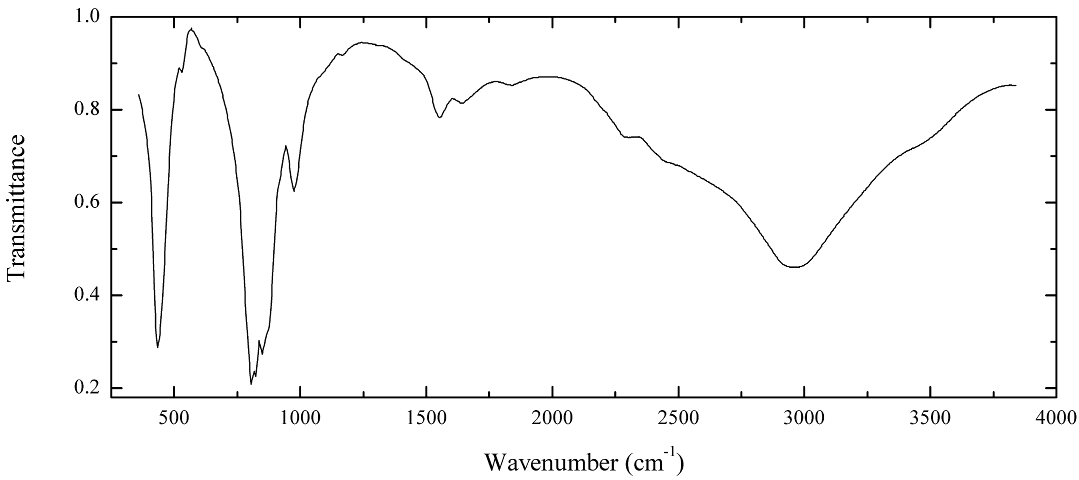


Locality: Schneeberg, Saxony, Germany.

Description: Bluish-green crystals. The empirical formula is (electron microprobe) $(Ba_{0.9}Ca_{0.1})(Fe_{2.2}Al_{0.6}Sb_{0.2})[(AsO_4)_{1.8}(PO_4)_{0.2}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3425, 3050, 1495w, 1453w, 1165w, 1077, 1008, 871s, 808s, 733, 698w, 600, 505s, 464s, 440sh.

As137 Talmessite $Ca_2Mg(AsO_4)_2\cdot 2H_2O$



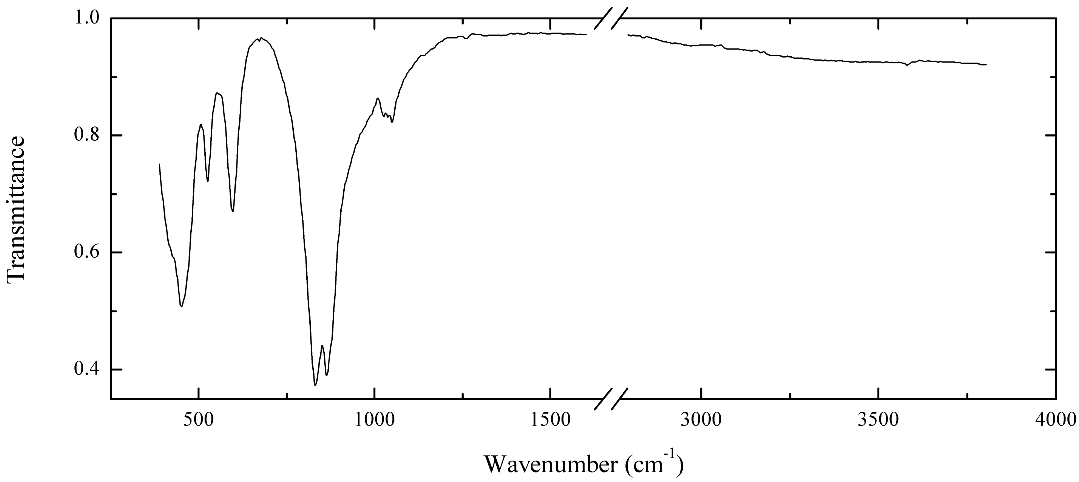
Locality: Khovu-Aksy deposit, 80 km SW of Kyzyl, Tuva, Middle Siberia, Russia.

Description: Pink massive. Identified by powder X-ray diffraction pattern.

The empirical formula is (electron microprobe) $(Ca_{2.02}Mg_{0.99}Co_{0.04})[(AsO_4)_{1.97}(PO_4)_{0.03}](H_2O,OH)_2$.

Wavenumbers (cm^{-1}): 3400sh, 2940s, 2450sh, 2290, 1830w, 1620w, 1540, 1165w, 972, 915sh, 865sh, 845s, 817s, 800s, 605sh, 525w, 430s.

As139 Tilasite $CaMg(AsO_4)F$



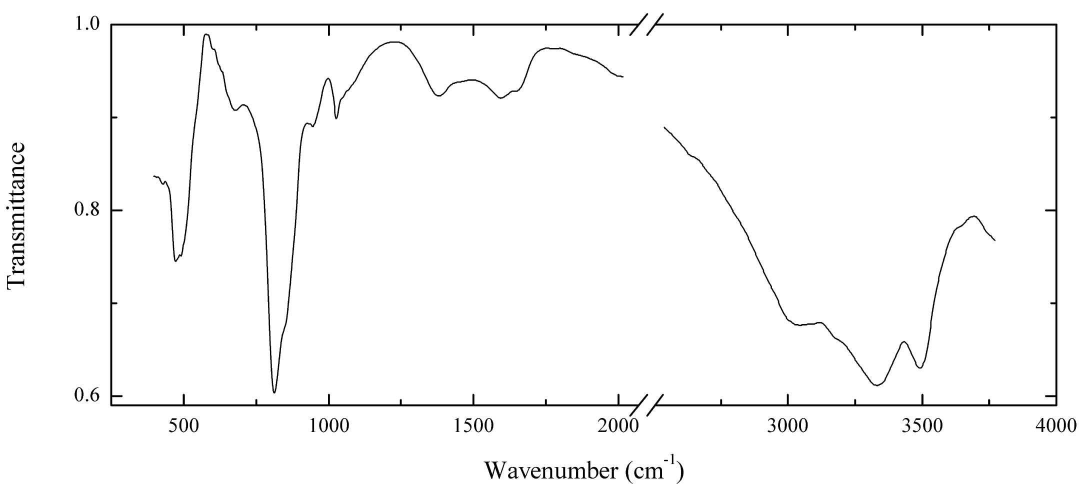
Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden (type locality).

Description: Pink fine-grained aggregate. Identified by IR spectrum.

The empirical formula is (electron microprobe) $Ca_{1.00}Mg_{0.98}Fe_{0.03}Mn_{0.02}[(AsO_4)_{0.97}(PO_4)_{0.03}]F_{1.05}$.

Wavenumbers (cm^{-1}): 1047w, 1040w, 1025w, 875sh, 860s, 828s, 593, 521, 447s, 420sh.

As140 Tyrolite $CaCu_5(AsO_4)_2(CO_3)(OH)_4{\cdot}6H_2O$

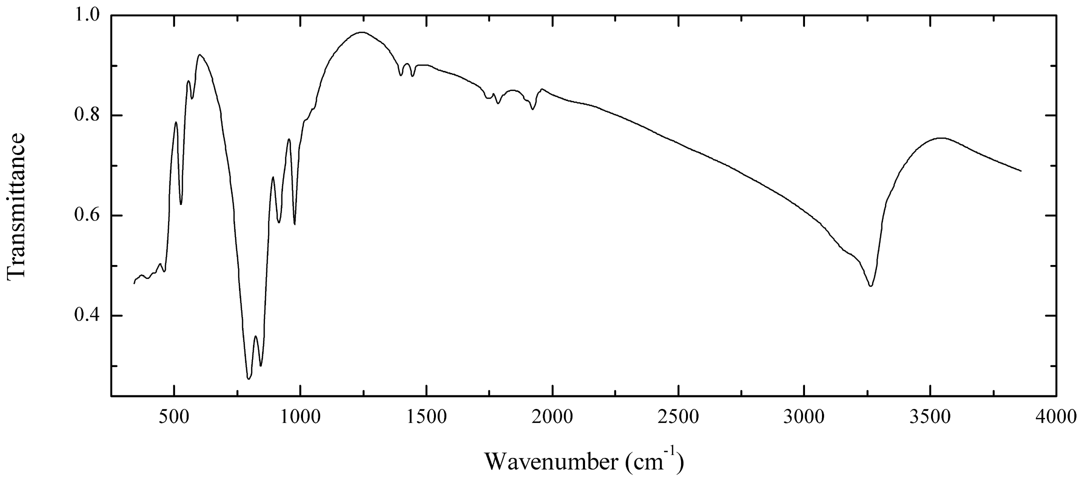


Locality: Berezovskoye deposit, Berezovsk town, Middle Urals, Russia.

Description: Bluish-green crusts consisting of prismatic crystals. Identified by IR spectrum and semi-qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3485s, 3320s, 3160sh, 3050, 1662, 1608, 1385, 1080sh, 1028, 947, 845sh, 811s, 672, 480sh, 468s, (425).

As141 Austinite $CaZn(AsO_4)(OH)$

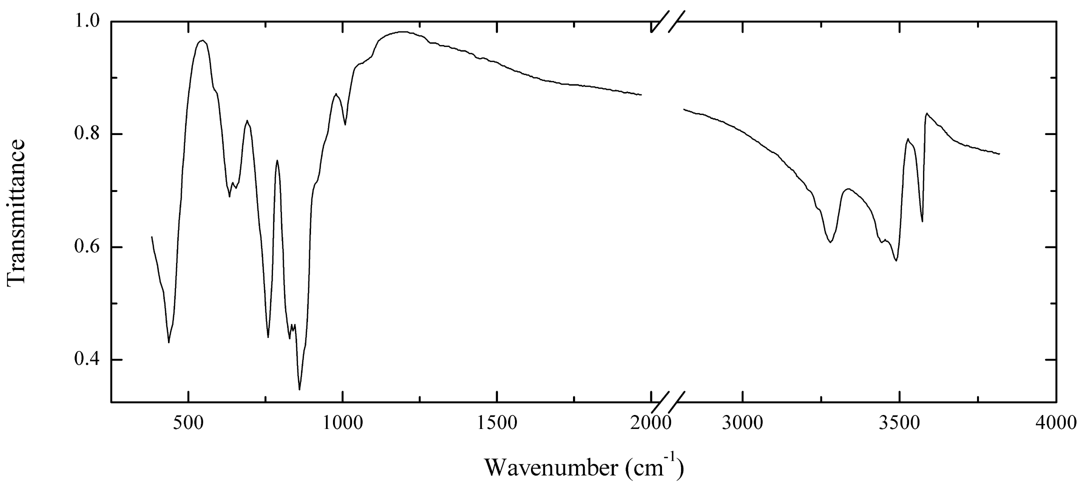


Locality: Guchab, Otavi, Namibia.

Description: Light green transparent crystals. The empirical formula is (electron microprobe) $Ca_{0.94}(Zn_{0.91}Cu_{0.08})[(AsO_4)_{0.83}(HAsO_4)_{0.14}(PO_4)_{0.03}](OH)$.

Wavenumbers (cm^{-1}): 3320sh, 3255, 3180sh, 1925w, 1900sh, 1785w, 1750w, 1450w, 1402w, 1050sh, 1025sh, 976, 916, 842s, 800sh, 794s, 570w, 524, 456s, 420sh, 397s.

As142 Allactite $Mn^{2+}{}_7(AsO_4)_2(OH)_8$

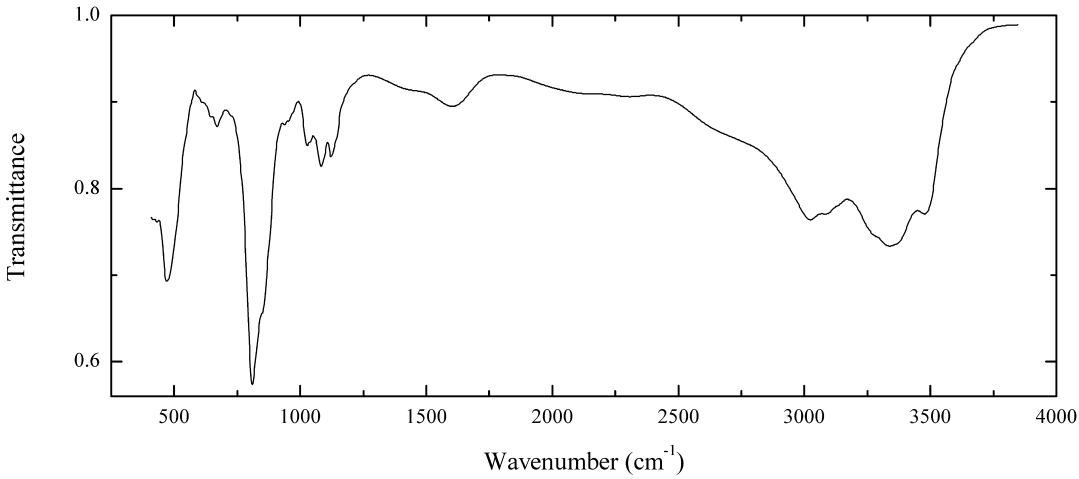


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: Red veinlet (2 mm thick) in skarn. Identified by powder X-ray diffraction pattern and qualitative electron microprobe analysis. Strongest reflections are [*d*, Å (*I*, %)] 5.016 (17), 4.648 (18), 3.712 (50), 3.287 (30), 3.231 (29), 3.049 (100), 2.926 (37), 2.676 (28).

Wavenumbers (cm^{-1}): 3560, 3472, 3420, 3250, 1070sh, 1010, 945sh, 910sh, 885sh, 859s, 839s, 826s, 757s, 653, 630, 590sh, 436s, 410sh.

As143 Fuxiaotuite $Ca_2Cu_9(AsO_4)_4(SO_4)_{0.5}(OH)_9 \cdot 9H_2O$

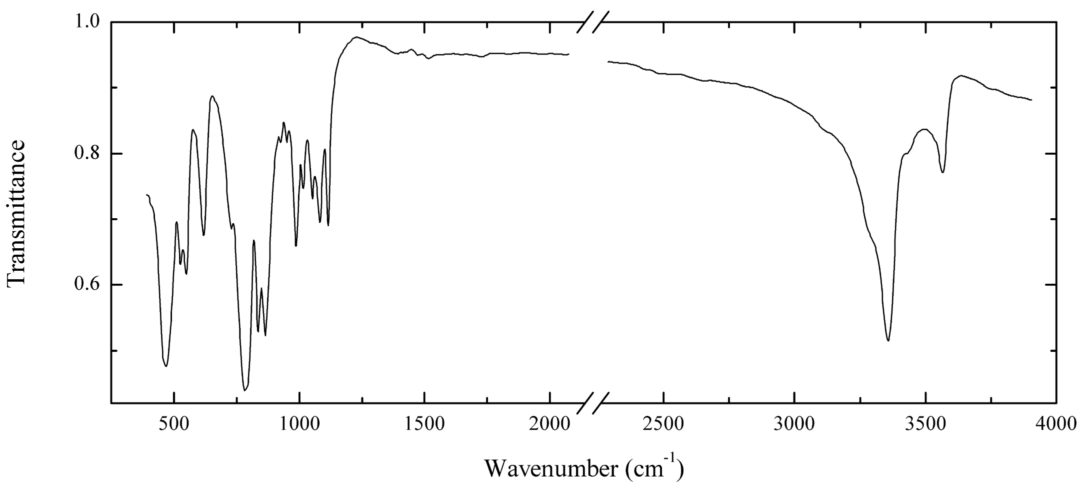


Locality: Novoveská Huta, Spisska Nova Ves, Slovakia.

Description: Bluish-green crust in the association with chalcophyllite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3455, 3315s, 3280sh, 3110sh, 3010, 1605, 1480sh, 1120, 1080, 1028, 845sh, 807s, 670, 645sh, 470s, 425sh.

As144 Clinoclase $Cu^{2+}_3(AsO_4)(OH)_3$

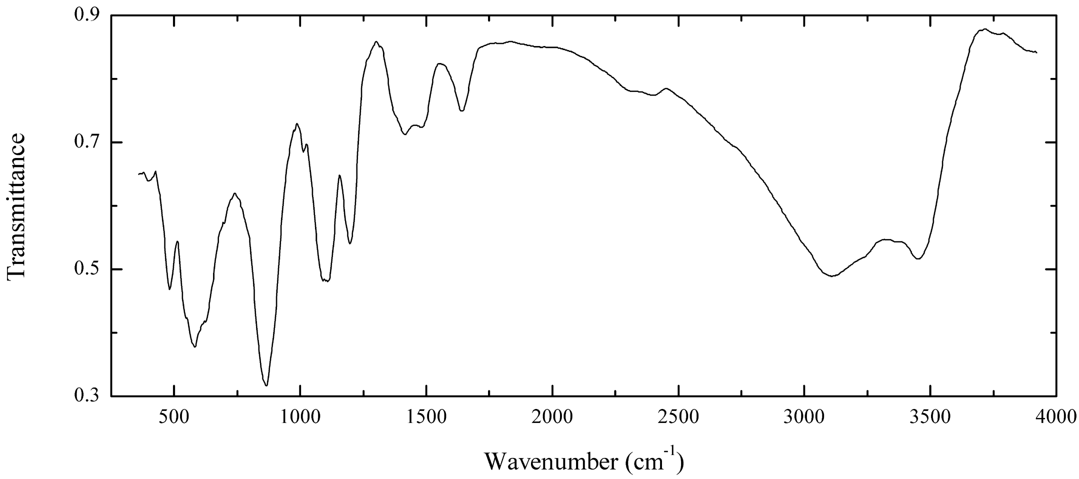


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Bluish-green crystals. The empirical formula is (electron microprobe) $Cu_{2.9}Zn_{0.1}[(AsO_4)_{0.9}(PO_4)_{0.05}(SO_4)_{0.05}](OH,H_2O)_3$.

Wavenumbers (cm^{-1}): 3540, 3410sh, 3335s, 3300sh, 3100sh, 1515w, 1485w, 1390w, 1114, 1082, 1052, 1015, 987, 949w, 923w, 864s, 835s, 786s, 731, 618, 550, 528, 472s, 460sh.

As145 Philipsbornite $PbAl_3(AsO_4)_2(OH,H_2O)_6$



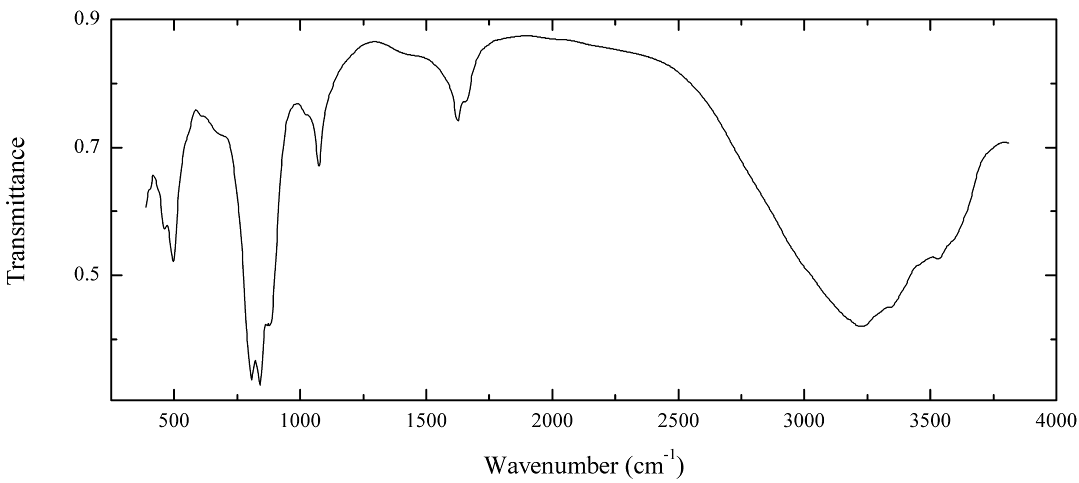
Locality: Glory Hole, Gold Hill, Utah, USA.

Description: Yellowish-green, massive. SO_4-rich variety, transitional to hidalgoite.

The empirical formula is (electron microprobe) $(Pb_{0.92}Ca_{0.07}Ba_{0.01})(Al_{2.78}Fe_{0.13}Mg_{0.10})[(AsO_4)_{1.52}(SO_4)_{0.40}(PO_4)_{0.05}(SiO_4)_{0.03}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3435s, 3360sh, 3225sh, 3100s, 2385w, 2320sh, 1642, 1485, 1418, 1375sh, 1197, 1105s, 1013, 864s, 625sh, 582s, 550sh, 483s, 400w.

As146 Kaňkite $Fe^{3+}(AsO_4)\cdot3.5H_2O$

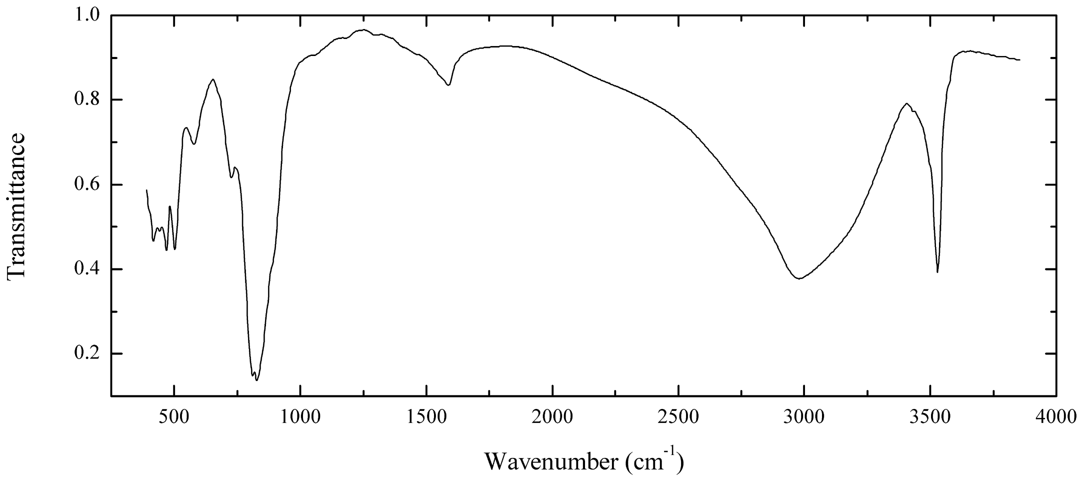


Locality: Horní Slavkov (former Schlaggenwald), Bohemia, Czech Republic.

Description: Yellow massive. Identified by IR spectrum. The empirical formula is (electron microprobe) $(Fe_{0.93}Al_{0.03}Cu_{0.02}Zn_{0.02}Mn_{0.02})[(AsO_4)_{0.94}(SO_4)_{0.06}](H_2O,OH)_n$.

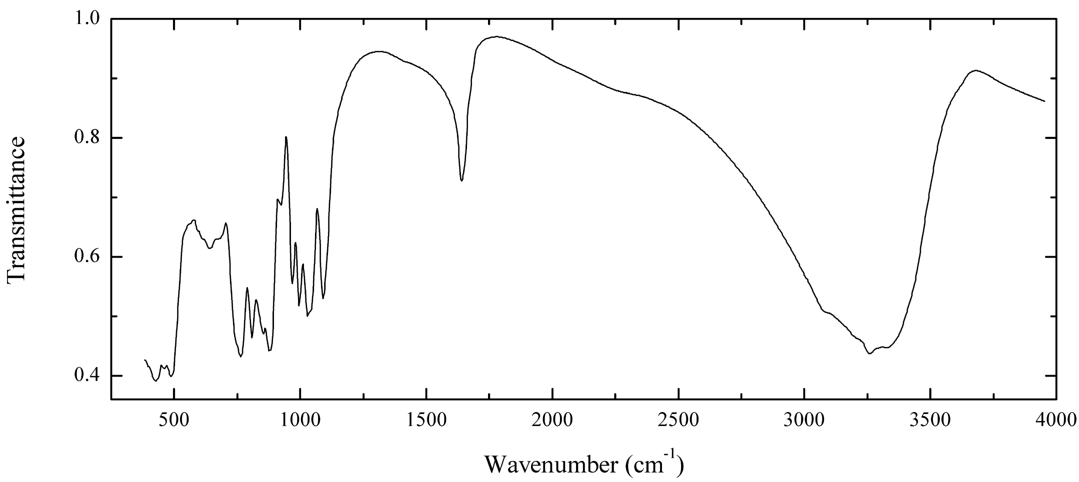
Wavenumbers (cm^{-1}): 3515, 3370sh, 3210s, 1650sh, 1623, 1440sh, 1073, 1025sh, 878s, 837s, 804s, 680sh, 494, 463.

As147 Scorodite $Fe^{3+}(AsO_4)\cdot 2H_2O$



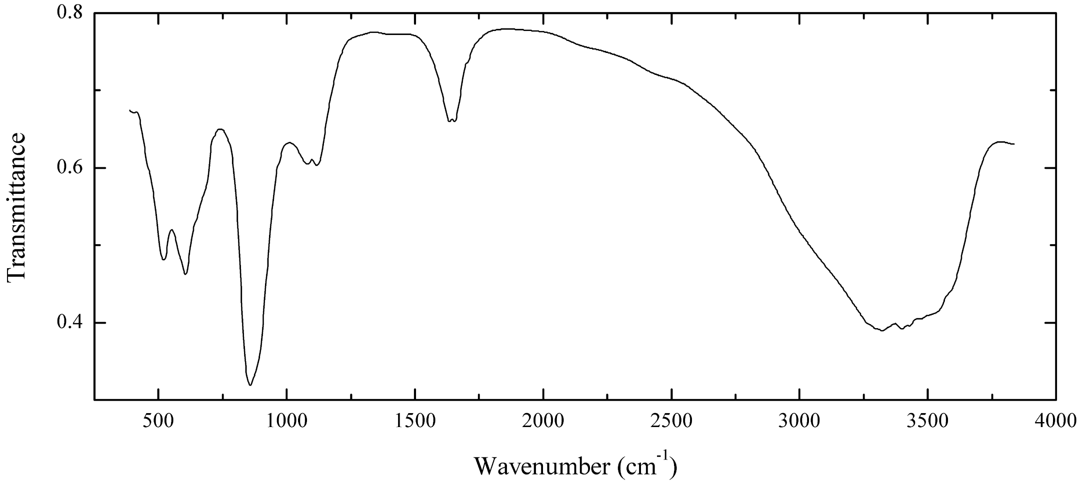
Locality: Svetloye deposit, Iul'tin district, Chukotka Autonomous Area, Russia.
Description: Greenish-brown massive. Nest in limonite. The empirical formula is (electron microprobe) $(Fe_{0.98}Cu_{0.03})[(AsO_4)_{0.98}(SO_4)_{0.02}]\cdot nH_2O$.
Wavenumbers (cm^{-1}): 3515, 3120sh, 2960s, 1588, 1550sh, 1188w, 1062w, 890sh, 825s, 808s, 727, 580, 499, 468, 440, 415.

As148 Bendadaite $Fe^{2+}Fe^{3+}{}_2(AsO_4)_2(OH)_2\cdot 4H_2O$



Locality: Lavra do Almerindo (Almerindo quarry), Linópolis, Divino das Laranjeiras county, Minas Gerais, Brazil (cotype locality).
Description: Globular aggregates of yellowish-brown elongate crystals. Associated minerals are albite, muscovite, quartz, schörl, elbaite, löllingite, scorodite, pharmacosiderite, saléeite and phosphuranylite. Cotype sample. Original material of crystal structure investigation.
Optically biaxial (+); $\alpha = 1.725(5)$, $\beta = 1.755(5)$, $\gamma = 1.785(5)$. The empirical formula is (electron microprobe, Fe^{2+}: Fe^{3+} ratio determined by Mössbauer data, H_2O determined by Penfield method) $(Fe^{2+}{}_{0.69}Fe^{3+}{}_{0.12}Mn_{0.04})(Fe^{3+}{}_{1.93}Al_{0.07})[(AsO_4)_{1.62}(PO_4)_{0.38}](OH)_{1.82}\cdot 4.18H_2O$.
Wavenumbers (cm^{-1}): 3320s, 3250s, 3200sh, 3085sh, 2300sh, 1643, 1092, 1045sh, 1033, 995, 969, 925w, 881s, 854, 811s, 768s, 755sh, 775sh, 650w, 620sh, 490s, 467s, 431s.

As149 Liskeardite $(Al,Fe^{3+})_3(AsO_4)(OH)_6 \cdot 5H_2O$

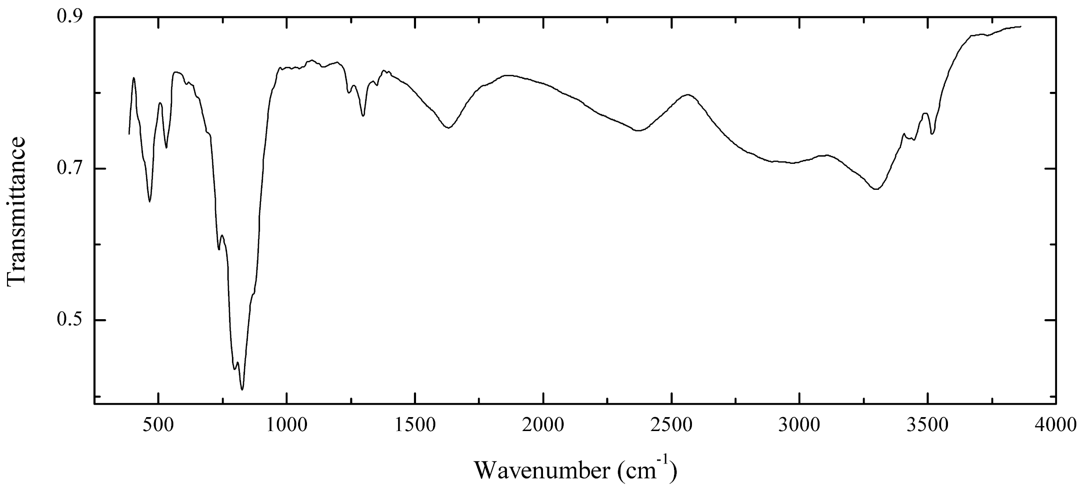


Locality: Penberthy Crofts mine, near St. Hilary, Cornwall, England.

Description: White spherulitic crust on rock. The bands at 1,117 and 1,083 cm^{-1} indicate the presence of SO_4^{2-} groups.

Wavenumbers (cm^{-1}): 3560sh, 3500sh, 3390s, 3300s, 3020sh, 1657, 1645, 1117, 1083, 885sh, 840s, 680sh, 640sh, 605s, 519.

As150 Pushcharovskite $Cu(AsO_3OH) \cdot H_2O$



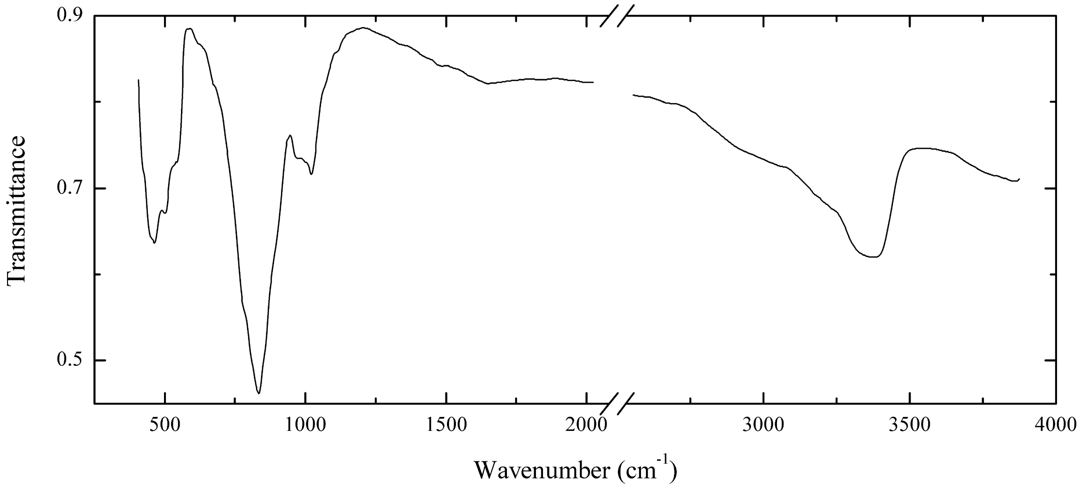
Locality: Jáchymov, Krušné Hory Mts. (Ore Mts.), Czech Republic.

Description: Aggregate of blue crystals. Identified by IR spectrum.

The empirical formula is (electron microprobe) $(Cu_{0.88}Fe_{0.08})(AsO_3OH) \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3505w, 3425w, 3290, 2900, 2850sh, 2380, 2250sh, 1630, 1370w, 1300w, 1245w, 870sh, 825s, 795s, 734, 527, 463, 450sh.

As151 Cornwallite $Cu^{2+}{}_5(AsO_4)_2(OH)_4$

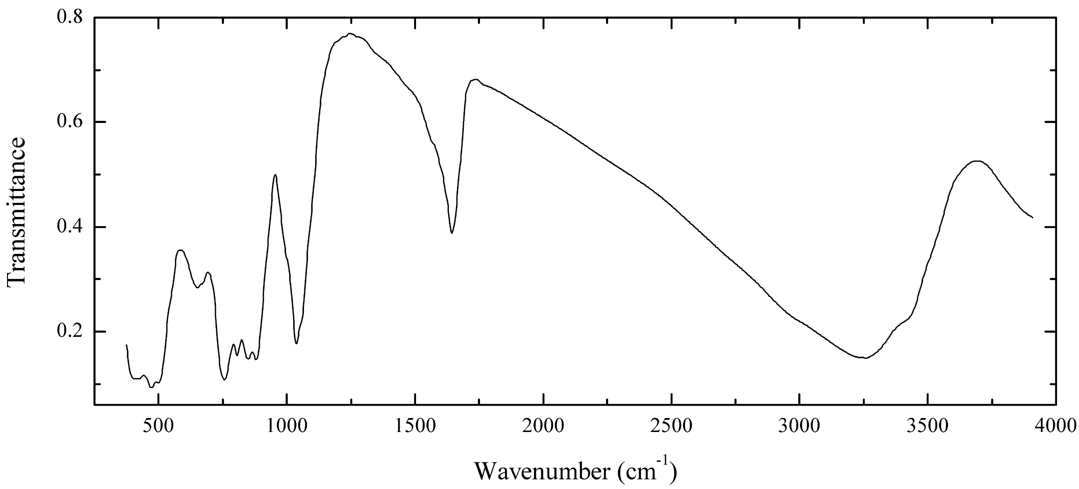


Locality: Mina el Guanaco, Taltal, Chile.

Description: Green massive, in the association with quartz and halloysite. Disordered variety. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3350, 3320sh, 3000sh, 1635w, 1465w, 1020, 980sh, 890sh, 832s, 780sh, 535sh, 503, 465, 425sh.

As152 Ojuelaite $ZnFe^{3+}{}_2(AsO_4)_2(OH)_2 \cdot 4H_2O$

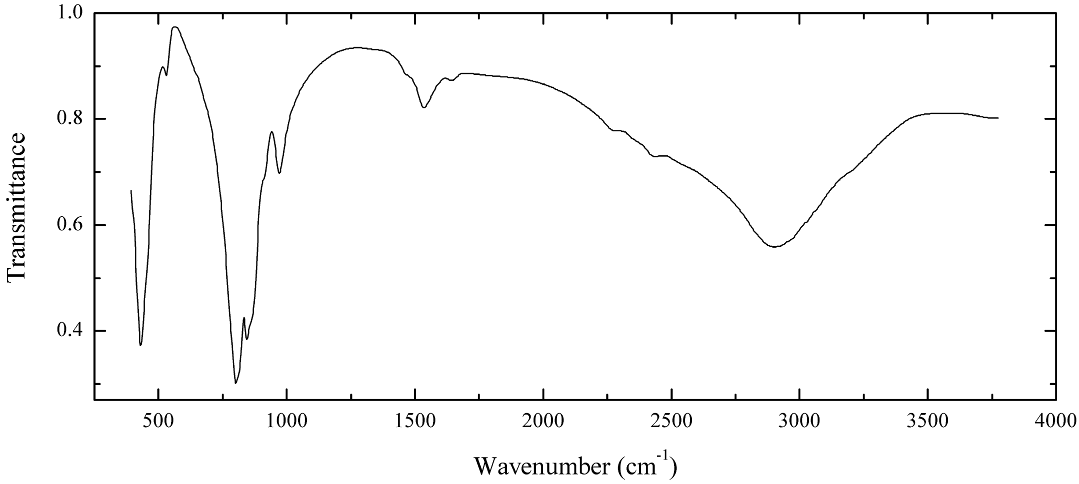


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Brownish-green prismatic crystals (to 0.3 × 1 mm). Associated minerals are goethite, jarosite, scorodite. By the IR spectrum close to isostructural arsenates arthurite and bendadaite. The empirical formula is (electron microprobe) $(Zn_{0.58}Fe_{0.32}Mg_{0.08})Fe^{3+}{}_{2.00}[(AsO_4)_{1.96}(PO_4)_{0.04}](OH)_2 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3400sh,3235s, 2990sh, 1647, 1580sh, 1050sh, 1036, 1000sh, 880s, 850s, 805s, 755s, 650, 497s, 470s, 415s.

As153 Talmessite $Ca_2Mg(AsO_4)_2 \cdot 2H_2O$



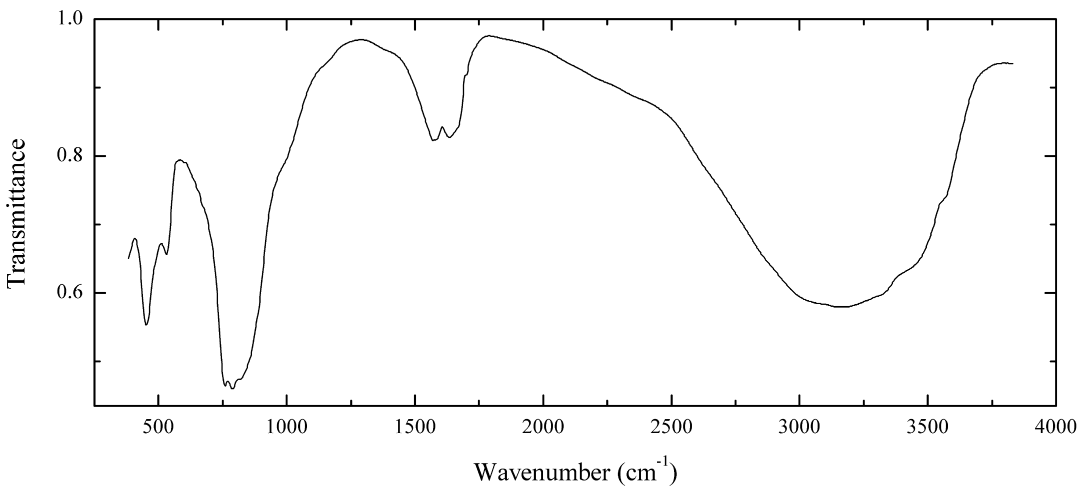
Locality: Bou Azzer deposit, Anti-Atlas, Morocco.

Description: Lilac split crystals in the association with dolomite. Identified by powder X-ray diffraction pattern. Co-rich variety.

The empirical formula is (electron microprobe) $Ca_{1.96}(Mg_{0.60}Co_{0.39}Fe_{0.03})(AsO_4)_{2.00} \cdot 2H_2O$.

Wavenumbers (cm^{-1}): 2880, 2420w, 2265w, 1640w, 1530, 1460sh, 972, 910sh, 865sh, 845s, 801s, 532w, 450sh, 431s.

As154 Smolyaninovite $Co_3Fe^{3+}{}_2(AsO_4)_4 \cdot 11H_2O$

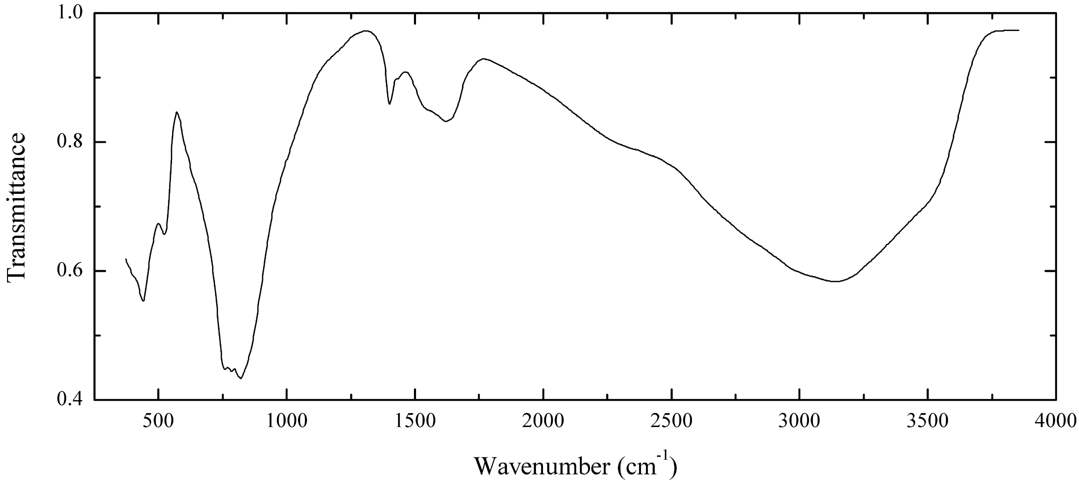


Locality: Khovu-Aksy deposit, 80 km SW of Kyzyl, Tuva, Middle Siberia, Russia (type locality).

Description: Straw-yellow massive, in the association with erythrine. Authors' sample investigated by the discoverer L.K. Yakhontova.

Wavenumbers (cm^{-1}): 3550sh, 3400sh, 3170s, 3040sh, 1640, 1580, 990sh, 815sh, 788s, 758s, 530, 448.

As155 Fahleite $CaZn_5Fe^{3+}_2(AsO_4)_6 \cdot 14H_2O$

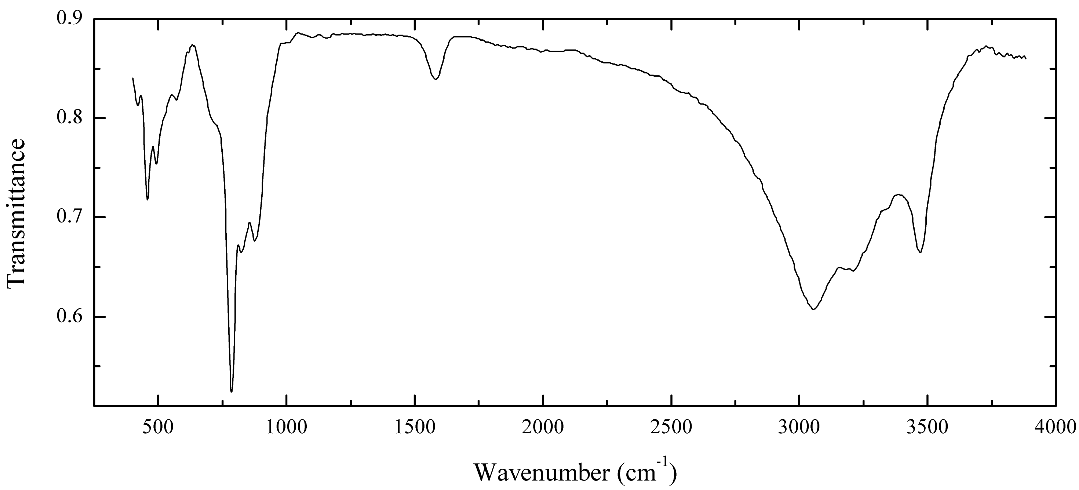


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).

Description: Light green massive aggregate. Close to the IR spectrum of related arsenate mineral smolyaninovite. Contains bands of acid species H^+ (1,400 cm^{-1}) and $HAsO_4^{2-}$ (2,350 cm^{-1}). Ca-deficient variety. The empirical formula is (electron microprobe) $Ca_{0.1}Zn_{5.0}Fe_{2.0}Cu_{0.25}(AsO_4, HAsO_4)_{6.0} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3430sh, 3110s, 2980sh, 2350sh, 1625, 1560sh, 1400, 835sh, 819s, 795s, 757s, 524, 442, 410sh.

As156 Erythrite $Co_3(AsO_4)_2 \cdot 8H_2O$

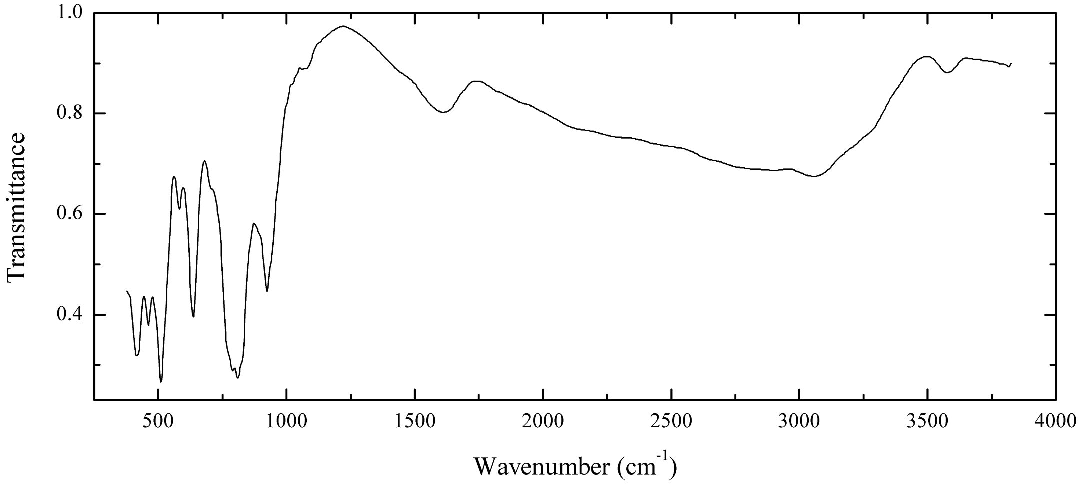


Locality: Marble quarry, Verkhniy Dashkesan, Azerbaijan.

Description: Red radiated aggregates to 0.7 mm in diameter in the association with roselite-beta and sphaerocobaltite. The empirical formula is (electron microprobe) $(Co_{2.38}Mg_{0.49}Cu_{0.09}Mn_{0.03}Zn_{0.01})(AsO_4)_{2.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3447, 3310sh, 3175s, 3030s, 1580, 1152w, 1098w, 1002w, 881, 828s, 785s, 715sh, 567, 492, 454, 418.

As157 Arseniosiderite $Ca_2Fe^{3+}{}_3(AsO_4)_3O_2{\cdot}3H_2O$

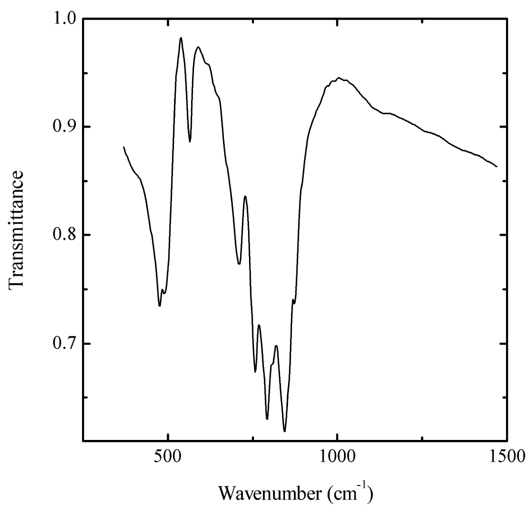


Locality: Benjamin Hill, Sonora, Mexico.

Description: Dark red crystals to 0.2 mm. The empirical formula is (electron microprobe) $Ca_{2.00}(Fe_{2.96}Mn_{0.05})(AsO_4)_{2.94}(PO_4)_{0.06}O_2{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3555, 3200sh, 3040, 2850sh, 2300sh, 2170sh, 1615, 1550sh, 1040w, 923, 830sh, 810s, 790s, 775sh, 636s, 582, 508s, 463s, 417s.

As158 Xanthiosite $Ni_3(AsO_4)_2$

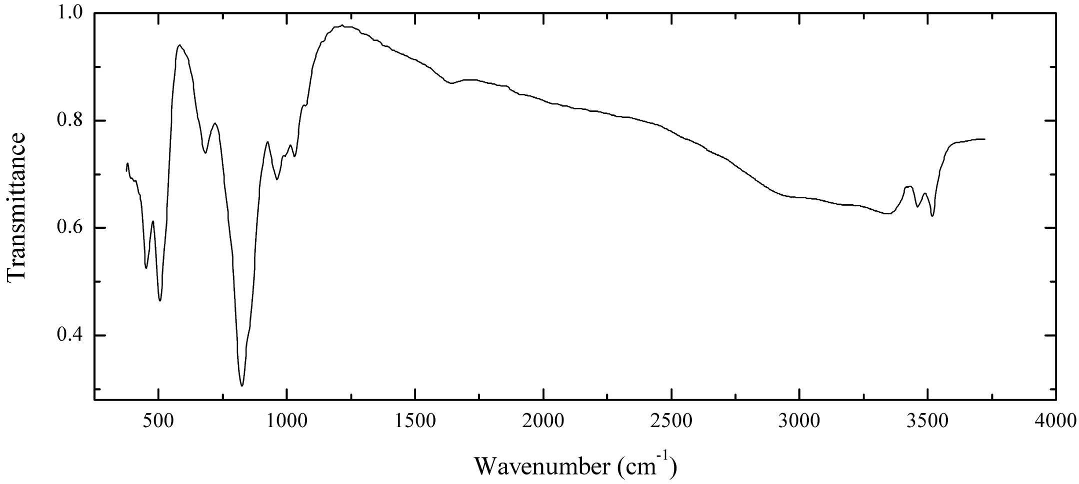


Locality: Johanngeorgenstadt, Erzgebirge, Saxony, Germany.

Description: Yellow, from the association with aerugite.

Wavenumbers (cm^{-1}): 873, 843s, 807sh, 792s, 755s, 707, 564, 490, 475, 410sh.

As159 Arhbarite $Cu_2Mg(AsO_4)(OH)_3$

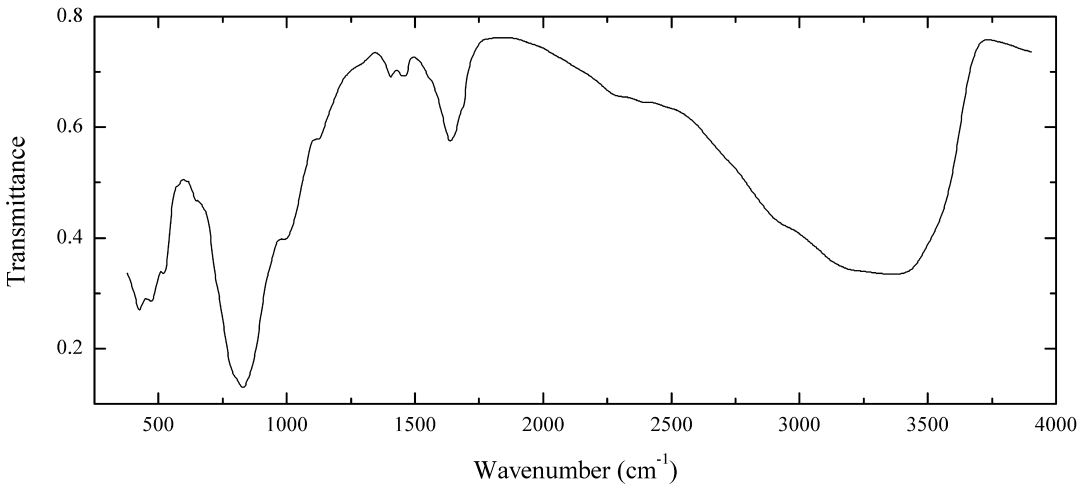


Locality: El Guanaco mine, Taltal, 2nd region, Chile.

Description: Greenish-blue, massive, in the association with guanacoite, chrysocolla and enargite. Close to the IR spectrum of related arsenate mineral smolyaninovite. Contains bands of acid species H^+ (1,400 cm^{-1}) and $HAsO_4^{2-}$ (2,350 cm^{-1}). Ca-deficient variety. The empirical formula is (electron microprobe) $Ca_{0.1}Zn_{5.0}Fe_{2.0}Cu_{0.25}(AsO_4,HAsO_4)_{6.0}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3505, 3450, 3335, 3175, 2950sh, 1645w, 1072w, 1033, 994, 964, 855sh, 827s, 684, 503s, 452s.

As160 Arsenate As160 $Ca_2MnFe^{3+}_2(HAsO_4)_6{\cdot}nH_2O$

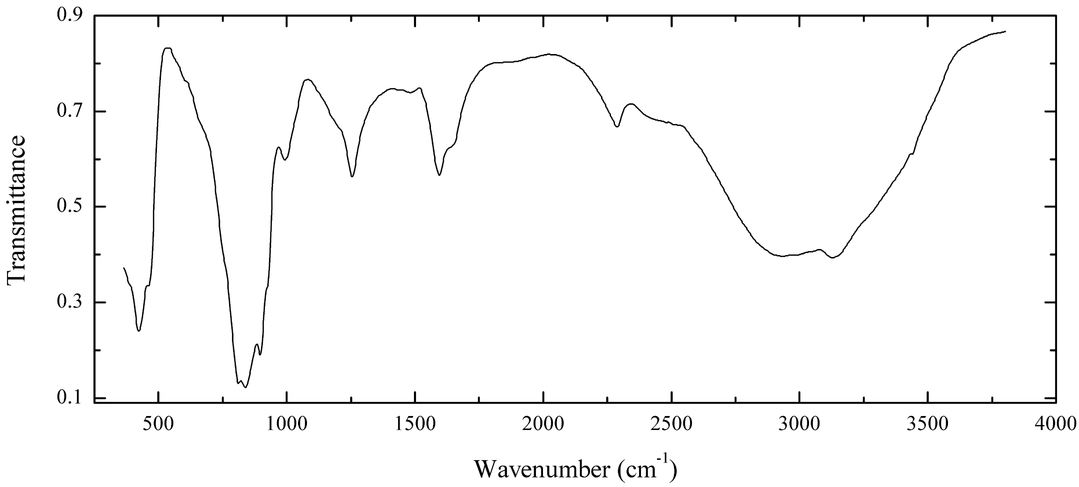


Locality: Alberoda, Aue, Saxony, Germany.

Description: Greenish-brown massive aggregate. The IR spectrum contains bands that could be assigned to acid species H^+ (1,407, 1,460 cm^{-1}) and $HAsO_4^{2-}$ (2,400 cm^{-1}). The charge-balanced empirical formula is (electron microprobe) $H_{5.85}Ca_{1.88}Mn_{0.82}Fe^{3+}_{2.25}(AsO_4,HAsO_4)_{6.00}{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3350s, 3200sh, 2930sh, 2400sh, 2300sh, 1680sh, 1640, 1460, 1407, 1120sh, 997sh, 828s, 518, 472, 424s.

As161 Irhtemite $Ca_4MgH_2(AsO_4)_4{\cdot}4H_2O$

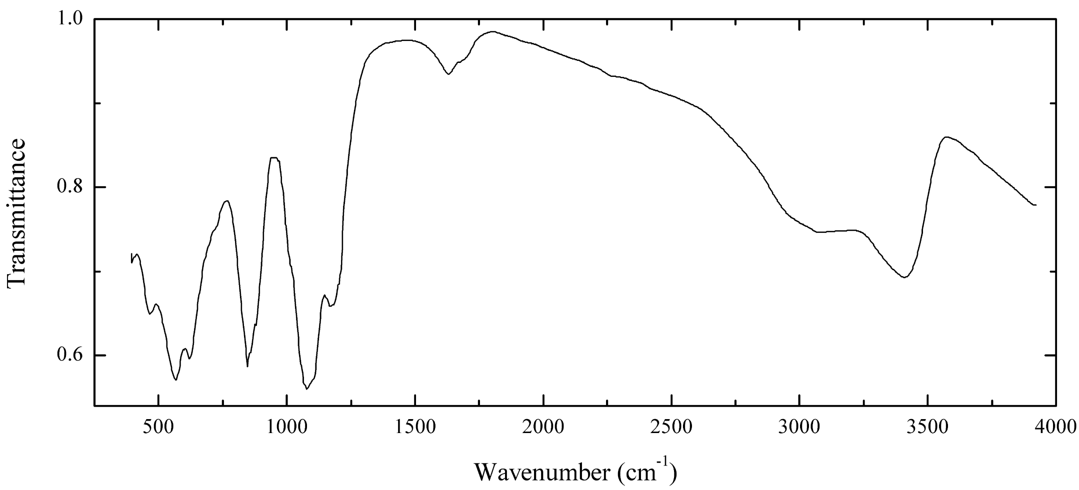


Locality: Sainte-Marie-aux Mines, Vosges Mts., Haut-Rhin, Alsace, France.

Description: White spherulites with radial-fibrous structure from the association with pharmacolite. The empirical formula is (electron microprobe) $H_{2+x}Ca_{3.95}(Mg_{0.85}Fe_{0.10})(AsO_4)_{4.10}{\cdot}nH_2O$. The IR spectrum contains bands of acid species H+ (1,256 cm^{-1}) and $HAsO_4$2− (2,500, 2,285 cm^{-1}).

Wavenumbers (cm^{-1}): 3380sh, 3120s, 2925s, 2500sh, 2285, 1650sh, 1598, 1485w, 1256, 998, 927, 895s, 837s, 807s, 760sh, 460, 422s, 390sh.

As162 Hidalgoite $PbAl_3(AsO_4)(SO_4)(OH)_6$

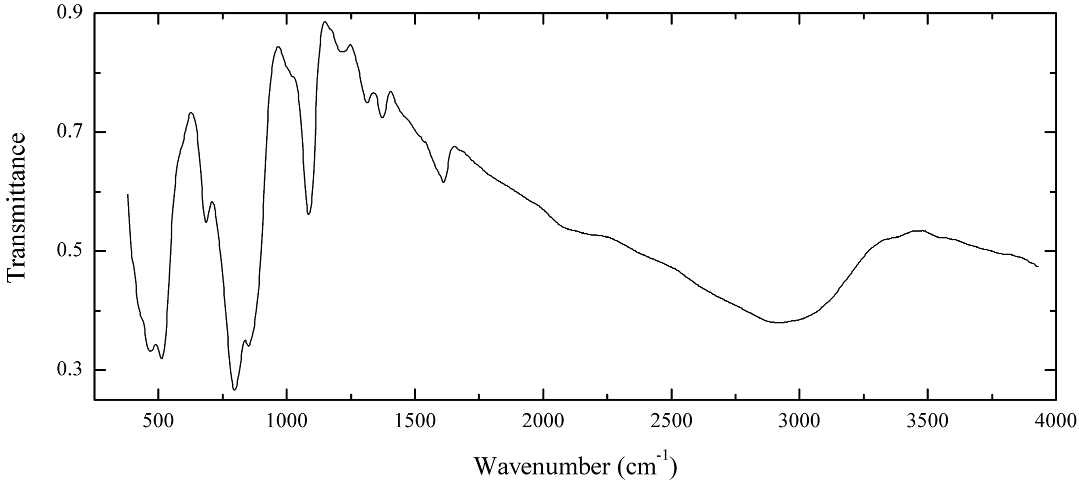


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Brownish-green fine-grained aggregate in quartz. The empirical formula is (electron microprobe) $Pb_{0.9}Al_{2.4}Fe_{0.5}Cu_{0.2}(SO_4)_{1.1}(AsO_4)_{0.8}(SiO_4)_{0.2}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3425, 3090, 2970sh, 1680sh, 1640w, 1172, 1078s, 848s, 623s, 567s, 462.

As163 Segnitite $PbFe^{3+}_3(AsO_4)(HAsO_4)(OH)_6$

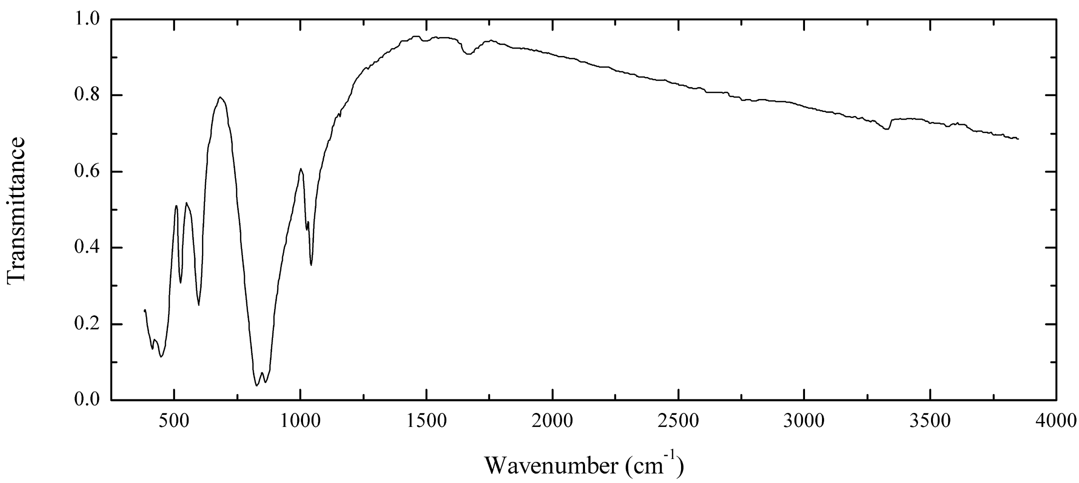


Locality: Kremikovtsi open-pit mine, near Sofia, Bulgaria.

Description: Olive green rhombohedral crystals in the association with azurite, malachite and barite. Investigated by I.V. Pekov. Identified by X-ray diffraction data and electron microprobe analysis. The empirical formula is $Pb_{1.00}Fe^{3+}_{3.00}(AsO_4,HAsO_4)_{2.00}(OH,H_2O)_6$. Single-crystal unit-cell parameters are $a = 7.397(7)$, $c = 17.086(19)$ Å. The IR spectrum contains bands of acid species H^+ (1,375, 1,315 cm^{-1}) and $HAsO_4^{2-}$ (2,685, 2,580 cm^{-1}).

Wavenumbers (cm^{-1}): 2920s, 2620sh, 2090sh, 1617, 1375, 1315, 1220w, 1085, 1025sh, 853s, 797s, 685, 514s, 467s, 435sh.

As164 Tilasite $CaMg(AsO_4)F$

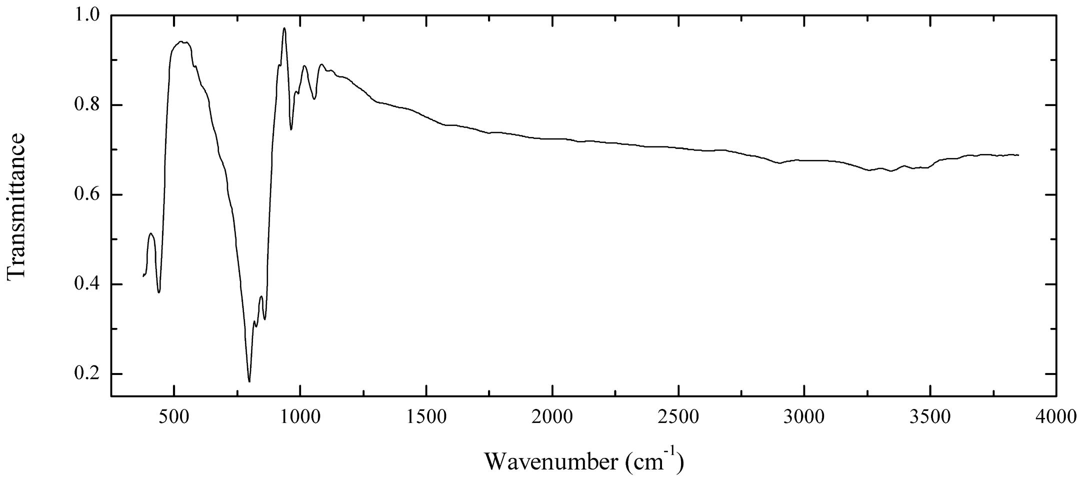


Locality: "Mixed Series" formation, Babuna valley, 40 km SW of Veles, near Nežilovo village, Jacupica Mountains, Macedonia.

Description: Grey twins (to several mm) from a vein hosted in dolomite marble. Associated minerals are nežilovite, barite, Zn-rich richterite, hematite, phlogopite, gahnite. The empirical formula is (electron microprobe) $Ca_{0.94}Mg_{1.06}Fe_{0.02}[(AsO_4)_{0.98}(PO_4)_{0.02}]F_{0.95}(OH)_{0.09}$.

Wavenumbers (cm^{-1}): 3325w, 1675w, 1500w, 1044, 1024, 862s, 829s, 595, 523, 447s, 414s.

As165 Hedyphane $Pb_3Ca_2(AsO_4)_3Cl$

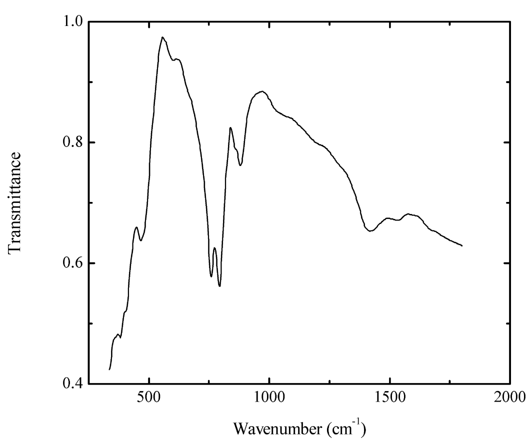


Locality: "Mixed Series" formation, Babuna valley, 40 km SW of Veles, near Nežilovo village, Jacupica Mountains, Macedonia.

Description: Yellow grains in skarn. Associated minerals are barite, Zn-rich richterite, phlogopite, quartz, albite, hematite, gahnite, galena, sphalerite, franklinite. The empirical formula is (electron microprobe) $Pb_{3.35}Ca_{1.6}[(AsO_4)_{2.75}(PO_4)_{0.15}(SO_4)_{0.1}]Cl_{0.9}(OH)_{0.1}$. Relatively weak bands in the IR spectrum correspond to the groups OH^- (the range 3,200–3,500 cm^{-1}), SO_4^{2-} (1,057, 660, 610 cm^{-1}) and PO_4^{3-} (992, 961, 921, 577 cm^{-1}).

Wavenumbers (cm^{-1}): 3465w, 3410w, 3325w, 3235w, 2870w, 1057, 992w, 961, 921w, 859s, 824s, 797s, 690sh, 660sh, 610sh, 577w, 440s, 380s.

As166 Sahlinite $Pb_{14}(AsO_4)_2O_9Cl_4$

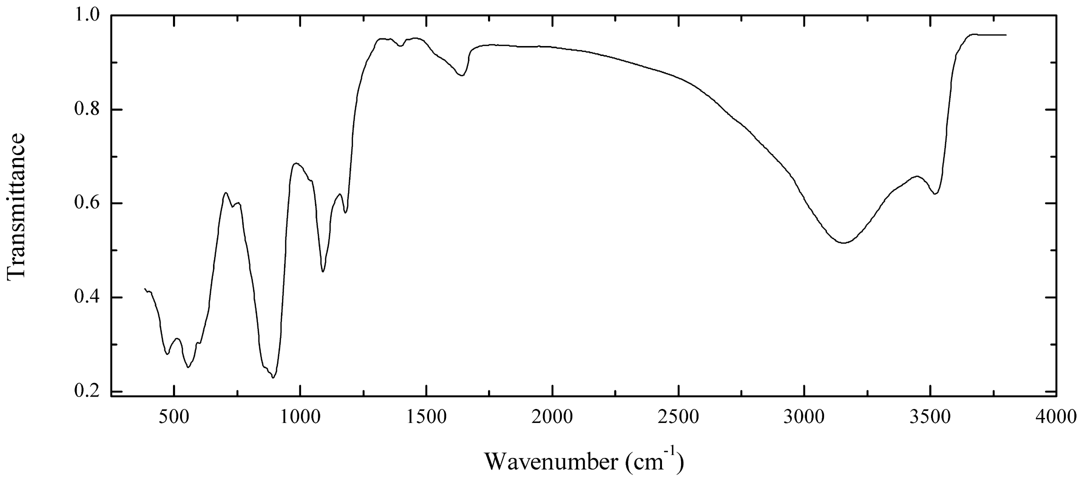


Locality: Kombat mine, Namibia.

Description: Orange grains in skarn. Associated minerals are britvinite and carbonates. The empirical formula is (electron microprobe) $Pb_{13.6}(AsO_4)_{1.5}(VO_4)_{0.2}Cl_{4.2}O_{8.95}$.

Wavenumbers (cm^{-1}): 1540w, 1422, 880, 860sh, 795s, 758s, 600w, 467, 400sh, 380s.

As167 Dussertite $BaFe^{3+}{}_3(AsO_4)_2(OH)_5{\cdot}H_2O$

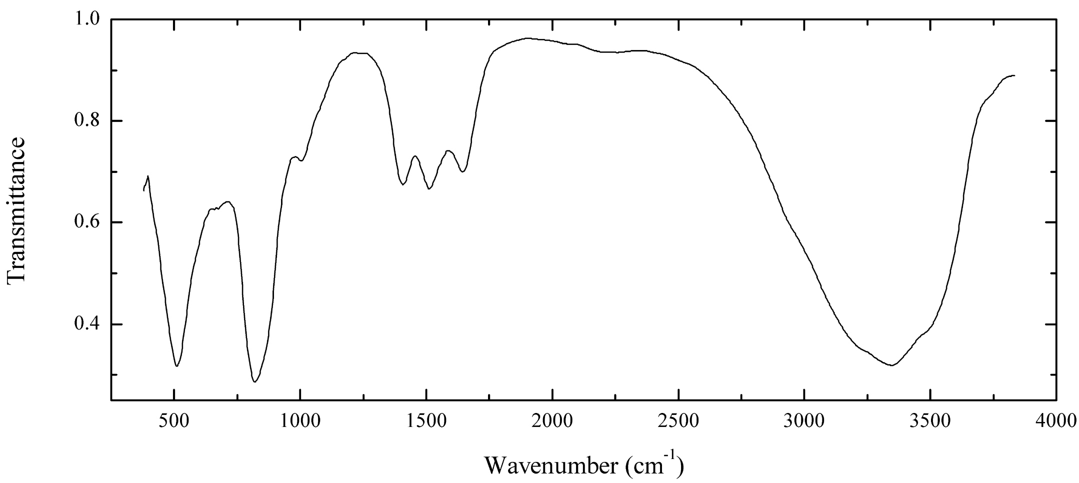


Locality: Grube Clara (Clara mine), Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Light yellow-green. The empirical formula is (electron microprobe) $Ba_{1.1}(Fe_{1.9}Al_{1.0})(AsO_4)_{1.7}(SO_4)_{0.3}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3495, 3135, 1640, 1550sh, 1400w, 1175, 1090, 1040sh, 893s, 855sh, 600sh, 560s, 474s.

As168 Arsenate As168 $Ca_2(Mg,Zn)Cr_4(AsO_4)_2(OH)_{12}{\cdot}nH_2O$

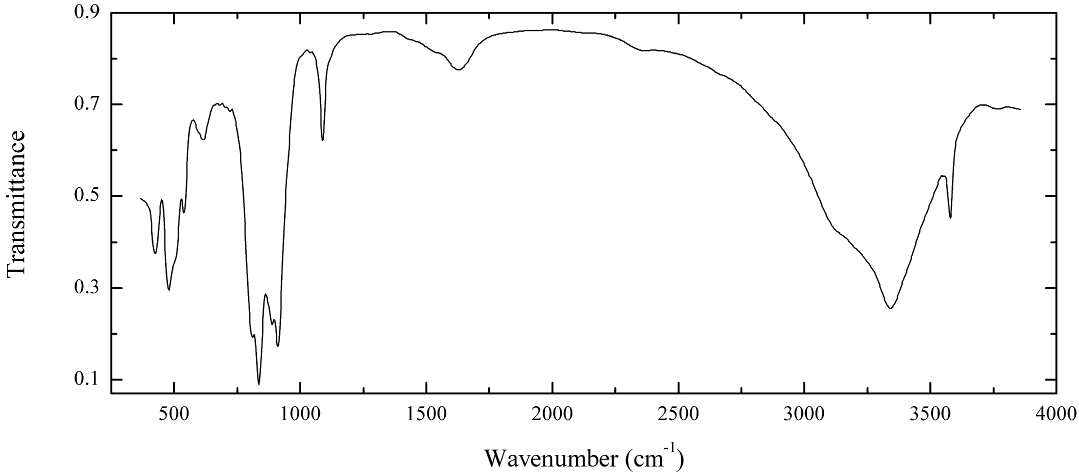


Locality: Bou Azzer, Morocco.

Description: Green, powdery. Amorphous. The empirical formula is (electron microprobe) $(Ca_{1.63}Na_{0.22}K_{0.02})(Mg_{0.53}Zn_{0.43}Cu_{0.05})(Cr_{3.80}Fe_{0.11}Al_{0.08})(AsO_4)_{2.00}(OH)_x{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3465sh, 3335s, 3220sh, 1648, 1517, 1410, 1005, 820s, 660w, 512s.

As169 Kamarizaite $Fe^{3+}_3(AsO_4)_2(OH)_3 \cdot 3H_2O$

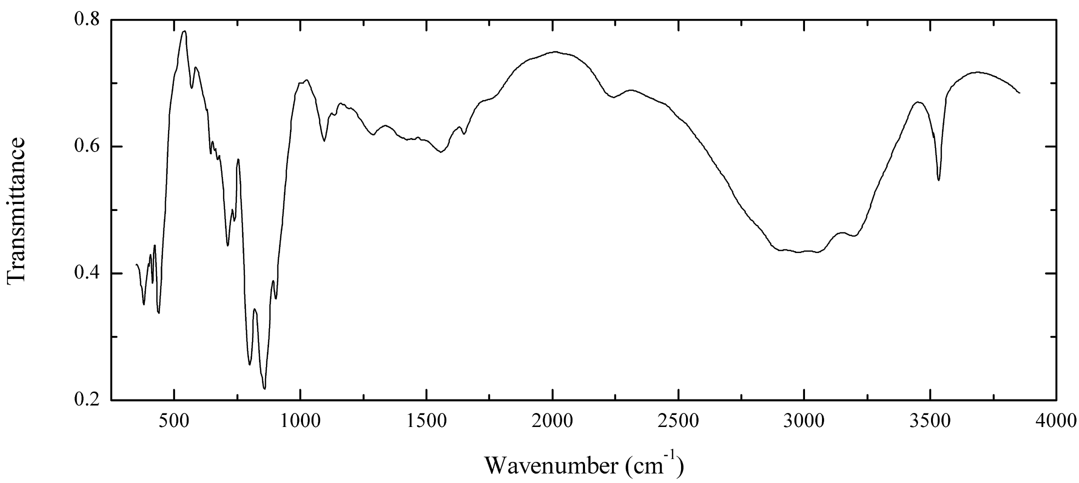


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Fine-grained, porcelain-like pseudomorphs (up to 3 cm) after grains of an unknown ore mineral. Associated minerals are scorodite, jarosite, goethite. Holotype sample. $D_{meas} = 3.16$ (1) g/cm^3. Optically biaxial (+), $n_{min} = 1.825$, $n_{max} = 1.835$. The empirical formula is (electron microprobe; H_2O determined by thermogravimetry in vacuum) $Ca_{0.03}Fe^{3+}_{2.86}(AsO_4)_{1.90}(SO_4)_{0.10}(OH)_{2.74} \cdot 3.27H_2O$.

Wavenumbers (cm^{-1}): 3552, 3315s, 3115sh, 1630w, 1540sh, 1450sh, 1089, 911s, 888s, 870sh, 835s, 808s, 614w, 540, 500sh, 478s, 429.

As170 Vladimirite $Ca_5H_2(AsO_4)_4 \cdot 5H_2O$

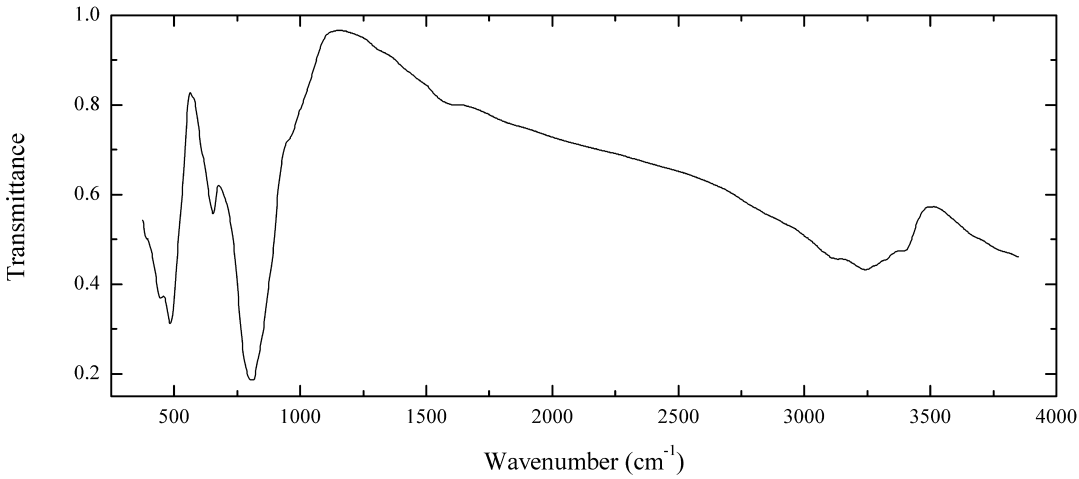


Locality: Bou Azzer, Anti-Atlas, Morocco.

Description: Radiated aggregates of colourless crystals to 1 mm. close to the IR spectrum of vladimirite from its type locality. The bands at 2,250, 1,300, 1,135 and 1,096 cm^{-1} correspond to acid groups. The weak band at 1,435 cm^{-1} can be due to the admixture of carbonate.

Wavenumbers (cm^{-1}): 3535, 3200, 3060, 2950, 2905, 2790sh, 2250w, 1750sh, 1660w, 1570, 1435w, 1300w, 1135w, 1096, 904s, 859s, 801s, 742, 714, 668, 644, 568w, 437s, 414, 380s.

As171 Jamesite $Pb_2\ Zn_2Fe^{3+}{}_5(AsO_4)_{5.0}O_4$.

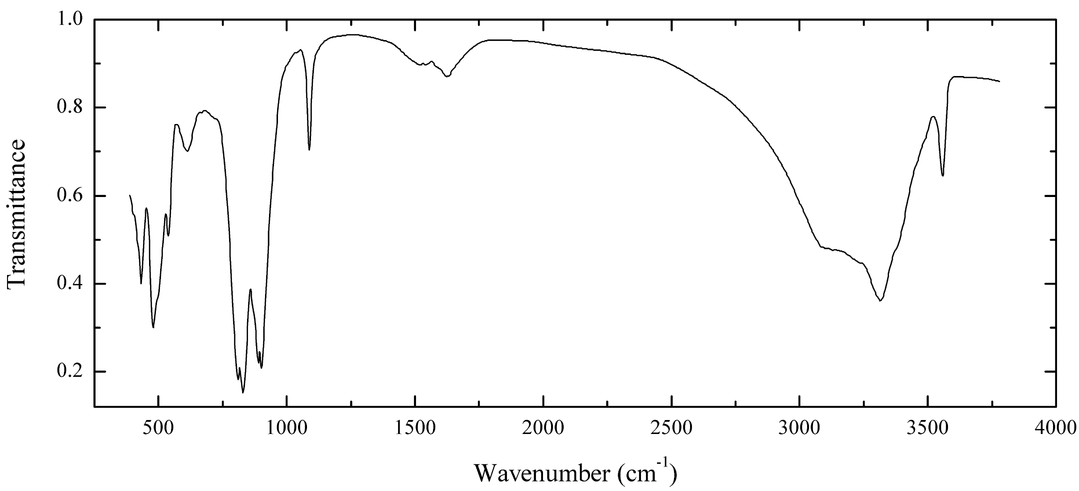


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia.

Description: Brownish-red clusters. The empirical formula is (electron microprobe) $Pb_{2.0}Zn_{2.1}Fe_{4.6}(AsO_4)_{5.0}(OH,O)_4$.

Wavenumbers (cm^{-1}): 3380, 3230, 3120, 1580w, 950sh, 811s, 654, 484s, 443s.

As172 Kamarizaite $Fe^{3+}{}_3(AsO_4)_2(OH)_3{\cdot}3H_2O$

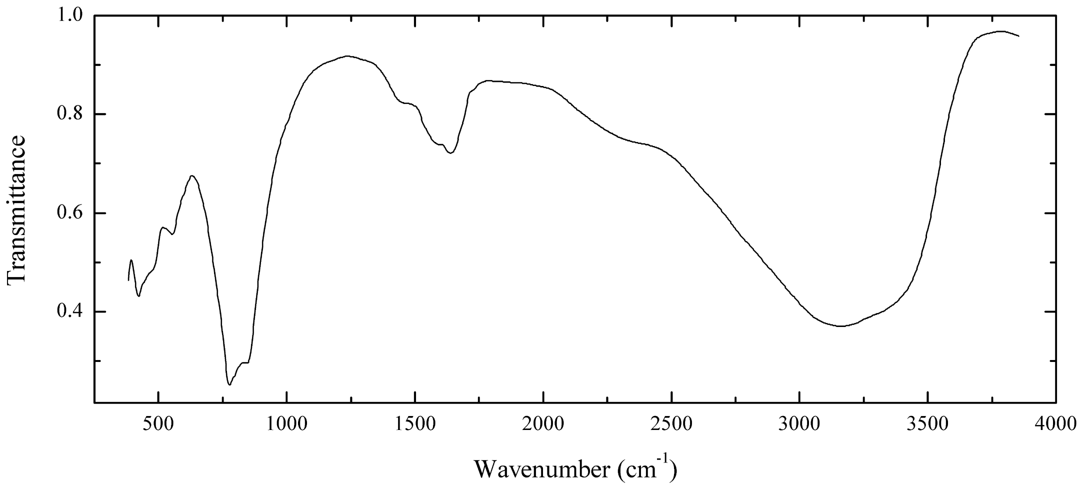


Locality: Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Fine-grained, brownish-yellow porcelain-like aggregate in limonite. The empirical formula is (electron microprobe) $Fe_{2.94}(AsO_4)_{1.87}(SO_4)_{0.13}(OH)_3{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3558, 3380sh, 3315s, 3240sh, 3120sh, 1645w, 1540w, 1088, 903s, 889s, 830s, 810s, 715sh, 611w, 537, 495sh, 474s, 429, 410sh.

As173 Metaköttigite $(Zn,Fe^{3+})_3(AsO_4)_2 \cdot 8(H_2O,OH)$

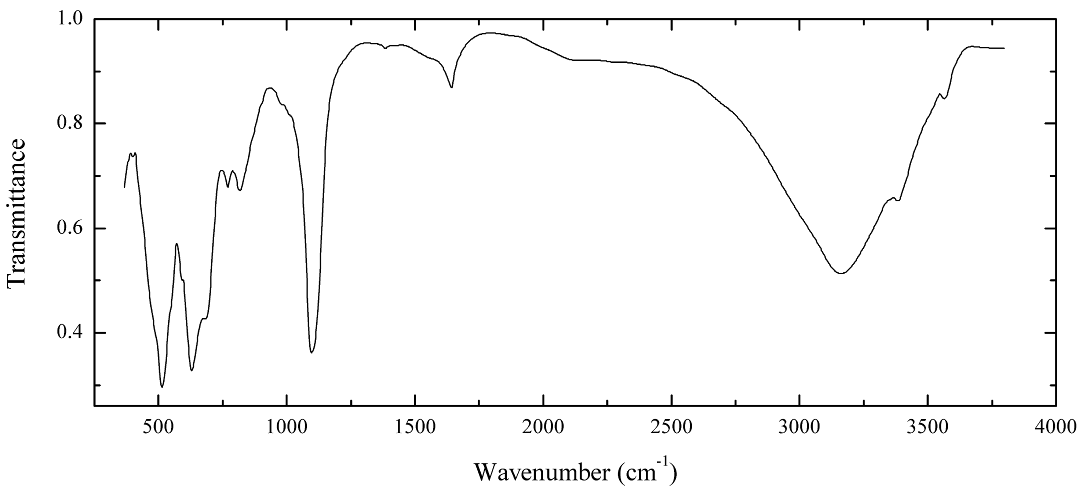


Locality: Ojuela mine, Durango, Mexico.

Description: Greenish-grey radiated aggregates to 0.6 mm in the association with adamite. The empirical formula is (electron microprobe) $(Zn_{1.6}Fe_{1.3}Mg_{0.1})(AsO_4)_{2.0} \cdot 8(H_2O,OH)$.

Wavenumbers (cm^{-1}): 3350sh, 3140s, 2350sh, 1635, 1600, 1465sh, 845s, 777s, 555, 470sh, 423.

As174 Tooeleite $Fe^{3+}{}_6(AsO_3)_4(SO_4)(OH)_4 \cdot 4H_2O$

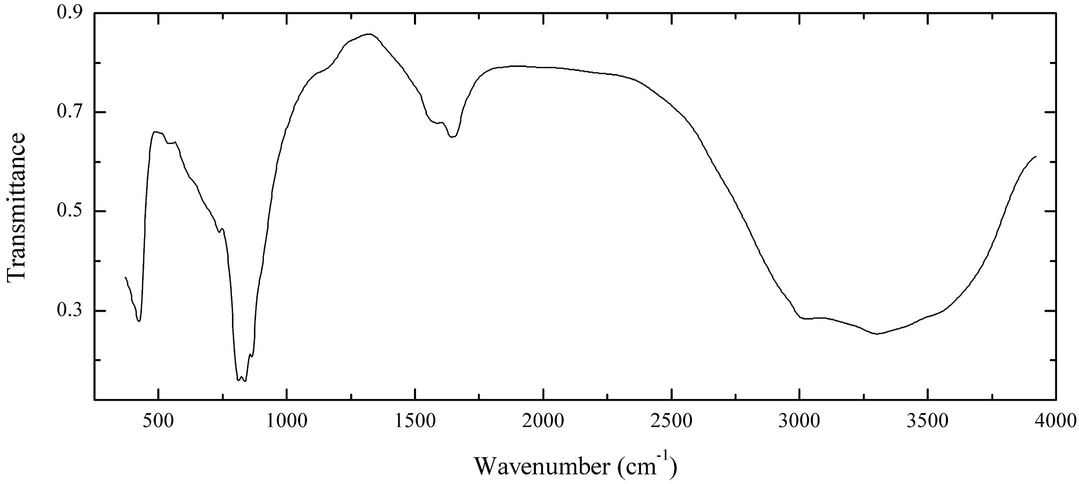


Locality: US mine, Gold Hill, Tooele Co., Utah, USA (type locality).

Description: Yellow crusts. The empirical formula is (electron microprobe) $Fe_{6.07}(AsO_3)_{3.85}(SO_4)_{1.15}(OH,H_2O)_8$.

Wavenumbers (cm^{-1}): 3565w, 3480sh, 3370, 3155s, 2130w, 1643, 1095s, 822, 772, 680sh, 629s, 588, 545sh, 510s, 480sh.

As175 Rauenthalite $Ca_3(AsO_4)_2 \cdot 10H_2O$

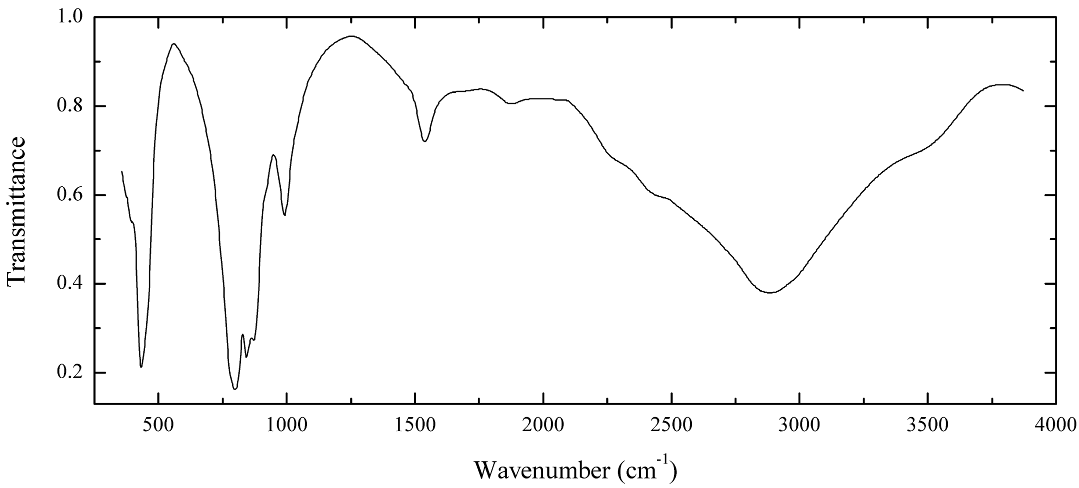


Locality: Gabe Gottes mine, Sainte-Marie-aux-Mines mining area, Vosges, Alsace, France (type locality).

Description: Soft white spherulite. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500sh, 3290, 3030, 1650, 1590, 866s, 838s, 810s, 736, 675sh, 630sh, 547w, 424.

As176 Nickeltalmessite $Ca_2Ni(AsO_4)_2 \cdot 2H_2O$

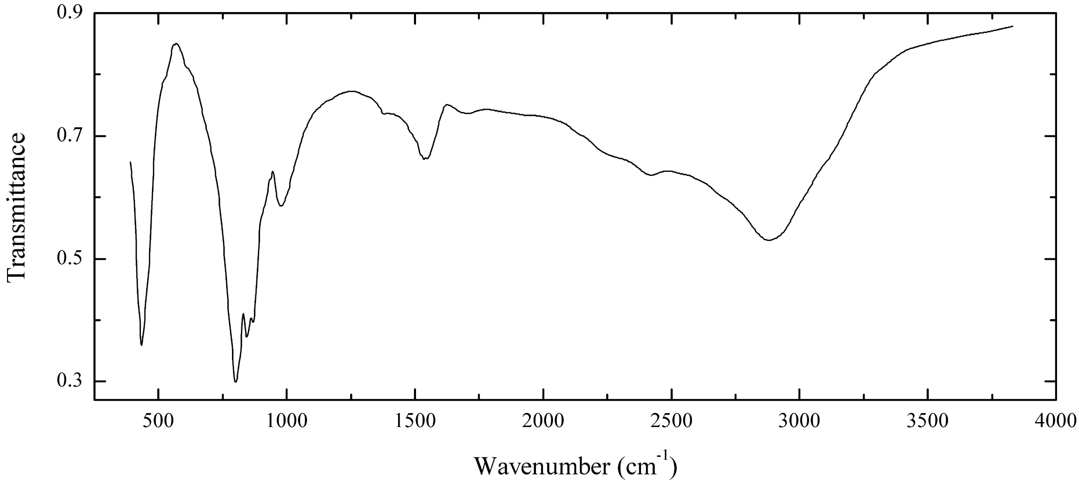


Locality: Aït Ahmane mine, Bou Azzer mining district, Anti-Atlas, Morocco (type locality).

Description: Apple-green botryoidal aggregates. Associated minerals are annabergite, nickelaustinite, pecoraite. The empirical formula is (electron microprobe) $Ca_{1.94}(Ni_{0.79}Mg_{0.20}Co_{0.03}Cu_{0.02}Zn_{0.01}Fe_{0.01})_{\Sigma 1.06}(AsO_4)_{2.00} \cdot 2H_2O$.

Wavenumbers (cm^{-1}): 3450sh, 2880s, 2450sh, 2300sh, 1875w, 1545, 995, 874s, 842s, 800s, 433s.

As177 Nickeltalmessite $Ca_2Ni(AsO_4)_2 \cdot 2H_2O$



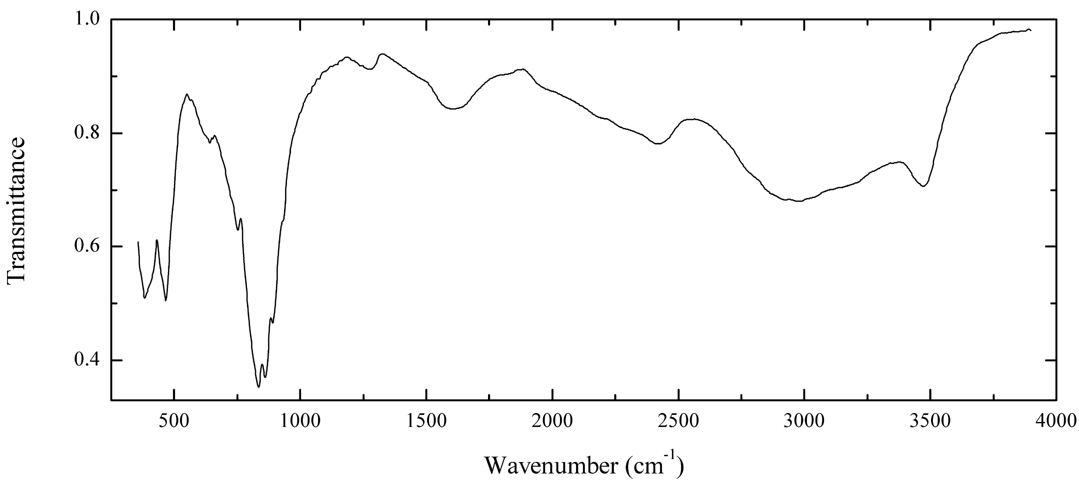
Locality: Aït Ahmane mine, Bou Azzer mining district, Anti-Atlas, Morocco.

Description: Apple-green botryoidal aggregates. Associated minerals are annabergite, nickelaustinite, pecoraite, calcite, manganochromite. Holotype sample. The empirical formula is (electron microprobe, H_2O determined by the Penfield method) $Ca_{2.04}(Ni_{0.77}Mg_{0.13}Co_{0.06})_{\Sigma 0.96}(AsO_4)_{2.00} \cdot 1.91H_2O$.

Biaxial (+), $\alpha = 1.715(3)$, $\beta = 1.720(5)$, $\gamma = 1.735(3)$. $D_{meas} = 3.72(3)$ g/cm^3. The strongest reflections of the powder diffraction pattern [d, Å (I, %)] are 5.05 (27), 3.57 (43), 3.358 (58), 3.202 (100), 3.099 (64), 2.813 (60), 2.772 (68), 1.714 (39).

Wavenumbers (cm^{-1}): 3100sh, 2885s, 2410, 2300sh, 1760w, 1540, 1390w, 997, 910sh, 865s, 844s, 803s, 530w, 434s.

As178 Sainfeldite $Ca_5(AsO_3OH)_2(AsO_4)_2 \cdot 4H_2O$

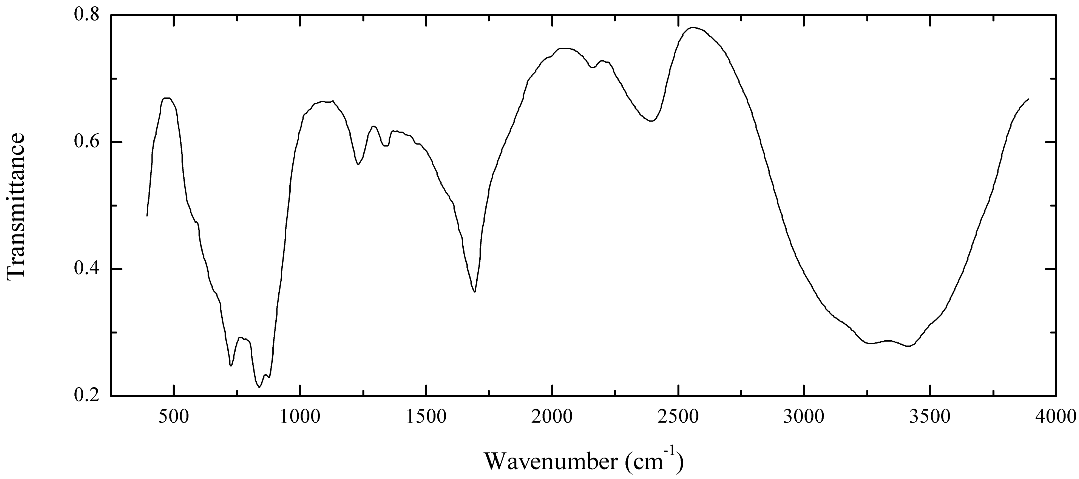


Locality: Tamdrost, Bou Azzer mining area, Morocco.

Description: Pink, from the association with picropharmacolite and erythrite. Close to the IR spectrum of structurally related villyaellenite. The bands at 2,410 and 1,275 cm^{-1} correspond to acid groups.

Wavenumbers (cm^{-1}): 3460, 3150sh, 2950, 2410, 1600, 1275w, 920sh, 890s, 862s, 835s, 751, 640, 467s, 385s.

As179 Rösslerite $MgH(AsO_4){\cdot}7H_2O$

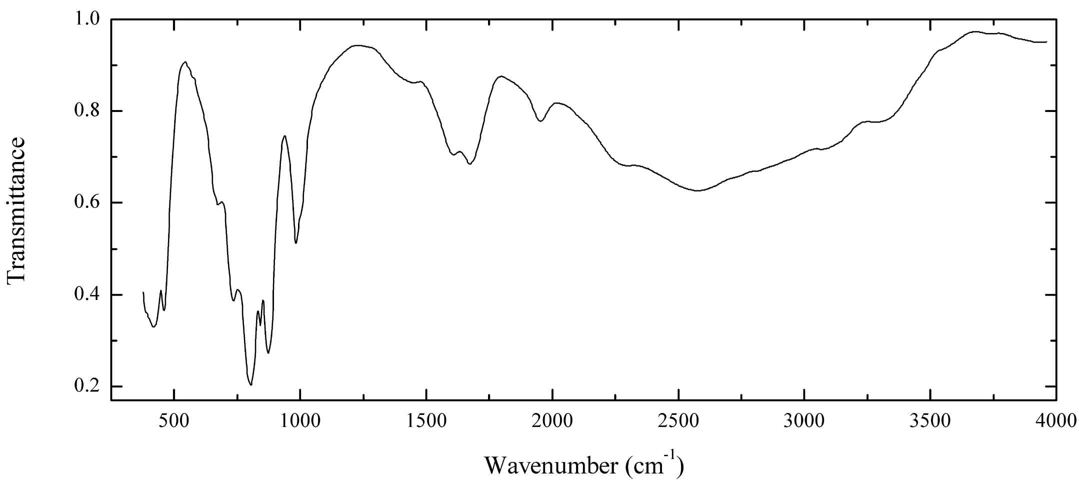


Locality: Belorechenskoye U deposit, North Caucasus, Russia.

Description: Colourless crystals. Identified by single-crystal X-ray diffraction data. The IR bands at 2,390, 2,160, 1,340 and 1,230 cm^{-1} correspond to acid groups.

Wavenumbers (cm^{-1}): 3500sh, 3400s, 3240s, 3130sh, 2390, 2160w, 1645, 1600sh, 1340w, 1230, 877s, 837s, 725s, 660sh, 594.

As180 Roselite $Ca_2Co(AsO_4)_2{\cdot}2H_2O$

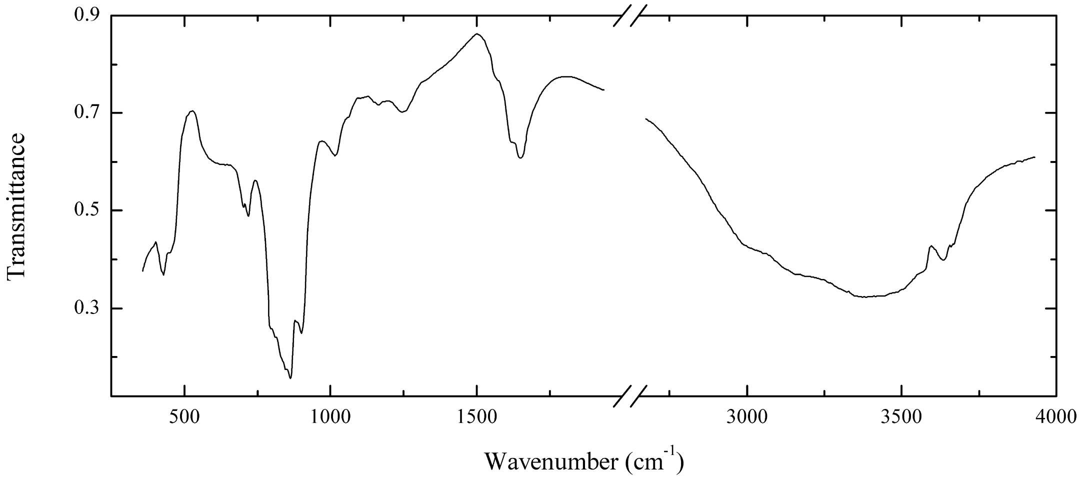


Locality: Aghbar mine, Bou-Azzer ore region, Morocco.

Description: Raspberry pink split crystals to 2 mm in the association with cobaltlotharmeyerite. Identified by powder X-ray diffraction pattern and electron microprobe analysis. The empirical formula is $Ca_{2.00}(Co_{0.50}Mg_{0.41}Zn_{0.04}Ni_{0.04}Mn_{0.01})(AsO_4)_{2.00}{\cdot}nH_2O$.

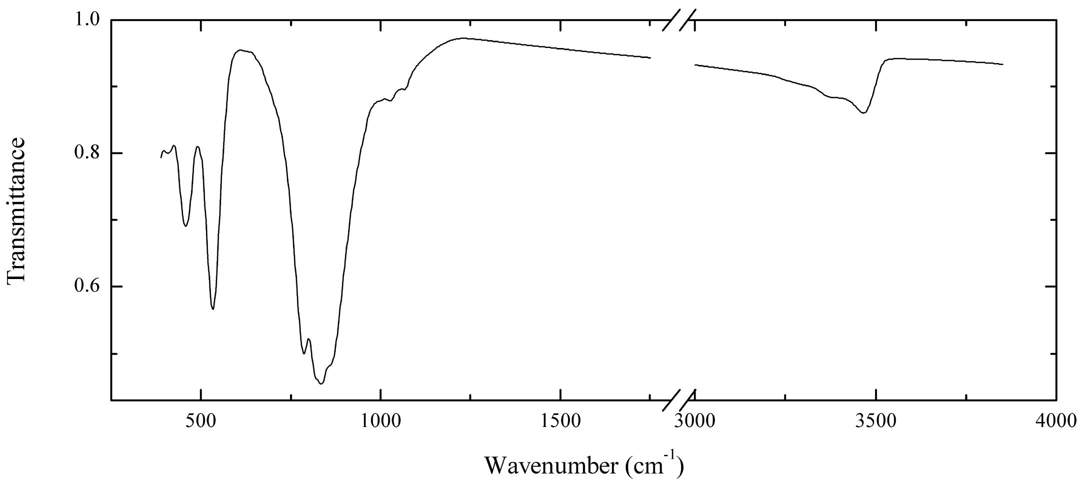
Wavenumbers (cm^{-1}): 3280, 3060, 2570, 2295, 1948, 1680, 1602, 1447w, 1005sh, 983, 881s, 842s, 802s, 734s, 673, 458s, 416s.

As182 Picropharmacolite $Ca_4Mg(AsO_3OH)_2\ (AsO_4)_2{\cdot}11H_2O$



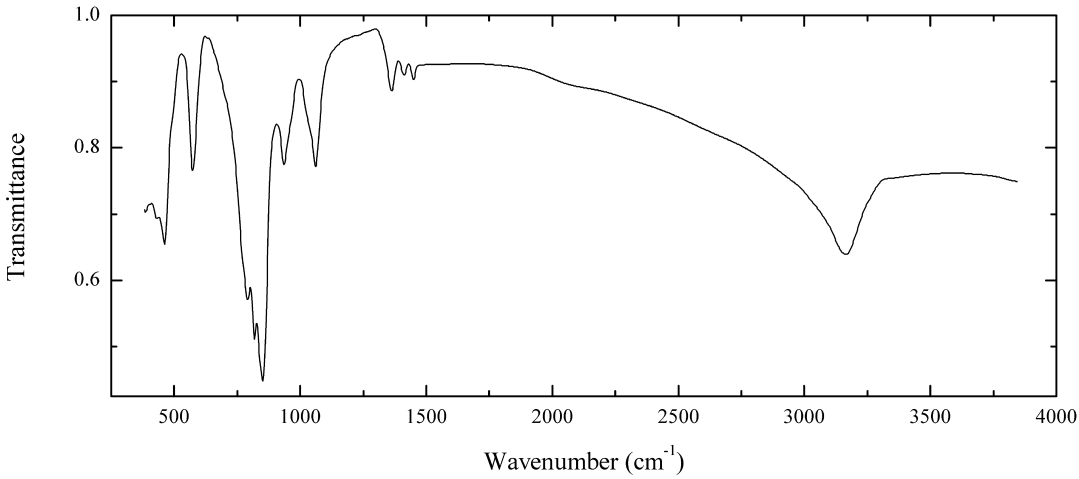
Locality: Salsigne, Aude, France.
Description: White spherulites. Probably contaminated by other arsenates.
Wavenumbers (cm^{-1}): 3650sh, 3520, 3550sh, 3385s, 3180sh, 3010sh, 1650, 1620sh, 1570sh, 1250, 1165w, 1020, 900s, 864s, 850s, 830sh, 810, 796, 718, 703, 630, 450sh, 427.

As183 Zincolivenite $CuZn(AsO_4)(OH)$



Locality: Jean Baptiste Mine, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.
Description: Green prismatic crystals (to 0.3 × 1.5 mm). The empirical formula is (electron microprobe) $Cu_{1.02}Zn_{0.94}Fe_{0.02}[(AsO_4)_{0.97}(PO_4)_{0.03}](OH)$.
Wavenumbers (cm^{-1}): 3480, 3368w, 3300sh, 1068w, 1030w, 860sh, 835s, 820sh, 786s, 530s, 455.

As184 Conichalcite $CaCu^{2+}(AsO_4)(OH)$

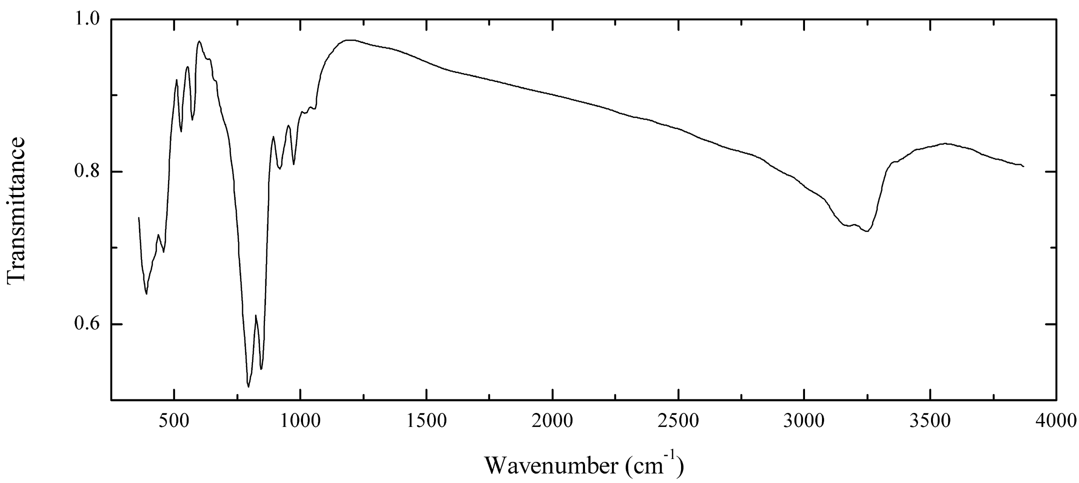


Locality: Jean Baptiste Mine, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Green spherulites to 2 mm. The empirical formula is (electron microprobe) $Ca_{0.97}Pb_{0.06}(Cu_{0.92}Zn_{0.05})(AsO_4)_{1.00}(OH)$.

Wavenumbers (cm^{-1}): 3135s, 2075w, 1449w, 1413w, 1360, 1058, 1030sh, 932, 850s, 835sh, 816s, 787s, 569, 461s, 425.

As185 Conichalcite $CaCu^{2+}(AsO_4)(OH)$

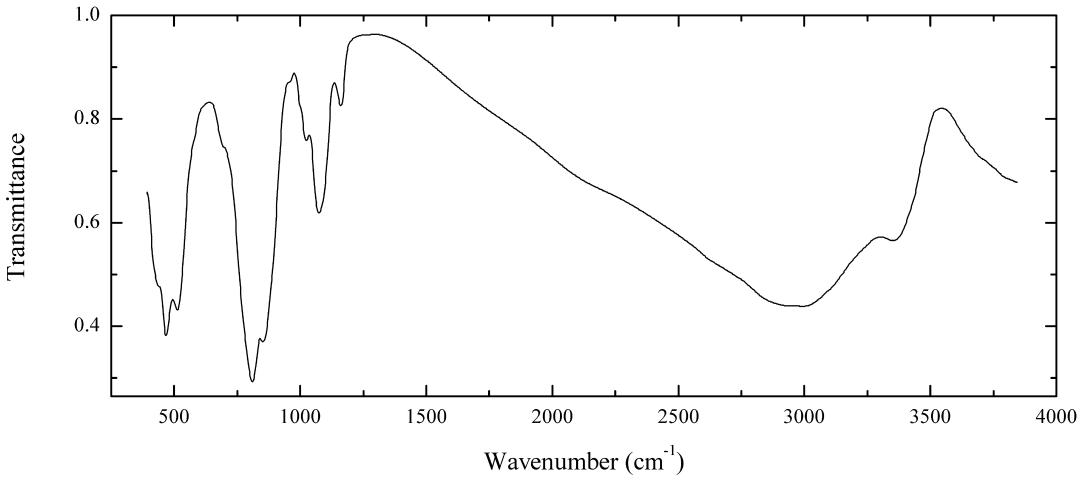


Locality: Jean Baptiste Mine, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Clusters of emerald-green transparent short-prismatic crystals to 2 mm in length. The empirical formula is (electron microprobe) $Ca_{0.96}Pb_{0.03}(Cu_{0.77}Zn_{0.24})(AsO_4)_{1.00}(OH)$.

Wavenumbers (cm^{-1}): 3245, 3150, 1054w, 1015w, 983, 917, 845s, 797s, 568, 525, 457, 387s.

As186 Segnitite $PbFe^{3+}_3(AsO_4)(HAsO_4)(OH)_6$

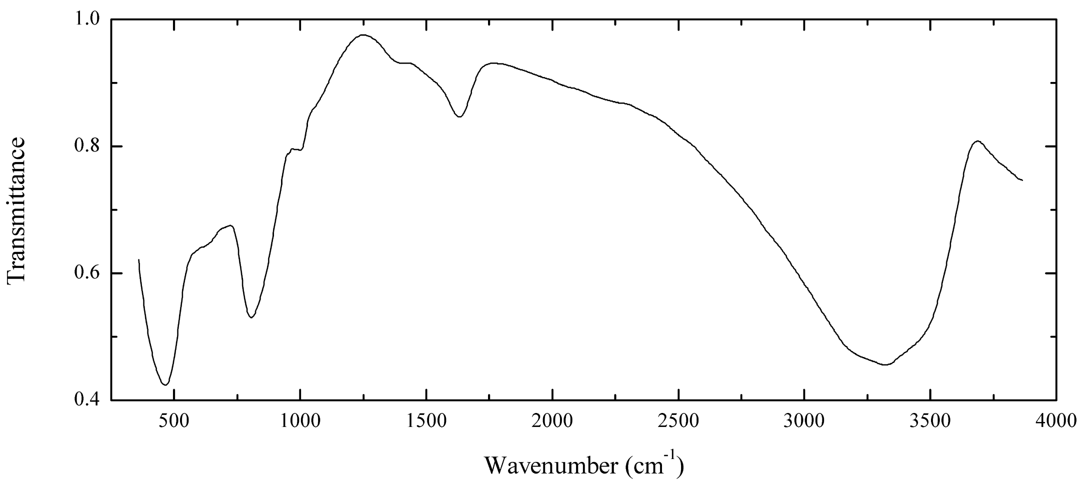


Locality: Large Dump, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Olive green massive, in the association with arseniosiderite. The empirical formula is (electron microprobe) $(Pb_{0.85}Na_{0.11}K_{0.01})(Fe_{2.42}Zn_{0.26}Mg_{0.24}Al_{0.05}Cu_{0.01})(AsO_4)_{2.00}(OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3330, 2960s, 2700sh, 2180sh, 1163w, 1075, 1023, 975sh, 850s, 806s, 692sh, 511s, 467s, 440sh.

As187 Arsenate As187 $Fe_4(AsO_4)(OH,O)_x{\cdot}nH_2O$

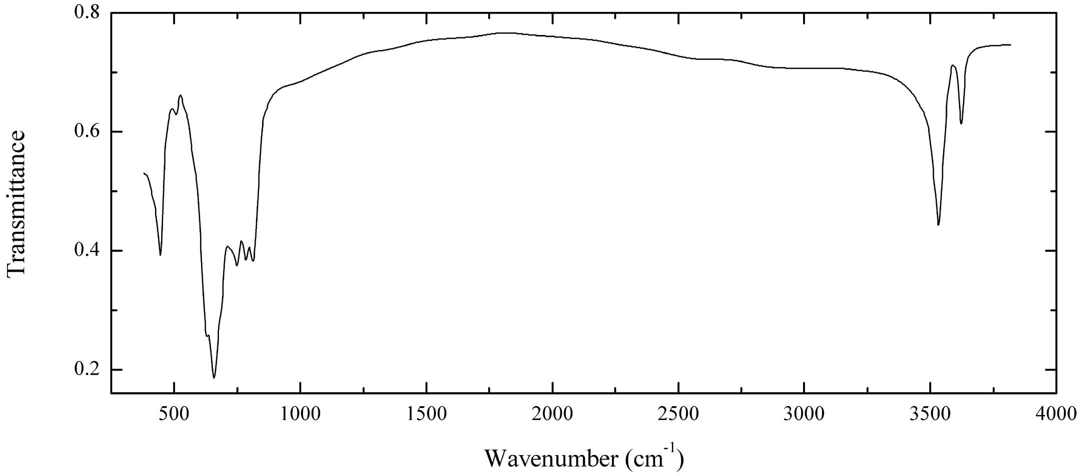


Locality: Hilarion mine, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Brown colloform, from the association with goethite. Amorphous. Fe:As ≈ 4:1 (by electron microprobe data).

Wavenumbers (cm^{-1}): 3400sh, 3310, 3200sh, 1637, 1390w, 1060sh, 1000w, 800s, (630sh), 460s.

As188 Manganarsite $Mn^{2+}{}_3As^{3+}{}_2O_4(OH)_4$

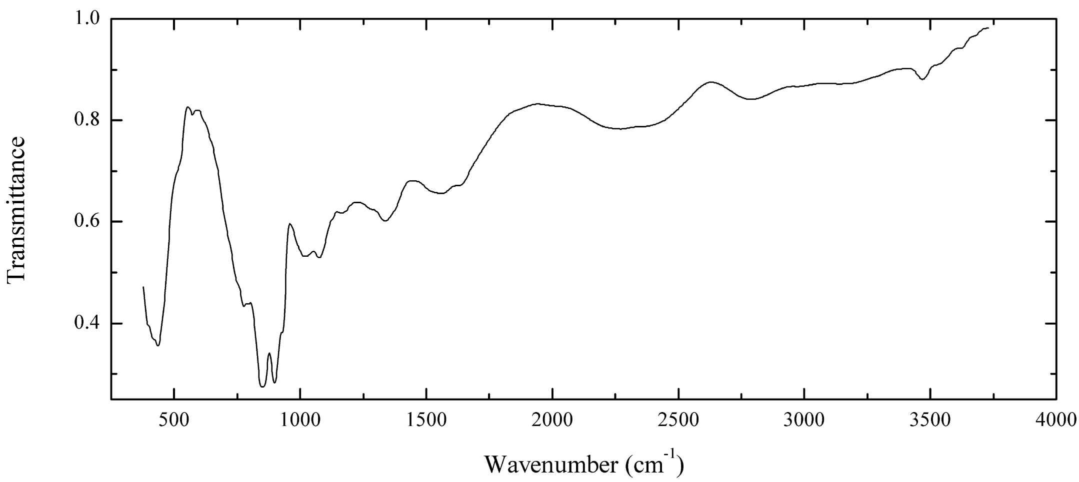


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.

Description: Brownish-yellow aggregates of imperfect crystals. Associated minerals are serpentine and calcite. Identified by qualitative electron microprobe analysis and single-crystal X-ray diffraction data. Trigonal unit-cell parameters are $a = 11.45$, $c = 7.25$ Å.

Wavenumbers (cm^{-1}): 3595, 3505, 811, 784, 749, 680sh, 654s, 628s, 510w, 455.

As189 Weilite $Ca(AsO_3OH)$

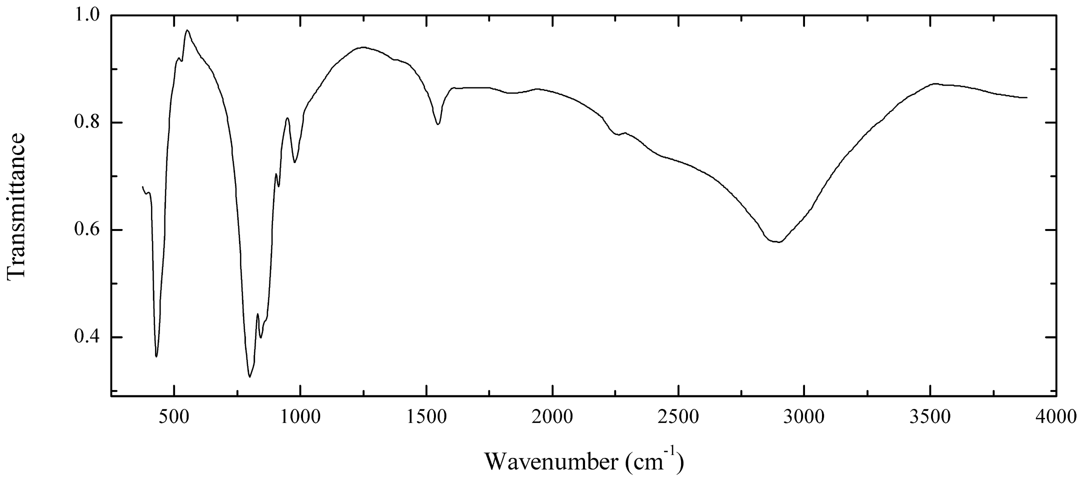


Locality: Sainte-Marie-aux-Mines mining area, Vosges, France.

Description: White. Identified by qualitative electron microprobe analysis, optical data and powder X-ray diffraction pattern. Shows violet fluorescence under long-wave UV radiation.

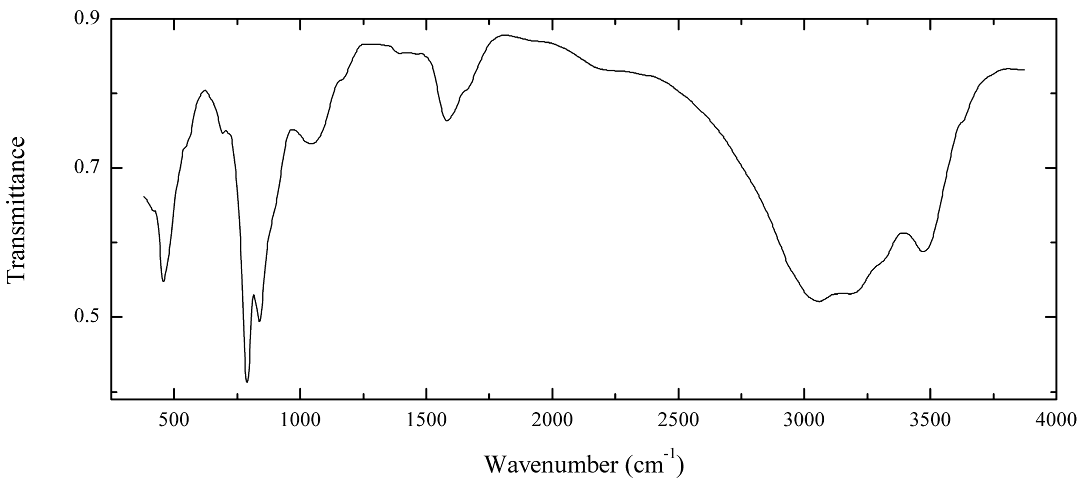
Wavenumbers (cm^{-1}): 3440w, 3100w, 2770w, 2360sh, 2260, 1625sh, 1555, 1335, 1075, 1020, 930, 896s, 849s, 780, 573w, 435s.

As190 Talmessite $Ca_2Mg(AsO_4)_2{\cdot}2H_2O$



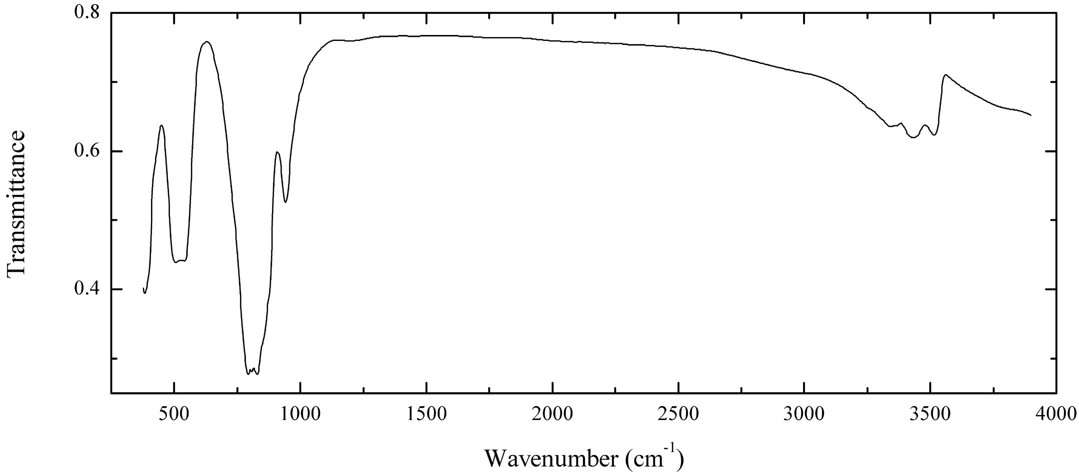
Locality: Bou Azzer deposit, Anti-Atlas, Morocco.
Description: Pink split crystals in the association with erythrite. Co-rich variety.
The empirical formula is (electron microprobe) $Ca_{1.97}(Mg_{0.55}Co_{0.47})(AsO_4)_{2.00}{\cdot}2H_2O$.
Wavenumbers (cm^{-1}): 2870, 2450sh, 2260, 1850w, 1545, 1377w, 977, 914, 865sh, 844s, 798s, 527w, 432s, 388.

As191 Erythrite $Co_3(AsO_4)_2{\cdot}8H_2O$



Locality: Veta Negra mine, Copiapo, Atacama, Chile.
Description: Pink clusters of prismatic crystals. Mn-rich variety. The empirical formula is (electron microprobe) $(Co_{1.34}Mn_{0.61}Ni_{0.30}Mg_{0.29}Cu_{0.25}Zn_{0.21})(AsO_4)_{2.00}{\cdot}8H_2O$.
Wavenumbers (cm^{-1}): 3445, 3270sh, 3155, 3040s, 2250sh, 1650sh, 1580, 1410w, 1165sh, 1050, 837s, 786s, 693, 455s.

As192 Olivenite $Cu_2(AsO_4)(OH)$

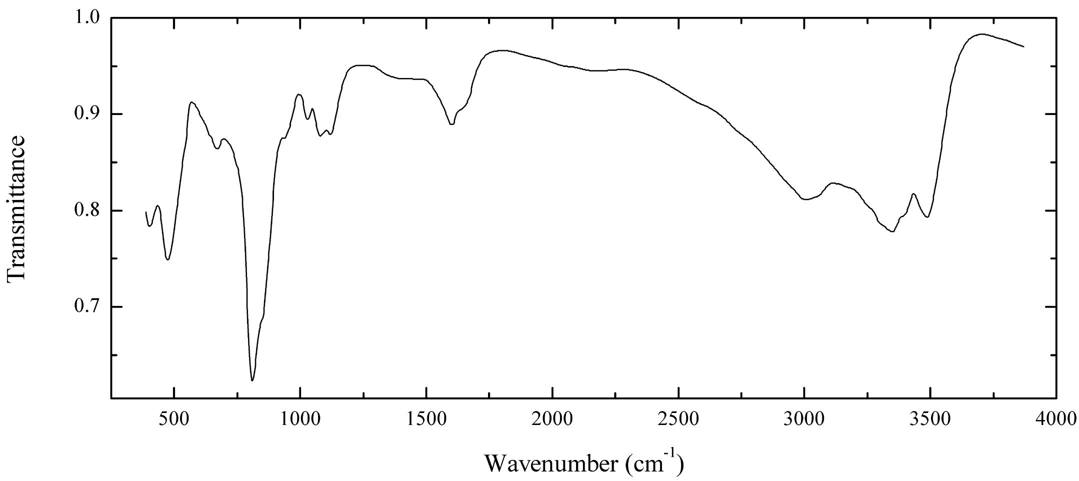


Locality: Cerro Minado, Huércal-Overa, Almería, Andalusia, Spain.

Description: Reddish-brown to green spherulites (up to 0.2 mm in diameter) in the association with reevesite. Co-, Ni-, Cu- and Zn-rich variety. The composition is non-uniform. By analogy with zincolivenite, and Zn-, Mg- and Ni-analogues of atacamite polymorphs, Cu and other cations can be ordered in the structure of this sample. In this case, the empirical formula could be written as follows (electron microprobe, apfu limits) $Cu(Co_{0.17–0.35}Cu_{0.17–0.34}Ni_{0.17–0.29}Zn_{0.11–0.23}Fe_{0-0.11}Mg_{0-0.05})(AsO_4)_{1.00}(OH)$.

Wavenumbers (cm^{-1}): 3493, 3420, 3320, 946, 830s, 796s, 545, 508, 380s.

As193 Fuxiaotuite $Ca_2Cu_9(AsO_4)_4(SO_4)_{0.5}(OH)_9{\cdot}9H_2O$



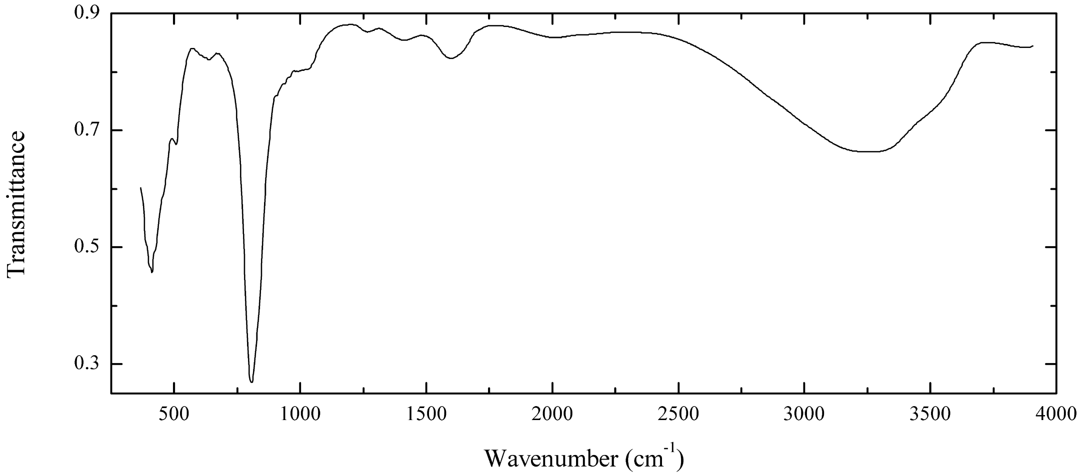
Locality: Southeast Dongchuan copper mining district, near Kunming, Yao'an County, Cuxiong Autonomous Prefecture, Yunnan Province, People's Republic of China (type locality).

Description: Radiated or foliated aggregates to 3 mm. Associated minerals are chalcopyrite, bornite, chalcocite, covellite, tennantite, enargite, cuprite, malachite, azurite, copper and brochantite. Holotype sample. The crystal structure is solved. Monoclinic, space group $C2/c$, $a = 54.490(9)$,

$b = 5.5685(9)$, $c = 10.469(2)$ Å, $\beta = 96.294(3)°$, $Z = 4$. Optically biaxial (−), $\alpha = 1.666$, $\beta = 1.686$, $\gamma = 1.694$, $2V = -65°$. $D_{meas} = 3.22$ g/cm^3, $D_{calc} = 3.32$ g/cm^3. The empirical formula is (electron microprobe) $Ca_{2.05}Cu_{9.08}$ $(AsO_4)_{4.10}(SO_4)_{0.32}(OH)_{9.31}·9.01H_2O$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 4.782 (100) (-311), 4.333 (71) (602), 5.263 (54) (-202), 3.949 (47) (802), 2.976 (46) (-15.1.1).

Wavenumbers (cm^{-1}): 3470, 3340, 3000, 2140w, 1640sh, 1604, 1121, 1080, 1029w, 940sh, 850sh, 810s, 671, 475, 402.

As194 Pharmacosiderite $KFe^{3+}{}_4(AsO_4)_3(OH)_4·6–7H_2O$

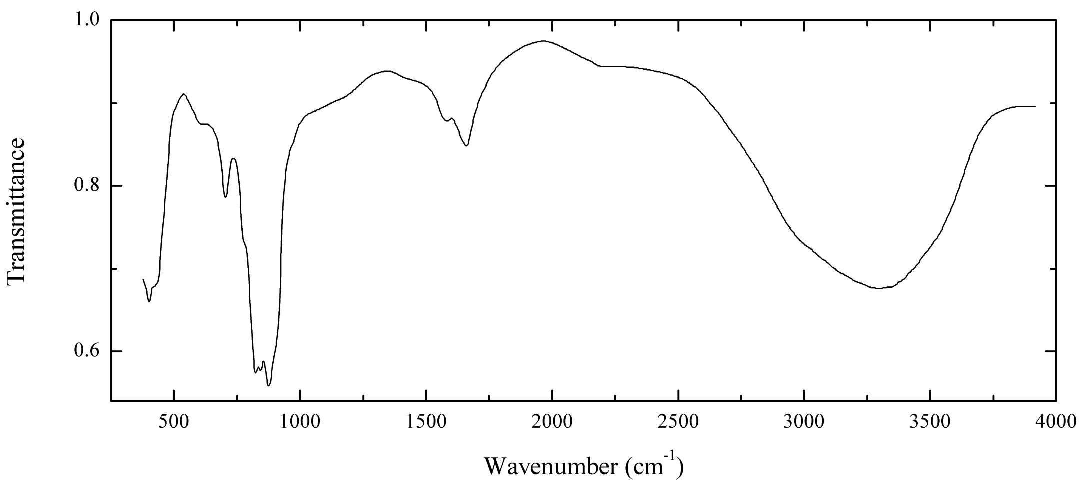


Locality: Boss mine, Nevada, USA.

Description: Orange cubic crystals. The empirical formula is (electron microprobe) $K_{0.7}Na_{0.5}Fe_{4.0}(AsO_4)_{2.9}·n(H_2O,OH)$.

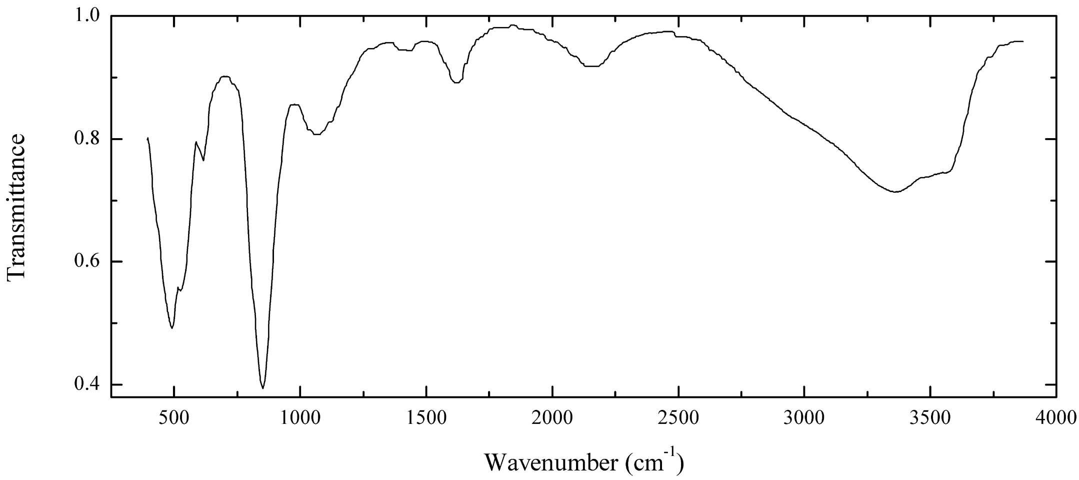
Wavenumbers (cm^{-1}): 3450sh, 3255, 2020w, 1605, 1425w, 1267w, 1010, 806s, 640w, 507, 407s.

As195 Guérinite $Ca_5H_2(AsO_4)_4·9H_2O$



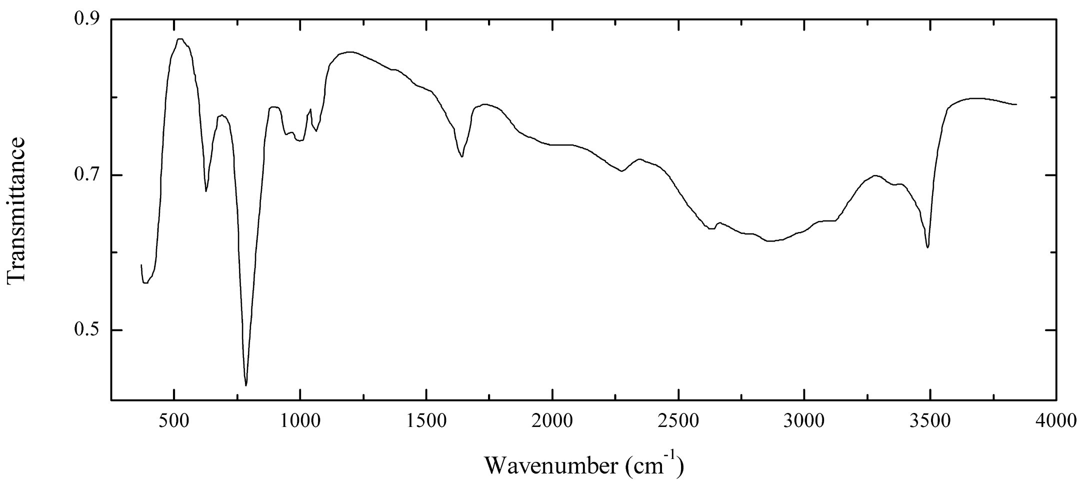
Locality: Wechselschacht, Richelsdorfer Gebiet (Richelsdorf region), 15 km E of Bebra, Hessen, Germany.
Description: White radiating aggregates of platy crystals. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3280, 3000sh, 2230w, 1655, 1580, 1150sh, 905sh, 875s, 845s, 822s, 775sh, 703, 620w, 435sh, 405s.

As196 Natropharmacoalumite $NaAl_4(AsO_4)_3(OH)_4 \cdot 4H_2O$



Locality: Maria Josefa gold mine, Rodalquilar, Andalusia region, Spain.
Description: Colourless cubic crystals. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3530sh, 3332, 3000sh, 2168, 1619, 1430w, 1405sh, 1085, 850s, 612, 524sh, 489s.

As197 Långbanshyttanite $Pb_2Mn_2Mg(AsO_4)_2(OH)_4 \cdot 6H_2O$

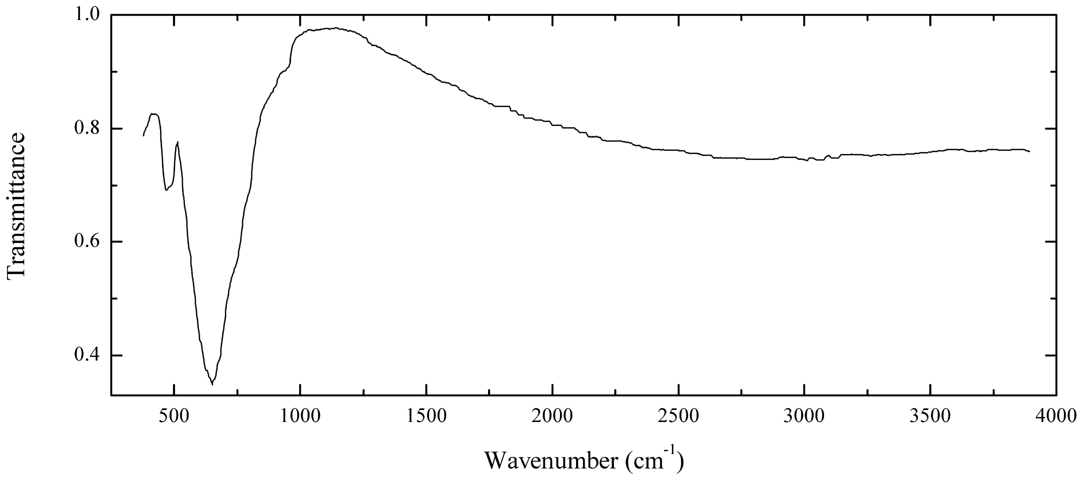


Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: Holotype sample. Unoriented, felty to radial, hemispherical aggregates (up to 1 mm in size) of acicular, lath-like crystals. Associated minerals are calcite, Mn-bearing phlogopite,

minerals of the jacobsite-magnetite series, antigorite and trigonite. The colour is white. Optically biaxial (+), $\alpha = 1.700$, $\beta = 1.741$, $\gamma = 1.792$. The crystal structure is solved. Triclinic, space group $P\overline{1}$, $a = 5.0528$, $b = 5.7671$, $c = 14.617(3)$ Å, $\alpha = 85.656$, $\beta = 82.029$, $\gamma = 88.728°$, $Z = 1$. The empirical formula is (electron microprobe, H_2O determined by gas chromatography) $Pb_{1.97}Mn_{1.85}Mg_{0.93}Fe_{0.26}(AsO_4)_{1.96}(PO_4)_{0.09}(OH)_{3.87}·5.93H_2O$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 14.48 (100) (001), 7.21 (43) (002), 4.969 (34) (100, 101), 4.798 (28) (003), 3.571 (54) (112, 1-1-1, 01-3, 11-1), 2.857 (45) (020, 021, 114), 2.800 (34) (11-3).

Wavenumbers (cm^{-1}): 3477, 3340w, 3090sh, 2860, 2625, 2275w, 1644, 1060, 1005, 943, 784s, 627, 390s.

As198 Zimbabweite $Na(Pb,Na,K)_2(Ta,Nb,Ti)_4As_4O_{18}$

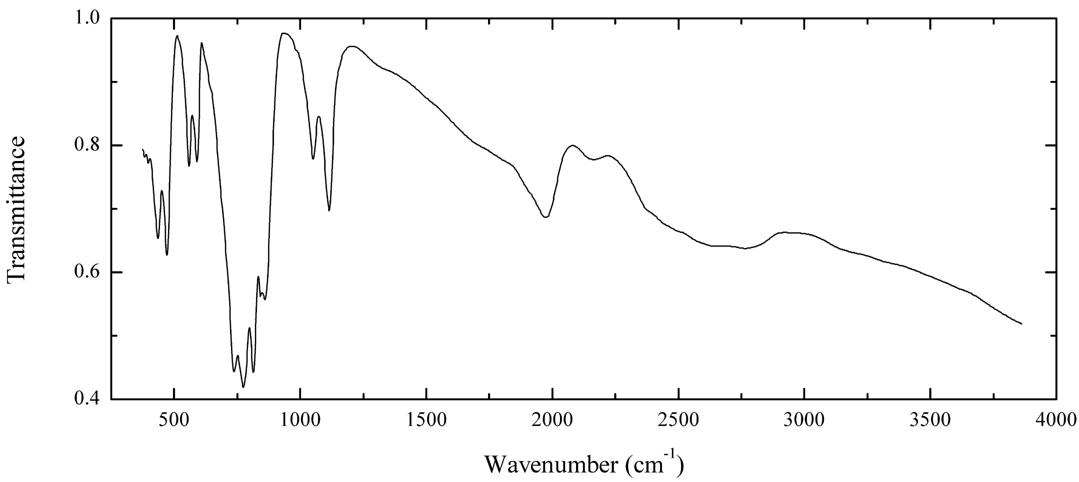


Locality: St. Ann's mine, Karoi district, south of Miami, Zimbabwe (type locality).

Description: Brown grains. The empirical formula is (electron microprobe) $Na_{1.00}(Pb_{1.28}Na_{0.37}K_{0.34})_2(Ta_{3.39}Nb_{0.45}Ti_{0.36})_4As_{3.95}O_{18}$.

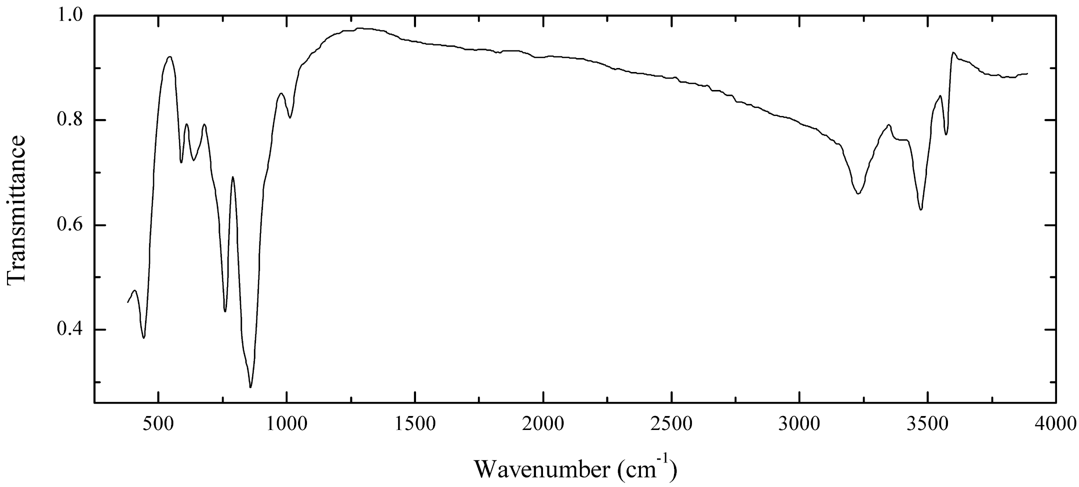
Wavenumbers (cm^{-1}): 940w, 790sh, 735sh, 651s, 482.

As199 Bayldonite $Cu_3PbO(AsO_3OH)_2(OH)_2$



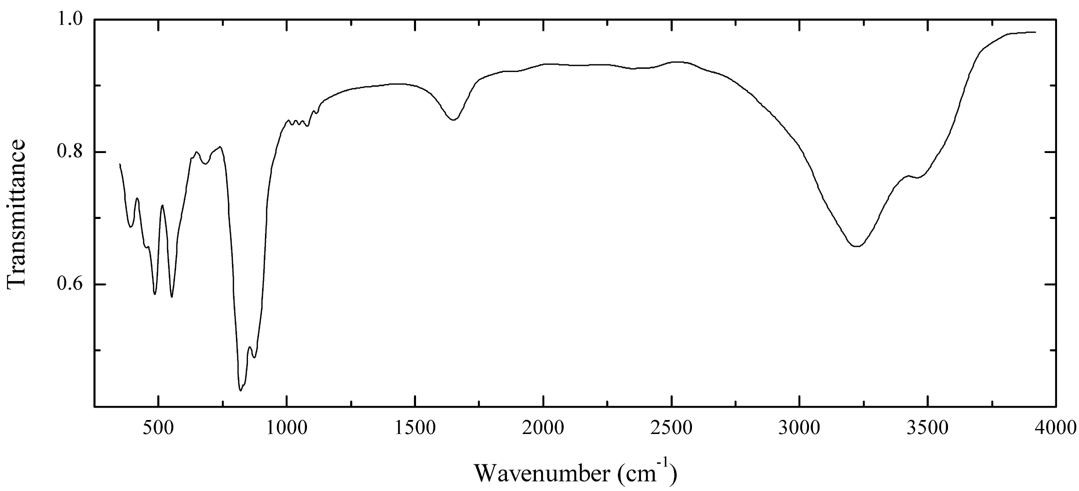
Locality: Berezovskoye deposit, Berezovsk town, Middle Urals, Russia.
Description: Yellowish-green crusts. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 2750, 2650, 2500sh, 2420sh, 2060w, 1980, 1115, 1050, 859, 840, 812s, 773s, 738s, 588, 553, 469, 434.

As200 Allactite $Mn^{2+}_7(AsO_4)_2(OH)_8$



Locality: Långban deposit, Bergslagen ore region, Filipstad district, Värmland, Sweden.
Description: Pink massive in the association with lizardite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3570, 3464, 3400w, 3231, 1014w, 920sh, 857s, 840sh, 760s, 632, 586, 439s.

As201 Attikaite $Ca_3Cu_2Al_2(AsO_4)_4(OH)_4{\cdot}2H_2O$

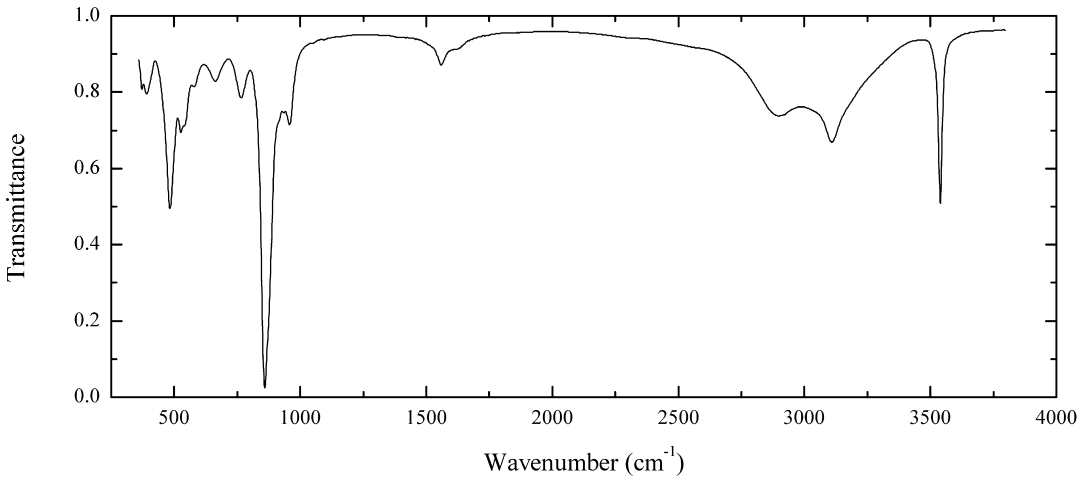


Locality: Christiana mine No. 132, Kamariza, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece (type locality).
Description: Holotype sample. Light blue spheroidal aggregates consisting of thin, flexible and typically curved scales with sizes up to 3 × 30 × 80 μm. Holotype sample. Associated minerals

are arsenocrandallite, arsenogoyazite, conichalcite, olivenite, philipsbornite, azurite, malachite, carminite, beudantite, goethite, quartz, allophane. Optically biaxial (−), $\alpha = 1.642(2)$, $\beta = 1.644(2)$, $\gamma = 1.644$, $2V = -10°$. Orthorhombic, space group *Pban*, *Pbam* or *Pba*2, $a = 10.01$, $b = 8.199$, $c = 22.78$ Å, $Z = 4$. The empirical formula is (electron microprobe, H_2O determined from TG data) $Ca_{2.94}Cu2+_{1.93}Al_{1.97}Mg_{0.04}Fe2+_{0.02}[(As_{3.74}S_{0.16}P_{0.12})O_{16.08}](OH)_{3.87}·2.05H_2O$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 22.8 (100) (001), 11.36 (60) (002), 5.01 (90) (200), 3.38 (50) (123, 205), 2.780 (70) (026), 2.682 (30) (126), 2.503 (50) (400), 2.292 (20) (404).

Wavenumbers (cm^{-1}): 3525sh, 3425, 3180s, 2350w, 1642, 1120w, 1070w, 1050w, 1020w, 900sh, 833s, 820s, 690w, 645w, 600sh, 555, 486, 458, 397.

As202 Mansfieldite $Al(AsO_4)·2H_2O$

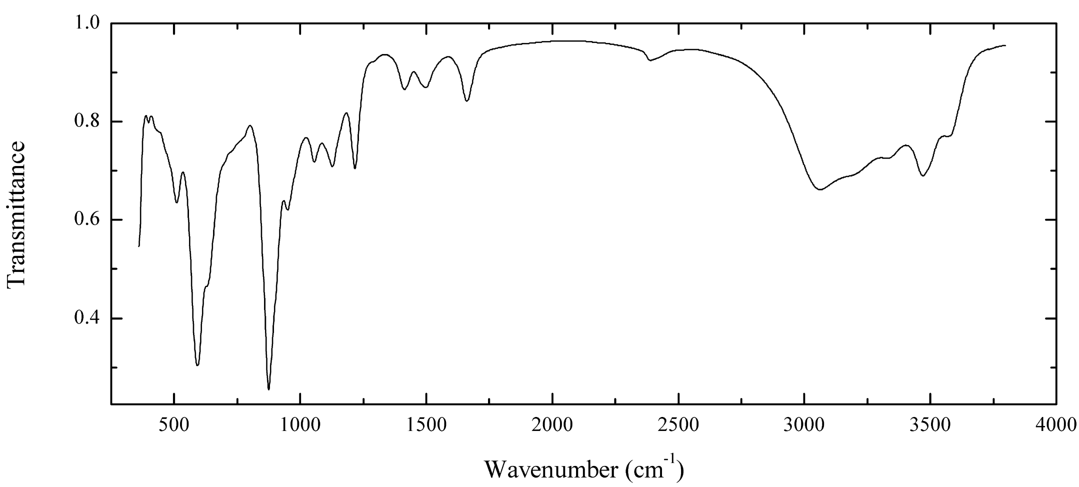


Locality: Abdylya district, near Chauvai Hg deposit, Kyrgyzstan.

Description: White fine-grained aggregate. Investigated by V.Yu. Karpenko. Identified by powder X-ray diffraction pattern and electron microprobe analysis.

Wavenumbers (cm^{-1}): 3540s, 3109, 2898, 2575sh, 2320sh, 1615w, 1559w, 958, 937, 859s, 766, 663, 540sh, 527, 483s, 392, 374.

As203 Arsenocrandallite $CaAl_3(AsO_4)_2(OH,H_2O)_6$

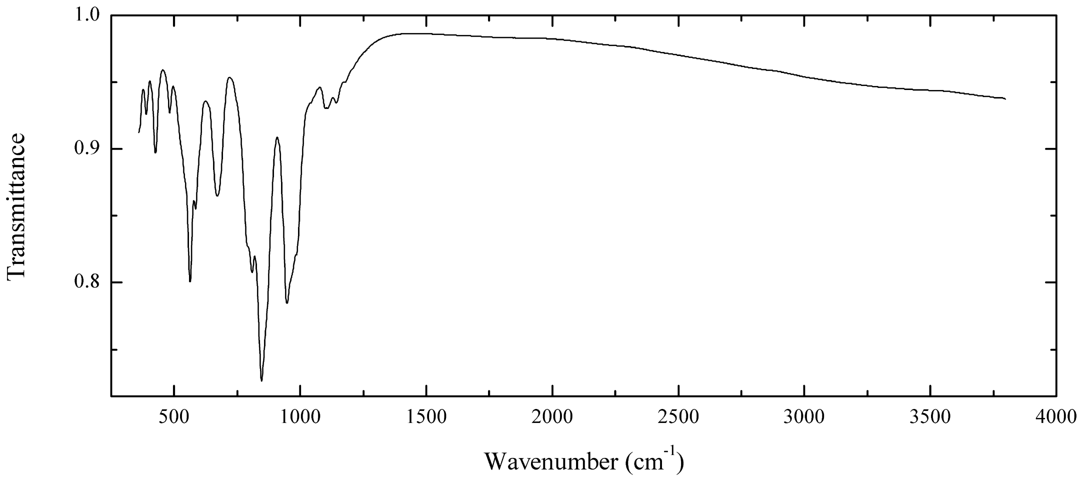


Locality: Christiana mine No. 132, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Light blue crystals from the association with conichalcite. Sr-rich variety. The empirical formula is (electron microprobe) $(Ca_{0.6}Sr_{0.4})Al_{3.0}[(AsO_4)_{1.7}(PO_4)_{0.2}(SO_4)_{0.1}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3571, 3471, 3333, 3180sh, 3062, 2387w, 1661, 1497, 1415, 1285sh, 1217, 1127, 1056, 950, 875s, 770sh, 725sh, 695sh, 630sh, 592s, 510, 435sh, 401w.

As204 Urusovite $CuAlAsO_5$

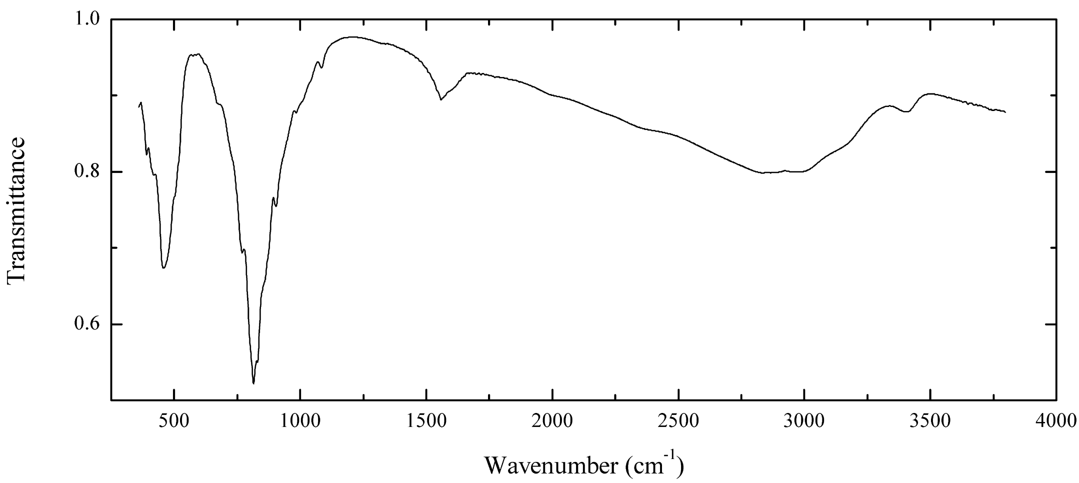


Locality: Fumarole Arsenatnaya, Second cone, Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.

Description: Light green grains. Investigated by I.V. Pekov. The empirical formula is (electron microprobe) $(Cu_{1.00}Zn_{0.03})(Al_{0.95}Mg_{0.01})(As_{0.91}S_{0.05}Si_{0.05})O_5$.

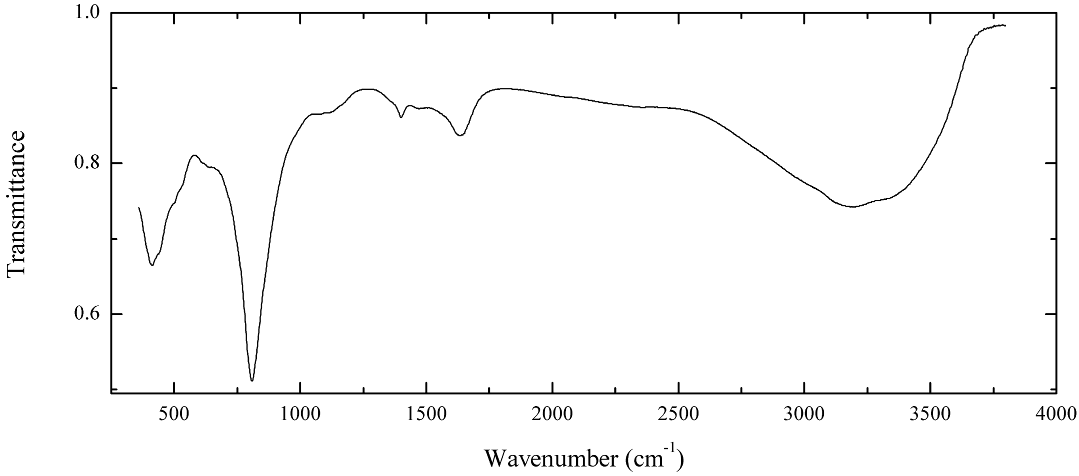
Wavenumbers (cm^{-1}): 1175sh, 1145w, 1109, 985sh, 965sh, 948s, 847s, 809s, 795sh, 675, 585, 563s, 482, 426, 392.

As205 Warikahnite $Zn_3(AsO_4)_2 \cdot 2H_2O$



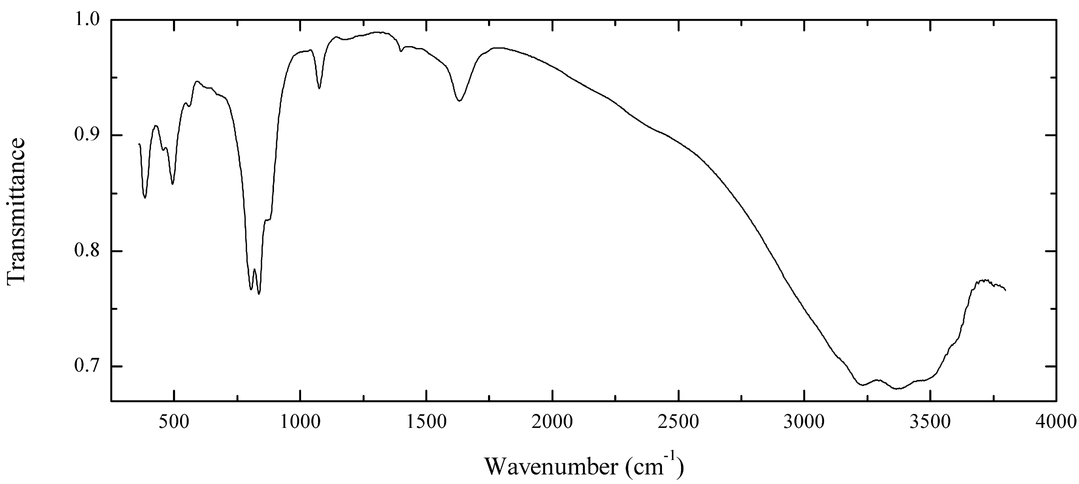
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: Yellow prismatic crystal. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3405, 3140sh, 2980, 2880, 2830, 1590sh, 1559, 1085w, 1040sh, 1005sh, 983w, 904, 860sh, 828, 815s, 774, 680sh, 500sh, 458, 422, 400.

As206 Arsenate As206 $H_x(Mn,Ca)_2(Mn,Co,Cu,Ni)_3Fe_2(AsO_4)_2(OH)_6 \cdot nH_2O$ (?)



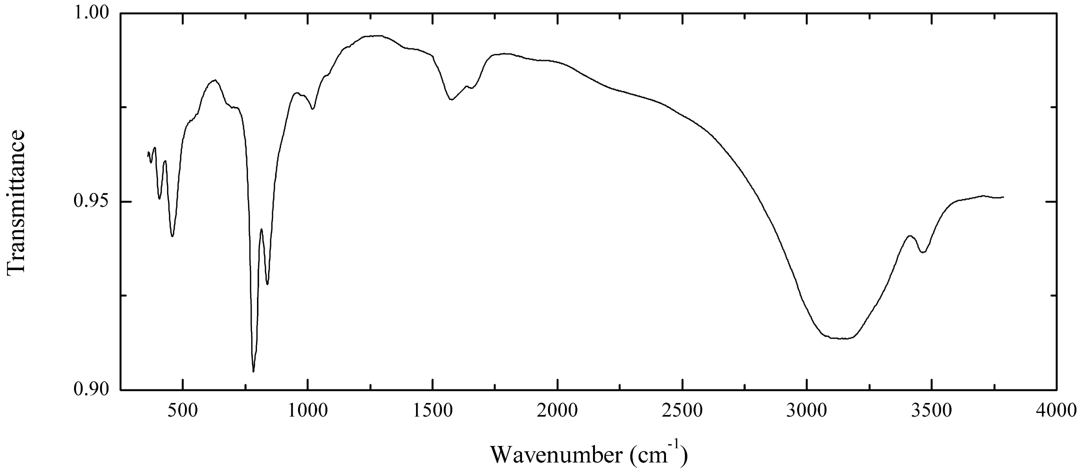
Locality: Veta Negra mine, Tierra Amarilla, Copiapó Province, Chile.
Description: Brown clusters from the association with manganesehörnesite. Related to smolyaninovite and fahleite. Needs further investigation. The empirical formula is (electron microprobe) $H_x(Mn_{1.8}Ca_{0.2})(Mn_{1.0}Co_{1.05}Cu_{0.8}Ni_{0.75}Zn_{0.3})(Fe_{1.7}Co_{0.3})(AsO_4)_6 \cdot nH_2O$. The strongest lines of the powder diffraction pattern are observed at 22.7, 10.5, 3.25, 3.18, 2.95 and 1.64 Å.
Wavenumbers (cm^{-1}): 3310sh, 3200, 3030sh, 2380w, 1634, 1480w, 1401, 1112w, 1070w, 809s, 648w, 615sh, 530sh, 495sh, 440sh, 413.

As207 Kaňkite $Fe^{3+}(AsO_4) \cdot 3.5H_2O$



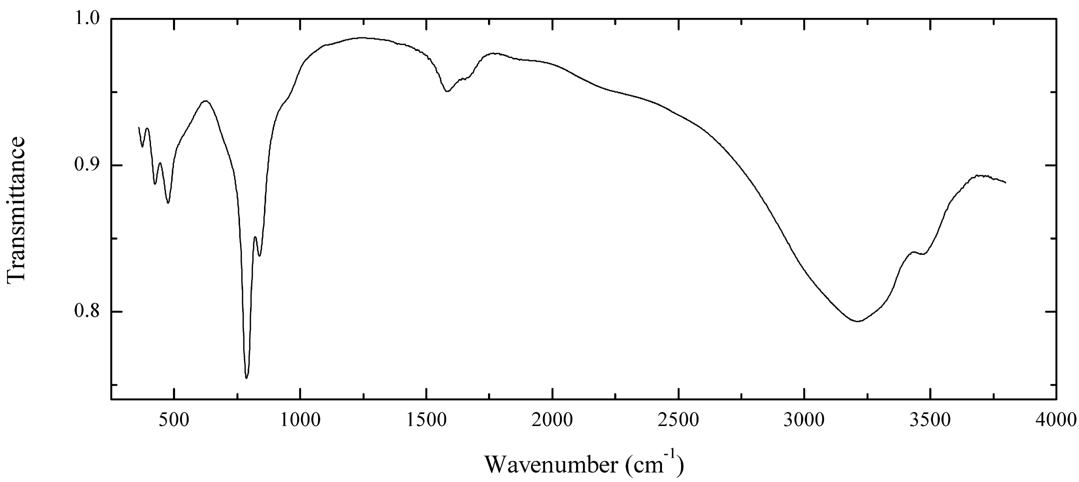
Locality: Kaňk, 5 km N of Kutná Hora, Bohemia, Czech Republic (type locality).
Description: Pale greyish yellow split crystals from the association with scorodite, pitticite and zýkaite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3595sh, 3470sh, 3365s, 3233s, 3150sh, 2125sh, 1635, 1403w, 1179w, 1075, 873sh, 836s, 805s, 680sh, 635sh, 560w, 493, 460, 387.

As208 Manganohörnesite $Mn^{2+}{}_3(AsO_4)_2 \cdot 8H_2O$



Locality: Veta Negra mine, Tierra Amarilla, Copiapó Province, Chile.
Description: Pink split crystals from the association with miguelromeroite. The empirical formula is (electron microprobe) $(Mn_{1.22}Co_{0.90}Cu_{0.37}Fe_{0.21}Zn_{0.17}Ni_{0.12})(AsO_4)_{1.82}(PO_4)_{0.18} \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3463, 3134, 3050sh, 2350sh, 1654, 1577, 1040sh, 1019, 980sh, 838s, 782s, 720sh, 565sh, 458, 406, (375).

As209 Babánekite $Cu_3(AsO_4)_2 \cdot 8H_2O$

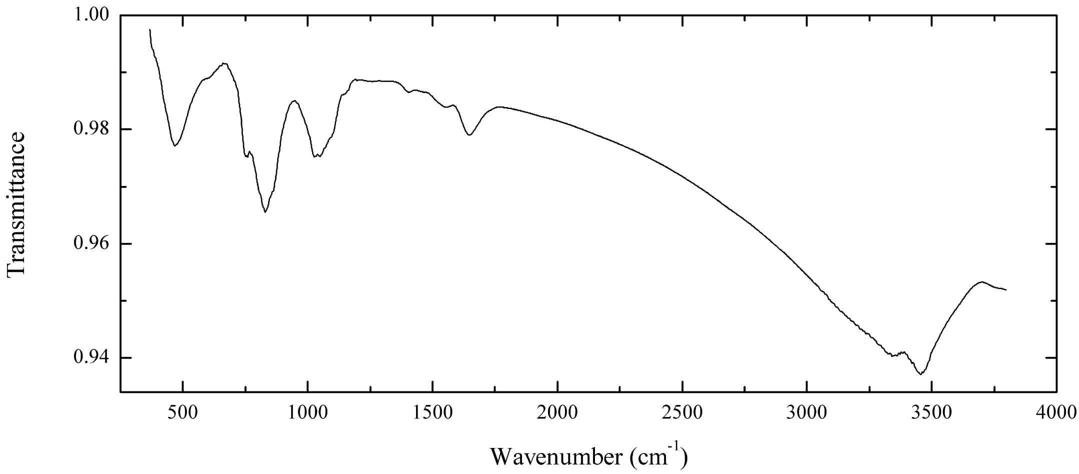


Locality: Rovnost mine, Geister Gang, Yáchymov, Krušné Hory Mts. (Ore Mts.), Czech Republic (type locality).

Description: Pink split crystals. The empirical formula is (electron microprobe) $(Cu_{1.40}Zn_{0.75}Co_{0.45}Ni_{0.16}Fe_{0.16}Mg_{0.06})(AsO_4)_{2.00}\cdot nH_2O$. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 3470, 3290sh, 3208s, 2300sh, 1920sh, 1652w, 1585, 935sh, 838, 786s, 540sh, 475, 423, 374.

As210 Cesarferreiraite $Fe^{2+}Fe^{3+}{}_2(AsO_4)_2(OH)_2\cdot 8H_2O$

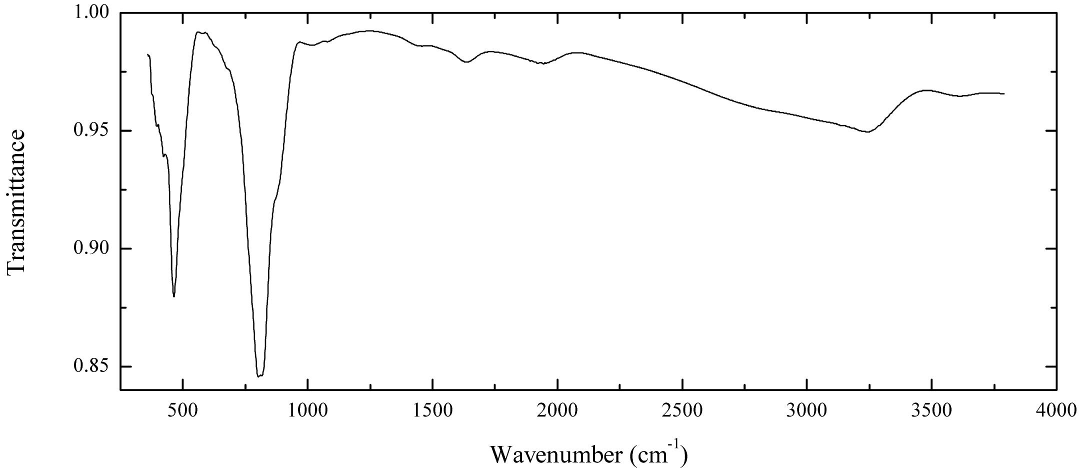


Locality: Eduardo pegmatite (Lavra do Eduardo), near Boa Vista creek, Conselheiro Pena municipality, Minas Gerais, Brazil (type locality).

Description: Greenish-yellow fibrous aggregate from the association with albite, schorl, spodumene, cryptomelane, cyrilovite, löllingite, fourmarierite, frondelite, rockbridgeite, heterosite, hureaulite, leucophosphite, saleeite, ushkovite, variscite, *etc*. Holotype sample. Triclinic, space group $P\overline{1}$, $a = 5.383(2)$, $b = 6.878(2)$, $c = 10.364(3)$ Å, $\alpha = 96.43(4)°$, $\beta = 102.29(2)°$, $\gamma = 109.17(3)°$, $V = 347.2(2)$ Å3, $Z = 1$. The empirical formula is $Fe^{2+}{}_{0.98}Fe^{3+}{}_{1.96}[(AsO_4)_{1.79}(PO_4)_{0.31}](OH)_{1.52}\cdot 8.08H_2O$. Optically biaxial (+), $n_{min} = 1.747(3)$, $n_{max} = 1.754(3)$. $D_{calc} = 2.934$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 9.85 (95), 6.35 (100), 3.671 (29), 3.158 (32), 2.960 (39), 2.884 (35), 2.680 (29).

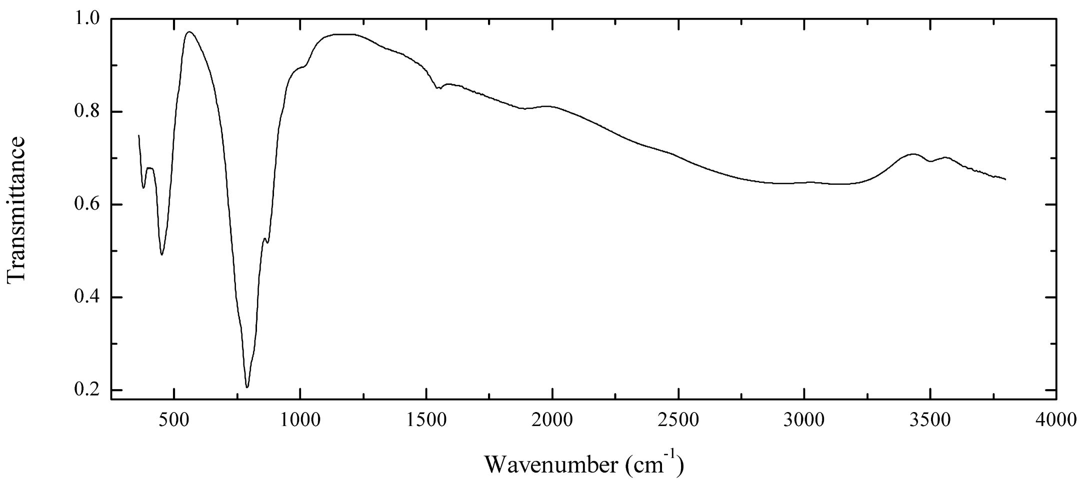
Wavenumbers (cm^{-1}): 3456s, 3352s, 3200sh, 1647, 1550w, 1096sh, 1050, 1026, 860sh, 830s, 759, 592w, 470.

As211 Nickeltsumcorite $Pb(Ni,Fe^{3+})_2(AsO_4)_2(H_2O,OH)_2$



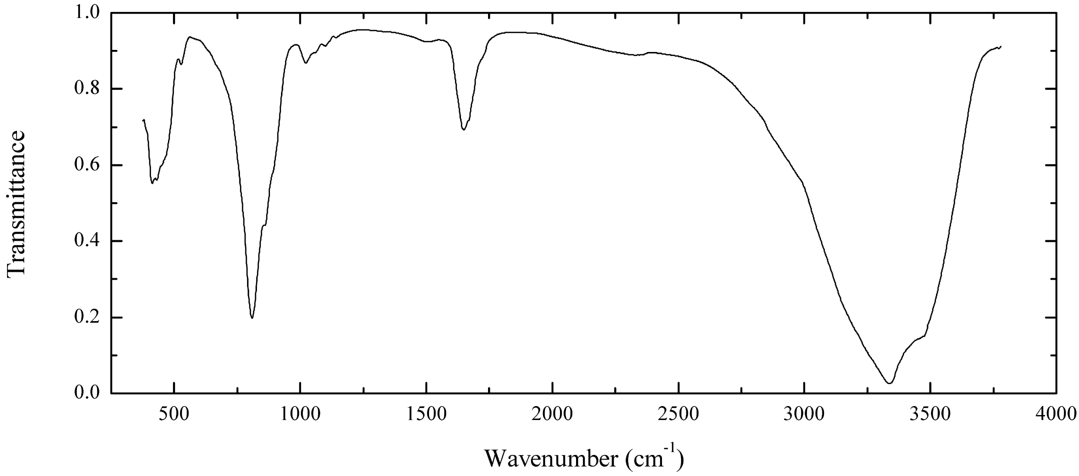
Locality: Km 3 dump, Lavrion, Greece.
Description: Greenish-brown crust from the association with annabergite and dolomite. The Ni-dominant analogue of tsumcorite.
Wavenumbers (cm^{-1}): 3610w, 3244, 2800sh, 1944, 1635, 1080w, 1020w, 870sh, 812s, 802s, 680sh, 578w, 464s, 425, 400.

As212 Tsumcorite $Pb(Zn,Fe^{3+})_2(AsO_4)_2(H_2O,OH)_2$



Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: Yellow clusters of prismatic crystals from the association with malachite and quartz. The empirical formula is (electron microprobe) $Pb_{1.00}(Zn_{1.01}Fe_{0.52}Cu_{0.49})[(AsO_4)_{1.94}(SO_4)_{0.06})(H_2O,OH)_2$.
Wavenumbers (cm^{-1}): 3505w, 3146, 2915, 1898, 1552w, 1360sh, 1010sh, 871, 810sh, 789s, 451s, 383.

As213 Whitecapsite $H_{16}Fe^{2+}{}_5Fe^{3+}{}_{14}Sb^{3+}{}_6(AsO_4)_{18}O_{16}\cdot 120H_2O$, or $(H_3O)_{16}Fe^{2+}{}_5Fe^{3+}{}_{14}Sb^{3+}{}_6(AsO_4)_{18}O_{16}\cdot 104H_2O$

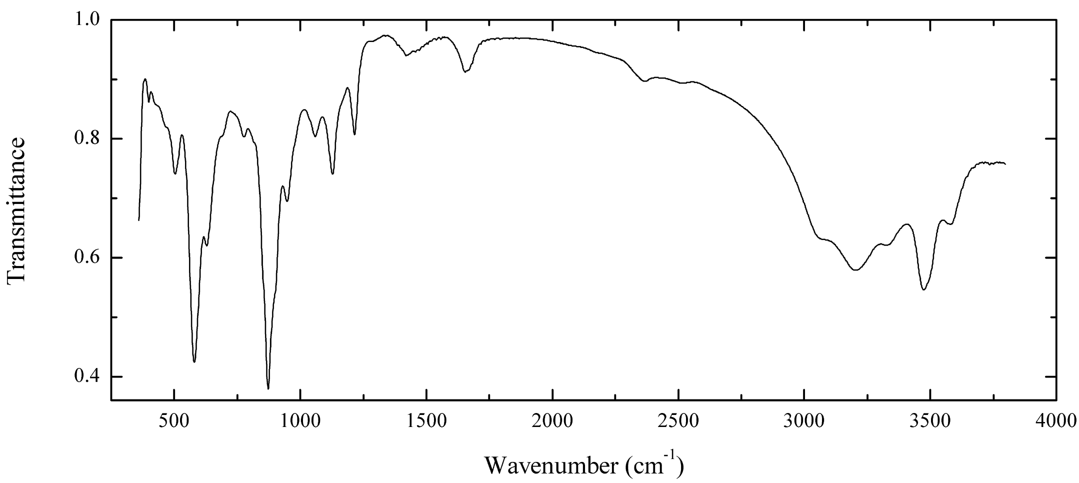


Locality: 95 m level of the East ore body, White Caps mine, Manhattan district, Nye Co., Nevada, USA (type locality).

Description: Orange crystals from the association with picropharmacolite, guerinite, pitticite, gypsum, jarosite, goethite, sulfur and metastibnite. Holotype sample. The crystal structure is solved. Hexagonal, space group $P6_3/m$, $a = 16.0916(8)$, $c = 21.7127(9)$ Å, $V = 4869.0(4)$ Å3, $Z = 1$. The empirical formula is $H_{16}Mn_{0.08}Fe2+_{4.95}Fe^{3+}{}_{14.07}Sb^{3+}{}_{6.10}As^{5+}{}_{17.89}O_{88}\cdot 120H_2O$. Optically uniaxial (+), $\omega = 1.590(2)$, $\varepsilon = 1.603(3)$. $D_{meas} = 2.230(3)$ g/cm^3, $D_{calc} = 2.297$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 13.99 (34), 11.73 (100), 3.644 (4), 2.999 (8), 2.757 (4), 2.648 (5).

Wavenumbers (cm^{-1}): 3455sh, 3348s, 1658, 3000sh, 2320w, 1720sh, 1500w, 1145sh, 1105w, 1065sh, 1029, 895sh, 860, 814s, 512 w, 455sh, 432, 415.

As214 Arsenogoyazite $SrAl_3(AsO_4)_2(OH,H_2O)_6$

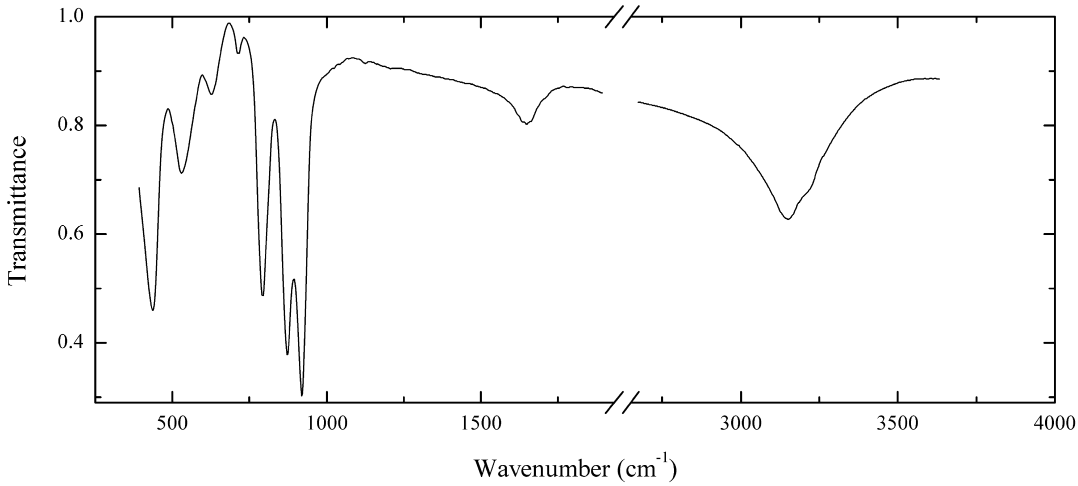


Locality: Christiana mine No. 132, Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Aggregate of white crystals from the association with conichalcite. The empirical formula is (electron microprobe) $(Sr_{0.73}Ca_{0.33})Al_{2.99}[(AsO_4)_{1.85}(PO_4)_{0.09}(SO_4)_{0.08}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3580, 3474s, 3325, 3205, 3075sh, 2520w, 2360w, 1653w, 1450sh, 1420w, 1281w, 1215, 1128, 1059, 948, 900sh, 872s, 820sh, 777, 690sh, 629, 580s, 503, 470sh, 435sh, 400w.

UAs1 Arsenuranylite $Ca(UO_2)_4(AsO_4)_2(OH)_4{\cdot}6H_2O$

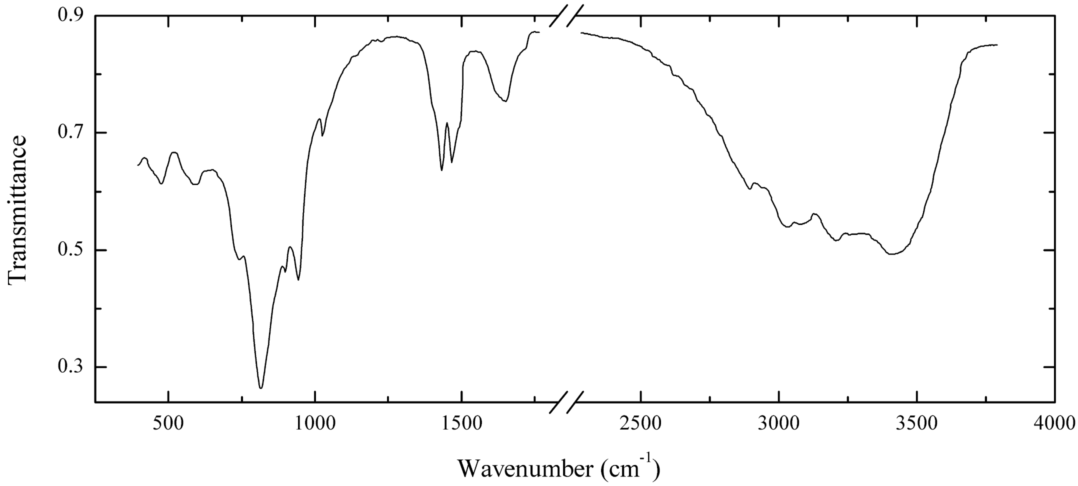


Locality: Cherkasar U deposit, Chatkal range, Uzbekistan (type locality).

Description: Orange-yellow massive from the association with paraschoepite, schoepite, metazeunerite, nováčekite and uranospinite. Holotype sample. Orthorhombic, space group *Bmmb*, $a = 15.40$, $b = 17.40$, $c = 13.768$ Å, $Z = 6$. The empirical formula is $Ca_{1.00}(UO_2)_{3.9}(AsO_4)_{2.3}(OH,H_2O)_x$. Optically biaxial (–), $\alpha = 1.737$, $\beta = 1.761$, $\gamma = 1.771–1.778$. $D_{calc} = 4.25$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 7.72 (100), 8.41 (80), 3.85 (100), 3.42 (70), 3.13 (80), 1.778 (70), 1.729 (70).

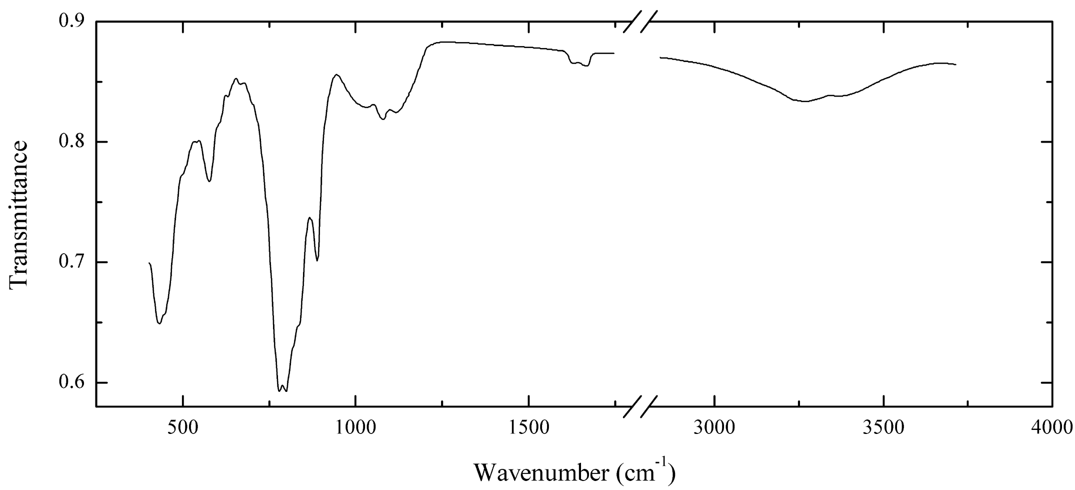
Wavenumbers (cm^{-1}): 3360sh, 3149, 1640, 916s, 867s, 788, 705w, 615, 520, 429.

UAs2 Abernathyite $K(UO_2)(AsO_4)·3H_2O$



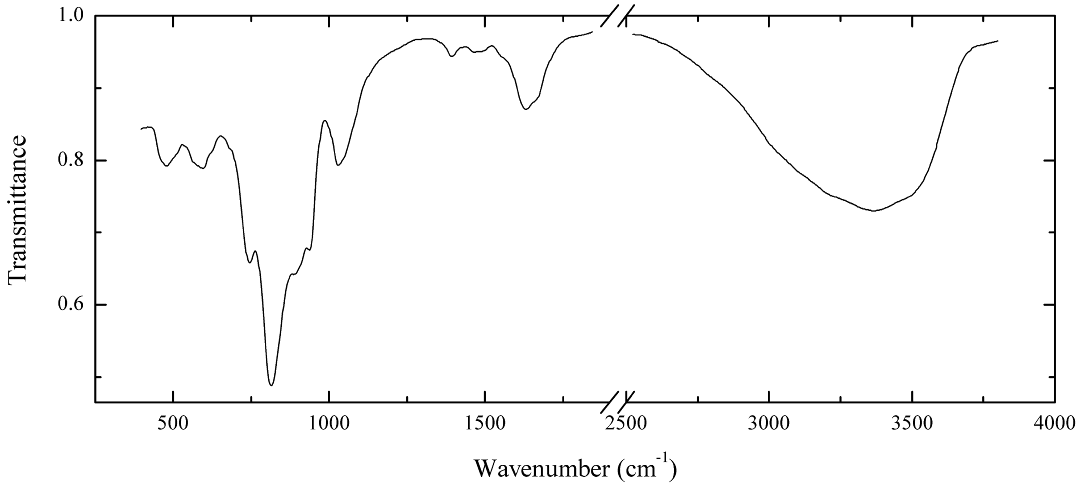
Locality: Bota-Burum U deposit, Almaty region, Kazakhstan.
Description: Yellow massive. NH_4^+-rich variety (K:N ≈ 1:1 in atomic units). Investigated by G.A. Sidorenko.
Wavenumbers (cm^{-1}): 3395, 3192, 3060, 3015, 2883, 1725sh, 1647, 1630sh, 1490sh, 1467, 1430, 1400sh, 1032w, 943, 899, 815s, 738, 583, 478, 440sh.

UAs3 Walpurgite $(BiO)_4(UO_2)(AsO_4)_2·2H_2O$



Locality: Grube Clara (Clara mine), Rankach valley, Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.
Description: Yellow crystals. The empirical formula is (electron microprobe) $(BiO)_{3.67}(UO_2)_{1.18}[(AsO_4)_{1.84}(PO_4)_{0.11}(SO_4)_{0.05}]·nH_2O$.
Wavenumbers (cm^{-1}): 3370, 3260, 1665w, 1630w, 1115, 1077, 1007, 891, 839, 820sh, 800s, 780s, 635w, 605sh, 576, 440sh, 430.

UAs4 Chistyakovaite $Al(UO_2)_2(AsO_4)_2(F,OH)\cdot6.5H_2O$

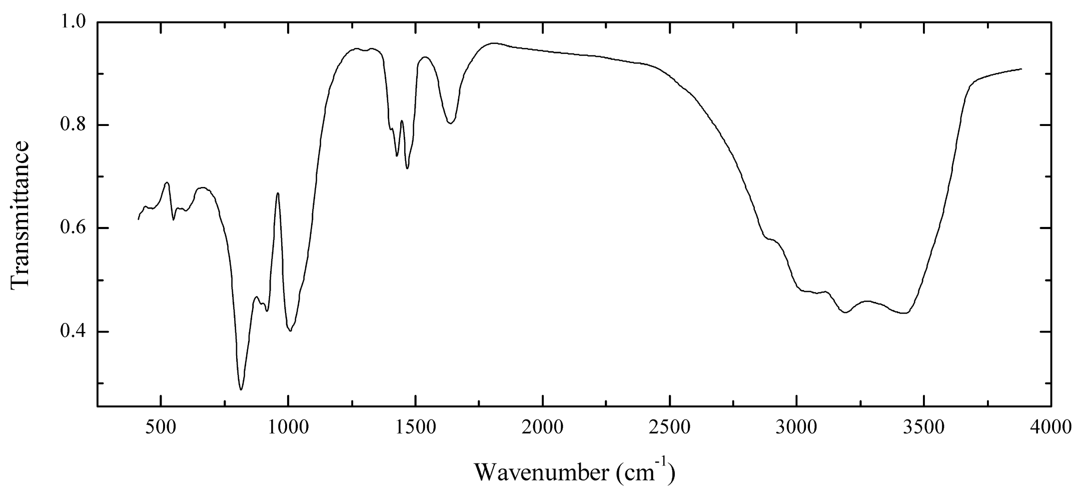


Locality: Bota-Burum U deposit, Almaty region, Kazakhstan (type locality).

Description: Yellow aggregate of imperfect platy crystals from the association with calcite, arsenopyrite, pyrite, galenite, scorodite, arseniosiderite, mansfieldite, metazeunerite, uramarsite and sodium uranospinite. Holotype sample. Monoclinic, space group *P*2/*m*, *P*2 or *Pm*; $a = 19.99(1)$, $b = 9.79(1)$, $c = 19.62(2)$ Å, $\beta = 110.7(2)°$. The empirical formula is $Al_{0.96}(UO_2)_{2.00}[(AsO_4)_{1.83}(PO_4)_{0.17}][F_{0.57}(OH)_{0.31}]\cdot6.50H_2O$. Optically biaxial (−), $\alpha = 1.557(2)$, $\beta = 1.580(1)$, $\gamma = 1.580(1)$, $2V_{meas} = -10(5)°$. $D_{meas} = 3.62(2)$ g/cm^3, $D_{calc} = 3.585$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 9.34 (100) (200); 9.14 (100) (9.14); 4.93 (18) (-402); 4.87 (20) (212, -104); 4.76 (27) (-313); 4.69 (17) (311, -121, 400).

Wavenumbers (cm^{-1}): 3475sh, 3360, 3130sh, 1665sh, 1640, 1480w, 1455w, 1397w, 1055sh, 1029, 940, 905sh, 888, 814s, 743, 595, 580sh, 505sh, 479.

UAs5 Uramarsite $(NH_4,H_3O)_2(UO_2)_2(AsO_4,PO_4)_2\cdot6H_2O$

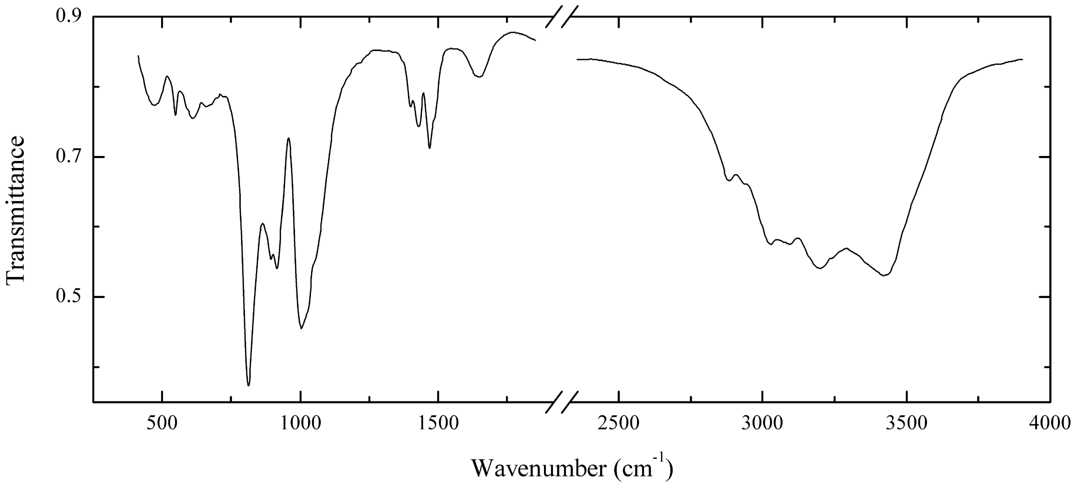


Locality: Bota-Burum U deposit, Almaty region, Kazakhstan (type locality).

Description: Black platy crystals from the association with calcite, arsenopyrite, pyrite, galenite, scorodite, arseniosiderite, mansfieldite, metazeunerite, chistyakovaite and sodium uranospinite. Contains submicroscopic inclusions of an oxide. Cotype sample.

Wavenumbers (cm^{-1}): 3420, 5188, 3075, 3020, 2880, 1647, 1495sh, 1473, 1434, 1404s, 1055sh, 1003s, 917, 895, 811s, 597, 548, 475.

UAs6 Uramarsite $(NH_4,H_3O)_2(UO_2)_2(AsO_4,PO_4)_2 \cdot 6H_2O$

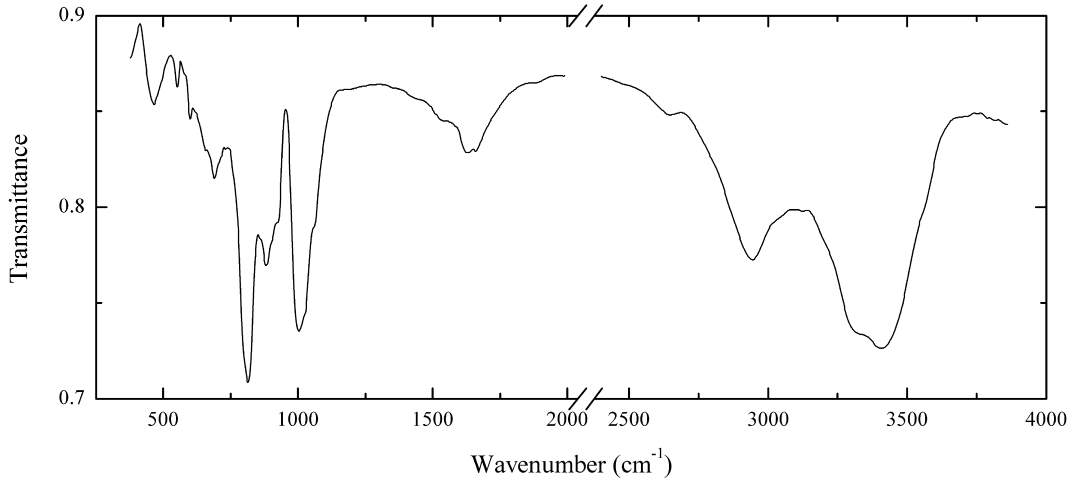


Locality: Bota-Burum U deposit, Almaty region, Kazakhstan (type locality).

Description: Yellow-green platy crystals from the association with calcite, arsenopyrite, pyrite, galenite, scorodite, arseniosiderite, mansfieldite, metazeunerite, chistyakovaite and sodium uranospinite. Holotype sample. Tetragonal, space group $P4/nmm$, $a = 7.19(1)$ Å, $c = 9.15(2)$ Å, $Z = 1$. The empirical formula is $[(NH_4)_{1.15}(H_3O)_{0.72}Na_{0.09}](UO_2)_{2.02}[(AsO_4)_{1.22}(PO_4)_{0.78}] \cdot 6.09H_2O$. Optically biaxial (−), $\alpha = 1.562(2)$, $\beta = 1.593(2)$, $\gamma = 1.593(2)$. $|2V_{meas}| < 5°$. $D_{meas} = 3.22(2)$ g/cm^3, $D_{calc} = 3.286$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 9.27 (100), 4.58 (25), 3.86 (20), 2.80 (13), 2.28 (20), 1.823 (8).

Wavenumbers (cm^{-1}): 3412, 3185, 3075, 3015, 2880, 1648, 1495sh, 1473, 1433, 1405, 1055sh, 1020sh, 1003s, 935sh, 918, 894, 880sh, 812s, 653w, 610, 590sh, 548, 474.

UAs7 Zeunerite $Cu^{2+}(UO_2)_2(AsO_4)_2 \cdot 10\text{–}16H_2O$

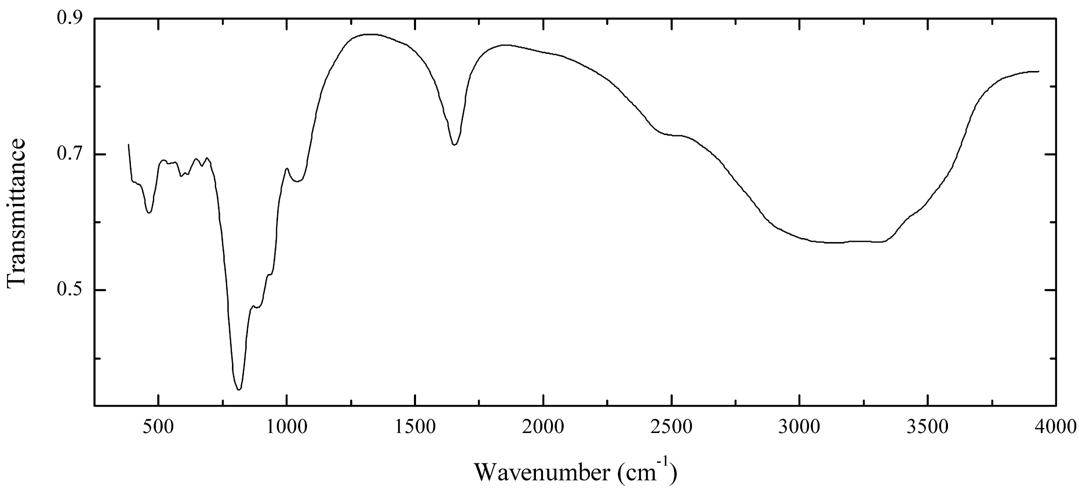


Locality: Menzenschwand U deposit, near Menzenschwand, Kunkelbach valley, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Green tabular crystals. The empirical formula is (electron microprobe) $Cu_{1.02}(UO_2)_{1.97}[(AsO_4)_{1.24}(PO_4)_{0.76}] \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3390s, 3300sh, 2930, 2620w, 1660w, 1630w, 1540w, 1440sh, 1060sh, 1025sh, 1002s, 925sh, 883, 812s, 690, 660sh, 600, 551, 466.

UAs8 Arsenuranospathite $Al(UO_2)_2(AsO_4)_2F \cdot 20H_2O$



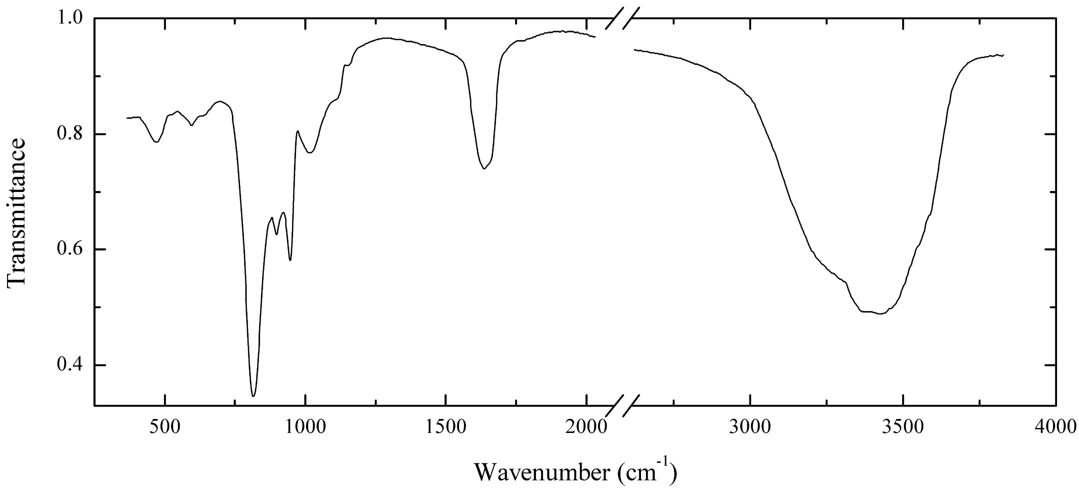
Locality: Menzenschwand U deposit, near Menzenschwand, Kunkelbach valley, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Yellow elongated platy crystals from the association with uranospathite, studtite, jachimovite, phosphuranylite and a mineral of the zippeite-group. Neotype sample. Orthorhombic, $a = 30.070$ Å, $b = 7.147$ Å, $c = 7.193$ Å, $Z = 2$. The empirical formula is $Al_{0.98}(UO_2)_{2.01}[(AsO_4)_{1.83}(PO_4)_{0.17}][F_{0.93}(OH)_{0.07}] \cdot nH_2O$ ($n \approx 20$). Strong lines of the powder

X-ray diffraction pattern [*d*, Å (*I*, %)] are 15.185 (100), 7.576 (87), 5.016 (25), 3.490 (8), 2.501 (8), 2.142 (12).

Wavenumbers (cm^{-1}): 3540sh, 3440sh, 3300, 3125sh, 2500, 1655, 1051, 1026, 1015sh, 939, 889s, 813s, 670w, 618, 595, 540w, 467, 400sh.

UAs9 Metanováčekite $Mg(UO_2)_2(AsO_4)_2 \cdot 4–8H_2O$

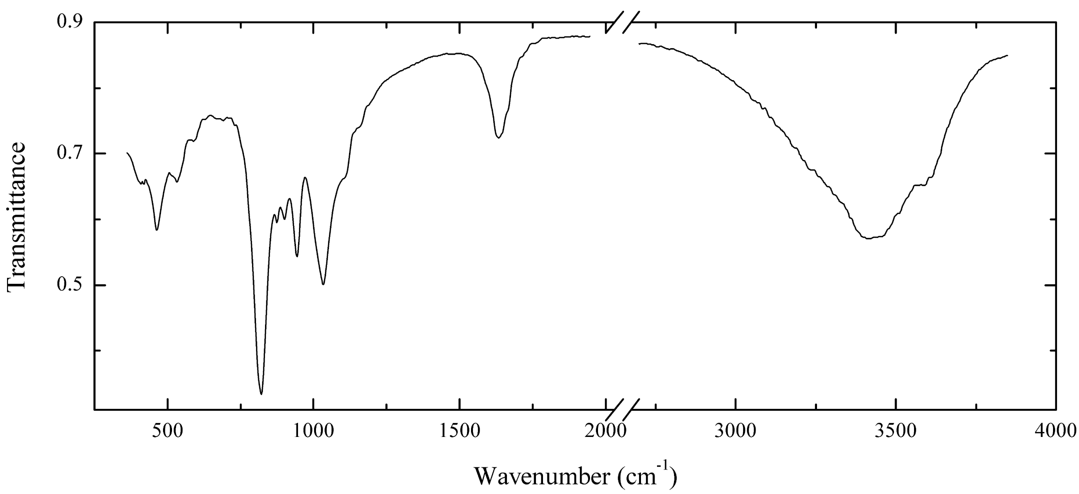


Locality: Northern Kazakhstan.

Description: Yellow platy crystals. Investigated by G.A. Sidorenko. The bands at 602 and 1,017 cm^{-1} correspond to vibrations of PO_4^{3-} groups partially substituting the groups AsO_4^{3-}.

Wavenumbers (cm^{-1}): 3540sh, 3415s, 3370sh, 3220sh, 1640, 1160w, 1110sh, 1017, 948, 893, 814s, 640sh, 602w, 475.

UAs10 Metalodèvite $Zn(UO_2)_2(AsO_4)_2 \cdot 10H_2O$

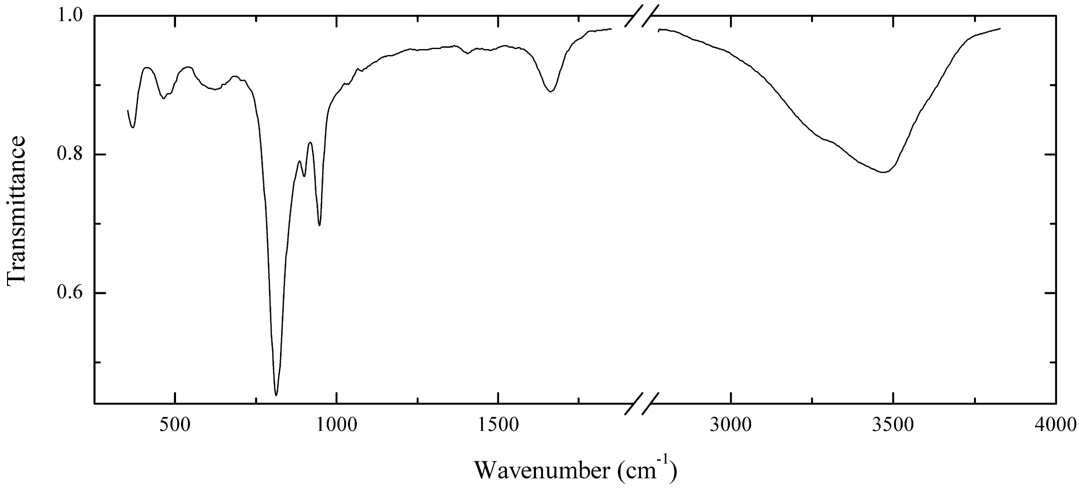


Locality: Lodève, Hérault, Languedoc-Roussillon, France (type locality).

Description: Yellow platy crystals. Confirmed by qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3550sh, 3400, 3250sh, 1630, 1150sh, 1100sh, 1034, 943, 899, 873, 818s, 587w, 531, 467, 410.

UAs11 Natrouranospinite $Na_2(UO_2)_2(AsO_4)_2{\cdot}5H_2O$

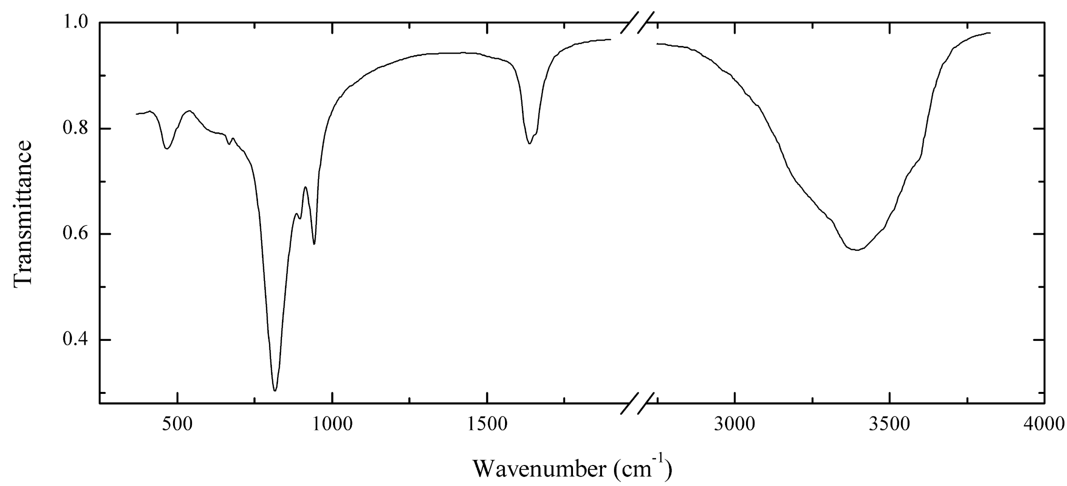


Locality: Bota-Burum U deposit, Almaty region, Kazakhstan (type locality).

Description: Yellow platy crystals from the association with metauranocircite. Tetragonal, $a = 7.113$, $c = 8.64$ Å. The empirical formula is $Na_{1.8}(UO_2)_{2.1}(AsO_4)_{2.0}{\cdot}nH_2O$ ($n \approx 5$). $D_{meas} = 3.84(6)$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 8,636 (100) (002), 4.32 (90) (004, 112), 3.70 (80) (104), 2.675 (40) (106), 2.153 (90) (216), 1.981 (31) (314, 118), 1.725 (31) (0.0.10).

Wavenumbers (cm^{-1}): 3540sh, 3440sh, 3280sh, 1655, 1460w, 1398w, 1051, 1026, 1015sh, 939, 889s, 813s, 670w, 618, 595, 540w, 467, 400sh.

UAs12 Nováčekite $Mg(UO_2)_2(AsO_4)_2{\cdot}10\text{–}12H_2O$

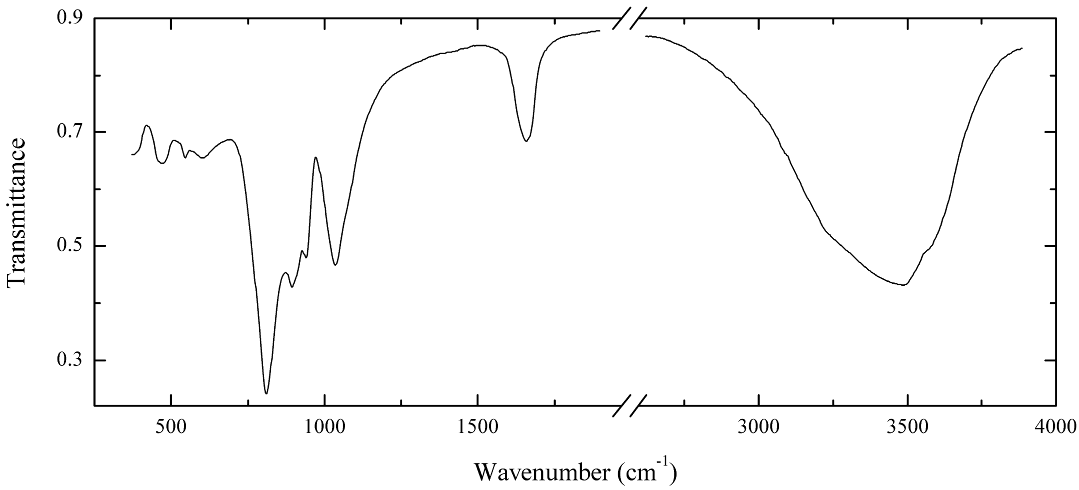


Locality: Cherkasar U deposit, Uzbekistan.

Description: Yellow platy crystals. Investigated by G.A. Sidorenko.

Wavenumbers (cm^{-1}): 3575sh, 3380, 3200sh, 1660sh, 1640, 943, 898, 816s, 667w, 620sh, 470.

UAs13 Natrouranospinite $Na_2(UO_2)_2(AsO_4)_2 \cdot 5H_2O$

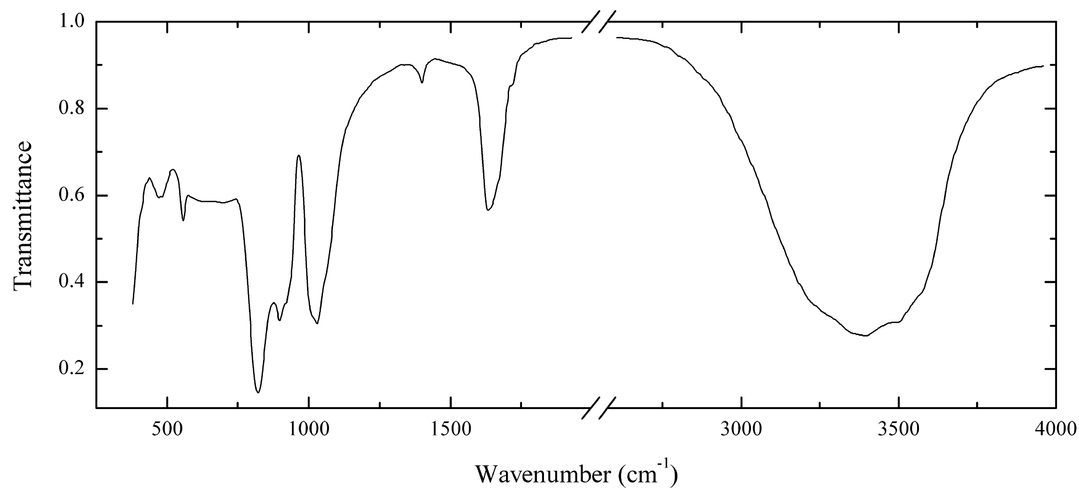


Locality: Djideli U deposit, Kazakhstan.

Description: Yellow platy crystals. Tetragonal, $a = 7.06$, $c = 8.62$ Å. The empirical formula is $Na_{0.86}Ca_{0.40}(H_3O)_{0.26}(UO_2)_{2.01}[(AsO_4)_{1.40}(PO_4)_{0.58}] \cdot nH_2O$ ($n \approx 5$). $D_{meas} = 3.84(6)$ g/cm^3. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3540sh, 3455, 3400sh, 3275sh, 1658, 1070sh, 1036, 941, 910sh, 895, 811s, 600w, 548w, 471, 370.

UAs14 Trögerite $(H_3O)(UO_2)(AsO_4) \cdot 3H_2O$

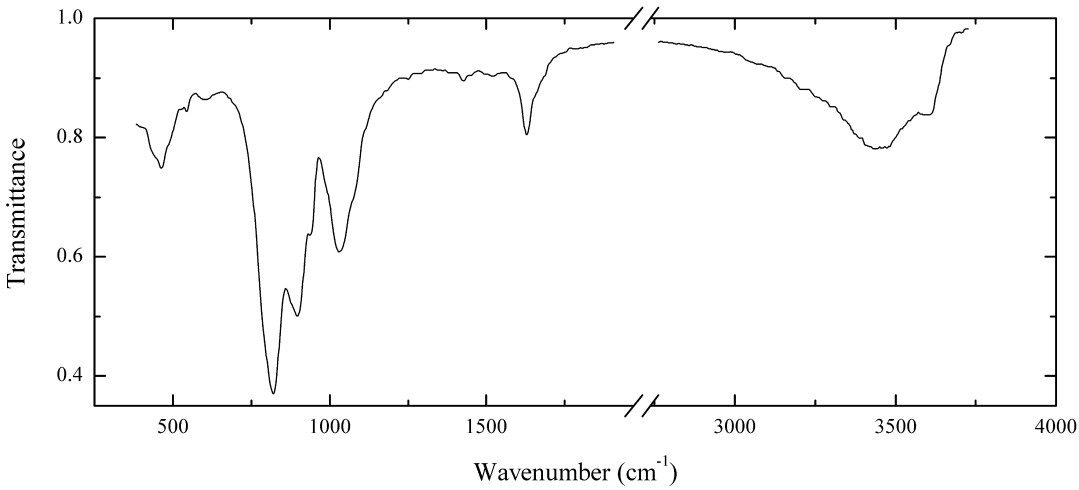


Locality: Weisser Hirsch mine, near Schneeberg, Saxony, Germany (type locality).

Description: Pale yellow platy crystals. Investigated by G.A. Sidorenko.

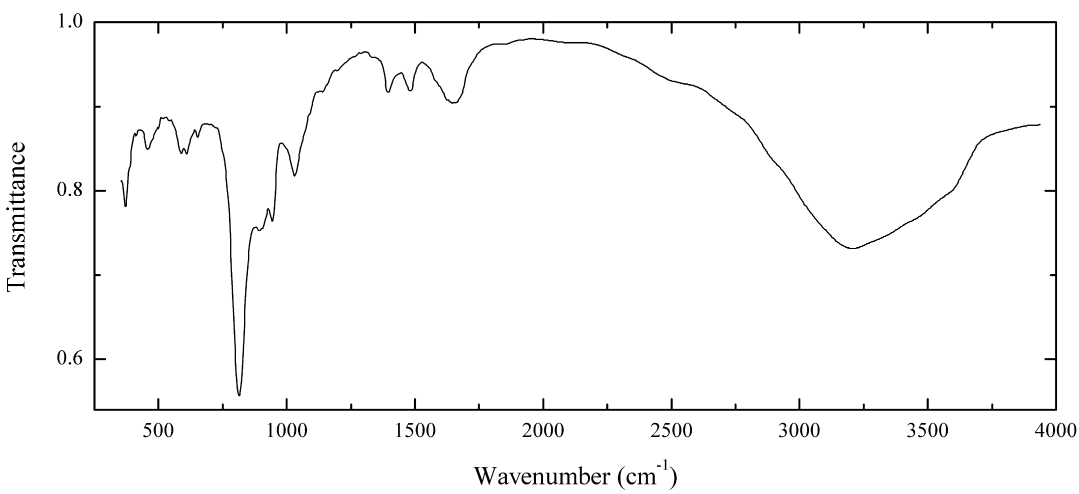
Wavenumbers (cm^{-1}): 3570sh, 3500sh, 3400s, 3250sh, 1720sh, 1660sh, 1638, 1402w, 1060sh, 1028s, 1010sh, 935sh, 915sh, 892s, 816s, 686w, 623w, 550, 470.

UAs15 Metauranospinite $Ca(UO_2)_2(AsO_4)_2{\cdot}8H_2O$



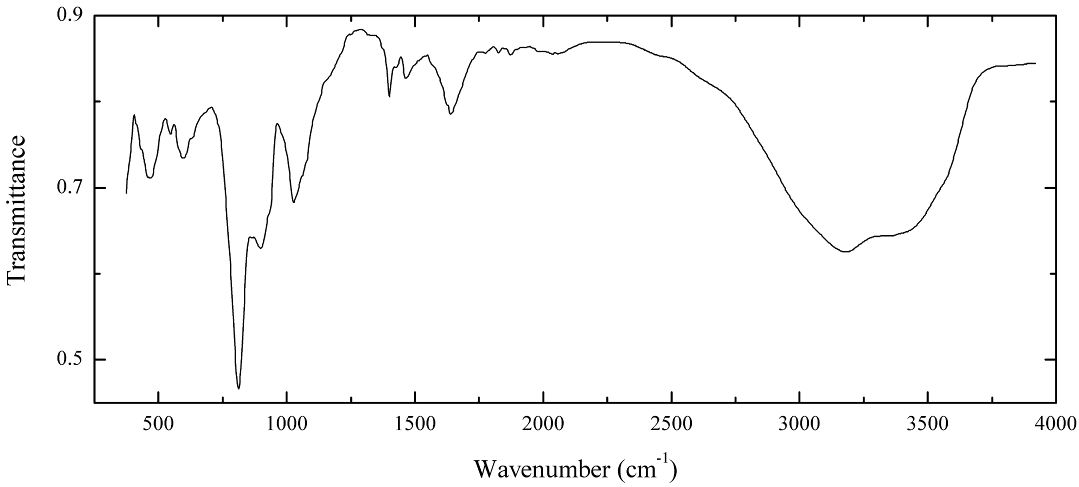
Locality: Djideli U deposit, Kazakhstan.
Description: Yellow platy crystals. Investigated by G.A. Sidorenko.
Wavenumbers (cm^{-1}): 3590, 3440, 1632, 1525w, 1430w, 1034, 940, 898s, 818s, 602w, 546w, 461.

UAs16 "Meta-arsenuranospathite" $Al(UO_2)_2(AsO_4)_2F{\cdot}8–10H_2O$



Locality: Menzenschwand U deposit, near Menzenschwand, Kunkelbach valley, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.
Description: Yellow elongated platy crystals from the association with uranospathite, studtite, jachimovite, phosphuranylite and a mineral of the zippeite-group. As-dominant analogue of sabugalite. Tetragonal, $a = 7.246$, $c = 20.79$ **Å.** The empirical formula is $Al_{0.98}(UO_2)_{2.04}[(AsO_4)_{1.66}(PO_4)_{0.34}]F_{0.88}(OH)_{0.14}{\cdot}8.77H_2O$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 10.54 (100) (002), 5.19 (73) (004), 3.56 (10) (021), 3.447 (5) (006), 2.581 (6) (117), 2.274 (5) (131), 2.060 (14) (226).
Wavenumbers (cm^{-1}): 3540sh, 3430sh, 3300sh, 3175, 1648, 1473, 1396, 1135w, 1032, 943, 897, 813s, 650w, 608, 587, 458, 374.

UAs17 Arsenuranospathite $Al(UO_2)_2(AsO_4)_2F{\cdot}20H_2O$

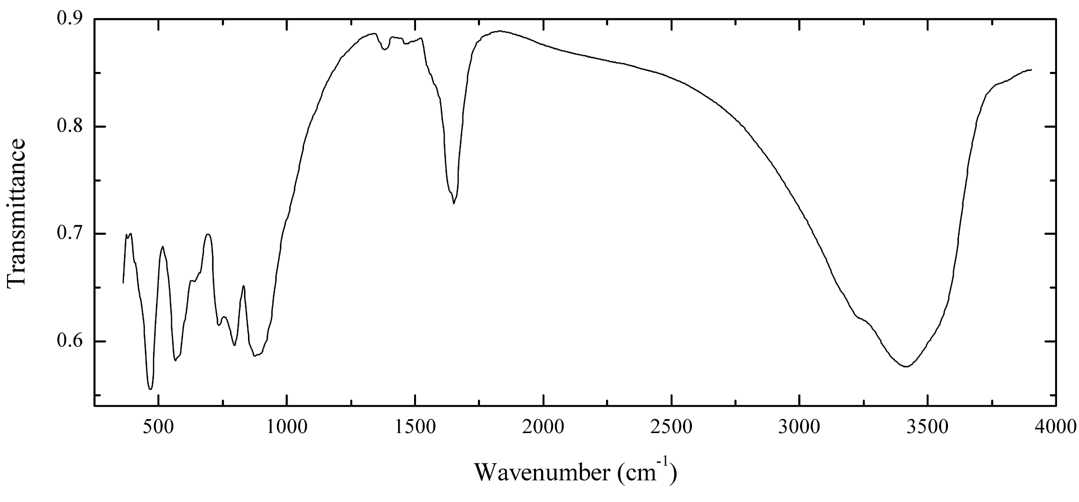


Locality: Menzenschwand U deposit, near Menzenschwand, Kunkelbach valley, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany.

Description: Yellow elongated platy crystals from the association with uranospathite, studtite, jachimovite, phosphuranylite and a mineral of the zippeite-group. The empirical formula is (electron microprobe) $Al_{1.01}(UO_2)_{1.99}[(AsO_4)_{1.62}(PO_4)_{0.38}][F_{0.88}(OH)_{0.12}]{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3560sh, 3420sh, 3320, 3155, 2055w, 1870w, 1822w, 1642, 1467w, 1403, 1160sh, 1050sh, 1027, 935sh, 898, 810s, 625sh, 598, 546w, 464.

UAs18 Seelite $Mg(UO_2)_2(AsO_3,AsO_4)_2{\cdot}7H_2O$

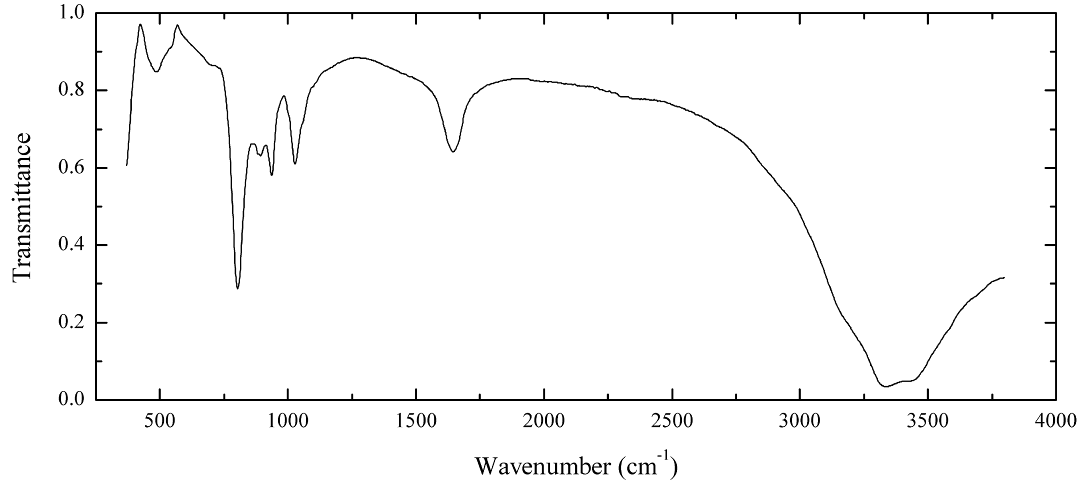


Locality: Rabejac U deposit, near Lodève, Hérault, France (type locality).

Description: Yellow crust. The empirical formula is (electron microprobe) $Mg_{0.94}(UO_2)_{2.10}(AsO_4,PO_4)_{1.84}(H_2O,OH)_x$.

Wavenumbers (cm^{-1}): 3450sh, 3390, 3220sh, 1647, 1460w, 1380w, 980sh, 875s, 796s, 735, 640, 565s, 468s.

UAs19 Rauchite $Ni(UO_2)_2(AsO_4)_2{\cdot}10H_2O$

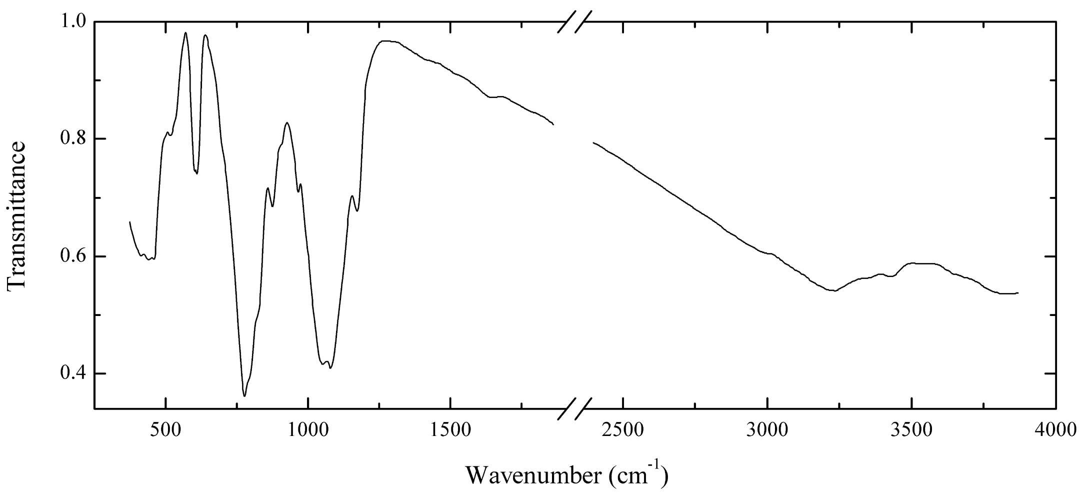


Locality: Belorechenskoye barite deposit, Adygea Republic, Northern Caucasus, Russia (type locality).

Description: Light yellowish-green lamellar crystals from the association with dymkovite, annabergite, goethite, dolomite, uraninite (pitchblende), nickeline, gersdorffite, *etc*. Triclinic, space group P-1, $a = 7.100(3)$, $b = 7.125(3)$, $c = 10.751(4)$ Å, $\alpha = 106.855(7)$, $\beta = 104.366(7)$, $\gamma = 90.420(6)°$, $V = 502.4(4)$ Å3, $Z = 1$.The empirical formula is $(Ni_{0.76}Mg_{0.19}Co_{0.01}Zn_{0.01})U_{2.00}O_4(As_{1.86}P_{0.16})O_8{\cdot}10H_2O$. Optically biaxial (−), $\alpha = 1.550(3)$, $\beta = 1.578(1)$, $\gamma = 1.581(1)$, $2V_{meas} = 40(5)°$. $D_{meas} = 3.21(2)$ g/cm^3, D_{calc} is 3.44 g/cm^3. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %) (hkl)] are 9.97 (100) (001), 6.641 (22) (10-1), 4.936 (62) (002, 011), 4.533 (41) (1-11), 3.539 (93) (02-1, 20-1, 10-3), 3.388 (43) (200, 01-3, 020, 10-3), 2.488 (27) (2-20, 22-2, 22-1, 2-21), 2.233 (27) (3-1-1, 31-1, 212, 1-30, 03-3).

Wavenumbers (cm^{-1}): 3440s, 3370s, 3200sh, 1650, 1035, 944, 901, 890sh, 813s, 730sh, 535sh, 491.

AsS1 Arsentsumebite $Pb_4Cu(AsO_4)(SO_4)(OH)$

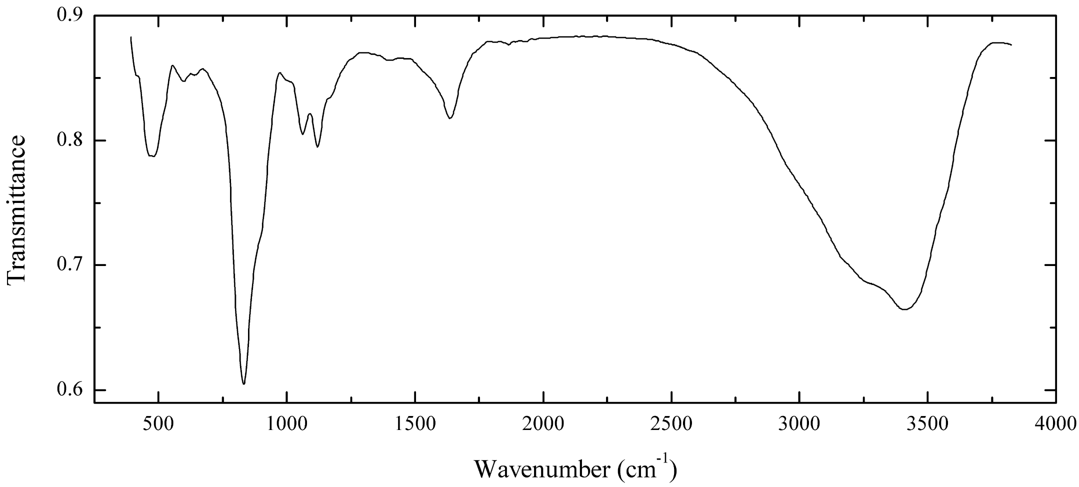


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).

Description: Grass-green crusts from the association with malachite, smithsonite, mimetite and bayldonite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Pb_{3.6}Ca_{0.1}Cu_{1.2}(AsO_4)_{1.14}(SO_4)_{0.86}(OH,H_2O)$.

Wavenumbers (cm^{-1}): 3415w, 3220, 2980sh, 1650w, 1174, 1080s, 1052s, 968, 910sh, 876, 820sh, 795sh, 778s, 608, 601, 520, 460, 446, 433.

AsS2 Zýkaite $Fe^{3+}{}_4(AsO_4)_3(SO_4)(OH)\cdot 15H_2O$

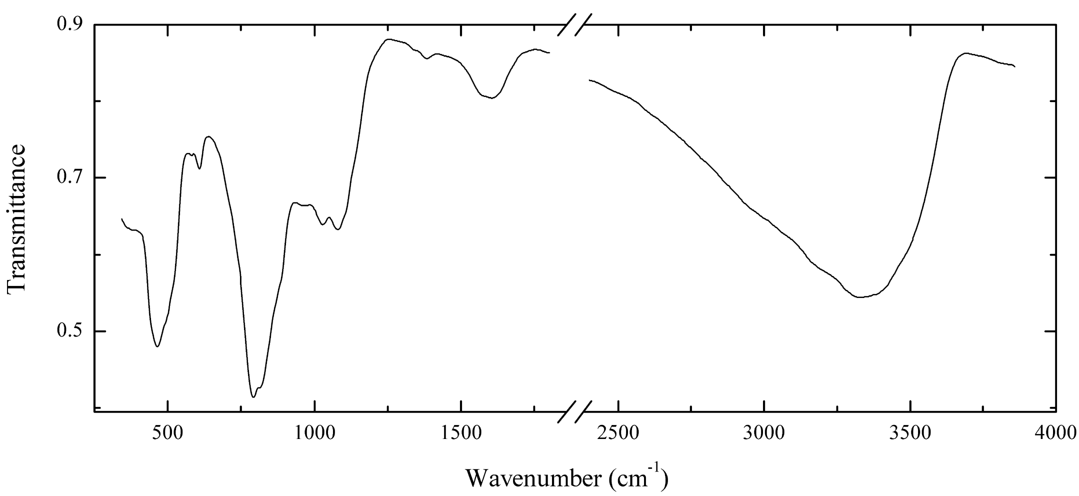


Locality: Munzig, Meißen, Saxony, Germany.

Description: White soft nodule from the association with scorodite, kaňkite and pitticite. Identified by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $Fe_{3.9}Mg_{0.2}(AsO_4)_{3.3}(SO_4)_{0.7}(OH,O)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3510sh, 3380s, 3240sh, 3150sh, 1855w, 1639, 1398w, 1180sh, 1119, 1059, 980sh, 890sh, 830s, 800sh, 640w, 595w, 520sh, 490, 470sh, 400sh.

AsS4 Parnauite $Cu^{2+}{}_9(AsO_4)_2(SO_4)(OH)_{10}\cdot 7H_2O$

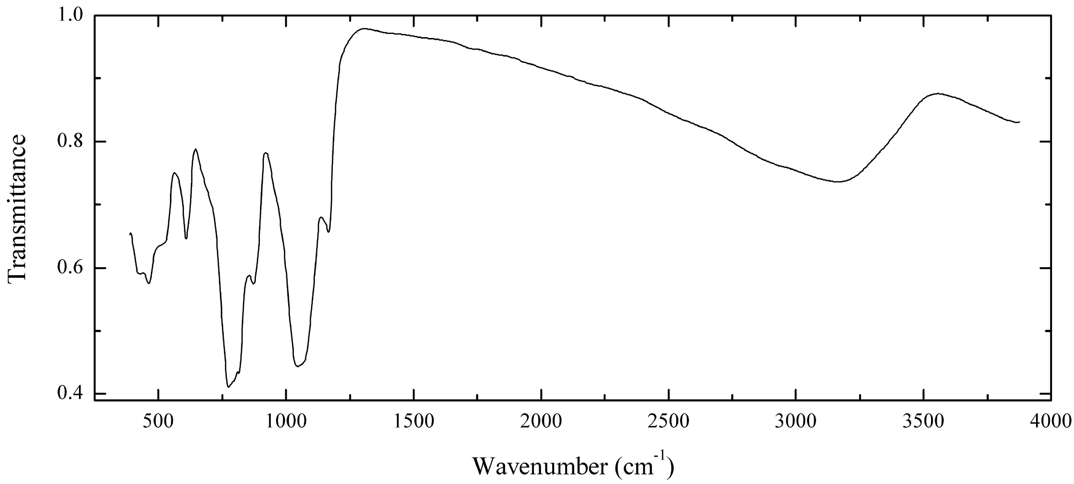


Locality: Svätoduška, Lubietová (former Libethen), Banská Bystrica, Slovakia.

Description: Green spherulitic crust, in the association with malachite. Identified by IR spectrum and powder X-ray diffraction pattern. The strongest reflections of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 14.12 (100), 10.25 (28), 4.442 (53), 3.952 (40), 3.394 (16), 2.861 (100).

Wavenumbers (cm^{-1}): 3330s, 3170sh, 3000sh, 1600, 1385w, 1350sh, 1080, 1025, 970, 880sh, 810s, 792s, 607, 580w, 495sh, 463s, 380sh.

AsS5 Arsentsumebite $Pb_4Cu(AsO_4)(SO_4)(OH)$

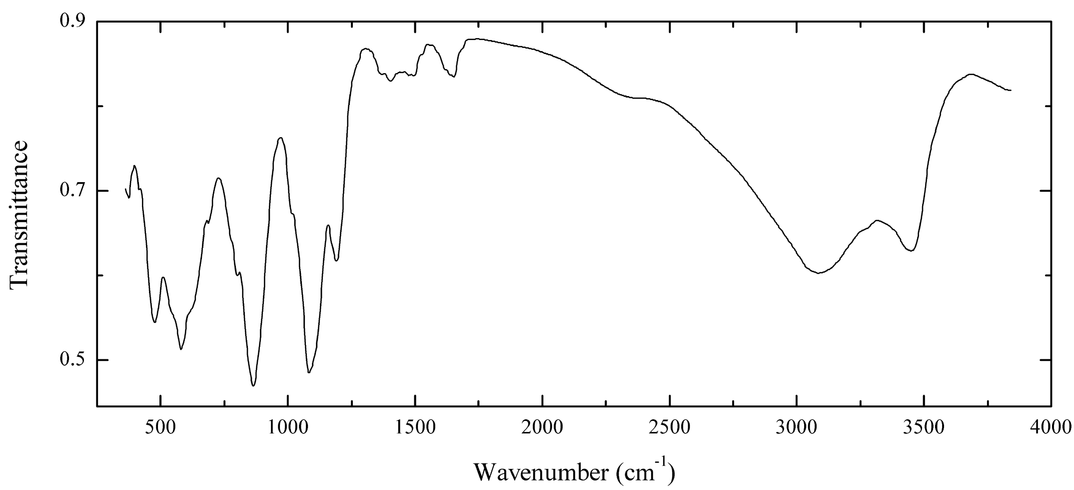


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).

Description: Grass-green crusts from the association with malachite, mimetite and duftite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Pb_{3.9}Ca_{0.1}Cu_{1.1}(AsO_4)_{1.0}(PO_4)_{0.1}(SO_4)_{0.9}(OH,O)$.

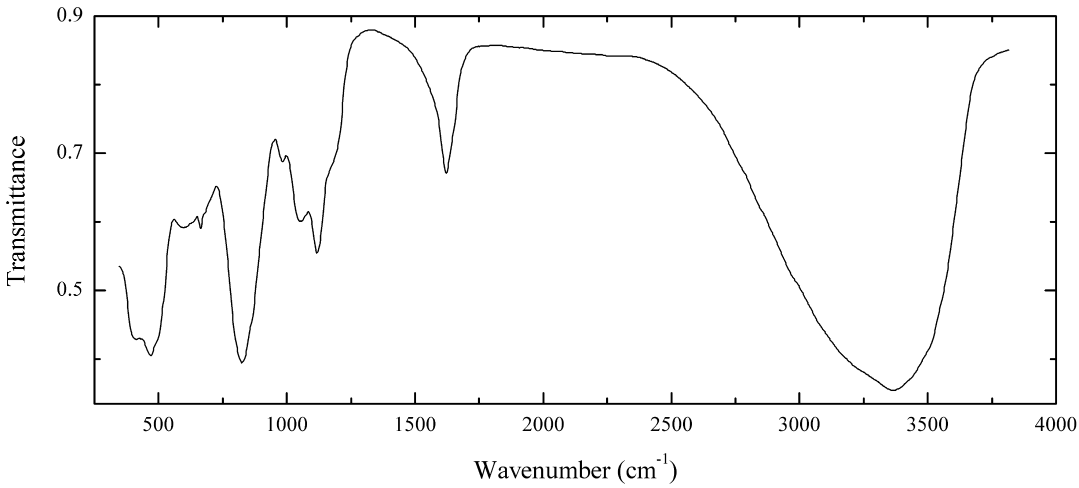
Wavenumbers (cm^{-1}): 3175, 2950sh, 1172, 1065sh, 1042s, 872, 815s, 795sh, 773s, 605, 525sh, 460, 423.

AsS6 Hidalgoite $PbAl_3[(As,S)O_4]_2(OH,H_2O)_6$



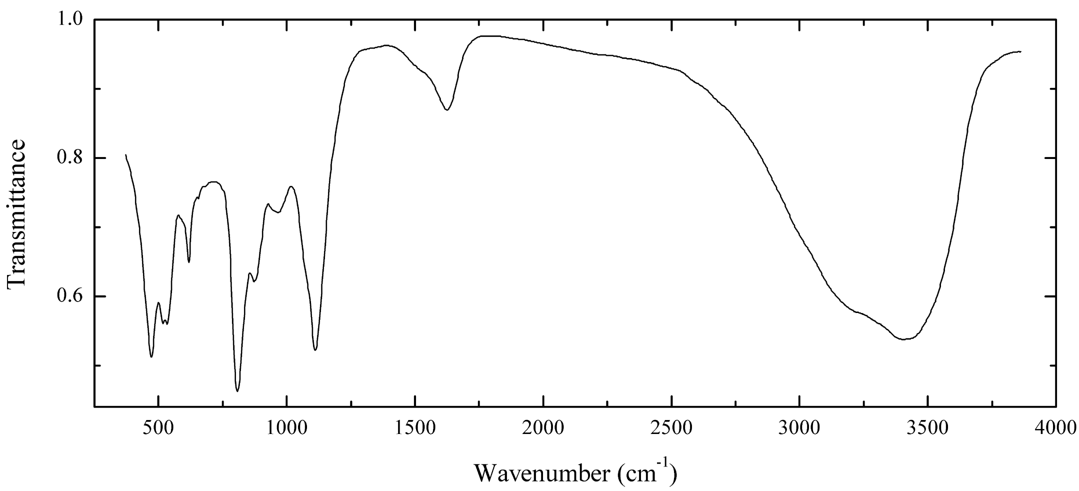
Locality: Gold Hill mine, Gold Hill district, Deep Creek Mts., Tooele Co., Utah, USA.
Description: Olive green massive from the association with plumbojarosite. The empirical formula is (electron microprobe) $Pb_{1.06}(Al_{2.90}Fe_{0.12})[(AsO_4)_{1.16}(SO_4)_{0.77}(SiO_4)_{0.05}(PO_4)_{0.02}](OH,H_2O)_6$.
Wavenumbers (cm^{-1}): 3443, 3075, 2360w, 1640w, 1490w, 1405w, 1365w, 1190, 1085s, 1010sh, 860s, 802, 685w, 620sh, 585s, 550sh, 475, 373w.

AsS7 Pitticite $Fe^{3+}{}_x(AsO_4)_y(SO_4)_{1.5x-1.5y}\cdot nH_2O$



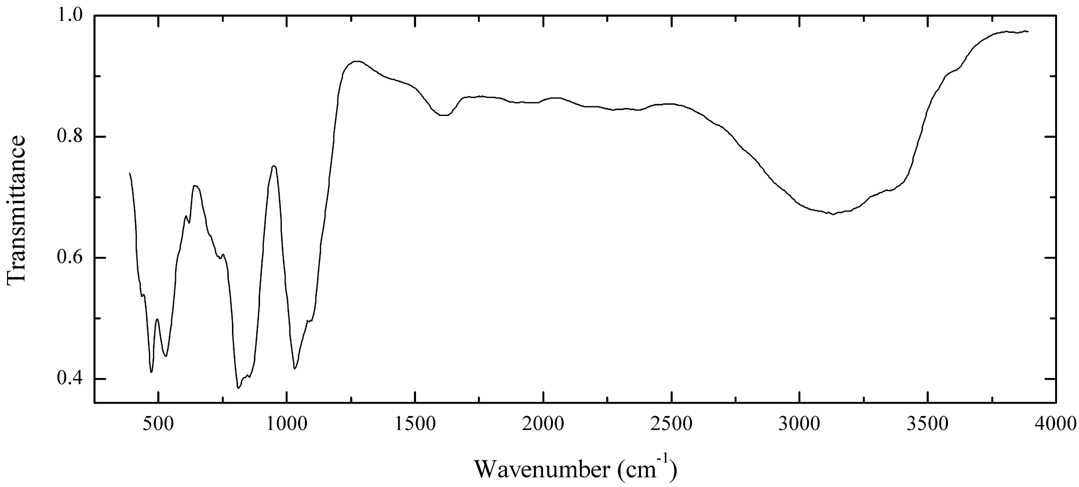
Locality: Munzig, near Meißen, Saxony, Germany.
Description: Brown colloform from the association with scorodite, kaňkite and zýkaite. Amorphous.
Wavenumbers (cm^{-1}): 3500sh, 3360s, 3240sh, 1625, 1180sh, 1123, 1055, 991w, 829s, 690sh, 655, 607, 520sh, 490sh, 470s, 415s.

AsS9 Chalcophyllite $Cu_9Al(AsO_4)_2(SO_4)_{1.5}(OH)_{12}\cdot 18H_2O$



Locality: Ting Tang mine, Carharrack, Cornwall, England, UK.
Description: Greenish-blue platy crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3390s, 3210sh, 1632, 1530sh, 1113s, 1075sh, 960, 876, 809s, 618, 532, 519, 474s.

AsS10 Beudantite $PbFe^{3+}{}_3[(As,S)O_4]_2(OH,H_2O)_6$

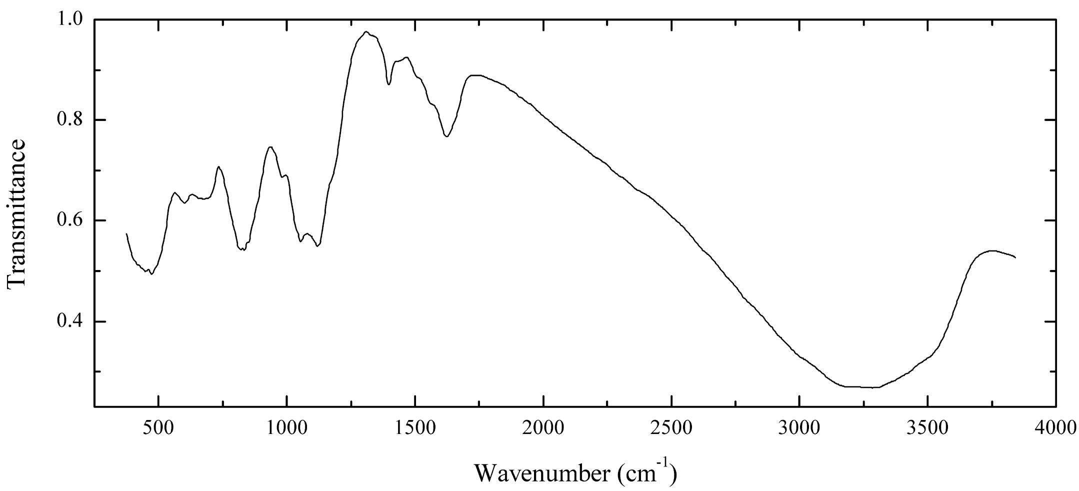


Locality: Kayrakty W–Mo–Bi deposit, Karagandy region, Kazakhstan.

Description: Yellow massive. The empirical formula is (electron microprobe) $Pb_{0.99}(Fe_{2.78}Al_{0.12}Mg_{0.16})[(AsO_4)_{0.98}(SO_4)_{0.81}(PO_4)_{0.21}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3580sh, 3400sh, 3125, 2365w, 2265w, 2070w, 1950w, 1900w, 1617, 1450sh, 1090, 1030s, 854s, 812s, 741, 617, 527, 471s, 440.

AsS11 Pitticite $Fe^{3+}{}_x(AsO_4)_y(SO_4)_{1.5x-1.5y}\cdot nH_2O$

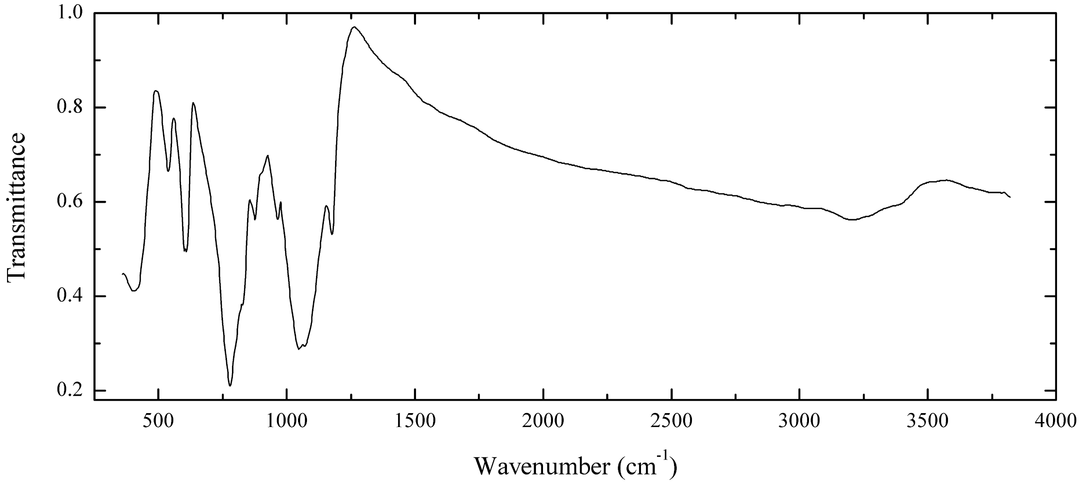


Locality: Neue Hoffnung Gottes mine, Bräunsdorf, Freiberg district, Saxony, Germany.

Description: Brown colloform from the association with scorodite and zýkaite. Amorphous. Identified by IR spectrum.

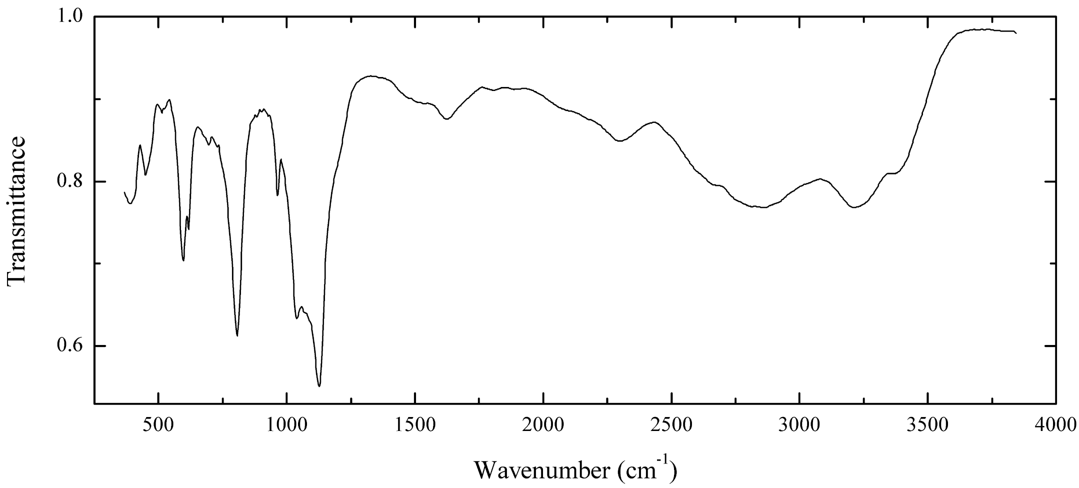
Wavenumbers (cm^{-1}): 3475sh, 3280s, 1625, 1570sh, 1510sh, 1395, 1170sh, 1120s, 1053s, 980, 825s, 760, 600, 472s, 452s, 425sh.

AsS12 Arsentsumebite $Pb_4Cu(AsO_4)(SO_4)(OH)$



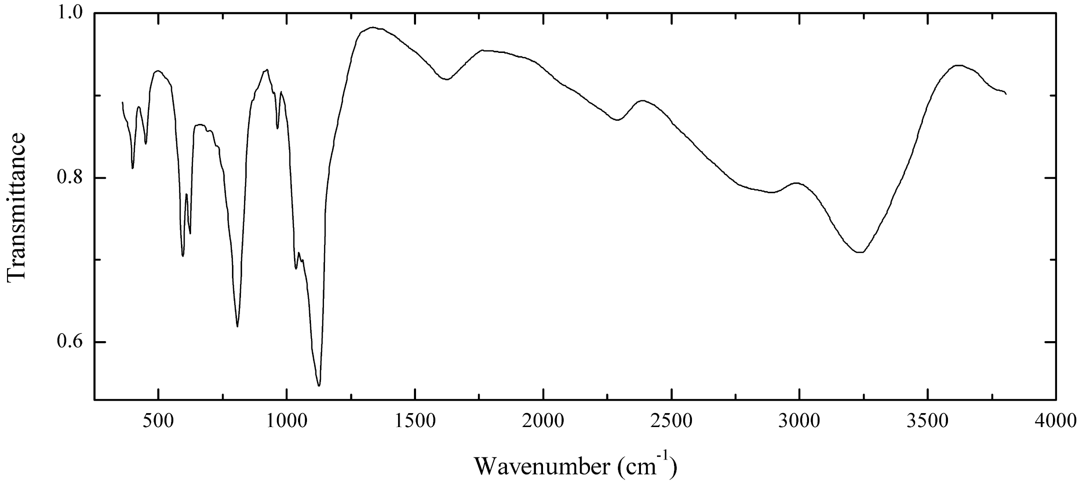
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: Green crystals. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3340sh, 3180, 1177, 1074s, 1052s, 967, 877, 825sh, 779s, 710sh, 609, 601, 540, 405.

AsS13 Mallestigite $Pb_3Sb[(SO_4)(AsO_4)](OH)_6{\cdot}3H_2O$



Locality: Finkenstein, Corinthia, Austria.
Description: Colourless long-prismatic crystals from the association with schultenite and anglesite. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3370, 3200, 2850, 2660sh, 2295, 2100sh, 1800w, 1625, 1530w, 1195sh, 1127s, 1038s, 965, 805s, 692w, 616, 594s, 510w, 448, 397.

AsS14 Mallestigite $Pb_3Sb[(SO_4)(AsO_4)](OH)_6{\cdot}3H_2O$

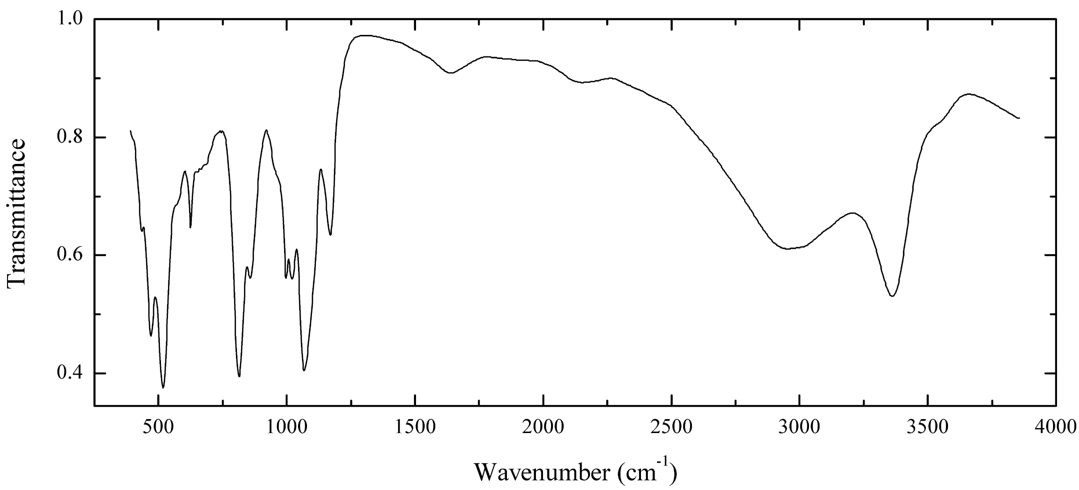


Locality: Mallestiger Mittagskogel, Westkarawanken, Corinthia, Austria (type locality).

Description: Colourless long-prismatic crystals from the association with anglesite. Identified by IR spectrum. The empirical formula is (electron microprobe) $Pb_{3.05}Sb_{1.1}[(SO_4)_{1.0}(AsO_4)_{0.9}(SiO_4)_{0.1}](OH,O)_6{\cdot}nH_2O$.

Wavenumbers (cm^{-1}): 3400sh, 3225, 2870, 2800sh, 2290, 2100sh, 1625, 1210sh, 1125s, 1037s, 965, 808s, 620s, 595s, 450, 399, 375sh.

AsS16 Beudantite $PbFe^{3+}{}_3[(As,S)O_4]_2(OH,H_2O)_6$

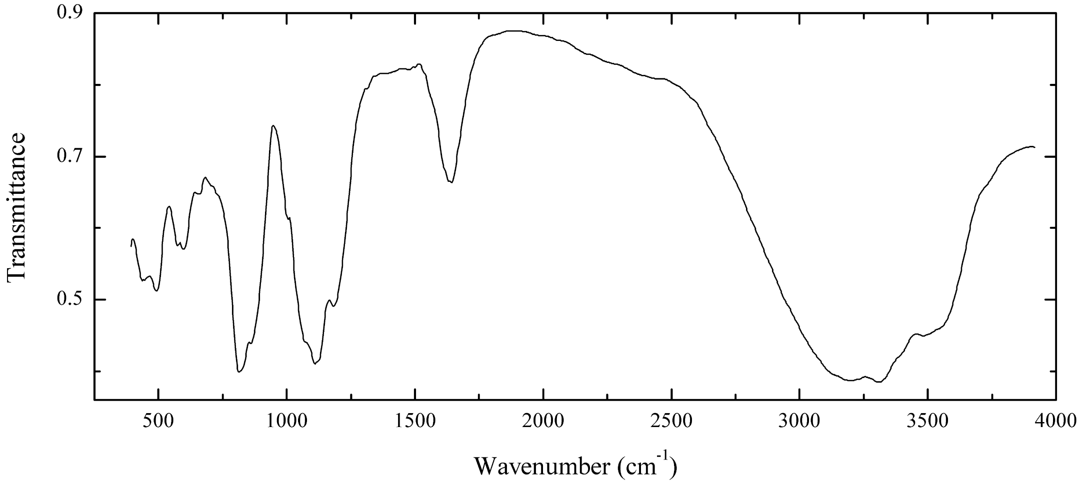


Locality: Large dump of the Kamariza mines, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Brown crystals in the association with goethite and jarosite. The empirical formula is (electron microprobe) $Pb_{1.07}(Fe_{2.63}Cu_{0.19}Al_{0.11})[(AsO_4)_{0.97}(SO_4)_{1.03}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3510sh, 3337s, 2920, 2140w, 1633w, 1170, 1068s, 1022, 998, 965sh, 856, 813s, 700sh, 627, 570sh, 517s, 470s, 435.

AsS17 Hilarionite $Fe^{3+}{}_2(SO_4)(AsO_4)(OH)\cdot 6H_2O$

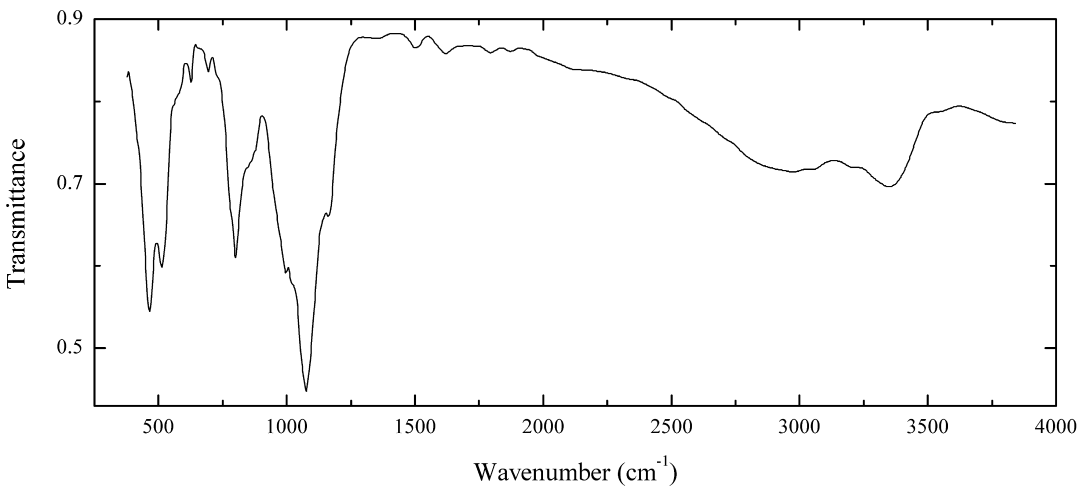


Locality: Hilarion Mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece (type locality).

Description: Light yellowish-green spherulites (up to 0.5 mm across) consisting of prismatic to acicular individuals striated along to elongation. Holotype sample. Associated minerals are goethite, hematite, gypsum, jarosite, chalcanthite, azurite and allophane. Monoclinic, space group *C*2/*m*, *Cm* or *C*2; $a = 18.53$, $b = 17.43$, $c = 7.56$, $\beta = 94.06°$. The empirical formula is $(Fe^{3+}{}_{1.90}Cu_{0.01}Zn_{0.01})[(SO_4)_{1.24}(AsO_4)_{0.74}(PO_4)_{0.01}](OH)_{1.01}\cdot 6.03H_2O$. Optically biaxial (+), $\alpha = 1.575(5)$, $\gamma = 1.64(2)$. $D_{calc} = 2.486$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 12.66 (100), 7.60 (6), 5.00 (10), 4.70 (10), 2.887 (5)

Wavenumbers (cm^{-1}): 3525sh, 3480s, 3295s, 3190s, 3125sh, 1640, 1184, 1120sh, 1107s, 1070sh, 1004, 860, 812s, 650w, 600, 577, 494, 440.

AsS18 Beudantite $PbFe^{3+}{}_3[(As,S)O_4]_2(OH,H_2O)_6$

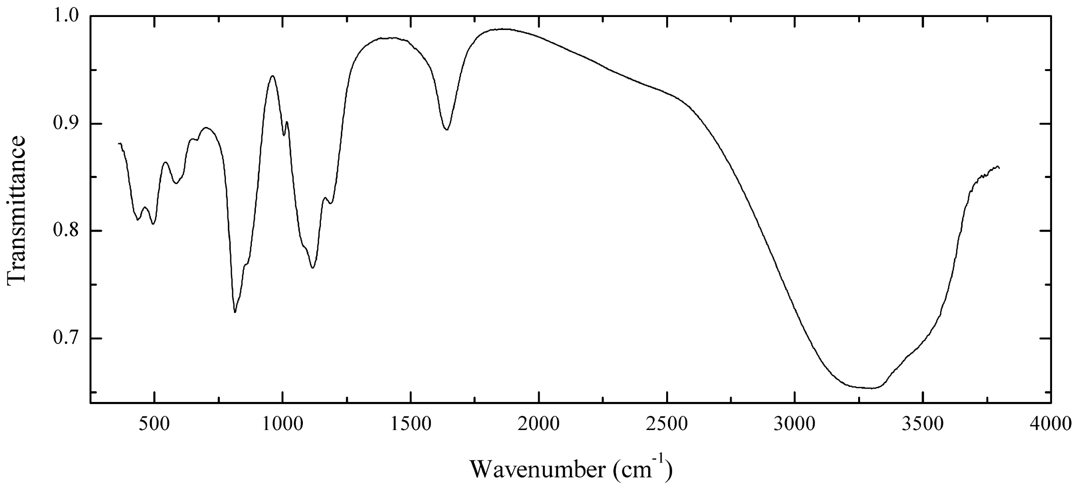


Locality: Jean Baptiste Mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Greenish-brown massive, from the association with segnitite and kintoreite. Zn-rich variety. The empirical formula is (electron microprobe) $Pb_{1.0}(Fe_{2.35}Zn_{0.45}Al_{0.1}Cu_{0.1})[(AsO_4)_{0.8}(SO_4)_{1.2}](OH,H_2O)_6$.

Wavenumbers (cm^{-1}): 3350, 3200, 2970, 1875w, 1790w, 1625w, 1510w, 1375w, 1163, 1077s, 1020sh, 996, 850sh, 800, 693w, 625w, 575sh, 510, 464s.

AsS20 Hilarionite $Fe^{3+}_2(SO_4)(AsO_4)(OH)·6H_2O$

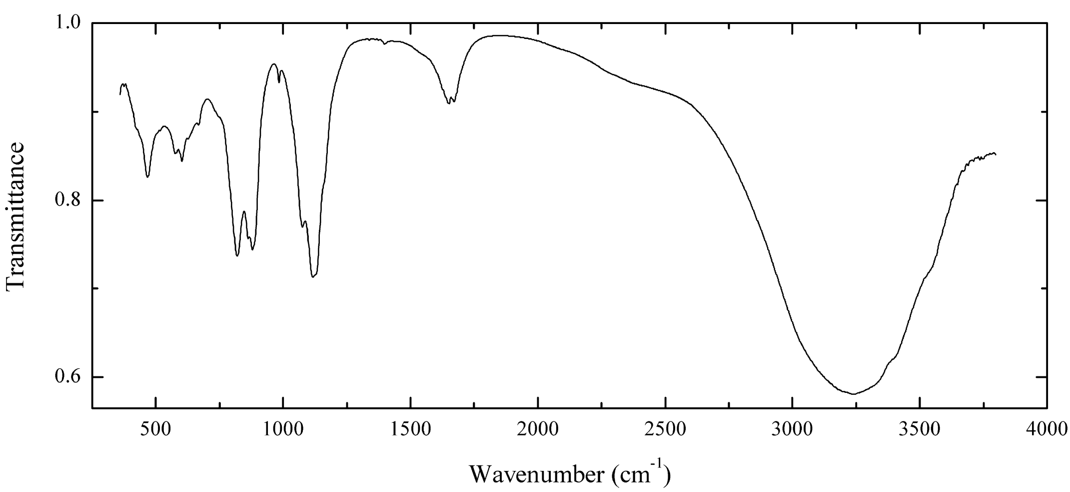


Locality: Hilarion Mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece (type locality).

Description: Beige spherulites from the association with goethite, jarosite, chalcanthite and azurite. Identified by IR spectrum, powder X-ray diffraction pattern and electron microprobe analysis.

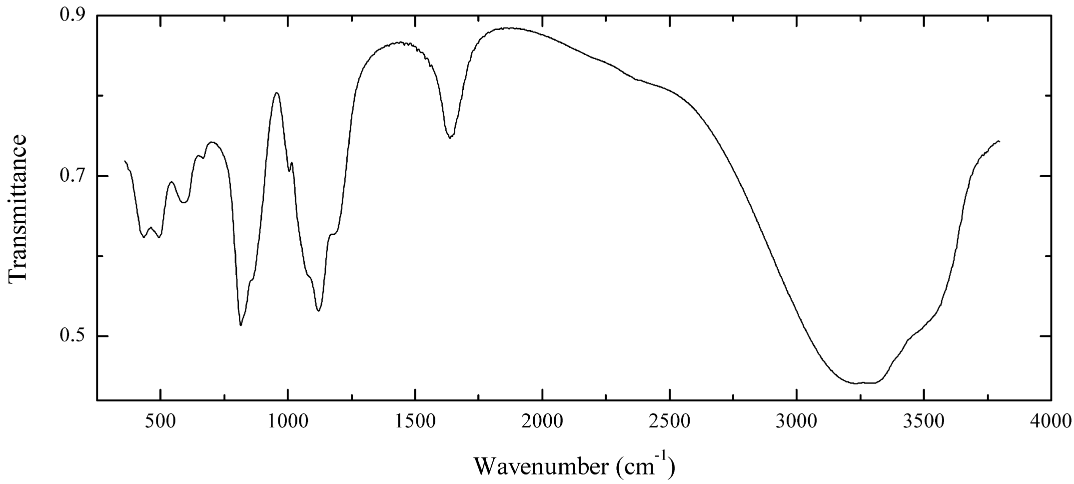
Wavenumbers (cm^{-1}): 3470sh, 3300s, 3230sh, 1640, 1187, 1118s, 1080sh, 1005, 860sh, 830sh, 814s, 660w, 605sh, 584, 494, 434.

AsS21 Bukovskýite $Fe^{3+}_2(SO_4)(AsO_4)(OH)·7H_2O$



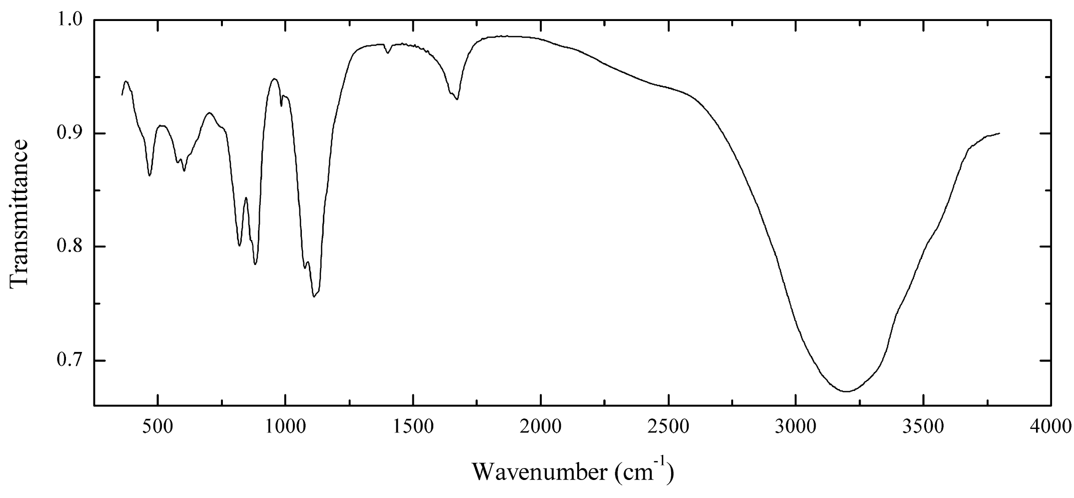
Locality: Kaňk, near Kutná Hora, Central Bohemia, Czech Republic (type locality).
Description: Yellowish nodule. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3535sh, 3390sh, 3241s, 2390sh, 1672, 1652, 1400w, 1130sh, 1117s, 1076, 984w, 880s, 866, 820s, 745sh, 667, 630sh, 602, 580, 467, 430sh.

AsS22 Hilarionite $Fe^{3+}{}_2(SO_4)(AsO_4)(OH)\cdot6H_2O$



Locality: Hilarion Mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece (type locality).
Description: Beige aggregates of acicular crystals from the association with gypsum, goethite, jarosite, chalcanthite and azurite. The empirical formula is (electron microprobe) $Fe^{3+}{}_{1.88}Mg_{0.04}Al_{0.03}Cu_{0.02}[(SO_4)_{1.14}(AsO_4)_{0.82}(PO_4)_{0.04}](OH)\cdot nH_2O$. Confirmed by IR spectrum.
Wavenumbers (cm^{-1}): 3470sh, 3395sh, 3290s, 3230s, 2400sh, 1636, 1180, 1120s, 1085sh, 1005, 860sh, 830sh, 815s, 665, 593, 493, 434.

AsS23 Sarmientite $Fe^{3+}{}_2(AsO_4)(SO_4)(OH)\cdot5H_2O$



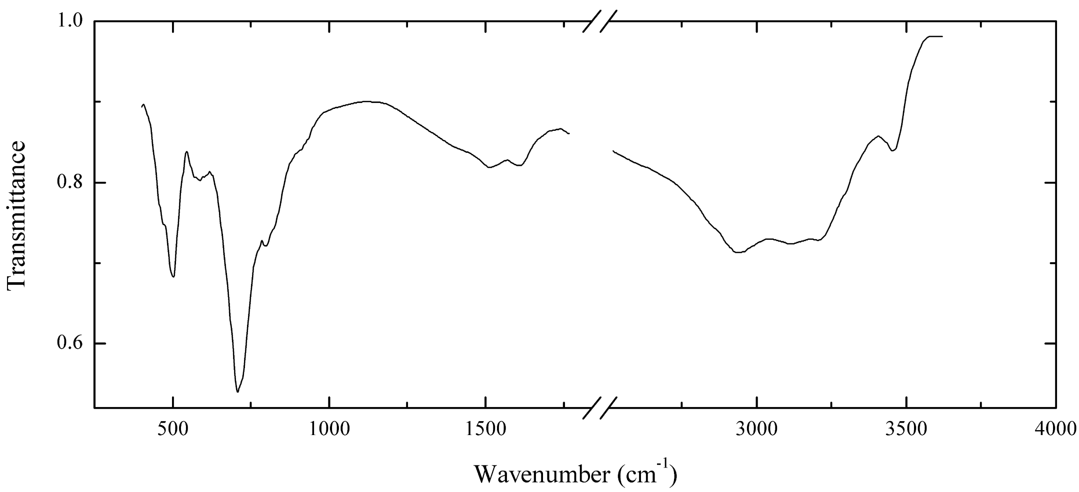
Locality: Hilarion mine, Agios Konstantinos, Lavrion mining District, Attikí (Attika, Attica) Prefecture, Greece.

Description: Beige spherulites from the association with chalcanthite. The empirical formula is (electron microprobe) $(Fe_{1.8}Cu_{0.1})[(AsO_4)_{1.05}(SO_4)_{0.95}](H_2O,OH)_6$. The strongest lines of the powder diffraction pattern [*d*, Å (*I*, %)] are 9.38 (100), 5.386 (19), 4.520 (19), 3.938 (28), 3.693 (24), 3.620 (33), 3.067 (20), 2.456 (20).

Wavenumbers (cm^{-1}): 3530sh, 3410sh, 3300sh, 3191s, 2400sh, 1672, 1655sh, 1401w, 1125sh, 1113s, 1076s, 984, 882s, 870sh, 819, 760sh, 650sh, 625sh, 603, 579, 468, 435sh.

2.14 Selenites, Molybdates, Tellurites, Tellurates, Iodites, Wolframates and Wolfram Oxides

Se1 Ahlfeldite $Ni(SeO_3)\cdot 2H_2O$

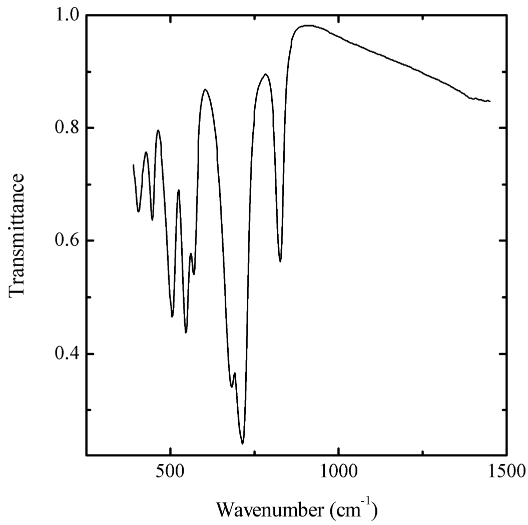


Locality: Mina el Dragon (el Dragon mine), Potosi, Bolivia.

Description: Brownish-pink spherulites from the association with mandarinoite and chalcomenite. The empirical formula is (electron microprobe) $Ni_{0.69}Co_{0.28}Cu_{0.03}(SeO_3)_{1.00}\cdot nH_2O$. Confirmed by IR spectrum.

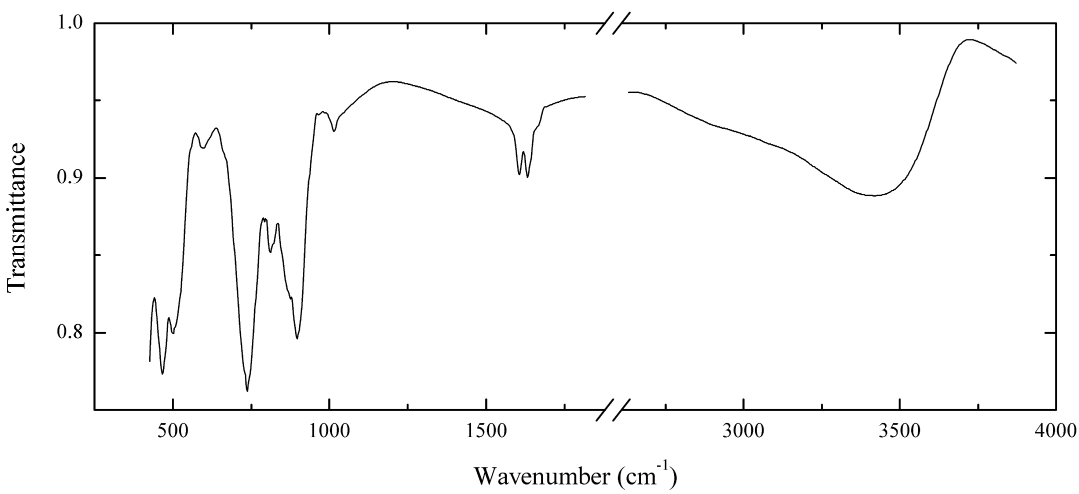
Wavenumbers (cm^{-1}): 3450, 3195, 3110, 2930, 1615, 1515, 1400sh, 900sh, 800, 712s, 594, 502, 475sh.

Se2 Georgbokiite $Cu_5(SeO_3)_2O_2Cl_2$



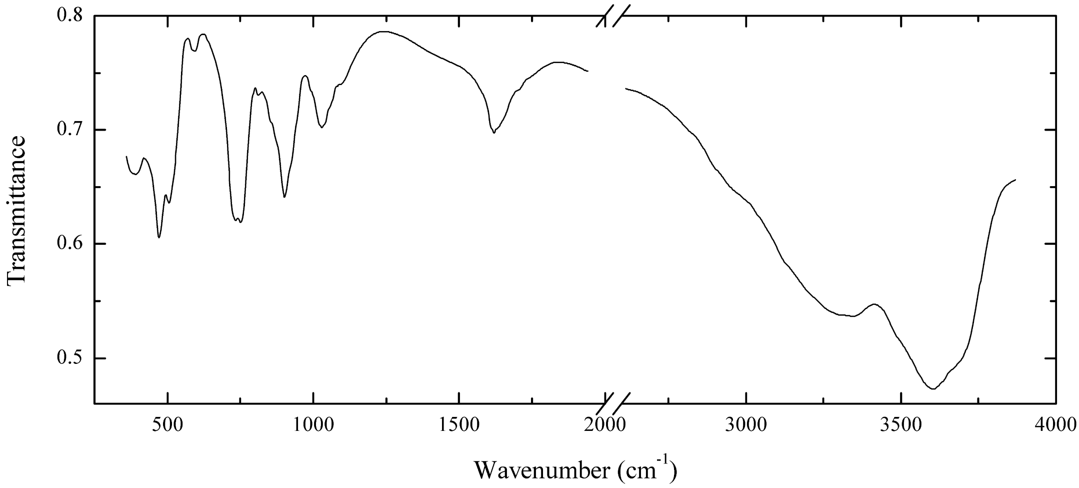
Locality: Synthetic.
Description: Bluish-black crystals.
Wavenumbers (cm^{-1}): 835, 718s, 685s, 576, 551, 510, 490sh, 455, 402.

Se3 Marthozite $Cu(UO_2)_3(SeO_3)_3(OH)_2 \cdot 7H_2O$



Locality: Musonoi, near Kolwezi, Shaba, Democratic Republic of Congo (type locality).
Description: Olive green crust. Confirmed by qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3450, 1630, 1605, 1014w, 897s, 814, 770sh, 736s, 600w, 504, 468s.

Se4 Larisaite $Na(H_3O)(UO_2)_3(SeO_3)_3O_2{\cdot}4H_2O$

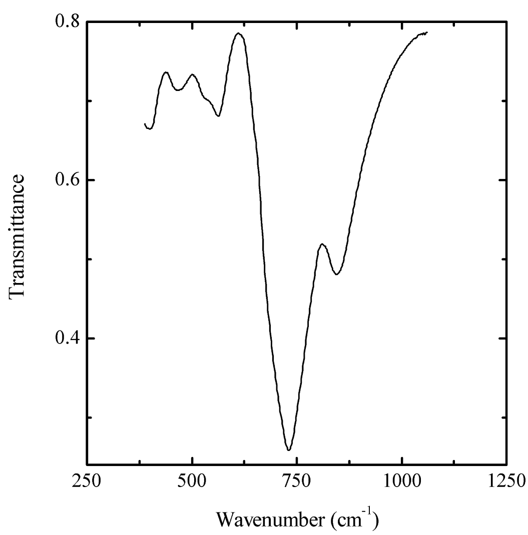


Locality: Repete mine, near Blanding, San Juan Co., Utah, USA (type locality).

Description: Yellow lamellar crystals from the association with quartz, haynesite, andersonite, wölsendorfite, uranophane, gypsum, calcite and montmorillonite. Holotype sample. The crystal structure is solved. Monoclinic, space group *P*11*m*; $a = 6.9806(9)$, $b = 7.646(1)$, $c = 17.249(2)$ Å, $\gamma = 90.039(4)$o, $Z = 2$. $D_{calc} = 4.46$ g/cm^3. Optically biaxial (–), $\alpha = 1.597(2)$, $\beta = 1.770(5)$, $\gamma = 1.775(5)$; $2V \approx -20°$. The empirical formula is $Na_{0.81}K_{0.18}Ca_{0.05}(H_3O)_{0.73}(UO_2)_{3.09}(SeO_3)_2O_2{\cdot}4.1H_2O$. The strongest lines in the powder diffraction pattern [*d*, Å (*I*, %) (*hkl*)] are 8.63 (43) (002), 7.67 (100) (010), 3.85 (40) (-113, 020, 113), 3.107 (77) (211), 2.874 (53) (006, -115).

Wavenumbers (cm^{-1}): 3675sh, 3600s, 3320s, 2970sh, 1700sh, 1622, 1095, 1044, 901s, 754s, 740s, 730sh, 592w, 506, 470s, 380.

Se5 Mandarinoite $Fe^{3+}{}_2(SeO_3)_3{\cdot}6H_2O$

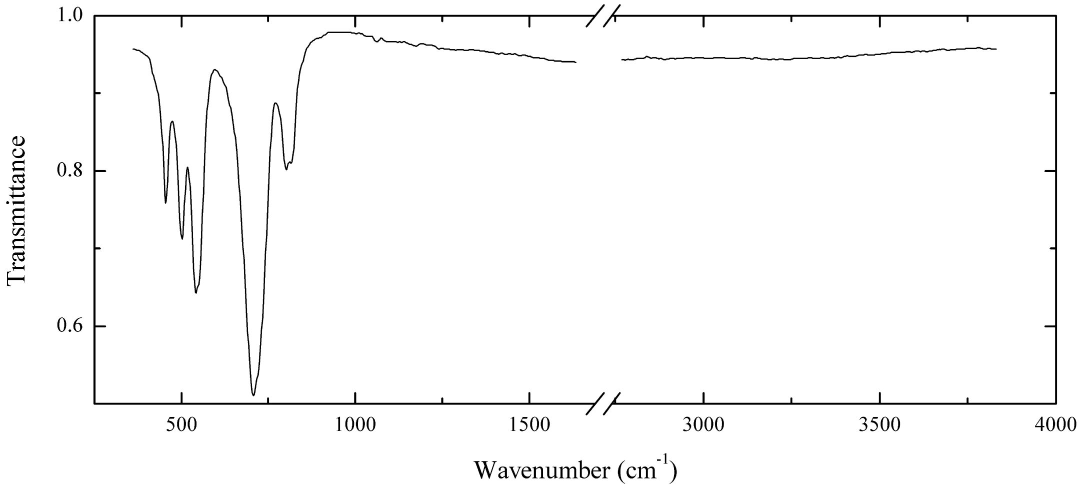


Locality: Mina el Dragon (el Dragon mine), Potosi, Bolivia.

Description: Pale green crystals from the association with ahlfeldite and chalcomenite. Al-rich variety. The empirical formula is $(Fe_{1.37}Al_{0.62}Cu_{0.02})(SeO_3)_{3.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 838s, 728s, 675sh, 565, 530sh, 480w, 400.

Se6 Francisite $Cu^{2+}{}_3Bi^{3+}(SeO_3)_2O_2Cl$

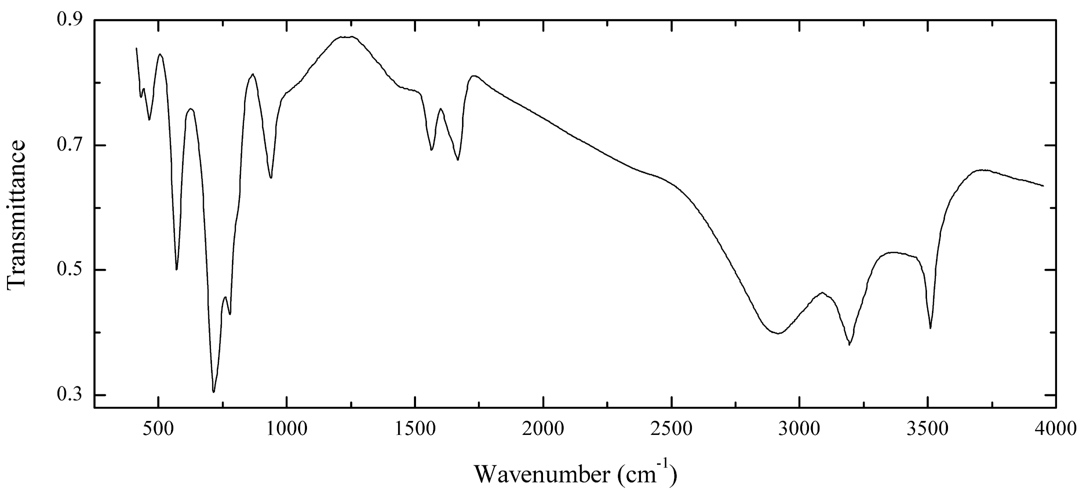


Locality: Synthetic.

Description: Green crystals. Confirmed by chemical analysis and powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 820, 802, 708s, 550sh, 540s, 500, 454.

Se7 Chalcomenite $Cu^{2+}(SeO_3)\cdot 2H_2O$

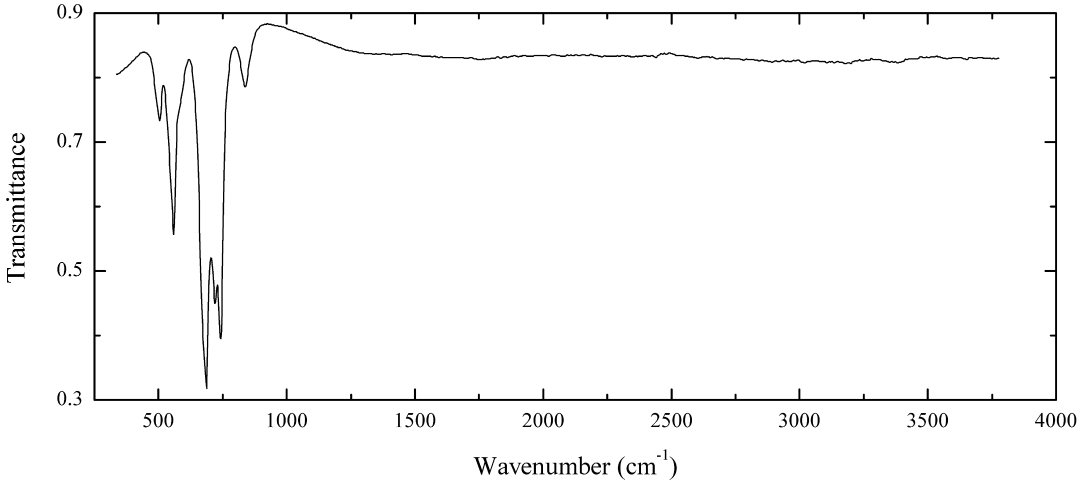


Locality: Mina el Dragon (el Dragon mine), Potosi, Bolivia.

Description: Blue crystals from the association with ahlfeldite and mandarinoite. Confirmed by chemical IR spectrum.

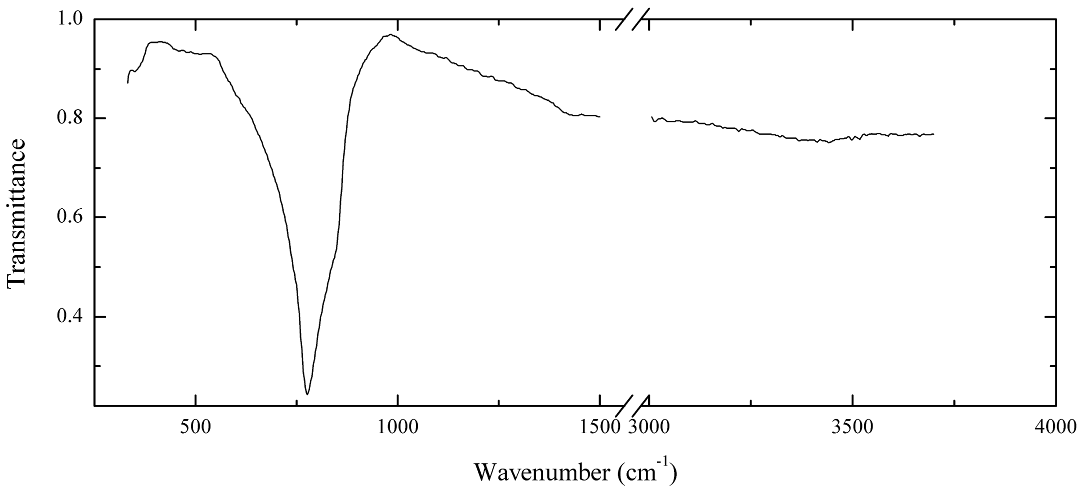
Wavenumbers (cm^{-1}): 3510, 3195, 2920, 1675, 1650sh, 1570, 1460sh, 936, 805sh, 776, 725sh, 715s, 571, 465, 435w.

Se8 Chloromenite $Cu^{2+}_9(SeO_3)_4O_2Cl_6$



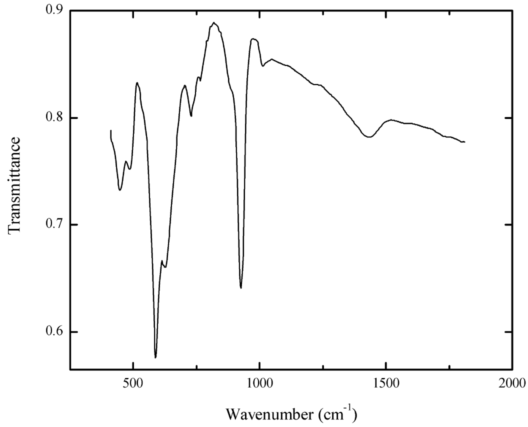
Locality: Great Fissure Tolbachik volcano eruption, Kamchatka peninsula, Russia.
Description: Tobacco-green crystals from the association with melanothallite, sofiite, georgbokiite, ilinskite, chloromenite, burnsite and cotunnite. Investigated by L.P. Vergasova with coauthors.
Wavenumbers (cm^{-1}): 849, 750s, 723, 693s, 610sh, 572, 519.

Mo1 Wulfenite $PbMoO_4$



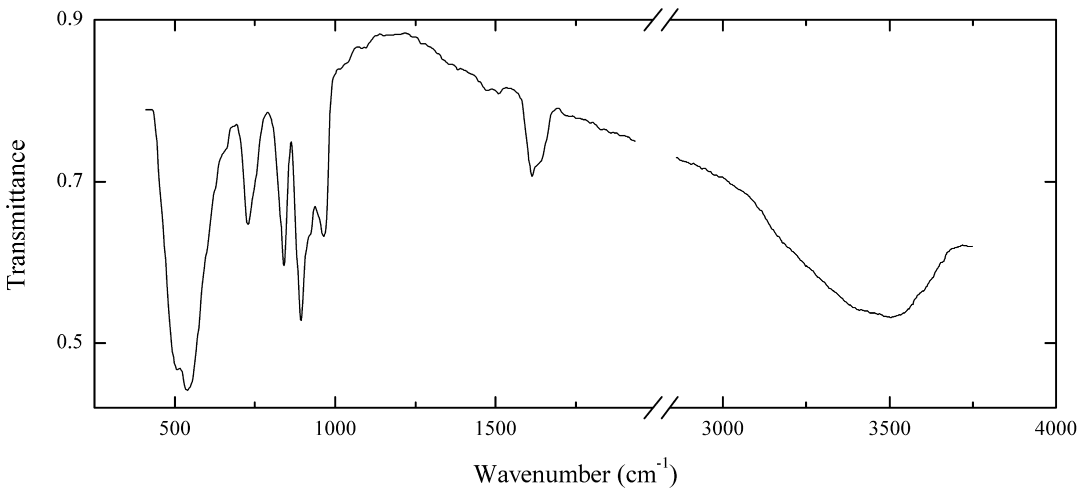
Locality: Mezice mine, Slovenia.
Description: Yellow platy crystals. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 830sh, 778s, 500w.

Mo2 Biehlite $(Sb,As)_2MoO_6$



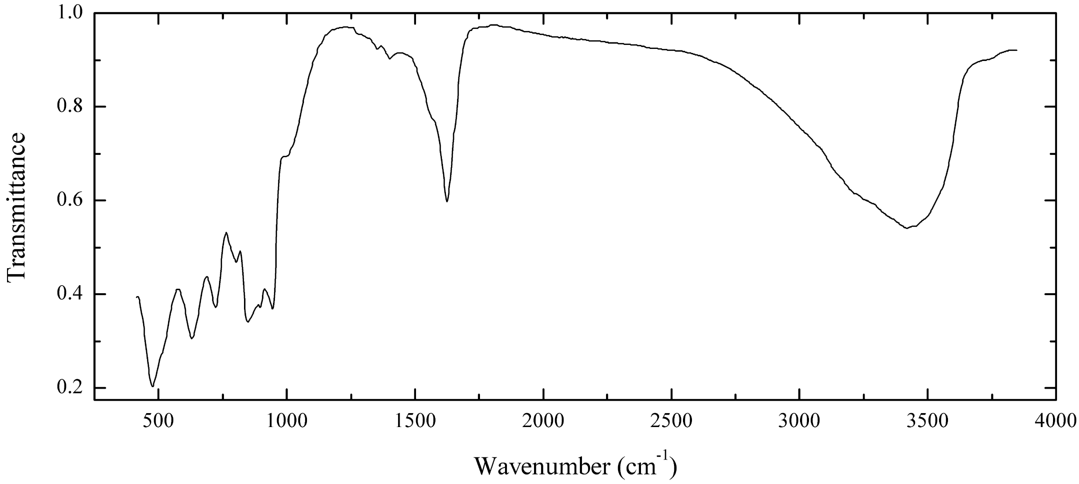
Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).
Description: White fibrous aggregate. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 1435w, 1012w, 924s, 875sh, 850sh, 764w, 727, 623, 587s, 486, 450.

Mo3 Iriginite $(UO_2)(Mo^{6+}{}_2O_7)\cdot 3H_2O$



Locality: Kyzylsai Mo–U deposit, Almaty region, Kazakhstan.
Description: Yellow crystals from the association with umohoite. Identified by IR spectrum, powder X-ray diffraction pattern and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 3500, 3410sh, 3200sh, 1640sh, 1615, 1510w, 1480w, 965, 920sh, 892s, 840, 726, 655sh, 539s, 505s.

Mo4 Calcurmolite $Ca_2(UO_2)_3Mo_2O_{11}\cdot nH_2O$

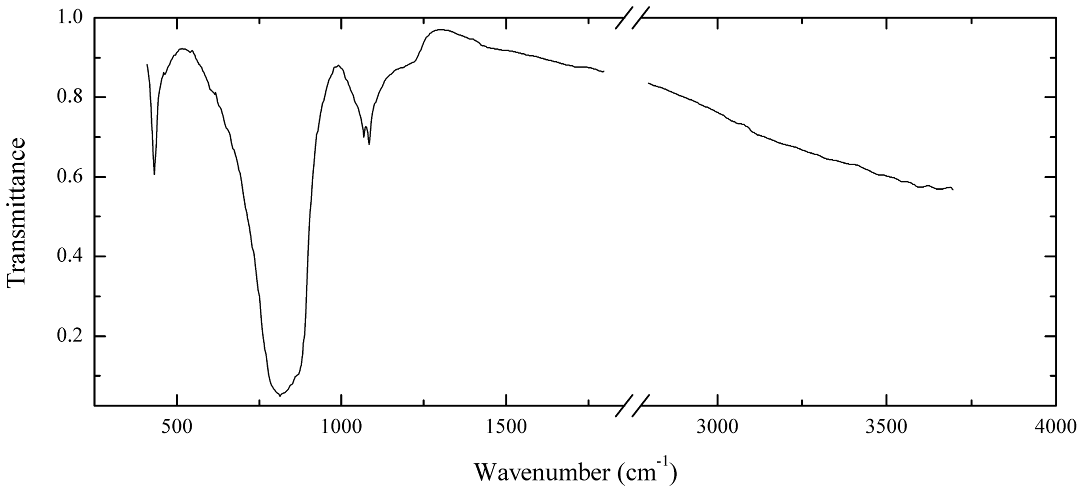


Locality: Kyzylsai Mo–U deposit, Almaty region, Kazakhstan.

Description: Yellow crystals from the association with umohoite. Identified by IR spectrum and powder X-ray diffraction pattern. The empirical formula is (electron microprobe) $H_x(Ca_{1.55}Na_{0.37}K_{0.06}Mg_{0.03})(UO_2)_{3.11}(MoO_4)_{2.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3390s, 3225sh, 1650sh, 1622, 1570sh, 1395w, 1360w, 1000, 944, 900, 846s, 806, 719, 627s, 515sh, 475s.

Mo5 Powellite $CaMoO_4$

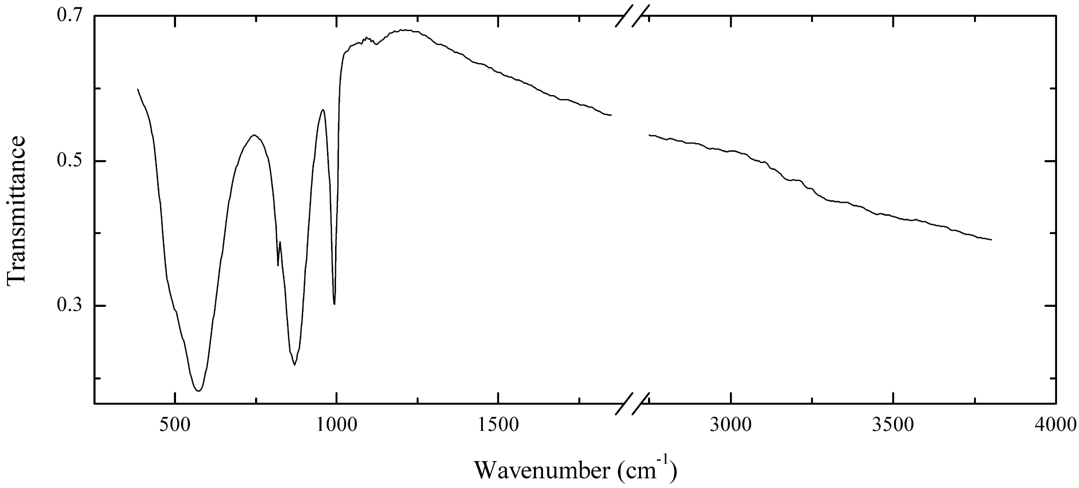


Locality: Ilmeny (Il'menskie) Mts., South Urals, Russia.

Description: Yellow crystals from the association with ferrimolybdite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{1.01}(MoO_4)_{0.98}(SiO_4)_{0.02}$.

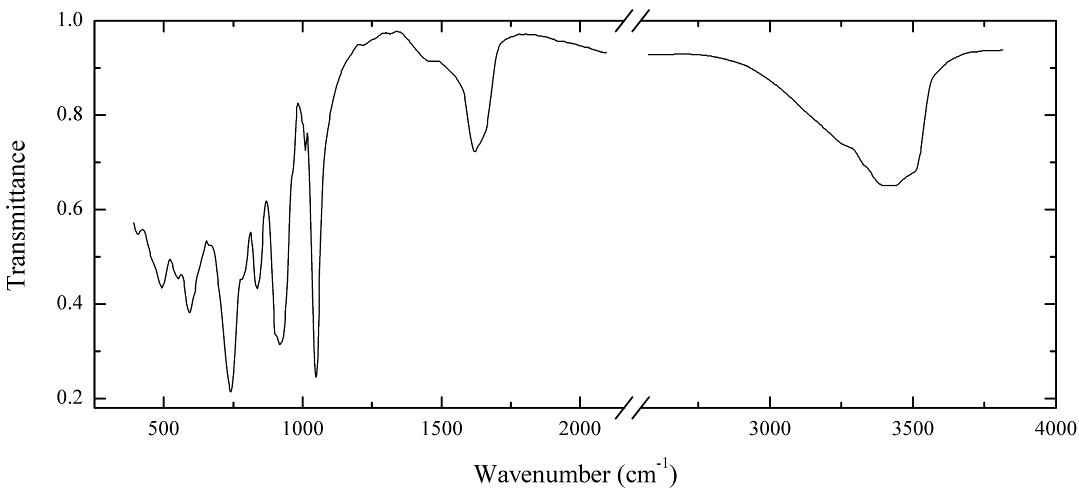
Wavenumbers (cm^{-1}): 1084w, 1068w, 860sh, 812s, 432.

Mo6 Molybdite MoO_3



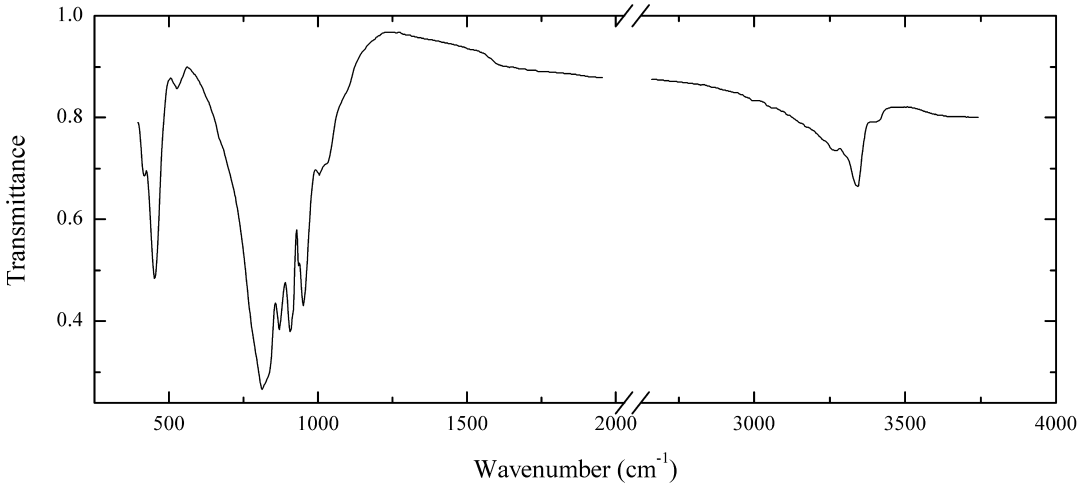
Locality: Burning dump of the Katharina mine, Radvanice, near Trutnov, Bohemia, Czech Republic.
Description: Colourless platy crystals from the association with ilsemannite and godovikovite. Identified by IR spectrum and qualitative electron microprobe analysis.
Wavenumbers (cm^{-1}): 995, 874s, 821, 574s, 520sh, 495sh.

Mo8 Melkovite $CaFe^{3+}H_6(MoO_4)_4(PO_4)\cdot 6H_2O$



Locality: U-Mo occurrence 60 km west of the Mointy railway station, Shunak Mts., near Balkhash lake, Karagandy region, Kazakhstan (type locality).
Description: Yellow powdery aggregate from the association with fluorite, molybdenite, magnetite, powellite, ferrimolybdite, iriginite and jarosite. Holotype sample. Monoclinic, $a = 17.46$, $b = 18.48$, $c = 10.93$ Å, $\beta = 94.5°$. Optically biaxial, $n_{mean} = 1.838$. $D_{meas} = 2.97$ g/cm^3. The empirical formula is (electron microprobe) $H_xCa_{1.3}Na_{0.5}Fe_{1.4}(MoO_4)_{3.9}(PO_4)_{1.0}\cdot nH_2O$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 2.916 (90), 3.537 (80), 8.42 (70), 3.036 (70), 1.789 (70), 1.992 (60), 2.415 (50).
Wavenumbers (cm^{-1}): 3470sh, 3380, 3340sh, 1650sh, 1617, 1460w, 1047s, 1008w, 930sh, 919s, 905sh, 838, 785sh, 740s, 615sh, 595, 550, 495, 403w.

Mo9 Lindgrenite $Cu_3(MoO_4)_2(OH)_2$

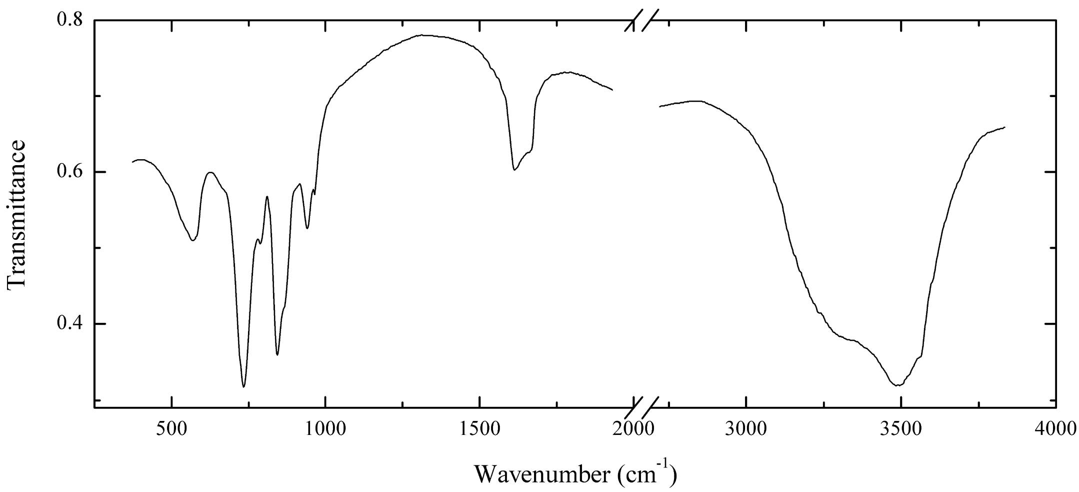


Locality: Childs-Aldwinkle mine, Copper Creek, Copper Creek district, Galiuro Mts., Pinal Co., Arizona, USA.

Description: Green veinlets in rock. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3390w, 3330, 3260w, 1620w, 1032, 1006, 950, 936, 909s, 871s, 835sh, 813s, 530w, 452, 417.

Mo10 Betpakdalite-NaCa $[Na_2(H_2O)_{17}Ca(H_2O)_6][Mo_8As_2Fe^{3+}{}_3O_{34}(OH)_3]$

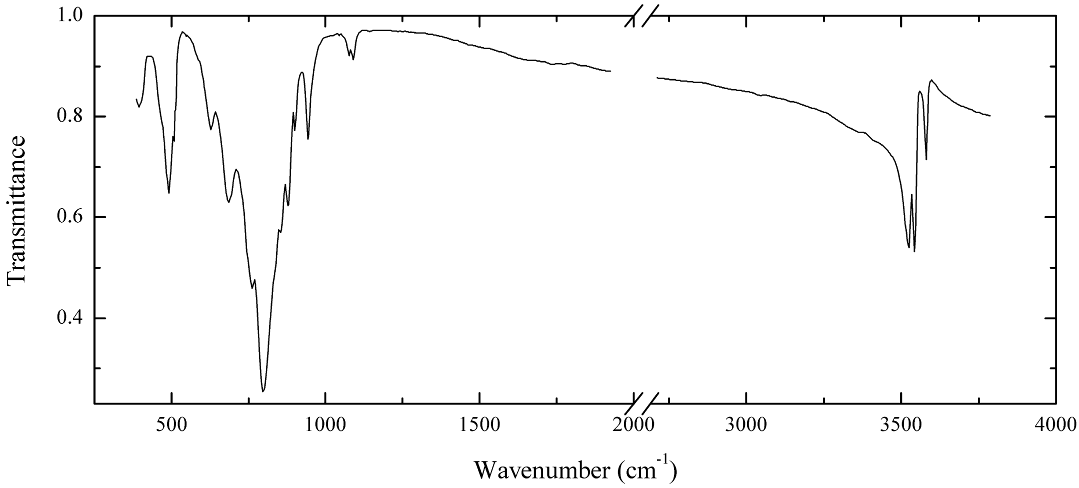


Locality: Kyzylsai Mo–U deposit, Almaty region, Kazakhstan (type locality).

Description: Yellow fine-grained aggregate from the association with umohoite. Confirmed by IR spectrum and semiquantitative electron microprobe analysis.

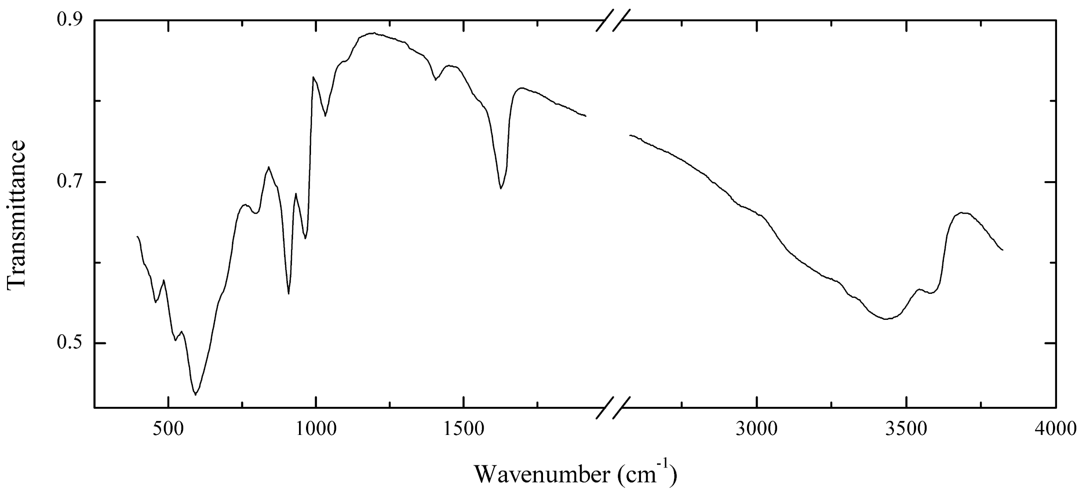
Wavenumbers (cm^{-1}): 3540sh, 3465s, 3320sh, 1660sh, 1615, 965w, 941, 865sh, 843s, 783, 732s, 670sh, 570.

Mo11 Szenicsite $Cu^{2+}_3(MoO_4)(OH)_4$



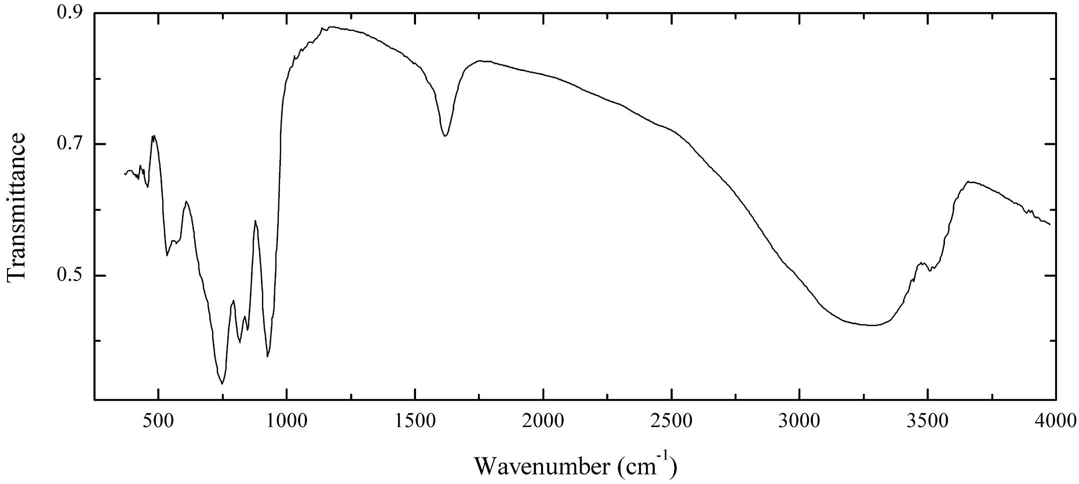
Locality: Jardinera No. 1 mine, Inca del Oro, near Tierra Amarilla, Chile (type locality).
Description: Radial aggregate of dark green-bladed crystals from the association with powellite and chrysocolla. Identified by IR spectrum.
Wavenumbers (cm^{-1}): 3550, 3510, 3490, 1090w, 1072w, 943, 900w, 878, 853, 830sh, 797s, 760s, 683, 625, 502, 487, 400.

Mo12 Umohoite $(UO_2)MoO_4{\cdot}2H_2O$



Locality: Kyzylsai Mo–U deposit, Almaty region, Kazakhstan.
Description: Dark blue massive. Identified by powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3550, 3410, 3300sh, 3220sh, 3130sh, 2950sh, 1627, 1403w, 1105sh, 1033, 964, 906s, 792, 690sh, 593s, 530s, 463s, 420sh.

Mo13 Ferrimolybdite $Fe^{3+}{}_2(MoO_4)_3 \cdot 8H_2O$

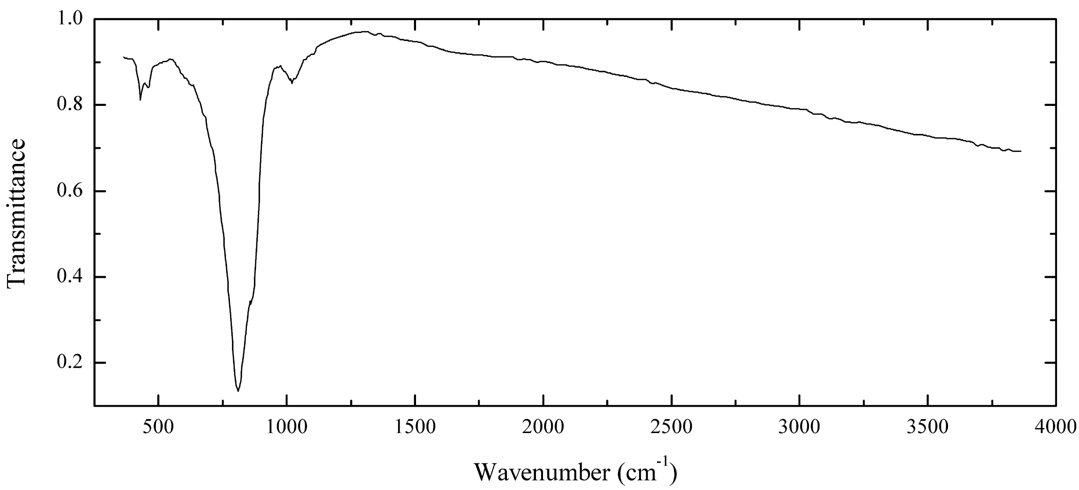


Locality: Tyrnyauz Mo-W deposit, Baksan valley, Kabardino-Balkarian Republic, Northern Caucasus, Russia.

Description: Yellow acicular crystals forming pseudomorph after molybdenite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $H_xFe_{1.92}Mg_{0.03}Al_{0.02}(MoO_4)_{3.00} \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3498, 3270s, 3170sh, 1615, 945sh, 919s, 845, 816s, 741s, 660sh, 575, 533, 453, 414.

Mo14 Powellite $CaMoO_4$

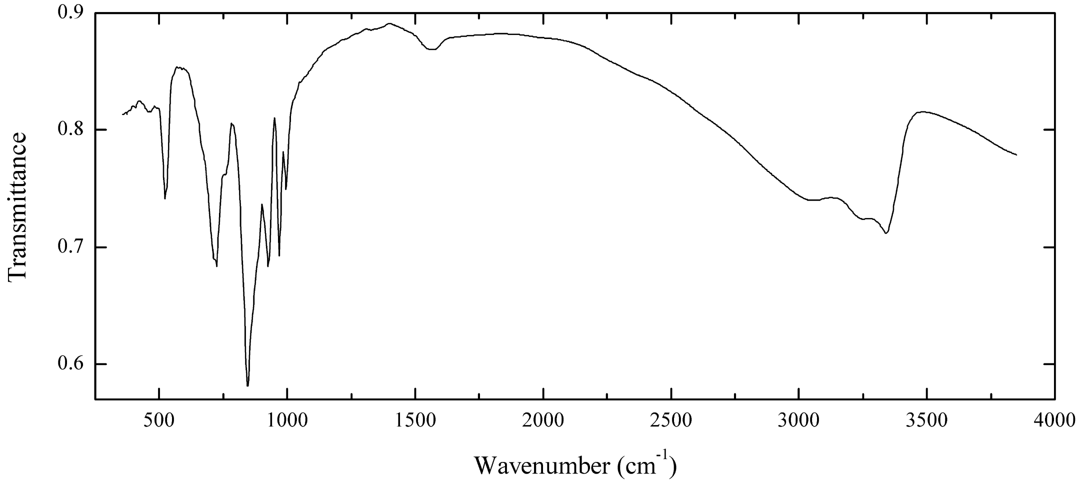


Locality: U deposit Bota-Burum, near Alakol lake, Almaty region, southern Kazakhstan.

Description: Dark brown dipyramidal crystals from the association with chistyakovaite, scorodite, arseniosiderite, mansfieldite, metazeunerite, sodium uranospinite and uramarsite. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{0.97}Pb_{0.02}Mo_{1.00}O_{3.99}$.

Wavenumbers (cm^{-1}): 1023w, 860sh, 809s, 458w, 428w.

Mo15 Bamfordite $Fe^{3+}Mo_2O_6(OH)_3{\cdot}H_2O$

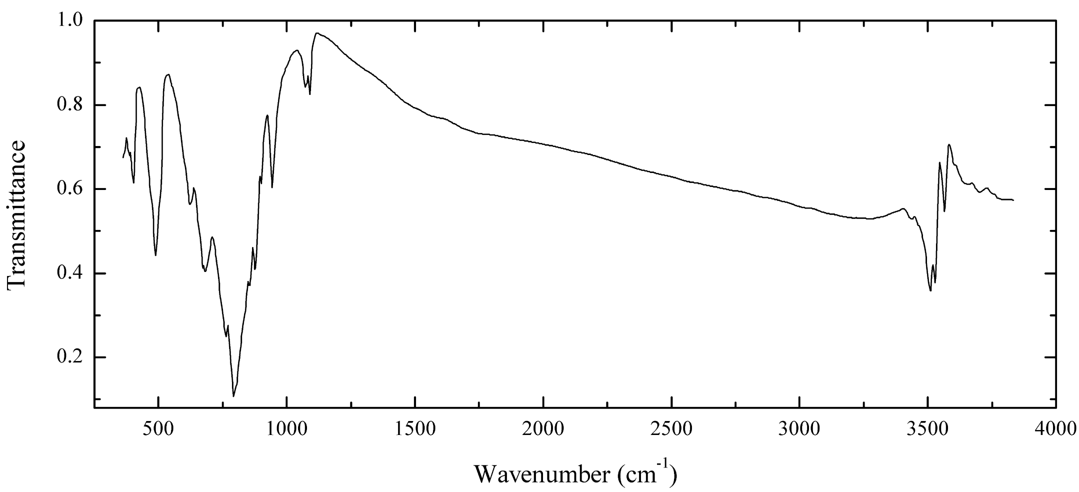


Locality: Bamford Hill, 85 km west-southwest of Cairns, northern Queensland, Australia (type locality).

Description: Yellowish-green crystal from the association with W–Mo–Bi oxides, clay minerals, muscovite and quartz. Holotype sample. Triclinic, space group *P*-1 or *P*1; $a = 5.889(5)$, $b = 7.545(5)$, $c = 9.419(5)$ Å, $\alpha = 71.46(4)°$, $\beta = 83.42(4)°$, $\gamma = 72.78(4)°$. Optically biaxial (−), $\alpha = 1.91(1)$, $\beta = 2.03(1)$, $\gamma = 2.11(1)$. $D_{meas} = 3.620(8)$ g/cm^3, $D_{calc} = 3.616$ g/cm^3. The empirical formula is $Fe_{1.00}(Mo_{2.01}W_{0.03}P_{0.02})O_6(OH)_{3.34}{\cdot}0.64H_2O$. Strong lines of powder X-ray diffraction pattern [d, Å (I, %)] are 3.319 (100), 3.232 (90), 5.620 (70), 4.095 (70), 4.711 (50), 2.614 (50), 1.956 (50).

Wavenumbers (cm^{-1}): 3345, 3220, 3040w, 1565w, 994, 966, 926s, 865sh, 842s, 755sh, 716, 524, 457w.

Mo16 Szenicsite $Cu^{2+}{}_3(MoO_4)(OH)_4$

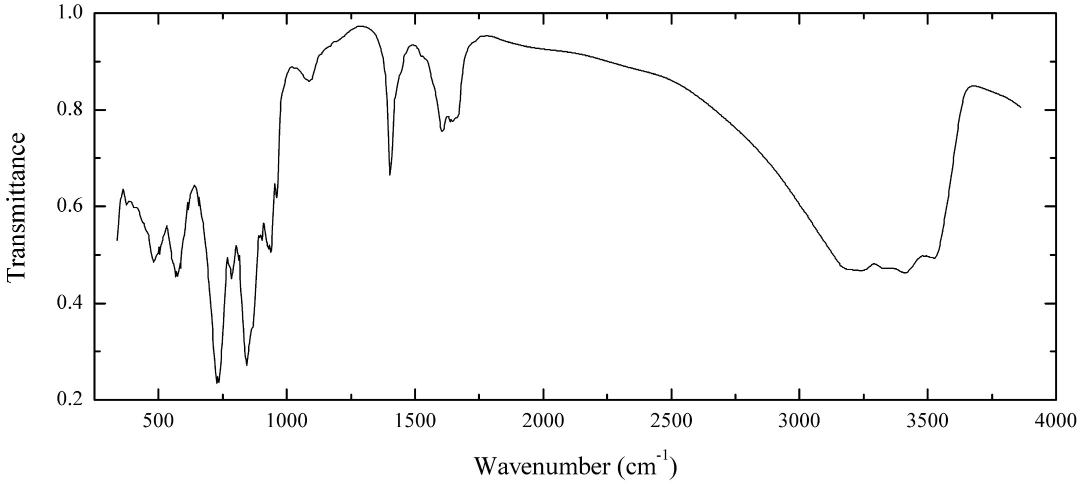


Locality: Jardinera No. 1 mine, Inca del Oro, near Tierra Amarilla, Chile (type locality).

Description: Green crystals from the association with powellite. Identified by IR spectrum.

Wavenumbers (cm^{-1}): 3550, 3515, 3493, 1089w, 1071w, 943, 900w, 877, 854, 830sh, 796s, 761s, 683, 623, 504, 488, 401.

Mo17 Betpakdalite-CaCa $[Ca_2(H_2O)_{17}Ca(H_2O)_6][Mo_8As_2Fe^{3+}{}_3O_{36}(OH)]$

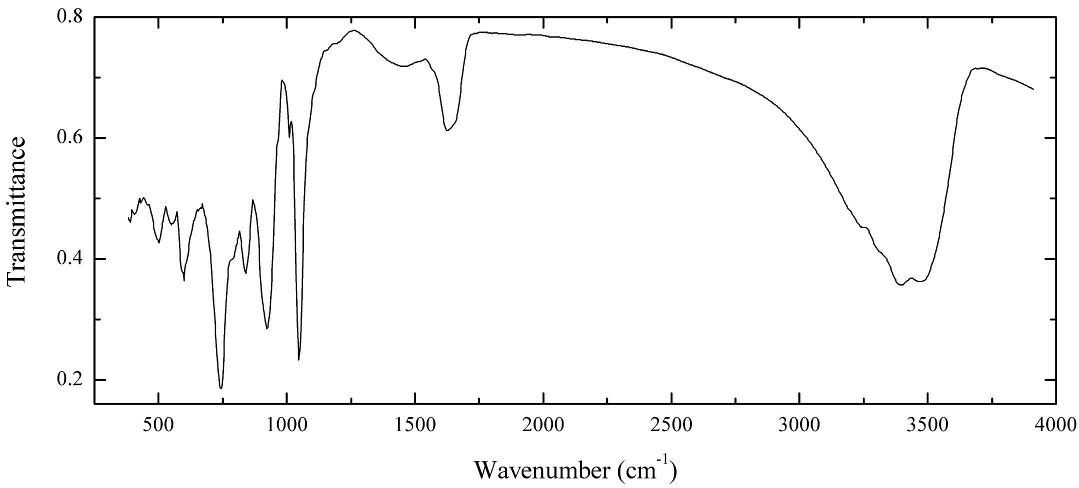


Locality: Kara-Oba W deposit, Betpakdala desert, Karagandy region, Kazakhstan (type locality).

Description: Yellow fine-grained aggregate from the association with ferrimolybdite, kaolinite and quartz. Identified by IR spectrum and semiquantitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3500, 3385, 3300, 3210, 1660sh, 1645, 1605, 1403, 1085w, 965, 940, 900, 832s, 784, 728s, 570, 481.

Mo18 Mendozavilite-CaFe $[Ca_2(H_2O)_{17}Fe(H_2O)_6][Mo_8As_2Fe^{3+}{}_3O_{34}(O,OH)_3]$

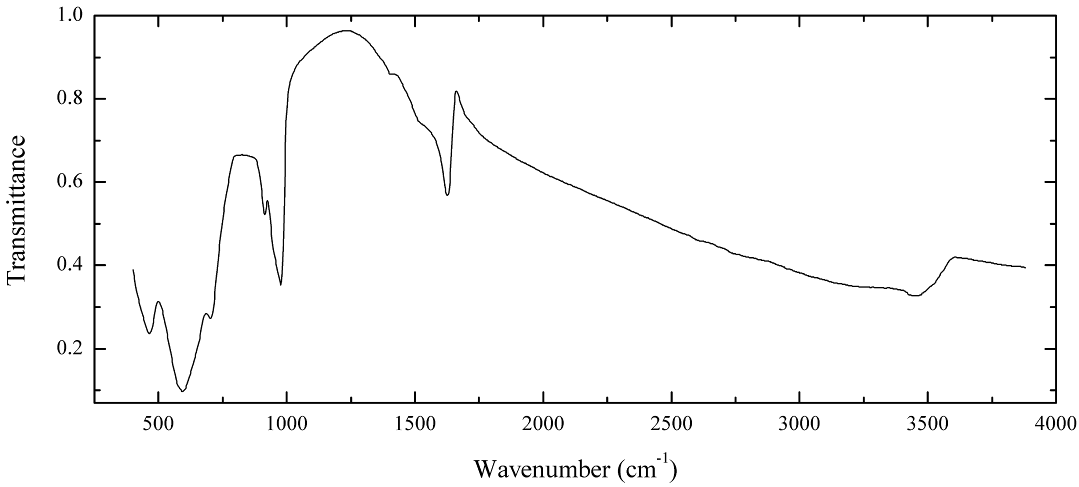


Locality: Rustler mine, Gold Hill district, Deep Creek Mts., Tooele Co., Utah, USA.

Description: Yellow fine-grained aggregate. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $[(Ca_{1.25}Na_{0.75})(H_2O)_{17}Fe_{1.0}(H_2O)_6][Mo_{7.9}P_{1.9}S_{0.2}Fe_{2.5}Ca_{0.3}Mg_{0.2}O_{34}(O,OH)_3]$.

Wavenumbers (cm^{-1}): 3450s, 3380s, 3310sh, 3230sh, 1650sh, 1620, 1455w, 1047s, 1007w, 920s, 905sh, 837, 785sh, 741s, 594, 550w, 497, 405w.

Mo19 Mourite $U^{4+}Mo^{6+}{}_5O_{12}(OH)_{10}$ (?)

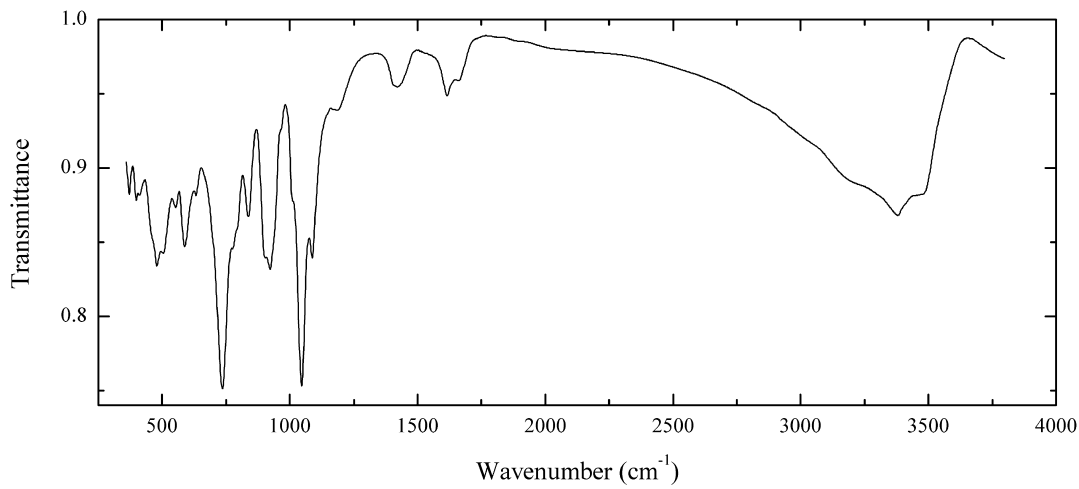


Locality: Kyzylsai Mo–U deposit, Chu-Ili Mountains, southwestern Balkhash territory, Kazakhstan (type locality).

Description: Dark violet-blue spherulitic aggregate from the association with uraninite, molybdenite, jordisite, ilsemannite, pyrite, umohoite, sedovite, iriginite, powellite, sodium uranospinite, uranophane, tyuyamunite, goethite, jarosite and kaolinite. Holotype sample. Monoclinic, space group *Pa* or *P*2/*a*. $a = 24.420$, $b = 7.183$, $c = 9.893$ Å, $\beta = 102.00°$, $Z = 4$. $D_{calc} = 4.22$ g/cm^3. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 12.77 (90), 5.897 (100), 3.285 (70), 3.193 (70), 3.148 (70), 2.871 (80), 1.728 (80). The formula is to be revised: the band at 1,620 cm^{-1} indicates the presence of H_2O molecules.

Wavenumbers (cm^{-1}): 3415, 3250, 1620, 1520sh, 1400w, 975, 960sh, 913, 703s, 588s, 460s.

Mo21 Mendozavilite-KCa $[K_2(H_2O)_{15}Ca(H_2O)_6][Mo_8P_2Fe^{3+}{}_3O_{34}(OH)_3]$

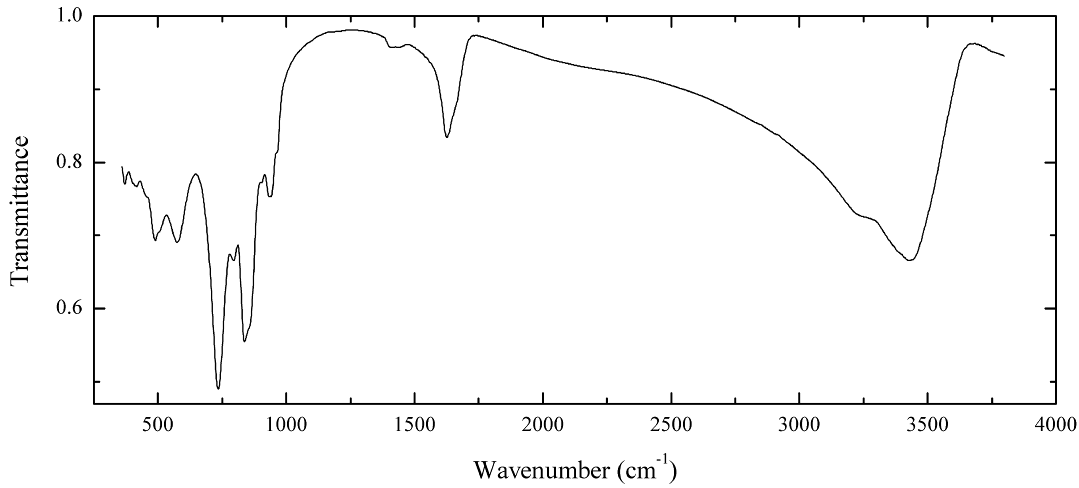


Locality: Chuquicamata mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile (type locality).

Description: Yellow fine-grained aggregate. Identified by IR spectrum and electron microprobe analysis. The empirical formula is $K_{1.5}Na_{1.0}Ca_{1.2}Fe_{4.7}Mo_{8.1}P_{1.9}O_{34}(O,OH,H_2O)_{58}$.

Wavenumbers (cm^{-1}): 3460sh, 3380, 3230sh, 3025sh, 2860sh, 1660w, 1616, 1421, 1184, 1088, 1047s, 1015sh, 923, 905sh, 837, 790sh, 775sh, 736s, 634w, 588, 553w, 504, 479, 465sh, 412w, 400w, 374w.

Mo22 Betpakdalite-CaMg $[Ca_2(H_2O)_{17}Mg(H_2O)_6][Mo_8As_2Fe^{3+}{}_3O_{36}(OH)]$

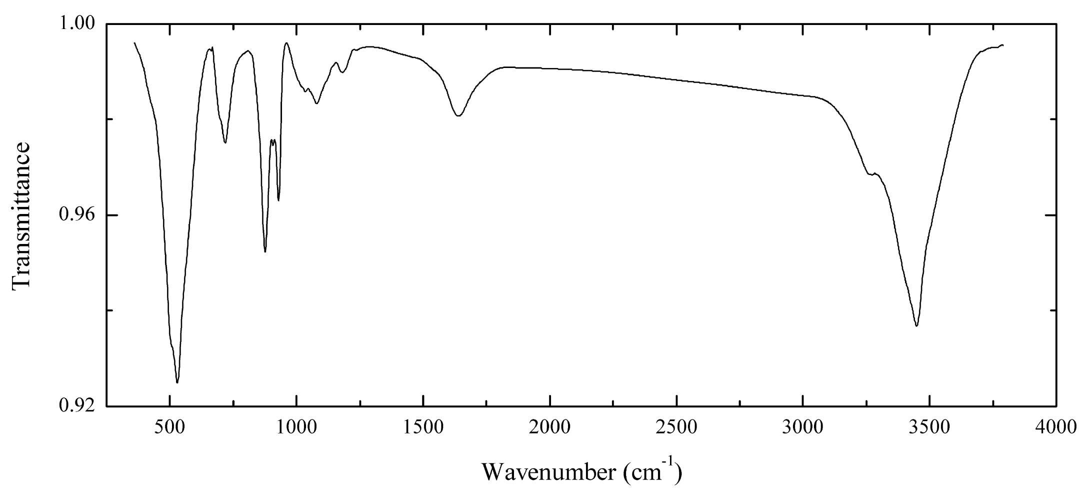


Locality: Tsumeb (Tsumcorp) mine, Tsumeb, Otjikoto (Oshikoto) region, Namibia (type locality).

Description: Yellow fine-grained aggregate. Confirmed by IR spectrum and electron microprobe analysis. The empirical formula is $Ca_{1.9}Na_{0.2}Mg_{0.9}Fe_{3.4}Mo_{7.5}As_{2.0}S_{0.2}W_{0.2}P_{0.1}O_{36}(OH)\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3426, 3250sh, 1655sh, 1625, 1440w, 1412w, 960sh, 934, 905sh, 855sh, 837s, 795, 735s, 575, 505sh, 489, 460sh, 418, 374.

Mo23 Sardignaite $BiMo_2O_7(OH)\cdot 2H_2O$

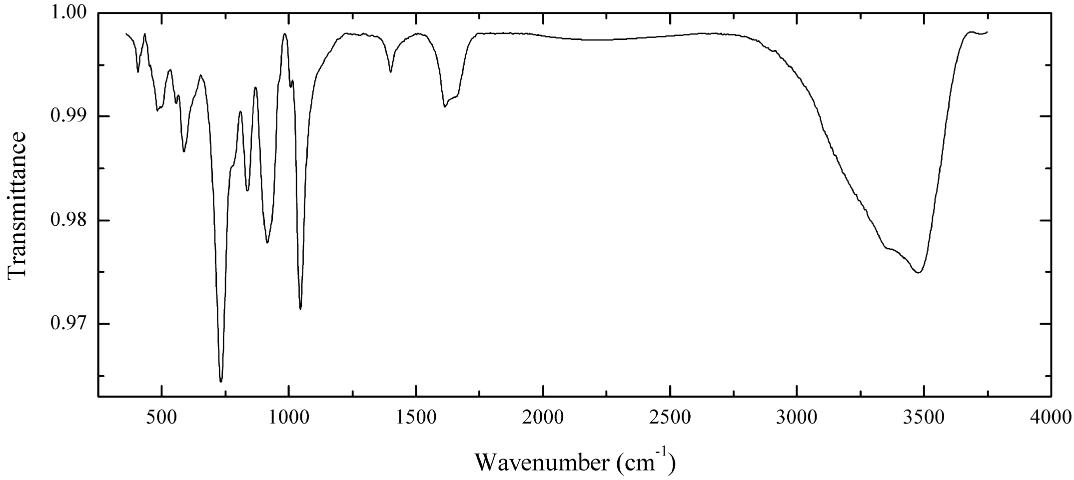


Locality: Su Seinargiu, Sarroch, Cagliari province, Sardinia, Italy (type locality).

Description: Light greenish-grey crystals from the association with molybdenite and quartz.

Wavenumbers (cm^{-1}): 3448s, 3268, 1636, 1182, 1079, 1036, 930, 907, 876s, 718, 700sh, 529s, 510sh.

Mo24 Mendozavilite-NaCu $[Na_2(H_2O)_{15}Cu(H_2O)_6][Mo_8P_2Fe^{3+}{}_3O_{34}(OH)_3]$

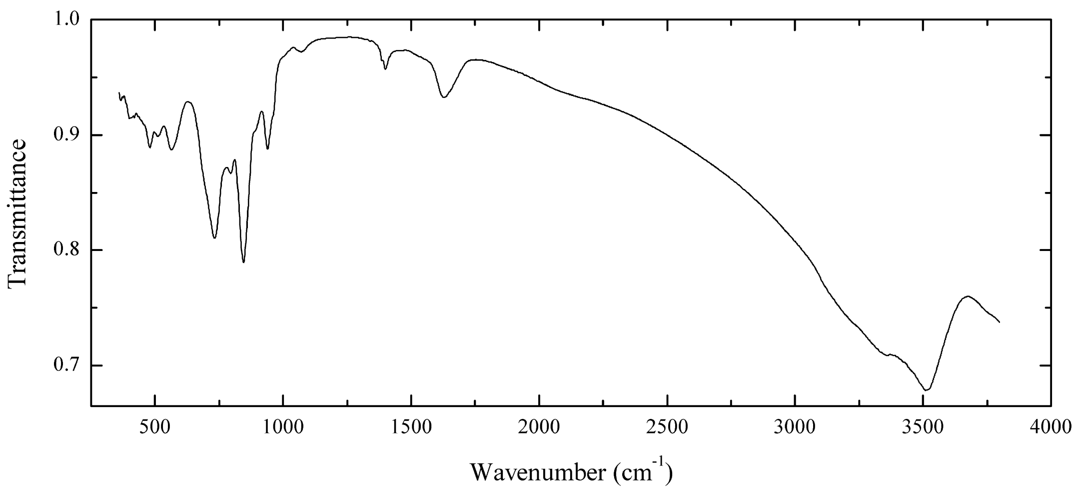


Locality: Chuquicamata mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile.

Description: Green granular aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.

Wavenumbers (cm^{-1}): 3475s, 3425sh, 3355sh, 3250sh, 1655sh, 1614, 1401w, 1046s, 1007w, 915, 837, 780sh, 732s, 625sh, 587, 557w, 498, 483, 407w.

Mo25 Obradovicite-NaNa $[Na_2(H_2O)_{16}Na(H_2O)_6][Mo_8As_2Fe^{3+}{}_3O_{33}(OH)_4]$

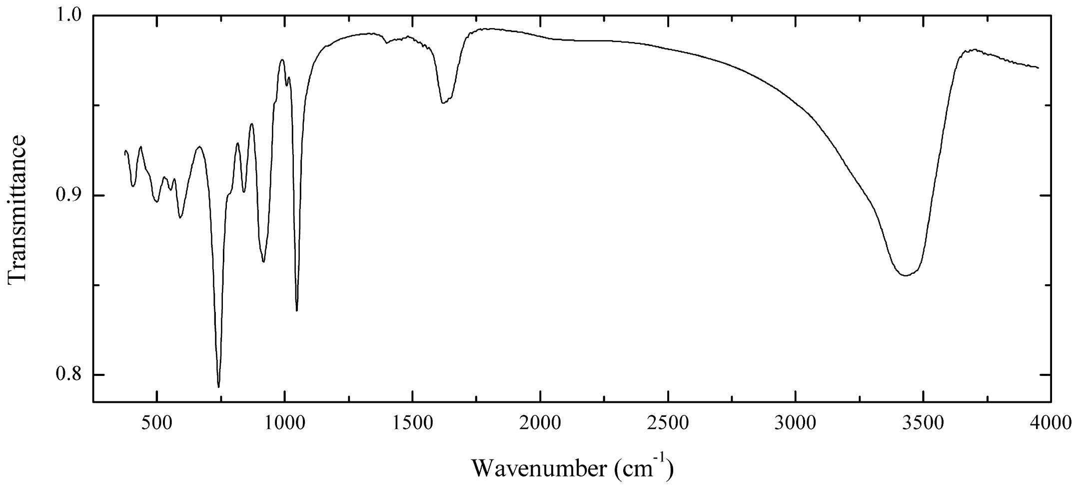


Locality: Chuquicamata mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile (type locality).

Description: Yellow granular aggregate. Confirmed by IR spectrum and qualitative electron microprobe analysis.

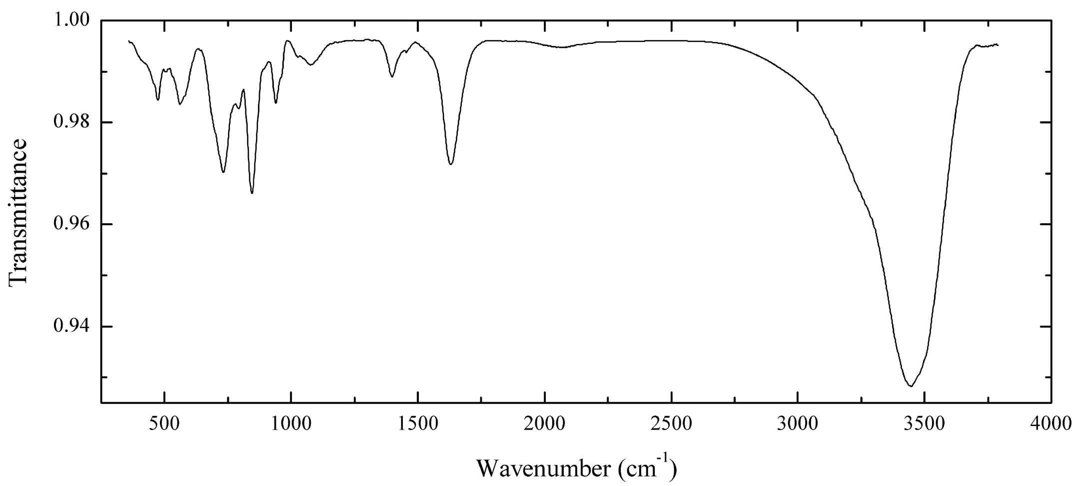
Wavenumbers (cm^{-1}): 3509s, 3346, 3225sh, 1650sh, 1623, 1400, 1075w, 940, 895sh, 846s, 796, 733s, 564, 510, 480, 410w.

Mo27 Mendozavilite-NaFe $[Na_2(H_2O)_{15}Fe^{3+}(H_2O)_6][Mo_8P_2Fe^{3+}{}_3O_{35}(OH)_2]$



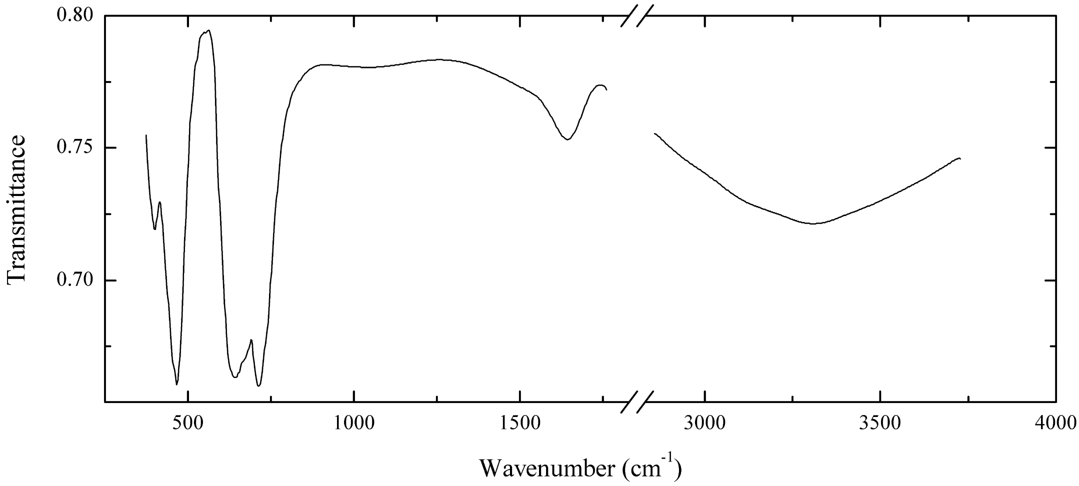
Locality: Rustler mine, Gold Hill district, Deep Creek Mts., Tooele Co., Utah, USA.
Description: Yellow powdery aggregate from the association with quartz and schorl.
Wavenumbers (cm^{-1}): 3431s, 1618, 1399w, 1047s, 1007w, 917s, 840, 770sh, 741s, 591, 554, 500, 407.

Mo28 Obradovicite-NaCu $[Na_2(H_2O)_{17}Cu(H_2O)_6][Mo_8As_2Fe^{3+}{}_3O_{34}(OH)_3]$



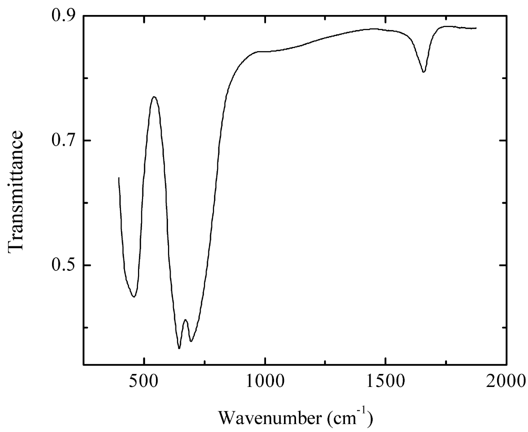
Locality: Chuquicamata mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile (type locality).
Description: Light green granular aggregate. Confirmed electron microprobe analysis and powder X-ray diffraction pattern.
Wavenumbers (cm^{-1}): 3444s, 3260sh, 2079w, 1625, 1400, 1076, 1028w, 960sh, 940, 845, 793, 732, 575sh, 561, 509w, 474.

Te1 Zemannite $Mg_{0.5}Zn^{2+}Fe^{3+}(TeO_3)_3 \cdot 4.5H_2O$



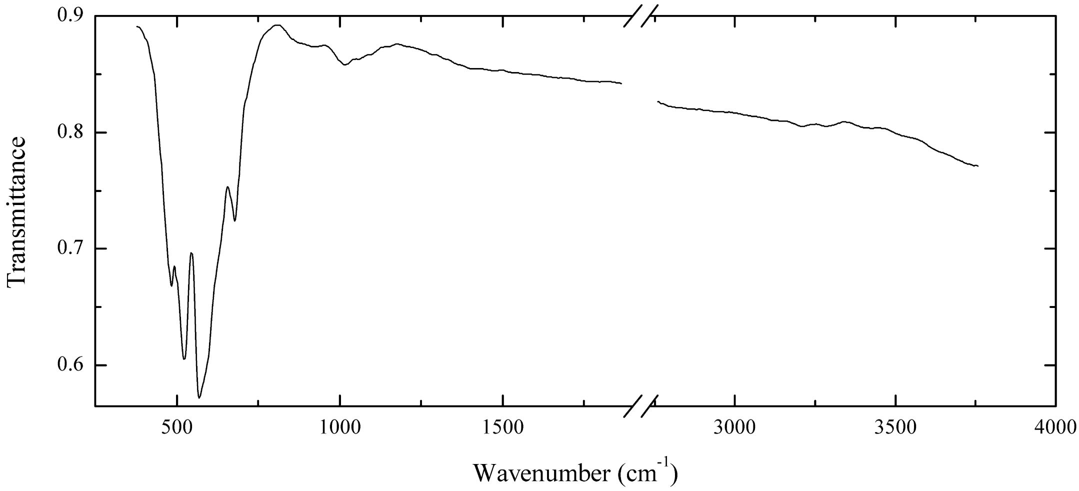
Locality: Moctezuma (La Bambolla) mine, Moctezuma, Sonora, Mexico (type locality).
Description: Light brown crystals from the association with tellurite, dickite and quartz. Mn-bearing variety. The empirical formula is (electron microprobe) $Mg_{0.6}Zn_{0.8}Mn_{0.3}Ca_{0.1}Fe_{0.9}(TeO_3)_3 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 3300, 1640, 730sh, 704s, 690sh, 647, 464s, 410.

Te2 Zemannite $Mg_{0.5}Zn^{2+}Fe^{3+}(TeO_3)_3 \cdot 4.5H_2O$



Locality: Moctezuma (La Bambolla) mine, Moctezuma, Sonora, Mexico (type locality).
Description: Light brown crystals from the association with tellurite, dickite and quartz. The empirical formula is (electron microprobe) $Mg_{0.6}Zn_{1.0}Mn_{0.1}Fe_{0.85}(TeO_3)_3 \cdot nH_2O$.
Wavenumbers (cm^{-1}): 1635, 710sh, 699s, 640s, 460s, 440sh.

Te3 Kuranakhite $PbMn^{4+}Te^{6+}O_6$

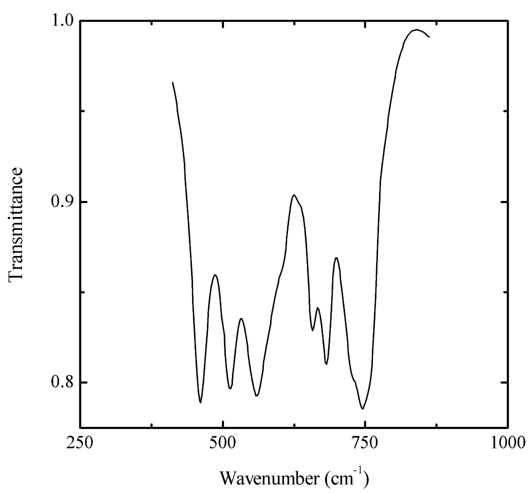


Locality: Kuranakh gold deposit, South Yakutia, Russia (type locality).

Description: Brown grains from the association with quartz, gold and iron oxides. Holotype sample. Orthorhombic, $a = 5.11(1)$, $b = 8.91(1)$, $c = 5.32(1)$ Å. Biaxial, optically neutral, $\alpha = 1.95$, $\beta = 1.98$, $\gamma = 2.01$. $D_{calc} = 2.66$ g/cm^3, $D_{meas} = 2.72(2)$ g/cm^3. The empirical formula is (electron microprobe) $(Pb_{0.92}Ca_{0.08})(Mn_{0.87}Al_{0.11}Fe_{0.05}Mg_{0.02})Te_{1.00}O_6$. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 3.40 (100), 2.558 (60), 2.322 (10), 2.050 (50), 1.851 (50), 1.668 (10), 1.596 (40).

Wavenumbers (cm^{-1}): 1020w, 910w, 682, 630sh, 590sh, 573s, 524s, 482.

Te4 Spiroffite $(Mn^{2+},Zn)_2Te^{4+}{}_3O_8$

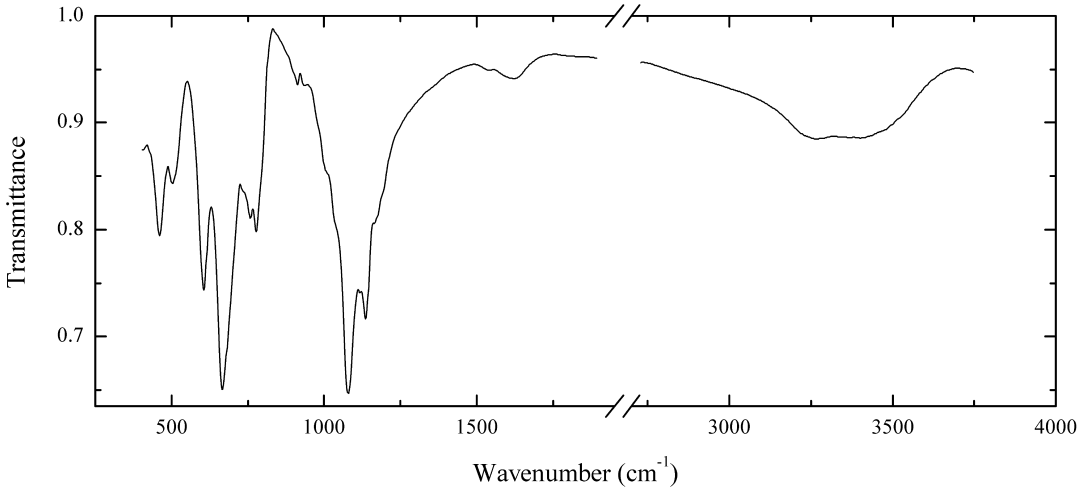


Locality: Moctezuma (La Bambolla) mine, Moctezuma, Sonora, Mexico (type locality).

Description: Pink grains from the association with tellurite, paratellurite and zemannite. The empirical formula is (electron microprobe) $(Mn_{1.79}Zn_{0.16}Fe_{0.02}Mg_{0.02})Te_{3.00}O_8$.

Wavenumbers (cm^{-1}): 760sh, 742s, 724sh, 678s, 653, 595sh, 555s, 507s, 454s.

Te5 Tlapallite $H_6(Ca,Pb)_2(Cu,Zn)_3(SO_4)(Te^{4+}O_3)_4(Te^{6+}O_6)$ (?)

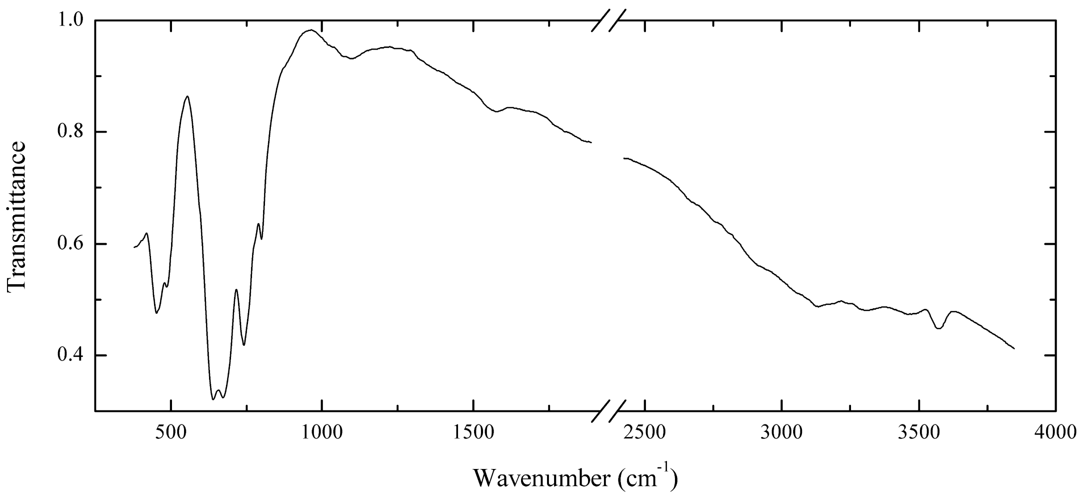


Locality: Moctezuma (La Bambolla) mine, Moctezuma, Sonora, Mexico (type locality).

Description: Green spherulites from the association with calcite, barite, muscovite and quartz. The empirical formula is (electron microprobe) $H_x(Ca_{2.02}Pb_{0.06})(Cu_{2.80}Zn_{0.13})S_{0.93}Te_{5.06}O_y$.The band at 1615cm^{-1} indicates the presence of H_2O molecules.

Wavenumbers (cm^{-1}): 3380, 3235, 1615, 1550w, 1180sh, 1139, 1085s, 1040sh, 1010sh, 920w, 800sh, 779, 756, 669s, 607, 501, 462.

Te6 Emmonsite $Fe^{3+}{}_2Te^{4+}{}_3O_9{\cdot}2H_2O$

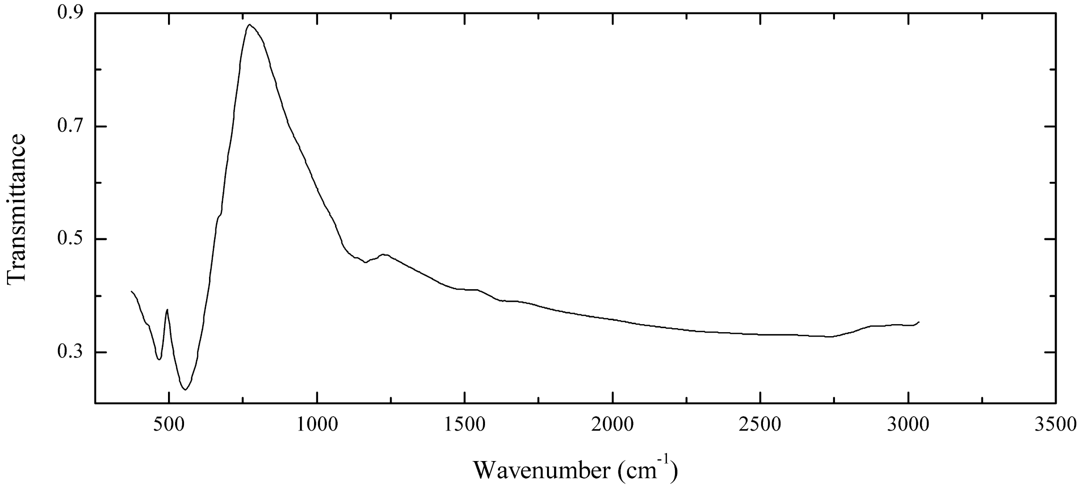


Locality: Moctezuma (La Bambolla) mine, Moctezuma, Sonora, Mexico.

Description: Green crystals from the association with tellurite. The empirical formula is (electron microprobe) $Fe_{1.99}Al_{0.05}Te_{3.00}{\cdot}nH_2O$

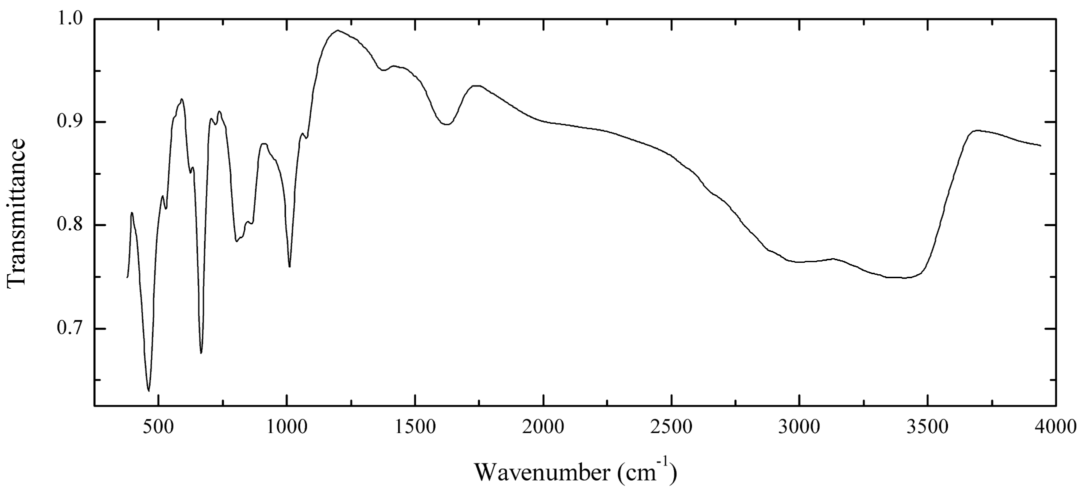
Wavenumbers (cm^{-1}): 3570, 3460, 3300, 3125, 2920sh, 1575w, 1095w, 800, 775sh, 750sh, 737s, 671s, 637s, 482, 452.

Te8 Chekhovichite, disordered variety $Bi_2Te^{4+}{}_4O_{11}$



Locality: Zod mine, Sotk deposit, Vardenis, Geghark'unik' province, Armenia (type locality).
Description: Greyish yellow grains from the association with tellurobismuthite, pyrite, chalcopyrite, emmonsite, tripuhyite, goethite and quartz. Holotype sample. Monoclinic, $a = 18.8963(8)$, $b = 7.9593(3)$, $c = 6.9909(3)$ Å, $\beta = 95.176(3)°$, $Z = 4$. Optically biaxial (+). $D_{calc} = 7.00$ g/cm^3, $D_{meas} = 6.88$ g/cm^3. The empirical formula is $Bi_{1.96}Pb_{0.04}Fe_{0.02}Te_{3.99}O_{10.99}$. Strong lines of the powder X-ray diffraction pattern [d, Å (I, %)] are 3.29 (100), 3.15 (94), 3.14 (100), 2.728 (48), 2.002 (42), 1.998 (45), 1.686 (32).
Wavenumbers (cm^{-1}): 1156w, 558s, 472, 430sh.

Te10 Eurekadumpite $(Cu,Zn)_{16}(TeO_3)_2(AsO_4)_3Cl(OH)_{18}·7H_2O$

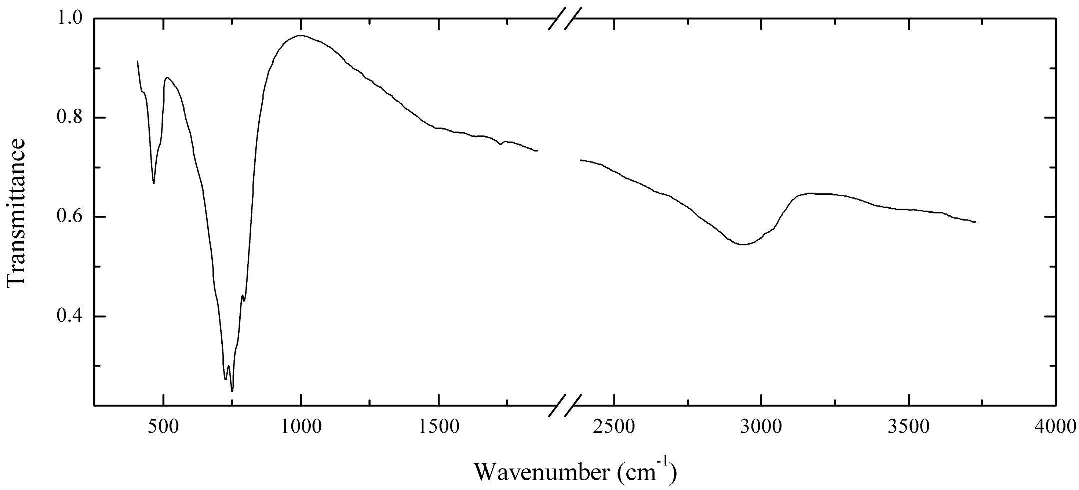


Locality: Centennial Eureka mine, Tintic district, Juab Co., Utah, USA (type locality).
Description: Blue-green spherulites from the association with quartz, mcalpineite, malachite, Zn-bearing olivenite, goethite and Mn oxides. Holotype sample. Monoclinic, space group $P2/m$, $P2$ or Pm, $a = 8.28(3)$, $b = 18.97(2)$, $c = 7.38(2)$ Å, $\beta = 121.3(6)°$, $Z = 1$. Optically biaxial (–), $\alpha = 1.69(1)$, $\beta = \gamma = 1.775(5)$, $2V_{meas} = 10(5)°$. $D_{calc} = 3.826$ g/cm^3, $D_{meas} = 3.76(2)$ g/cm^3.

The empirical formula is $(Cu_{10.32}Zn_{5.85}Fe_{0.01})(TeO_3)_2(AsO_4)_{2.97}[Cl_{0.93}(OH)_{0.07}](OH)_{18.45}\cdot 7.29$ H_2O. Strong lines of the powder X-ray diffraction pattern [*d*, Å (*I*, %)] are 18.92 (100) (010), 9.45 (19) (020) 4.111 (13) (-201) 3.777 (24) (050, -221, 041), 2.692(15) (-311, 151, -302), 2.524 (41) (170, -252, -171), 1.558 (22) (-482, -3.10.1, 024).

Wavenumbers (cm^{-1}): 3400, 2990, 1980w, 1628, 1373w, 1077, 1010s, 860, 825, 803, 721w, 668s, 622, 528, 461s.

I1 Bellingerite $Cu^{2+}{}_3(IO_3)_6\cdot 2H_2O$

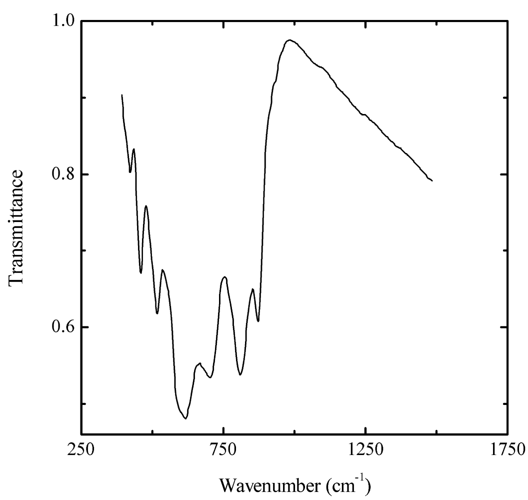


Locality: Chuquicamata mine, Chuquicamata district, Calama, El Loa province, Antofagasta region, Chile (type locality).

Description: Green crystals from the association with gypsum. The empirical formula is (electron microprobe) $H_{0.1}Cu_{2.95}(IO_3)_{6.00}\cdot nH_2O$.

Wavenumbers (cm^{-1}): 3000sh, 2920, 1720w, 1630w, 1500w, 794, 765sh, 749s, 725s, 690sh, 489, 468, 424w.

W1 Hübnerite $Mn^{2+}WO_4$

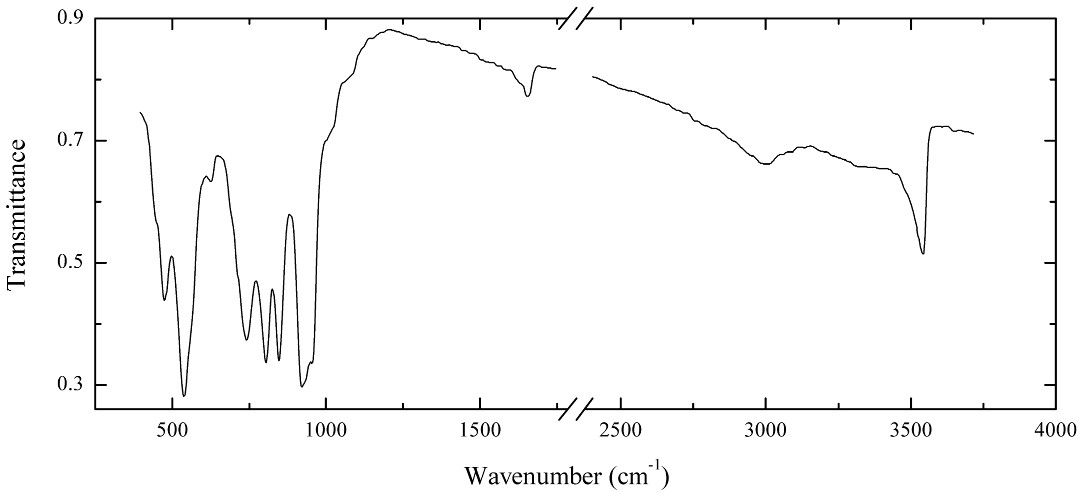


Locality: Pasto Bueno district, Pallasca province, Ancash department, Peru.

Description: Brown crystal from the association with quartz. Fe-free variety. The empirical formula is (electron microprobe) $Mn_{1.00}WO_4$.

Wavenumbers (cm^{-1}): 872, 812, 704s, 615s, 517, 458, 422.

W2 Yttrotungstite-(Y) $(Y,\mathit{REE},Ca)W_2O_6(OH,O)_3$

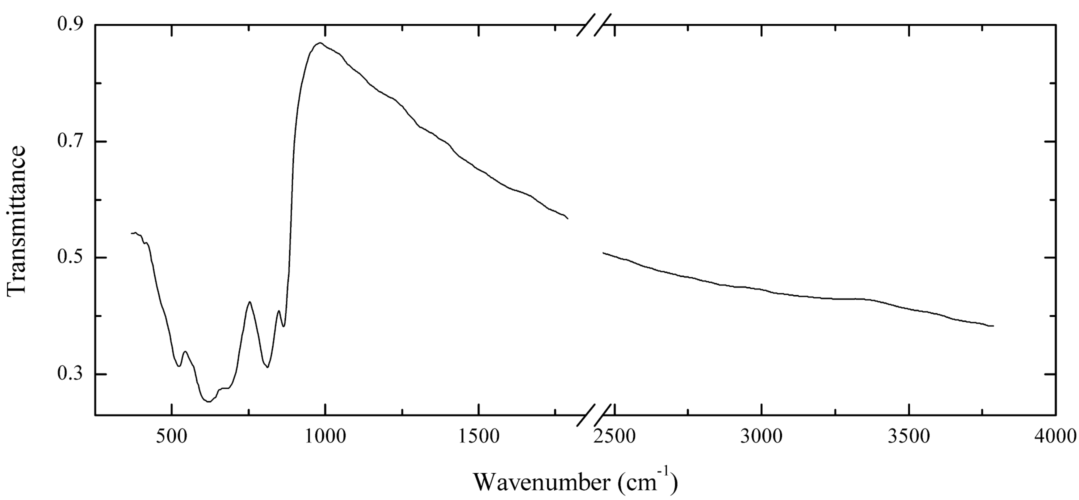


Locality: Kramat Pulai mine, Pulai, Kinta district, Perak, Malaysia (type locality).

Description: Yellow granular aggregate from the association with kaolinite, quartz, muscovite, cassiterite, scheelite and gypsum. The empirical formula is (electron microprobe) $(Y_{0.59}Ce_{0.09}Nd_{0.06}Ca_{0.05}Na_{0.05}Yb_{0.04}La_{0.03}K_{0.02}Mg_{0.02})(W_{1.97}Ti_{0.03})(O,OH)_9 \cdot nH_2O$.

Wavenumbers (cm^{-1}): 3535, 3350w, 2975, 1652, 1080sh, 1020sh, 953s, 930sh, 918s, 845s, 804s, 741, 623, 565sh, 538s, 478, 450sh.

W3 Ferberite $Fe^{2+}WO_4$

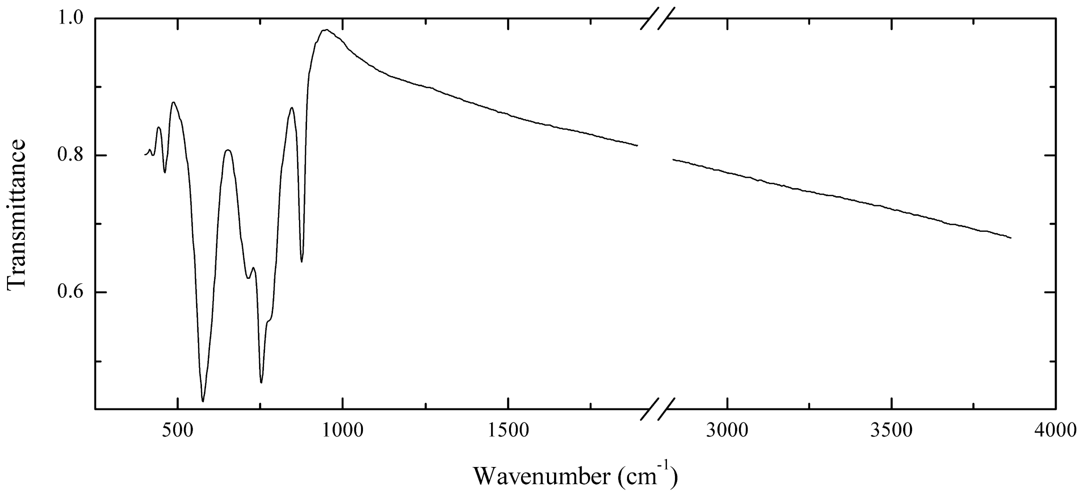


Locality: Tazna (Tasna) mine, Cerro Tazna, Atocha-Quechisla district, Potosí department, Bolivia.

Description: Black twin. The empirical formula is (electron microprobe) $(Fe_{0.89}Mn_{0.08}Mg_{0.02})WO_4$.

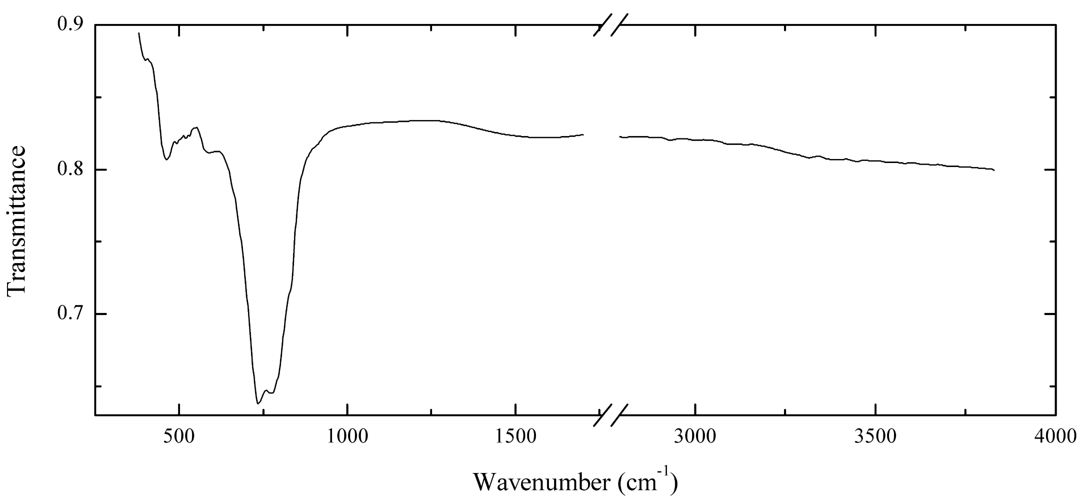
Wavenumbers (cm^{-1}): 866, 811, 685s, 620s, 521, 470sh, 415w.

W4 Raspite $Pb(WO_4)$



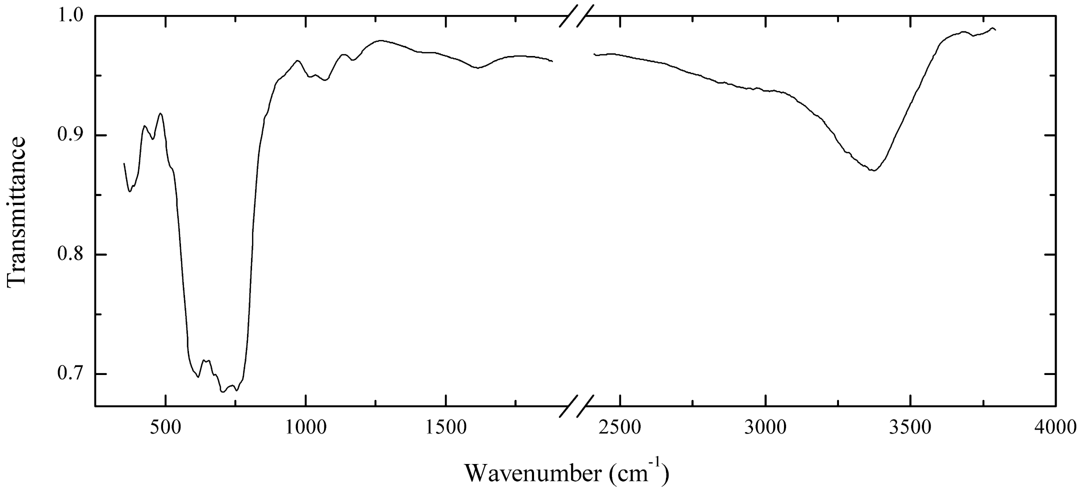
Locality: Proprietary mine, Broken Hill, New South Wales, Australia (type locality).
Description: Yellow crystals from the association with stolzite and hydrokenoelsmoreite ("ferritungstite").
Wavenumbers (cm^{-1}): 874, 775sh, 750s, 713, 590sh, 573s, 460, 430w.

W5 Russellite Bi_2WO_6



Locality: Kara-Oba W deposit, Betpakdala desert, Karagandy region, Kazakhstan.
Description: Yellow powdery from the association with scheelite and quartz. Investigated by P.M. Kartashov.
Wavenumbers (cm^{-1}): 830sh, 777s, 735s, 605w, 455, 405w.

W6 Plumboelsmoreite ("Jixianite") (Pb,H_2O,□)(W,Fe^{3+})$_2$(O,OH)$_7$

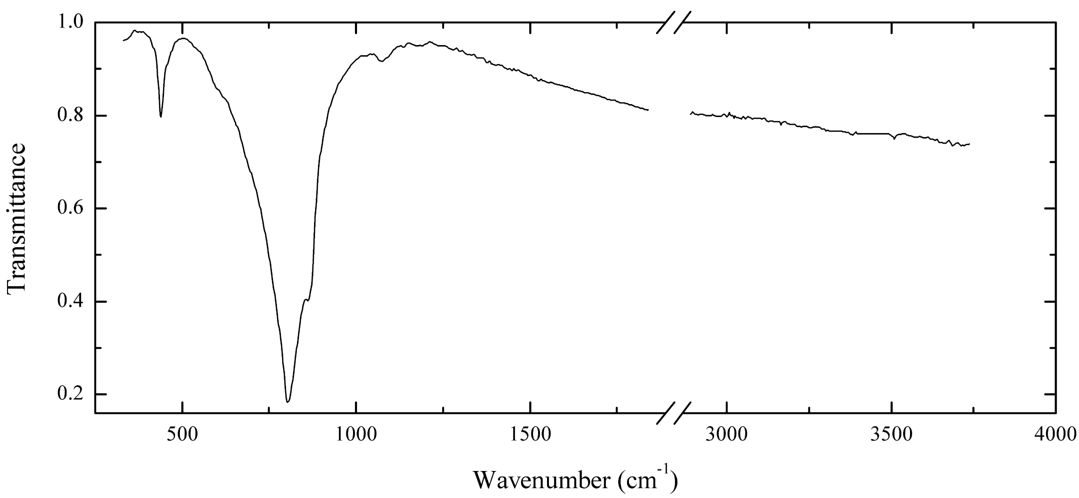


Locality: Kara-Oba W deposit, Betpakdala desert, Karagandy region, Kazakhstan.

Description: Yellow-brown pseudomorph after wolframite. The empirical formula is (electron microprobe) [$Pb_{0.47}K_{0.02}Ca_{0.01}(H_2O,□)_{0.50}$]($W_{1.42}Fe_{0.58}$)(O,OH)$_7$. Confirmed by powder X-ray diffraction pattern.

Wavenumbers (cm^{-1}): 3360, 1610, 1175w, 1075w, 1015w, 865sh, 760s, 716s, 610s, 520sh, 460w, 500.

W7 Scheelite Ca(WO_4)

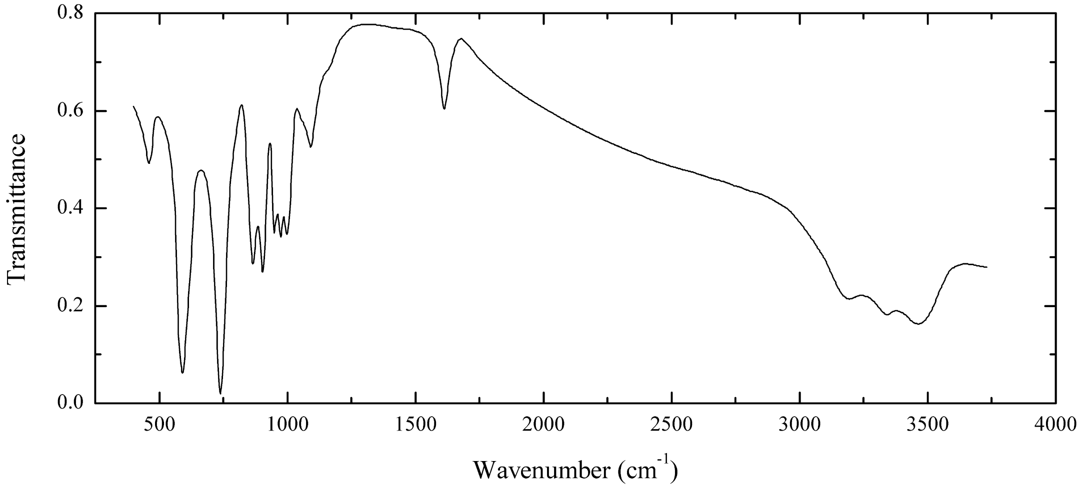


Locality: Kara-Oba W deposit, Betpakdala desert, Karagandy region, Kazakhstan.

Description: Orange coarse-grained aggregate from the association with tungstite and quartz. Confirmed by IR spectrum.

Wavenumbers (cm^{-1}): 1074w, 860, 805s, 441.

W8 Rankachite $Ca_x(V^{4+},V^{5+})(W^{6+},Fe^{3+})_2O_8(OH){\cdot}nH_2O$ ($x \approx 0.5$, $n \approx 2$)

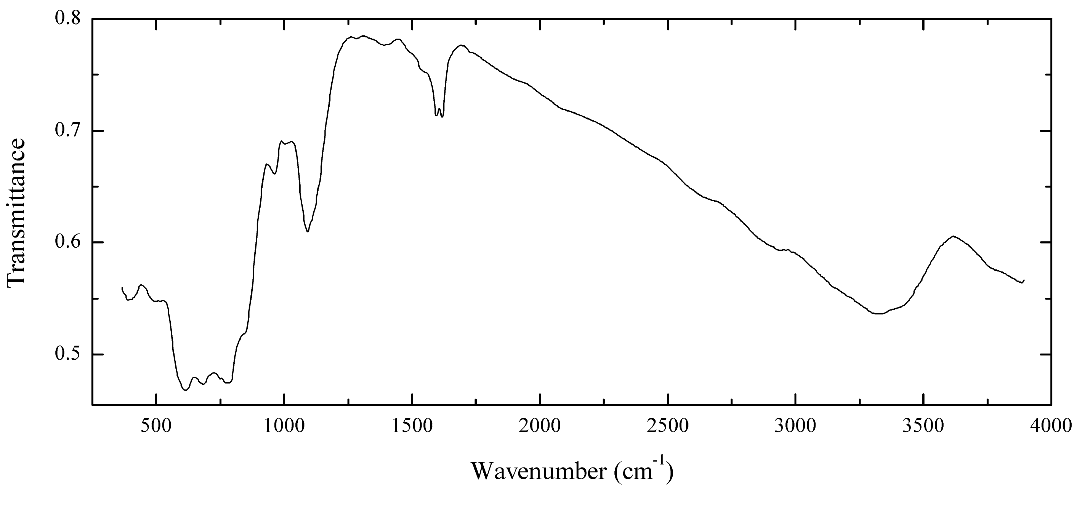


Locality: Clara mine, near Oberwolfach, Schwarzwald (Black Forest) Mts., Baden-Württemberg, Germany (type locality).

Description: Aggregate of brown crystals from the association with scheelite and quartz. The bands at 463 and 1,088 cm^{-1} correspond to the admixture of quartz.

Wavenumbers (cm^{-1}): 3483, 3359, 3203, 1620, 1088, 1001, 975, 947, 906, 864, 738s, 592s, 463.

W9 Hydrokenoelsmoreite $\square_2W_2O_6(H_2O)$

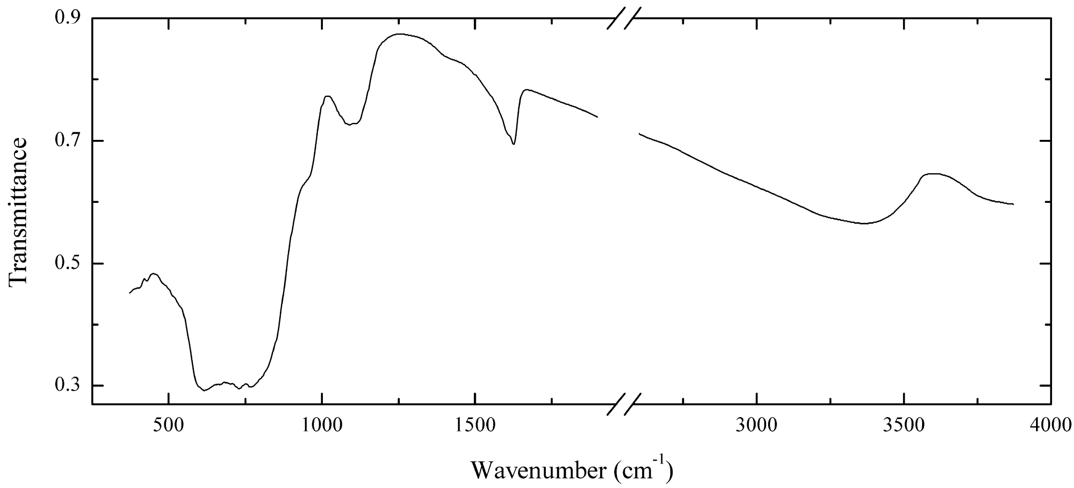


Locality: Kirwa mine, Kigezi district, Uganda.

Description: White spherulites on wolframite. Al-rich variety ("alumotungstite"). The empirical formula is (electron microprobe) $(Ca_{0.04}Y_{0.01})(W_{1.37}Al_{0.50}Fe_{0.13})(O,OH)_6{\cdot}nH_2O$.

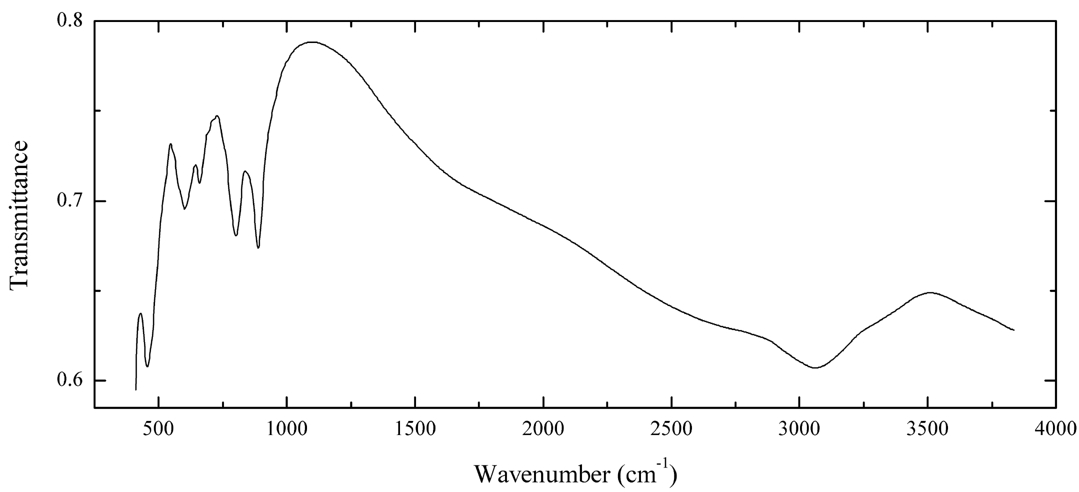
Wavenumbers (cm^{-1}): 3325, 2910w, 2640sh, 1625, 1600, 1400w, 1095, 960w, 840sh, 787s, 686s, 615s, 500, 395.

W10 Hydrokenoelsmoreite $\square_2W_2O_6(H_2O)$



Locality: Lutsiro, Sebeya river, Kabaya district, Rwanda.
Description: Yellow massive. Pseudomorph after wolframite. Fe^{3+}-rich variety ("ferritungstite"). The empirical formula is (electron microprobe) $(K_{0.20}Ca_{0.05}Na_{0.05})(W_{1.37}Fe_{0.42}Al_{0.21})(O,OH)_6{\cdot}nH_2O$.
Wavenumbers (cm^{-1}): 3345, 2430w, 1627, 1610sh, 1092, 950sh, 770s, 728s, 615s.

W11 Pittongite $(Na,H_2O)_x(W,Fe)(O,OH)_3$ ($x \approx 0.7$)



Locality: Pittong W deposit, near Ballarat, Victoria, Australia (type locality).
Description: Brown pseudomorph after wolframite from the association with quartz and muscovite.
Wavenumbers (cm^{-1}): 3050, 888, 796, 657, 697, 453s.

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