NEW MINERALS

ABRAMOVITE*


The new species abramovite was found in open cavities and fractures in fumarolic crusted of the Kupol fumarole field, atop the andesite dome of the Kudryavy stratovolcano, on the northernmost part of Iturup Isle in the southern Kurile Islands. The mineral, a product of high-temperature (600–620 °C) volcanic gases, forms crystals to 0.2 x 1 mm as encrustations on anhydrite and chaotic intergrowths with halite, sylvite, and wurtzite, and is commonly coated with a fine encrustation of galena framboids. It is silvery black, metallic luster, black streak, perfect {100} cleavage; fracture, hardness, and density were not measured. In reflected light, it is white with yellowish gray tones, weak birefringence; reflectance data are (λ = 589.3 nm, Rmin = 89.1%, Rmax = 91.5%); space group P12121 (a = 5.72, b = 5.64, c = 22.42 Å) layers. The mineral would seem to be related to the cylindrite–lévyclaudite–franckeite group, and by analogy to honor Russian mineralogist Dmitry Vadimovich Abramov (1963–) of the Fersman Museum. Type material is deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 3436/1). T.S.E.

AQUALITE*


Aqualite is a new member of the eudialyte group; it occurs in an alkaline pegmatite in the Inagli massif, about 30 km ESE of Aldan in the Sakha Republic (former Yakutsk), Russia. The pegmatite lies in dunites of the peripheral part of the central stock of the massif. The mineral occurs as idiomorphic crystals to 3 cm in diameter in nests of natrolite, associated with microcline, aegirine, batiste, innelite, Lorenzenite, thorite, and galena. It is pink with a glassy luster, no cleavage, conchoidal fracture, white streak, H = 4–5, brittle. Dmax = 2.58(2), Dcalc = 2.66 g/cm³. In thin section, it is uniaxial (+) and pleochroic: ω = 1.569(1) (colorless to pink), ε = 1.571(1) (pink). Nonfluorescent in short-wave UV, but fluoresces pale yellow in long-wave UV. Unlike eudialyte, it decomposes readily in 50% HCl and HNO3 at room temperature.

X-ray powder diffraction (Ni-filtered Cu radiation) gives a = 14.128(2), c = 31.514(8) Å, somewhat different from the values of a = 14.078(3), c = 31.241(1) Å from single-crystal studies, which the authors attribute to grain heterogeneity. Space group R3. The strongest maxima in the powder XRD pattern are [d Å (I%, hkl)]: 4.39(100,205), 2.850(79,404), 10.50(44,003), 6.63(43,104), 7.06(42,110), 3.624(41,027), and 2.329(15,214), and 2.186 (18,125).

Chemical composition by electron microprobe is: Sr 20.66, Se 0.98, Cu 0.01, Cd 0.03, In 11.40, Sn 12.11, Pb 37.11, Bi 17.30, total 99.60 wt%, giving the formula Pb1.02Sn1.02Bi1.02Se1.02 with a basis of 12 atoms, or ideally PbSnInBiSe3. Z undefined. It has no known synthetic analogs. The mineral is named to honor Russian mineralogist Dmitry Vadimovich Abramov (1963–) of the Fersman Museum. Type material is deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 3436/1). T.S.E.

New Mineral Names*

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and strongly hydrogen-bonded OH groups. Upon heating to 140 °C, the c cell parameter shrinks to 18.77(1) Å, (OH) is retained and only interlayer H2O is lost (weight loss of 4.3%). The empirical formula per 22(O, OH) = Ca2.86Cu0.13Al1.25Mg0.19Fe0.17, CaO 17.48, FeO 0.12, CuO 16.28, Al2O3 2.292(20, 404).

Discussion: The paper frequently uses the term “H-eudialyte.” This is not an IMA-accepted name, and contrary to the name, it is unlikely. The strongest maxima in the powder XRD pattern are [Asn.40, 51, 16, 42, 12, 0.12, 20, 0.06] (OH)2 2.05H2O, which implies the ideal formula Ca6Cu2Al3(AsO4)3(OH)2 2H2O. The name of the mineral is for the place of its occurrence. Type material is deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 3435/1). T.S.E.

AVDONINITE


The new mineral avdoninite occurs among oxidation products of exhalative sediments of the Yadovitaya (“Poisonous”) fumarole of the Second Cinder Cone at the Northern Breach of the Tolbachik Large Fissure Eruption, Tolbachik Volcano, Kamchatka Region, Russia. The mineral comprises part of cavity-lining crusts to several millimeters in thickness that have had access to air, but no direct contact with water. Along with paratacamite, belloite, and langbeinite, it occurs as a replacement of primary euchlorine, and along with atacamite, as a constituent of pseudomorphs after large crystals of melanothalite. The mineral occurs as poorly formed, short-prismatic to thick tabular, bright green crystals to 0.2 mm, with (001) and (100) as forms. Perfect {001} cleavage, stepped fracture, pale green streak, vitreous luster, H = 3, brittle, Dmax = 3.03(3), Dcalc = 3.066 g/cm3. In thin section, the mineral is optically neutral, but biaxial, α = 1.669(2), β = 1.688(2), γ = 1.707(5), 2V = 90°, no dispersion, optical orientation γ = c, X = b (?); the optic plane lies in the plane of perfect cleavage. Upon heating to 900 °C, the mineral melts and evaporates, losing 71% of its mass. It slowly decomposes in cold water and dissolves in dilute HCl with no evolved gases. X-ray powder diffraction study (special RKG-86 camera, FeKα radiation, internal silicon standard) gives a = 24.34(2), b = 5.878(4), c = 11.626(5) Å, β = 93.3(1)°, Z = 4, space group P2/m, Pm, or P2. The strongest maxima in the powder XRD pattern are [d Å (I %, hkl)]: 11.63(100,001), 5.88(20,010), 5.80(27,002), 5.73(17,020), 2.518(19,214), and 2.321(17,005). Due to poor crystal quality, single-crystal studies were not possible; however, IR spectroscopy indicates the presence of (OH)2 and two types of H2O molecule in the crystal structure. Chemical composition by electron microprobe (average of 4 analyses) and the Penfield method is: K2O 11.94(40), CuO 51.43(70), Cl37.07(60), H2O 6.9, –O = Cl3 8.37; sum 98.97 wt%, giving the formula K1.86Cu2.66Cl3.69OH0.97·3.87H2O, or idealily K2CuCl3(OH)2·H2O. The mineral is named after Ural mineralogist V.N. Avdonin (1925−). The type sample is deposited with the Mineralogical Museum of the Department of Mineralogy, SPBGU (catalog no. 19175). The mineral also occurs at the Degtjarsky chalcopryte deposit, Sverdlovsk Oblast’, Russia, and in technogenic products from the Blyavinsky deposit, Orenburg region, Ura, Russia.

Discussion: Previously known as an inadequately described mineral, avdoninite has been properly characterized for the first time here. T.S.E.
Batisivite


Batisivite occurs as an accessory mineral in a Cr-V-rich, quartz-diorite rock of the Syludyanka Complex, southern Baikal region, Russia. It is associated with Cr-V-bearing diopside and tremolite, calcite, schreyerite, berdesinskite, V-bearing titanite, anagnite, chromite-coulombite series spinels, Fe-bearing oxides of the eskolaite-karelianite series, uraninite, cherryhnkyt-roscelite series micas, Cr-bearing goldmanite, dravite-vanadumdravite tourmalines, albite, barite, zircon, and a suite of unnamed, U-Ti-V-Oxide phases. The mineral occurs as isometric and elongate anhedral grains up to 200 μm. It is black, with a black streak, resinous luster, no observed cleavage, a conchoidal fracture, and is brittle and insoluble in HCl. The microhardness was measured on five grains with a UI PMT-3 microhardness tester with a load of 30 g, resulting in a range of 1200–1470 kgf/mm², with an average of 1330 kgf/mm², corresponding to a Mohs hardness of 7.0–7.5. Batisivite is almost white in reflected light, with a weak cream hue, and range in size from a few micrometers to 0.05 × 1 × 2 cm. Aggregates are white to pale brown or yellowish and semi-transparent; single crystals are transparent and colorless; white streak, dull vitreous luster. Cleavage is [010] perfect, and [100], [001] good, fracture stepped to conchoidal, H = 2.5, brittle, Dmeas = 1.68(2), Dcalc = 1.60 to 1.64 g/cm³. In thin section, it is colorless, biaxial (+), α = 1.449(2), β = 1.453(2), γ = 1.458(3), 2V = 80(5)°, straight extinction, orientation XY || [010], Z = b, no dispersion. IR spectroscopy indicates the presence of H₂O molecules and Si–OH bonds.

The chemical composition of batisivite was determined by electron microprobe methods (WDS, 72 grains, 237 analyses), giving an average (range) of Nb₂O₅ 0.26(0.00–0.09), SiO₂ 6.16(5.38–8.17), TiO₂ 31.76(26.15–35.82), Al₂O₃ 1.81(0.97–2.51), VO₂ 8.20(1.07–13.05), V₂O₅ 2.96(16.99–34.63), Cr₂O₃ 12.29(7.13–20.49), FeO 1.48(0.33–5.18), MgO 0.08(0.00–0.66), BaO 11.42(10.39–12.25), total 99.45 wt% (where VO₂ is calculated from V₂O₅ and VO₂ are calculated from V₂O₅, corresponding to an empirical formula (V₆Ti₅)₃[V₃O₁₀]₃Fe₂O₃(Al₅O₁₅)⋅14H₂O based on a fixed number of cations (V+Cr+Fe+Nb = 14). The ideal formula is V₆Ti₅[Si₃O₁₀]O₉, requiring V₂O₅ 44.33, TiO₂ 35.45, SiO₂ 8.88, BaO 11.34, total 100 wt%.

Batisivite is triclinic, PT, a = 7.521(1), b = 7.643(1), c = 9.572(1) Å, α = 110.20, β = 103.34(1), γ = 98.28(1)°, V = 487.14(7) Å³, Z = 1, Dcalc = 2.64 g/cm³. The strongest lines on the powder X-ray diffraction pattern (RMD 7.2 mm camera, FeKα2 radiation) are [d(Å) (I%, hkl)]: 3.38(40,111), 3.10(80,122), 2.85(100,021,120), 2.63(80,213), 2.48(40,032), 2.23(60,220), 2.13(80,317), 1.78(100,324), 1.58(100,242), 1.43(100,322,124), 1.06(40,452), and 1.03(60,518). The structure of batisivite is a combination of zigzag double chains of octahedra of α-PhO₂-type and columns of V₂O₅-type. The chains formed by these structural units can be described as chains of cubo-octahedral cavities running parallel to [011]. Titanium, V, Cr, Fe, and Nb occupy the octahedral sites, whereas Ba and Si-O groups occupy the cubo-octahedral sites.

Batisivite is a member of the derbyleite group, the only member not to contain OH. The name is for its major cations (Ba, Ti, Si, and V). Type material has been deposited at the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow. P.C.P.

Chesnokovite


The new mineral chesnokovite (чесноковит) occurs in underground workings intersecting the Kedyverpakkh–22 hydrothermal vein on Kedyverpakkh Mt. in the northwestern part of the Lovozero alkaline massif, Kola Peninsula, Russia.

Chesnokovite occurs in one of the ussingitic parts of the vein along with natrolite, sodalite, vuonnemite, steenstrupine-(Ce), phosinate-(Ce), natite, gobsinite, villaumite, natrosilite, revdite, and other phases. Along with natrophosphate, it forms cavity-filling nests to 4 × 6 × 10 cm. Crystals are poorly formed, unwinnted, and lamellar with {101} as the dominant pinacoid, and range in size from a few micrometers to 0.05 × 1 × 2 cm. Aggregates are white to pale brown or yellowish and semi-transparent; single crystals are transparent and colorless; white streak, dull vitreous luster. Cleavage is [010] perfect, and [100], [001] good, fracture stepped to conchoidal, H = 2.5, brittle, Dmeas = 1.68(2), Dcalc = 1.60 to 1.64 g/cm³. In thin section, it is colorless, biaxial (+), α = 1.449(2), β = 1.453(2), γ = 1.458(3), 2V = 80(5)°, straight extinction, orientation XY || [010], Z = b, no dispersion. IR spectroscopy indicates the presence of H₂O molecules and Si–OH bonds.

Chemical composition by electron microprobe, atomic emission, and the Ailamir method is: Na₂O 21.49, K₂O 0.38, Li₂O 0.003, SiO₂ 21.42, H₂O 54.86, total 98.15 wt%, which gives the formula (Na₁₉K₈Si₂O₇(OH)₂)·8H₂O or ideally Na₁₉Si₂O₇(OH)₂·8H₂O (Z = 8). X-ray powder diffraction (monochromated CuKα radiation) shows that chesnokovite is the natural analogue of the synthetic compound Na₂Si₆O₁₆·9H₂O.

The strongest maxima in the powder XRD pattern are [d Å (I%, hkl)]: 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), and 2.774(100,341,143,114). Crystal structure refinement by the Rietveld method gives a = 11.7119(6), b = 16.973(1), c = 11.5652(6) Å, space group Pbcn, I = 77.7, R₁ = 0.16, R₂ = 0.23, R = 0.174%. The structure consists of isolated [Si₆O₁₆]³⁻ tetrahedra and chains of edge-sharing [Na(H₂O)]⁺ octahedra; interconnection of these groups is achieved only by hydrogen bonding, which accounts for the poor stability of the mineral under atmospheric conditions. It is the first natural sodium orthosilicate and forms only under conditions of low temperature (<50 °C) and extremely low α(Al₂O₃). It was named after mineralogist Boris Valentinovich Chesnokov (1928–2005) of the Urals Department, Russian Academy of Sciences. Type material is deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 3419/1). T.S.E.
**Epidote-(Sr)**


Epidote-(Sr) is a new member of the epidote group, clinozoisite subgroup, from the Nagakawara and Hohomori deposits at the Ananai mine, Kochi Prefecture, Japan. The mineral occurs as prismatic crystals (up to 1 cm in length) in tinzenite veins at the Nagakawara deposit and as fine crystal aggregates in piemontite breccia at the Hohomori deposit. The Ananai mine deposits are lenticular bodies in a red metachert and a basaltic rock comprised of albite, hematite, andradite, aegirine, actinolite, prehnite, chlorite, and calcite. Multiple stages of mineralization have resulted in various ore mineral assemblages in each of the deposits.

Epidote-(Sr) is translucent pale reddish brown to brown, has perfect cleavage on {001}, twinning on (100), and a Mohs hardness of 6.5. The reddish tense increases with increasing Mn content. It is biaxial negative, \( \alpha = 1.747(2), \beta = 1.780(2), \gamma = 1.792(2), V_{\text{calc}} = 62^\circ \). It exhibits pleochroism: \( X \) – pale greenish yellow, \( Y \) and \( Z \) – pale reddish brown to brownish pink.

The chemical composition of epidote-(Sr) was determined by WDS methods on a JEOL JXA5400 on samples from each of the two deposits. The average composition for epidote-(Sr) from the Nagakawara deposit (average of 41 analyses) is SiO\textsubscript{4} 34.32, Al\textsubscript{2}O\textsubscript{3} 18.53, Fe\textsubscript{2}O\textsubscript{3} 13.17, MgO 2.96, CaO 11.72, SrO 17.63, H\textsubscript{2}O 1.71, total 100.04 wt\%, corresponding to \((\text{Ca}_{18}\text{Sr}_{24}\text{Fe}_{56}\text{Al}_{31}\text{Mn}_{18}\text{Si}_{110}\text{O}_{12} \text{H}_{170})\) based on O = 12.5. The average composition for epidote-(Sr) from the Hohomori deposit (average of 85 analyses) is SiO\textsubscript{4} 34.25, Al\textsubscript{2}O\textsubscript{3} 16.99, Fe\textsubscript{2}O\textsubscript{3} 13.83, Mn\textsubscript{2}O\textsubscript{3} 5.59, CaO 12.29, SrO 14.57, H\textsubscript{2}O 1.70, total 99.22 wt\%, corresponding to \((\text{Ca}_{11.4}\text{Sr}_{2.4}\text{Fe}_{0.6}\text{Al}_{0.8}\text{Mn}_{0.6}\text{Si}_{0.10}\text{O}_{10} \text{H}_{0.1})\) (OH).

A Rietveld refinement was used to refine the structure of epidote-(Sr). The powder X-ray diffraction pattern was collected according to (Ca\textsubscript{18}Sr\textsubscript{24}Fe\textsubscript{56}Al\textsubscript{31}Mn\textsubscript{18}Si\textsubscript{110}O\textsubscript{12}H\textsubscript{170})\] include 5.04(20,101), 3.26(23,201), 2.92(100,111), 2.18(22,407), 2.09(21,023), and 1.650(18,517). Single-crystal X-ray diffractometry (monochromated CuK\textalpha radiation) gives \( a = 8.912(8), c = 3.112(4), Z = 2 \). The strongest maxima in the powder XRD pattern are \( d_{\text{max}} \) (1% unhkl) of 7.69(52,010), 4.45(82,110), 2.916(42,120), 2.573(65,030), 2.551(49,111), 2.422(100,021), 2.141(44,130), 2.128(60,121). Single-crystal X-ray diffractometry [MoK\textalpha, 238 \( I > 2 \sigma(I) \)] gives \( a = 8.924(5), c = 3.116(2) \), space group \( P6_3/m, R = 0.054, wR_2 = 0.115 \). The mineral is isostructural with fluoborite. It is named for its composition and relationship to fluoborite. Holotopy material is deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 91968) and with the Geological Museum, All-Russian Scientific Research Institute of Mineral Resources (VIMS; catalog no. M-1663). T.S.E.

**Germanium-Aluminum species**


A potentially new species of Ge-Al mineral has been discovered in primary ore from the Huize Pb-Zn deposit, Yunnan Province, China. The mineral (80 μm) has an irregular shape and is found in association with pyrite, sphalerite, and calcite. A WDS analyses of the mineral revealed GeO\textsubscript{2} 39.84, Al\textsubscript{2}O\textsubscript{3} 49.96, F 5.92, and SiO\textsubscript{2} 3.52, total 99.24 wt\%. Further study is required. P.C.P.

**Hydroxyborite**


The new mineral hydroxyborite (гидроксилборит) occurs in “calciphyre” containing suanite-kotoite-ludwigite ore of the Titovskoe deposit, Chersky Ridge, Dogdo River basin, Sakha Republic (former Yakutsk), Russia. Most of the calciphyre is comprised of calcite and clinohumite, but some sections are enriched in hydroxyborite, which itself is often replaced by fibrous saizubelite, and sometimes ludwigite occurs as inclusions in the hydroxyborite. The mineral occurs as sharp {100} hexagonal prisms, devoid of terminations, to 1–1.5 mm in length, often as radial to fan-shaped aggregates. Colorless, transparent, vitreous, photoluminesces blue in short-wave UV (246 nm). Imperfect {001} cleavage, conchoidal fracture, \( H = 3.5, \) brittle, \( D_{\text{meas}} = 2.89(1), D_{\text{calc}} = 2.872 \text{ g/cm}^3, \) dissolves in concentrated H\textsubscript{2}SO\textsubscript{4} but not in water or dilute HCl. In thin section, it is uniaxial (−), \( \omega = 1.566(1), e = 1.531(1) \), length slow. The IR spectrum unambiguously indicates the presence of (OH)\textsubscript{4}. Chemical composition by electron microprobe and the Penfield method is B\textsubscript{2}O\textsubscript{3} 18.43; Mg\textsubscript{2}O 66.45, F 10.23, H\textsubscript{2}O 9.73, \( -O = F_2, 4.31, \) total 99.79 wt\%, giving the formula (based on 6 anions) Mg\textsubscript{2}O\textsubscript{3}B\textsubscript{2}O\textsubscript{3}(OH)\textsubscript{4}F\textsubscript{1.04} O\textsubscript{0.08}, or ideally Mg\textsubscript{2}O\textsubscript{3}(BO\textsubscript{3})(OH)\textsubscript{4}. X-ray powder diffraclometry (monochromated CuK\textalpha radiation) gives \( a = 8.912(8), c = 3.112(4) \), \( Z = 2 \). The strongest maxima in the powder XRD pattern are \( d_{\text{max}} \) (I % unhkl) of 7.69(52,010), 4.45(82,110), 2.916(42,120), 2.573(65,030), 2.551(49,111), 2.422(100,021), 2.141(44,130), 2.128(60,121). Single-crystal X-ray diffractometry [MoK\textalpha, 238 \( I > 2 \sigma(I) \)] gives \( a = 8.924(5), c = 3.116(2) \), space group \( P6_3/m, R = 0.054, wR_2 = 0.115 \). The mineral is isostructural with fluoborite. It is named for its composition and relationship to fluoborite. Holotopy material is deposited with the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 91968) and with the Geological Museum, All-Russian Scientific Research Institute of Mineral Resources (VIMS; catalog no. M-1663). T.S.E.

**Lasalite**

J.M. Hughes, W.S. Wise, M.E. Gunter, J.P. Morton, and J. Rakowan (2008) Lasalite, NaMg\textsubscript{2}(V\textsubscript{6}O\textsubscript{3})\textsubscript{2}OH\textsubscript{2}O, a new de-
Lasalite occurs as bright yellow to orange efflorescence on sandstone in fractures and walls in the Vanadium Queen Mine in the La Sal district in Utah. Initially thought to be pascoite, X-ray powder diffraction produced a pattern that matched no known mineral. Lasalite forms by the oxidation of primary curvusite by vadose water and reaction with the carbonate content of the sandstone. Subsequent evaporation produces efflorescences containing lasalite, rossite, dickthomsonite, and hewettite. Lasalite has been identified at other mines in the Colorado Plateau.

Lasalite occurs as 1–3 mm crusts and isolated single crystals 1–2 mm long on sandstone. On euhedral crystals the major forms are {100}, {010}, {001}, {111}, and {111}. It is yellow to yellow-orange, transparent with an adamantine luster and a yellow streak. The crystals dehydrate to a yellow powder. Crystals are very brittle with a Mohs hardness of 1. There are 22, 238(2) and 2.362 g/cm³ respectively. Optically lasalite is biaxial (−), 2V = 53(1)°, respectively, indicating strong dispersion. The pleochroic formula is yellow = 1.743(5), β = 1.773(5), and γ = 1.780(5) respectively. Indices of refraction are 1.614(56,5.0,2.7), 1.89(52,2.0,2.2), and 2.55 (2.34–2.91), H = 2. There is strong pleochroic, biaxial (−), α = 1.534(3) yellowish to colorless, β = 1.562(2) brown, γ = 1.563(2) dark brown; 2V = 10(5)°, orientation X ~ c; no dispersion. Electron diffraction gives a = 12.55(1), b = 5.72(1), c = 26.85(5) Å, ϑ = 114.0(1)°, space group F2/m or F21. X-ray powder diffraction (Mn-filtered FeKα radiation) gives a = 12.55(1), b = 5.72(1), c = 26.86(2) Å, ϑ = 114.04(7)°, Z = 2. The strongest maxima in the powder XRD pattern are [d Å (l%, hkl)]: 12.28(100,002), 4.31(81,117), 3.555(62,301,212), 3.063(52,008,315), 2.840(90,312,039,315), 2.634(88,219,1,0,TT,124), 2.366(76,225,3.1,TT,3023, 2.109(54,427,425,19,414), 1.669(64,2,2,TT,3,2,TT,623,6,1,TT), 1.614(56,5.0,TT,137,333,717). IR spectroscopy indicates the presence of both H₂O and (OH⁻). Chemical composition by electron microprobe and the Penfield method is: Na₂O 4.55, K₂O 10.16, CaO 0.11, MgO 0.18, MnO 24.88, FeO 0.68, ZnO 0.15, Al₂O₃ 0.20, SiO₂ 50.87, TiO₂ 0.17, F 0.23, H₂O 0.73, O = O₃ 0.10, total 99.81 wt%, giving the formula K₃₋₀(Na₂₋₀Ca₀.₃₋₀Mg₋₀₋₀Fe₋₀₋₀₃₋₀Mg₀.₃₋₀Ca₀.₃₋₀Zn₀.₃₋₀Si₂₋₀₋₀₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋₀₋₁₋₀₋
less to weak blue). Munakataite is a secondary mineral in the hydrothermal ore veins at the Kato mine, which developed in a tertiary porphyritic andesite. The main ore minerals included electrum, chalcopryite, sphalerite, galena, hessite, and sylvanite. Secondary minerals include cerussite, anglesite, linarite, pyromorphite, malachite, and brochantite. Munakataite occurs with malachite and is extremely rare.

The chemical composition of munakataite was determined using a Link Systems EDS detector. The average of 7 analyses gave PbO 53.71, CuO 18.33, CaO 0.40, SO 9.73, SeO 13.19, H₂O 4.19, total 99.19 wt%. giving an empirical formula of Pb₃Ca₃Cu₆(SeO₄)₃(SO₄)₉(OH)₉, which is composed mainly of microcline, quartz, adularia, feldspar, and muscovite. The dike consists of alternating bands of hornfels and aplite in a 2–4 m thick dike, which crosscuts a hornfels xenolith. Smaller

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The structure of nevanlite consists of infinite chains of \( \text{BeO}_2(\text{OH}) \), tetrahedra linked with common OH groups. These tetrahedra are linked to CO\(_2\) groups via two shared vertices. Sodium cations occur in sevenfold edge-linked polycrystal \([\text{NaO}_2(\text{H}_2\text{O})]\), which form columns. The Be tetrahedra and Na polyhedra are aligned parallel to the c axis and form large channels containing H\(_2\)O molecules. G.P.

**Phosphoinnelite**


The new mineral phosphoinnelite occurs in hydrothermally altered agpatic "hybrid" pegmatite cross-cutting calcite carbonatite in the plagiposite deposit of the Kovdor alkaline-ultrabasic massif, Kola Peninsula, Russia. Associated minerals include primary cancrinite, orthoclase, aegirine-diopside and petrolite, and secondary magnesio-ardvedsonite, golyshievite, titanite, fluorapatite, and pyrrhotite. Much of the new mineral occurs with white to greenish thompsonite-Ca that hydrothermally replaces the cancrinite, yet the new mineral seems to be secondary in origin (i.e., coeval with petrolite, golyshievite, etc.). It occurs as plate-like crystals to 0.2 \( \times \) 1 \( \times \) 6 mm with chambered terminations, which are most commonly split and bent. The main form seems to be \{010\}; crystals are striated along their length. Aggregates consist of beams, sheaves, and rosettes. Transparent, vitreous, yellow-brown to brown with a pale yellow streak; greasy fracture; non-fluorescent. Cleavage is \{010\} perfect, \{100\} good, stepped fracture, \( H = 4.5–5\) brittle, \( \alpha = 3.82(5), \beta = 3.92 \text{ g/cm}^3 \). In thin section, it is colorless to pale yellow, non-pleochroic, biaxial (+), \( \gamma = 1.745(3) \), \( 2\text{F}_{\text{calc}} \sim 90^\circ \), \( 2\text{F}_{\text{calc}} \sim 94^\circ \), \( Z \cdot c \sim 5^\circ \); no dispersion. X-ray powder diffraction (RKU-114.6 camera, Mn-filtered Fe \( \gamma \) radiation) gives \( a = 5.38(2), b = 7.10(2), c = 14.76(5) \) \( \alpha \), \( \gamma = 99.00(7), \beta = 94.94(6) \); \( Z = 1 \), space group \( \text{P}T\text{O} \) or \( \text{P}1 \). The powder XRD pattern is practically identical to that of innelite; the strongest maxima are \( [d \text{ A} (\%)] : [100, 001] : 14.5(100,001), 3.455(40,103), 3.382(35,022), 2.921(35,005), 2.810(40,174), 2.683(90,200,001), 2.133(80,222), 2.059(40,204,133,221), 1.772(30,021,127,232,273) \). Crystals were too poor in quality for single-crystal studies. IR spectroscopy indicates an absence of \( \text{H}_2\text{O} \) or \( \text{OH} \). Chemical composition by electron microprobe is: \( \text{Na}_2 \text{O} 0.66, \text{K}_2 \text{O} 0.04, \text{CaO} 0.15, \text{SrO} 0.99, \text{BaO} 41.60, \text{MgO} 0.64, \text{MnO} 1.07, \text{Fe}_2\text{O}_3 1.55, \text{Al}_2\text{O}_3 0.27, \text{SiO}_2 17.83, \text{TiO}_2 16.88, \text{Nb}_2\text{O}_5 0.74, \text{Po}_4 \text{O}_9 5.93, \text{SO}_4 5.29, \text{F} 0.14, \sim \text{O} = 0.06 \), total 99.12 wt\%. For the empirical formula \( \text{Ba}_{1.98}^{0.87}\text{Fe}^{0.74}\text{Ti}^{0.07}\text{Si}_3\text{Al}_0.01\text{O}_{14}((\text{PO}_4\text{SO}_4))_2(\text{OF})_5 \).

**Zhangpeishanite**


Fine inclusions of Ba minerals—barite [\( \text{BaSO}_4 \)], norsethite [\( \text{BaMg(CO}_3\text{)}_2 \)], and a new species of barium fluoride chloride, up to 100 \( \mu \)m across, were recognized in a specimen of deep purple fluorite from Bayan Obo, Inner Mongolia, China. Bayan Obo is a world-class Nb–REE–Fe deposit located in Inner Mongolia, China (109°57'E, 41°46'N). The majority of Nb–REE–Fe deposit is hosted by the "H8" dolomite marble unit, along with units of sandstones and slates that belong to the Proterozoic Bayan Obo Group.

Thin sections of zhangpeishanite were prepared from the type specimen using oil, as the mineral is soluble in water. Chemical analyses of zhangpeishanite (12 analyses on 6 grains) and synthetic \( \text{BaFCl} \) were carried out by means of an electron microprobe (JEOL XJA-8800M, WDS mode, 15 kV, 20 nA, 2 \( \mu \)m beam diameter). The empirical formula for zhangpeishanite (based on 3 apfu) is \( \text{Ba}_{0.09}^{0.06}\text{Fe}_{0.09}\text{Cl}_{1.02} \) and is within the analytical error of the ideal formula. The simplified formula is \( \text{BaFCl} \), which requires: Ba 71.61, F 9.91, Cl 18.48, total 100 wt\%. The electron-microprobe analysis for the synthetic \( \text{BaFCl} \) leads to the empirical formula \( \text{Ba}_{0.09}^{0.06}\text{Fe}_{0.09}\text{Cl}_{1.02} \).

Zhangpeishanite occurs as transparent, colorless crystals with a white streak and vitreous luster. It is non-fluorescent under short or long wave UV light. The hardness is 2½ on Mohs' scale (measured on a synthetic sample). Tenacity and fracture could not be determined. Synthetic \( \text{BaFCl} \) shows perfect cleavage on \{010\}. The density of zhangpeishanite could not be measured because of small grain size; however, the calculated density is 4.54 g/cm\(^3\) on the basis of the empirical formula and unit cell. The optical data from synthetic \( \text{BaFCl} \) are: uniaxial (–), \( \alpha = 1.656(2) \), and \( \varepsilon = 1.652(2) \) (589 nm). The forms and twinning could not be observed due to the small grain size.

Single-crystal X-ray studies could not be carried out due to the small crystal size. Powder X-ray diffraction (PXRD) data were obtained using a 114.6 mm diameter Gandolfi camera with Ni-filtered Cu\( \kappa \) radiation. A fragment consisting of zhangpeishanite with small amount of fluorite was hand-picked from the thin section used for the chemical analysis under a binocular microscope. Zhangpeishanite is tetragonal, with space group \( P4/nmm \) and unit-cell parameters \( a = 4.3951(8), c = 7.223(2) \) Å, \( Z = 139.52(7) \) Å\(^3\), \( Z = 2 \). The \( \alpha/\varepsilon \) ratio calculated from the unit-cell parameters is 1.6434:1. The five strongest lines in the powder XRD pattern are \( [d_{\text{calc}} (\%)] : 3.75(100,101), 3.11(94,110), 2.36(82,112), 2.79(67,012), 1.89(49,211) \).

Zhangpeishanite is a member of the matlockite group and is the Ba-analogue of matlockite (\( \text{PbFCl} \)) and rorisite (\( \text{CaFCl} \)). The crystal structure of zhangpeishanite can be described as a stacking or a packing of layers with a sequence of F–BaCl–Cl–BaF along the c axis. The two adjacent Cl layers are weakly connected, causing cleavage on \{001\}. Although zhangpeishanite (\( \text{BaFCl} \)) and rorisite (\( \text{CaFCl} \)) are isostructural with each other, they show no isomorphous substitution between
Ca and Ba. This is likely due to the significant difference in the ionic radii.

The type material is housed in the mineralogical collections of the National Museum of Nature and Science, Tokyo, Japan, under the registered number NSM-MF14696 and at the Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China (registration number KDX013). K.T.T.

**NEW DATA**

**CARROLLITE***


The oxidation states of Cu and Co in carrollite were determined by X-ray absorption spectroscopy using large monocrystalline crystals from Katanga, Democratic Republic of Congo (crystals contain 0.6 wt% Ni). $L_{2,3}$ absorption edges for both elements were measured on the Magnetic Spectroscopy beamline 1.1 of the Synchrotron Radiation Source (SRS) at the Daresbury Laboratory. The spectroscopy indicates that copper in carrollite is Cu$^+$, giving an electronic formula of Cu$^{2+}$(Co$^{3+}$)$_3$(S$^{2-}$)$_6$. This requires half a hole per atom in the S$^3p$ band (per unit formula). Spectroscopy of the Co $L_{2,3}$ edge indicates a covalent low-spin structure. G.P.

**DELLAITE***


Dellaite was first discovered by Agrell (1965, *Mineral. Mag.*, 34, 1–15) at Kilchoan, Scotland, in a metamorphosed limestone. It has further been synthesized as a major calcium silicate hydrate phase in the C-S-H system in the cement industry. To date, neither chemical nor X-ray diffraction data have been published on the natural material. The Akagane mine is located on the National Museum of Nature and Science, Tokyo, Japan, and the type locality (Kvanefjeld in the Ilímaussaq alkaline complex, South Greenland) was studied with respect to chemistry and crystal structure. The same crystal was used for both crystal

H$_2$O 3.37, total 100.00 wt%.

The powder X-ray diffraction pattern for dellaite was collected on a 114.6 mm Gandolfi camera (Ni-filtered Cu$K\alpha$ radiation) on a crystal fragment 100 × 70 × 30 μm in size. The strongest lines on the powder pattern ($d_{obs}$ Å (I$_{obs}$%, hkl)) include: 6.66(9,100), 4.60(10,012), 3.43(23,020), 3.34(30,200), 3.28(16,021), 3.25(24, T0), 3.19(15, T10), 3.07(53,022), 2.99(38,022), 2.89(34,120), 2.86(44, T1), 2.82(100,023), 2.73(33, T2), 2.71(28,023), 2.63(31,023), 2.59(16, T20), 2.55(51,005), 2.29(38,030), 2.24(29, T1), 2.14(22, T1) and 1.937(27, T24). The unit cell was refined as triclinic from the powder diffraction data, with $a = 6.815(4), b = 6.937(3), c = 12.890(6) Å, \alpha = 90.71(4), \beta = 97.68(4), \gamma = 98.20(4)\degree, and V = 597.4(5) Å$.

Dellaite is a late-stage hydration product of pre-existing skarn minerals in a silica-deficient environment. Experimental studies on the synthetic equivalent confirm that dellaite is stable up to 800 °C. P.C.P.

**NABALAMPROPHYLLITE-20***


Chemical composition and crystal structure were determined for nabalamprophyllite-20, an orthorhombic polytype of Nabalamprophyllite. The sample originated in the Yubileinyaya vein, Karsnasurt Mountain, Lovozero alkaline massif. The chemical composition determined by WDS (wt%) is SiO$_2$ 79.79, Al$_2$O$_3$ 0.16, Nb$_2$O$_5$ 0.71, TiO$_2$ 27.85, Fe$_2$O$_3$ 1.05, MnO 3.52, MgO 0.20, CaO 0.15, SrO 6.09, BaO 16.55, K$_2$O 1.14, Na$_2$O 10.89, F 1.53, H$_2$O 0.99 (calculated from structure refinement), O = F – 0.64, total 99.98. This gives an empirical formula (on the basis of 4 Si apfu) of (Ba$_{0.43}$Sr$_{0.07}$Na$_{0.03}$K$_{0.26}$Ca$_{0.04}$)O$_{1.37}$Ti$_{1.02}$Fe$_{0.17}$Nb$_{0.01}$Al$_{0.01}$Mn$_{0.01}$ vacancy$_{2}$ (Si$_{3.13}$O$_{10.6}$F$_{0.01}$O$_{0.4}$)$_{2}$, Z = 2.

Single-crystal data was collected on a Bruker P4 diffractometer with a CCD 4k Smart detector and Mo$K\alpha$ radiation. R$_{I}$ was refined to 5.1% on the basis of 669 unique reflections with $F_{o} > 4eF$. Nabalamprophyllite-20 has space group $Pnnm$, $a = 19.564(2), b = 7.1173(5), c = 5.4144(4) \text{Å}, V = 753.90(4) \text{Å}^{3}, Z = 2, D_{calc} = 3.410 \text{g/cm}^{3}$.

The structure of nabalamprophyllite-20 is identical to that of lamprophyllite-20. Barium and Barium are disordered on one unique site in the 2O polytype, whereas in the 2M polytype Ba and Na are disordered over two distinct sites. The two polytypes also differ in the stacking order of the titanium silicate (TS) blocks. G.P.

**NACARENIOSITE-(Ce)**


Nacareniosite-(Ce), ideal formula Na$_2$Ca$_2$REE$_2$(Si$_4$O$_{10}$)$_2$F$_2$, from the type locality (Kvanefjeld in the Ilmaaussaq alkaline complex, South Greenland) was studied with respect to chemistry and crystal structure. The same crystal was used for both crystal
structure analysis and determination of chemical composition. WDS analysis yielded the following composition (in wt%): SiO\(_2\) 28.30, Nb\(_2\)O\(_5\) 12.01, TiO\(_2\) 2.24, Ta\(_2\)O\(_5\) 0.33, Ce\(_2\)O\(_3\) 10.55, La\(_2\)O\(_3\) 4.42, Nd\(_2\)O\(_3\) 4.34, Pr\(_2\)O\(_3\) 1.12, Sm\(_2\)O\(_3\) 0.64, Gd\(_2\)O\(_3\) 0.47, Y\(_2\)O\(_3\) 0.57, SrO 0.45, CaO 19.79, Na\(_2\)O 10.07, F 6.15, total 98.86 leading to an empirical formula (on the basis of O + F = 18 apfu) of Na\(_{2.77}\)(Ca\(_{3.01}\)Sr\(_{0.04}\))\(_{3.05}\)(Ce\(_{0.55}\)La\(_{0.23}\)Nd\(_{0.22}\)Pr\(_{0.06}\)Sm\(_{0.00}\)Gd\(_{0.00}\)Y\(_{0.00}\))\(_{1.15}\)(Nb\(_{0.77}\)Ti\(_{0.24}\)Ta\(_{0.01}\))\(_{1.02}\)(Si\(_2\)O\(_7\)F\(_{2}\))\(_{2}\)\(_{2}\)\(_{0.76}\)). Single-crystal data was collected on a Bruker P4 diffractometer with a CCD 4k Smart detector and MoK\(_\alpha\) radiation. \(R_1\) was refined to 6.5% on the basis of 1866 unique reflections with \(F_0 > 4\sigma F\). Nacareniobsite-(Ce) has \(a = 7.468(2), b = 5.689(1), c = 18.891(4)\) Å, \(\beta = 101.37(3)°, V = 786.9(1)\) Å\(^3\), space group \(P2_1/c, Z = 2, D_{\text{calc}} = 3.539\) g/cm\(^3\).

Nacareniobsite-(Ce) is topologically identical to mosandrite with respect to crystal structure. They differ in the cation content of the titanium silicate block and are related by the substitution Nb\(^{5+}\) + Na\(^+\) → Ti\(^{4+}\) + Ca\(^{2+}\). In nacareniobsite-(Ce), the O sheet of the titanium silicate block consists of \([^{[8]}\text{Na}^{[6]}\text{Na}^{[6]}\text{Nb}^{5+}]\), whereas in mosandrite, this sheet consists of \([^{[8]}\text{Na}^{[6]}\text{Na}^{[8]}\text{Na}^{[6]}\text{Ca}^{[6]}\text{Ti}^{4+}]\). G.P.