New Mineral Names*

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Barahonite-(Fe) and barahonite-(Al)*

J. Viñals, J.L. Jambor, M. Raudsepp, A.C. Roberts, J.D. Grice, M. Kokinos, and W.S. Wise (2008) Barahonaite-(Al) and barahonaite-(Fe), new Ca-Cu arsenate mineral species from Murcia province, Southeastern Spain, and Gold Hill, Utah. Can. Mineral., 46, 205–217.

Barahonite-(Fe) and barahonite-(Al) were found at the Dolores prospect near Pastrana, Murcia province, northern Spain. Barahonite-(Al) is also found at the Gold Hill Mine in Toole County, western Utah. At the Dolores prospect, the new minerals occur in a small lens of sulfides that have been completely oxidized to an assembly of 25 supergene minerals. Associated minerals include arsenocrandallite, arsenogoyazite, conichalcite, cobaltarthurite, chlorargyrite, olivenite, azurite, cornwallite, pharmacosiderite, zálesíite, and lavendulan. At the Gold Hill mine, primary sulfides have been oxidized to arsenate and sulfate assemblages.

Barahonite-(Fe) typically occurs as isolated beads (rosettes) forming sparse coatings on pharmacosiderite in fracture surfaces. The beads commonly coalesce. Barahonaite-(Al) from the Dolores prospect has a similar habit but is sparser. SEM imaging shows that these beads consist of thin tabular composite crystals with a maximum length of 20 μm. Barahonaite-(Al) from Gold Hill is rare but more common than at Dolores. It forms thin submillimeter crusts on weathered fracture surfaces. These crusts commonly form on a nearly amorphous Al silicate.

Barahonite-(Fe) is greenish-yellow and has a white to pale yellow streak, whereas barahonaite-(Al) is pale blue with a white streak. Both minerals are transparent to translucent, nonfluorescent, have a vitreous luster, are brittle, and are easily dissolved by room-temperature 10% HCl. Measured density for the Utah barahonaite is 3.03 g/cm^3 while D_{calc} = 2.99 g/cm^3 for Z = 2. Barahonaite-(Fe) is biaxial negative, α = 1.664(2), β ≈ γ, γ = 1.677(2), $2V_{meas}$ = 45–80°; the indices of refraction of barahonaite-(Al) are α = 1.616(2), γ = 1.622(2). Barahonaite-(Al) is presumed to be biaxial negative by analogy to barahonaite-(Fe).

Compositions of the Spanish material (determined by WDS) are Na$_2$O 2.07, MgO 0.14, CaO 12.96, CuO 12.41, Al$_2$O$_3$ 1.71, Fe$_2$O$_3$ 13.78, SiO$_2$ 0.33, P$_2$O$_5$ 0.42, As$_2$O$_5$ 41.18, SO$_3$ 0.29, Cl 0.91, H$_2$O (by difference) 14.01 wt% for barahonaite-(Fe), and Na$_2$O 1.65, MgO 0.00, CaO 15.71, CuO 14.59, Al$_2$O$_3$ 9.52, Fe$_2$O$_3$ 0.10, SiO$_2$ 0.14, P$_2$O$_5$ 0.35, As$_2$O$_5$ 42.16, SO$_3$ 1.24, Cl 0.06, H$_2$O (by difference) 14.49 wt% for barahonaite-(Al). Differential thermal and thermogravimetric analyses of barahonaite-(Al) indicate that it contains 17.9 wt% H$_2$O. These compositions lead to empirical formulae (based on XO$_4$ = 8) of (Ca$_{4.95}$Cu$_{3.34}$Na$_{1.43}$Mg$_{0.07}$Fe$^{3+}_{1.70}$A$_{10.72}$)$_{\Sigma12.21}$Fe$^{3+}_{2.00}$[(As$_{0.96}$P$_{0.02}$S$_{0.01}$Si$_{0.01}$)O$_4$]$_8$[(OH)$_{6.82}$Cl$_{0.55}$]$_{\Sigma7.37}$·13.2H$_2$O for barahonaite-(Fe) and to (Ca$_{5.75}$Cu$_{3.77}$Na$_{1.09}$Al$_{1.84}$Fe$^{3+}_{0.03}$)$_{\Sigma12.48}$Al$_{2.00}$[(As$_{0.94}$S$_{0.04}$P$_{0.01}$Si$_{0.01}$)O$_4$]$_8$[(OH)$_{7.95}$Cl$_{0.04}$]$_{\Sigma7.99}$·12.5H$_2$O for barahonaite-(Al). The simplified formulae for barahonaite-(Fe) and barahonaite-(Al) are (Ca,Cu,Na,Fe^{3+},Al)$_{12}$Fe$^{3+}_2$(AsO$_4$)$_8$(OH)$_x$·nH$_2$O and (Ca,Cu,Na,Al)$_{12}$Al$_2$(AsO$_4$)$_8$(OH)$_x$·nH$_2$O, respectively, where n is between 16 and 18, and x varies with trivalent substitution on the Ca site. The authors note that the grouping of monovalent, divalent, and trivalent ions into the Ca site is an oversimplification that cannot be resolved until crystal-structure data is available.

Infrared spectra for the two minerals are similar. Strong absorption bands in the 300–3500 cm^{-1} range are ascribed to OH-H$_2$O stretching, medium strength bands at 1650^{-1} are assigned to H$_2$O bending. Other absorption bands include a strong sharp band at 1080 (As-OH) interaction, and bands at 980 and 840 cm^{-1} ascribed to As-O stretching. Laser-Raman spectra for the two minerals are similar.

Unit-cell parameters were obtained using a Debye-Scherrer camera and trial and error indexing are a = 10.161(7), b = 22.39(2), c = 10.545(10) Å, β = 93.3(1)° for barahonaite-(Fe), and a = 9.964(3), b = 22.43(1), c = 10.555(6) Å, β = 92.76(6)° for Utah barahonaite-(Al). The strongest lines in the patterns are [d_{obs} in Å (I%,*hkl*)] 22.0(100,010), 11.2(70,020), 5.068(20,200), 3.345(20,023,310), 2.763(30,053), 2.659(20,$\bar{1}$72), and 2.541(20,400) for barahonaite-(Fe), and 22.0(100,010), 11.16(70,020), 4.983(50,200), and 3.333(45,250,$\bar{1}$13) for barahonaite-(Al). The pattern from the Spanish barahonaite-(Al) exhibits sharper diffraction peaks than the Utah barahonaite-(Al) and the barahonaite-(Fe). No pleochroism or dispersion was observed. The physical, chemical, and X-ray properties of barahonaite-(Fe) and barahonaite-(Al) suggest a relationship

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to the smolianinovite group, and a close relationship between attikaite and barahonaite-(Al).

The name barahonaite-(Fe) is for Antonio Barahona of Madrid who recognized the potential of the Dolores site and provided the original specimens. Barahonaite-(Al) is named for its mineralogical and compositional relationship with barahonaite-(Fe). The names and minerals have been approved by the IMA (IMA no. 2006-51 and 2006-52). Co-type specimens have been deposited at the Canadian Museum of Nature, Ontario (CMNMC 85716 and CMNMC 85719). **G.P.**

CUPROMAKOVICKYITE*

D. Topa and W.H. Paar (2007) Cupromakovickyite, $Cu_8Pb_4Ag_2Bi_{18}S_{36}$, a new mineral species of the pavonite homologous series. Can. Mineral., 46, 503–514.

Cupromakovickyite occurs in two different ore deposits. At Băița Bihor, Romania, it occurs in a skarn, the result of interaction of granitic magma with Triassic dolomites. The mineral occurs as lamellar intergrowth with makovickyite and as rare separate grains. Associated minerals are aikinite-friedrichite, hodrušite, paděraite, trace kupčikite, emplectite, wittichenite, tetradymite, and abundant chalcopyrite in a matrix of dolomite. It is interpreted as forming in the late stages of skarn formation. Cupromakovickyite found in the Felbertal scheelite deposit, Hohe Tauern, Austria, is associated with aikinite-krupkaite, hodrušite, cuprobismutite, kupčikite, trace wittichenite, native bismuth, chalcopyrite, and pyrrhotite in a matrix of quartz. It occurs mainly as lamellar intergrowths with makovickyite. This deposit formed by the recrystallization of sulfide and sulfosalt bearing quartz veins in felsic gneisses and amphibolites.

Optically, cupromakovickyite is grayish with no internal reflections, no anisotropy, and a moderate bireflectance in oil. There is no pleochroism; anisotropy is strong in oil and moderate in air. The reflectance data (air) are 42.1, 48.5% at 470 nm, 41.0, 46.9% at 546 nm, 40.2, 45.8% at 589 nm, and 39.6, 45.0% at 650 nm.

Chemical analyses were obtained using an electron microprobe. Empirical formulae for the Băița Bihor and Felbertal material, respectively, are $Cu_{7.79}Ag_{2.40}$ $Pb_{2.95}$ $Bi_{18.55}(S_{35.37}Se_{0.25}Te_{0.39})_{\Sigma36.00}$ and $Cu_{7.93}Ag_{2.43}(Pb_{2.73}Cd_{0.43})_{\Sigma3.16}Bi_{18.45}(S_{35.95}Te_{0.05})_{\Sigma36.00}$ (on the basis of S + Se +Te = 36 atoms). Only minor variations in composition were observed.

Single-crystal X-ray data were collected on several fragments $(0.06 \times 0.05 \times 0.04$ mm) using a four circle X-ray diffractometer. Cupromakovickyite is monoclinic with space group $C2/m$, a = 13.405(8), b = 4.016(3), c = 29.949(19) Å, β = 99.989(16)°, V = 1587.8(17) Å^3, and Z = 1. Powder X-ray diffraction data were not obtained due to a lack of material. The strongest lines in the calculated diffraction pattern [d_{obs} in Å (I%,hkl)] are: 3.478(100,$\bar{1}$14), 2.842(94,312), 3.646(57,206), 3.486(41,$\bar{2}$08), 3.345(33,$\bar{4}$02), 2.964(33,310), and 2.282(31,11$\overline{10}$). Crystal structure data are presented in a separate paper.

The mineral name expresses the main chemical difference between makovickyite and cupromakovickyite. The mineral and name were approved by the IMA (2002-58). Holotype material is deposited in the reference collection of the Division of Mineralogy, University of Salzburg, Austria (14943 and 14944). **G.P.**

FAIZIEVITE*

Y.A. Uvarova, F.C. Hawthorne, A.A. Agakhanov, and L.A. Pautov (2008) The crystal chemistry of faizievite, $K_2Li_6Na(Ca_6Na)Ti_4[Si_6O_{18}]_2[Si_{12}O_{30}]F_2$, a novel structure based on intercalated blocks of the baratovite and berezanskite structures. Can. Mineral., 46, 163–171.

Faizievite is a new species (IMA 2006-37) found in a quartz-pectolite boulder in moraine of the Dara-i-Pioz glacier, Alai ridge, Tien-Shan Mountains, Tajikistan. It forms a rim around grains of baratovite and is associated with aegirine, luorite, polylithionite, neptunite, hyalotekite, baratovite, sokolovaite, pectolite, senkevichite, and Ti-rich mica. Optical and physical properties are reported elsewhere.

The chemical composition was determined using ICP-OES (Li, Rb, Sr, and Ba) and WDS (all other elements). Results of chemical analysis are SiO_2 60.65, TiO_2 13.44, Nb_2O_5 0.11, CaO 14.52, K_2O 3.93, Na_2O 1.99, SrO 0.72, Rb_2O 0.13, F 1.30, Li_2O 3.76, sum 100.24 wt%. The empirical formula on the basis of (O + F) = 68 atoms is $(K_{1.97}Ba_{0.04}Rb_{0.03})_{\Sigma2.05}Li_{6.00}(Na_{0.86}\square_{0.14})_{\Sigma1.00}$ $(Ca_{6.16}Na_{0.67}Sr_{0.17})_{\Sigma7.00}(Ti_{4.00}Nb_{0.02})_{\Sigma4.02}Si_{24.01}O_{66}(F_{1.63}O_{0.37})_{\Sigma2}$.

Single-crystal X-ray diffraction data were collected using a Bruker P4 diffractometer equipped with a 4K CCD detector (Mo$K\alpha$ radiation). The structure was refined by direct methods, R_1 = 0.075 for 5044 unique reflections ($F_0 > 4\sigma F$). Faizievite is triclinic, $P\bar{1}$, a = 9.8156(9), b = 9.8249(9), c = 17.3087(16) Å, α = 99.209(2), β = 94.670(2), γ = 119.839(1)°, V = 1403.7(4) Å^3, and Z = 1. Faizievite has 15 tetrahedrally coordinated sites (12 containing Si and three containing Li), six octahedrally coordinated sites (two occupied by Ti and four occupied by Ca with minor Na and Sr), and two interstitial A sites (one is 12-coordinated and occupied by K, minor Ba and Sr and the other is nine-coordinated and almost completely filled by Na). The structure consists of four distinct (001) sheets having the following compositions: (1) (Si_6O_{18}), (2) $(Si_{12}O_{30})$Na, (3) KLi_3Ti_2, and (4) $(Ca_6Na)F_2$. These sheets form units that correspond to the structures of baratovite, $KLi_3Ca_7Ti_2(Si_6O_{18})_2F_2$, and berezanskite, $KLi_3Ti_2(Si_{12}O_{30})$. The baratovite block consists of layers [(3)(1)(4)(1)] and the berezanskite block consists of layers [(3)(2)]. The faizievite structure can be considered as alternating baratovite and berezanskite blocks alternating along [001] in the following sequence of layers [(3)(1)(4)(1)(3)(2)]. Chemical differences between baratovite and berezanskite and the corresponding blocks in the faizievite structure, require that the assembly of faizievite from baratovite and berezanskite blocks is accompanied by the substitution: $^{[6]}Ca^{2+} + ^{[9]}\square \leftrightarrow ^{[6]}Na^+ + ^{[9]}Na^+$. **G.P.**

HAYDEEITE*

J. Schlüter and T. Malcherek (2007) Haydeeite, $Cu_3Mg(OH)_6Cl_2$, a new mineral from the Haydee mine, Salar Grande, Atacama desert, Chile. Neus Jb. Mineral. Abh., 184, 39–43.

Haydeeite was discovered underground, in situ, in the Haydee mine (21°11′S 69°59′W), western border of the southern end of Salar Grande, Atacama desert, northern Chile. The Haydee mine is a fracture-bound copper mine with atacamite, chrysocolla, and copper oxides hosted by andesitic rock. The mineral occurs with fine, acicular atacamite, gypsum, and halite, with the occasional

crust of bassanite. Haydeeite is transparent with a vitreous luster, has a bright greenish-blue streak, is not fluorescent, has a Vickers microhardness $VHN_{15/25} = 57.8$ kg/mm², a Mohs hardness of approximately 2, and is brittle with an uneven fracture and perfect {0001} cleavage. It is not soluble in water, but dissolves in hydrochloric and nitric acids. It displays the forms {0001}, {10$\overline{1}$0}, and {10$\overline{1}$1}. No twinning was observed. $D_{meas} = 3.27(1)$ g/cm³ (floating method with methyl iodide), $D_{calc} = 3.24$ g/cm³. Haydeeite is uniaxial (–), pleochroic with O = greenish blue and E = faint greenish-blue, $\omega = 1.753(5)$, $\varepsilon = 1.710(5)$.

The chemical composition of haydeeite was determined by electron microprobe methods, with C, H, and N determined with a Carlo Erba element analyzer. The average composition (10 analyses) is CuO 61.83, MgO 10.06, Cl 17.91, H_2O 14.97, O = Cl –4.05, total 100.72 wt%, corresponding to the empirical formula $Cu_{2.95}Mg_{0.95}H_{6.30}Cl_{1.92}O_{6.08}$, based on 8 anions, which can be simplified to $Cu_3Mg(OH)_6Cl_2$.

Single-crystal X-ray structure determinations of haydeeite [$R(F)$ = 0.020 for 562 reflections with $I > 3\sigma(I)$, and $R(F)$ = 0.023 for all 628 independent reflections] indicate the mineral to be trigonal, space group $P\overline{3}m1$, $a = 6.2733(4)$, $c = 5.7472(5)$ Å, $V = 195.88(2)$ Å³, $Z = 1$. Unit-cell parameters refined from the powder X-ray data are $a = 6.2728(1)$, $c = 5.7462(1)$ Å, $V = 195.81(1)$ Å³, $c:a = 0.9161$. The strongest lines on the powder X-ray diffraction pattern (Philips X'Pert diffractometer, Cu$K\alpha$ radiation) include [d in Å (I%,hkl)]: 5.745(100,0001), 2.872(17,0002), 2.455(6,20$\overline{2}$$\overline{1}$), and 1.915(9,0003). Due to the platy nature of the mineral, the powder X-ray diffraction pattern is strongly affected by preferred orientation effects and thus does not match well the calculated pattern presented.

Haydeeite is a member of the atacamite family and is isostructural with kapellasite. The structure consists of sheets of edge-sharing $Cu(OH)_4Cl_2$ and $Mg(OH)_6$ octahedra that are weakly linked by O-H-Cl bridges, which result in the perfect {0001} cleavage. The mineral is named for the type locality (IMA no. 2006-046). Type material has been preserved in the collection of the Mineralogical Museum, University of Hamburg, Germany. **P.C.P.**

KNASIBFITE*

F. Demartin, C.M. Gramaccioli, I. Campostrini, and P. Orlandi (2008) Knasibfite, $K_3Na_4[SiF_6]_3[BF_4]$, a new hexafluorosilicate–tetrafluoroborate from La Fossa crater, Vulcano, Aeolian Islands, Italy. Can. Mineral., 46, 447–453.

Knasibfite was found in an altered pyroclastic breccia from a low-temperature fumarole at the rim of the crater. Associated minerals are hieratite, avogadrite, and demartinite. Knasibfite occurs as colorless, transparent crystals with maximum dimensions of about 0.1 mm. It has vitreous luster, a white streak, and a brittle fracture, with no distinct cleavage. Measured and calculated densities are 2.75(1) and 2.77 g/cm³, respectively. The crystals are nearly isotropic with a refractive index near $n = 1.32$. The compatibility index is –0.030 (excellent).

The chemistry was determined using EDS (B was detected with WDS but full analyses were precluded due to stability issues) with B calculated from structure determination. The empirical formula of knasibfite based on 33 atoms (average of 10 analyses) is $K_{3.09}Na_{4.11}Si_{2.91}B_{1.00}F_{21.89}$.

Powder X-ray diffraction data were obtained using a Gandolfi camera with Cu$K\alpha$ radiation. Knasibfite is orthorhombic, space group $Imm2$, $a = 5.521(1)$, $b = 17.115(4)$, $c = 9.186(2)$ Å, and $V = 868.1(2)$ Å³. The strongest lines in the pattern are [d_{obs} in Å (I%,hkl)]: 4.044(100,022), 8.558(50,020), 2.280(50,222), 3.175(30,141), 8.107(25,011), and 2.094(25,251). Single-crystal X-ray diffraction data were collected from a prismatic crystal ($0.10 \times 0.06 \times 0.05$ mm) with Mo$K\alpha$ radiation, using a diffractometer equipped with a 2K CCD detector ($R = 0.0272$). The structure consists of two 12-coordinated K atoms in irregular polyhedra [average K-F distances for K(1) 2.974 and 2.872 Å for K(2)]. Sodium occurs in two differently coordinated sites: Na(1) is coordinated by 9 F ions in a very distorted polyhedron, while Na(2) is in octahedral coordination. The two SiF_6^{2-} ions occur in distorted octahedra, while the single BF_4^- ion is located on the $mm2$ site.

The name is for the chemical composition. The name and mineral have been approved by the IMA (2006-42). The holotype specimen is held in the reference collection of the Dipartimento di Chimica Strutturale e Stereochimica Inorganica di Università degli Studi di Milano (no. 2006-03). **G.P.**

NIOBOAESCHYNITE-(Y)*

V. Bermanec, N. Tomašić, G. Kniewald, M.E. Back, and G. Zagler (2008) Nioboaeschynite-(Y), a new member of the aeschynite group from the Bear Lake diggings, Haliburton County, Ontario, Canada. Can. Mineral., 46, 395–402.

Nioboaeschynite-(Y) was found at the Bear Lake Diggings, Lot 9, concession X, Monmouth Township, Haliburton County, near Gooderham, Ontario, Canada. It is found in a series of calcite vein-dikes, which form a broad dike zone paralleling the boundary between the Central Metasedimentary belt and the Central Gneiss belt. The dikes are hosted by highly syenitized metasediments and meta-alaskite. The calcite veins also contain apatite-(CaF), amphibole, titanite, feldspars (anorthite and microcline), annite (biotite), calcite, quartz, monazite, pyrite, and U-rich thorite.

Nioboaeschynite-(Y) is translucent, deep brownish-red to black, has a vitreous luster, a conchoidal fracture, and a grayish-brown streak. The reflectance values for oil/air, respectively, are 3.4/14.6 (470 nm), 3.3/14.1 (546 nm), 3.2/13.8 (589 nm), and 3.2/13.7 (650 nm). The estimated Mohs hardness is 5–6 with a VHN_{100} of 922 kg/cm³. Measured and calculated densities are 5.34 and 5.33 g/cm³, respectively.

The composition determined by WDS is CaO 4.34, MnO 0.11, Fe_2O_3 2.16, Y_2O_3 5.34, La_2O_3 0.84, Ce_2O_3 4.50, Pr_2O_3 0.65, Nd_2O_3 4.47, Sm_2O_3 1.21, Eu_2O_3 0.10, Gd_2O_3 0.91, Dy_2O_3 0.60, Er_2O_3 0.42, Tm_2O_3 0.05, Yb_2O_3 0.57, ThO_2 12.10, UO_2 0.59, TiO_2 18.41, Nb_2O_5 31.46, Ta_2O_5 3.97, H_2O 2.61, total 95.41 wt% (H_2O determined by thermogravimetric analysis in a nitrogen atmosphere). No explanation was put forward for the low totals. The empirical formula (based on 6 O atoms) is [$(Y_{0.19}REE_{0.34})$ $Ca_{0.31}Th_{0.18}U_{0.009}Mn_{0.006}]_{\Sigma1.04}(Nb_{0.94}Ti_{0.92}Ta_{0.07}Fe^{3+}_{0.11})_{\Sigma2.04}O_6$.

Powder X-ray diffraction patterns (graphite-monochromated Cu$K\alpha$ radiation) were obtained from a sample that had been heated for 21 h at 1000° C. Nioboaeschynite-(Y) is orthorhom-

bic, space group *Pbnm*, with $a = 5.279(3)$, $b = 10.966 (5)$, $c = 7.443(3)$ Å, $V = 430.9(3)$ Å^3, $Z = 4$. The strongest lines on the X-ray powder-diffraction pattern include [d_{obs} in Å (I%,*hkl*)]: 3.009(100,130), 2.931(69,112), 3.079(20,022), 1.580(16,134), 1.863(14,004), 2.783(12,131), 2.636(12,200), and 2.006(11,222). The crystal structure is assumed to be analogous with other minerals of the aeschynite group.

The name is for the dominant B-site cation. Name and mineral are approved by the IMA (IMA 2003-38a) and the holotype specimen is held in the Croatian Natural History Museum collection (no. 600:ZAG; 9613MP1). **G.P.**

SUGAKIITE*

A. Kitakaze (2008) Sugakiite, Cu(Fe,Ni)$_8$S$_8$, A new mineral species from Hokkaido, Japan. Can. Mineral., 46, 263–267.

Previous examination of sulfide minerals in lherzolite from the Horoman peridotite massif, Samanicho, Samani-gun, Hokkaido, saw the discovery of three unknown copper, cobalt, nickel sulfides (X, Y, and Z). Previously published descriptions of these minerals did not include crystallographic and optical data. This paper deals with mineral Y, now known as sugakiite.

Sugakiite occurs with a number of unknown minerals, and in some cases native copper, bornite, and talnakhite in sulfide aggregates in the lherzolite. The grains are interstitial to olivine, clinopyroxene, and orthopyroxene aggregates. An unknown mineral and sugakiite occur as lamellae along the cleavages of a second unknown mineral. Sugakiite is reddish yellow with a metallic luster. Average VHN$_{50}$ is 145 kg/mm^2. Density was not measured; the calculated density based on empirical formula and $Z = 4$ is 4.71 g/cm^3. Optically (in reflected light) sugakiite is creamy white with a reddish tint. It has no internal reflections or pleochroism but a dark gray to light gray anisotropy is observed. Reflectance values in air are 25.6–31.9% (436 nm), 29.9–36.1% (497 nm), 33.239.1% (543 nm), 36.1–41.5% (586 nm), and 39.3–44.3% (648 nm). A brownish gray tarnish is observed after 72 h in air.

The chemical composition, obtained by WDS, is Cu: 6.95 (6.21–7.91), Fe: 43.27 (42.75–44.03), Ni: 16.10 (15.25–17.02), Co: 0.18 (0.10–0.28), S: 33.04 (32.66–33.61), for a total of 99.54 (98.63–100.80) giving an empirical formula of Cu$_{0.85}$(Fe$_{6.01}$,Ni$_{2.13}$,Co$_{0.02}$)$_{\Sigma 8.16}$S$_{7.99}$.

Powder X-ray diffraction data were obtained using a Gandolfi camera (Cu*K*α radiation). Single-crystal X-ray diffraction data were obtained using the precession method. Sugikiite is tetragonal with space group $P4_2/mnm$, $a = 10.566(5)$ Å, $c = 9.749(8)$ Å, $V = 1008.4(14)$ Å^3, and $Z = 4$. The strongest reflections in the X-ray diffraction pattern are [d_{obs} in Å (I%,*hkl*)] 2.072(100,510), 1.793(85,404), 1.804(83,215), 3.061(74,103), 1.954(42,005), 1.962(38,520), 2.641(33,400), 2.975(32,113), 2.93(30,320). Synthetic sugakiite has optical and X-ray properties that correspond well to those of the naturally occuring material. Based on the results of other synthesis experiments, this mineral is stable at temperatures below 860 °C.

The mineral is named for emeritus professor Asahiko Sugaki of Tohoku University, Sendai, Japan. The name and mineral have been approved by the IMA (2005-033). The type material is held in the collection of the Tohoku University Museum. **G.P.**

SURKHOBITE*

R.K. Rastsvetaeva, E.M. Eskova, D. Dusmatov, N.V. Chukanov, and F. Schneider (2008) Surkhobite: revalidation and redefinition with the new formula, (Ba,K)$_2$CaNa(Mn,Fe^{2+},Fe^{3+})$_8$Ti$_4$(Si$_2$O$_7$)$_4$O$_4$(F,OH,O)$_6$. Eur. J. Mineral., 20, 289–295.

Surkhobite (named for the discovery locality in the basin of the Surkhob river) was found by V.D. Dusmatov in 1976 in an alkaline pegmatite at the massif Dara-i-Pioz, Tajikistan. Surkhobite was approved in 2002 as a new mineral (IMA no. 2002-037). This proposal was based only on an electron microprobe analysis carried out for the holotype specimen of surkhobite, which demonstrated predominance of Na. According to the results of voting on the latter proposal, surkhobite was discredited with the conclusion: "Name and species surkhobite are discredited because the species corresponds to jinshajiangite and this species has priority" (decision $06-E$ of the IMA CNMMN). In this study, it is redefined with a new formula and revalidated with the original name (IMA 07-A).

Surkhobite is translucent, brownish-red, luster vitreous, streak white, cleavage perfect on {001}; hardness is anisotropic: the minimum value $H1 = 250$ kg/mm^2, the maximum value $H2 = 482$ kg/mm^2; Mohs hardness is 4.5. The mineral is optically biaxial, negative, β = 1.858(10), γ = 1.888(10); $2V = 65(5)°$; α = 1.790 (calculated from $2V$). Optical orientation: $X = b$, $Z \wedge a = 34°$. Dispersion is strong, $r < v$. Pleochroism: Y (orange) > Z (bright yellow) ≥ X (yellow). Micro-twinning on (001) is observed. Density measured by volumetric method is $D_{meas} = 3.84(10)$ g/cm^3, $D_{calc} = 3.98$ g/cm^3.

The chemical composition, determined by electron microprobe and Mössbauer spectroscopy, is Na$_2$O 2.27, K$_2$O 1.87, CaO 2.53, SrO 0.26, BaO 11.16, MgO 0.13, MnO 16.32, FeO 13.92, Fe$_2$O$_3$ 2.11, Al$_2$O$_3$ 0.02, SiO$_2$ 27.17, TiO$_2$ 16.14, Nb$_2$O$_5$ 2.14, ZrO$_2$ 0.34, F 2.94, H$_2$O (by Penfield method) 1.17, –O = F$_2$ –1.24, total 99.25 wt%. The empirical formula is ($Z = 2$): Na$_{2.60}$K$_{1.41}$Ca$_{1.60}$ Sr$_{0.09}$Ba$_{2.58}$(Mn$_{8.17}$Fe$_{6.88}^{2+}$ Fe$_{0.94}^{3+}$Mg$_{0.11}$Al$_{0.01}$)$_{\Sigma 16.11}$(Ti$_{7.17}$Nb$_{0.57}$Zr$_{0.10}$)$_{\Sigma 7.84}$ Si$_{16.06}$H$_{4.61}$F$_{5.49}$O$_{70.51}$. The simplified formula, taking into account the crystal structure, is ($Z = 2$): KBa$_3$Ca$_2$Na$_2$(Mn, Fe^{2+},Fe^{3+})$_{16}$Ti$_8$ (Si$_2$O$_7$)$_8$O$_8$(OH)$_4$(F,O,OH)$_8$.

The crystal structure was refined on a single crystal to $R = 0.043$ with 3686 independent reflections ($F > 2σ$). Surkhobite is monoclinic, *C*2, $a = 10.723(1)$, $b = 13.826(2)$, $c = 20.791(4)$ Å, β = 95.00(1)°. The strongest lines of the powder diffraction pattern [d in 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).

A crystal has been deposited as holotype material in the Fersman Mineralogical Museum, RAS, Moscow. **K.T.T.**

UEDAITE-(CE)*

R. Miyawaki, K. Yokoyama, S. Matsubara, Y. Tsutsumi, and A. Goto (2008) Uedaite-(Ce), a new member of the epidote group with Mn at the A site, from Shodoshima, Kagawa Prefecture, Japan. Eur. J. Mineral., 20, 261–269.

The new mineral, uedaite-(Ce), was found in a granite at a quarry in Shodoshima Island, Kagawa Prefecture, western Japan (34°33′N 134°20′E). The granite is Cretaceous in age, intruding

into the Ryoke metamorphic belt. Both granite and metamorphic rocks comprise the basement of the island and were widely covered by Miocene volcanoclastic sediments. A manganese-rich mineral in the epidote group was recognized with allanite-(Ce), monazite-(Ce), zircon, and thorite in a sample of heavy mineral separates. The mineral is named according to the recently approved nomenclature scheme for epidote-group minerals with Mn replacing Ca at the A site.

The short, prismatic crystals are translucent to opaque, black to dark brown in color with gray streak and vitreous luster. They are elongated along the b axis and less than 1 mm in length. $2V$ (meas.) = large. The Mohs hardness is 5–6. It is brittle with uneven fracture. Cleavage is poor on {001}. Density could not be measured because of intergrowth with other minerals. The calculated density is 4.19 g/cm³ based on the empirical formula and single-crystal data. Uedaite-(Ce) is optically biaxial negative with $\beta = Y = 1.770(5)$ (589 nm). X and Z could not be determined because of the tiny, platy fragment available.

Uedaite-(Ce) is monoclinic, $P2_1/m$, $a = 8.939(8)$ Å, $b = 5.742(4)$ Å, $c = 10.187(8)$ Å, $\beta = 115.10(6)°$, $V = 473.5(6)$ Å³, $Z = 2$. The four strongest lines in the powder XRD pattern [d in Å (I/I_0, hkl)] are: 2.92(100,$\overline{3}$02), 3.53(54,$\overline{2}$11), 2.71(43,013,120,300), and 2.62(39,$\overline{3}$11). Electron microprobe analysis gave SiO_2 29.94, Al_2O_3 16.02, FeO 16.01, MnO 6.01, MgO 0.07, CaO 2.42, La_2O_3 3.09, Ce_2O_3 10.75, Pr_2O_3 1.83, Nd_2O_3 6.44, Sm_2O_3 1.35, Gd_2O_3 0.54, Y_2O_3 0.72, ThO_2 0.51 wt%, and lead to the empirical formula $Mn_{0.51}Ca_{0.26}Ce_{0.39}Nd_{0.23}La_{0.11}Pr_{0.07}Sm_{0.05}Y_{0.04}Gd_{0.02}Th_{0.01}$ $Al_{1.89}Fe_{1.34}Mg_{0.01}(Si_2O_7)(SiO_4)O_{0.85}(OH)$ on the basis of 3 silicon and 1 hydrogen atoms per formula unit. The crystal structure of uedaite-(Ce) is isostructural with allanite-(Ce), consisting of two types of chains of edge-sharing MO_6 octahedra. The diorthosilicate (Si_2O_7) groups and isolated SiO_4 tetrahedra cross-link the chains to form a three-dimensional framework having large voids for the A-site cations, such as Mn, Ca, and REE.

The mineral is named after the late Tateo Ueda (1912–2000), who was the first to solve the crystal structure of allanite. Type material is deposited in the National Museum of Nature and Science, Japan, under the registration number NSM-M28864. **K.T.T.**

NEW DATA

JOOSTEITE*

P. Keller, F. Lissner, and T. Schleid (2007) The crystal structure of joosteite, $(Mn^{2+},Mn^{3+},Fe^{3+})_2[PO_4]O$, from the Helikon II Mine, Karibib (Namibia), and its relationship to staněkite, $(Fe^{3+},Mn^{2+},Fe^{2+},Mg)_2[PO_4]O$. Neus Jb. Mineral. Abh., 184, 225–230.

The crystal structure of a fragment of joosteite (0.25 × 0.18 × 0.15 mm³) from the type locality Helikon II pegmatite, Karibib, Namibia, was determined by single-crystal X-ray methods (Nonius Kappa-CCD diffractometer, Mo$K\alpha$ radiation). Intensity data were refined to $R_1 = 0.0414$, $R = 0.0373$ for $I < 4\sigma$, w$R_2 = 0.058$ for 854 equivalent, and 99 unique reflections. The mineral is monoclinic, space group $I2/a$, $a = 11.888(2)$, $b = 6.409(1)$, $c = 9.804(2)$ Å, $\beta = 106.17(3)°$, $Z = 8$. The crystal structure consists of distorted (PO_4) tetrahedron and two crystallographically

unique, distorted (MO_6) octahedra (where $M = Mn^{2+}, Mn^{3+}, Fe^{3+}$), which share edges to form zigzag chains running parallel to the [010] for M1 and to [100] for M2, respectively. The chains are connected via edges along the c axis, creating an open framework that hosts the PO_4 tetrahedra. The M^{2+} and M^{3+} cations are distributed over the two octahedrally coordinated sites, with M^{3+} cations preferring the Jahn-Teller distorted M2 site. The mineral is isostructural with staněkite-$Mabc$, and differs in the coordination of cations and anions compared to minerals in the triplet and triploidite group. Joosteite results from the alteration of oxidized sicklerite. **P.C.P.**

MCKELVEYITE-(Y)-2*M**

F. Demartin, C.M. Gramaccioli, I. Campostrini, and V. Diella (2008) The crystal structure of mckelveyite-(Y)-2*M*, a new monoclinic polytype from Val Malenco, Italian Alps. Can. Mineral., 46, 195–203.

The authors report the first accurate structure determination of the mckelveyite-(Y) minerals and describe a new mckelveyite-(Y) polytype. This new polytype of mckelveyite-(Y) was found in the Cava Fabi Talc quarry near Lanzada, Val Malenco, Sondrio, Lombardy, Italy. It is hosted in hydrothermal carbonate veins that are intercalated with dolomite veins and ultrabasic rocks associated with serpentinite. The associated minerals include anatase, brookite, brucite, calcite, dolomite, ilmenite, lindsleyite, magnesite, magnetite, pyrite, quartz, redledgeite, and rutile. The formation of these minerals is related to the circulation of CO_2-rich fluids in serpentinite during the last stages of Alpine metamorphism. Crystals of mckelveyite-(Y)-2*M* are pseudo-pyramidal, up to 4 mm in length and have a distinct trigonal character caused by the intergrowth of three crystals about a pseudo-threefold axis. Crystals are photosensitive going from pale pink to almost colorless on exposure to sunlight. The color reappears when they are returned to a dark environment.

The chemical composition (determined using WDS with CO_2 and H_2O calculated from structure) is Na_2O 3.50 (3.22–3.74), CaO 5.68 (5.40–5.89), SrO 3.45 (2.35–5.18), BaO 45.33 (41.82–46.55), Y_2O_3 8.82 (7.72–10.10), Sm_2O_3 0.05 (0.00–0.10), Gd_2O_3 0.45 (0.20–0.55), Dy_2O_3 1.10 (1.04–1.51), Er_2O_3 0.85 (0.59–1.09), Yb_2O_3 0.08 (0.04–0.12), CO_2 27.13, H_2O 5.55, total 101.99 wt%, which gives the empirical formula (on the basis of six metal sites in the asymmetric unit) $Na_{1.00}(Ca_{0.83}Na_{0.07}Sr_{0.11})_{\Sigma1.01}$ $(Ba_{2.79}Sr_{0.20})_{\Sigma2.99}(Y_{0.74}REE_{0.13}Ca_{0.12})_{\Sigma0.99}[CO_3]_6 \cdot 3H_2O$.

The infrared spectrum of mckelveyite-(Y)-2*M* exhibits sharp carbonate absorption peaks at 665, 722, 865, 1066, and 1075 cm⁻¹, and wider bands in the ranges 1399–1700 cm⁻¹ and 2800–3400 cm⁻¹, which contain a series of minor absorptions at 1766, 1786, 2423, 2450, and 2539 cm⁻¹. The first band includes H-O-H flexing modes and bending modes from the carbonate anions. The second band includes the O-H stretching modes.

Single-crystal X-ray diffraction data were collected from a crystal fragment measuring 0.10 × 0.06 × 0.03 mm (Bruker Apex II diffractomter, 2K CCD detector, Mo$K\alpha$ radiation), $R_1 = 0.0283$ for 4454 reflections. Mckelveyite-(Y)-2*M* is monoclinic, space group Cc, $a = 15.8213(7)$, $b = 9.1364(4)$, $c = 13.7522(6)$ Å, $\beta = 112.44(1)°$, $V = 1837.35(15)$ Å³. Powder diffraction data were obtained using graphite-monochromated Cu$K\alpha$ radiation. The

pattern is significantly different from mckelveyite-(Y)-1*A*. The strongest six lines in the X-ray powder-diffraction pattern [d_{obs} in Å (I%,*hkl*] are: 3.106(100,312), 4.299(48,310), 6.369(36,002), 2.029(29,602), 3.180(28,004), 2.635(27,60$\overline{2}$)

The structure of mckelveyite-(Y)-2*M* contains three independent atomic sites occupied by Ba plus minor Sr, and three sites occupied almost entirely by Na^+, Ca^{2+}, and Y^{3+} (plus the REE), respectively. These sites occur in alternate double layers of pseudo-hexagonal rings perpendicular to the *c** axis; there is no substantial disorder. Each double layer is the mirror image on {010} of the adjacent ones. The authors recommend that in light of the existence of this new polymorph, type mckelveyite-(Y) should be referred to as mackelveyite-(Y)-1*A*. **G.P.**

Tundrite-(Ce)*

J. Grice, R. Rowe, G. Poirier, and Q. Wight (2008) Tundrite-(Ce) from Mont Saint-Hilaire, Quebec: Crystal-structure analysis and species characterization. Can. Mineral., 46, 413–422.

Previous descriptions of tundrite have been marked by significant disparities in chemical composition and formulae. The discovery of large well-crystallized samples of tundrite-(Ce) at Mont Saint-Hilaire in Quebec provided the impetus for this study. Tundrite-(Ce) was found embedded in analcime in a boulder of pegmatitic segregation on the floor of the quarry. Associated minerals are aegirine, albite, analcime, an astrophyllite-group mineral, catapleiite, a eudialyte-group mineral, gonnardite, mangan-neptunite, monazite-(Ce), natrolite, quartz, rhodochrosite, sphalerite, and vinogradovite. The crystals are triclinic pinacoidal, bladed on {010} elongate on [100] and up to 9 mm in length. Twinning was not observed and {100} faces are heavily striated. The crystals are translucent, pale yellow with a white streak and vitreous luster. Mohs hardness is approximately 3. The mineral has a perfect {010} cleavage and is brittle and splintery. No fluorescence was observed in short or long-wave ultraviolet light. Measured and calculated densities are 4.08 and 4.19 g/cm³, respectively. Optically tundrite-(Ce) is biaxial positive $2V_{meas}$ = 84(5)° with β = 1.80. The dispersion is strong, with *r* > *v* and pleochroism is weak, with *Y* = pale yellow and *Z* = greenish yellow. The optical orientation is *X* = [010], *Z* ≈ *c*.

Compositions were obtained by WDS (and thermogravimetric analysis for H_2O and CO_2). The average (range) composition (20 analyses) is Na_2O 9.44 (9.07–9.66), CaO 0.34 (0.16–0.42), La_2O_3 16.12 (15.26–17.95), Ce_2O_3 27.01 (25.41–28.56), Pr_2O_3 2.13 (1.72–2.38), Nd_2O_3 6.16 (5.61–6.58), Sm_2O_3 0.38 (0.18–0.73), TiO_2 11.17 (10.73–11.93), Nb_2O_5 2.30 (1.14–3.11), Ta_2O_5 0.07 (0.00–0.15), SiO_2 9.32 (9.10–9.54), CO_2 13.91 (TGA), H_2O 0.36 (TGA), for a total of 98.80 (97.43–100.17) wt%. This gives an empirical formula (on the basis of 24 O) of $2[(Na_{1.906}Ca_{0.039})_{\Sigma 1.945}(Ce_{1.030}La_{0.621}Nd_{0.229}Pr_{0.081}Sm_{0.014})_{\Sigma 1.975}(Ti_{0.875}Nb_{0.109})_{\Sigma 0.984}O_2H_{0.250}(Si_{0.971}O_4)(C_{0.989}O_3)_2]$. Limited substitution of Nb^{5+} for Ti^{4+} was observed.

Single-crystal data were collected using a four-circle diffractometer (graphite monochromated Mo*K*α radiation) and a CCD detector, R_1 = 0.027 for 2827 unique reflections. Tundrite-(Ce) is triclinic, space group $P\overline{1}$, *a* = 7.5702(6), *b* = 13.949(2), *c* = 5.0235(5) Å, α = 100.19(1), β = 70.88(1), γ = 101.26(1)°, *V* = 487.91(6) Å³, and *Z* = 2. The strongest lines on the powder X-ray diffraction pattern (Bruker microdiffractometer and Cu*K*α radiation) are (d_{obs} in Å (I%,*hkl*): 13.548 (100,010), 6.776 (65,020), 3.460(45,$\overline{1}$01), 2.771(35,$\overline{1}$ $\overline{3}$1), 2.719(34,050), 3.544(33,200), 3.323(33,$\overline{2}$20), 3.064(32,$\overline{1}$21), 3.101(30,$\overline{1}\overline{2}$1), 2.513 (25,1$\overline{1}$2). The structure has three chemically distinct layers parallel to (010): (1) a Na-Ti-Si-O slab, (2) a Ce-C-O slab, and (3) a Na-O slab. These slabs are cross-linked by independent $[CO_3]^{2-}$ and $[SiO_4]^{4-}$ groups. Minor amounts of OH in the structure cancel charge imbalances caused by Nb ↔ Ti and Ca ↔ REE substitution.

The infrared spectrum of tundrite-(Ce) shows a broad low peak centered at 3401 cm⁻¹ reflecting the stretch frequency of O-H or H-O-H. The H-O-H bend region at 1690 to 1590 cm⁻¹ is interpreted as all [OH] on the basis of structure analysis. The remaining peaks are assigned to stretching and bending of $[CO_3]^{2-}$ and $[SiO_4]^{4-}$ groups. Material for this study is held in the collection of the Canadian Museum of Nature, Ottawa, Ontario (CMNMC 85806). **G.P.**