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New Mineral Names*

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NEW MINERALS

ALFREDSTELZNERITE*

M.A. Galliski, M.A. Cooper, M.F. Márquez-Zavalía, and F.C. Hawthorne (2010) Alfredstelznerite: a new species of calcium borate hydrate from the Santa Rosa Mine, Salta, northwestern Argentina. Can. Mineral., 48, 123–128.

M.A. Cooper, F.C. Hawthorne, M.A. Galliski, and M.F. Márquez-Zavalía (2010) The crystal structure of alfredstelznerite, $Ca_4(H_2O)_4[B_4O_4(OH)_6]_4(H_2O)_{15}$, a complex hydroxy-hydrated calcium borate mineral. Can. Mineral., 48, 129–138.

Alfredstelznerite occurs as white radial aggregates up to 5 mm long and 30 μm wide in fractured mudstones at the Santa Rosa Mine, Sijes, Salta province, República Argentina. The Santa Rosa mine is situated in the upper part of the sedimentary Pastos Grandes Group, in the Monte Amarillo and Monte Verde members of the late Miocene Sijes Formation. The borate deposit in which alfredstelznerite was discovered consists of beds of intercalated colemanite and hydroboracite in a playa lake sequence dominated by mudstones, siltstones, sandstones, tuffs, and evaporites. Other minerals found in the borate deposits include common gypsum and anhydrite, abundant ulexite and inyoite, rare meyerhofferite, nobleite, gowerite and inderborite, and very rare orpiment and realgar.

Alfredstelznerite occurs as white sprays in a cavity in fractured mudstone. It was found immediately after the rainy season and is of secondary origin. Crystals are up to 5 mm long and up to 30 μm wide. They are elongate along [001]; observed forms are {010} dominant, {*hk*0}, {100}, {*hkl*}, and $\{\bar{h}kl\}$. Crystals are colorless and transparent and turn translucent on dehydration. The streak is white and the luster varies from vitreous in individual crystals to silky in aggregates. No fluorescence in ultraviolet light was observed. There is a perfect cleavage parallel to {010}, fracture is irregular, and needles are brittle. Measured and calculated densities are 1.77(1) and 1.775 g/cm^3 respectively. The Mohs hardness is 2. Alfredstelznerite dissolves slowly in warm water, and is soluble in HCl. It is biaxial positive (+) with $\alpha = 1.476(3)$, $\beta = 1.478(3)$, $\gamma = 1.494(3)$ (measured with light of wavelength 589 nm), and $2V$(calc) = 39°. The optical orientation is X = *b*, Y = *c*, Z = *a*; no pleochroism or dispersion were observed. The compatibility index is 0.022 or excellent.

The chemical composition was determined using a synthesis of WDS, thermogravimetric analysis, and crystal-structure data. WDS analysis of alfredstelznerite is problematic due to rapid dehydration in vacuum. Analytical results give excessively high totals (122 wt%) assuming 19 H_2O (as determined from structure refinement) but produce a 4:1 ratio of B to Ca. Thermogravimetric analysis gives a H_2O of 37.0 wt% compared to 41.7 wt% for the ideal formula. The authors suggest that this discrepancy stems from the inclusion of some dehydrated material in the bulk sample used for TGA. Using the combined microprobe analyses and structure data the ideal composition is (in wt%): B_2O_3 41.57, CaO 16.74, H_2O 41.69. This composition gives an empirical formula of $Ca_{4.07}(H_2O)_4[B_{3.99}O_4(OH)_6]_4(H_2O)_{15}$ on the basis of 59 anions [16 O^{2-} + 24 $(OH)^-$ + 19H_2O].

A sample of alfredstelznerite powdered and mixed in a pellet of KBr was used to obtain an infrared spectrum. A broad minimum at 3450 cm^{-1} is assigned to H_2O stretching modes, weak absorption at 1630 cm^{-1} assigned to H-O-H bending, and strong absorptions in the 1500–1000 cm^{-1} region assigned to B-O stretching modes.

A X-ray powder diffraction pattern was obtained from a single crystal using Ni-filtered Cu*K*α radiation and a Debye-Scherrer camera with a Gandolfi attachment. The strongest six lines [d_{obs} in Å(I_{obs}%,*hkl*)] on the pattern are: 10.501(100,120), 5.226(70,201), 3.837(70,222), 3.118(70 broad,322), 2.612(60,402), and 2.538(60,004).

After several years of searching, a suitable crystal of alfredstelznerite suitable for single-crystal diffraction was obtained. The diffraction data was collected using a Bruker P4 diffractometer equipped with a Smart 1K CCD detector using Mo*K*α radiation. The structure was refined using direct methods and repeated difference-Fourier synthesis. The structure was refined to $R_1 = 0.141$ for 3795 independent reflections with $|F_o| > 4\sigma|F|$. The high value of R_1 is attributable to a high degree of pseudosymmetry, stacking disorder, and a large unit cell with many weakly bonded H_2O groups. Alfredstelznerite is orthorhombic, space group $Pca2_1$, $a = 12.161(2)$, $b = 40.477(8)$, $c = 10.1843(17)$ Å, $V = 5013(3)$ Å^3, $Z = 4$.

The structure of alfredstenznerite has four Ca sites, each fully occupied by Ca and coordinated by three O atoms, four OH groups, and one H_2O group. There are 16 B sites that are fully occupied by B; they form eight triangles and eight octahedra. Each B site is coordinated to at least one OH, and four of the triangles and four of the octahedra are coordinated by two OH groups. Sixteen anion sites are occupied by O^{2-}, 24 by OH groups, and 19 by H_2O groups for a total of 59 anion sites. The main unit of the structure is a $[B_4O_4(OH)_6]$ polyhedron cluster formed

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* All minerals marked with an asterisk have been approved by the IMA CNMMC.

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from two $B\Phi_3$ triangles and two $B\Phi_4$ tetrahedra. The clusters are linked along [100] and [001] by Ca-Φ to form wavy layers parallel to (010) with a composition of $[Ca(H_2O)B_4O_4(OH)_6]$. These layers further connected within and between layers by OH and H_2O groups. Three symmetrically distinct $[Ca(H_2O)B_4O_4(OH)_6]$ layers repeat along [010] to form an ABCB… layering sequence. The layering sequence produces tunnels that extend along [001] and contain interstitial H_2O groups.

The name is for Alfred Wilhelm Stelzner (1840–1895), first professor of geology at the University of Córdoba and founder of the Mineralogical Museum "Alfred Stelzner." The name and mineral have been approved by the IMA CNMNC (IMA no. 2007-50). The type material is held in the collection of Facultad de Ciencias Exactas Físicas y Naturales of the Universidad Nacional de Córdoba, Argentina (catalog no. MS003266). **G.P.**

AURIACUSITE*

S.J. Mills, A.R. Kampf, G. Poirier, M. Raudsepp, and I.M. Steele (2010) Auriacusite, $Fe^{3+}Cu^{2+}AsO_4O$, the first M^{3+} member of the olivenite group, from the Black Pine mine, Montana, USA. Mineral. Petrol., 99, 113–120.

Auriacusite is a new Fe^{3+} member of the olivenite group. It was discovered at the Black Pine mine, 14.5 km NW of Philipsburg, Granite County, Montana, U.S.A. The mineral is a late-stage weathering product of the breakdown of the primary ore body that consists of vuggy comb quartz hosting Ag-bearing tetrahedrite, hübnerite, and pyrite, with minor galena, sphalerite, chalcopyrite, and native Au, Ag, and Cu. Auriacusite likely formed in mildly oxidizing and acidic atmospheric temperatures. The mineral occurs as acicular needles lining quartz vugs and coating quartz crystals. It is associated with brochantite, malachite, tetrahedrite, and pyrite. Fibrous needles are brownish golden-yellow, up to 5 μm across, 100 μm long, and extremely thin (no greater than 1–2 μm in thickness). The needles are always intergrown, forming fibrous mats lining the vugs. Auriacusite is transparent, has a brownish yellow streak, a silky luster, $D_{calc} = 4.447$ g/cm^3, is non-fluorescent in SW and LW UV light, has an estimated Mohs hardness of 3, is brittle, and has an irregular fracture. The only form observed was the prism {110}. Auriacusite is biaxial positive (+), $\alpha = 1.830(5)$, $\beta = 1.865(5)$, $\gamma = 1.910(5)$, $2V_{obs} = 83.3(3)°$, $2V_{calc} = 84.6°$, X = a, Y = c, Z = b. It is non-pleochroic with strong dispersion.

Chemical analyses of auriacusite were performed on a JEOL 733 electron microprobe in WDS mode. The average (range) of 14 analyses gave Ag_2O 0.03(0.00–0.09), PbO 0.16(0.04–0.22), CuO 19.93(13.86–25.76), ZnO 0.80(0.45–1.07), Fe_2O_3 31.36(21.93–40.73), Sb_2O_5 12.71(8.87–14.89), P_2O_5 0.04(0.00–0.09), V_2O_5 0.00(0.00–0.01), As_2O_5 17.32(13.48–21.46), SiO_2 0.76(0.57–0.90), SeO_3 0.04(0.00–0.11), TeO_3 0.53(0.29–0.67), SO_3 0.50(0.12–0.94), Cl 0.04(0.00–0.07), Cl=O –0.01, total 84.21 wt%, corresponding to the empirical formula (based on 5 O atoms) $(Fe^{3+}_{1.33}Cu^{2+}_{0.85}Zn_{0.03})_{\Sigma 2.21}(As_{0.51}Sb_{0.27}Si_{0.04}S_{0.02}Te_{0.01})_{\Sigma 0.85}O_5$. The simplified, fully ordered end-member formula is $Fe^{3+}Cu^{2+}AsO_4O$, which requires CuO 29.00, Fe_2O_3 29.11, As_2O_5 41.89, total 100.00 wt%. A complete solid-solution series exists between auriacusite and olivenite via the coupled substitution $(Cu^{2+}OH) \leftrightarrow (Fe^{3+}O)$ and between auriacusite and an unnamed Fe^{3+}-dominant member. Both of these solid solutions also require $Sb^{5+} \leftrightarrow As^{5+}$ substitutions.

Single-crystal X-ray structure data were collected at ChemMatCARS, Sector 15, Advanced Photon Source at Argonne National Laboratory, U.S.A. A 50 × 1 × 2 μm crystal was used for collection of intensity data using synchrotron radiation (0.41328 Å and a 200 × 200 μm^2 beam) and an APEX II CCD detector on a Bruker diffractometer with fixed χ. The structure was solved by direct methods in SHELXS-97 and refined by full-matrix least-squares refinements on F^2 using SHELXL-97. The model converged to $R_1 = 0.1010$, w$R_2 = 0.2361$, for 951 independent reflections with $F_o > 4\sigma F$. Auriacusite is orthorhombic, *Pnnm*, $a = 8.6235(7)$, $b = 8.2757(7)$, $c = 5.9501(5)$ Å, $V = 424.63(6)$ Å^3, $Z = 4$. Powder X-ray diffraction data were collected on a Rigaku R-Axis Spider curved imaging plate microdiffractometer (Mo$K\alpha$ radiation). The strongest lines on the pattern [d_{obs} in Å(I_{obs}%,hkl)] include: 5.996(44,110), 4.884(100,101), 4.218(69,111), 3.838(29,210), 2.991(92,220), 2.669(74,221), 2.589(28,301), 2.476(85,311), 2.416(83,022), 2.354(26,212), 1.657(26,501), 1.628(27,511), 1.61(39,422), and 1.582(54,133). Refined unit-cell parameters are $a = 8.653(7)$, $b = 8.283(6)$, and $c = 5.941(6)$ Å, which agree well with those from the single-crystal refinement. Auriacusite is a member of the olivenite group, and an intermediate member between olivenite and an unnamed $Fe^{3+}Fe^{3+}$-dominant member.

The mineral is derived from the Latin *auri* (golden yellow) and *acus* (needle), in reference to its color and habit. The mineral and name have been approved by the IMA CNMNC (IMA no. 2009-037). Co-type material has been deposited in the collections of the Mineral Sciences Department, Natural History Museum of Los Angeles County (catalog no. 62374), and at the Canadian Museum of Nature, Ottawa, Canada (catalog no. CMNMC 86090). **P.C.P.**

BALLIRANOITE*

N.V. Chukanov, N.V. Zubkova, I.V. Pekov, L.V. Olysych, E. Bonaccorsi, and D.Y. Pushcharovski (2010) Balliranoite, $(Na,K)_6Ca_2(Si_6Al_6O_{24})Cl_2(CO_3)$, a new cancrinite-group mineral from Monte Somma–Vesuvio volcanic complex. Eur. J. Mineral., 22, 113–119.

Balliranoite was discovered at Monte Somma–Vesuvio volcanic complex, Campania, Italy, in an alkaline skarn-like rock formed as a product of metasomatic interaction between the alkaline magma and the limestone. It occurs in the cavities of the rock as coarse prismatic crystals up to 1 × 1 × 2 mm and as anhedral grains up to 1 cm in the groundmass. Associated minerals are orthoclase, phlogopite, clinohumite, calcite, diopside, pargasite, haüyne, and apatite. Balliranoite is related to davyne being its CO_3-dominant analogue, as well as to cancrinite being its Ca-Cl-dominant analogue.

A crystal with approximate dimensions 0.13 × 0.15 × 0.30 mm was used for the structure determination at room temperature on a Xcalibur S diffractometer equipped with CCD detector operating at 50 kV and 40 mA. Balliranoite is hexagonal, $P6_3$, $a = 12.695(2)$, $c = 5.325(1)$ Å, $V = 743.2(2)$ Å^3, $Z = 1$. The strongest lines of the powder diffraction pattern [d_{obs} in Å(I_{obs},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), and 2.120(18,330).

The chemical composition is (mean of 5 analyses): Na_2O 13.05, K_2O 3.08, CaO 12.70, Al_2O_3 27.28, SiO_2 32.38, SO_3 1.96, Cl 7.43, $-O{=}Cl_2$ −1.68; CO_2 (determined by selective sorption of ignition products) 3.24; H_2O (determined by Penfield method) 0.19; total 99.63 wt%. The empirical formula based on 12 (Si + Al) is: $Na_{4.70}Ca_{2.53}K_{0.73}(Si_{6.02}Al_{5.98}O_{23.995})Cl_{2.34}(CO_3)_{0.82}(SO_4)_{0.27}\cdot0.12H_2O$. The simplified formula is $Na_5KCa_2(Si_6Al_6O_{24})Cl_2(CO_3)$. The crystal structure was refined (R_1 = 0.0396). The FTIR spectrum of balliranoite (in cm^{-1}; s = strong band, w = weak band, sh = shoulder) has bands as follows: 3485w, 3390w (O–H-stretching vibrations of H_2O molecules); 1645w (bending vibrations of H_2O molecules); 1519, 1480sh, 1453w, 1410 (degenerate stretching vibrations of CO_3^{2-} ions); 1125s (Si–O- and probably S–O-stretching vibrations); 1045sh, 1008s, 945sh (stretching vibrations of the tetrahedral framework); 860 (out-of-plane bending vibrations of CO_3^{2-} ions); the absorptions below 700 cm^{-1} are due to the bending vibrations of the tetrahedral framework. Balliranoite is transparent, colorless, with vitreous luster. The mineral is brittle, with Mohs hardness 5 and perfect cleavage on $(10\bar{1}0)$. D_{meas} is 2.48(1), D_{calc} is 2.486(12) g/cm^3. Optically, the new mineral is uniaxial (+), ω = 1.523(2), ε = 1.525(2).

Balliranoite belongs to the cancrinite group, characterized by the stacking sequence *AB* and presenting two kinds of channels running along [001]. Narrow channels are formed by base-sharing cancrinite cages and contain either ...Na–H_2O...Na–H_2O... clusters [in cancrinite, vishnevite, hydroxycancrinite, and kyanoxalite or infinite chains ...Ca–Cl–Ca–Cl... (in davyne and balliranoite)]. The most important difference between davyne and balliranoite is the content of the anionic sites in wide channels, with prevalence of SO_4^{2-} anions in davyne and CO_3^{2-} anions in balliranoite.

Balliranoite was named in honor of the Italian crystallographer Paolo Ballirano (b. 1964), Department of Earth Sciences, University of Rome "La Sapienza," who has made important contributions to the crystal chemistry of cancrinite-group minerals. The holotype specimen of balliranoite is deposited in the Fersman Mineralogical Museum of Russian Academy of Sciences, Moscow, Russia (catalog no. 3756/1). **K.T.T.**

DEMICHELEITE-(I)*

F. Demartin, C.M. Gramaccioli, and I. Campostrini (2010) Demicheleite-(I), BiSI, a new mineral from La Fossa Crater, Vulcano, Aeolian Islands, Italy. Mineral. Mag., 74, 141–145.

Demicheleite-(I) is the iodine-dominant analogue of demicheleite-(Br) and demicheleite-(Cl), discovered in a medium-temperature (~250 °C) intracrateric fumarole on altered pyroclastic breccia at La Fossa crater, Vulcano Island, Aeolian archipelago, Sicily, Italy. It is associated with demicheleite-(Br), bismoclite, bismuthinite, and aiolosite. It is the first naturally occurring bismuth sulpoiodide and corresponds to a known synthetic BiSI phase. The mineral is prismatic, with dominant forms {110} and {111}, is dark red to black, has a brown streak, a submetallic luster, is non-fluorescent, brittle, and no cleavage was observed. The D_{calc} = 6.411 g/cm^3. Optical data are not given.

Chemical analyses of demicheleite-(I) were collected on a JEOL JXA 8200 electron microprobe in WDS mode. The average of an unknown number of analyses gave Bi 58.32, S 9.43, I 23.69, Br 5.66, Cl 1.01, total 98.11 wt%, corresponding to the empirical formula, based on 3 apfu, $Bi_{0.97}S_{1.03}(I_{0.65}Br_{0.25}Cl_{0.10})_{\Sigma1.00}$. The ideal, simplified formula is BiSI, which requires Bi 56.80, S 8.71, I 34.49, total 100.00 wt%.

Powder X-ray diffraction data were collected on a Philips PW1830 diffractometer (Cu$K\alpha$ radiation). Unit-cell parameters were refined on an orthorhombic cell, *Pnam*, a = 8.4501(7), b = 10.1470(9), c = 4.1389(4) Å, V = 354.88(4) $Å^3$. The strongest lines on the diffraction pattern [d_{obs} in Å(I_{obs}%,*hkl*)] include 6.490(100,110), 4.346(94,120), 4.234(20,200), 3.896(90,210), 3.243(22,220), 2.999(22,121), 2.709(60,310), 2.466(21,320), and 2.161(38,330).

The mineral is named for its chemistry, being the iodine-dominant analogue of demicheleite-(Br) and demicheleite-(Cl). The mineral and name have been approved by the IMA CNMNC (IMA no. 2009-049). Type material has been deposited in the Reference Collection of Dipartimento di Chimica Strutturale e Stereochimica Inorganica of Università degli Studi di Milano (catalog no. 2009-02). **P.C.P.**

DEVITOITE*

A.R. Kampf, G.R. Rossman, I.M. Steele, J.J. Pluth, G.E. Dunning, and R.E. Walstrom (2010) Devitoite, a new heterophyllosilicate mineral with astrophyllite-like layers from eastern Fresno County, California. Can. Mineral., 48, 29–40.

Devitoite was found at the Esquire 8 claim along Big Creek in SE¼ SW¼, Section 22, T11S, R25E, Mount Diablo Meridian, eastern Fresno County, California, in a sequence of minerals resulting from the interaction of fluids with the margin of a quartz sanbornite vein and country rock. Devitoite occurs along the cleavage planes of gillespite and is associated with titantaramellite, celsian, anandite, quartz, and the Fe^{2+} analogue of ericssonite. Both devitoite and the Fe^{2+} analogue of ericssonite are believed to be alteration products of gillespite. Other associated minerals are bazirite, edingtonite, fresnoite, macdonaldite, pellyite, sanbornite, Ba-rich tobermorite, walstromite, and witherite. Textural relationships indicate devitoite formed after celsian, gillespite, sanbornite, titantaramelite, and walstromite.

Crystals of devitoite are up to 5 mm long and 3 mm wide but typically smaller and are rarely thicker than 1 μm. The crystals are flattened on {001}, elongate, and striated parallel to [100] with no terminations, and occur in subparallel intergrowths. The color is brown with a cream to pale brown streak, and a silky luster. They are transparent to translucent. Devitoite has one perfect cleavage on {001} and a good cleavage on {010}. Fracture is irregular and tenacity is flexible. The Mohs hardness is approximately 4. Density could not be measured; the calculated density is 4.044 g/cm^3. Devitoite dissolves slowly in dilute HCl becoming white and opaque. Optically devitoite is biaxial positive (+) with α = 1.730(3), β = 1.735(6), and γ = 1.755(3)° in white light. $2V$ and dispersion could not be determined, $2V_{calc}$ = 53.6°. Pleochroism is brown, Y >>> X > Z and the optical orientation is $X \approx b$, $Y \approx c$, $Z \approx a$.

Infrared absorption spectra were obtained from a 49 × 123 × 5 μm crystal mounted on a BaF_2 slab. A prominent band at 3559

cm^{-1} is attributed to OH, broad features between 1550 and 1750 cm^{-1} normally attributed to molecular H_2O are believed to have other undetermined origins. An intense absorption at 1410 cm^{-1} shows strong polarization and is attributed to carbonate groups oriented in the *a-c* plane. Quantitative determination of H_2O content indicated 1.2 wt% H_2O in good agreement structural data indicating 1.67 wt% H_2O

The chemical composition was determined on an electron microprobe in WDS mode. The average composition is BaO 36.30, CaO 0.47, MgO 0.70, FeO 25.70, Al_2O_3 1.40, SiO_2 19.60, TiO_2 0.75, P_2O_5 4.52. Even considering water and CO_2 contents determined from the single-crystal structure refinement, this results in totals approximately 6.5 wt% too low. The authors believe the low totals are the result of volatile loss from the interlayer area and a resultant increase in porosity. Using the cation ratios derived from WDS analyses and constraining the formula as following (1) the layer portion of the structure contains 17 cations (Fe + Mg + Al + Si + Ti), 30 O atoms and 4 H; (2)Fe^{2+}/Fe^{3+} based on structure; and (3) the interlayer contains 1 C atom and sufficient O atoms to maintain charge balance an empirical formula was determined. These constraints yield an empirical formula of $[(Ba_{5.45}Ca_{0.19})_{\Sigma 5.64}(PO_4)_{1.47}O_{0.30}(CO_3)]$ $[(Fe^{2+}_{6.60}Mg_{0.40})_{\Sigma 7}(Fe^{3+}_{1.64}Ti^{4+}_{0.22}Al^{3+}_{0.14})_{\Sigma 2}(Si_{7.51}Al_{0.49})_{\Sigma 8}O_{26}(OH)_4]$. Ideally this requires BaO 38.83, CaO 0.50, MgO 0.75, FeO 22.02, Fe_2O_3 6.08, Al_2O_3 1.50, SiO_2 20.97, TiO_2 0.80, P_2O_5 4.84, H_2O 1.67, CO_2 2.04, total 100.00 wt%. The ideal formula is $[Ba_6(PO_4)_2(CO_3)]$ $[Fe^{2+}_7Fe^{3+}_2(Si_4O_{12})_2O_2(OH)_4]$.

Powder X-ray diffraction data were obtained using a Rigaku R-Axis Spider curved imaging plate microdiffractometer and monochromated Mo$K\alpha$ radiation. The ten strongest lines in the powder X-ray diffraction pattern [d_{obs} in Å(I_{obs}%,*hkl*)] are: 2.911(100,005), 2.665(100,$\bar{1}\bar{3}2$,$\bar{2}11$,$\bar{2}10$), 3.629(73,$1\bar{2}2$,031), 1.5597(73,combination of 10 weaker peaks), 3.457(70,$\bar{1}\bar{1}3$), 2.089(66,134,$\bar{2}15$,$\bar{2}\bar{2}3$), 3.859(62,$\bar{1}22$), 2.225(58,$\bar{1}\bar{4}2$,$\bar{1}44$,$2\bar{1}3$), 4.02(57,111), 4.85(53,003). The unit-cell parameters refined from the powder data are a = 5.3533(3), b = 11.6953(5), c = 14.6816(8) Å, α = 91.197(5), β = 96.844(5), γ = 103.277(5)°, V = 887.14(6) $Å^3$.

X-ray structure data were collected from a single crystal with the dimensions 130 × 23 × 1 μm using a Rigaku R-Axis Spider curved imaging plate microdiffractometer and monochromatized Mo$K\alpha$ radiation. Direct methods were used to determine the locations of Ba, Fe, Si, and most O atoms in the sheets. Difference Fourier maps were used to determine the locations of all other atoms except hydrogen. The structure was refined to R_1 = 0.0956 and wR_2 = 0.2467 for 1379 reflections with $F_o > 4\sigma F$. High R values are attributed to poor crystal quality and its size. Devitoite is triclinic, space group $P\bar{1}$, with a = 5.3437(7), b = 11.6726(15), c = 14.680(2) Å, α = 91.337(4), β = 96.757(4), γ = 103.233(4)°, V = 884.0(2) $Å^3$, and Z = 1. The structure of devitoite consists of composite HOH sheets with an interlayer region containing Ba atoms and PO_4 and CO_2 groups. The HOH sheets consist of layers of close packed $Fe^{2+}O_6$ octehedra (O layers) between heterophyllosilicate layers (H layers) The H layers consist of $[Si_4O_{12}]^{8-}$ chains cross-linked by corner sharing with FeO_5 tetragonal pyramids. These sheets are wavy when viewed along [100] due to distortions caused by mismatches in the sizes of the O and H layers.

The name is for Alfred (Fred) Devito (1937–2004) a leading micromounter and contributor to the local mineralogical community. The mineral and name have been approved by the IMA CNMNC (IMA 2009–010). Four cotype samples are held in the collection of the Natural History Museum of Los Angeles County (catalog nos. 61591, 61592, 61593, and 61594). **G.P.**

EDWARDSITE*

P. Elliott, J. Brugger, and T. Caradoc-Davies (2010) Description and crystal structure of a new mineral, edwardsite, $Cu_3Cd_2(SO_4)_2(OH)_6{\cdot}4H_2O$, from Broken Hill, New South Wales, Australia. Mineral. Mag., 74, 39–54.

Edwardsite is only the third known Cd-bearing sulfate mineral, and the third new Cd-dominant mineral to be discovered from the oxidized zone at the Broken Hill deposit, New South Wales, Australia. Edwardsite was discovered in material mined from the Block 14 Opencut, Broken Hill, and dumped 15 km southwest of the mine at the Pinnacles Mine. The mineral occurs as druses and aggregates of pale blue, transparent, vitreous, tabular-to-bladed crystals (up to 0.06 mm in length). Edwardsite has a white streak, is non-fluorescent, has an estimated Mohs hardness of 3–3½, is brittle with an uneven fracture, has excellent {100} cleavage, with crystals flattened on {100} and elongated along [010]. Dominant forms include {100}, {001}, and {043}, with minor {010}. Optically, edwardsite is biaxial negative (–), α ~ 1.74, β = 1.762(4), γ ~ 1.77, $2V_{calc}$ ~ +62°, X = b, Y ~ a, Z ~ c. It has inclined extinction, negative elongation and no pleochroism.

The chemistry of edwardsite was determined on a Cameca SX51 electron microprobe (WDS). The average (range) of 10 analyses gave CuO 28.06 (25.96–30.59), ZnO 2.26 (0.86–2.65), CdO 32.43 (30.72–34.02), FeO 0.08 (0.00–0.17), SO_3 20.35 (17.67–23.01), H_2O_{calc} 16.14, total 99.32 wt%, corresponding to the empirical formula (based on 18 O atoms) $Cu_{2.77}Cd_{1.98}Zn_{0.22}Fe_{0.01}(SO_4)_{2.00}(OH)_{5.95}{\cdot}4.06H_2O$. The ideal simplified formula is $Cu_3Cd_2(SO_4)_2(OH)_6{\cdot}4H_2O$, which requires CuO 30.53, CdO 32.85, SO_3 20.48, H_2O 16.14, total 100.00 wt%. The infrared absorption spectrum of edwardsite shows bands at 3655–2810 cm^{-1} (O-H stretching), 1620 cm^{-1} (H-O-H bending), 1097 and 1065 cm^{-1} (SO^{4-} asymmetric stretch ν_3), 945 cm^{-1} (SO^{4-} symmetric stretch ν_1), and 660 cm^{-1} (SO^{4-} asymmetric bend ν_4).

The crystal structure of edwardsite was determined using X-ray intensity data collected at the Australian Synchrotron Facility, ADSC Quantum 210r detector (λ = 0.773418 Å) and a 0.033 × 0.025 × 0.008 mm crystal. A total of 16 269 reflections were collected, 2258 unique and 1904 observed $F_o > 4\sigma(F_o)$. The structure was solved by direct methods and refined to R_1 = 0.031, wR_2 = 0.031, GoF = 1.078. The structure of edwardsite consists of infinite sheets of edge-sharing $Cu\phi_6$ octahedra and $Cd\phi_7$ polyhedra, which are parallel to (100). Bonded to these sheets are corner-sharing SO_4 tetrahedra, which are also corner-shared to isolated $Cd\phi_6$ octahedra, connecting adjacent sheets with additional weak to moderately strong hydrogen bonding.

The mineral is named for Austin Burton Edwards (1909–1960) who was a mineralogist and petrologist in the Mineragraphic Section of the Council for Scientific and Industrial Research (CSIR, later CSIRO), Melbourne, Australia (1934–1960), in recognition of his contribution to the Earth sciences, in particular Australian ore deposits such as Broken Hill. The mineral and name have been approved by the IMA CNMNC (IMA no. 2009-048). Holotype material has been deposited in the South Australian Museum, Adelaide, South Australia (catalog no. G32703). **P.C.P.**

HUANZALAITE*

R. Miyawaki, K.Yokoyama, T. Matsubara, I. Furuta, A. Gomi, and R. Murakami (2010) Huanzalaite, $MgWO_4$, a new mineral species from the Huanzala Mine, Peru. Can. Mineral., 48, 105–112.

Huanzalite was first found as a single grain in a heavy mineral separate from the FG740-V-2T pit of the Huanzala mine, Huallanca district, Bolognesi Province, Ancash Department, Peru. The current sample was found as inclusions in a copper ore consisting mainly of enargite and chalcopyrite, where it occurs as an inclusion in scheelite. The orebodies occur as the result of skarn deposits formed by the intrusion of Miocene or Pliocene granodiorite and quartz porphyry into Cretaceous limestone and intercalations of shale and sandstone. The orebodies consist of enargite, pyrite, sphalerite, scheelite, quartz, calcite, and "sericite," with chlorite, dolomite, sellaite, talc, and phlogopite making up the wallrock. The deposits are believed to be the result of a magnesium-rich ore fluid.

Huanzalaite occurs as orange to reddish brown inclusions (average size 10 μm) that form 0.1 mm aggregates. It is transparent with a white streak and admantine to vitreous luster. Like synthetic $MgWO_4$ it is fluorescent pale blue in short- and long-wave UV light. Density, hardness cleavage, fracture, and optical properties were not determined due to the size of the crystals. The calculated density is 6.953 g/cm^3 and the calculated mean index of refraction is 2.20.

The chemical composition of huanzalaite was determined with an electron microprobe operating in WDS mode. The average (range) of 10 analyses is: WO_3 84.81 (86.17–83.55), MgO 12.49 (13.14–11.85), MnO 1.78 (3.92–0.83), FeO 1.39 (2.05–0.22), and CaO 0.02 (0.07–0.0), total 100.47 wt%, which gives an empirical formula (on the basis of four O) of $(Mg_{0.85}Mn_{0.07}Fe_{0.05})_{\Sigma 0.97}W_{1.01}O_4$. The orange to reddish brown color of huanzalaite may be the result of the presence of small amounts of Mn and Fe. The surrounding scheelite is almost free of Mg, Fe, and Mn. The authors suggest that there is continuous solid solution of Mg for Fe, Mn, and Zn.

A powder X-ray diffraction pattern was collected using Ni-filtered Cu$K\alpha$ radiation on a handpicked fragment from the thin section used for chemical analysis. Indexing was by analogy with monoclinic synthetic $MgWO_4$. The strongest seven lines in the powder XRD pattern [d_{obs} in Å(I_{obs}%,hkl)] are: 3.73(100,011), 2.91(94,111), 2.93(83,11$\bar{1}$), 4.70(74,100), 3.63(39,110), 2.47(39,002), and 2.18(32,121). Huanzalaite is monoclinic, space group $P2/c$. Unit-cell parameters (refined from the powder data) are a = 4.7027(15), b = 5.6894(11), c = 4.9413(9) Å, β = 90.70(2)°, V = 132.20(5) Å^3, Z = 2.

The name is for the type locality, and the name and mineral have been approved by the IMA CNMNC (IMA no. 2009–018). The type sample is held in the collection of the National Museum of Nature and Science, Tokyo, Japan (catalog no. NSM-MF15366). **G.P.**

KARCHEVSKYITE*

S.N. Britvin, N.V. Chukanov, G.K. Bekenova, M.A. Yagovkina, A.V. Antonov, A.N. Bogdanova, and N.I. Krasnova (2007) Karchevskyite, $[Mg_{18}Al_9(OH)_{54}][Sr_2(CO_3,PO_4)_9(H_2O,H_3O)_{11}]$, a new mineral species of the layered double hydroxide family. Zap. Ross. Mineral. Obshch., 136(5), 20–23 (in Russian, English abstract), Geol. Ore Deposits, 50, 556–564 (2008; in English).

Karchevskyite was discovered by S.N. Britvin at the Iron pit of the Kovdor massif, western Kola Peninsula, Russia, in 1999. It occurs in small cavities in fine-grained dolomite and in phlogopite-dolomite-magnetite ore. Cavities are lined by millimeter-scale druses of pink dolomite, centimeter-scale octahedra of magnetite, and millimeter-scale crystals of colorless disk-shaped quintinite-3T and white spherulites of apatite-group minerals. Karchevskyite occurs as white spherulites to 1.5 mm in diameter. Individual crystals are soft (H = 2), flexible, colorless, nacreous luster, with occasionally curved lamellar hexagonal morphology and show prominent {001} cleavage. The lamellae are coaxially intergrown (micrometer scale) with indistinguishable quintinite-3T; XRD-determined ratios of karchevskyite:quintinite-3T average 70–80% (to pure karchevskyite at outer shell of spherulites). Colorless, nonpleochroic, uniaxial (–), ω = 1.542(2), ε = 1.534(2); often anomalously biaxial with 2V to 20°. D_{meas} = 2.21(2), D_{calc} = 2.18(1) g/cm^3. Electron microprobe analysis (C coated; Al coated for C analysis) gives MgO 29.7, Al_2O_3 18.3, SrO 7.4, CaO 0.2, P_2O_5 1.3, CO_2 14.5, H_2O (by diff.) 28.6, total 100.0 wt% (average of 10 samples), giving the empirical formula $Mg_{18.48}Al_{9.00}(Sr_{1.79}Ca_{0.09})_{1.88}(CO_3)_{8.26}(PO_4)_{0.46}(OH)_{49.82}(H_2O)_{14.90}$. Thermograms (DTA, DTG, and TG) of intergrown karchevskyite + quintinite-3T indicate the presence of CO_2 and interlayer H_2O, totalling 42.0 wt%, or 42(1)% after correction for 20–30% quintinite-3T. Infrared spectroscopy indicates the presence of two types of carbonate groups in the structure, one of which may actually be an $(HCO_3)^-$ group, and the presence of OH, H_2O, and/or H_3O^+. Interpretation of X-ray powder diffraction and SAED patterns gives a = 16.055(6), c = 25.66(1) Å, Z = 3, possible space groups $P\bar{3}$, $P3$, $P\bar{3}1m$, $P31m$, $P\bar{3}m1$, $P3m1$, $P312$, $P321$. The strongest maxima in the powder XRD pattern [d_{obs} in Å(I_{obs}%,hkl)] are: 8.52(100,003), 6.41(40,004), 5.13(30,005), 4.27(60,006), 3.665(90,007), 3.547(90,107), and 3.081(60,315). Consideration of all data indicates two possible empirical formulae: (1) model with H_3O^+: $[Mg_{18.00}Al_{9.00}(OH)_{54.00}][Sr_{1.79}Mg_{0.48}Ca_{0.09})_{\Sigma 2.36}(CO_3)_{8.26}(PO_4)_{0.46}(H_2O)_{6.34}(H_3O)_{4.18}]$, or ideally $[Mg_{18}Al_9(OH)_{54}][Sr_2(CO_3,PO_4)_9(H_2O,H_3O)_{11}]$; (2) model with $(HCO_3)^-$: $[Mg_{18.00}Al_{9.00}(OH)_{54.00}][Sr_{1.79}Mg_{0.48}Ca_{0.09})_{\Sigma 2.36}(CO_3)_{4.08}(HCO_3)_{4.18}(PO_4)_{0.46}(H_2O)_{10.72}]$, or ideally $[Mg_{18}Al_9(OH)_{54}][Sr_2(CO_3,HCO_3,PO_4)_9(H_2O)_{11}]$. The first of the two models is preferred. Karchevskyite is a member of a layered double hydroxide family of minerals including hydrotalcite, manasseite, quintinite, and woodruffite; it is the only member of the group with a cation (Sr^{2+}) in the interlayer, which predominantly hosts carbonate. The mineral is named in memory of Russian mineralogist Pavel Karchevsky (1976–2002). The holotype has been split and resides at the Mineralogical Museum, St. Petersburg State University, and at the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow.

Discussion. In this abstract, I have taken the liberty to correct several minor mistakes in the English translation of the paper, a list that includes the calculated density of the mineral, the formula of the mineral (abstract), possible space groups for the mineral (abstract), and the name of an associated phase (woodruffite, not "woodravite"). Note also that sample numbers for the holotypes are not reported in the paper. **T.S.E.**

LECOQITE-(Y)*

I.V. Pekov, N.V. Chukanov, N.V. Zubkova, D.A. Ksenofontov, L. Horváth, A.E. Zadov, and D.Y. Pushcharovsky (2010) Lecoqite-(Y), $Na_3Y(CO_3)_3·6H_2O$, A new mineral species from Mont Saint-Hilaire, Quebec, Canada. Can. Mineral., 48, 95–104.

Lecoqite-(Y) was found in the Poudrette pegmatite dike at Mont Saint-Hilaire, Quebec, Canada. It has been know as UK91 since its discovery in 1991 and remained undescribed for years due to its minute crystal size. It is found as silky white spray-like aggregates from a few millimeters in size up to 2.5 cm. Individual crystals exhibit a capillary habit and are colorless transparent with a white streak. Lecoqite-(Y) has a silky luster and does not fluoresce under UV radiation. No cleavage or parting was observed, but the mineral has splintery fracture and crystals are flexible and slightly elastic. Hardness and density could not be measured due to the nature of the specimens. It is optically uniaxial negative (–) with $\omega = 1.521(3)$, $\varepsilon = 1.497(3)$, and is non-pleochroic. It dissolves in dilute HCl. Electron microprobe, modified Penfield method and selective absorption analyses gave an average chemical composition of Na_2O 19.22, CaO 0.03, Y_2O_3 17.95, Nd_2O_3 0.54, Sm_2O_3 0.41, Gd_2O_3 0.75, Dy_2O_3 3.31, Ho_2O_3 1.12, Er_2O_3 3.20, Yb_2O_3 1.48, CO_2 27.0, H_2O 23.4, sum 98.41 wt% corresponding to $Na_{2.94}(Y_{0.755}Dy_{0.085}Er_{0.08}Yb_{0.035}Ho_{0.03}Gd_{0.02}Nd_{0.015}Sm_{0.01})_{\Sigma 1.03}(CO_3)_{2.91}(OH)_{0.21}(H_2O)_{6.06}$ based on 15 O apfu. The ideal formula is $Na_3Y(CO_3)_3·6H_2O$. The FTIR spectrum for lecoqite-(Y) is a diagnostic characteristic, since it is very different from other carbonates. It contains bands at 2810–3585 cm^{-1} (O–H stretching vibrations of H_2O molecules), 2330 cm^{-1} (vibrations of polarized O–H bonds), 1638 cm^{-1} (bending vibrations of H_2O molecules), doublet at 1495 + 1389 cm^{-1} (degenerate asymmetric C–O stretching vibrations), 1067 cm^{-1} (non-degenerate symmetric C–O stretching vibrations), 595 and 900 cm^{-1} (other modes involving vibrations of H_2O molecules), and 685–849 cm^{-1} (bending vibrations of CO_3^{2-} anions).

The thinness of lecoqite-(Y) crystals prevented the authors from solving the structure using single-crystal data. Instead, it was solved through Rietveld method using the synthetic $Na_3Y(CO_3)_3·6H_2O$ structure as a reference model with final agreement factors of $R_p = 0.0468$, $R_{wp} = 0.0657$, $R_{bragg} = 0.0343$, $R_f = 0.0356$. The new mineral species is hexagonal, $P6_3$ with refined unit-cell parameters from powder data of $a = 11.316(4)$, $c = 5.931(2)$ Å, $V = 657.7(4)$ Å^3, $Z = 2$, $D_{calc} = 2.358$ g/cm^3. The strongest lines of the X-ray diffraction pattern (STOE STADI MP powder diffractometer, Cu$K\alpha$ radiation, 67 lines) include [d_{obs} in Å(I_{obs}%,hkl)] 9.82(57,100), 5.669(19,110), 5.081(100,101), 3.779(39,201), 3.269(17,300), 3.142(23,121), 2.968(17,002), 2.840(18,102), 2.720(17,310), 2.627(39,112), 2.471(37,131), 2.316(29,122), 2.104(21,231), 2.047(30,222), 1.938(27,103), 1.887(15,402,330), and 1.735(15,412). Lecoqite-(Y) is the fifth carbonate containing only Na and Y as defining cations, the other four being horváthite-(Y), thomasclarkite-(Y), adamsite-(Y), and shomiokite-(Y), which were also discovered in the Poudrette pegmatite. Lecoqite-(Y) has no structurally related minerals, although it shares common structural features with shomiokite-(Y).

The mineral is late-stage hydrothermal, formed under hyperagpaitic conditions and is associated with microcline, albite, natrolite, gonnardite, aegirine, siderite, elpidite, gaidonnayite, zircon, franconite, dawsonite, rhodochrosite, cryolite, rutile, and sphalerite. The mineral is name in memory of the French chemist P.É. Lecoq de Boisbaudran (1838–1912) and in agreement with the proper Levinson suffix modifier -(Y). Cotype specimens were deposited at the Fersman Mineralogical Museum of Russian Academy of Sciences, Moscow (catalog no. 3761/1), and at the Canadian Museum of Nature, Ottawa (catalog no. CMNMC 86065). **R.R.**

MANGAZEITE*

G.N. Gamyanin, Yu.Ya. Zhdanov, N.V. Zayakina, V.V. Gamyanina, and V.S. Suknev (2006) Mangazeite, $Al_2(SO_4)(OH)_4·3H_2O$, a new mineral. Zap. Ross. Mineral. Obshch., 135(4), 20–23 (in Russian, English abstract).

The new species mangazeite was found in the Mangazeyskoe polymetallic-silver deposit in West Verkhoyani, eastern Yakutsk (Sakha Republic), Russia (65° 43' 40" N, 130° 7' E). The mineral and deposit are named for nearby Mangazeya Creek. Mangazeite occurs in the selvages of a quartz-arsenopyrite vein in fractured and intensively sericitized-pyritized granodiorite and has a supergene origin. It forms fine-acicular crystals to 40 μm long by 1 μm in diameter in jumbled radial aggregates associated with gypsum and chlorite. The new mineral is pale yellowish white, at times glassy, colorless streak, colorless, and transparent in transmitted light. Cleavage and parting unobserved, $H = 1–2$. It is biaxial, $\alpha = 1.525(9)$, β undetermined, $\gamma = 1.545(9)°$, optic sign not determined. Infrared spectra and DTA data indicate the presence of both OH and H_2O. Wet chemical analysis (average of 5) gives: Al_2O_3 36.28, SO_3 28.81, H_2O^+ 34.35, H_2O^- 9.27, total (less H_2O^-) 99.44 wt%, giving the empirical formula $Al_{1.99}(SO_4)_{1.01}(OH)_{3.94}·3.37H_2O$, $D_{calc} = 2.15$ g/cm^3 or ideally $Al_2(SO_4)(OH)_4·3H_2O$. Use of the programs IND and PARAM of PDWin on X-ray powder diffractometer data (Cu$K\alpha$) indicates a best fit to triclinic symmetry, $P1$ or $P\bar{1}$, $a = 8.286(5)$, $b = 9.385(5)$, $c = 11.35(1)$ Å, $\alpha = 96.1(1)$, $\beta = 98.9(1)$, $\gamma = 96.6(1)°$, and $Z = 4$. The strongest lines in the powder pattern [d_{obs} in Å(I_{obs}%,hkl)] are: 8.14(19,100), 7.59(49,$0\bar{1}1$), 7.16(46,$\bar{1}01$), 4.520(13,012), 4.258(100,102), 4.060(48,200), 3.912(43,$2\bar{1}0$), 3.795(12,$0\bar{2}2$). Among all aqueous aluminum sulfates, mangazeite is most similar to meta-aluminite in its various properties, but has a unique diffraction pattern. The type sample is housed at the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow (catalog no. 3291/1). **T.S.E.**

PUNKARUAIVITE*

V.N. Yakovenchuk, G.Y. Ivanyuk, Y.A Pakhomovsky, E.A. Selivanoya, Y.P. Men'Shikov, J.A. Korchak, S.V. Krivovichev, D.V. Spiridonova, and O.A. Zalkind (2010) Punkaruaivite, $LiTi_2[Si_4O_{11}(OH)]_2 \cdot H_2O$, a new mineral species from hydrothermal assemblages, Khibiny and Lovozero alkaline massifs, Kola Peninsula, Russia. Can. Mineral., 48, 41–50.

Punkaruaivite, a new vinogradovite-related titanosilicate series member was found through a study that re-examined mineral localities of the Khibiny and Lovozero massifs. Hydrothermal veins in two different localities yielded punkaruaivite (Mt. Punkaruaiv in the Lovozero massif and Mt. Eveslogschorr in the Khibiny massif). A composition between punkaruaivite and lintisite was also found at Mt. Alluaiv in the Lovozero. The new mineral occurs in association with belovite-(Ce), chlakovite, ferronordite-(Ce), gmelenite-Ca, manganoneptunite, manganonordite-(Ce), and sphalerite within voids inside ussingite crystals in a ussingite-aegirine-microcline bearing pegmatite in the nepheline syenite at Mt. Punkaruaiv and associated with belovite-(La), chivruaiite, kuzmenkoite-Mn, monazite-(La), and murmanite inside natrolite crystals at Mt. Eveslogschorr. The vitreous transparent, yellowish brown to colorless mineral is usually found in small flat-prismatic crystals (up to 3 mm) part of a sheaf-like and radiating mass. It has a white streak, also a Mohs hardness of 4.5 and a density of 2.60(5) g/cm^3 were experimentally determined. It shows a perfect cleavage {100}, is brittle with a step-like fracture and no twinning was observed. Punkaruaivite is biaxial negative (–) with following optical properties: indices of refraction α = 1.658(2), β = 1.696(2), γ = 1.726(5), $2V_{meas}$ = 85(5)°, $2V_{calc}$ = 82°, optical orientation $X = b$, $Y \wedge c = 12°$, and showing weak pleochroism from light brownish yellow to brownish yellow. Electron microprobe, flame photometry, and Penfield method analyses gave a mean chemical composition of Li_2O 3.22, Na_2O 0.29, K_2O 0.14, CaO 0.01, MnO 0.31, FeO 0.21, Al_2O_3 0.05, SiO_2 51.35, TiO_2 32.50, Nb_2O_5 1.06, H_2O 10.50, sum 99.64 wt%, corresponding to $(Li_{1.02}Na_{0.04}K_{0.01})_{\Sigma 1.07}\{\{Ti_{1.92}Nb_{0.04}Mn_{0.02}Fe^{3+}_{0.01})_{\Sigma 1.99}(OH)_{2.00}[Si_{4.03}O_{11.03}(OH)_{0.97}]\} \cdot 1.26H_2O$ based on Si + Ti + Nb + Fe + Mn + Al = 6 apfu. The ideal formula is $LiTi_2[Si_4O_{11}(OH)](OH)_2 \cdot H_2O$. The FTIR spectrum contains bands at 700 cm^{-1} and 1000–1050 cm^{-1} (SiO_2), 420–530 cm^{-1} (probably TiO_2), 3360 cm^{-1} [O–H from H_2O and $(OH)^-$], and 1640 cm^{-1} (H_2O).

The structure of punkaruaivite was solved and refined on a 0.12 × 0.24 × 0.06 mm crystal by direct method to $R_1 = 0.0837$ for 1347 unique observed reflections. It is monoclinic, $C2/c$, a = 26.688(2), b = 8.7568(7), c = 5.2188(5) Å, β = 91.189(2)°, V = 1219.4(2) Å^3, Z = 4, D_{calc} = 2.55 g/cm^3. The strongest powder X-ray diffraction lines (URS-1 with Deby-Scherrer camera 114.6 mm, Fe$K\alpha$ radiation, 28 observed lines) [d_{obs} in Å(I_{obs}%,hkl)] include: 13.3(100,200), 6.23(80,310), 4.56(30,510), 4.38(60,020), 4.16(40,220), 3.50(80,710), 3.01(70,$42\bar{1}$), 2.81(70,910), 2.70(40,$62\bar{1}$), 2.665(40,621,10.0.0), 2.13(40,$73\bar{1}$), 1.934(40,$44\bar{1}$), and 1.605(40,$13.3\bar{1}$). The structure of this new mineral consists of a 3D framework of parallel chains of corner-sharing SiO_4 tetrahedra, edge-sharing TiO_6 octahedra, corner-sharing LiO_4 tetrahedra and framework channels filled by H_2O molecules. It is structurally related to vinogradovite, lintisite, and kukisvumite, being the Na-free analogue of lintisite based on the chemical substitution $Na^+ + O^{2-} \leftrightarrow \square + (OH)^-$. Also the authors consider punkaruaivite to be transformation-induced from the mineral vinogradovite based on a study by Khomyakov et al. (2003, *Can. Mineral.*, 41, 989–1002).

The mineral was named after one the co-type localities, Mt. Punkaruaiv. The co-type material (IMA 2008-018) was deposited at the Mineralogical Museum of St. Petersburg State University, Russia, and the Geological and the Mineralogical Museum of the Geological Institute of the Kola Science Centre of the Russian Academy of Sciences (no. 6441). **R.R.**

NEW DATA

CHAROITE*

I. Rozhdestvenskaya, E. Mugnaioli, M. Czank, W. Depmeier, U. Kolb, A. Reinholdt, and T. Weirch (2010) The structure of charoite, $(K,Sr,Ba,Mn)_{15-16}(Ca,Na)_{32}[(Si_{70}(O,OH)_{180})](OH,F)_{4.0} \cdot nH_2O$, solved by conventional and automated electron diffraction. Mineral. Mag., 74, 159–177.

The crystal structure of charoite was investigated using a combination of electron microprobe analyses, high-resolution transmission electron microscopy, selected-area electron diffraction, X-ray spectroscopy, precession electron diffraction, and a newly developed technique of automated electron diffraction tomography. The structure was solved ab initio by direct methods from 2878 unique reflections and refined to $R_1 = 0.17$, $wR_2 = 0.21$. Charoite is monoclinic, $P2_1/m$, a = 31.96(6), b = 19.64(4), c = 7.09(1) Å, β = 90.0(1)°, V = 4450(24) Å^3, and Z = 1. The structure is composed of three different dreier silicate chains: a double dreier chain, $[Si_6O_{17}]^{10-}$; a tubular loop-branched dreier triple chain, $[Si_{12}O_{30}]^{12-}$; and a tubular hybrid dreier quadruple chain, $[Si_{17}O_{43}]^{18-}$. The chains occur between ribbons of edge-sharing Ca and Na octahedra, all of which extend parallel to the z axis. Within the tubes and channels are atoms of K, Ba, Sr, Mn, and H_2O molecules. The crystal-chemical formula for this sample of charoite can be written $(K_{13.88}Sr_{1.00}Ba_{0.32}Mn_{0.36})_{\Sigma 15.56}(Ca_{25.64}Na_{6.36})_{\Sigma 32}\{[Si_6O_{11}(O,OH)_6]_2[Si_{12}O_{18}(O,OH)_{12}]_2[Si_{17}O_{25}(O,OH)_{18}]_2\}(OH,F)_{4.0} \cdot 3.18H_2O$. **P.C.P.**

MURUNSKITE*

I.V. Pekov, N.V. Zubkova, D.V. Lisitsyn, and D.Y. Pushcharovsky (2009) Crystal structure of murunskite. Dokl. Akad. Nauk, 424, 385–387 (in Russian), Dokl. Earth Sci., 424, 139–141 (in English).

The crystal structure of murunskite from Mt. Koashva of the Khibiny massif has been investigated. Electron microprobe analysis gives the empirical formula $(K_{1.42}Na_{0.08}Tl_{0.005})_{\Sigma 1.505}(Cu_{2.715}Fe_{1.27})_{\Sigma 3.985}S_{4.015}$, in good agreement with past studies. The crystal structure was solved by direct methods from single-crystal X-ray diffraction data comprising 156 independent ($I > 2\sigma[I]$; Mo$K\alpha$) reflections, on a tetragonal unit cell with a = 3.8460(10), c = 13.308(3) Å, $I4/mmm$, and Z = 1, and was refined using SHELX-97 to R_{hkl} = 0.0364. The mineral is attributed to the bukovite structure type; its crystal structure consists of (001) layers of edge-sharing $(Cu,Fe)S_4$ tetrahedra interconnected by layers of [8]-coordinated K atoms. Up to 1/3 of the large cation (K) site can be vacant; the empirical formula is $(K,Tl)_{2-x}(Cu,Fe)_4S_4$, $x < 0.7$, or ideally $K_2(Cu,Fe)_4S_4$. It forms a solid-solution series with thalcusite, $Tl_2(Cu,Fe)_4S_4$. **T.S.E.**