

New Mineral Names*

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ARAPOVITE*

A.A. Agakhanov, Pautov, L.A., Uvarova, Y.A., Sokolova, E.V., Hawthorne, F.C., Karpenko, V.Yu., Dusmatov, Y.D., Semenov, E.I. (2004) Arapovite, (U,Th)(Ca,Na)₂(K_{1-x}□_x)Si₈O₂₀·H₂O—New mineral. *New Data Mineral. M.*, 39, 14–19.

Y.A. Uvarova, E. Sokolova, F.C. Hawthorne, A.A. Agakhanov, L.A. Pautov (2004) The crystal structure of arapovite, U⁴⁺(Ca,Na)₂(K_{1-x}□_x)[Si₈O₂₀], $x \approx 0.5$, a new mineral species of the steacyite group from the Dara-i-Pioz moraine, Tien-Shan mountains, Tajikistan. *Can. Mineral.*, 42, 1005–1011.

Arapovite occurs as dark green zones (0.1 to 0.3 mm) in larger (up to 1 cm) turkestanite crystals. It is vitreous and pitchy, transparent in thin section, conchoidal fracture, does not display cleavage, and has a Mohs hardness of 5.5 to 6 (average VHN load in the range 682–766 kg/mm²). The mineral is uniaxial negative, ω 1.615(2) and ϵ 1.610(2).

Electron microprobe analyses (EDS, average of 6 grains) gave SiO₂ 53.99, UO₂ 16.63, ThO₂ 10.57, Ce₂O₃ 0.55, La₂O₃ 0.14, Pr₂O₃ 0.05, Nd₂O₃ 0.62, Sm₂O₃ 0.11, Eu₂O₃ 0.14, Gd₂O₃ 0.03, Dy₂O₃ 0.13, PbO 0.82, CaO 8.11, Na₂O 2.54, K₂O 4.52, H₂O (Penfield method) 1.80, sum 100.76 wt%, corresponding to (U_{0.55}Th_{0.36}Pb_{0.03}Ce_{0.03}Nd_{0.03}La_{0.01}Sm_{0.01}Eu_{0.01}Dy_{0.01})_{Σ1.04}(Ca_{1.29}Na_{0.73})_{Σ2.02}(K_{0.83}□_{0.15})_{Σ1.00}Si₈O₂₀₋₀₆·0.89H₂O based on 8 Si atoms. The ideal formula of arapovite is (U,Th)(Ca,Na)₂(K_{1-x}□_x)Si₈O₂₀·H₂O, $Z = 2$, $D_{\text{meas}} = 3.43(2)$ g/cm³, $D_{\text{calc}} = 3.365$ g/cm³. The IR spectrum has absorption bands at 3460, 1091sh, 1043, 797, 778, 590, and 491 cm⁻¹. No designation of bands has been given.

Due to the metamict nature of arapovite, the crystal used for the structure refinement was annealed at 1100 °C in air for 3.5 hours prior to data collection. The structure was refined using the atomic coordinates of turkestanite (Kabalov et al. 1998; *Crystallogr. Rep.*, 43, 584–588) on a 0.120 × 0.100 × 0.080 mm crystal, $R_1 = 0.029$ for 528 unique reflections with $F_o > 4\sigma(F_o)$. Arapovite is tetragonal, $P4/mcc$, $a = 7.5505(4)$, $c = 14.7104(9)$ Å, $V = 838.6(1)$ Å³, $\mu = 9.64$ mm⁻¹. The strongest lines on the powder X-ray diffraction pattern [diffractometer, CuK α radiation, 13 lines given for the non-annealed arapovite, 36 lines given for the annealed arapovite (presented here)] include 7.57(14,010),

5.34(23,100), 5.28(38,012), 3.37(100,120), 3.31(58,014), 2.672(15,220), 2.640(64,024), 2.515(21,030), 2.493(15,124), 2.161(45,224), 2.016(29,232), 1.821(21,234), 1.689(16,240), 1.644(30,242), and 1.618(18,128). Arapovite is the U⁴⁺ analogue of turkestanite and the U⁴⁺-Ca analogue of steacyite. The topology of the structure is identical to that of both turkestanite and steacyite and consists of four-membered double rings of SiO₄ tetrahedra in the form [Si₈O₂₀]. Eight coordinated A and B polyhedra share edges to form (001) sheets that are connected through [Si₈O₂₀] groups to form a framework.

Arapovite was found in the moraine of the Dara-i-Pioz glacier, Alai mountain ridge, Tien-Shan mountains, Garm region, northern Tajikistan. It is associated with microcline and subordinate aegirine, polyolithionite, stillwellite and turkestanite, and has been replaced by sogdianite and zektzerite. Accessory minerals in this rock include albite, hyalotekite, pyrochlore, quartz and tadhikite-group minerals. The mineral is named for Yu. A. Arapov (1907–1988), a famous geologist and author of many works on the geochemistry, mineralogy and petrology of Middle Asia. Type material has been deposited at the Fersman Mineralogical Museum, Moscow, Russia. **P.C.P.**

CADMOINDITE*

S.V. Chaplygin, N.N. Mozgova, I.A. Bryzgalov, A.V. Mokhov (2004) Cadmoindite CdIn₂S₄ — A new mineral from Kudriavy Volcano (Iturup Isle, Kurile Islands). *Zap. Vser. Mineral. Obshch.*, 133(4), 21–27 (in Russian, English abstract).

Cadmoindite, the cadmium analogue of indite, has been found in high-temperature fumarolic crusts of the Kudriavy stratovolcano on the northernmost part of Iturup Isle in the southern Kurile Islands. The crusts consist of an upper oxidized zone and a lower sulfide zone; cadmoindite is found in the lower zone. The mineral is inferred to have formed as a replacement of indium and cadmium chlorides with decreasing fumarolic gas temperature. It occurs as well-formed, sharp, octahedral crystals to 0.15 mm showing characteristic stepped growths, in druses with pyrite, wurtzite and a rhenium disulphide, within sulphide-silicate masses to 5–8 cm. In detail two associations exist: one as intergrowths with pyrite and cadmian wurtzite, and the other in fractures and voids, as isolated crystals with wurtzite and an acicular lead-bismuth sulphide, but lacking associated pyrite. Cadmoindite is generally lustrous black to dark brown with a brown streak, but is red in thin slivers. Isotropic grey in reflected light with strong reddish brown internal reflections. Reflectance data are (λ nm, R %): (400, 24.9), (480, 23.5), (540, 21.7), (580,

*Before publication, minerals marked with an asterisk were approved by the Commission on New Minerals and Mineral Names, International Mineralogical Association.

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21.0), (640, 20.3), (700, 19.8). Conchoidal fracture; VHN_{20} 206 kg/mm²; D_{calc} 4.864 g/cm³. Electron microprobe analyses gave (mean [range]): Cd 19.98 [18.86–21.31], In 49.51 [48.33–50.45], S 27.53 [27.11–27.94], Fe 1.71 [1.01–2.42], Zn 0.77 [0.23–1.26], Ge 0.29 [0.00–1.19], Se 0.04 [0.00–0.08] wt%, giving the empirical formula $(\text{Cd}_{0.82}\text{Fe}_{0.14}\text{Zn}_{0.05})_{\Sigma 1.01}(\text{In}_{1.99}\text{Ge}_{0.02})_{\Sigma 2.01}\text{S}_{3.98}$, or ideally CdIn_2S_4 . X-ray powder diffraction study with a 57.3 mm Debye camera gave a 10.81(2) Å, Z 8, space group $Fd\bar{3}m$. The strongest maxima in the powder diffraction pattern are (d Å, I %; hkl): (3.27, 100; 311, 222), (1.91, 90; 440, 531, 442, 620), (1.107, 90; 844, 771, 755), (2.07, 80; 511, 333), (1.045, 80; 951, 773), (1.246, 70; 751, 555, 662, 840, 753, 911, 842, 664), (2.70, 60; 400, 331, 422), (1.41, 60; 731, 553, 800, 733, 644, 660, 822). Like indite, cadmoindite is a thiospinel. The name is for its chemistry as the Cd analogue of indite. Type material has been deposited with the Fersman Mineralogical Museum, Moscow (catalog no. 317/1).

Discussion. (1) The Kudriavy volcano is located at 45° 21' N, 148° 49' E. Its island ("Iturup" to Russians; "Etorofu" to Japanese) has been occupied by Russia since 1945, but is still claimed by Japan. (2) The name "rheniite" has been used in the manuscript without IMA approval. **T.S.E.**

ELSMOREITE*

P.A. Williams, P. Leverett, J.L. Sharpe, D.M. Colchester (2005) Elsmoreite, cubic $\text{WO}_3 \cdot 0.5\text{H}_2\text{O}$, a new mineral species from Elsmore, New South Wales, Australia. *Can. Mineral.*, 43, 1061–1064

Elsmoreite occurs as a white microcrystalline powder. Due to the minute grain-size, the physical and optical properties were acquired on the synthetic equivalent of elsmoreite prepared following the hydrothermal procedure of Günter et al. [*J. Sol. State Chem.* (1989) 38, 312–320]. The synthetic crystals were octahedral grains up to 20 µm in size. It is translucent, colorless, has a white streak, and adamantine luster. The mineral is brittle with splintery fracture, no apparent cleavage, and a Mohs hardness of 3. It is isotropic, $n = 2.24$. Electron microprobe analyses (WDS, average of 5 spot-analyses on individual grains) and a single thermogravimetric analysis for H_2O on elsmoreite gave WO_3 96.0, H_2O 3.3, sum 99.3 wt%, corresponding to $\text{WO}_3 \cdot 0.44\text{H}_2\text{O}$ based on a single W atom. The ideal formula is $\text{WO}_3 \cdot 0.5\text{H}_2\text{O}$.

Elsmoreite is cubic, $Fd\bar{3}m$, with unit-cell parameters refined using least-squares methods on powder X-ray diffraction data, $a = 10.203(1)$ Å, $V = 1062.1(2)$ Å³, $Z = 16$. The strongest lines on the X-ray diffraction pattern (Philips PW1820-25 powder diffractometer, $\text{CuK}\alpha$ radiation, 15 lines) include 5.88(100,111), 3.08(62,311), 2.944(78,222), 2.551(12,400), 1.964(17,511) 1.804(23,440), 1.725(14,531), 1.538(14,622). Elsmoreite has a structure based on a defect pyrochlore lattice, with the general formula $\text{A}_2\text{B}_2\text{O}_6\text{O}'$. Other structurally related species include alumotungstite, ferritungstite, and jixianite.

The type locality is the Elsmore tin deposit in Elsmore Hill, 17 km east of Inverell and adjacent to the village of Elsmore, New England region, New South Wales, Australia. Elsmoreite formed as a result of the oxidation of ferberite in the oxidized zone of weakly mineralized Sn, W, Mo, Bi granitic pegmatite dykes.

The host rocks for the dykes are pegmatitic greisen veins in a granite stock. Elsmoreite is associated with quartz, white mica, and cassiterite, with accessory arsenopyrite, native bismuth, chalcopyrite, ferberite, and molybdenite. Other secondary minerals found to be associated with elsmoreite include betpakdalite, bismite, bismutite, bismutostibiconite, koechlinite, powellite, rooseveltite, russellite, and scheelite. The name is for the type locality. Type material has been deposited in the collection of the Australian Museum in Sydney (catalog no. D53020). **R.R.**

JARANDOLITE*

S.V. Malinko, S. Anic'ic', D. Joksimovic', A.E. Lisitsyn, V.V. Rudnev, G.I. Dorokhova, N.A. Yamnova, V.V. Vlasov, A.A. Ozol, N.V. Chukanov (2004) Jarandolite $\text{Ca}[\text{B}_3\text{O}_4(\text{OH})_3]$, calcium borate from Serbia: New name and new data. *New Data Mineral. M.*, 39, 26–31.

Jarandolite occurs as elongate, tabular crystals ranging in size from a few millimeters to 1.5 cm. It is colorless to very pale brown (due to inclusions of smectite), vitreous, transparent, and has a white streak. Jarandolite is brittle, has perfect (001) cleavage, elongated along [100], flattened on [001], and has a Mohs hardness of 6. It dissolves slowly in dilute HCl and H_2SO_4 , and is not fluorescent. The mineral is biaxial positive, $\alpha = 1.573(2)$, $\beta = 1.586(2)$, $\gamma = 1.626(2)$, $2V_{\text{meas}} = 60(2)^\circ$, $2V_{\text{calc}} = 59^\circ 23'$, medium dispersion, $r > v$, $X = c$, $Y = B$, $Z \wedge a = 8^\circ$.

Wet chemical analyses of the mineral gave Na_2O 0.05, K_2O 0.07, CaO 30.56, MgO 0.02, MnO 0.01, Fe_2O_3 0.20, Al_2O_3 0.03, SiO_2 0.20, B_2O_3 55.44, Cl 0.21, H_2O 13.36, $\text{O} = \text{Cl} - 0.05$, sum 100.10 wt%, corresponding to $\text{Ca}_{1.02}(\text{B}_{2.99}\text{Si}_{0.01})_{\Sigma 3.00}\text{O}_{4.125}(\text{OH})_{2.79}\text{Cl}_{0.01}$ based on three B+Si atoms pfu. The ideal formula for jarandolite is $\text{Ca}(\text{B}_3\text{O}_4)(\text{OH})_3$, $D_{\text{meas}} = 2.49$ g/cm³, $D_{\text{calc}} = 2.57$ g/cm³, $Z = 4$. The IR spectrum of jarandolite is characterized by the following bands (s = strong, w = weak, sh = shoulder): 3350s, 3115, 2980, 1447, 1402s 1369, 1300s, 889s, 867s, 810, 795sh, 756, 695sh, 687, 587w, 577, 560, 533, 444w, and 419w cm⁻¹. Absorption bands in the range 850–1050 cm⁻¹ and 1220–1450 cm⁻¹ correspond to stretching vibrations of the B-O bonds in the $\text{BO}_3(\text{OH})$ and BO_3 groups, respectively. Absorption bands at 2980, 3115, and 3550 cm⁻¹ have been attributed to O-H vibrations in the two OH groups and OH substitution for Cl. Thermal and DTG/DTA analysis of jarandolite indicate that a 15% mass loss occurs at temperatures between 440 and 485 °C, close to the H_2O content determined by chemical analysis (13.36 wt%). The melting point of jarandolite is 820 °C.

The crystal structure of jarandolite was solved by direct methods and refined (Laue swing method and Syntex diffractometer) to $R_1 = 0.035$. It is monoclinic, $P2_1/a$, $a = 8.386(3)$, $b = 8.142(4)$, $c = 7.249(3)$ Å, $\beta = 98.33(3)^\circ$, $V = 489.7$ Å³. The strongest lines on the powder diffraction pattern (DRON MM-1, $\text{CoK}\alpha$ radiation, 38 lines given) include 4.32(57,111), 3.39(100,201), 3.13(50,211), 2.93(23,202), 2.606(25,221), 2.360(17,311), 2.287(19,320), and 1.849(25,421,420). Jarandolite is structurally and chemically similar to colemanite, $\text{Ca}[\text{B}_3\text{O}_4(\text{OH})_3] \cdot \text{H}_2\text{O}$. Details concerning the structure can be found in Yamnova et al. [*Kristallografiya* (1993) 38, 71–76].

Jarandolite was found in the mixed volcanic-sedimentary deposits of Pobrđjski Potok and Piskanja in the Jarandol lacustrine

basin (Miocene), 280 km south from Belgrade, Serbia. Magnesite deposits containing both borate and coal layers alternate with tuffaceous rocks, clays, and marls. The borate deposits occur predominantly in the tuffaceous deposits and have thicknesses from 1 to 12 m (average 4 m). Associated minerals include colemanite, howlite, lüneburgite, montmorillonite, pentahydroborite, searlesite, studenitsite, ulexite, and veatchite. The mineral is named for the locality, the Jarandol basin. Type material has been deposited in the Fersman Mineralogical Museum, Moscow, Russia (catalog no. 1538/1).

Discussion: The first data on jarandolite was published at an earlier date [Stojanovic' 1992; *Conf. Serbian Crystallogr. Soc. Abstracts I.*, 32–33; Stojanovic' et al. 1993; *Conf. Yugoslav Mineral. Assoc.*] under the tentative name "srbianite". Structural data was published by Yamnova [Kristallografiya (1993) 38, 71–76] prior to approval by the IMA CNMMN. **P.C.P.**

PAARITE*, SALZBURGITE*

D. Topa, E. Makovicky, T. Balić-Žunić (2005) Mineralogical data on salzburgite and paarite, two new members of the bismuthinite-aikinite series. *Can. Mineral.*, 43, 909–917.

Paarite $\text{Cu}_{1.7}\text{Pb}_{1.7}\text{Bi}_{6.3}\text{S}_{12}$ and salzburgite $\text{Cu}_{1.6}\text{Pb}_{1.6}\text{Bi}_{6.4}\text{S}_{12}$, are two new Cu–Pb–Bi sulfosalts, found in quartz veins of the Felbertal scheelite deposit, Hohe Tauern, about 10 km south of the town of Mittersill, Salzburg province, Austria. Abstracts for paarite and for salzburgite (as an unnamed species) were given previously (*Am. Mineral.*, 89, 1831; *Am. Mineral.*, 86, 199; respectively), based on reports of their crystal structures (Makovicky et al. 2001, *Can. Mineral.*, 39, 1377–1382; Topa et al. 2000, *Can. Mineral.*, 38, 611–616). For comparative purposes, further data are given here.

Paarite is brittle, $\text{VHN}_{50} = 204$ (range 170–228) kg/mm^2 , $\text{VHN}_{100} = 246$ (range 195–286) kg/mm^2 , $H_{\text{calc}} = 3.3$ –3.6, opaque, light grey, streak not given, metallic luster, with perfect $\{0kl\}$ cleavage and an uneven fracture. It is white in reflected light with a creamy tint, bireflectance perceptible in air and moderate in oil, weakly pleochroic white to creamy white, no internal reflections, distinctly anisotropic. An average of electron microprobe analyses from 12 samples gave Cu 4.90, Fe 0.02, Pb 16.45, Bi 60.74, S 17.84, sum 99.95 wt%, corresponding (on the basis of $\text{Bi} + [(\text{Pb} + \text{Fe} + \text{Cu})/2] = 8$) to $\text{Cu}_{1.67}\text{Fe}_{0.01}\text{Pb}_{1.72}\text{Bi}_{6.30}\text{S}_{12.06}$, ideally $\text{Cu}_{1.7}\text{Pb}_{1.7}\text{Bi}_{6.3}\text{S}_{12}$. Reflectance values of paarite (in air, WTiC standard) are (R_1 – R_2) 38.27–48.23 (470 nm), 37.34–48.56 (546 nm), 36.75–47.90 (589 nm), and 36.00–46.53 (650 nm). $D_{\text{calc}} = 6.963$ for the empirical formula, 6.948 g/cm^3 for the ideal formula and $Z = 5$. Single-crystal X-ray structure study ($R = 0.0703$) showed the mineral to be a 56 Å derivative of the bismuthinite-aikinite series: orthorhombic, space group *Pmnc* (alternative setting of *Pnma*), $a = 4.007(1)$, $b = 55.998(8)$, $c = 11.512(2)$ Å, $V = 2583(1)$ Å³. Powder diffraction data were calculated from the structure using Powder Cell 2.3 ($\lambda = \text{CuK}\alpha$), strongest lines [d in Å (I, hkl)] are 4.01 (56.3, 0.10.2), 3.630 (100, 053), 3.585 (55.3, 151), 3.551 (84.7, 0.15.1), 3.155 (57.2, 152), 3.136 (92.4, 1.10.1), 2.836 (92.6, 1.10.2), 2.658 (36.4, 1.15.1), 2.560 (40.6, 0.10.4), 2.004 (34.5, 200). The most closely related species are salzburgite, lindströmite $\text{Cu}_3\text{Pb}_3\text{Bi}_7\text{S}_{15}$, krupkaite $\text{PbCuBi}_3\text{S}_6$,

and gladite $\text{PbCuBi}_3\text{S}_9$.

Salzburgite is brittle, VHN not given, H not given, opaque, light grey, streak not given, with metallic luster, cleavage not given, and uneven fracture. Grayish white in reflected light with optical properties similar to paarite, but pleochroism was not observed. An average of electron microprobe analyses from 19 samples gave Cu 4.67, Fe 0.03, Pb 15.86, Bi 61.90, S 17.87, sum 100.33 wt%, corresponding (on the basis of $\text{Bi} + [(\text{Pb} + \text{Fe} + \text{Cu})/2] = 8$) to: $\text{Cu}_{1.58}\text{Fe}_{0.01}\text{Pb}_{1.65}\text{Bi}_{6.38}\text{S}_{12.00}$, ideally $\text{Cu}_{1.6}\text{Pb}_{1.6}\text{Bi}_{6.4}\text{S}_{12}$. Reflectance values of salzburgite (in air, WTiC standard) are (R_1 – R_2) 39.15–48.36 (470 nm), 38.26–47.65 (546 nm), 37.23–47.14 (589 nm), and 36.55–45.71 (650 nm). $D_{\text{calc}} = 6.942$ for the empirical formula, 6.925 g/cm^3 for the ideal formula and $Z = 4$. Single-crystal X-ray structure study ($R = 0.0467$) showed the mineral to be a 44.8 Å derivative of the bismuthinite-aikinite series: orthorhombic, space group *Pmc2*₁, cell dimension and angles $a = 4.0074(9)$, $b = 44.81(1)$, $c = 11.513(3)$ Å, $V = 2067(1)$ Å³. Powder diffraction data were calculated from the structure using Powder Cell 2.3 ($\lambda = \text{CuK}\alpha$), strongest lines [d in Å (I, hkl)] are 4.015 (57.3, 082), 3.631 (100, 043), 3.586 (55.3, 141), 3.552 (85.8, 0.12.1), 3.156 (56.9, 142), 3.136 (92.9, 181), 2.836 (93.5, 182), 2.658 (36.7, 1.12.1), 2.560 (42.9, 084), 2.004 (37.2, 200). The most closely related species are paarite, lindströmite $\text{Cu}_3\text{Pb}_3\text{Bi}_7\text{S}_{15}$, krupkaite $\text{CuPbBi}_3\text{S}_6$, and gladite $\text{CuPbBi}_3\text{S}_9$.

It is emphasized that the small differences in composition between paarite and salzburgite are real, and correspond to differences in their structures. They are superstructures of the bismuthinite-aikinite series with a periodicity of order equal to a fivefold, and fourfold multiple, respectively, of the bismuthinite substructure motif. The structure determinations show that paarite and salzburgite cannot be reduced to the integer formulae hitherto assumed for all members of the bismuthinite-aikinite series. In particular, salzburgite appears to require a set of partly occupied Cu sites for its stability.

Paarite and salzburgite occur as rare elongate crystals up to 0.2 and 0.3 mm in length, respectively, in columnar aggregates, and as exsolution lamellae formed by the decomposition of intermediate compositions of the bismuthinite-aikinite series. The intergrowths include krupkaite-paarite, gladite-paarite, krupkaite-salzburgite, and gladite-salzburgite. The minerals are hosted in quartz and associated with: other sulfosalts in the range gladite-krupkaite, the gustavite-lillianite solid solution, pavonite and makovickyite, traces of cosalite, cannizzarite, tetradymite, native Bi, chalcopyrite, and pyrite. Paarite is named after Werner Hermann Paar (b.1942), Professor of Mineralogy at the University of Salzburg, for his contributions to ore mineralogy. Salzburgite is named after the province of Salzburg in the Republic of Austria, in which the Felbertal deposit is located. Holotype samples have been deposited at the Geological Museum of the University of Copenhagen (Denmark) and in the reference collection of the Mineralogical Institute, University of Salzburg.

Discussion. A possible additional occurrence of a paarite- or salzburgite-type mineral is described by Förster et al. 2005 (*Can. Mineral.*, 43, 899–908), and is abstracted here under Watkinsinite, Nevskite, Bohdanowiczite, $\text{Cu}_2\text{Bi}_2\text{Se}_4$, $\text{CuPbBi}_4\text{S}_8$. **A.J.L.**

ROUXELITE*

P. Orlandi, A. Meerschaut, Y. Moëlo, P. Palvadeau, P. Léone (2005) Lead-antimony sulfosalts from Tuscany (Italy). VII. Rouxelite, $\text{Cu}_2\text{HgPb}_{22}\text{Sb}_{28}\text{S}_{64}(\text{O},\text{S})_2$, a new sulfosalts from Buca Della Vena Mine, Apuan Alps: definition and crystal structure. *Can. Mineral.*, 43, 919–933.

Rouxelite, $\text{Cu}_2\text{HgPb}_{22}\text{Sb}_{28}\text{S}_{64}(\text{O},\text{S})_2$, is a new species of sulfosalts discovered in the Buca della Vena Fe–Ba deposit, near the village of Ponte Stazemese, Apuan Alps, Italy. The mineral occurs as very rare acicular crystals up to 2 mm long, elongated and striated parallel to [010]. The crystals are black with metallic luster, with the following properties not given due to the size and scarcity of the material: tenacity, microhardness, *H*, opacity, streak, and fracture; cleavage was not observed. Light grey in reflected light, weak bireflectance, distinctly anisotropic without polarization tints. The average of six electron microprobe analyses gave Cu 1.34, Hg 1.76, Pb 45.08, Sb 31.50, S 20.07, O 0.39, sum 100.14 wt%, corresponding to $\text{Cu}_{2.20}\text{Hg}_{0.92}\text{Pb}_{22.78}\text{Sb}_{27.10}\text{S}_{65.53}\text{O}_{2.55}$ for 53 cations, ideally $\text{Cu}_2\text{HgPb}_{22}\text{Sb}_{28}\text{S}_{64}(\text{O},\text{S})_2$. Reflectance values of randomly oriented rouxelite (in air, NPL 50 SiC standard) are 38.2 (470 nm), 36.4 (546 nm), 35.4 (589 nm), and 32.8 (650 nm). $D_{\text{calc}} = 5.92$ for the empirical formula from the mean of the electron microprobe results, 5.86 g/cm^3 for the ideal formula (with S 64.67 and O 1.33 atoms pfu) and $Z = 2$. Single-crystal X-ray structure study ($R = 0.1686$) showed a novel structure and supported the presence of oxygen: empirical formula $\text{Cu}_2\text{Hg}_1\text{Pb}_{22.61}\text{Sb}_{27.39}\text{S}_{64.67}\text{O}_{1.33}$ for 53 cations (from structure), monoclinic, space group $C2/m$, $a = 43.113(9)$, $b = 4.0591(8)$, $c = 37.874(8)$ Å, $\beta = 117.35(3)^\circ$, $V = 5887(2)$ Å³. Powder diffraction data were measured with a Gandolfi camera (114.6 mm diameter, $\lambda = \text{CuK}\alpha$), strongest lines [d in Å (I, hkl)] are 3.84 (31, $\bar{1}0, 0.8$), 3.402 (100, $\bar{1}0, 0.2, \bar{1}2, 0.8, 115$), 3.369 (74, $\bar{7}14, 0.0, 10$), 2.815 (70, $317, \bar{1}\bar{1}, 1.4$), 2.756 (36, $516, 12, 0.3$), 2.251 (31, $1, 1, 12, 3, 1, 11$), 2.116 (31, $\bar{1}\bar{1}, 1, 1, 15$), 1.955 (30, $\bar{1}9, 1.5, 11, 1, 8$). The most closely related species from a structural viewpoint are kobellite $\text{Pb}_{22}\text{Cu}_4(\text{Bi},\text{Sb})_{30}\text{S}_{69}$ and neyite $\text{Ag}_2\text{Cu}_6\text{Pb}_{25}\text{Bi}_{26}\text{S}_{68}$.

Rouxelite occurs in small veinlets that cross-cut dolomitic lenses interstratified in Ba and Fe-oxide ore, and is closely associated with bournonite, as well as tetrahedrite and sphalerite. A second occurrence has been noted from the antimony deposit of Magurka, Slovakia, in which silver-bearing rouxelite (Ag 0.35 wt%) is closely associated with bournonite in a sample composed mainly of boulangerite, pyrite, and mercurian sphalerite in a quartz gangue. The mineral is named after Jean Rouxel (1935–1998), specialist in solid-state chemistry and member of the French Academy of Science, for his studies of chalcogenides. Type material is deposited at the Museo di Storia Naturale e del Territorio, Università di Pisa, Italy. The mineral corresponds to IMA no. 2002-062.

Discussion. Powder diffraction data calculated from the structure using FULLPROF had maximum intensity 59%, implying some problem with either the calculation or the report. The structure refinement is of low precision. **A.J.L.**

TERLINGUACREEKITE*

A.C. Roberts, R.A. Gault, W.H. Paar, M.A. Cooper, F.C. Hawthorne, P.C. Burns, S. Cisneros, E.E. Foord, (2005) Terlingua-

creekite, $\text{Hg}_2^3\text{O}_2\text{Cl}_2$, a new mineral species from the Perry Pit, Mariposa mine, Terlingua mining district, Brewster county, Texas, U.S.A.

Terlinguacreekite is found as millimeter-sized, anhedral, dark orange to reddish crystalline crusts. Most crusts have no discernable crystal form, but rare crystal aggregates up to 0.5 mm are found. The crystals are up to 0.2 mm in length, subhedral, acicular to prismatic, elongation [001] with a maximum length-width ratio of 4:1. Terlinguacreekite is brittle with an uneven fracture, no observable cleavage, and non-fluorescent. The mineral is vitreous, transparent, and has a yellow streak. The hardness could not be properly determined owing to the small crystal size, but the mineral is relatively soft. Electron microprobe analyses of terlinguacreekite (average of 8 analyses) gave HgO 92.03, Cl 9.54, Br 1.22, sum 102.79, less O = Cl + Br 2.28, sum 100.51 wt%, corresponding to $\text{Hg}_{3.00}^2\text{O}_{2.00}(\text{Cl}_{1.90}\text{Br}_{0.11})_{22.01}$ based on O + Cl + Br = 4. The ideal formula is $\text{Hg}_2^3\text{O}_2\text{Cl}_2$. Terlinguacreekite is bluish grey in plane-polarized light, weakly birefringent, and non-pleochroic. In crossed-polars, it is anisotropic and shows yellowish orange internal reflections. Reflectance percentages for R_{min} and R_{max} are 15.4, 16.5 (470 nm), 14.5, 15.6 (546 nm), 14.3, 15.4 (589 nm), and 14.2, 15.2 (650 nm), respectively.

According to the work done by X-ray precession methods, terlinguacreekite is orthorhombic, *Imam*, *Imcm*, *Ima2*, or *I2cm*, $a = 6.737(3)$, $b = 25.528(10)$, $c = 5.533(2)$ Å, $V = 951.6(6)$ Å³, $Z = 8$, $D_{\text{calc}} = 9.899 \text{ g/cm}^3$. The strongest lines on the powder X-ray diffraction pattern (114.6 mm Debye-Scherrer camera, $\text{CuK}\alpha$ radiation, 54 lines) include 12.764(20,020), 5.413(30,011), 5.277(20,130), 4.629(15,031), 4.063(80,121), 3.376(15,200), 3.201(50,080), 3.023(50,161), 2.983(60,240), 2.858(30,211), 2.765(50,002), 2.726(20,231), 2.518(100b,091,251), 2.447 (15,132), 2.259(15,271), 2.191(20,1,11,0), 2.090(20,082), 2.026(30,242), 1.869(15,361), 1.798(25,2,12,0), 1.684(20,400), 1.639(15,163), 1.606(15,2,14,0), 1.542(25,093,253), 1.507 (20,2,12,2), 1.450(15,0,17,1), 1.438(15,402), 1.402(20,491). Terlinguacreekite has no direct relation with any of the other six Hg–O–Cl bearing phases found in nature or any other inorganic phase listed in the Powder Diffraction File (PDF). Two other polymorphs of $\text{Hg}_2^3\text{O}_2\text{Cl}_2$ are known, but their X-ray powder patterns differ from terlinguacreekite.

The mineral was found as a thin orange crust on massive calcite in an isolated area (approximately $1 \times 0.5 \text{ m}$) within the lower level of the Perry pit, Mariposa mine, Terlingua district, Brewster County, Texas, U.S.A. It is also found at the McDermit mine where it is associated with kleinite and calomel in silicified volcanic rocks and sediments. Terlinguacreekite is thought to form at the expense of primary cinnabar and native mercury. The mineral is named after the Terlingua Creek, which flows in the Terlingua mining district in Texas. The holotype material has been deposited in the Systematic Reference Series of the National Mineral Collection at the Geological Survey of Canada (catalog no. MNC68100). The polished sections used for probe and reflectance analyses have been deposited at the Natural Museum of History, London, U.K. (catalog no. BM2004, 54).

Discussion. The authors are unable to solve the structure for the mineral at this time, despite several attempts. **R.R.**

ZERAVSHANITE*

L.A. Pautov, A.A. Agakhanov, Y.A. Uvarova, E.V. Sokolova, F.C. Hawthorne (2004) Zeravshanite, $\text{Cs}_4\text{Na}_2\text{Zr}_3(\text{Si}_{18}\text{O}_{45})(\text{H}_2\text{O})_2$, new cesium mineral from Dara-i-Pioz massif (Tajikistan). *New Data Mineral. M.*, 39, 21–25.

Y.A. Uvarova, E. Sokolova, F.C. Hawthorne, L.A. Pautov, A.A. Agakhanov (2004) A novel $[\text{Si}_{18}\text{O}_{45}]^{18-}$ sheet in the crystal structure of zeravshanite, $\text{Cs}_4\text{Na}_2\text{Zr}_3[\text{Si}_{18}\text{O}_{45}](\text{H}_2\text{O})_2$. *Can. Mineral.*, 42, 125–134.

Zeravshanite occurs as colourless, transparent single crystals 0.02 to 0.1 mm in size, or in aggregates of tabular crystals up to 0.2 mm. It is vitreous, not fluorescent in short- or long-wave UV light, has cleavage in one direction (not given), and a Mohs hardness of 6. It is biaxial negative, $\alpha = 1.585(2)$, $\beta = 1.598(2)$, $\gamma = 1.603(2)$, $2V_{\text{calc}} = -63^\circ$, medium dispersion $v > r$, negative elongation.

Electron microprobe analyses of the mineral (WDS, average of 18 analyses) gave SiO_2 52.20, TiO_2 0.043, ZrO_2 16.41, SnO_2 0.46, Fe_2O_3 0.21, Na_2O 3.06, K_2O 0.09, Cs_2O 26.58, $\text{H}_2\text{O}_{\text{calc}}$ 1.74, sum 101.18 wt%, corresponding to $(\text{Cs}_{3.80}\text{Na}_{0.18}\text{K}_{0.02})_{\Sigma 4.00}\text{Na}_{2.00}(\text{Zr}_{2.73}\text{Ti}_{0.19}\text{Fe}^{3+}_{0.04}\text{Sn}_{0.04})_{\Sigma 3.00}(\text{Si}_{18}\text{O}_{45})(\text{H}_2\text{O})_2$ based on 18 Si atoms. The ideal formula of zeravshanite is $\text{Cs}_4\text{Na}_2\text{Zr}_3(\text{Si}_{18}\text{O}_{45})(\text{H}_2\text{O})_2$, $D_{\text{meas}} = 3.09(5) \text{ g/cm}^3$, $D_{\text{calc}} = 3.17 \text{ g/cm}^3$, $Z = 4$. The IR spectrum of the mineral has strong absorption bands at 1089, 1045, 978, 709, 662, 585, and 538 cm^{-1} (no designations given).

The structure of zeravshanite was solved and refined using direct methods on a $0.200 \times 0.105 \times 0.084$ single crystal to $R_1 = 0.028$ for 4508 reflections with $F_o > 4\sigma(F_o)$. The mineral is monoclinic, $C2/c$, $a = 26.3511(8)$, $b = 7.5464(3)$, $c = 22.9769(8) \text{ \AA}$, $\beta = 107.237(1)^\circ$, $V = 4363.9(4) \text{ \AA}^3$, $\mu = 4.49 \text{ mm}^{-1}$. The strongest lines in the powder X-ray diffraction pattern (114 mm RKD camera, $\text{FeK}\alpha$ radiation, 36 lines given) include $6.32(50, \bar{4}02)$, $3.65(50, 006)$, $3.35(100, \bar{7}12)$, $3.25(40, 206)$, $3.14(90, \bar{2}24)$, $2.82(50, \bar{7}16)$, $2.62(70, 026)$, $1.946(40, \bar{2}.2.10)$, $1.891(40, \bar{1}2.2.4)$, and $1.865(40, \bar{5}38)$. The structure contains SiO_4 tetrahedra linked together to form $[\text{Si}_{18}\text{O}_{35}]^{18-}$ sheets parallel to (101), with 5- and 8-membered silicate rings. These sheets are linked together with $M\phi_6$ octahedra and $\text{Na}\phi_5$ polyhedra to form a mixed framework. The A cations (Cs, Na, K) are located in the framework cages. This is the first occurrence of a $[\text{Si}_{18}\text{O}_{45}]^{18-}$ sheet in a mineral. The topology of the sheet is identical to what is observed in the $[\text{Si}_6\text{O}_{15}]^{6-}$ sheets of nekoite and okenite which can be considered as geometrical isomers.

Zeravshanite was discovered in the moraine of the Dara-i-Pioz glacier at the junction of the Zeravshan, Turkestan and Alay Ranges, Tajikistan. It was found in a block of rock in the moraine consisting predominantly of quartz as well as aegirine, pectolite, polyolithionite, and reedmergerite. Accessory phases include baratovite, berezanskite, bismuth, calcite, darapiosite, dusmatovite, fluorapatite, fluorapophyllite, fluorite, galena, kapit-saite-(Y), neptunite, pyrochlore, and tadzhikite-group minerals. It is often found as an intergrowth with pectolite and an unnamed Cs-Ca-Si mineral. No speculation on the origins of the mineral is given, although the authors suggest that the rock is the quartz core of a pegmatite or a fragment of a silicate vein body. The

mineral is named after the type locality (Zeravshan Range). Type material has been deposited at the Fersman Mineralogical Museum, Moscow, Russia. **P.C.P.**

NEW DATA**ALAMOSITE* (SYNTHETIC)**

S.V. Krivovichev, P.C. Burns (2004) Crystal structure of synthetic alamosite $\text{Pb}[\text{SiO}_3]$. *Zap. Vser. Mineral. Obshch.*, 133(5), 70–76 (in Russian, English abstract).

Gray, semi-transparent crystals of synthetic alamosite, PbSiO_3 , to 0.1 mm, were prepared hydrothermally in a 17 h run at 220°C . A single-crystal X-ray structure refinement ($R[F^2] = 0.047$, $wR[F^2] 0.089$; 1201 observed [$I > 2\sigma$] reflections, $\text{MoK}\alpha$ radiation) gave monoclinic symmetry, $P2/n$, $a = 11.209(1)$, $b = 7.0410(8)$, $c = 12.220(1) \text{ \AA}$, $\beta = 113.010(2)^\circ$, $D_{\text{calc}} = 6.36 \text{ g/cm}^3$. Each of the three crystallographically independent, six-coordinated Pb^{2+} cations shows an asymmetric bonding environment consistent with the presence of a stereoactive lone pair of $6s^2$ electrons. Silicon-oxygen tetrahedra link to form zigzag $[\text{Si}_{12}\text{O}_{36}]$ chains along [101] with a modulation amplitude of $b/2$. The high periodicity and degree of zigzagging of the chains are related to shortened Pb^{2+} -O bonding in the Pb1 and Pb2 polyhedra that cross-link every first and fourth tetrahedron in the chain sequence, which is in turn related to the stereoactivity of the Pb^{2+} cations. **T.S.E.**

BERNALITE*

M.D. Welch, W.A. Crichton, N.L. Ross (2005) Compression of the perovskite-related mineral bernalite $\text{Fe}(\text{OH})_3$ to 9 GPa and a reappraisal of its structure. *Min. Mag.*, 69, 309–315.

Re-investigation of the symmetry of bernalite, $\text{Fe}(\text{OH})_3$, using material from the type specimen, by synchrotron powder diffraction, showed that it is orthorhombic, space group $Pmmm$, with cell dimensions at ambient pressure $a = 7.6191(2)$, $b = 7.6191(2)$, $c = 7.5534(4) \text{ \AA}$, $V = 438.48(3) \text{ \AA}^3$, $Z = 8$, $D_{\text{calc}} = 3.24 \text{ g/cm}^3$. Bernalite had been considered previously to have space group $Immm$. It is noted that the unit cell is metrically tetragonal. Electron microprobe analyses (methods and data not given; 12 analyses on 3 grains) gave the composition for the cation site $\text{Fe}_{0.89(4)}\text{Si}_{0.07(1)}\text{Pb}_{0.02(1)}\text{Zn}_{0.02(1)}$, in agreement with the literature. **A.J.L.**

CALCIUM TSCHERMAK'S COMPONENT OF CLINOPYROXENE, $\text{CaAl}_2\text{SiO}_6$

M.-L. Pascal, I. Katona, M. Fontelles, J. Verkaeren (2005) Relics of high-temperature clinopyroxene on the join Di-Ca-Ts with up to 72 mol% $\text{Ca}(\text{Al}, \text{Fe}^{3+})\text{AlSiO}_6$ in the skarns of Ciclova and Magureaua Văței, Carpathians, Romania. *Can. Mineral.*, 43, 857–881.

Electron microprobe analysis of clinopyroxene (one crystal, two compositions discussed, one composition reported) from a wollastonite endoskarn gave SiO_2 34.37, TiO_2 0.22, Al_2O_3 24.04, Cr_2O_3 0.05, FeO_{tot} 9.67, MnO 0.16, MgO 5.11, CaO 24.83, Na_2O

0.08, sum 98.53 wt%, which corresponds (on the basis of 4 cations and 6 anions) to $(\text{Ca}_{1.009}\text{Na}_{0.006})_{\Sigma 1.015}(\text{Al}_{0.377}\text{Fe}^{3+}_{0.307}\text{Mg}_{0.289}\text{Ti}_{0.006}\text{Mn}_{0.005}\text{Cr}_{0.001})_{\Sigma 0.985}(\text{Si}_{1.303}\text{Al}_{0.697})\text{O}_6$. These data are interpreted to represent the first natural occurrence of clinopyroxene in which the calcium Tschermak's component is dominant. The endmember proportions are 37.8% CaTs, calcium Tschermak's component, $\text{CaAl}_2\text{SiO}_6$; 30.7% Ess, esseneite, $\text{CaFe}^{3+}\text{AlSiO}_6$; 28.9% Di, diopside, $\text{CaMgSi}_2\text{O}_6$; 0.6% CaTi, calcium-titanium Tschermak's component, $\text{CaTiAl}_2\text{O}_6$; 2.0% remainder, sum 100.0%. The analysis technically corresponds to a new mineral species, but it is stated that the crystal is too small to be extracted for a formal description of its properties, and it is provisionally referred to as "ferrian CaTs". This nomenclature is in accord with the usage in the report of the IMA Subcommittee on Pyroxenes (Morimoto et al. 1988, *Amer. Mineral.*, 73, 1123–1133). Esseneite, $\text{CaFe}^{3+}\text{AlSiO}_6$, is the only approved pyroxene species whose endmember formula requires a Tschermak's-type substitution. **A.J.L.**

EPISTOLITE*, MURMANITE*, SHKATULKALITE*

P. Nèmeth, G. Ferraris, G. Radnóczy, O.A. Ageeva (2005) TEM and X-ray study of syntactic intergrowths of epistolite, murmanite and shkatulkalite. *Can. Mineral.*, 43, 973–987.

Syntactic intergrowths of the heterophyllosilicates epistolite and murmanite, and epistolite with minor shkatulkalite (members of the mero-pleisotype bafertisite series) were investigated by transmission electron microscopy, X-ray single-crystal and powder diffraction methods. In conjunction with electron microprobe analyses, these results are consistent with the ideal formulae $(\text{Na}, \square)_2\{(\text{Na}, \text{Ti})_4[\text{Nb}_2(\text{O}, \text{H}_2\text{O})_4\text{Si}_4\text{O}_{14}](\text{OH}, \text{F})_2\} \cdot 2\text{H}_2\text{O}$ for epistolite, and $(\text{Na}, \square)_2\{(\text{Na}, \text{Ti})_4[\text{Ti}_2(\text{O}, \text{H}_2\text{O})_4\text{Si}_4\text{O}_{14}](\text{OH}, \text{F})_2\} \cdot 2\text{H}_2\text{O}$ for murmanite. The formula $\{(\text{Na}, \text{Mn}, \text{Ca}, \square)_4[\text{Nb}_2(\text{O}, \text{H}_2\text{O})_4\text{Si}_4\text{O}_{14}](\text{OH}, \text{F})_2\} \cdot 2(\text{H}_2\text{O}, \square)$ is given for shkatulkalite. Syntaxy amongst these minerals is favored by the presence in epistolite, murmanite and shkatulkalite of common supercells. The widespread presence of syntaxy leads to the systematic overlap of diffraction spots belonging to different intergrown minerals, and gives rise to problems in the refinement of their structures (e.g., unusually short bond-lengths, substantial residual electron-density peaks, convergence at high *R*-values). It is emphasized that epistolite and murmanite are not isostructural, but have topologically distinct structures that are closely related. **A.J.L.**

GOSLARITE*

J.L. Anderson, R.C. Peterson, I.P. Swanson (2005) Combined neutron powder diffraction and X-ray single-crystal structure refinement of the atomic structure and hydrogen bonding of goslarite ($\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$). *Mineral. Mag.*, 69, 259–271.

The structure of goslarite, $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$, orthorhombic, space group $P2_12_12_1$, was determined through the combined investigation of deuterated synthetic material by neutron powder diffraction ($R = 0.1266$), $a = 11.8176(6)$, $b = 12.0755(7)$, $c = 6.8270(4)$ Å, $V = 974.24(7)$ Å³, $Z = 4$, $D_{\text{calc}} = 2.06$ g/cm³, and of synthetic material by X-ray single-crystal structure refinement ($R = 0.0872$), $a = 11.728(4)$, $b = 11.973(4)$, $c = 6.772(2)$ Å, V

$= 950.8(8)$ Å³, $Z = 4$, $D_{\text{calc}} = 2.01$ g/cm³. The data reveal the hydrogen bonding in the structure. Variations in the Zn-O bond lengths are attributed to the influence of the H bonds. Goslarite is isostructural with epsomite, $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, and morenosite, $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$, but not melanterite, $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$. **A.J.L.**

HOLTITE*

S.S. Kazantsev, D.Yu. Pushcharovskiy, M. Pазero, S. Merlino, N.V. Zubkova, Yu.K. Kabalov, A.V. Voloshin (2005) Crystal structure of holtite I. *Kristallogr.*, 50, 49–54 (in Russian).

Holtite occurs in two varieties in granitic pegmatites, a paragenetically early one sometimes referred to as "holtite I" ([Sb,As]-poor) and a later one, "holtite II" ([Sb,As]-rich). Single-crystal X-ray structure refinement ($R = 0.047$) gives the formula of "holtite I" from a granitic pegmatite in the Voron'i Tundra, Kola Peninsula, Russia as $(\text{Si}_{2.43}\text{Sb}_{0.36}\text{As}_{0.21})[(\text{Al}_{0.62}\text{Ta}_{0.26}\square)\text{Al}_2(\text{Al}_{0.98}\square)_2(\text{Al}_{0.94}\square)_2\text{O}_{12}](\text{BO}_3)(\text{O}, \text{OH}, \square)_{2.65}$, in good agreement with previously published refinements of the crystal structure of holtite. An X-ray Rietveld refinement was also done on "holtite I", giving $R_{\text{wp}} 0.027$, $R_f 0.029$, $S 1.23$, $a = 4.6880(1)$, $b = 11.884$, $c = 20.35(3)$ Å, space group *Pnma*. Single-crystal structure refinement of "holtite II" (Kola Peninsula), was not successful, nor were attempts at a Rietveld refinement, but cell parameters $a = 4.6875(1)$, $b = 11.881$, $c = 20.418(9)$ Å were obtained from the Rietveld refinement. As compared to "holtite I", extra diffraction maxima appear in the powder pattern of "holtite II", and may be due to admixture with another mineral phase; however, the "instability" of its structure refinement may point to as-yet undefined structural differences.

Discussion. (1) The names "holtite I" and "holtite II" ("holtite-I" and "holtite-II" in earlier publications of one of the authors) are paragenetic-compositional varietal terms for holtite with *inferred* but not proven structural differences. Given that the varietal distinction is based upon amounts of antimony and arsenic *subordinate* to the silicon they replace, given the lack of any established structural difference between the two varieties, and given that this terminology has not been approved by the IMA, its continued use seems ill-advised, especially with its similarity to accepted terminology currently in use for some polymorphic *species* (e.g., dimorphite-I, dimorphite-II). (2) The positional and thermal parameters resulting from the Rietveld refinement of "holtite I" are not given. (3) Standard deviations on the *b* cell parameters from the Rietveld refinements were omitted in the original paper, not by this abstractor. **T.S.E.**

HYDROROMARCHITE*

G. Garuti, F. Zaccarini (2005) Minerals of Au, Ag and U in volcanic-rock-associated massive sulfide deposits of the northern Apennine ophiolite, Italy. *Can. Mineral.*, 43, 935–950.

Hydroromarchite, ideally $\text{Sn}_3\text{O}_2(\text{OH})_2$, was identified by electron microprobe analysis. Analyses from eight grains yielded the compositional ranges (and average) Sn 80.35–84.78 (83.41), Fe 0.50–1.36 (0.79), Zn 0–1.17 (0.57), S 0–0.17 (0.04), O (calculated) 11.33–11.87 (11.61), H₂O (assumed from ideal formula) 4.27, sum 97.86–102.59 (100.68) wt%. The average corresponds (on the basis of 3 cations and neglecting S) to $(\text{Sn}_{2.90}\text{Fe}_{0.06}\text{Zn}_{0.04})$

$\Sigma_{3.00} \text{O}_2(\text{OH})_{1.96}$. Hydromorarchite occurs with pyrite, sphalerite, or siderite as coatings, spots, or crystals 5–50 μm across. It is found as part of an assemblage of siderite, pyrite, smithsonite, barite, and an unidentified Fe-Ca sulfate associated with the interstitial quartz-calcite gangue of massive sphalerite-pyrite ore at “Cantiere Speranza”, Corchia (Emilia Romagna), Italy. Hydromorarchite has most often been described as a corrosion product of pewter. This is the first non-anthropogenic occurrence of hydromorarchite. **A.J.L.**

NICKELALUMITE

V.Yu. Karpenko, A.A. Agakhanov, L.A. Pautov, T.V. Dikaya, G.K. Bekenova (2004) New occurrence of nickelalumite on Kara-Chagyr, South Kirgizia. *New Data Mineral. M.*, 39, 32–39.

Nickelalumite was found in carboniferous-siliceous vanadium-bearing schists of Kara-Chagyr and Kara-Tangi, Batkensk region, south Kirgizia (Kyrgyzstan). This is the second occurrence of the mineral world-wide. At Kara-Chagyr, nickelalumite was found in the dumps of an old mine working associated with other Ni and V minerals in quartz breccia within the carboniferous-siliceous schists. It has a variable V content which is reflected in the range of colors observed with V-free crystals being light blue and V-bearing to V-rich samples pistachio-green to dark green in color. It forms fibrous, radiating aggregates with fibers from 0.05 to 0.5 mm in length, and as crusts of solid spherulites up to 1.5 mm. Spherulites are often coated in ankinovichite and intercalated with allophane. At Kara-Tangi, V-free nickelalumite was found in the dumps near a mine adit. It occurs as a light blue crust composed of fibrous, radiating, lamellar aggregates up to 1.5 mm. Some of these aggregates have been replaced by allophane. Nickelalumite is biaxial negative, $n_g = 1.533(2)$, $n_p = 1.524(2)$, with inclined extinction 40° relative to the crystal elongation. Electron microprobe analyses (EDS) were performed on a variety of samples with differing V and Zn contents. V-free (Kara-Chagyr, 597/24): NiO 12.07, ZnO 0.66, CuO 0.00, FeO 0.02, Al_2O_3 38.05, SiO_2 0.77, SO_3 14.45, V_2O_5 0.00, H_2O 31.10, sum 97.12 wt%, corresponding to $(\text{Ni}_{0.85}\text{Zn}_{0.04})_{\Sigma 0.89}(\text{Al}_{3.93}\text{Si}_{0.07})_{\Sigma 4.00}(\text{SO}_4)_{0.95}(\text{OH})_{11.95} \cdot 3.12\text{H}_2\text{O}$. V-rich (Kara-Chagyr, 5341): NiO 10.03, ZnO 1.15, CuO 1.10, FeO 0.00, Al_2O_3 26.35, SiO_2 1.08, SO_3 11.99, V_2O_5 5.40, H_2O 31.10, sum 98.20 wt%, corresponding to $(\text{Ni}_{0.73}\text{Zn}_{0.08}\text{Cu}_{0.08})_{\Sigma 0.89}(\text{Al}_{3.90}\text{Si}_{0.10})_{\Sigma 4.00}[(\text{SO}_4)_{0.82}(\text{VO}_4)_{0.32}]_{\Sigma 1.14}(\text{OH})_{11.28} \cdot 3.81\text{H}_2\text{O}$. Zn-analog of nickelalumite (Kara-Tangi, 5360): NiO 4.34, ZnO 9.45, CuO 0.95, FeO 0.41, Al_2O_3 37.85, SiO_2 0.42, SO_3 14.54, V_2O_5 0.00, H_2O 31.10, sum 99.06 wt%, corresponding to $(\text{Zn}_{0.62}\text{Ni}_{0.31}\text{Cu}_{0.06}\text{Fe}_{0.03})_{\Sigma 1.02}(\text{Al}_{3.96}\text{Si}_{0.04})_{\Sigma 4.00}(\text{SO}_4)_{0.97}(\text{OH})_{12.14} \cdot 3.15\text{H}_2\text{O}$. All formulae have been calculated based on 4(Al + Si) atoms pfu. The ideal formula is $(\text{Ni,Zn,Cu})(\text{Al,Si})(\text{SO}_4)(\text{VO}_4)(\text{OH})_{12} \cdot 3\text{H}_2\text{O}$, and for its potentially new Zn-analogue $(\text{Zn,Ni})(\text{Al,Si})(\text{SO}_4)(\text{VO}_4)(\text{OH})_{12} \cdot 3\text{H}_2\text{O}$. The IR spectrum of nickelalumite has bands at 598–606, 1010–1011, and 1098–1103 cm^{-1} which are characteristic of SO_4 tetrahedra vibrations. The presence of bands at 750–800 cm^{-1} , characteristic for vanadates, confirms the presence of V^{5+} in tetrahedral coordination. Based on this new chemical data, nickelalumite appears to form a ternary solid solution series (Ni-Zn-Cu) with chalcoalumite and its Zn-analogue.

The strongest lines on the powder X-ray diffraction pattern (RKD camera, 57.3 mm, $\text{CuK}\alpha$ radiation, 30 lines given) for V-free nickelalumite include 8.35(100,002), 6.61(30,110), 4.62(30,202), 4.27(90,004), 3.71(20,114), 3.30(50,220), 3.16(40,222), 3.02(60,311), 2.683(60,132), 2.508(80,133), 2.276(70,126), 2.222(30,414), 1.981(90,235), 1.824(30,137), 1.811(30,145), 1.740(40,146,151), 1.710(40,209), and 1.556(30,319).

Nickelalumite is a product of low-temperature hydrothermal processes. At Kara-Chagyr, nickelalumite occurs in quartz breccia in schist fragments (early Paleozoic) found within a serpentinite matrix, part of the early Carboniferous Fergana complex. The host schists are the source of the Ni, Zn, and V. Kara-Tangi is located 25 km west of the village of Zadamdzhai within the same belt and was exploited for U in the 1960s. Nickelalumite is associated with allophane, ankinovichite, tangeite, and tyuyamunite.

Discussion: Neither nickelalumite nor chalcoalumite are recognized mineral species; nickelalumite was rejected by the IMA CNMMN in 1980. **P.C.P.**

NIFONTOVITE*

F.C. Hawthorne, W.W. Pinch, F.H. Pough (2005) Nifontovite from Charcas, San Luis Potosi, Mexico. *Min. Rec.*, 36, 375–376.

The occurrence of nifontovite, $\text{Ca}_3\text{B}_6\text{O}_6(\text{OH})_{12}(\text{H}_2\text{O})_2$, at Charcas, San Luis Postosi, Mexico, the third locality world-wide, is discussed. A crystal drawing is presented, and indexed relative to the conventional setting of the unit cell. The crystals from Charcas are considered the world's finest for the species.

A.J.L.

PEZZOTTAITE*

S.-I. Liu, M.-S. Peng (2005) A new gem mineral—the vibrational spectroscopic characterization of pezzottaite. *Acta Mineral. Sin.*, 25, 60–64 (in Chinese).

Fourier-transform infrared and Raman spectroscopy were performed on oriented samples of pezzottaite to investigate the speciation of water in the structural channels. Results were compared with red beryl and morganite. The FTIR spectrum of pezzottaite is characterized by a Si-O vibration band at 1039 cm^{-1} and two absorption bands for H_2O at 3590.9 and 3544.4 cm^{-1} , which are thought to be related to the high Cs contents in the channel. The polarized Raman spectrum of pezzottaite is characterized by bands at 1120 (Si-O) and 1096 (Si-O-Be) cm^{-1} . **P.C.P.**

POTASSIC-CARPHOLITE*

W.C. Van Laer (2005) Potassic-carpholite and the myth of Centerville, Idaho. *Can. Mineral.*, 43, 1125–1126.

The actual type locality of the recently described mineral species potassic-carpholite (abstracted in *Am. Mineral.*, 89, 1831) is in the Fall Creek drainage, in the vicinity of Glens Peak, Boise County, Idaho. The correct type locality had been deliberately kept secret for 22 years by a collector because of the legal status

URANOSPATHITE*

A.J. Locock, W.S. Kinman, P.C. Burns (2005) The structure and composition of uranospathite, $Al_{1-x}□_x[(UO_2)(PO_4)]_2(H_2O)_{20+3x}F_{1-3x}$, $x = 0 - 0.33$, a non-centrosymmetric fluorine-bearing mineral of the autunite group, and of a related synthetic lower hydrate, $Al_{0.67}□_{0.33}[(UO_2)(PO_4)]_2(H_2O)_{15.5}$. *Can. Mineral.*, 43, 989–1003.

Single-crystal X-ray structure study of uranospathite ($R1 = 0.040$), $Al_{1-x}□_x[(UO_2)(PO_4)]_2(H_2O)_{20+3x}F_{1-3x}$, indicated that it is orthorhombic, space group $Pnn2$, with cell dimensions $a = 30.020(4)$, $b = 7.0084(9)$, $c = 7.0492(9)$ Å, $V = 1483.1(3)$ Å³, $Z = 2$, $D_{calc} = 2.54$ g/cm³. The presence of F in both uranospathite and arsenuranspathite was confirmed by qualitative WDS on an electron microprobe and appears to be necessary to maintain electroneutrality in the crystals studied. Uranospathite appears to be one of only a few acentric compounds that contain the autunite-type sheet. The data resolve previous uncertainties about the symmetry, space group, and composition of uranospathite and arsenuranspathite. **A.J.L.**

**WATKINSONITE*, NEVSKITE*, BOHDANOWICZITE*,
Cu₂Bi₂Se₄, CuPbBi₄S₈**

H.-J. Förster, G. Tischendorf, D. Rhede (2005) Mineralogy of the Niederschlema-Alberoda U-Se-polymetallic deposit, Erzgebirge, Germany. V. Watkinsonite, nevskite, bohdanowiczite, and other bismuth minerals. *Can. Mineral.*, 43, 899–908.

Watkinsonite, ideally $Cu_2PbBi_4Se_8$, is reported from its second-known locality: an unconformity-related vein-type uranium deposit at Niederschlema-Alberoda in the western Erzgebirge of Germany. Electron microprobe analysis of watkinsonite (mean of 27 analyses) gave Cu 5.13, Ag 2.92, Hg 0.11, Pb 11.46, Cd 0.01, Fe 0.02, Bi 45.59, S 0.08, Se 34.53, sum 99.85 wt% (99.86 reported), which corresponds (on the basis of 15 atoms) to $(Cu_{1.47}Ag_{0.49})_{\Sigma 1.96}(Pb_{1.01}Hg_{0.01}Fe_{0.01})_{\Sigma 1.03}Bi_{3.98}(Se_{7.98}S_{0.05})_{\Sigma 8.03}$. Watkinsonite from this locale matches the ideal stoichiometry more closely than do the data for material from the type locality. It is richer in Ag and poorer in S relative to the analyses given for material from the type locality, which have no reported Ag, and S 3.03–3.47 wt%. The identity of watkinsonite was confirmed by powder X-ray diffraction (Debye-Scherrer camera 57.3 mm in diameter). Watkinsonite occurs as anhedral grains (maximum size 120×30 μm) intergrown with clausthalite, and associated with bohdanowiczite and/or nevskite.

The Niederschlema-Alberoda U-Se-polymetallic deposit, Erzgebirge, Germany is the fourth locality for nevskite, ideally BiSe. Electron microprobe analysis of nevskite (2 analyses) gave Cu 0.03, 0.03; Ag nd, 0.20; Pb 3.47, 4.44; Bi 69.71, 67.85; S 0.04, 0.03; Se 27.05, 26.99; sum 100.30, 99.54 wt% (100.30, 99.53 reported), which corresponds (on the basis of 2 atoms) to $(Bi_{0.96}Pb_{0.05})_{\Sigma 1.01}Se_{0.99}$, and $(Bi_{0.94}Pb_{0.06}Ag_{0.01})_{\Sigma 1.01}Se_{0.99}$, respectively. Analyses richer in Ag were rejected by the authors as corresponding to analytical artifacts caused by surrounding

grains. Nevskite from this locality is poorer in S relative to the analyses reported for the type locality: S 1.4–1.8 wt%. Nevskite either occurs as small rims between watkinsonite and clausthalite or as small grains (<20 μm) associated with watkinsonite and bohdanowiczite in the body of clausthalite.

The composition of bohdanowiczite, ideally $Ag_2Bi_2Se_4$, appears to depend on the local mineral assemblage. Bohdanowiczite associated with clausthalite or clausthalite and watkinsonite, has very low Cu, and has minor As, Pb, and S. A representative electron microprobe analysis gave: Cu 0.03, Ag 22.92, Hg 0.16, Pb 0.10, As 0.47, Bi 43.46, S 0.80, Se 32.16, sum 100.10 wt%, which corresponds (on the basis of 8 atoms) to $(Ag_{1.98}Hg_{0.01})_{\Sigma 1.99}(Bi_{1.93}As_{0.06})_{\Sigma 1.99}(Se_{3.79}S_{0.23})_{\Sigma 4.02}$.

Bohdanowiczite associated with copper selenides is devoid of S and As, but contains significant Cu (1.60–7.37 wt%). The range of Cu contents is interpreted to possibly represent solid solution, with Cu⁺ in substitution for Ag⁺. An electron microprobe analysis of the material richest in Cu gave Cu 7.37, Ag 11.22, Au 0.08, Bi 46.43, Se 34.60, sum 99.70 wt%, which corresponds (on the basis of 8 atoms) to $(Cu_{1.05}Ag_{0.95})_{\Sigma 1.99}Bi_{2.02}Se_{3.98}$. This particular composition is consistent with a new mineral, ideally $Cu_2Bi_2Se_4$: the Cu-dominant analogue of bohdanowiczite and the Se-analogue of emplectite, $Cu_2Bi_2S_4$. The small grain-size (<25 μm) precluded identification by X-ray methods, and so the symmetry and structural affiliation of this material is unknown. It should be noted that bohdanowiczite has trigonal symmetry, with Ag and Bi in near-regular octahedral coordination, whereas emplectite has orthorhombic symmetry, with Cu in tetrahedral coordination and Bi in distorted square pyramidal coordination. Simple solid solution between such differing structure types is unlikely. The authors noted that Cu-bearing bohdanowiczite has been observed by others to be inhomogeneous and have submicroscopic intergrowths on a scale less than 5 μm, and that recent attempts to synthesize the Se-analogue of emplectite were unsuccessful and instead yielded $Cu_4Bi_4Se_9$.

An unidentified Cu-Pb-Bi sulfosalt, idealized as $CuPbBi_4S_8$, is found locally intergrown with bismuthinite as small anhedral grains, 30–50 μm in size. Electron microprobe analysis (2 analyses) gave Cu 4.60, 4.67; Pb 15.55, 15.37; Sb nd, 0.05; Bi 60.46, 60.69; S 18.19, 18.01; Se 1.00, 1.53; sum 99.80, 100.31 wt%, which corresponds (on the basis of 14 atoms) to $Cu_{1.00}Pb_{1.03}Bi_{3.98}(S_{7.81}Se_{0.17})_{\Sigma 7.98}$ and $Cu_{1.01}Pb_{1.02}Bi_{3.99}Sb_{0.01}(S_{7.71}Se_{0.27})_{\Sigma 7.98}$, respectively. These results are most similar to salzburgite $Cu_{1.6}Pb_{1.6}Bi_{6.4}S_{12}$ and paarite $Cu_{1.7}Pb_{1.7}Bi_{6.3}S_{12}$ (Topa et al. 2005, *Can. Mineral.*, 43, 909–917), and for comparison to these minerals, the analytical results can be expressed on the basis of $S + Se = 12$: $Cu_{1.50}Pb_{1.55}Bi_{5.99}(S_{11.74}Se_{0.26})_{\Sigma 12.00}$ and $Cu_{1.52}Pb_{1.53}Bi_{6.00}Sb_{0.01}(S_{11.60}Se_{0.40})_{\Sigma 12.00}$, respectively. The authors noted that because of the small grain-size and intimate intergrowth with bismuthinite and aikinite, the analytical results may reflect contamination with the neighboring minerals. The material is found in an assemblage of Bi sulfides, including bismuthinite-aikinite solid solutions, associated with Bi-bearing galena and Pb-bearing chalcopyrite. **A.J.L.**