

New mineral names*

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BOBTRAILLITE*

A.M. McDonald, G.Y. Chao (2005) Bobtraillite, (Na,Ca)₁₃Sr₁₁(Zr,Y,Nb)₁₄Si₄₂B₆O₁₃₂(OH)₁₂·12H₂O, a new mineral species from Mont Saint-Hilaire, Quebec: Description, structure determination and relationship to benitoite and wadeite. *Can. Mineral.*, 43, 747–758.

The mineral generally occurs as blocky to prismatic crystals, elongated along [001], up to 2 mm and averaging <0.5 mm in length. The crystals are brittle, *H* = 5.5, transparent, commonly gray to brown in color, with a white streak, vitreous luster, no observable cleavage, and uneven to conchoidal fracture. Bobtraillite is nonpleochroic, uniaxial positive, with $\omega = 1.627(1)$ and $\epsilon = 1.645(1)$. An average of seven electron microprobe analyses on one crystal gave Na₂O 5.62, CaO 1.11, SrO 17.76, BaO 0.40, B₂O₃ (calc.) 3.38, Y₂O₃ 1.15, SiO₂ 40.51, ZrO₂ 25.32, HfO₂ 0.48, Nb₂O₅ 1.32 and H₂O (calc.) 5.25, sum 102.30 wt%, corresponding to (Na_{11.20}Ca_{1.22}) Σ 12.42(Sr_{10.59}Ba_{0.16}) Σ 10.75(Zr_{12.69}Y_{0.63}Nb_{0.61}Hf_{0.14}) Σ 14.07Si_{41.64}B₆O₁₃₂(OH)₁₂·12H₂O on the basis of 156 anions, ideally (Na,Ca)₁₃Sr₁₁(Zr,Y,Nb)₁₄Si₄₂B₆O₁₃₂(OH)₁₂·12H₂O. *D*_{calc} = 3.16 for the empirical formula, 3.12 g/cm³ for the idealized formula Na₁₃Sr₁₁Zr₁₃YSi₄₂B₆O₁₃₂(OH)₁₂·12H₂O and *Z* = 1.

Single crystal X-ray structure refinement (*R* = 0.0349) revealed the unit cell to be trigonal, space group *P* $\bar{3}$ *c*1, *a* = 19.720(1), *c* = 9.9788(5) Å, *V* = 3360.7(1) Å³. The structure is pseudo-hexagonal, space group *P*6₃*cm*, but refinement in this space group yields inappropriate interatomic distances for one of the SiO₄ tetrahedra; therefore *P* $\bar{3}$ *c*1 is considered to be the correct space group. The structure may be considered a hybrid of benitoite, wadeite and catapleite, with which it shares chemical and structural features, but the presence of essential B, Sr, H₂O and trigonal symmetry make it unique. The strongest lines of a Gandolfi powder pattern (114.6 mm, CuK α radiation) are in good agreement with those calculated from the structure using the program Powder Cell v.2.3: 17.08(44,100), 6.46(39,210), 5.69(30,300), 5.42(34,211), 3.95(60,212), 3.75(46,302), 3.44(15,312), 3.29(29,330), 3.12(55,331), 2.818(26,502), 2.745(100,332), 2.495(17,004), 1.987(43,334), 1.898(32,900), 1.718(18,624), 1.4840(16,336).

The mineral is found in igneous breccias and nepheline syenite pegmatites at the Poudrette quarry, Mont Saint-Hilaire,

* 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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Quebec (type locality). It is associated with a burbankite-group mineral, donnayite-(Y), clinoamphibole, albite, aegirine, pyrrhotite, pyrite, annite, analcime, microcline, a white mica (muscovite?), yellow titanite, clinopyroxene and calcite. The mineral is paragenetically late, arising from unusual, hydrous fluids enriched in B, Sr, Na, and Zr. The name honors Dr. Robert ("Bob") James Traill (b. 1921), mineralogist and former head of the Mineralogy Section at the Geological Survey of Canada, Ottawa (1953–1986), in recognition of his contributions to mineralogy. Type material is deposited in the Canadian Museum of Nature, Ottawa, (catalog no. CMNMC 83718). **A.J.L.**

HEULANDITE-BA*

A.O. Larsen, F.S. Nordrum, N. Döbelin, T. Armbruster, O.V. Petersen, M. Erambert. (2005) Heulandite-Ba, a new zeolite species from Norway. *Eur. J. Mineral.*, 17, 143–153.

Heulandite-Ba occurs as euhedral, thick tabular, trapezoidal crystals up to 4 mm across. Aggregates of crystals up to a few cm across are common. The crystals are dominated by the pinacoids {100}, {010}, and {001} with $\bar{1}11$ and $\{20\bar{1}\}$ modifications. The mineral is colorless to white, very pale yellowish white or beige, has a white streak, is transparent to translucent with a vitreous luster, pearly on {010}, has perfect {010} cleavage, subconchoidal to uneven fracture and a Mohs hardness of 3.5. It is not fluorescent. Finely ground material decomposes in warm 6 M HCl. Heulandite-Ba is biaxial positive, $\alpha = 1.5056(5)$, $\beta = 1.5064(5)$, $\gamma = 1.5150(5)$, $2V_{\text{meas}} = 38(1)^\circ$, $2V_{\text{calc}} = 34.1^\circ$, distinct dispersion $r > v$, $X \wedge c$ varies between 39 and 51°, *Z* = *b*.

Electron microprobe analyses (WDS, average of 14 analyses) and thermogravimetric analysis (H₂O) gave SiO₂ 54.26, Al₂O₃ 15.27, MgO <0.1, CaO 2.65, SrO 1.03, BaO 12.76, Na₂O 0.34, K₂O 0.58, H₂O 13.1, sum 99.99 wt%, corresponding to (Ba_{2.49}Ca_{1.41}Sr_{0.30}K_{0.37}Na_{0.33}) Σ 4.90Al_{8.96}Si_{27.00}O_{72.00}·21.75H₂O, based on 72 framework oxygen atoms, *D*_{meas} = 2.35(1) g/cm³, *D*_{calc} = 2.350 g/cm³, *Z* = 1. The ideal formula for heulandite-Ba is (Ba,Ca,Sr,K,Na)₅Al₉Si₂₇O₇₂·22H₂O. The thermogravimetric analysis indicated three weight-loss steps: 1) 35–250 °C, 8.2 wt% loss (13.6 H₂O), 2) 250–520 °C, 3.4 wt% loss (5.6 H₂O), and 3) 520–815 °C, 1.5 wt% loss (2.5 H₂O). The FTIR spectrum has broad absorption bands at 3603 and 3459 cm⁻¹ (O-H stretching) and a sharp band at 1631 cm⁻¹ (H-O-H bending). Other bands (*w* = weak, *sb* = strong, broad, *m* = medium) include 1192w, 1030sb, 778w, 718m, 661w, 597m, 519w, and 456m cm⁻¹.

The crystal structure of heulandite-Ba was refined on *F*² by single-crystal X-ray diffraction methods on a 0.300 × 0.125 ×

0.250 mm grain, $R_1 = 0.0354$ for 2731 observed reflections with $I > 2\sigma(I)$. Heulandite-Ba is monoclinic, $C2/m$, $a = 17.738(3)$, $b = 17.856(2)$, $c = 7.419(1)$ Å, $\beta = 116.55^\circ$, $V = 2102.0(7)$ Å³. The strongest lines on the powder X-ray diffraction pattern (diffractometer, $\text{CuK}\alpha_1$ radiation, 96 lines given) include 8.946(26,020), 7.941(66,200), 5.942(24,220), 5.266(17,311), 5.116(59,111), 5.085(28,310), 4.378(26,401), 3.978(97,131), 3.904(16,240), 3.738(18,241), 3.711(18,041), 3.564(48,312), 3.484(17,511), 3.428(42,222), 3.403(22,402), 3.323(17,002), 3.181(56,422), 3.131(45,510), 3.074(24, 132), 3.038(26,512), 2.994(25,331), 2.973(100,151), 2.807(65,621), 2.734(29,261), 2.429(18,712), 2.093(16,621), and 1.770(13,772). Heulandite-Ba is isostructural with other members of the heulandite series of zeolites; Ba is concentrated in the C ring over three cation sites.

The type locality for heulandite-Ba is the Northern Ravnås prospect, southern Vinoren, Kongsberg ore district, Flesberg community, Buskerud county, Norway. It has also been found at the Bratteskjerpet mine, Saggrenda, and at Sjoa in Sel community, Oppland county. Heulandite-Ba at the Northern Ravnås prospect occurs in calcite-quartz veins of the Kongsberg silver ore type. These Permian hydrothermal veins are found cross-cutting early Precambrian metamorphic rocks, often deposited along fractures and fissures. The silver ore occurs at the intersections between these calcite veins and zones of disseminated sulphides (pyrite and pyrrhotite, called "fahlbands") which are roughly parallel to the north-south strike of the Precambrian rocks. The veins containing the heulandite-Ba range in size from a few mm to 10 cm in thickness and contain acanthite, barite, chalcocopyrite, fluorite, galena, sphalerite, and silver. Late-stage minerals include brewsterite- and heulandite-series zeolites, calcite, and harmotome. The mineral is named for its chemistry and relationship to other heulandite minerals. Type material has been deposited at the Geological Museum, University of Oslo (catalog no. 33929). **P.C.P.**

HOLTSTAMITE*

U. Hålenius, U. Häussermann, H. Harryson. (2005) Holtstamite, $\text{Ca}_3(\text{Al}, \text{Mn}^{3+})_2(\text{SiO}_4)_{3-x}(\text{H}_4\text{O}_4)_x$, a new tetragonal hydrogarnet from Wessels Mine, South Africa. *Eur. J. Mineral.*, 17, 375–382.

Holtstamite from the Wessels Mine, South Africa, occurs as scarce, rounded grains up to 3 mm within vesuvianite. The rounded grains are composed of small, <0.4 mm, often twinned crystals, occasionally as pseudo-octahedra with twinning around [111]. Holtstamite is pale brownish yellow, transparent, vitreous, non-fluorescent, has a Mohs hardness of 6, is brittle with conchoidal fracture and does not show cleavage. The mineral is uniaxial positive, $\omega = 1.718$, $\epsilon = 1.746$, weakly pleochroic with $O =$ pale orange, and $E =$ lemon yellow.

The chemical composition of holtstamite was determined by a combination of electron microprobe (WDS), FT infrared spectroscopy, and optical spectroscopy. The average of 15 analyses gave SiO_2 26.26, Al_2O_3 10.77, Mn_2O_3 11.64, Fe_2O_3 6.30, CaO 36.76, H_2O 7.87, sum 99.61 wt%, corresponding to $\text{Ca}_3(\text{Al}_{0.96}\text{Mn}_{0.68}\text{Fe}_{0.37}^{3+})_{2.01}(\text{SiO}_4)_{2.00}(\text{H}_4\text{O}_4)_{0.99}$ based on 24 negative charges. The ideal formula is $\text{Ca}_3(\text{Al}, \text{Mn}^{3+})_2(\text{SiO}_4)_{3-x}(\text{H}_4\text{O}_4)_x$. The presence of Mn^{3+} was confirmed by optical absorption spectroscopy,

with absorption bands due to spin-allowed d-d transition in octahedrally-coordinated Mn^{3+} at ~12 500, 19 500, 21 500, and 23 000 cm^{-1} . Single-crystal FTIR spectra of holtstamite have strong OH-stretching bands at 3480, 3560, and 3670 cm^{-1} . Based on the FTIR spectrum, OH concentrations are comparable to those in henritermierite, the Mn^{3+} analogue of holtstamite.

The structure of holtstamite ($0.017 \times 0.013 \times 0.009$ mm crystal) was refined on F^2 using starting parameters from henritermierite (Armbruster *et al.* 2001; *Am. Mineral.*, 86, 147–158), $R_1 = 0.037$ for 549 unique reflections with $F_o > 4\sigma(F_o)$. Holtstamite is tetragonal, $I4_1/acd$, $a = 12.337(3)$, $c = 11.930(5)$ Å, $V = 1815.76$ Å³, $D_{\text{calc}} = 3.25$ g/cm³, $Z = 8$. The strongest lines on the powder X-ray diffraction pattern (diffractometer, $\text{CuK}\alpha$ radiation, 46 measured and indexed lines) include 4.920(17,112), 4.360(17,220), 4.291(20,022), 3.268(29,312), 3.082(44,400), 2.978(45,004), 2.757(55,420), 2.743(100,402), 2.685(54,204), 2.501(47,422), 2.464(26,224), 2.415(15,431), 2.248(24,521), 2.240(20,512), 2.188(18,215), 2.003(20,611), 1.994(32,532), 1.987(19,523), 1.761(15,444), 1.671(37,406), 1.643(36,642), 1.633(39,624), and 1.614(56,426). Holtstamite is the Al-analogue of henritermierite, with most crystals showing compositional zoning with cores approaching henritermierite compositions and rims with 65% of the $\text{Ca}_3\text{Al}_2(\text{SiO}_4)_2(\text{OH})_4$ molecule. It is polymorphous with hibsichte, and is a polyhedral framework of M1O_6 octahedra and SiO_4 tetrahedra that share corners. Apart from the extensive $\text{Al} \leftrightarrow \text{Mn}^{3+}$ substitution between henritermierite and holtstamite, the main difference in the two structures is the slightly cation deficient Si1 site in holtstamite. It is proposed that Jahn-Teller distorted Mn^{3+} is a necessary requirement in this Al-dominant hydrogarnet to stabilize the mineral with respect to its cubic counterparts.

Holtstamite was found in vesuvianite-rich skarns formed by hydrothermal alteration of primary Mn ores at Wessels Mine, Kalahari manganese field, South Africa. It is associated with Mn^{3+} -bearing vesuvianite, calcite and henritermierite. The mineral is named after Dr. Dan Holtstam (b. 1963) in honor of his contributions to Swedish mineralogy and specifically of Mn-deposits of the Långban type. Type material has been deposited in the mineral collection at the Swedish Museum of Natural History, Stockholm, Sweden (catalog no. 960380).

Discussion. The powder X-ray diffraction data provided in the abstract was taken from the IMA proposal (2003-047) and was not present in the original manuscript. **P.C.P.**

KUDRIAVITE*

I.V. Chaplygin, N.N. Mozgova, L.O. Magazina, O.Yu. Kuznetsova, Y.G. Safonov, I.A. Bryzgalov, E. Makovicky, T. Balić-Žunić (2005) Kudriavite, $(\text{Cd}, \text{Pb})\text{BiS}_2$, a new mineral species from Kudriavyy volcano, Iturup Island, Kurile arc, Russia. *Can. Mineral.*, 43, 695–701.

The mineral occurs as slender platy crystals (usually striated along the elongation) up to 400 μm long, which form chaotic aggregates some millimeters in diameter. The crystals are very brittle, $\text{VHN}_{10} = 129$ kg/mm², H not given, opaque, dark gray with a reddish tint, black streak, metallic luster, and uneven fracture. Under reflected light, the mineral is white with a slight yellow hue, no internal reflections, distinct birefractance, and strongly

anisotropic (but with no color effect). An average of nine electron microprobe analyses gave Cd 8.25, Pb 13.10, Fe 0.17, Mn 0.26, Bi 55.37, In 2.80, Tl 0.02, S 17.70, Se 2.23, Cl 0.02, sum 99.71 wt%, corresponding to $(\text{Cd}_{0.51}\text{Pb}_{0.44}\text{Fe}_{0.02}\text{Mn}_{0.03})_{\Sigma 1.00}(\text{Bi}_{1.83}\text{In}_{0.17})_{\Sigma 2.00}(\text{S}_{3.81}\text{Se}_{0.19})_{\Sigma 4.00}$ for seven atoms, ideally CdBi_2S_4 . Reflectance values for randomly oriented grains (in air, Si standard) are (R_1 - R_2) 36.4–29.6 (470 nm), 38.8–32.4 (546 nm), 38.2–31.8 (589 nm), and 37.7–31.4 (650 nm). $D_{\text{calc}} = 6.593$ for the empirical formula, 6.289 g/cm³ for the ideal formula and $Z = 4$.

Single crystal X-ray structure refinement ($R = 0.0488$) revealed that the mineral is a homologue of pavonite with $N = 3$: monoclinic, space group $C2/m$, $a = 13.095(1)$, $b = 4.0032(3)$, $c = 14.711(1)$ Å, $\beta = 115.59(1)^\circ$, $V = 695.5(1)$ Å³. The cell dimensions are very similar to synthetic CdBi_2S_4 . The strongest lines of a Gandolfi powder pattern (114.6 mm, $\text{CuK}\alpha$ radiation) are in good agreement with those calculated from the structure using the program LAZY PULVERIX: 4.694(24,201), 3.690(97,202), 3.640(95,204), 3.508(83,112), 3.317(16,004), 3.273(32,402), 3.111(38,112), 2.935(83,311), 2.807(100,310), 2.341(39,114), 2.331(21,115), 2.211(18,006), 2.082(16,601), 2.037(31,116), 2.017(31,115), 2.002(39,020), 1.907(40,511), and 1.754(21,224). Grumiplucite, HgBi_2S_4 , is the only other known natural pavonite homologue with $N = 3$.

Platy or box-shaped-skeletal crystals of the mineral occur as a high-temperature (about 400 °C) fumarole encrustation in the steep inner wall of the crater rim of Kudriavý volcano, on Iturup Island, in the Kurile arc, Russia (type locality). Kudriavite is found beneath a layer of secondary sulfates and oxides in a sulfide-rich layer up to 0.5 m thick (on altered basaltic andesite debris) that includes pyrite, Pb–Bi sulfosalts, wurtzite, greenockite and ReS_2 . Minerals directly associated with kudriavite include cannizzarite, greenockite and pyrite. The mineral is named after the type locality. Type material is deposited in the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (catalog no. 3112/1).

Discussion. The density presented here (calculated from the empirical formula) differs from that reported by the authors: $D_{\text{calc}} = 6.578$ g/cm³. **A.J.L.**

MILOTAITE*

W.H. Paar, D. Topa, E. Makovicky, F.J. Culletto (2005) Milotaite, PdSbSe , a new palladium mineral species from Předbořice, Czech Republic. *Can. Min.*, 43, 689–694.

The mineral was found in a single polished section as sub-hedral grains up to 25 µm in diameter. Synthetic PdSbSe was also investigated, because of the scarcity of natural material. The synthetic material is brittle, $\text{VHN}_{100} = 465$ kg/mm², $H = 4.5$, opaque, silvery gray, gray streak, metallic luster, and has no cleavage or parting. White in reflected light, isotropic, no internal reflections. An average of five electron microprobe analyses on two grains of natural material gave Pd 34.17, Cu 0.78, Ag 0.35, Sb 38.03, Se 26.38, sum 99.71 wt%, corresponding to $\text{Pd}_{0.98}\text{Cu}_{0.04}\text{Ag}_{0.01}\text{Sb}_{0.95}\text{Se}_{1.02}$ for three atoms, ideally PdSbSe . Reflectance values of natural milotaite (in air, WTiC standard) are 48.6 (470 nm), 47.5 (546 nm), 47.6 (589 nm), and 49.0 (650 nm). $D_{\text{calc}} = 8.009$ for the empirical formula, 8.088 g/cm³ for the ideal formula and $Z = 4$. Single crystal X-ray structure refinement ($R = 0.0184$)

of synthetic material showed milotaite to be a member of the ullmanite subgroup of the gersdorffite group: cubic, space group $P2_13$, $a = 6.3181(5)$ Å, $V = 252.20(5)$ Å³. Powder diffraction data were calculated from the structure using Powder Cell v.2.3 ($\lambda = 1.540598$ Å), strongest lines [d in Å (I,hkl)] are 3.159(53,200), 2.825(100,201), 2.579(81,211), 2.234(32,220), 1.9047(98,311), 1.7521(27,320), 1.6883(25,312), and 1.3785(18,412). The most closely related minerals are the isostructural species michenerite PdBiTe and testibiopalladite PdSbTe .

The mineral occurs in a low-temperature selenium-rich assemblage developed in uraninite-bearing calcite veins that cross-cut metamorphic rocks at Předbořice, Czech Republic (type locality), and is found enclosed in eucairite and tiemannite, and randomly intergrown with a graphic intergrowth of bornite and selenian digenite. Associated minerals include chrisstanleyite, fischesserite, gold, silver-rich hakite, tyrellite, clausenthalite, chaméanite and uraninite. The mineral is named after Milota Makovicky (b. 1941), Geological Institute, University of Copenhagen, for her outstanding investigations of sulfide and sulfarsenide systems with platinum-group elements. Type material (one polished section) is deposited in the Department of Geography, Geology and Mineralogy, Division of Mineralogy and Material Sciences (Mineralogical Museum), Salzburg, Austria (catalog no. 14935). **A.J.L.**

PDCU (= SKAERGAARDITE), $(\text{Fe}, \text{Ni}, \text{Ir})_8\text{S}_8$, $\text{Cu}_3\text{PbPt}_8\text{S}_{16}$, Pt_2As_3 , Bi_3Te , Pd_5Bi_2 , $\text{Pd}_3(\text{Sb}, \text{Bi})$ Pd_3Bi_2 , PtBi , Pd_3Pb (= ZVYAGINTSEVITE), Pd_2Ge , PGE OXIDES, PGE HYDROXIDES

I.Ya. Nekrasov, A.M. Lennikov, B.L. Zalizhchak, R.A. Oktyabrsky, V.V. Ivanov, V.I. Sapin, V.I. Taskaev (2005) Compositional variations in platinum-group minerals and gold, Konder alkaline-ultrabasic massif, Aldan Shield, Russia. *Can. Mineral.*, 43, 637–654.

PdCu (= skaergaardite, *Mineral. Mag.*, 68, 615–632) occurs in solid solution with hongshiite PtCu and tulameenite $\text{Pt}(\text{Cu}, \text{Fe})$ as rims on isoferroplatinum $(\text{Pt}, \text{Pd})_3(\text{Fe}, \text{Cu})$. Three listed electron microprobe analyses have Pt 25.20, 25.65, 20.32; Pd 40.97, 41.02, 45.83; Cu 26.16, 26.41, 28.44; Fe 5.23, 5.20, 5.06; Ag 0.42, 0.26, 0.38; sum 97.98, 98.54, 100.03 wt% corresponding to $\text{Pd}_{0.75}\text{Pt}_{0.25}\text{Cu}_{0.81}\text{Fe}_{0.18}\text{Ag}_{0.01}$, $\text{Pd}_{0.75}\text{Pt}_{0.26}\text{Cu}_{0.81}\text{Fe}_{0.18}$, $\text{Pd}_{0.80}\text{Pt}_{0.19}\text{Cu}_{0.83}\text{Fe}_{0.17}\text{Ag}_{0.01}$, for two atoms, ideally PdCu .

$(\text{Fe}, \text{Ni}, \text{Ir})_8\text{S}_8$ (iron-nickel-iridium monosulfides) are found intergrown with magnetite and pyrrhotite in dikes of magnetite-phlogopite pyroxenite. The material is isotropic and has microhardness 180–220 kg/mm². Two listed electron microprobe analyses have Pt 2.13, 1.09; Ir 26.23, 25.54; Rh 2.21, 2.71; Fe 19.21, 19.96; Ni 17.93, 18.31; Cu 2.88, 2.87; S 27.66, 28.29; sum 98.24, 98.77 wt% corresponding to $(\text{Fe}_{3.19}\text{Ni}_{2.83}\text{Ir}_{1.27}\text{Cu}_{0.42}\text{Rh}_{0.20}\text{Pt}_{0.10})_{\Sigma 8.01}\text{S}_8$, $(\text{Fe}_{3.24}\text{Ni}_{2.83}\text{Ir}_{1.20}\text{Cu}_{0.41}\text{Rh}_{0.24}\text{Pt}_{0.05})_{\Sigma 7.97}\text{S}_8$ for eight anions, ideally $(\text{Fe}, \text{Ni}, \text{Ir})_8\text{S}_8$. The stoichiometry of this material is not consistent with its description as being like pentlandite $(\text{Fe}, \text{Ni})_9\text{S}_8$.

$\text{Cu}_3\text{PbPt}_8\text{S}_{16}$ occurs in solid solution with konderite $\text{Cu}_3\text{PbRh}_8\text{S}_{16}$ and inagylyte $\text{Cu}_3\text{PbIr}_8\text{S}_{16}$ in an assemblage of platinum-group-element (PGE)-bearing sulfides and PGE alloys in dunite. This material has microhardness 412–435

kg/mm², and two listed electron microprobe analyses have Pb 8.12, 7.60; Cu 9.32, 10.12; Ir 18.73, 18.20; Pt 29.15, 30.67; Rh 9.25, 9.14; Fe 0.74, 0.72; S 24.12, 24.47; sum 99.43, 100.92 wt% corresponding to (Cu_{3.12}Pb_{0.83}Pt_{3.18}Ir_{2.07}Rh_{1.91}Fe_{0.28})_{Σ11.39}S₁₆, (Cu_{3.34}Pb_{0.77}Pt_{3.30}Ir_{1.99}Rh_{1.86}Fe_{0.27})_{Σ11.53}S₁₆ for sixteen anions, ideally Cu₃PbPt₈S₁₆.

Pt₂As₃ occurs as fine inclusions up to 25 μm across in isoferroplatinum (Pt,Pd)₃(Fe,Cu). This material has microhardness 500 kg/mm², and one chemical analysis (method unspecified) has Pt 51.62, Rh 1.08, Ir 10.57, Os 0.28, Cu 0.16, S 2.2, As 33.14, sum 99.05 wt% corresponding to (Pt_{1.57}Ir_{0.32}Rh_{0.06}Os_{0.01}Cu_{0.01})_{Σ1.97}(As_{2.62}S_{0.41})_{Σ3.03} for five atoms, ideally Pt₂As₃.

Bi₃Te occurs with native Bi and “Pt oxide” in the decomposition products of bismuthian telluropalladinite Pd₉(Te,Bi)₄, as mica-like accumulations up to 5 μm across, and cementing gold segregations. No analytical data are given.

Pd₅Bi₂ occurs on the margin of grains of sobolevskite PdBi, and in platinian tetra-auricupride AuCu and as inclusions in froodite PdBi₂. One electron microprobe analysis has Pd 57.69, Bi 43.68, sum 101.37 wt% corresponding to Pd_{5.05}Bi_{1.95} for seven atoms, and analogous to stibiopalladinite Pd₅Sb₂.

Pd₃(Sb,Bi) occurs with Pd₅Bi₂. Two electron microprobe analyses have Pd 77.26, 77.34; Sb 15.01, 15.03; Bi 8.14, 8.54; sum 100.41, 100.91 wt% corresponding to Pd_{3.27}Sb_{0.56}Bi_{0.18}, for four atoms. In the text, this compound is given the formula Pd₃(Bi,Sb), which is not consistent with the reported compositions. The closest valid mineral species is mertieite-I Pd₁₁(Sb,As)₄.

Pd₃Bi₂ is not referred to in the text, and its occurrence is not reported, but two electron microprobe analyses are tabulated: Pd 44.27, 47.27; Bi 55.31, 52.00; sum 99.58, 99.27 wt% corresponding to Pd_{3.06}Bi_{1.94}, Pd_{3.20}Bi_{1.80}, for five atoms. The closest valid mineral species is sobolevskite PdBi.

PtBi is not referred to in the text, and its occurrence is not reported, but one electron microprobe analysis is tabulated: Pd 12.23, Pt 34.10, Sb 13.64, Bi 39.95, sum 99.92 wt% corresponding to Pt_{0.93}Pd_{0.18}Bi_{0.56}Sb_{0.33} for two atoms, ideally PtBi, the platinum analogue of sobolevskite PdBi.

Pd₃Pb (= zvyagintsevite) is reported as a “new phase” present as inclusions 5–15 μm across in cuprian gold. One chemical analysis (method unspecified) has Pd 57.52, Pb 34.74, Bi 7.02, Pt 1.20, sum 100.48 wt% corresponding to Pd_{2.89}Pb_{0.90}Bi_{0.18}Pt_{0.03} for four atoms, ideally Pd₃Pb, and in excellent agreement with the accepted mineral species zvyagintsevite.

Pd₂Ge occurs as a narrow 5–17 μm rim along with a new Pd-Au-bearing sulfide (for which no analytical data are given) on skaergaardite PdCu. The average of eight electron microprobe analyses is Pd 75.62, Ag 1.12, Ge 23.89, sum 100.63 wt%, corresponding to Pd_{2.03}Ag_{0.03}Ge_{0.94} for three atoms. This is the first germanide, and the first PGE–Ge mineral known.

PGE oxides and PGE hydroxides are reported to form thin films on earlier PGE minerals (isoferroplatinum, tulameenite, hongshiite). Electron microprobe analyses of the oxides show most of the PGE oxides to be Pt-dominant, but Os-dominant, and Ir-Rh-dominant oxides are also reported. Analytical totals for the PGE oxides range from 83.73–89.66 wt%; oxygen was not analysed. Electron microprobe analyses of the hydroxides show Pt-dominant, Ir-dominant, and Ir-Rh-dominant compositions. Analytical totals for the PGE hydroxides range from

70.44–77.56 wt%; oxygen was not analysed. No PGE oxides or PGE hydroxides have yet been accepted as mineral species by the CNMMN of the IMA despite recent reports (*Mineral. Mag.*, 63, 345–352). The mineral palladinite (Pd,Cu,Hg?)O is a poorly described species (P.N. Johnson 1837, *J. prakt. Chem.*, 11, 311), whose validity is not widely accepted.

The platinum-group-element minerals occur in two generations of mineralization in the Konder zoned alkali-ultrabasic massif, Russia. It should be noted that native ruthenium is not a new species (*Can. Min.*, 29, 231–237), and neither is antimonian kotulskite Pd(Te,Sb). **A.J.L.**

RIOMARINAITE*

P. Rögner (2005) Riomarinaite, a new bismuth mineral from Falcacci stope, Rio Marina, Elba (Italy). *Der Aufschluss*, 56, 53–60 (in German with English abstract).

The mineral commonly forms hollow masses and botryoidal crusts up to several millimeters across; rare globular aggregates are composed of tufts and sphaerolites of acicular crystals elongated along *c* and not exceeding 60 μm in length or 10 μm in width. Semi-quantitative EDX analysis gave only O, S and Bi among elements with *Z* > 6; tests for CO₂ and Cl were negative. Wet chemical analysis gave: Bi₂O₃ 68.86, SO₃ 24.28, H₂O 6.86 (by difference) Sum 100.00 wt%, corresponding to Bi_{1.02}H_{2.64}S_{1.05}O₆, ideally Bi(OH)SO₄·H₂O for 6 O atoms by analogy with the synthetic compound. Soluble in HCl, HNO₃ and warm H₂SO₄ (>60%), but not in cold H₂O. Transparent, color whitish-beige to light gray, is not fluorescent, has a white to light gray streak, vitreous luster, is brittle, no cleavage, uneven fracture and a Mohs hardness of 2 to 3. *D*_{calc} = 4.80(3) g/cm³ for *Z* = 4. Average *n* = 1.78(3). By analogy with the synthetic compound, the mineral has monoclinic symmetry, space group *P2₁/n*, powder X-ray study gave *a* = 6.0118(3), *b* = 13.3355(6), *c* = 6.4854(4) Å, β = 112.906(4)°, *V* = 478.94(3) Å³. Strongest lines of the powder pattern (133 given, diffractometer, CuKα radiation): 5.4530(42,011), 5.1926 (32,101), 5.1152 (37,110), 4.2598(100,120), 3.3350 (42,111,040), 3.1127 (36,112), 2.9151 (22,111,012,041), and 2.7239 (22,131).

The mineral occurs on weathered and corroded pyrite in the Falcacci stope of the Rio Marina iron ore mine on the east coast of Elba Island, Tuscany, Italy. It is most closely associated with bismoclite, bismutite, cannonite, anglesite, hydroniumjarosite and plumbojarosite, and is probably derived from the breakdown of primary bismuthinite and cosalite, a few relics of which remain. The name is from the locality. Type material is in the Mineralogische Staatssammlung München, Munich, Germany. **E.S.G.**

VÄSTMANLANDITE-(Ce)*

D. Holtstam, U. Kolitsch, U.B. Andersson (2005) Västmanlandite-(Ce)—a new lanthanide- and F-bearing sorosilicate mineral from Västmanland, Sweden: description, crystal structure, and relation to gatelite-(Ce). *Eur. J. Mineral.*, 17, 129–141.

Västmanlandite-(Ce) occurs as black to dark brown anhedral crystals ranging from 0.2 to 3 mm in size. It is translucent, vitreous, has a yellowish-gray streak, good cleavage along

{001}, uneven to conchoidal fracture and a Mohs hardness of 6. Västmanlandite-(Ce) is biaxial positive with $\alpha = 1.781(4)$, $\beta_{\text{calc}} = 1.792$, $\gamma = 1.810(4)$, $2V_{\alpha} = 75(5)^{\circ}$, strong dispersion $r > v$, strongly pleochroic with $X = \text{pale yellow}$, $Y = \text{reddish brown}$, $Z = \text{dark brown}$, $Z \sim Y > X$ (orientation unknown). Chemical analyses (WDS, average of three analyses) gave La_2O_3 13.65, Ce_2O_3 23.90, Pr_2O_3 2.07, Nd_2O_3 6.28, Sm_2O_3 0.42, Gd_2O_3 0.15, Dy_2O_3 0.01, Ho_2O_3 0.02, Er_2O_3 0.00, Yb_2O_3 0.02, Y_2O_3 0.18, CaO 4.65, FeO 3.56, MgO 5.51, Al_2O_3 8.58, SiO_2 26.61, P_2O_5 0.05, TiO_2 0.04, F 1.06, H_2O 1.6, sum 97.91 wt%, corresponding to $(\text{Ce}_{1.62}\text{La}_{0.93}\text{Nd}_{0.42}\text{Pr}_{0.14}\text{Sm}_{0.03}\text{Y}_{0.02}\text{Gd}_{0.01})_{\Sigma 3.17}\text{Ca}_{0.92}(\text{Mg}_{1.52}\text{Fe}_{0.18}^{2+}\text{Fe}_{0.37}^{3+})_{\Sigma 2.07}\text{Al}_{1.88}(\text{Si}_{4.94}\text{P}_{0.01})_{\Sigma 4.95}\text{O}_{0.19}(\text{OH})_2(\text{F}_{0.62}\text{O}_{0.38})$ based on 13 cations. The ideal formula for västmanlandite-(Ce) is $(\text{Ce},\text{La})_3\text{CaAl}_2\text{Mg}_2[\text{Si}_2\text{O}_7][\text{SiO}_4]_3\text{F}(\text{OH})_2$, $D_{\text{calc}} = 4.51(2)$ g/cm³, $Z = 2$. The $\text{Fe}^{2+}/\text{Fe}^{3+}$ ratio was determined by ⁵⁷Fe Mössbauer spectroscopy and applied to the electron microprobe data. Single-crystal laser-Raman spectroscopy on västmanlandite-(Ce) indicates at least six different local environments for the OH groups with broad bands at 3671(sh), 3586, 3517, 3446, 3317, and 33201 cm⁻¹. The remainder of the spectrum is too complex, especially between 1100 and 150 cm⁻¹, to attempt a complete assignment of bands.

The crystal structure of västmanlandite-(Ce) was solved by direct methods and refined on F^2 using a $0.06 \times 0.07 \times 0.07$ mm crystal, $R_1 = 0.0173$ for 2864 observed reflections with $F_o > 4\sigma(F_o)$. Västmanlandite-(Ce) is monoclinic, $P2_1/m$, $a = 8.939(1)$, $b = 5.706(1)$, $c = 15.855(2)$ Å, $\beta = 94.58(1)^{\circ}$, $V = 806.1(2)$ Å³, $\mu = 9.960$ mm⁻¹. The strongest lines on the X-ray powder diffraction pattern (diffractometer, $\text{CuK}\alpha$ radiation, 55 observed lines given) include 15.81(16,00 $\bar{1}$), 3.503(20,210), 2.9831(100,114), 2.6852(13,12 $\bar{1}$), 2.6250(19,31 $\bar{1}$), and 2.1874(15,40 $\bar{2}$). The crystal structure of västmanlandite-(Ce) is nearly isotypic to that of gatelite-(Ce), ideally $\text{Ce}_2\text{CaAl}_2\text{AlMg}[\text{Si}_2\text{O}_7][\text{SiO}_4]_3\text{O}(\text{OH})_2$, although has a different space group and unit cell. It can be described as a regular dollaseite-(Ce)-törnebohmitte-(Ce) poly-some and can be transformed to gatelite-(Ce) cell by the matrix $(\bar{2}00,0\bar{1}0,101)$. Continuous weak streaking parallel to c^* at $a^*/2$ in the diffraction patterns, along with the presence of two pairs of mirror-related, disordered atoms ($\text{Ce}3/\text{Ce}3'$ and $\text{O}15/\text{O}15'$), suggests that the structure is only an average. There is no solid solution series between västmanlandite-(Ce) and gatelite-(Ce) due to limited $\text{Al} \leftrightarrow \text{Mg}$ substitution. However, chemical and structural data suggest the presence of a second end-member with a dominance of Fe^{3+} and the västmanlandite-(Ce) structure.

Västmanlandite-(Ce) was discovered from the lanthanide mineral deposits in Västmanland county, Bergslagen mining region, south-central Sweden. Holotype material is from a now abandoned Fe mine, the Malmkärra deposit, which consists of disseminated magnetite-amphibole skarn replacements in marble. At Malmkärra and associated, similar deposits (Bastnäs, Östansmossa) it is associated with fluorbritholite-(Ce), a blue-green serpentine mineral, tremolite, dolomite, and magnetite. Accessory phases include arsenopyrite, bastnäsite-(Ce), bismuthinite, cerite-(Ce), chalcopyrite, dollaseite-(Ce), ferriallanite, gadolinite-(Ce), molybdenite, pyrite, talc, and zircon. From petrographic evidence, it is thought to be the product of secondary reactions involving fluorbritholite-(Ce) and tremolite with an addition of Al from other sources. The name is for Västmanland, the

county where the majority of the lanthanide deposits are found. Type material has been deposited in the mineral collection of the Swedish Museum of Natural History, Stockholm, Sweden (catalog no. 01+0081).

Discussion: There are large discrepancies between the observed and calculated intensities in the powder X-ray diffraction pattern; no explanation for these differences is given by the authors. In the manuscript, the mineral is given as biaxial negative. Taking into consideration the information given, the mineral is actually biaxial positive and this has been corrected in the abstract. **P.C.P.**

VURROITE*

A. Garavelli, N.N. Mozgova, P. Orlandi, E. Bonaccorsi, D. Pinto, Y. Moëlo, Y.S. Borodaev (2005) Rare sulfosalts from Vulcano, Aeolian Islands, Italy. VI. Vurroite, $\text{Pb}_{20}\text{Sn}_2(\text{Bi},\text{As})_{22}\text{S}_{54}\text{Cl}_6$, a new mineral species. *Can. Mineral.*, 43, 703–711.

The mineral occurs as acicular crystals up to 400 μm long, which generally form fibrous aggregates. The crystals are silver-gray with a metallic luster, with the following properties not given: tenacity, microhardness, H , opacity, streak, and fracture or cleavage. Under reflected light, the mineral is white with no observable pleochroism or birefractance, and weak anisotropy. An average of twelve electron microprobe analyses gave Sn 1.60, Pb 40.92, Tl 0.06, Bi 28.30, As 8.38, S 18.28, Se 0.18, Cl 1.85, Br 0.24, sum 99.81 wt%, corresponding to $\text{Pb}_{18.95}\text{Sn}_{1.30}\text{Bi}_{12.99}\text{As}_{10.73}\text{Tl}_{0.03}\text{S}_{54.71}\text{Se}_{0.22}\text{Cl}_{5.00}\text{Br}_{0.29}$ for 44 cations, ideally $\text{Pb}_{20}\text{Sn}_2(\text{Bi},\text{As})_{22}\text{S}_{54}\text{Cl}_6$. Reflectance values (in air, polarization perpendicular to elongation, SiC standard) are 34.25 (470 nm), 32.95 (546 nm), 32.60 (589 nm), and 31.05 (650 nm). $D_{\text{calc}} = 6.182$ for the empirical formula, 6.149 g/cm³ for the idealized formula $\text{Pb}_{20}\text{Sn}_2(\text{Bi}_{12}\text{As}_{10})_{\Sigma 22}\text{S}_{54}\text{Cl}_6$ and $Z = 8$.

Single crystal X-ray structure study of synchrotron data revealed the unit cell to be orthorhombic, space group $F2mm$, $a = 45.824(6)$, $b = 8.368(2)$, $c = 53.990(6)$ Å, $V = 20702(6)$ Å³, with a strong C-centered subcell: $a = 22.912(3)$, $b = 4.184(1)$, $c = 26.995(3)$ Å, $V = 2587.8(8)$ Å³. The structure refinement (in prep.) is consistent with possible twinning and the true symmetry of the mineral may be monoclinic. Powder diffraction data were collected with a Gandolfi camera (114.6 mm, $\text{CuK}\alpha$ radiation) and yielded refined unit cell parameters $a = 45.836(9)$, $b = 8.386(2)$, $c = 53.97(1)$ Å, $V = 20743(7)$ Å³, and the strongest lines: 4.27(20,10.0.4), 3.71(45,12.0.4), 3.34(80,822), 3.17(60,826), 3.02(25,10.2.4), 2.85(80,16.0.2), 2.69(80,12.2.6), 2.55(20,10.2.12), 2.24(35,8.2.18), 2.17(60,18.2.2), 2.10(70,040), 2.07(100,18.2.8), 2.04(50,20.0.12), 1.917(30,6.2.24), 1.846(20,8.4.10), 1.777(40,10.0.28), 1.707(35,26.0.8), 1.619(20,18.4.0), 1.584(15,10.0.32). Kirkiite $\text{Pb}_{10}\text{Bi}_3\text{As}_3\text{S}_{19}$ is the only other sulfosalts with essential Pb, Bi and As.

The mineral occurs in an assemblage of Pb-Bi sulfosalts encrusting high temperature (400–600 °C) fumaroles on the rim and inner slope of the La Fossa crater of Vulcano Island, Italy (type locality). It is intimately admixed with bismuthinite, lillianite, kirkiite, heyrovskýite, galena and sulfochlorides of Pb and Bi. The name honors Filippo Vurro, Professor of Mineralogy at the University of Bari and specialist in the mineralogy and geochemistry of modern volcanic deposits. Type material

is deposited in the mineralogical museum of the University of Bari, catalog number 6/nm.

Discussion. Space group $F2mm$ is a non-standard setting of space group $Fmm2$. **A.J.L.**

YAZGANITE*

H. Sarp, R. Černý (2005) Yazganite, $\text{NaFe}^{3+}_2(\text{Mg,Mn})(\text{AsO}_4)_3 \cdot \text{H}_2\text{O}$, a new mineral: its description and crystal structure. *Eur. J. Mineral.*, 17, 367–373.

Yazganite occurs as masses and aggregates of euhedral prismatic crystals up to $2 \times 3 \times 10$ mm. Crystals are elongate parallel to c , flattened on $\{010\}$ with forms $\{010\}$, $\{100\}$, $\{110\}$, $\{131\}$, $\{111\}$, and $\{\bar{3}11\}$. No cleavage or parting is observed. Yazganite is brown or brown-black, slightly metallic, translucent, has an adamantine luster and a bright brown to yellow-gray streak. It is brittle with a conchoidal fracture, a Mohs hardness of 5, is non-fluorescent and not soluble in HCl. The mineral is biaxial negative, $\alpha = 1.870(2)$, $\beta = 1.897(2)$, $\gamma = 1.900(2)$, $2V_{\text{obs}} = 35(2)^\circ$, $2V_{\text{calc}} = 36.5(3)^\circ$, strong dispersion $r < v$, with $X \wedge a = 5^\circ$, $Y = b$, $Z \wedge c = 17^\circ$.

Electron microprobe analyses (average of 5 analyses) gave Na_2O 5.10, MgO 4.12, MnO 3.70, ZnO 0.30, Fe_2O_3 27.20, As_2O_5 56.94, H_2O 2.64 (by difference), sum 100.00 wt%, corresponding to an empirical formula, based on 12 O atoms, of $\text{Na}_{0.99}\text{Fe}^{3+}_{2.05}(\text{Mg}_{0.61}\text{Mn}_{0.32}\text{Zn}_{0.02})_{\Sigma 0.95}\text{As}_{2.99}\text{O}_{12} \cdot 0.88\text{H}_2\text{O}$. The ideal formula is $\text{NaFe}^{3+}_2(\text{Mg,Mn})(\text{AsO}_4)_3 \cdot \text{H}_2\text{O}$, $D_{\text{meas}} = 4.18(2)$ g/cm³, $D_{\text{calc}} = 4.182(1)$ g/cm³, $Z = 4$. The IR spectrum of yazganite contains absorption bands at 3400, 1630, 1110, 940, 880, 800, 745, 665, 555, 505, 400, and 335 cm⁻¹.

The structure of yazganite was solved and refined on a $0.30 \times 0.25 \times 0.10$ mm single crystal, $R_1 = 0.029$ for 1528 unique reflections. Yazganite is monoclinic, $C2/c$, $a = 12.181(1)$, $b = 12.807(1)$, $c = 6.6391(5)$, $\beta = 112.441(9)^\circ$, $V = 957.2(2)$ Å³, $\mu = 13.93$ mm⁻¹. The strongest lines in the powder X-ray diffraction pattern (Guinier-Hägg camera, $\text{CuK}\alpha_1$ radiation, 33 lines given) include 6.400(20,020), 5.630(20,200), 3.766(15, $\bar{3}$ 11), 3.575(30, $\bar{1}$ 31), 3.202(40,040), 2.780(100,240), 2.611(40, $\bar{1}$ 32), and 1.645(15,370). Yazganite is a variation of the johillerite structure and part of the allaudite group. It consists of zigzag chains of edge-sharing $M^{2+,3+}\text{O}_6$ octahedra along $[10\bar{1}]$ which are interconnected by AsO_4 tetrahedra into (101) sheets. The structure contains two channels parallel to $[001]$ which host (1) a water molecule which is fixed by hydrogen bonds, and (2) Na^+ ; both channels are fully ordered. Yazganite is the first hydrated member of the allaudite group.

Yazganite was discovered in fissures 1 m thick in porphyric andesite from the Erciyes volcanic complex, 10 km south of the prefecture of Kayseri, near Hisarcik, Kiranardi, Turkey. The Erciyes stratovolcano is composed of calc-alkaline basaltic andesite and dacite lavas with intercalated pyroclastics. Yazganite is associated with cassiterite, hematite, magnetite, orpiment, realgar, and tridymite. It most likely has a hydrothermal origin. The mineral is named for Dr. Evren Yazgan (b. 1943), a geologist in Turkey who worked in this region. Type material is deposited at the Department of Mineralogy, Natural History Museum of Geneva, Switzerland (catalog no. 478.188). **P.C.P.**

ZINCOLIBETHENITE*

R.S.W. Braithwaite, R.G. Pritchard, W.H. Paar, R.A.D. Patrick (2005) A new mineral, zincolibethenite, CuZnPO_4OH , a stoichiometric species of specific site occupancy. *Mineral. Mag.*, 69, 145–153.

The mineral occurs as bright blue-green, transparent, prismatic crystals < 1 mm long, which are terminated by domes or prisms. On other specimens, zincolibethenite forms translucent green to blue-green, compact, radiating spherical clusters ~ 1 mm in diameter, along with aggregates of clusters in which individual crystals cannot be distinguished. Zincolibethenite has a cleavage perpendicular to the crystal length and a Mohs hardness of 3.5. It is biaxial negative, $\alpha = 1.660$, $\beta = 1.705$, $\gamma = 1.715$, $2V_{\text{calc}} = 49^\circ$, dispersion $r < v$, medium, and pleochroism is absent.

Electron microprobe analyses (EDS, average of 15 analyses on 3 grains) gave 32.55 CuO, 34.48 ZnO, 29.33 P₂O₅, 3.63 H₂O, sum 99.99 wt%, corresponding to $\text{Cu}_{0.987}\text{Zn}_{1.022}(\text{P}_{0.997}\text{O}_4)\text{OH}$. The simplified formula is CuZnPO_4OH for $Z = 4$ and a D_{calc} of 3.972 g/cm³. The infrared spectrum of zincolibethenite contains bands at 3510m (O-H stretching), 1055vs and 970 (PO_4 ν_3 antisymmetric stretching), 855m and 828w (Zn-O-H bending), 633ms (metal-O stretching), 602m (metal-O stretching), 558m (PO_4 ν_4 bending), 525w and 495 (metal-O stretching), and 450w cm⁻¹ (PO_4 ν_2 bending) where s = strong, m = medium, w = weak, and v = very.

The crystal structure of zincolibethenite was solved on a $0.025 \times 0.015 \times 0.015$ mm single crystal using a Nonius Kappa CCD diffractometer at 293(2) K. The structure was refined on F^2 to $R_1 = 0.0525$, resulting in an orthorhombic cell, $Pnmm$, $a = 8.3263(3)$, $b = 8.2601(3)$, $c = 5.8771(2)$ Å, $V = 404.520(2)$ Å³. The strongest lines on the powder X-ray diffraction pattern (diffractometer, radiation not given, 28 lines given) include 5.8676(39,110), 4.7937(100,011), 3.6993(22,120), 2.9351(33,220), 2.6325(47,310), 2.4049(19,311), 2.3040(18,320), and 1.6892(11,042). Zincolibethenite is isostructural and forms a solid solution with libethenite. In zincolibethenite, Cu and Zn are completely ordered, with Cu^{2+} occupying the Jahn-Teller distorted 6-coordinated site and Zn^{2+} occupying a 5-coordinated site. Cu-Zn substitution is limited by the fact that Zn will not enter into the distorted 6-coordinated site. Synthesis experiments using Zn-rich solutions resulted in a mixture of zincolibethenite and hopeite, confirming the limited Cu-Zn substitution in the solid solution series.

Zincolibethenite was discovered as far back as 1908 on material from the Broken Hill mines, Northern Rhodesia (now Kabwe, Zambia). It occurs on spongy “limonite” gozzan which is sometimes encrusted by hopeite or tarbuttite crystals. Zincolibethenite is thought to have formed from a Zn-rich cupriferous fluid which possibly originated from the late-stage alteration of tarbuttite. The name is for its relationship to libethenite. Type material has been deposited in the collections of the Institut für Mineralogie, Universität Salzburg, Austria, the Royal Scottish Museum, and the Natural History Museum, London.

Discussion. Details concerning the structure determination, including bond lengths, etc., are not given. A discussion of the structure is also not provided. **P.C.P.**

NEW DATA

AGARDITE*

R.L. Frost, A.R. McKinnon, P.A. Williams, K.L. Erikson, M.L.

Weier, P. Leverett (2005) Studies of natural and synthetic agardites. *N. Jahrb. Mineral. Abh.*, 181, 11–19.

Natural agardite-(Ce) and a potentially new species with the formula $[(Al,Nd,REE)Cu_6(AsO_4)_3(OH)_6 \cdot 3H_2O]$ has been discovered at Cobar, New South Wales, Australia. The mineral occurs as sky blue, fine, hexagonal needles which form small, flat sprays and masses of randomly-oriented needles which range in length from 2 to 10 μm , with 500 μm as the maximum. It occurs with oxidized arsenopyrite, chenevixite, olivenite and segnitite. A set of pure end-member, fully-hydrated agardites with the general formula $ACu_6(AsO_4)_2(OH)_6 \cdot 3H_2O$, where A = rare earth element, was synthesized to determine the effects of REE size on the cell parameters, as well as to determine the effects of substitution on the mid-IR and near-IR spectra. Results indicate that a correlation exists between the effective ionic radius of the REE^{3+} in the M site and the unit cell size for each pure end-member agardite. The IR OH-stretching region contains found bands at 3568, 3489, 3382, and 3290 cm^{-1} , the former two which are attributed to the stretching mode of the OH units and the latter two to H_2O stretching vibrations. Near-IR spectra shows a series of bands assigned to the first overtones of the OH fundamentals: 7242, 7007, 6809, 6770, and 6579 cm^{-1} . Bands assigned to H_2O combination modes include 5200, 5173, 5082, and 4837 cm^{-1} . **P.C.P.**

HEINRICHITE, META-URANOCIRCITE I,
URANOCIRCITE, URANOSPINITE, METAHEINRICHITE

A.J. Locock, P.C. Burns, T.M. Flynn (2005) Structures of strontium- and barium-dominant compounds that contain the autunite-type sheet. *Can. Mineral.*, 43, 721–733.

Single-crystal X-ray structure study of synthetic heinrichite ($R_1 = 0.043$), $Ba[(UO_2)(AsO_4)]_2(H_2O)_{10}$, and meta-uranocircite I ($R_1 = 0.052$), $Ba[(UO_2)(PO_4)]_2(H_2O)_7$ indicated that both are monoclinic, space groups $P2/c$ and $P2_1$ respectively, with respective cell dimensions a 7.155(1), b 7.134(1) \AA , c 21.290(3) \AA , $\beta = 104.171(5)^\circ$, V 1053.6(3) \AA^3 , $Z = 2$, D_{calc} 3.579 g/cm^3 , and a 6.943(2), b 17.634(6), c 6.952(2) \AA , $\beta = 90.023(7)^\circ$, V 851.2(5) \AA^3 , $Z = 2$, D_{calc} 3.876 g/cm^3 . Investigation (but not refinement) of synthetic uranocircite $Ba[(UO_2)(PO_4)]_2(H_2O)_{10}$, yields crystal data $P2/c$, a 7.01, b 6.99, c 21.2 \AA , $\beta = 103.9^\circ$, V 1008.4 \AA^3 , $Z = 2$, D_{calc} 3.45 g/cm^3 . On the basis of the isotopy of synthetic $Sr[(UO_2)(PO_4)]_2(H_2O)_{11}$ and $Sr[(UO_2)(AsO_4)]_2(H_2O)_{11}$ with synthetic autunite $Ca[(UO_2)(PO_4)]_2(H_2O)_{11}$, crystal data are predicted for uranospinite: $Ca[(UO_2)(AsO_4)]_2(H_2O)_{11}$, orthorhombic, space group $Pnma$, a 14.35 \AA , b 20.66 \AA , c 7.17 \AA , V 2125 \AA^3 , $Z = 4$, D_{calc} 3.3 g/cm^3 . Similarly, by analogy with meta-uranocircite I, crystal data are predicted for metaheinrichite: $Ba[(UO_2)(AsO_4)]_2(H_2O)_7$, monoclinic, space group $P2_1$, a 7.08 \AA , b 17.7 \AA , c 7.09 \AA , $\beta = 90.02^\circ$, V 889 \AA^3 , $Z = 2$, D_{calc} 4.0 g/cm^3 . The data resolve previous uncertainties about unit cells and the space-group assignments. **A.J.L.**

PLOMBIERITE (TOBERMORITE 14 \AA)*

E. Bonaccorsi, S. Merlino (2005) The crystal structure of tobermorite 14 \AA (plombierite), a C-S-H phase. *J. Am. Ceram. Soc.*, 88, 505–512.

The crystal structure of plombierite, the 14 \AA , most hydrated phase in the tobermorite group, was determined using a combination of X-ray and synchrotron diffraction methods. A single crystal (0.04 \times 0.3 mm) of plombierite from Crestmore, Riverside county, California, was selected for the data collection. Preliminary studies were performed by Weissenberg and precession photographs which confirmed the occurrence of the known orthorhombic subcell. Single-crystal X-ray diffraction data were collected on a Nonius Kappa CCD diffractometer (only family reflections) and synchrotron data were collected at the Elettra synchrotron radiation facility ($\lambda = 1 \text{\AA}$; $k = 2n + 1$ reflections). The two datasets were combined for the final refinement, $R_1 = 0.152$ for 1291 reflections with $F_o > 4\sigma(F_o)$. Order-disorder theory was applied to the crystal structure and two polytypes were observed, along with possible disordered sequences of layers, resulting in diffuse streaks along c^* . Only one of the polytypes was refined (MDO₂) and is monoclinic, $B11b$ (non-standard cell setting) with $a = 6.735(2)$, $b = 7.425(2)$, $c = 27.987(5) \text{\AA}$, $\gamma = 123.25(1)^\circ$, $V = 1170.4(5) \text{\AA}^3$, $Z = 2$, $D_{\text{calc}} = 2.23 \text{g/cm}^3$, $D_{\text{meas}} = 2.20 \text{g/cm}^3$. Characteristics of the other polytype, MDO₁, were recognized but too weak and diffuse to be used in the refinement. The resultant crystal chemical formula for plombierite is $Ca_5Si_6O_{10}(OH)_2 \cdot 7H_2O$. The crystal structure of plombierite is comprised of complex layers consisting of sheets of 7-coordinated Ca sandwiched between wollastonite-like chains. The interlayer space contains both Ca and H_2O . Plombierite is similar to the so-called C-S-H(1) compound which is one of the main products of the binding process in Portland cement. **P.C.P.**

ERRATA

A number of errors were discovered in the abstract for ankinovichite (*Am.Mineral.*, 90, p. 768). The corrected abstract is published here, with apologies to the authors.

ANKINOVICHITE*

V.Yu. Karpenko, L.A. Pautov, E.V. Sokolova, F.C. Hawthorne, A.A. Agakhanov, T.V. Dikaya, G.K. Bekenova (2004) Ankinovichite, the nickel analogue of alvanite, a new mineral from Kurumsak (Kazakhstan) and Kara-Chagyr (Krygyzstan). *Zapiski Vseross. Mineral. Obsch.* 133(2), 59–70 (in Russian, English abstract).

Ankinovichite is described from two localities—Kurumsak, Chimkent Oblast', Kazakhstan, and Mount Kara-Chagyr, Osh Oblast, Kyrgyzstan. The material from Kurumsak occurs as crusts of prismatic, pale green, elongate crystals up to 0.5 mm. The material from Mount Kara-Chagyr occurs as green to light blue, tabular, commonly elongate crystals 0.05 to 0.2 mm in length. The crystals often occur in aggregates, and are commonly twinned. Ankinovichite is brittle, with perfect (010) cleavage, Mohs

hardness 2.5 to 3, microindentation hardness VHN 68 kg/mm². The mineral is transparent and vitreous. Electron microprobe analyses (Kara-Chagyr/Kurumsak) gave Al₂O₃ 33.82/33.79, SiO₂ 0.59/0.67, V₂O₅ 28.41/27.98, FeO 0.14/0.35, NiO 8.43/7.19, CuO 0.27/0.20, ZnO 2.24/4.20, H₂O 23.30 (Penfield method)/25.65 (by difference), sum 97.20/100.00 wt%, corresponding to (Ni_{0.68}Zn_{0.17}Cu_{0.02}Fe_{0.01})_{20.88}Al₄(VO₃)_{1.88}Si_{0.06}(OH)_{12.12}(H₂O)_{2.67} for material from Kara-Chagyr and (Ni_{0.58}Zn_{0.31}Cu_{0.02}Fe_{0.03})_{20.94}Al₄(VO₃)_{1.85}Si_{0.06}(OH)_{12.27}(H₂O)_{2.46} for material from Kurumsak. The simplified general formula is (Ni,Zn)Al₄(VO₃)₂(OH)₁₂·2H₂O based on 4 Al atoms pfu. The IR spectrum of ankinovichite contains bands in the range of 3460 to 3440 cm⁻¹ (H₂O/OH), and 1025 to 1020 cm⁻¹ that is characteristic and attributed to symmetric vibrations of the VO₄ tetrahedra. It is biaxial positive, $\alpha = 1.653(2)$ $\beta = 1.677(2)$, $\gamma = 1.706(3)$, $2V_{\text{obs}} 86(2)^\circ$, $2V_{\text{calc}} 86^\circ$. Ankinovichite has parallel extinction, positive elongation, is non-pleochroic and non-fluorescent under UV radiation.

The crystal structure of ankinovichite was refined on a 0.06 × 0.004 × 0.006 mm crystal by single-crystal X-ray diffraction methods, $R_1 = 0.128$ for 1143 reflections with $I > 4\sigma(I)$. Starting parameters were taken from alvanite (Dunn et al. 1990; *Mineral. Mag.* 54, 609–611; Pertlik et al. 1990; *Neues Jahrb. Mineral. Mh.* 385–392). The mineral is monoclinic, $P2_1/n$, $a = 17.8098(8)$, $b = 5.1228(2)$, $c = 8.8665(4)$ Å, $\beta = 92.141(1)^\circ$, $V = 808.4(2)$ Å³, $Z = 2$, $D_{\text{obs}} = 2.48(2)$ g/cm³, $D_{\text{calc}} = 2.476$ g/cm³. The strongest lines on the powder X-ray diffraction pattern (FeK α radiation, 34 lines) are 8.89(100,200), 7.83(100,101), 5.01(30, $\bar{3}$ 01), 4.91(20,110), 3.354(40,012), 3.266(50,501), 2.944(30, $\bar{3}$ 12), 2.631(20,412), 2.463(20, $\bar{7}$ 01,220), 2.378(30, $\bar{3}$ 13, $\bar{2}$ 1), 2.323(30,313), 1.970(80, $\bar{6}$ 13,422), 1.935(20,023),

1.904(70, $\bar{6}$ 21), 1.680(40,820), 1.605(50,623), 1.539(30,804,332). The mineral is isostructural with alvanite and is its Ni analogue. The high R_f value is thought to be due to twinning, although the refined site occupancies match well with those obtained by electron microprobe analyses. Ankinovichite is only the second mineral known to have chains of V tetrahedra.

Ankinovichite was found in the vanadium-bearing schists of the Kara-Tau range, south Kazakhstan. It is a low-temperature hydrothermal or supergene mineral. At Kurumsak, ankinovichite was found in a dump at a bore pit within a middle Cambrian schist rich in carbonaceous material and clay and interbedded with dolomites. It is associated with volborthite, carnotite, goethite and an unknown dark orange V oxide. Ankinovichite at Kara-Chagyr (Isfayramsay River, Osh Oblast') occurs in fractures and as a cement in schist fragments (early Paleozoic) found within a serpentinite matrix, part of the early Carboniferous Fergana complex. It is associated with allophone, kolovratite, volborthite, nickelalumite, metatuyamunite, roscelite and tangeite. Ankinovichite was named for Ekaterina Aleksandrovna Ankinovich (1911–1991) and Stepan Gerasimovich Ankinovich (1912–1985), a well-known mineralogist and geologist, respectively. The type material has been deposited at the A.E. Fersman Mineralogical Museum, Russian Academy of Science, Moscow, Russia (catalog no. 6798). **P.C.P./T.S.E.**

Discussion. The authors state that they succeeded in locating two hydrogen atoms of the H₂O group although this seems unlikely given the poor quality of the final refinement. In the manuscript, the mineral is given as biaxial negative. Taking into consideration the information given, the mineral is actually biaxial positive and this has been corrected in the abstract.

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