

## NEW MINERAL NAMES\*

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### Clinoatacamite\*

J.L. Jambor, J.E. Dutrizac, A.C. Roberts, J.D. Grice, J.T. Szymański (1996) Clinoatacamite, a new polymorph of  $\text{Cu}_2(\text{OH})_3\text{Cl}$ , and its relationship to paratacamite and "anarakite." *Can. Mineral.*, 34, 61–72.

J.D. Grice, J.T. Szymański, J.L. Jambor (1996) The crystal structure of clinoatacamite, a new polymorph of  $\text{Cu}_2(\text{OH})_3\text{Cl}$ . *Can. Mineral.*, 34, 73–78.

Electron microprobe analysis gave CuO 74.7 (73.4–76.0), Cl 16.5 (15.7–17.2),  $\text{H}_2\text{O}$  (calc.) 13.5, sum 104.7, less O = Cl 3.7, total 101.0 wt%, corresponding to  $\text{Cu}_{1.96}\text{O}_{3.03}\text{H}_{3.11}\text{Cl}_{0.97}$ , ideally  $\text{Cu}_2(\text{OH})_3\text{Cl}$ . The morphology is variable, from simple twinned pseudorhombic grains up to 1 mm across, to complicated intergrowths of euhedra. Varicolored from green to dark greenish black, less commonly greenish blue; vitreous to adamantine luster, transparent to translucent, brittle with an even fracture, nonfluorescent, cleavage {012} perfect, twinned on {100},  $H = 3$ ,  $D_{\text{calc}}$  (idealized) = 3.77 g/cm<sup>3</sup> for  $Z = 4$ . Optically biaxial negative, nonpleochroic,  $2V_{\text{meas}} = 75(5)$ ,  $2V_{\text{calc}} = 69(3)^\circ$ ; strong dispersion,  $r \ll v$ ; orientation  $X = b$ ,  $Y:a = 10^\circ$  in obtuse angle  $\beta$ . Single-crystal X-ray structure study ( $R = 0.052$ ) indicated monoclinic symmetry, space group  $P2_1/n$ ,  $a = 6.157(2)$ ,  $b = 6.814(3)$ ,  $c = 9.104(5)$  Å,  $\beta = 99.65(4)^\circ$  as refined from 114 mm Debye-Scherrer ( $\text{CoK}\alpha_1$ ) powder data; strongest lines are 5.47(100,  $\bar{1}01, 011$ ), 2.767(60,  $\bar{2}11$ ), 2.742(70, 013,  $\bar{2}02$ ), 2.266(60, 220), 2.243(50, 004), and 1.704(50,  $\bar{2}24, 040$ ). Reliably distinguished from paratacamite only by optical or X-ray study.

The mineral has been found on specimens from several localities worldwide. On the type specimen, from Chuquicamata, Chile, the mineral is associated with atacamite, paratacamite, gypsum, and alunite on a quartzose matrix. The new name alludes to the monoclinic symmetry and polymorphic relationship to atacamite. Type material is in the Royal Ontario Museum, Toronto. **A.C.R.**

### Hanawaltite\*

A.C. Roberts, J.D. Grice, R.A. Gault, A.J. Criddle, R.C. Erd (1996) Hanawaltite,  $\text{Hg}_6^{2+}\text{Hg}_2^{2+}[\text{Cl}(\text{OH})_2\text{O}_3] - \text{A}$  new

mineral from the Clear Creek claim, San Benito County, California: Description and crystal structure. *Powder Diffraction*, 11(1), 45–50.

The mineral occurs sparingly with calomel, native mercury, cinnabar, montroydite, and quartz in a single specimen of float near a prospect pit at the former Clear Creek mercury mine in the new Idria district of California. The specimen contains subhedral to anhedral crystals, typically bladed to platy, maximum size  $0.3 \times 0.3$  mm, striated [001], black to dark brown-black color, dark red-brown to black streak, opaque to translucent on thin edges, metallic luster, brittle, uneven fracture, good {001} cleavage,  $H = <5$ , nonfluorescent,  $D_{\text{calc}} = 9.51$  g/cm<sup>3</sup> for  $Z = 4$ , decrepitates on exposure to sunlight. Electron microprobe analysis gave HgO 96.2, Cl 3.3, O = Cl 0.75, sum 98.79 wt%; the recalculated empirical formula on the basis of the crystal-structure determination is  $\text{Hg}_{6.60}^{2+}\text{Hg}_{1.00}^{2+}[\text{Cl}_{1.43}(\text{OH})_{0.57}]_{32.00}\text{O}_{3.00}$ . Bright bluish white to duller grayish white in reflected light, birefractant and slightly pleochroic, straight extinction; reflectance percentages in air and in oil are given in 20 nm steps from 400 to 700 nm. Single-crystal X-ray structure study ( $R = 0.152$ ) indicated orthorhombic symmetry, space group  $Pbma$ ,  $a = 11.790(3)$ ,  $b = 13.881(4)$ ,  $c = 6.450(2)$  Å as refined from a 114 mm Debye-Scherrer powder pattern (Cu radiation, 55 lines listed) with strongest lines of 5.25(80, 111), 3.164(60, 231), 3.053(100, 041), 2.954(70, 141), 2.681(50, 401), and 2.411(50, 232, 341).

The new name is for J.D. Hanawalt (1903–1987), a pioneer in the field of X-ray powder diffraction. Type material is in the Systematic Reference Series of the National Mineral Collection at the Geological Survey of Canada, Ottawa. **J.L.J.**

### Jensenite\*

A.C. Roberts, J.D. Grice, L.A. Groat, A.J. Criddle, R.A. Gault, R.C. Erd, E.A. Moffatt (1996) Jensenite,  $\text{Cu}_3\text{Te}^{6+}\text{O}_6 \cdot 2\text{H}_2\text{O}$ , a new mineral species from the Centennial Eureka mine, Tintic district, Juab County, Utah. *Can. Mineral.*, 34, 49–54.

J.D. Grice, L.A. Groat, A.C. Roberts (1996) Jensenite, a cupric tellurate framework structure with two coordinations of copper. *Can. Mineral.*, 34, 55–59.

Electron microprobe analysis gave CuO 50.91, ZnO 0.31,  $\text{TeO}_3$  38.91,  $\text{H}_2\text{O}$  (calc.) 8.00, sum 98.13 wt%, cor-

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

responding to  $(\text{Cu}_{2.92}\text{Zn}_{0.02})_{\Sigma 2.94}\text{Te}_{1.01}^{\text{VI}}\text{O}_{5.97} \cdot 2.03\text{H}_2\text{O}$ . An IR spectrum confirmed the presence of structurally bound  $\text{H}_2\text{O}$ , and the formula was obtained by X-ray crystal-structure analysis ( $R_w = 0.025$ ). The mineral occurs as emerald-green, transparent, single crystals (up to 0.4 mm long) and groups of crystals on white to colorless quartz. Green streak, fair  $\{\bar{1}01\}$  cleavage, brittle,  $H = 3-4$ , uneven fracture, adamantine luster, nonfluorescent,  $D_{\text{calc}} = 4.78 \text{ g/cm}^3$  for  $Z = 4$ . Crystals are mainly simple rhombs, some slightly elongate  $[101]$ , showing  $\{\bar{1}01\}$ ,  $\{110\}$ , minor  $\{100\}$ , and several smaller forms. Weakly birefractant and nonpleochroic in reflected light; gray in plane-polarized light in air; anisotropy not detectable. Single-crystal X-ray study indicated monoclinic symmetry, space group  $P2_1/n$ ,  $a = 9.204(2)$ ,  $b = 9.170(2)$ ,  $c = 7.584(1) \text{ \AA}$ ,  $\beta = 102.32(3)^\circ$ , as refined from a powder pattern (114 mm Debye-Scherrer, Cu radiation) with strongest lines of  $6.428(100, \bar{1}01, 110)$ ,  $3.217(70, \bar{2}02)$ ,  $2.60(60, 202)$ ,  $2.530(50, 230)$ ,  $2.144(35, \bar{3}31)$ , and  $1.750(35, \bar{4}32)$ .

The mineral is associated with mcalpineite, xocomecatlite, and several unnamed Cu- and Te-bearing minerals that occur in dumps at the Centennial Eureka mine. The new name is for M.C. Jensen (b. 1959), who first recognized the mineral. Type material is in the National Mineral Collection at the Geological Survey of Canada, Ottawa. **J.L.J.**

#### Lenaite\*

V.A. Amuzinsky, Yu.Ya. Zhadov, N.V. Zayakina, N.V. Leskova (1995) Lenaite  $\text{AgFeS}_2$ —A new mineral species. *Zapiski Vseross. Mineral. Obshch.*, 124(5), 85–91 (in Russian, English abs.).

The mineral occurs as xenomorphic or equant grains, to 0.2 mm, in goethite pseudomorphs after magnesian siderite. Electron microprobe analysis of 22 grains gave an average and range of Ag 46.58 (44.9–47.3), Fe 24.08 (23.7–24.5), S 28.86 (28.0–30.6), Hg 0.3 (0.0–0.4), sum 99.8 (98.8–101.5) wt%, corresponding to  $\text{Ag}_{0.98}\text{Fe}_{0.98}\text{S}_{2.04}$ , ideally  $\text{AgFeS}_2$ . Megascopic color not observed, metallic luster, opaque,  $H = 4.5$ ,  $VHN_{10} = 310$  (270–360),  $D_{\text{calc}} = 4.63 \text{ g/cm}^3$  for  $Z = 4$ . Cream with a grayish tint in reflected light, nonpleochroic, no birefractance, moderate anisotropism. Reflectance percentages, given in 20 nm steps for  $R_{\text{max}}$  and  $R_{\text{min}}$  from 420 to 680 nm, are 27.2, 30.1 (470 nm), 32.3, 36.4 (546 nm), 33.0, 37.1 (589 nm), and 31.2, 35.3 (650 nm). Indexing of the X-ray powder pattern (57 mm Debye-Scherrer, Fe radiation) indicated tetragonal symmetry, possible space group  $P4_2mc$ ,  $a = 5.64(1)$ ,  $c = 10.34(3) \text{ \AA}$ ; strongest lines (14 given) are  $3.15(100, 112)$ ,  $2.445(20, 211)$ ,  $2.340(\leq 20, 104)$ ,  $1.910(40, 204)$ , and  $1.692(20, 312)$ .

The mineral is associated with acanthite, chalcopyrite, and Ag-rich members of the tetrahedrite group (24–54 wt% Ag) in quartz-siderite veins and veinlets at the Khashchanskoe deposit near the Lena River in eastern Yakutia, Russia. The new name is for the locality. The repository for type material is not given.

**Discussion.** For reports of  $\text{AgFeS}_2$  as an unnamed mineral, see *Am. Mineral.*, 73, p. 1497 (1988); 75, p. 435 (1990); 80, p. 186 (1995). **V.A.K.**

#### Magnesiocoulsonite\*

L.Z. Reznitskii, E.V. Sklyarov, Z.F. Ushchapovskaya (1995) Magnesiocoulsonite—A new mineral species in the spinel group. *Zapiski Vseross. Mineral. Obshch.*, 124(4), 91–97 (in Russian).

Electron microprobe analyses (extremes of ten listed) gave  $\text{TiO}_2$  0.12, 0.16,  $\text{Al}_2\text{O}_3$  0.35, 0.41,  $\text{V}_2\text{O}_5$  46.68, 55.88,  $\text{Cr}_2\text{O}_3$  31.72, 21.49, FeO 0.07, 0.61, MnO 0.19, 0.19, MgO 20.94, 21.03, sum 99.87, 99.77 wt%, corresponding to  $\text{Mg}(\text{V}, \text{Cr})_2\text{O}_4$ , with 59–72 mol%  $\text{MgV}_2\text{O}_4$ . Occurs as black, irregular grains up to 0.25 mm; black streak, metallic luster, uneven fracture, brittle,  $H_{100} = 969$  (873–1080)  $\text{kg/mm}^2$  (Mohs 6.5), insoluble in HCl and  $\text{HNO}_3$ . Light gray in reflected light, isotropic, no internal reflection. Reflectance measurements for grains containing 50.2–51.9 wt%  $\text{V}_2\text{O}_5$  gave (nm, R%): 400, 14.3; 420, 14.2; 440, 14.1; 460, 14.0; 480, 13.9; 500, 13.8; 520, 13.8; 540, 13.7; 560, 13.7; 580, 13.7; 600, 13.7; 620, 13.7; 640, 13.7; 660, 13.8; 680, 13.8; 700, 13.7. The X-ray powder pattern of a grain containing 48.7 wt%  $\text{V}_2\text{O}_5$  was indexed by analogy with magnesiocromite and  $\text{MgV}_2\text{O}_4$ . Isometric symmetry, space group  $Fd\bar{3}m$ ,  $a = 8.385 \text{ \AA}$ ,  $D_{\text{calc}} = 4.31 \text{ g/cm}^3$  for  $Z = 8$ . Strongest lines of the powder pattern are  $4.84(90, 111)$ ,  $2.52(100, 311)$ ,  $2.093(80, 400)$ ,  $1.612(80, 511)$ , and  $1.582(90, 440)$ .

The mineral occurs in quartz-diopside rocks of the Slyudyanka complex, southern Baikal region, Siberia, Russia, in association with Cr- and V-bearing tremolite, diopside, chlorite, and muscovite, and with calcite, quartz, goldmanite, pyrite, karelianite and chromian karelianite, Cr-V spinels, and unnamed  $\text{Mg}(\text{Cr}, \text{V})_4\text{O}_9$ . The name alludes to the composition and the relationship to coulsonite,  $\text{FeV}_2\text{O}_4$ . Type material is at the Fersman Mineralogical Museum, Moscow, Russia. **J.P.**

#### Smrkovecite\*

T. Řídkolšil, J. Sejkora, V. Šrein (1996) Smrkovecite, monoclinic  $\text{Bi}_2\text{O}(\text{OH})(\text{PO}_4)$ , a new mineral of the atelestite group. *Neues Jahrb. Mineral. Mon.*, 97–102.

Electron microprobe analysis gave  $\text{Bi}_2\text{O}_3$  85.16,  $\text{P}_2\text{O}_5$  12.74,  $\text{As}_2\text{O}_5$  0.17,  $\text{V}_2\text{O}_5$  0.03,  $\text{SiO}_2$  0.02,  $\text{H}_2\text{O}$  (calc.) 1.62, sum 99.77 wt%, corresponding to  $\text{Bi}_{2.01}\text{O}(\text{OH})_{1.00}(\text{PO}_4)_{0.98}(\text{AsO}_4)_{0.01}$ . Occurs within cavities in quartz as crusts and mamillary to spherical aggregates to 0.2 mm, and as intergrown crystals to 0.1 mm. White to pale yellow color, transparent to translucent, vitreous to adamantine luster, indistinct  $\{010\}$  cleavage, subconchoidal fracture,  $H = 4-5$ ,  $D_{\text{calc}} = 4.75 \text{ g/cm}^3$  for  $Z = 4$ , nonfluorescent. Optically biaxial positive,  $\alpha = 2.05(6)$ ,  $\beta = 2.06(7)$ ,  $\gamma = 2.09(6)$ ,  $2V_{\text{meas}} = 58.0(6)$ ,  $2V_{\text{calc}} = 61^\circ$ , dispersion  $r > v$  distinct. Monoclinic symmetry by analogy to atelestite, space group

$P2_1/c$ ,  $a = 6.954(2)$ ,  $b = 7.494(4)$ ,  $c = 10.869(6)$  Å,  $\beta = 107.00^\circ$  as calculated from the X-ray powder pattern (diffractometer, Cu radiation). Strongest lines are 4.268 (17,012), 3.271(51,20 $\bar{2}$ ), 3.254(100,112), 3.145(34,013), 2.727(29,211), and 1.885(16,3 $\bar{2}$ ).

The mineral occurs in weathered dump material from a small Ag-Bi-As-U deposit at Smrkovec, near Mariánské Lázně, Czech Republic. Among the numerous associated secondary minerals are atelestite, bismutite, bismutoferite, eulytite, pucherite, petitjeanite, preisingerite, and silenite. Type material is in the Department of Mineralogy and Geology, National Museum, Praha, Czech Republic. **J.L.J.**

#### Studenitsite\*

S.V. Malinko, S. Anichich, D. Yoksimovich, A.E. Lisitsyn, G.I. Dorokhova, M.A. Yamnova, V.V. Vlasov, A.A. Ozol (1995) Studenitsite  $\text{NaCa}_2[\text{B}_5\text{O}_{14}(\text{OH})_4] \cdot 2\text{H}_2\text{O}$ —A new borate from Serbia, Yugoslavia. *Zapiski Vseross. Mineral. Obshch.*, 124(3), 57–64 (in Russian).

Microchemical analysis of specimen, which was also studied by physical, optical, and X-ray methods, gave  $\text{SiO}_2$  0.09,  $\text{TiO}_2$  0.00,  $\text{Al}_2\text{O}_3$  0.05,  $\text{Fe}_2\text{O}_3$  0.05,  $\text{MnO}$  0.01,  $\text{CaO}$  20.84,  $\text{MgO}$  0.02,  $\text{SrO}$  0.09,  $\text{Na}_2\text{O}$  5.96,  $\text{K}_2\text{O}$  0.08,  $\text{B}_2\text{O}_3$  59.64,  $\text{H}_2\text{O}^-$  0.00,  $\text{H}_2\text{O}^+$  13.64,  $\text{CO}_2$  0.00, sum 100.47 wt%, corresponding to  $\text{Na}_2\text{O} \cdot 4\text{CaO} \cdot 9\text{B}_2\text{O}_3 \cdot 8\text{H}_2\text{O}$  or  $\text{NaCa}_2[\text{B}_5\text{O}_{14}(\text{OH})_4] \cdot 2\text{H}_2\text{O}$ . No reaction with water, slowly dissolves in dilute HCl and  $\text{H}_2\text{SO}_4$ . Occurs as aggregates of closely intergrown, striated crystals up to 5 mm long. Colorless to light gray or dirty yellow, translucent, thin pieces transparent, white streak, no cleavage, fragile,  $H_{50} = 527$  kg/mm<sup>2</sup> (Mohs 5½–6),  $D_{\text{meas}} = 2.29$ ,  $D_{\text{calc}} = 2.34$  g/cm<sup>3</sup> for  $Z = 4$ . Crystals show {001}, {011}, and {111}, plus poorly developed {100}, {110}, and {012}. DTA-TGA study revealed endotherms at 435 and 470 °C (15% weight loss, corresponding to vaporization of  $\text{H}_2\text{O}$  and OH), 605 °C (changes in structure), 780 °C (melting), and an exotherm at 710 °C (structural change). Weak endotherms at 80, 170, and 260 °C are due to dissociation of impurities of other borates. The infrared spectrum shows absorption bands at 450, 480, 525, 560, 670, 695, 740, 780, 815, 870, 900, 960, 1015, 1060, 1120, 1185, 1290, 1340, 1375, 1420, 1455, 1590, 1665, 3150, 3230, 3450, 3540, 3570, and 3650 cm<sup>-1</sup>. Optically biaxial positive,  $\alpha = 1.532(2)$ ,  $\beta = 1.538(2)$ ,  $\gamma = 1.564(2)$ ,  $2V = 54(2)^\circ$ ,  $X = \gamma$ ,  $Y = \alpha$ ,  $Z \wedge \beta = 10^\circ$ , medium dispersion  $r > v$ . Single-crystal X-ray study ( $R = 0.051$ ) showed the mineral to be monoclinic, space group  $P2_1/c$ ,  $a = 11.4994(8)$ ,  $b = 12.5878(9)$ ,  $c = 10.5297(7)$  Å,  $\beta = 99.423(6)^\circ$ . Strongest lines of the powder pattern (44 lines given) are 5.41(66,021), 3.35(89,11 $\bar{3}$ ), 3.27(59,032), 3.04(100,12 $\bar{3}$ ), and 2.210(59,034). The basic units of the structure are  $[\text{B}_5\text{O}_{14}(\text{OH})_4]^{2-}$  layers parallel to (001).

The mineral occurs in volcanic-sedimentary rocks of the Yarondolskij basin, 280 km south of Belgrade (Serbia). Associated minerals are ulexite, colemanite, and pentahydroborite, plus a coaly substance, which occur in

the interstices of aggregates of studenitsite. The name is for the cloister Studenica in western Serbia, close to the place of occurrence. Type material is at the Fersman Mineralogical Museum, Moscow, Russia.

**Discussion.** The initial report on the crystal structure of the then-unnamed mineral was abstracted in *Am. Mineral.*, 79, p. 1213 (1994). **J.P.**

#### Viaeneite\*

H. Kucha, W. Osuch, J. Elsen (1996) Viaeneite,  $(\text{Fe,Pb})_4\text{S}_8\text{O}$ , a new mineral with mixed sulphur valencies from Engis, Belgium. *Eur. Jour. Mineral.*, 8, 93–102.

The mineral occurs as oval aggregates, up to 4 mm, inside pyrite, marcasite, and sphalerite at the carbonate-hosted La Mallieue Pb-Zn deposit, about 40 km from Liege, Belgium. Individual grains in the aggregates are up to 80 µm, homogeneous,  $H = 3$ ,  $VHN_{200} = 252$  (123–357), {110} cleavage,  $D_{\text{meas}} = 3.8(1)$ ,  $D_{\text{calc}} = 3.65$  g/cm<sup>3</sup> for  $Z = 2$ . In reflected light, yellow with a brassy hue, darker than pyrite and marcasite, bireflectant from grayish brown through orange to yellow-orange; strong anisotropy, with polarization colors of orange, yellow-orange, greenish gray. Reflectance percentages are given in 10 nm steps (SiC standard) from 400 to 700 nm;  $R_{\text{max}}$  and  $R_{\text{min}}$  in air and in oil, respectively, are 19.5, 32.1, 11.3, 17.0 (470 nm), 23.8, 36.8, 14.8, 21.6 (550 nm), 24.6, 37.4, 15.3, 21.9 (590 nm), 25.1, 37.3, 14.9, 20.6 (650 nm). Tarnishes in air in a few weeks. Electron microprobe analysis gave Fe 42.37, Ni 0.20, Zn 0.05, As 0.17, Pb 4.02, S 49.74, sum 96.55,  $O_{\text{meas}} = 3.69$ , O by difference 3.45 wt%, corresponding to  $(\text{Fe}_{3.91}\text{Pb}_{0.10}\text{Ni}_{0.02})_{24.03}(\text{S}_{8.00}\text{As}_{0.01})_{28.01}\text{O}_{1.16}$ , simplified as  $(\text{Fe,Pb})_4\text{S}_8\text{O}$ .

**Discussion.** The above data supplement those from an incomplete description abstracted in *Am. Mineral.*, 81, p. 1015 (1996). **J.L.J.**

#### Warrierite

J.G. Olliver, M. Thompson (1996) Warrierite—A new black tourmalinite gemstone from Western Australia. *Australian Gemmologist*, 19, 210–214.

The mineral is a fine-grained, spherulitic black tourmaline, as confirmed by X-ray diffraction data. Chemical analysis gave results, including 4.57–6.76 wt% MgO, that indicate the mineral is in the dravite-schorl series. The new name alludes to the occurrence in the Warriedar fold belt of Western Australia.

**Discussion.** It is unfortunate that the new, unapproved name, which is intended for marketing purposes, was introduced in a nonmarketing journal. **J.L.J.**

#### Native tungsten, unnamed $\text{Y}_2\text{O}_3$

M.I. Novgorodova, N.N. Nedashkovskaya, A.V. Rasskazov, N.V. Trubkin, E.I. Semenov, B.L. Koshelev (1995)

Native tungsten with inclusions of yttrium oxide from the alluvium of the Bolshaya Polya River (subpolar Urals). Doklady Akad. Nauk, 340(5), 681–684 (in Russian).

Aggregates of native tungsten to 5 mm in diameter occur throughout cored intervals to depths of 30 m in alluvial deposits of the Bolshaya Polya River. The aggregates consist of 1–2  $\mu\text{m}$  cubo-octahedra. Electron microprobe analysis gave 99.93–100.19 wt% W, with Mo to 0.11 wt%, and Ca, Al, Fe, Mn, Mg, and Ti from 0.01 to 0.06 wt%. The X-ray powder pattern (114 mm Debye-Scherrer, Fe radiation) has lines similar to those of metallic W: 2.226(100,100), 1.577(70,200), 1.292(100,211), 1.119(60,220), and 1.000(100,310), from which  $a = 3.157 \text{ \AA}$ .

In the voids of aggregates of tungsten is a phase identified as  $\text{Y}_2\text{O}_3$ . Microdiffraction patterns gave  $a = 10.60(3) \text{ \AA}$ , in good agreement with the cell parameter for synthetic  $\text{Y}_2\text{O}_3$ . J.P.

### Pb-Pb-Te-S minerals

E.M. Spiridonov (1995) Minerals of the metamorphosed plutogenic gold-quartz Kochkar deposit, southern Urals: 1. Gold-telluride ores. Zapiski Vseross. Mineral. Obshch., 124(6), 24–39 (in Russian, English abs.).

#### $\text{Pb}_2\text{Bi}_2\text{Te}_2\text{S}_3$

Occurs as lamellar and tabular grains to  $20 \times 20 \times 4$  mm in galena and calcite, or intergrown with aleksite, pyrrhotite, and native gold. Silver-gray color, metallic luster,  $VHN_{5-15} = 19-94$ , mean 45 ( $n = 36$ ),  $D_{\text{meas}} = 7.65(5) \text{ g/cm}^3$ . In reflected light, white with a grayish brown tint, weak to moderate birefractance, strong anisotropism. Reflectance percentages (Si standard, air) are given in 20 nm steps from 420 to 700 nm; representative values for  $R_1$  and  $R_2$  are 46.8, 40.6 (440), 46.4, 43.6 (480), 46.8, 46.4 (520), 47.3, 47.9 (560), 47.7, 48.7 (600), 47.9, 49.3 (640), and 48.1, 49.9 (680). Electron microprobe analysis (average of 33) gave Bi 36.87, Pb 33.57, Te 20.79, S 8.20, Sb 0.31, Ag 0.04, sum 99.78 wt%, corresponding to  $\text{Pb}_{1.92}\text{Bi}_{2.09}\text{Sb}_{0.03}\text{Te}_{1.93}\text{S}_{3.03}$ , ideally  $\text{Pb}_2\text{Bi}_2\text{Te}_2\text{S}_3$ . Electron diffraction and X-ray powder diffraction study (57 mm camera, Fe radiation) indicated rhombohedral symmetry, space group  $P\bar{3}m1$ ,  $a = 4.247(1)$ ,  $c = 97.97(2) \text{ \AA}$ ,  $Z = 6$ . Strongest lines of the powder pattern (24 lines given) are 4.26(20–30,0.0.22), 3.93(20,0.0.23), 3.21(20,1.0.15), 3.05(100,1.0.18), 2.44(20,1.0.30), 2.19(40,1.0.36), 2.11(30,1.0.38,115,116), 1.99(20,1.1.17), 1.78(20,1.1.30,0.0.55,2.0.10), 1.74(30,2.0.18), 1.660(20,0.0.59,1.1.37), and 1.520(20,1.1.45).

#### $\text{Pb}_2\text{Bi}_2\text{TeS}_3$

Electron microprobe analysis (mean of two) gave Bi 39.02, Pb 38.86, Te 13.02, Sb 0.39, Ag 0.12, S 9.07, sum 100.48 wt%, corresponding to  $\text{Pb}_{1.96}\text{Ag}_{0.01}\text{Bi}_{1.97}\text{Sb}_{0.03}\text{Te}_{1.07}\text{S}_{2.96}$ , ideally  $\text{Pb}_2\text{Bi}_2\text{TeS}_3$ . This mineral and the ones given below occur as lamellar grains up to  $3 \times 3 \times 1$  mm in

galena, or intergrown with tetradyomite, native gold, and pyrrhotite. Optical properties of the minerals are similar to those of tetradyomite and aleksite.

#### $\text{Pb}_2\text{Bi}_3\text{Te}_2\text{S}_3$

Electron microprobe analysis (mean of ten) gave Bi 44.32, Pb 29.29, Ag 0.02, Te 18.83, S 7.00, sum 99.46 wt%, corresponding to  $\text{Pb}_{1.96}\text{Bi}_{2.96}\text{Te}_{2.05}\text{S}_{3.03}$ .

#### $\text{Pb}_2\text{Bi}_5\text{Te}_5\text{S}_2$

Electron microprobe analysis gave Bi 48.39, Pb 19.79, Sb 0.29, Te 29.74, S 3.04, sum 101.25 wt%, corresponding to  $\text{Pb}_{2.03}\text{Bi}_{4.93}\text{Sb}_{0.05}\text{Te}_{4.96}\text{S}_{2.02}$ .

#### $\text{PbBi}_4\text{Te}_2\text{S}_2$

The mean of three electron microprobe analyses gave Bi 59.92, Pb 16.08, Sb 0.21, Te 18.97, S 4.59, sum 99.77 wt%, corresponding to  $\text{Pb}_{1.06}\text{Bi}_{3.92}\text{Sb}_{0.02}\text{Te}_{2.03}\text{S}_{1.96}$ .

#### $\text{PbBi}_4\text{Te}_3\text{S}$

An electron microprobe analysis gave Bi 56.10, Pb 13.95, Ag 0.11, Sb 0.08, Te 25.71, S 2.07, sum 98.02 wt%, corresponding to  $\text{Pb}_{1.00}\text{Ag}_{0.01}\text{Bi}_{4.01}\text{Sb}_{0.01}\text{Te}_{3.01}\text{S}_{0.96}$ .

**Discussion.**  $\text{Pb}_2\text{Bi}_2\text{Te}_2\text{S}_3$  is the same composition given for approved mineral IMA no. 94–051, but the properties of the approved mineral and the mineral from the Kochkar deposit are distinctly different. V.A.K.

## New Data

### Belovite-(Ce)

I.V. Pekov, N.V. Chukanov, O.V. Beletskaya, A.P. Khomyakov, Yu.P. Menshikov (1995) Belovite-(Ce): New data, refined formula and relationship to other minerals of the apatite group. Zapiski Vseross. Mineral. Obshch., 124(2), 98–110 (in Russian).

Detailed chemical study of nine samples of belovite-(Ce), including the holotype specimen, showed the formula to be  $\text{Na}(\text{Ce},\text{La})\text{Sr}_3[\text{PO}_4]_3(\text{F},\text{OH})$ . X-ray study confirmed the  $P3$  space group. The “recommended X-ray pattern” of the mineral is given, as well as the IR pattern. All samples have  $\text{F} > \text{OH}$  and a stable ratio of  $\text{Na}:\text{REE}:\text{Sr} = 1:1:3$ . The formula and designation as belovite-(Ce) are new. The redefinition is informal in that it has not been approved by the IMA. J.P.

### Ludlockite

M.A. Cooper, F.C. Hawthorne (1996) The crystal structure of ludlockite,  $\text{PbFe}_3^+\text{As}_3^+\text{O}_{22}$ , the mineral with pentameric arsenite groups and orange hair. Can. Mineral., 34, 79–89.

Electron microprobe analysis gave  $\text{PbO}$  14.41,  $\text{Fe}_2\text{O}_3$  19.96,  $\text{As}_2\text{O}_3$  60.67, sum 95.04 wt%, corresponding to  $\text{Pb}_{1.04}\text{Fe}_{3.04}\text{As}_{3.93}^+\text{O}_{22}$ . Single-crystal X-ray structure study ( $R = 0.047$ ) showed the mineral to be triclinic,  $a =$

10.426(4),  $b = 12.074(5)$ ,  $c = 18.349(8)$  Å,  $\alpha = 101.84(3)$ ,  $\beta = 100.21(3)$ ,  $\gamma = 90.60(3)^\circ$ , space group  $A\bar{1}$ ,  $D_{\text{calc}} = 4.58$  g/cm<sup>3</sup> for  $Z = 4$ . In the new formula As is trivalent rather than pentavalent. The designation of the mineral as an arsenite is informal in that the redefinition has not been approved by the IMA. J.L.J.

#### Phosinaite-(Ce)

A.M. McDonald, G.Y. Chao (1996) Phosinaite-(Ce) from Mont Saint-Hilaire, Quebec: New data and structure refinement. *Can. Mineral.*, 34, 107–114.

Electron microprobe analysis gave Na<sub>2</sub>O 31.68, CaO 8.92, MnO 0.89, La<sub>2</sub>O<sub>3</sub> 4.18, Ce<sub>2</sub>O<sub>3</sub> 6.52, Nd<sub>2</sub>O<sub>3</sub> 0.99, Pr<sub>2</sub>O<sub>3</sub> 0.26, ThO<sub>2</sub> 1.84, SiO<sub>2</sub> 18.36, P<sub>2</sub>O<sub>5</sub> 23.69, sum 97.33 wt%, corresponding to (Na<sub>12.72</sub>Ca<sub>0.14</sub>)<sub>Σ12.86</sub>(Ca<sub>1.84</sub>Mn<sub>0.16</sub>)<sub>Σ2.00</sub>-(Ce<sub>0.49</sub>La<sub>0.32</sub>Th<sub>0.09</sub>Nd<sub>0.07</sub>Pr<sub>0.02</sub>)<sub>Σ0.99</sub>[(Si<sub>3.77</sub>P<sub>0.15</sub>Al<sub>0.04</sub>)<sub>Σ3.96</sub>O<sub>12</sub>](PO<sub>4</sub>)<sub>4</sub>, ideally Na<sub>13</sub>Ca<sub>2</sub>(Ce,La)Si<sub>4</sub>O<sub>12</sub>(PO<sub>4</sub>)<sub>4</sub>. Single-crystal X-ray structure study ( $R = 0.031$ ) indicated orthorhombic symmetry, space group  $P2_22_1$ ,  $a = 12.297(2)$ ,  $b = 14.660(3)$ ,  $c = 7.245(1)$  Å,  $D_{\text{meas}} = 2.97(1)$ ,  $D_{\text{calc}} = 3.09$  g/cm<sup>3</sup> for  $Z = 2$ . The X-ray powder pattern is in good agreement with previous data, except that the line reported at 6.92 Å (intensity 50) was not detected and is not indexable. The structure indicates that the mineral is a silicophosphate. The formula is new, and the name phosinaite-(Ce) is in recognition of a specific structural site for REE. The redefinition is informal in that it has not been approved by the IMA. J.L.J.

#### Shigaite

M.A. Cooper, F.C. Hawthorne (1996) The crystal structure of shigaite, [AlMn<sub>2</sub><sup>2+</sup>(OH)<sub>6</sub>]<sub>3</sub>(SO<sub>4</sub>)<sub>2</sub>Na(H<sub>2</sub>O)<sub>6</sub>(H<sub>2</sub>O)<sub>6</sub>, a hydrotalcite-group mineral. *Can. Mineral.*, 34, 91–97.

Single-crystal X-ray structure study ( $R = 0.042$ ) of shigaite indicated rhombohedral symmetry, space group  $R\bar{3}$ ,  $a = 9.512(1)$ ,  $c = 33.074(5)$  Å,  $D_{\text{calc}} = 2.21$  g/cm<sup>3</sup> for  $Z = 3$ . The structural formula corresponds to NaMn<sub>6</sub>Al<sub>3</sub>(SO<sub>4</sub>)<sub>2</sub>(OH)<sub>18</sub>(H<sub>2</sub>O)<sub>12</sub>, which is new. The redefinition is informal in that it has not been approved by the IMA. J.L.J.

#### AuO(OH)

M.I. Novgorodova, N.V. Trubkin, M.E. Generalov (1995) Gold hydroxide—A new mineral phase from an alluvial gold placer in the southern Urals. *Doklady Akad. Nauk*, 344(4), 525–529 (in Russian).

The mineral occurs as superfine (<0.1 μm) rounded grains in fine-grained mixtures within native gold and iron hydroxide, and iron and bismuth tellurates that coat native gold. Electron diffraction studies indicated cubic symmetry, space group  $Fm\bar{3}m$ ,  $a = 4.45$  Å. The strongest diffraction spots are 2.47(002), 2.02(211), 1.75(220), and 1.43(222). The infrared spectrum corresponds to that of AuO(OH).

**Discussion.** Previously abstracted as AuO(OH,Cl)· $n$ H<sub>2</sub>O in *Am. Mineral.*, 81, 768–769 (1996). V.A.K.

#### Tl-Sb-As sulfosalt

V.A. Boronikhin, L. Cvetković, D. Krajnović, I. Gržetić, M.K. Pavićević (1993) Investigation of a Tl-As-Sb-sulfosalt from the Allchar ore deposit. *Ann. Geol. Penins. Balk.*, 57(1), 301–306.

Electron microprobe analysis and optical properties in reflected light are given for a mineral from the Crven Dol deposit at Allchar. The mineral is assigned the formula Tl<sub>5</sub>Sb<sub>10</sub>As<sub>3</sub>S<sub>22</sub>.

**Discussion.** This is clearly a preliminary report for the mineral subsequently described as jankovičite. In the later description the formula was revised to Tl<sub>5</sub>Sb<sub>5</sub>(As,Sb)<sub>4</sub>S<sub>22</sub> on the basis of a crystal-structure analysis (*Am. Mineral.*, 81, p. 250, 1996). J.L.J.

#### K analog of nenadkevichite

O.V. Petersen, R.A. Gault, E.S. Leonardsen (1996) A K-dominant nenadkevichite from the Narssârssuk pegmatite, South Greenland. *Neues Jahrb. Mineral. Mon.*, 103–113.

Electron microprobe analysis, after correction for Na migration, gave Na<sub>2</sub>O 3.75, CaO 1.04, K<sub>2</sub>O 6.53, Ba 1.28, Ce<sub>2</sub>O<sub>3</sub> 0.41, Nb<sub>2</sub>O<sub>5</sub> 35.81, TiO<sub>2</sub> 2.54, SiO<sub>2</sub> 35.48, Al<sub>2</sub>O<sub>3</sub> 0.23, H<sub>2</sub>O (calc.) 13.40, sum 100.47 wt%, corresponding to (K<sub>0.47</sub>Na<sub>0.41</sub>Ca<sub>0.06</sub>Ba<sub>0.02</sub>Ce<sub>0.01</sub>)<sub>Σ0.97</sub>(Nb<sub>0.91</sub>Ti<sub>0.11</sub>)<sub>Σ1.02</sub>(Si<sub>1.98</sub>Al<sub>0.02</sub>)<sub>Σ2.00</sub>O<sub>6.53</sub>(OH)·2H<sub>2</sub>O. Occurs as platy to bladed, colorless, transparent crystals (to 0.05 mm) in aggregates to 1 × 2 mm. Optically biaxial positive,  $\alpha = 1.6386(5)$ ,  $\beta = 1.6474(5)$ ,  $\gamma = 1.7680(5)$ ,  $2V_{\text{meas}} = 145$ – $155$ ,  $2V_{\text{calc}} = 148(0.5)^\circ$ , dispersion  $r < v$ , orientation  $\alpha = c$ ,  $\beta = b$ ,  $\gamma = a$ . Single-crystal X-ray study gave a unit cell similar to that reported by Rastsvetaeva et al. for the K analog of nenadkevichite from the Vuorijarvi complex, Kola Peninsula (*Am. Mineral.*, 80, p. 633, 1995). J.L.J.