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New Mineral Names*,†

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This New Mineral Names has entries for 13 new mineral species, including arsiccioite, bluelizardite, diegogattaite, disulfodadsonite, fabriesite, laachite, oskarssonite, philrothite, putnisite, therasiaite, trinepheline, tubulite, and whitecapsite.

ARSICCIOITE*

C. Biagioni, E. Bonaccorsi, Y. Moëlo, P. Orlandi, L. Bindi, M. D'Orazio, and S. Vezzoni (2014) Mercury-arsenic sulfosalts from the Apuan Alps (Tuscany, Italy). II. Arsiccioite, $AgHg_2TlAs_2S_6$, a new mineral from the Monte Arsiccio mine: occurrence, crystal structure and crystal chemistry of the routhierite isotypic series. Mineralogical Magazine, 78(1), 101–117.

Arsiccioite (IMA 2013-058), ideally $AgHg_2TlAs_2S_6$, is a new mineral found at the baryte-pyrite-iron oxide deposit of the Monte Arsiccio mine, Apuan Alps, Tuscany, Italy. The mineral was identified on specimens from the Sant'Olga tunnel excavated in the quartz-muscovite schists with tourmalinite layers progressively enriched in baryte and pyrite towards the ore body. A lens of microcrystalline baryte with pyrite and minor amount of other sulfides and sulfosalts occurs near the contact between schists and pyrite-rich dolostone. The assemblages interpreted as the result of the crystallization from a sulfide melt during the greenschist-facies Alpine metamorphism. Arsiccioite forms anhedral grains up to 1 mm in size at the interstices of polygonal baryte aggregates. It is associated with cinnabar, laffittite, protochabournéite, pyrite, realgar, Hg-bearing sphalerite and stibnite. Arsiccioite is red with an orange streak, metallic to submetallic, brittle with an irregular fracture. Micro-indentation measurements VHN_{50} = 124 (111–132) kg/mm^2 correspond to Mohs hardness 2–2½. The density could not be measured due to paucity of material; D_{calc} = 5.989 g/cm^3. Arsiccioite is yellowish-white in plane-polarized reflected light, non-pleochroic, and weakly anisotropic, with gray to bluish rotation tints. Reflectance values for COM wavelengths in air [R_{min}, R_{max} % (nm)] are: 29.0, 29.4 (471); 27.6, 28.3 (548); 26.1, 26.5 (586); 24.2, 24.6 (652). The average of 5 electron probe analyses (WDS) gives: Cu 0.78±6, Ag 8.68±21, Zn 0.47±27, Fe 0.04±1, Hg 35.36±87, Cd 0.20±5, Tl 18.79±33, As 10.77±19, Sb 4.75±10, S 18.08±21, Se 0.07±5, total 97.99±44 wt%. On the basis of 6 cations pfu, the empirical chemical formula is $(Ag_{0.87}Cu_{0.13}Fe_{0.01})_{\Sigma 1.01}(Hg_{1.91}Zn_{0.08}Cd_{0.02})_{\Sigma 2.01}Tl_{1.00}(As_{1.56}Sb_{0.42})_{\Sigma 1.98}S_{6.12}Se_{0.01}$. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I* %; *hkl*)] are: 4.195 (m; 211), 3.542 (m; 103), 3.025 (vs; 222), 2.636 (m; 114), 2.518 (s; 400, 303). The unit-cell parameters obtained from the powder-diffraction experiment are a = 10.131(1), c = 11.348(2) Å, V = 1164.7 Å^3. Single-crystal X-ray diffraction data collected on a crystal 0.05 × 0.05 × 0.04 mm, refined to R_1 = 0.0304 for 893 unique reflections with $I \geq 4\sigma(I)$, shows arsiccioite is tetragonal and crystallizes in space group $I42m$ with cell parameters a = 10.1386(6), c = 11.3441(5) Å, V = 1166.1 Å^3, Z = 4. Arsiccioite is derived from isotype routhierite, with a framework of two independent $(Hg,Ag)S_4$ corner-sharing tetrahedra hosting channels parallel to [001]. These channels contain TlS_6 and $(As,Sb)S_3$ polyhedra that share corners and edges with the tetrahedron framework. Arsiccioite is named for the type locality. The holotype specimen of arsiccioite is deposited in the Museo di Storia Naturale, Università di Pisa, Italy, and a cotype specimen is kept in the Museo di Storia Naturale, Università degli Studi di Firenze, Florence, Italy. **O.C.G.**

BLUELIZARDITE*

J. Plášil, A.R. Kampf, A.V. Kasatkin, and J. Marty (2014) Bluelizardite, $Na_7(UO_2)(SO_4)_4Cl(H_2O)_2$, a new uranyl sulfate mineral from the Blue Lizard mine, San Juan County, Utah, USA. Journal of Geosciences, 59, 145–158.

Bluelizardite (IMA 2013-062), ideally $Na_7(UO_2)(SO_4)_4Cl(H_2O)_2$, is a new monoclinic uranyl sulfate from the Blue Lizard old underground U mine, San Juan County, Utah, U.S.A. (37°33′26″N 110°17′44″W). The mineral was named for the type locality. It occurs as efflorescence on sandstone and is in close association with chalcanthite, copiapite, ferrinatrite, gypsum, kröhnkite, johannite, and a few new unnamed uranyl sulfates of Na and Mg. The general secondary assemblage also includes atacamite, belakovskiite, blodite, cobaltoblodite, manganoblodite, brochantite, cyanotrichite, d'ansite-(Mn), halotrichite,

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* All minerals (and their names) marked with an asterisk have been approved by the IMA CNMMC.
† For a complete listing of all IMA-validated unnamed minerals and their codes, see http://pubsites.uws.edu.au/ima-cnmnc/.

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meisserite, metavoltine, natrozippeite, pseudo-johannite, romerite, rhomboclase, sideronatrite and tamarugite. Bluelizardite has a supergene origin related to the post-mining oxidation of primary ores containing uraninite, pyrite, chalcopyrite, bornite, covellite (disseminated in lenses of organic matter) in the humid environment. The mineral forms bladed crystals elongated up to 0.4 mm by [010] and flattened by {001}. Other faces belong to {100}, {001}, and {111}. The crystals form hedgehog-like aggregates. Bluelizardite is pale yellow with a yellowish-white streak, transparent, vitreous. It has good cleavage on {001} and uneven fracture. The estimated Mohs hardness is 2. The density was not measured due to the paucity of material; D_{calc} = 3.116 g/cm^3. Bluelizardite exhibits bright yellow-green fluorescence under long- and short-wave UV radiation. The mineral is optically biaxial (–), with $\alpha = 1.515$, $\beta = 1.540$, and $\gamma = 1.545$ (white light), $2V = 48(2)°$, $2V_{calc} = 47.6°$. Pleochroism and dispersion were not observed. $X = \boldsymbol{b}$, $Y \approx \boldsymbol{a}$, $Z \approx \boldsymbol{c}$. The Raman spectrum is dominated by the U-O and S-O symmetric stretching vibrations and by the O–H stretching and bending vibrations of the H_2O molecules. The average (range) of 5 electron probe EDS analysis yielded: Na_2O 24.15 (23.40–24.55) SO_3 35.84 (34.70–37.45), UO_3 32.89 (30.45–35.14), Cl 3.76 (3.46–4.01), H_2O 4.05 (by structure), –OH=Cl 0.85, total 99.94 wt%. The empirical formula based on 21 anions pfu is $Na_{6.94}(U_{1.02}O_2)(SO_4)_{4.00}Cl_{0.94}O_{0.06}(H_2O)_2$. Powder X-ray diffraction data were obtained using a curved imaging plate microdiffractometer (Mo$K\alpha$ radiation, Gandolfi method). The strongest reflections of the powder X-ray diffraction pattern are [d Å (I %; hkl)]: 17.08 (52; 002), 10.31 (60; 200), 5.16 (100; 110,$\bar{1}$11,111,400), 4.569 (22; 402,$\bar{1}$14), 4.238 (23; $\bar{1}$15,310,008), 3.484(27; $\bar{6}$02,$\bar{6}$04,$\bar{2}$ 0 10), 3.353 (28; 600,406), 3.186 (36; $\bar{4}$ 0 10,602,118). Unit-cell parameters refined from the powder data are: $a = 21.1822(6)$, $b = 5.3544(1)$, $c = 34.730(3)$ Å, $\beta = 104.879(7)°$. The crystal structure of bluelizardite was refined to $R_1 = 0.016$ for 4268 reflections with $I_{obs} > 3\sigma I$. According to the single-crystal data the mineral is monoclinic, $C2/c$, $a = 21.1507(6)$, $b = 5.3469(12)$, $c = 34.6711(9)$ Å, $\beta = 104.913(3)°$, $V = 3788.91$ Å^3, and $Z = 8$. Topologically unique structure is based upon uranyl-sulfate clusters $[(UO_2)_2(SO_4)_8]^{12-}$. Two UO_7 pentagonal bipyramids are linked through two vertices of SO_4 tetrahedra. The remaining three vertices of each UO_7 polyhedra are occupied by other SO_4 tetrahedra linking into 3D framework through Na-O and Na-Cl bonds along with hydrogen bonds (involving H···O and H···Cl bonds). Type specimens of bluelizardite (one holotype and three cotypes) were deposited in the Natural History Museum of Los Angeles County, U.S.A. **D.B.**

DIEGOGATTAITE*

M.S. Rumsey, M.D. Welch, A.R. Kampf, and J. Spratt (2013) Diegogattaite, $Na_2CaCu_2Si_8O_{20}\cdot H_2O$: a new nanoporous copper sheet silicate from Wessels Mine, Kalahari Manganese Fields, Republic of South Africa. Mineralogical Magazine, 77(8), 3155–3162.

Diegogattaite (IMA 2012-96), ideally $Na_2CaCu_2Si_8O_{20}\cdot H_2O$, is a new mineral from the central-eastern ore-body of the Wessels mine (27°12′S, 22°58′E) in the Kalahari manganese fields of South Africa. The ore-body is hydrothermally altered and supposedly formed at temperature 300–400 °C and a maximum pressure of 0.05–0.1 GPa. Diegogattaite is disseminated in areas with wesselite. Other associated minerals are aegirine, Cu-rich pectolite, sugilite, quartz, and undifferentiated Fe-Mn oxides, as well as scottyite, lavinskyite, and richterite. New mineral has been named in honor of Diego Gatta (b. 1974), Professor of Mineral Sciences in the Department of Earth Sciences, University of Milan (Italy), who has published extensively on the structures and crystal chemistry of zeolites and related silicates with cage structures, which are of wide mineralogical and technological interest. Diegogattaite is found in main massive patch ~3 mm in diameter and in submillimetric aggregates nearby. Individual crystals are <0.5 mm. Some of the blue coloration in hand specimen is due to bounding rims of barium-rich wesselsite surrounding diegogattaite, which is actually a pale "teal" blue color (hardly distinguishable from wesselsite). Diegogattaite enclosed grains of Cu-rich pectolite and is closely related to aegirine as well as wesselite. It was not possible to assess crystal forms of diegogattaite, but fragments are platy and cleavage is probably (001). The crystals are pale blue, transparent, with pale blue streak and vitreous luster. Estimated hardness is 5–6 Mohs (determined approximately using VHN methods). Diegogattaite does not fluoresce in both short- and long-wave UV light. It is optically biaxial (–), $\alpha = 1.598$, $\beta = 1.627$ and $\gamma = 1.632$ (white light) is $X = \mathbf{b}$, $Y \approx \perp(001)$, $Z \approx \mathbf{a}$, $2V_{calc} = 44.5°$, observed $2V = 44.0(6)°$. Diegogattaite shows strong dispersion of optical axes $r < v$ and is pleochroic: X = colorless, $Y \approx Z$ = blue green. Electron microprobe WDS analyses gave the average composition (mean of 17 analyses, in wt%): Na_2O 8.07, CaO 7.3, CuO 20.5, FeO 0.36, SiO_2 62.4, H_2O (calculated by stoichiometry based on the crystal structure analysis) 2.34, total 100.97 wt%. F on the basis of 21 O apfu is: $Na_{2.00}Ca_{1.00}Cu_{1.98}Fe_{0.04}\ Si_{7.99}H_2O_{21}$. D_{calc} = 3.10 g/cm^3. Insufficient material was available (three small crystals) for routine powder diffraction. The crystal used in the structure determination was mounted on a Rigaku R-Axis Rapid II curved imaging plate microdiffractometer (Mo$K\alpha$ radiation) to obtain a quasi-random powder data set by randomized crystal movement achieved by rotations on the ϕ and ω axes. Refined unit-cell parameters were $a = 12.247(7)$, $b = 15.766(8)$, $c = 10.620(7)$ Å, $\beta = 125.71(2)°$ and $V = 1665$ Å^3; $Z = 4$. The strongest reflections in the X-ray powder-diffraction pattern [d in Å (I %; hkl)] are: 4.25 (75; 002,$\bar{2}$22,220), 3.951 (77; 040), 3.261 (100; $\bar{1}$31,$\bar{1}$13), 2.898 (89; 042,$\bar{4}$03,003), 2.332 (66; 331,$\bar{4}$43,$\bar{2}$62,260,043). The structure of diegogattaite was determined by single crystal X-ray diffraction using a XcaliburE four-circle diffractometer equipped with an Eos CCD detector (Agilent Industries) and graphite monochromated Mo$K\alpha$-radiation. The single crystal parameters of the monoclinic unite-cell are: $a = 12.2439(6)$, $b = 15.7514(4)$, $c = 10.6008(3)$ Å, $\beta = 125.623(2)°$, $V = 1661.87$ Å^3, space group $C2/m$. Refinement in $C2/m$ gave by far the best resulting structure compared with space groups Cm or $C2$. The crystal structure of diegogattaite represents a new silicate topology based on a double sheet of SiO_4 tetrahedra, parallel to (001), composed of connected 6^48^2 cages. The structure of diegogattaite is related to those of synthetic nanoporous Na-Cu-Si-O-(OH)-H_2O (CuSH) compounds, which are of interest to the solid-state chemistry community as potential ion-exchangers, catalysts and molecular sieves. The structure of diegogattaite forms a bridge between these structures and those of the gillespite-group minerals, including wesselsite. The holotype is preserved in the collection of the Museum of Natural History, London (U.K.), registered as BM 2012,2. **F.C.**

DISULFODADSONITE*

P. Orlandi, C. Biagioni, Y. Moëlo, and E. Bonaccorsi (2013) Lead-antimony sulfosalts from Tuscany (Italy). XIV. Disulfodadsonite, $Pb_{11}Sb_{13}S_{30}(S_2)_{0.5}$, a new mineral from the Ceragiola marble quarry, Apuan Alps: Occurrence and crystal structure. European Journal of Mineralogy, 25, 1005–1016.

Disulfodadsonite (IMA 2011-076), ideally $Pb_{11}Sb_{13}S_{30}(S_2)_{0.5}$, is a new sulfosalt discovered at the quarry in the Ceragiola area, near Seravezza, Apuan Alps, Italy. The mineral name indicates the relationship to dadsonite and the presence of the disulfide ion in its crystal structure. Disulfodadsonite occurs in a cavity of the Liassic age marbles in association with boulangerite, calcite and sphalerite. It forms thin acicular crystals, 3–4 mm long and a few micrometers thick. The mineral is black, has a black streak, metallic luster, and is brittle. Due to small amount of material and poor quality of two studied grains, optical properties (supposedly close to those of dadsonite by qualitative observations), hardness and density could not be determined. D_{calc} = 5.898 g/cm^3. The chemical composition of two grains of disulfodadsonite is similar: Pb 46.42/46.76, Sb 32.29/32.30, As 0.41/0.40, S 20.19/20.64, Cl 0.03/0.02, total 99.34/100.12 wt%. The empirical formula based on 48 metal atoms: $Pb_{21.74}(Sb_{25.73}As_{0.53})_{\Sigma 26.26}S_{61.11}Cl_{0.08}$ and $Pb_{21.83}(Sb_{25.66}As_{0.51})_{\Sigma 26.17}S_{62.27}Cl_{0.06}$ for the two studied grains. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*; *hkl*)] are: 3.820 (ms; 005, $0\bar{1}5$, $1\bar{2}0$, 120), 3.649 (s; $\bar{1}\bar{2}1$, 112, $0\bar{2}5$, 121), 3.416(s; 043), 3.381 (vs; $0\bar{5}2$, $\bar{1}31$, $1\bar{3}2$), 2.857 (ms; 124, $0\bar{6}2$, $1\bar{3}4$), 2.814 (ms; $\bar{1}05$, $1\bar{1}5$, 105, $\bar{1}\bar{1}5$), 1.897 (ms; $\bar{1}38$, 091, $1\bar{6}7$) (vs = very strong; s = strong; ms = medium strong). The crystal structure of disulfodadsonite was solved by direct methods and refined to R_1 = 0.102 based on 3389 $F_o > 4\sigma(F_o)$ reflections. The mineral is triclinic, $P\bar{1}$, *a* = 4.1192(3), *b* = 17.4167(14), *c* = 19.1664(16) Å, α = 96.127(6), β = 90.015(7), γ = 91.229(7)°, *V* = 1366.9 Å^3; *Z* = 2. The structure ocontains 5 sites occupied solely by Pb, 5 sites occupied solely by Sb, 2 sites occupied by a mixture of Sb and Pb, and 16 S positions. The structure is formed by two types of rod-layers alternating along the b stacking direction. Disulfodadsonite is the Cl-free homeotype of dadsonite, $Pb_{23}Sb_{25}S_{60}Cl$, related by the coupled substitution $Pb^{2+} + Cl^- \rightarrow Sb^{3+} + (S_2)^{2-}$. The holotype specimen of disulfodadsonite is deposited in the mineralogical collection of the Museo di Storia Naturale, Università di Pisa, Pisa, Italy. **Yu.U.**

FABRIESITE* AND TRINEPHELINE*

C. Ferraris, G.C. Parodi, S. Pont, B. Rondeau, and J-P. Lorand (2014) Trinepheline and fabriesite: two new mineral species from the jadeite deposit of Tawmaw (Myanmar). European Journal of Mineralogy, 26(2), 257–265.

Two new mineral species, trinepheline $NaAlSiO_4$ (IMA 2012-024) and fabriesite $Na_3Al_3Si_3O_{12}\cdot 2H_2O$ (IMA 2012-080) have been discovered within late-stage metamorphic veins of the jadeite deposit at Tawmaw-Hpakant, Myanmar (25°68′ N, 96°26′ E). Both species were found in the only polished section left of the original sample (catalog no. 105-S of the petrologic collection of the Museum National d'Histoire Naturelle, Paris, France) which is deposited as type material at the Mineralogical Collection of that museum under the number MNHN 212.001. This specimen represents nephelinitic-albitic jadeitite where trinepheline and fabriesite form pseudomorphs after jadeite and occur as skeletal allotriomorphic crystals up to 15–20 mm long and 5–10 mm wide, respectively and rarely as pseudo-idiomorphic prismatic crystals. Both new species are intimately intergrown with nepheline, more rarely with albite, banalsite and stronalsite. Other associated minerals (natrolite and harmotome) formed at the later stage. Trinepheline and fabriesite are detectable only by the contrast on scanning electron microscope images, microprobe analysis, and EBSD techniques. Thus some physical properties could not be determined. However it is noted that new phases are softer and more sensitive to polishing-induced damage than nepheline and jadeite so the estimated Mohs hardness is 5–5½. Macroscopically the aggregate containing new minerals is white to yellowish with a white streak and the luster is vitreous to greasy. Both new minerals are colorless in thin section and non-fluorescent. The calculated mean refractive indexes for trinepheline and fabriesite are 1.538 and 1.511 and calculated density 2.642 and 2.386 g/cm^3, respectively. Synthetic nepheline hydrate corresponding to fabriesite is biaxial (–) with α = 1.503, β = 1.506, γ = 1.508, $2V_{calc}$ = 78°. The comparison of the Raman spectrum of trinepheline with that of nepheline (reference spectrum of RRUFF database) indicates that peaks of trinepheline coincide with those of nepheline in the region 150–264 cm^{-1} while strong peaks are shifted (406 vs. 347, 453 vs. 400, and 494 vs. 466 cm^{-1} respectively). The differences in the region between 926 and 1031 cm^{-1} are only in intensities. Comparison of the Raman spectrum of fabriesite with those of natrolite and trinepheline obtained in the same sample shows that peaks at frequencies <1800 cm^{-1} are similar and fabriesite is characterized by peaks centred at around 3200 and 3500 cm^{-1} due to the presence of water. The average (range) of electron probe WDS analyses for trinepheline (12 analysis on 4 grains) is: Na_2O 21.68 (20.31–22.22), MgO 0.01 (0.00–0.09), SiO_2 41.76 (41.33–42.09), Al_2O_3 36.19 (35.70–37.15), K_2O 0.08 (0.03–0.12), CaO 0.10 (0.00–0.25), FeO 0.06 (0.00–0.18), total 99.88 wt% while for fabriesite (10 analyses on 3 grains) it is: Na_2O 19.67 (18.31–20.22), MgO 0.06 (0.03–0.11), SiO_2 38.93 (37.95–40.09), Al_2O_3 33.00 (32.81–33.95), K_2O 0.08 (0.05–0.11), CaO 0.36 (0.28–0.68), FeO 0.06 (0.03–0.18), MnO 0.01 (0.00–0.03), BaO 0.07 (0.02–0.09), H_2O (by difference) 7.76, total 100.00 wt%. The empirical formula for trinepheline based on 4O apfu is $Na_{1.00}Al_{1.01}Si_{0.99}O_4$ simplified to $NaAlSiO_4$. For fabriesite the empirical formula based on 14 O apfu is $(Na_{2.94}Ca_{0.03}K_{0.01}Mg_{0.01})_{\Sigma 2.99}Al_{3.00}Si_{3.00}O_{12}\cdot 2H_{1.99}O$ simplified to $Na_3Al_3Si_3O_{12}\cdot 2H_2O$. Crystallographic information was obtained by single-crystal EBSD analyses. For trinepheline, the experimental EBSD pattern was successfully matched (MAD = 0.3°) to that calculated using the structural data of synthetic hexagonal $NaAlSiO_4$ (space group $P6_1$, *a* = 9.995, *c* = 24.797 Å, *Z* = 24; ICSD 85553). All the other tested structures with chemical composition $NaAlSiO_4$ were discarded (MAD > 0.5°). The strongest lines of the calculated powder diffraction pattern [d_{calc} Å (I_{calc}; *hkl*)] are: 4.328 (22; 020), 4.133 (49; 006), 3.834 (81; 023), 3.272 (40; 120), 3.163 (100; 122), 2.989 (21;

026), 2.403 (31; 127), 2.401 (22; 130). The experimental EBSD pattern of fabriesite was matched (MAD = 0.4°) to that calculated using data of synthetic orthorhombic $Na_3Al_3Si_3O_{12}·2H_2O$ (space group $Pna2_1$, a = 16.426, b = 15.014, c = 5.223 Å, Z = 4; ICSD 201460). For all other tested structures with similar chemical composition MAD was >1°. The strongest lines of the calculated powder diffraction pattern [d_{calc} Å (I_{calc}%; hkl)] are: 8.21 (36; 200), 7.51 (32; 020), 4.41 (77; 201), 3.41 (100; 240), 2.97 (70; 421), 2.86 (25; 241), 2.61 (40; 002), 2.45 (29; 441). The structure of synthetic trinepheline is known and is a type of stuffed tridymite structure with close relationships to other tridymite derivatives: kalsilite, yoshiokaite, and nepheline. It is characterized by layers of six-membered tetrahedral rings built up by regularly alternating AlO_4 and SiO_4 tetrahedra. The layers are stacking along the ***c*** axis into a 3D framework with channels occupied by irregularly coordinated Na cations. The structure differs from that of idealized nepheline $Na_6K_2Al_8Si_8O_{32}$ by the accommodation of the excess Na in samples containing more than 6 Na apfu in the large alkali site. The structure of fabriesite (=synthetic nepheline hydrate I) constitutes a link between anhydrous tectosilicates and zeolites. The tetrahedral framework of fabriesite is also topologically related to the one in nepheline. It consists of a parallel set of two-repeat chains with alternating single and double chains built up by a regular alternation of AlO_4 and SiO_4 tetrahedra and zigzagging along ***c***. The framework contains channels (occupied by Na and H_2O) running along ***c***, with elongated apertures consisting of eight-membered tetrahedra rings. Trinepheline crystallization is related to a metamorphic decompression stage with destabilization of jadeite according to the reaction $2NaAlSi_2O_6 \rightarrow NaAlSi_3O_8$ (albite) + $NaAlSiO_4$ (trinepheline) where the trinepheline takes place of nepheline in case of a deficiency in K to form nepheline and deficiency in Si and Al to form albite. Fabriesite formation is related to the hydration of trinepheline during the late stage of metamorphism. The name trinepheline was used in the literature for the polymorph of the synthetic compound $NaAlSiO_4$ with a value of the c parameter three times more to that of nepheline. Fabriesite is named in memory of Jacques Fabriés (1932–2000), an outstanding professor of Mineralogy at the Museum National d'Histoire Naturelle (MNHN) in Paris, France. Fabriés occupied the chair of Mineralogy from 1969 until 1998; and was also the MNHN director (1990–1994). **D.B.**

LAACHITE*

N.V. Chukanov, S.V. Krivovichev, A.S. Pakhomova, I.V. Pekov, C. Schäfer, M.F. Vigasina, and K.V. Van (2014) Laachite, $(Ca,Mn)_2Zr_2Nb_2TiFeO_{14}$, a new zirconolite-related mineral from the Eifel volcanic region, Germany. European Journal of Mineralogy, 26(1), 103–111.

A new mineral laachite $(Ca,Mn)_2Zr_2Nb_2TiFeO_{14}$ (IMA 2012-100) was discovered in a sanidinite specimen from the Laach Lake (Laacher See) volcano, Eifel region, Rheinland-Pfalz, Germany. It occurs in one of the upper, coarse-grained layers within the pyroclastic formation of the Laach Lake volcano well known as "Graue Laacher SeeBimstuffe" (coordinates: 50°23′52.71″ N; 07°17′18.18″E). Associated minerals are sanidine, allanite-(Ce), baddeleyite, haüyne, hedenbergite, intermediate members of the jacobsite-magnetite series, phlogopite, rhodonite, spessartine, tephroite, thorite, zircon, and a pyrochlore-group mineral. The new mineral has been named laachite for the type locality. Laachite forms isolated, imperfect, long prismatic to acicular crystals, up to 0.02 × 0.04 × 0.5 mm, which occurs as random intergrowth and twins in cavities in sadinidite. Observed twinning plane is (130), with an angle of 65° between the ***a*** axes of the twin components. Laachite is translucent in thin fragments, otherwise deep brownish red with adamantine luster. Streak is brownish red. It is brittle, with uneven fracture, and no cleavage observed. No hardness is reported. D_{calc} = 5.417 g/cm^3. Refractive indexes and 2V angle were not determined due to the lack of the high refraction media. Mean n = 2.26 is calculated from the Gladstone-Dale relationship. Raman scattering spectra of laachite show the absence of absorption bands of H_2O molecules, OH group and CO_3^{2-} groups. The average composition of 5 electron probe EDS analyses yielded (wt%): CaO 4.29, MnO 9.42, FeO 5.73, Y_2O_3 2.56, La_2O_3 2.00, Ce_2O_3 6.37, Nd_2O_3 2.22, Al_2O_3 0.99, ThO_2 7.75, TiO_2 10.98, ZrO_2 19.39, Nb_2O_5 27.82, total 99.52, providing the empirical formula (based on 14 O): $(Ca_{0.66}Mn_{0.37}Th_{0.25}Y_{0.20}La_{0.11}Ce_{0.34}Nd_{0.11})(Zr_{1.36}Mn_{0.64})(Nb_{1.81}Ti_{1.19})(Fe_{0.69}Al_{0.17}Mn_{0.14})O_{14.00}$. The X-ray powder diffraction data was obtained on a Stoe IPDS II Image Plate diffractometer (Gandolfi geometry) utilizing monochromatized Mo$K\alpha$ radiation. The diffraction pattern was indexed in monoclinic unit-cell with a = 7.311(9), b = 14.14(2), c = 10.19(2) Å, β = 90.08(2)°, V = 1053 Å^3, and Z = 4. The strongest reflections in the X-ray powder-diffraction pattern [d Å (I %; hkl)] are: 4.298 (22; 022), 2.967 (100; $20\bar{2}$, 202), 2.901 (59; 042), 2.551 (32; $15\bar{1}$, 151, 240, 004), 1.800 (34; $24\bar{4}$, 244), 1.541 (24; $37\bar{1}$, 371), 1.535 (23; $20\bar{6}$, 206), 1.529 (23; 046). Single-crystal X-ray data (collected with a structure Bruker APEX DUO II CCD diffractometer, and monochromated Mo$K\alpha$-radiation) was indexed with a monoclinic cell with a = 7.3119(5), b = 14.1790(10), c = 10.1700(7) Å, β = 90.072(2)°, V = 1054.38 Å^3, space group $C2/c$. Attempts to refine the structure in orthorhombic space groups were unsuccessful. The structure was solved by direct methods and refined to R_1 = 3.1 % considering a pseudomerohedral twin using a matrix [–100/010/001]. The crystal structure is based upon a module composed of an octahedral layer and a layer of large cations in seven- and eight-fold coordinations. The octahedral layer is built up with NbO_6 and TiO_6 octahedra linked by corner sharing to form six- and three-membered rings, and the Fe sites are located in the centers of six-membered rings. The second layer is composed of the CaO_8 and ZrO_7 polyhedra, with each CaO_8 polyhedron sharing two opposite edges with two adjacent CaO_8 polyhedra to form chains running parallel to the ***a*** axis. Similar chains are formed by the ZrO_7 polyhedra. Polymerization of the chains results in a dense layer. Laachite is a Nb-dominant monoclinic analog of zirconolite-3O, the orthorhombic zirconolite polytype. The type material is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **F.C.**

OSKARSSONITE*

M.J. Jacobsen, T. Balić-Žunić, D. Mitolo, A. Katerinopoulou, A. Garavelli, and S.P. Jacobsson (2014) Oskarssonite, AlF_3, a new fumarolic mineral from Eldfell volcano, Heimaey, Iceland. Mineralogical Magazine, 78(1), 215–222.

Oskarssonite (IMA 2012-088), AlF_3, is a fumarolic mineral described from the Eldfell volcano on the Heimaey Island in the Vestmannaeyjar archipelago, Iceland. It is named after Niels Oskarsson, a prominent volcanologist from Iceland, in recognition of his work on Icelandic fumaroles. The probable presence of this mineral was reported from Hekla after the 1970 eruption (Oskarsson 1981) and from Mont Erebus, Antarctica (Rosenberg 1988). The mineral occurs as white to grayish-yellow fine powder in encrustations that were recently deposited at a temperature of 90 °C and occurring close to the surface of fumaroles vents. Oskarssonite occurs in association with anhydrite, bassanite, gypsum, jarosite, anatase, hematite, opal, ralstonite, jacobssonite, meniaylovite, and four other fluorides that are potentially new mineral species. Hardness and refraction indices could not be determined due to sub-micrometer size of oscarssonite crystals. Synthetic AlF_3 is uniaxial positive with $\omega = 1.3765$ and $\varepsilon = 1.3770$ ($\lambda = 589$ nm) . $D_{calc} = 3.184$ g/cm^3. The averaged chemical analyses (5 points) obtained by SEM energy-dispersive spectroscopy gave: Al 31.70, F 58.41, O 9.22, total 99.33 wt%. The presence of O was attributed to (OH) substituting for F. The empirical formula calculated on the basis of 1 Al atom is $AlF_{2.62}(OH)_{0.49}$. The strongest lines of the powder X-ray pattern are [d Å (I %; hkl)]: 3.54 (100; 012), 2.131 (13; 113), 1.771 (20; 024), 1.59 (15; 116), 1.574 (10; 122). The crystal structure of oskarssonite was refined with the Rietveld method to $R_P = 3.96\%$. The mineral is trigonal, $P\bar{3}c$, $a = 4.9817(4)$, $c = 12.387(1)$ Å, $V = 266.23$ Å^3, and $Z = 6$. The crystal structure of oskarssonite is based on rhombohedraly deformed perovskite-type octahedral framework of corner-sharing AlF6 octahedra. The holotype specimen is deposited in the collection of the Icelandic Institute of Natural History, Gardabaer, Iceland, and other specimens in which oskarssonite was identified are in the mineral collection of the Natural History Museum of Denmark. **Yu.U.**

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PHILROTHITE*

L. Bindi, F. Nestola, E. Makovicky, A. Guastoni, and L. De Battisti (2014) Tl-bearing sulfosalt from the Lengenbach quarry, Binn Valley, Switzerland: Philrothite, $TlAs_3S_5$. Mineralogical Magazine, 78(1), 1–9.

Philrothite (IMA 2013-066), ideally $TlAs_3S_5$, is a new mineral from the Lengenbach quarry in the Binn Valley, Valais, Switzerland. Philrothite was found on realgar, associated with smithite, rutile, and sartorite, and is presumably the result of late-stage Tl- and As-bearing hydrothermal solutions during alpine metamorphism. Philrothite forms anhedral grains up to 200 mm across in size and shows no inclusions or intergrowths. The mineral is black, metallic, opaque, has a dark brown streak, no cleavage and uneven fracture. The micro-indentation measurements $VHN_{25} = 128$ (120–137) kg/mm^2 correspond to a Mohs hardness 3–3½. The density could not be measured due to small grain size; $D_{calc} = 4.635$ g/cm^3. Philrothite is moderately bireflectant in plane-polarized reflected light, is weakly pleochroic, from dark gray to a light gray, and shows no internal reflections. It is anisotropic with gray to bluish rotation tints. Reflectance values for COM wavelengths in air [R_{min}, R_{max} % (nm)] are: 26.5, 28.8 (471); 25.4, 27.2 (548); 24.6, 26.3 (586); 24.0, 25.1 (652). The average of 5 electron probe analyses (EDS, WDS) gives [wt% (range)]: Tl 26.28 (24.33–26.98), Pb 6.69 (6.25–6.92), Ag 2.50 (2.30–2.53), Cu 0.04 (0.02–0.09), Hg 0.07 (0.00–0.12), As 32.50 (31.97–33.09), Sb 3.15 (3.10–3.37), S 26.35 (26.12–26.91), total 97.58. On the basis of 9 atoms, the empirical formula of philrothite is $(Tl_{0.79}Pb_{0.20})_{\Sigma 0.99}(As_{2.66}Sb_{0.16}Ag_{0.14}Cu_{<0.01}Hg_{<0.01})_{\Sigma 2.97}S_{5.04}$. The attempts to obtain a powder-diffraction pattern have failed due to small size and poor diffraction quality. The strongest lines in the calculated X-ray powder-diffraction pattern [d_{calc} Å (I_{calc}%; hkl)] are: 3.677 (100; 161), 2.764 (77; 234), 2.769 (76; 230), 12.415 (52; 020), 2.894 (52; 181), 2.324 (52; 092), 3.015 (46; 153), 3.454 (45; 131). Single-crystal X-ray diffraction data collected on a crystal 0.055 × 0.060 × 0.065 mm, refined to $R_1 = 0.0985$ for 1217 unique reflections with $I \geq 2\sigma(I)$, shows philrothite is monoclinic, space group $P2_1/c$ with cell parameters $a = 7.225(2)$, $b = 5.547(3)$, $c = 8.946(3)$ Å, $\beta = 113.55(3)°$, $V = 1715.9$ Å^3, $Z = 8$. Philrothite can be considered the N = 4 homolog of the sartorite homologous series. Thallium assumes tricapped prismatic sites alternating to form columns perpendicular to the ***b*** axis, organized into zigzag layers parallel to (010). Between the zigzag walls are coordination pyramids of As(Sb) forming diagonally oriented double layers separated by broader interspaces that house the lone-pair electrons. The mineral name honors Philippe Roth (b. 1963), President of the FGL (Forschungsgemeinschaft Lengenbach) and a well-known mineral expert on the Lengenbach minerals for more than 25 years. The holotype material is deposited in the Museum of Mineralogy of the Department of Geosciences at the University of Padova, Italy. **O.C.G.**

PUTNISITE*

P. Elliott, G. Giester, R. Rowe, and A. Pring (2014) Putnisite, $SrCa_4Cr^{3+}_8(CO_3)_8SO_4(OH)_{16}\cdot 25H_2O$, a new mineral from Western Australia: description and crystal structure. Mineralogical Magazine, 78(1), 131–144.

Putnisite (IMA 2011-106), ideally $SrCa_4Cr^{3+}_8(CO_3)_8SO_4(OH)_{16}\cdot 25H_2O$, is a new mineral from the Halls Knoll gossan, in the Polar Bear peninsula Southern Lake Cowan, Western Australia, Australia. The area is located within the southern section of the Norseman-Wiluna Greenstone Belt of the Yilgarn Craton, which is composed of volcanic and sedimentary rocks that were deposited around 2.7 Ga and extensively folded, followed by metamorphism to middle amphibolite facies, extensive intrusion by granitoids and major faulting. The Halls Knoll gossan has formed by the oxidation of massive nickel sulfides and contains extremely high levels of Ni, Cu, and platinum group metals. Putnisite formed during the oxidation of the sulfide-bearing komatiite/diorite rocks, and occurs as isolated pseudocubic crystals up to 0.5 mm in size in a matrix composed of quartz and masses of a near-amorphous dark green Cr-silicate with minor amounts of Ca, Mg, Na, Ni, S, and Cl. The mineral has been named putnisite in honor of Australian mineralogists Christine and Andrew Putnis of the Institut für Mineralogie, Universtität Münster, Germany, in recognition of their outstanding contributions to mineralogy. Putnisite is translucent, with vitreous luster and color ranging from pale to dark purple, with a pink streak. Crystals are brittle, with an uneven fracture and Mohs hardness is 1½–2. One excellent and two good cleavages parallel to {100}, {010}, and {001} are observed. D_{meas} = 2.20(3) g/cm^3 (Clerici solution) and D_{calc} = 2.23 g/cm^3 (based on the chemical formula from the chemical analysis). Optically, putnisite is biaxial (–), with α =1.552(3), β = 1.583(3), and γ = 1.599(3) (measured in white light) and uncertain optical orientation. Pleochroism is distinct: X = pale bluish gray, Y = pale purple, Z = pale purple. Infrared-absorption spectrum of powdered putnisite shows bands due to OH stretching vibrations (broad band ~3680 to ~2280 cm^{-1}, centered on 3420 cm^{-1}), bending of H_2O groups (1645 cm^{-1}), vibration of CO_3^{2-} groups (1375 cm^{-1}, and split bands 1544 and 1525 cm^{-1}, 830 and 702 cm^{-1}), overlapping bands of the vibration of the SO_4 tetrahedra and vibration of CO_3^{2-} groups (1122 and 1076 cm^{-1}), and vibration of the SO_4 tetrahedra (at 922 cm^{-1}). The average composition of 13 electron probe WDS analyses yielded (wt%): Na_2O 0.17, MgO 0.08, CaO 10.81, SrO 5.72, BaO 0.12, CuO 0.29, Cr_2O_3 31.13, SO_3 3.95, SiO_2 0.08, Cl^- 0.28, CO_2 17.94, H_2O 30.30 (CO_2 and H_2O calculated by stoichiometry based on the crystal structure analysis; confirmed by infrared spectroscopy), O=Cl –0.06, total 100.81. The empirical formula, based on O+Cl = 69 pfu, with the OH content derived from charge balance is: $Cr^{3+}_{8.02}Ca_{3.78}Sr_{1.08}Na_{0.11}Cu^{2+}_{0.07}Mg_{0.04}Ba_{0.02}[(SO_4)_{0.96}(SiO_4)_{0.03}]_{0.99}(CO_3)_{7.98}(OH)_{16.19}Cl_{0.15}\cdot 24.84H_2O$. The X-ray powder diffraction data were collected using a microdiffractometer (Bruker AXS Discover 8) using a two-dimensional area detector (Hi-Star), with Cu$K\alpha$-radiation. The diffraction pattern was indexed in orthorhombic unit-cell: a = 15.325(6), b = 20.40(2), c = 18.21(3) Å, V = 5692 Å^3, Z = 4. The strongest reflections in the X-ray powder-diffraction pattern [d Å (I %; hkl)] are: 13.577 (100; 011), 7.659 (80; 200), 6.667 (43; 211), 5.084 (19; 222, 230), 3.689 (16; 411). The crystal structure was determined from single-crystal X-ray data (collected with an Oxford Diffraction Xcalibur E equipped with an Eos CCD and monochromatized Mo$K\alpha$-radiation). The single crystal parameters of the orthorhombic unit cell are: a = 15.351(3), b = 20.421(4), c = 18.270(4) Å, V = 5727 Å^3, space group $Pnma$. The structure was solved by direct methods and refined to R_1 = 0.0604. Putnisite has a complex framework structure that is unique among minerals and synthetic compounds. It consists of eight-membered rings of edge-sharing $Cr(OH)_4O_2$ octahedra, which are decorated by CO_3 triangles, each of which links by corner-sharing to two $Cr(OH)_4O_2$ octahedra. The Sr^{2+} cation lies at the center of each ring and rings are linked in the **b** and **c** directions by Ca cations and by hydrogen bonds to form a sheet parallel to (100). Adjacent sheets are joined along [100] by corner-sharing SO_4 tetrahedra and H_2O molecules occupy channels running along [100]. Cotype material of putnisite is deposited at the collections of South Australian Museum, Adelaide, South Australia, (registration number G33429) and the Canadian Museum of Nature, Ottawa, Canada (catalog number CMNMC 86133). **F.C.**

THERASIAITE *

F. Demartin, C. Castellano, and I. Campostrini (2014) Therasiaite, $(NH_4)_3KNa_2Fe^{2+}Fe^{3+}(SO_4)_3Cl$, a new sulfate chloride from La Fossa Crater, Vulcano, Aeolian islands, Italy. Mineralogical Magazine, 78(1), 203–213.

A new monoclinic anhydrous sulfate chloride therasiaite (IMA 2013-050), ideally $(NH_4)_3KNa_2Fe^{2+}Fe^{3+}(SO_4)_3Cl_5$, was discovered on the only fragment of pyroclastic breccia in an active fumarole (~250 °C) at La Fossa crater, Vulcano, Aeolian Islands, Sicily, Italy. It was named for the type locality, Therasia, one of the ancient names for Vulcano island (from the Greek θηρασια = warm earth). The mineral is associated with salammoniac, kremersite and adranosite. It forms aggregates of brown to dark brown (streak is brown) vitreous equant to short prismatic crystals up to 0.1 mm with the main forms {012}, {210}, {101}, {$\bar{1}$01}, and {010}. No cleavage was observed. The mineral does not fluoresce under short- or long-wave UV radiation. Therasiaite is unstable on the open air and decomposes after a couple of weeks. The data on Mohs hardness and fracture are not given. D_{meas} = 2.41(1); D_{calc} = 2.395 g/cm^3. The mineral is optically biaxial (–) with α = 1.585, β = 1.615, and γ = 1.630° (white light); nonpleochroic (color in transmitted light not given). The strong absorption peaks at 3205 and 1410 cm^{-1} of IR spectrum confirm the presence of NH_4^- group. The mean of 12 electron probe EDS analysis [wt% (range)] is: $(NH_4)_2O$ (by stoichiometry) 9.64, K_2O 8.61 (8.02–9.12), Na_2O 8.72 (7.32–9.10), FeO 8.75 (17.50–19.05), Fe_2O_3 9.72 (Fe^{2+}/Fe^{3+} by the structural data), MnO 1.21 (0.22–1.29), Al_2O_3 0.87 (0.77–0.95), SO_3 32.93 (32.02–33.19), Cl 24.70 (24.22–26.13), –O=Cl 5.58, total 99.57. The empirical formula (based on 17 anions pfu) is $(NH_4)_{2.68}K_{1.32}Na_{2.04}Fe_{1.76}Al_{0.12}Mn_{0.12}S_{2.98}O_{11.95}Cl_{5.05}$. The X-ray powder diffraction data were obtained using powder diffractometer (Cu$K\alpha$ radiation) and calculated from single crystal X-ray data. The strongest lines of the experimental X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 9.99 (6; 110), 7.36 (8; $\bar{1}$11), 5.22 (6; 310), 3.297 (28; 33$\bar{1}$), 3.208 (14; $\bar{5}\bar{1}$2), 3.008 (12; 040), 2.942 (11; 331), 2.812 (100; $\bar{2}$23), 2.664 (77; $\bar{5}$13). The significant difference in intensities of some reflections between experimental and calculated data could be assigned to the preferred orientation in powder sample and to instability after grinding. The unit-cell parameters obtained from powder diffraction data are: a = 18.415(3), b = 12.048(2), c = 9.531(1) Å, β = 108.71(2)°. The unit-cell parameters obtained from single-crystal data are: a = 18.284(4), b = 12.073(2), c = 9.535(2) Å , β = 108.10(3)°, V = 2000.6 Å^3, space group Cc, and Z = 4. The structure solved by direct methods and refined to R = 0.0240 for 5574 independent reflections with $I > 2\sigma(I)$. The crystal structure of therasiaite represents the unique topology of infinite chains running along [001] and is made of two independent Fe-distorted octahedra and three independent sulfate tetrahedra. Each of Fe^{2+} and Fe^{3+} atoms surrounded by three Cl atoms and three oxygen atoms of the sulfate group. Voids between the chains are occupied by three independent ammonium ions (partially replaced by K^+), one K^+ and two Na^+ ions. The structural formula is $[(NH_4)_{2.25}K_{0.75}]KNa_2Fe_2(SO_4)_3Cl_5$. The holotype is deposited in the Reference Collection of the Dipartimento di Chimica, Università degli Studi di Milano, Italy. **D.B.**

TUBULITE*

Y. Moëlo, R. Pecorini, M.E. Ciriotti, N. Meisser, M.T. Caldes, P. Orlandi, P-E. Petiti, B. Martini, and A. Salvetti (2013) Tubulite, $\sim Ag_2Pb_{22}Sb_{20}S_{53}$, a new Pb-Ag-Sb sulfosalt from

Le Rivet quarry, Peyrebrune ore field (Tarn, France) and Biò, Borgofranco mineas, Borgofranco d'Ivrea (Piedmont, Italy). European Journal of Mineralogy, 25, 1017–1030.

Tubulite (IMA 2011-109), ~$Ag_2Pb_{22}Sb_{20}S_{53}$, is a new sulfosalt species discovered at two locations: Le Rivet quarry, Peyerebrune Pb-Zn-Ag ore filed, Tarn, France, and at Biò, in the upper galleries (Veneziana and Torinese) of the Pb-Ag-As-Sb Borgofranco mines, Borgofranco d'Ivrea, Turin, Piedmont, Italy ("unknown mineral UKMBB 703" of Ambrino et al. 2008; Ciriotti et al. 2009). Tubulite found in quartz-baryte-carbonate (calcite, siderite, dolomite) veins with galena, sphalerite, chalcopyrite, pyrite and other sulphides and various sulfosalts (bournonite, tetrahedrite-freibergite, semseyite, boulangerite, freieslebenite, miargyite, polybasite, proustite, pyrargyrite-proustite, pyrostilpnite, polybasite, wittichenite, semseyite, geocronite, fizélyite, diaphorite). These veins intersect black schists with metadolerites and meta-basalts of metamorphosed volcano-sedimentary complex at Le Rivet and a non-fossiliferous sedimentary sequence of mudstones, sandstones, arkoses and impure limestones at Biò. The mineral is named for its appearance, as it forms thin micro-tubes. Tubulite crystals appear in vugs as rare metallic black perfect hollow cylinders up to 600 μm in length, 40 to 100 μm in diameter, and only 1–2 μm thick. The tubes show no plasticity and are very difficult to crush. Tubulite is closely associated with galena, and also boulangerite at Le Rivet and with geocronite, bournonite, fizélyite at Biò where it also (rarely) found as elongated lamellae on crystal faces of calcite and barite. At that location tubulite also occurs in a hair-like variety (earlier thought to be another sulfosalt; "unknown mineral UKMBB708" of Ambrino et al. 2008) consisting of micro-fibers 0.2 μm thick forming a nest-like scrolls with a diameter of about 400 μm, and at least about 50 turns. The length of such a micro-fiber may reach 6 cm. Due to morphology of tubulite its optical properties and hardness could not be determined. The electron probe analysis (EDS and WDS) were performed focusing the beam on the top surface of the tube put horizontally on a flat surface. The results (mean of 8 WDS analysis of Biò sample/ mean of two EDS analysis of Le Rivet sample; wt%) are: Ag 2.7/3.6, Pb 46.6/39.95, Sb 26.1/23.55, S 17.8/17.05, total 93.2/84.15. No other elements with $Z > 10$ were detected. Low total and strong dispersion of data are due to the thickness of the tubes. The significantly higher Pb content for hair-like variety (EDS) could be an analytical artefact due to the size of "nano-wires." The empirical formula calculations show more suitable results when based on 44 cations pfu: $Ag_{2.4}Pb_{21.3}Sb_{20.3}S_{52.5}$, ideally $Ag_2Pb_{22}Sb_{20}S_{53}$. The tubulite composition is close to those of the owyheeite, sterryite and parasterryite (but higher in Pb content, mainly to the detriment of Ag) and appears to be an intermediate between owyheeite and those of boulangerite and semseyite. Powder X-ray diffraction (114.6 mm Gandolfi camera, Cu$K\alpha$ radiation) on material from Le Rivet and Biò (including hair-like variety) gave similar patterns which are close but differ from those of sterryite and parasterryite. Due to the poor quality of the patterns, and to the high values of the b and c parameters, these patterns could not be fully indexed to refine the unit cell. The strongest reflections [d Å (I %)] are: 4.11 (30), 3.99 (35), 3.69 (60), 3.36 (100), 3.28 (55), 2.99 (55), 2.912 (55), 2.063 (75). Both powder and single-crystal X-ray diffraction studies were not successful in determining the crystal structure of tubulite. X-ray precession and TEM electron diffraction study indicated monoclinic symmetry with $\beta = 93.2°$, possible space groups $P2/c$, Pc, or $P2_1/c$, and unit cell parameters of $a = 4.132(2)$ (×2), $b = 43.1(2)$, $c = 27.4(1)$ Å, $V = 4872$ (×2) Å^3 (TEM indicates a disordered 2a superstructure ~8 Å commonly observed in acicular Pb sulfosalts). The c parameter is perpendicular to tube wall while b is parallel to the cylinder axe of the tube. The density calculated on the basis of this ideal formula and $Z = 2$ is 6.05 g/cm^3, which is close to that of owyheeite, semseyite, and boulangerite. The relationships with other lead sulfosalts are discussed. The similarity in unit cells of tubulite, sterryite, and parasterryite allows suggesting that tubulite is probably an expanded derivative of owyheeite. The genesis of other minerals with a circular symmetry is discussed. It is proposed that for tubulite the micro-tubes might be initiated by capillary forces acting on very thin lath-like crystallites around gas bubbles or oil droplets in hydrothermal solutions. The holotype specimen from Le Rivet quarry is deposited in the Museum of Mineralogy of the École Nationale Supérieure des Mines de Paris, France, the one from Biò is in the Museo Regionale di Scienze Naturali, Turin, Italy, while cotypes are in the Museo di Storia Naturale, Università di Pisa, Italy, and in the Musée Cantonal de Géologie, Université-Anthropole, Switzerland. **Yu.U. and D.B.**

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WHITECAPSITE*

I.V. Pekov, N.V. Zubkova, J. Göttlicher, V.O. Yapaskurt, N.V. Chukanov, I.S. Lykova, D.I. Belakovskiy, M.C. Jensen, J.F. Leising, A.J. Nikischer, and D.Yu. Pushcharovsky (2014) Whitecapsite, a new hydrous iron and trivalent antimony arsenate mineral from the White Caps mine, Nevada, USA. European Journal of Mineralogy, 26(3), in press (online), DOI: 10.1127/0935-1221/2014/0026-2384.

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Whitecapsite (IMA 2012-030), ideally $H_{16}Fe^{2+}_5Fe^{3+}_{14}Sb^{3+}_6(AsO_4)_{18}O_{16}\cdot120H_2O$, has been found in several specimens collected at the 310 foot level of the East orebody in the oxidation zone of the White Caps gold deposit (White Caps mine), Manhattan district, Nye Co., Nevada, U.S.A., and named for the locality. It occurs within small cavities and cracks of a tight breccia consisting of fragments of jasperoid, silicified marble, and mica schist and is closely associated with earlier quartz and realgar. Other associated minerals are picropharmacolite, guerinite, pitticite, gypsum, jarosite, goethite, sulfur, metastibnite and earlier calcite, kaolinite, stibnite, arsenopyrite, pyrite, sphalerite, orpiment, cinnabar, and metacinnabar. Whitecapsite forms hexagonal prismatic {110} crystals (up to 0.3 × 0.3 × 1.5 mm) terminated by bipyramids

{111}. Their clusters rich the size up to 1 mm. It is also found as flattened anhedral grains up to 1 × 0.1 mm. The mineral is bright orange to golden-brownish orange, transparent, vitreous. Mohs hardness is 2–2½. It is brittle, cleavage was not observed, fracture is uneven. D_{meas} = 2.30(3), D_{calc} = 2.297 g/cm^3. Whitecapsite is optically uniaxial (+), ω = 1.590(2), ε = 1.603(3), crystals elongation is positive. It is very weakly pleochroic, with yellowish colors, $E > O$. Absorption bands of the IR and Raman spectra (cm^{-1}; s = strong, w = weak, sh = shoulder) for IR are: 3455sh, 3348s (O-H stretching vibrations of H_2O molecules), 1658 (H-O-H bending vibrations of H_2O molecules), 3000sh, 2320w, 1720w, 1500w, 1144w, 1105w, 1063w, 1029 (vibrations of hydrated proton and/or other acid groups forming strong hydrogen bonds), 895sh, 860, 814s (As-O-stretching vibrations of AsO_4^{3-} groups), and 512w, 455sh, 432, 415 (lattice modes involving mainly Fe-O and Sb^{3+}-O stretching, O-As-O bending and H_2O libration) and for Raman are: 3400s, 3250, 1655, 2930sh, 2350w, 1720w, 1380w, 1165w, 1095w, 870s, 790sh, 585, 531s, 466, 318, 268, 202s, 175 and 120s. The spectroscopic evidences confirm high content of H_2O, the presence of hydrated protons (the complex cations $H^+ \cdot nH_2O$) and an absence of OH groups. The mean of 5 electron probe WDS analysis [wt% (range)] is: MnO 0.09 (0.03–0.15), Fe_2O_3 22.73 (21.89–23.61), Sb_2O_3 13.30 (12.89–13.62), As_2O_5 30.78 (30.18–31.50), H_2O_{calc} 34.53, total 100.84. FeO and Fe_2O_3 contents were calculated as 5.32 and 16.82, respectively, assuming ratio Fe^{3+}:(Fe^{2+}+Mn^{2+}) = 14:5 (by crystal structure refinement and XANES data, as well as trivalent state of Sb). The empirical formula calculated on the basis of 208 O and 256 H apfu is: $H_{16}Mn^{2+}_{0.08}Fe^{2+}_{4.95}Fe^{3+}_{14.07}Sb^{3+}_{6.10}As^{5+}_{17.89}O_{88} \cdot 120H_2O$. The X-ray powder-diffraction data for whitecapsite were obtained with a single-crystal diffractometer (Mo$K\alpha$ radiation) using the Gandolfi method. The hexagonal unit-cell parameters calculated from the powder data are: a = 16.09(1), c = 21.73 (3) Å, V = 4873(3) Å^3. The strongest lines of the X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 13.99 (49; 100), 11.73 (100; 101), 5.267 (6; 120), 3.644 (4, 205,132,006), 2.999 (8; 411,126,225), 2.757 (4; 501,234); 2.648 (5; 331,414,316). The crystal structure was solved on a single crystal to R_1 = 0.0579 in space group $P6_3/m$, a = 16.0916(8), c = 21.7127(9) Å, V = 4869.0 Å^3, Z = 1. In the whitecapsite structure, heteropolyhedral clusters $[(\square,Fe^{2+})_6Fe^{3+}{}_7Sb_3O_8(AsO_4)_9(H_2O)_{30}]$ are formed by two types of AsO_4 tetrahedra, SbO_5 polyhedra and three types of Fe-centered polyhedra with the $Fe^{3+}O_6$ trigonal prism as a central polyhedron are isolated from one another and bound by H-bonds involving H_2O molecules in the intercluster space. The crystal structure of whitecapsite is related to another arsenate mineral bouazzerite. The type specimen of whitecapsite is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**