New Mineral Names*,†

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In this issue

This New Mineral Names has entries for 9 new minerals, including argentotetrahedrite-(Fe), bytízite, calamaite, fluorlamprophyllite, honzaite, katerinopoulosite, meitnerite, melcherite, and rozhdestvenskayaite-(Zn).

ARGENTOTETRAHEDRITE [-(FE)]* AND ROZHDESTVENSKAYAITE [-(ZN)]*

M.D. Welch, C.J. Stanley, J. Spratt and S.J. Mills (2018) Rozhdestvenskayaite $Ag_{10}Zn_2Sb_4S_{13}$ and argentotetrahedrite $Ag_6Cu_4(Fe^{2+},Zn)_2Sb_4S_{13}$: two Ag-dominant members of the tetrahedrite group. European Journal of Mineralogy, 30(6), 1163–1172.

New Ag-dominant members of the tetrahedrite group, argentotetrahedrite (IMA 2016-093) $Ag_6Cu_4(Fe^{2+},Zn)_2Sb_4S_{13}$ and rozhdestvenskayaite (IMA 2016-094) $Ag_{10}Zn_2Sb_4S_{13}$ were discovered while study specimens from museum collections. Argentotetrahedrite found in the specimen M8224 (considered as holotype) of Miller Museum collection, University of Western Ontario, Canada, from Keno Hill, Yukon, Canada (63°55′N, 135°25′W). The cotype is deposited at the Natural History Museum, London, Great Britain. Rozhdestvenskayaite found in specimen BM2016,120 (considered as a type) of the Natural History Museum, London, Great Britain, from the Moctezuma mine, Moctezuma, Sonora, Mexico (29°48′N, 109°40′W). Along with those the specimens of Ag-rich tetrahedrite from the St. Andreaskreuz silver mine, Andreasberg, Harz mountains, Germany (BM57605) and freibergite from Beschert Glück mine, Freiberg district, Saxony, Germany (Senckenberg Museum Collection, Frankfurt, Germany; specimen #2289Sa) were studied. The name "argentotetrahedrite" as a possible new mineral was previously used in literature (see comments) but no structural data was provided, and no proposal was submitted to CNMNC IMA. In the specimen BM2016,120 rozhdestvenskayaite coexists with galena, pyrite and hessite (the only other Ag-rich mineral in the rock). No data on association, morphology, grain sizes etc. of argentotetrahedrite are provided. The microindentation hardness of argentotetrahedrite is VHN_{100} = 306 (296–319) kg/mm², whereas for rozhdestvenskayaite is VHN_{25} = 160 (148–172) kg/mm², corresponding to ~4 and ~3 of Mohs scale, respectively. Neither measured nor calculated densities are reported for any of species. In plane-polarized reflected light rozhdestvenskayaite is greenish-gray, and in crossed-polars it has ubiquitous deep red internal reflections. No according data for argentotetrahedrite are provided. The reflectance values for both minerals in comparison with those of Ag-rich tetrahedrite and freibergite were measured between 400 and 700 nm with 20 nm interval. The values [nm *R*% (**argentotetrahedrite / rozhdestvenskayaite**, Ag-rich tetrahedrite, freibergite)] are: 400 **31.3 / 30.8**, 32.0, 34.1; 420 **31.2 / 30.7**, 31.9, 34.0; 440 **31.1 / 30.5**, 31.7, 33.9; 460 **31.0 / 30.3**, 31.5, 33.7; 480 **30.9 / 30.1**, 31.3, 33.5; 500 30.8 33.2 31.2 29.7; 520 **30.8 / 29.1**, 31.1, 33.0, 540 **30.7 / 28.2**, 31.0, 32.7; 560 **30.7 / 27.1**, 31.0, 32.4, 580 **30.6 / 26.0**, 30.9, 32.0, 600 **30.4 / 25.0**, 30.8, 31.6; 620 **30.3 / 24.3**, 30.5, 31.2; 640 **30.1 / 23.5**, 30.2, 30.8; 660 **29.9 / 23.1**, 30.0, 30.5; 680 **29.7 / 22.9**, 29.8, 30.3; 700 **29.6 / 22.7**, 29.7, 30.1. The averages of electron probe WDS analysis of "four tetrahedrites" [i.e. **argentotetrahedrite (21) / rozhdestvenskayaite (7)**; Ag-rich tetrahedrite (15); freibergite (11)] [wt%(error)] are: S **22.0(2) / 18.93(9)**, 23.1(3) 20.1(3), Fe **4.64(3) / 0.23(9)**, 3.5(1) 5.0(1), Cu **19.29(7) / 0.14(2)**, 26.7(3), 14.1(8), Zn **1.43(2) / 5.0(3)**, 3.1(2), 1.0(1), As **0.17(2) / 1.2(5)**, 0.14(5), bdl, Ag **25.5(2) / 51.3(3)**, 15.3(3), 33(1), Cd bdl/ 0.9(4), bdl, bdl, Sb 26.69(7)/ 21.3(9), 28.13(9), 26.5(1); total **99.76 / 99.77**, 100.11, 99.86. The empirical formulae calculated on the basis of *Me* = 16 are respectively: $(Cu_{5.61}Ag_{4.37})_{\Sigma9.98}(Fe_{1.53}Zn_{0.40})_{\Sigma1.93}(Sb_{4.05}As_{0.04})_{\Sigma4.09}S_{12.68}$ / $(Ag_{10.05}Cu_{0.05})_{\Sigma10.10}(Zn_{1.62}Cd_{0.17}Fe_{0.09})_{\Sigma1.88}(Sb_{3.70}As_{0.34})_{\Sigma4.04}S_{12.44}$; $(Cu_{7.43}Ag_{2.51})_{\Sigma9.94}(Fe_{1.11}Zn_{0.84})_{\Sigma1.95}(Sb_{4.08}As_{0.03})_{\Sigma4.09}S_{12.76}$; $(Ag_{5.76}Cu_{4.18})_{\Sigma10.10}(Fe_{1.68}Zn_{0.29})_{\Sigma1.97}Sb_{4.10}S_{11.81}$. It is noted that the calculation of empirical formulae for tetrahedrite-group minerals based on S = 13 apfu is unsatisfactory since the sulfur content can be highly variable. The peaks in the X-ray powder diffraction patterns [*d* Å (*I*%; *hkl*)] are: 4.331 (6; 112), 3.063 (100; 222), 2.836 (5; 123), 2.652 (28; 004), 2.501 (8; 114), 2.081 (19; 134,015), 1.937 (12; 125), 1.876 (35; 044), 1.599 (25; 226) for argentotetrahedrite and 3.463 (5; 013), 3.161 (100; 222), 2.927 (8; 123), 2.738 (35; 004), 2.581 (8; 114), 2.148 (18; 134,015), 1.999 (10; 125), 1.936 (24; 044), 1.651 (19; 226) for rozhdestvenskayaite. Both minerals are cubic *I*43*m* with unit-cell parameters refined from powder data *a* = 10.6097(1) and *a* = 10.950(1) Å, respectively. Those obtained using single-crystal data are *a* = 10.6116(1) Å, *V* = 1194.92 Å³ and *a* = 10.9845(7) Å, *V* = 1325.37 Å³, respectively. The crystal structures of argentotetrahedrite and rozhdestvenskayaite were refined to R_1 = 0.022 [for 416 unique *I* > 4σ(*I*) reflections] and R_1 = 0.036 [for 409 unique *I* > 4σ(*I*) reflections], respectively. The general structural formula of the tetrahedrite group is $A_6B_6X_4Y_{12}Z_{0-1}$, where A is a planar [3]-coordinated site occupied by a monovalent cation; B is a tetrahedrally coordinated site with an average occupancy of two-thirds M⁺ and one-third M²⁺ and no evidence for short- or long-range ordering of monovalent and divalent metals; X site is [3]-coordinated and occupied by trivalent cations with a stereoactive lone-pair of electrons, usually Sb³⁺ and As³⁺; Y is a [4]-coordinated anion site fully occupied by S; Z site is occupied by octahedrally coordinated S, and can be fully or partially occupied or vacant (as in freibergite). The structural formula of argentotetrahedrite is defined as $^A[Ag_6]^B[Cu_4(Fe,Zn)_2]^XSb_4^YS_{12}^ZS$. In rozhdestvenskayaite Ag is also dominant in the B site leading to a large unit-cell volume. Ag–Ag distances of the Ag_6 octahedron in argentotetrahedrite and rozhdestvenskayaite are 3.23 and 3.24 Å, respectively, indicative of no

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metallic bonding while in freibergite it is 2.84 Å (almost the same as that of silver metal) suggesting the presence of metallic bonding in this octahedral group. The consequence of the metallically bonded Ag_6 group in freibergite is that it has an aggregate formal charge of +4 (not +6), leading to a charge-balanced ideal formula $(Ag_6)^{4+}(Cu^+)_4(Fe^{2+},Zn)_2Sb_4S_{12}$. Argentotetrahedrite named as the Sb-analogue of argentotennantite. The name rozhdestvenskayaite honors Irina V. Rozhdestvenskaya, Department of Crystallography of Saint Petersburg University in recognition of her important contributions to mineralogy, and particular to the crystal chemistry of the tetrahedrite group. **D.B.**

Comments: The name "argentotetrahedrite" as a possible new mineral was previously used by Spiridonov et al. (1986) (not referred in the abstracted paper). Contrary to the authors statement the name "argentotetrahedrite" was never used by Zhdanov et al. (1992), who described a "potential new mineral" without any name. This mineral has a very high silver content (up to 54 wt%) and is by composition (and by cell parameter $a = 10.92$ Å) is close to rozhdestvenskayaite but in all reported analysis Fe apfu is dominant over Zn. The empirical formula for the composition close to an average one (based on $\Sigma Me = 16$ apfu) is $Ag_{10.17}(Fe_{1.07}Zn_{0.75}Hg_{0.14})_{\Sigma1.96}(Sb_{3.77}As_{0.09})_{\Sigma3.86}S_{12.72}$.

According recently (after the abstracted paper published) approved nomenclature and classification of the tetrahedrite group (proposal 18-K of CNMNC IMA; CNMNC NEWSLETTER 49) the general structural formula of minerals belonging to this group is $^{M(2)}A_6^{M(1)}(B_4C_2)_{\Sigma6}^{X(3)}D_4^{S(1)}Y_{12}^{S(2)}Z$ ($Z = 2$), where A = Cu^+, Ag^+, □; B = Cu^+, Ag^+; C = Zn^{2+}, Fe^{2+}, Hg^{2+}, Cd^{2+}, Mn^{2+}, Cu^{2+}, Cu^+, Fe^{3+}; D = Sb^{3+}, As^{3+}, Bi^{3+}, Te^{4+}; Y = S_{2-}, Se^{2-}; and Z = S^{2-}, Se^{2-}, □. The tetrahedrite group is divided into five different series on the basis of the A, B, D, and Y constituents, i.e., the tetrahedrite, tennantite, freibergite, hakite, and giraudite series. The dominance of the C constituent reflected using a hyphenated suffix between parentheses. Eleven minerals of the tetrahedrite group as to date are considered to be a valid species: argentotennantite-(Zn), argentotetrahedrite-(Fe), kenoargentotetrahedrite-(Fe), giraudite-(Zn), goldfieldite, hakite-(Hg), tennantite-(Fe), tennantite-(Zn), tetrahedrite-(Fe), and tetrahedrite-(Zn). Thus, the minerals described in the abstracted paper now should be named argentotetrahedrite-(Fe) and rozhdestvenskayaite-(Zn) while the mineral described by Zhdanov et al. (1992) is a potential new species of the group; rozhdestvenskayaite-(Fe).

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BYTÍZITE*

P. Škácha, J. Sejkora and J. Plášil (2018) Bytízite, a new Cu-Sb selenide from Příbram, Czech Republic. Mineralogical Magazine, 82(1), 199–209.

The new mineral bytízite, (IMA 2016-044), ideally Cu_3SbSe_3, orthorhombic, was discovered at the Bytíz deposit, near the village of Bytíz, the most important deposit (provided 52% of the net U production of the entire district) within abandoned complex uranium and base-metal ore district of Příbram, Czech Republic. It is named for its type locality. One hand-sized sample with bytízite was found at the mine dump of shaft #16 (49°40′33.7″N, 14°03′30.5″E), exploited mainly the middle and deeper parts of the vein system of the deposits Háje, Bytíz, and Jerusalem. Bytízite occurs as a substantial part of up to 1 mm large steel-gray segregations in a calcite vein several millimeters thick, which cuts perpendicularly an older calcite vein containing common umangite and uraninite. Bytízite forms anhedral grains 10–40 μm, growing together in aggregates up to 300 μm enclosing other coexisting selenides: chaméanite, bukovite, příbramite, eskebornite, crookesite, and giraudite. Bytízite appears to be the youngest selenide in the association which also includes relatively late hakite, tetrahedrite and berzelianite. The mineral is steel gray, opaque, with a metallic luster. No cleavage or specific fracture was observed. Mohs hardness is assumed at 2–3 by analogy with wittichenite and skinnerite. Density was not measured; $D_{calc} = 6.324$ g/cm³. In reflected light, bytízite is gray with a yellowish hue and weak bireflectance. It has weak pleochroism and strong anisotropy with gray to brownish rotation tints. Internal reflections were not observed. The reflectance values in air [R_{max}/R_{min} (nm)] (COM wavelengths are bolded) are: 40.0/36.3 (400), 40.2/36.3 (420), 40.1/36.2 (440), 40.2/36.1 (460), **40.2/36.1 (470)**, 40.2/36.1 (480), 40.1/36.2 (500), 39.8/36.2 (520), 39.4/36.2 (540), **39.3/36.1 (546)**, 39.0/36.0 (560), 38.5/35.6 (580), **38.3/35.5 (589)**, 38.1/35.3 (600), 37.7/35.0 (620), 37.3/34.8 (640), **37.0/34.7 (650)**, 36.8/34.5 (660), 36.3/34.1 (680), 35.8/33.6 (700). The averaged 68 point WDS electron probe analyses [wt%, (range)]: Ag 0.25 (0.08–1.54), Cu 34.64 (31.98–36.23), Fe 0.07 (0.00–0.37), Hg 0.04 (0.00–0.75), Sb 21.39 (19.07–22.51), As 0.80 (0.18–2.09), Se 42.19 (40.65–43.33), S 0.08 (0.00–0.93), total 99.46 wt%. The empirical formula based on $\Sigma7$ apfu is $(Cu_{3.00}Fe_{0.01}Ag_{0.01})_{3.02}(Sb_{0.97}As_{0.06})_{1.03}Se_{2.94}$. The strongest lines of the calculated powder X-ray diffraction pattern are [d_{calc} Å (I_{calc}%; hkl)]: 3.73 (37; 210), 3.27 (62; 211), 2.867 (40; 022), 2.698 (100; 122), 2.646 (37; 040). The crystal structure of bytízite was refined based on the structure model for the synthetic orthorhombic Cu_3SbSe_3 to $R_1 = 4.37$%. The new mineral is orthorhombic, $Pnma$, $a = 7.9594(12)$, $b = 10.5830(14)$, $c = 6.8240(11)$ Å, $V = 574.82$ Å³, and $Z = 4$. The crystal structure of bytízite contains two Cu, one Sb, and two Se sites. The structure of both synthetic Cu_3SbSe_3 and bytízite is based on a 3D framework built from groups of three cis-edge-sharing tetrahedra [Cu_3Se_8], which are interlinked by $SbSe_3$ groups. The cotype material (two polished sections) is deposited in the National Museum, Prague, Czech Republic, and in the Mining Museum Příbram, Czech Republic. **Yu.U.**

CALAMAITE*

I.V. Pekov, O.I. Siidra, N.V. Chukanov, V.O. Yapaskurt, D.I. Belakovskiy, A.G. Turchkova and G. Möhn (2018) Calamaite, a new natural titanium sulfate from the Alcaparrosa mine, Calama, Antofagasta region, Chile. European Journal of Mineralogy, 30(4), 801–809.

Calamaite (IMA 2016-036), ideally $Na_2TiO(SO_4)_2 \cdot 2H_2O$, orthorhombic, is a new supergene mineral discovered in the oxidation zone of a pyrite orebody at the abandoned Alcaparrosa sulfate mine, Calama commune, El Loa province, Antofagasta region, Chile, an area famous in both mining and mineralogical aspects due to the location of outstanding ore deposits with very rich and interesting supergene mineralization in the oxidation zone. The Alcaparrosa deposit contains veins and lenses consisting of diverse iron sulfates and formed as a result of the oxidation of pyrite ore under the extremely arid conditions of the Atacama Desert. Calamaite was found in a römerite-enriched cavernous zone located inside a sulfate body mainly composed by coquimbite. Other minerals found are metavoltine, tamarugite, halotrichite, szomolnokite, rhomboclase, and in minor amounts, ferrinatrite and krausite. The new mineral overgrows römerite or forms intimate intergrowths with it, as well as with coquimbite and metavoltine. Calamaite typically forms thin, acicular to hair-like crystals up to 2 mm long and up to 0.01 mm thick combined in bunches or radial spherulitic clusters up to 4 mm in diameter. Rarely it occurs as isolated prismatic crystals up to 1×1×3 mm. Twins are common as cross-like interpenetration rotation with the rotation axis [001] and a rotation angle of 90°. Calamaite is transparent, colorless in

separate crystals, and white in aggregates. Its luster is vitreous. Calamaite is brittle, fracture is uneven and cleavage [probably with (001)] is good. Mohs hardness is ~3. The mineral is non-fluorescent under ultraviolet light or an electron beam. The density was not measured; $D_{calc} = 2.45$ g/cm³. In plane-polarized light, it is colorless and non-pleochroic. It is optically biaxial (+), $\alpha = 1.557(2)$, $\beta = 1.562(2)$, $\gamma = 1.671(3)$ (589 nm), $2V_{meas} = 30(10)°$, $2V_{calc} = 25°$. Dispersion of an optical axes was not observed; XZ is coplanar to the cleavage plane; if the cleavage plane is (100) then $Y = \mathbf{a}$. Extinction is straight, and elongation is positive. The FTIR spectra show bands (cm⁻¹; s = strong, w = weak, sh = shoulder) at: 3598, 3470sh, 3320s, 3240sh [O–H stretching vibrations of H_2O molecules and minor OH⁻ groups substituting O^{2-} at the O(1) site], 2324w [combination mode of S–O stretching vibrations], 1655 [bending vibrations of H_2O molecules], 1250sh, 1231s, 1133s, 1085sh [$v_3(F_2)$ = asymmetric stretching vibrations of SO_4^{2-} anions], 987s [$v_1(A_1)$ = symmetric stretching vibrations of SO_4^{2-} anions], 906w [possibly, (Ti, Fe^{3+})···O–H bending vibrations], 767 [Ti–O-stretching vibrations involving short bonds Ti–O(1) along octahedral chains], 603 [$v_4(F_2)$ = bending vibrations of SO_4^{2-} anions], 489 [$v_2(E)$ bending mode of SO_4^{2-} anions combined with Ti–O-stretching vibrations in Ti–O–S bridges with longer Ti–O(3) and Ti–O(5) bonds], 395sh, 373 [mixed lattice modes involving O–Ti–O bending vibrations]. Bands corresponding to BO_3^{3-}, CO_3^{2-}, and NO_3^- (in the range 1260–1600 cm⁻¹) are absent in the IR spectrum of calamaite. Calamaite is hardly soluble in H_2O at room temperature, however, the surface of its crystals turns white and dull if exposed to cold water for a day. The average of eight electron microprobe WDS analyses is [wt% (range)]: Na_2O 18.21 (16.02–20.79), K_2O 0.06 (0.02–0.11), Fe_2O_3 1.58 (1.20–2.33) [Fe^{3+} determined with color reactions with potassium hexaferricyanide, $K_3Fe^{3+}(CN)_6$, and potassium hexaferrocyanide, $K_4Fe^{2+}(CN)_6$], TiO_2 21.80 (20.95–23.59), SO_3 48.25 (47.30–49.66), H_2O_{calc} 10.74, total 100.73. The empirical formula calculated on the basis of 11 O apfu is: $Na_{1.97}(Ti_{0.92}Fe^{3+}_{0.07})P_{0.99}S_{2.02}O_9 \cdot 2H_2O$. The strongest X-ray powder diffraction lines are [d Å (I%; hkl)]: 8.10 (100; 020,200), 5.04 (55; 121,211), 3.787 (26; 231), 3.619 (18; 240,420), 3.417 (27; 141,411), 3.185 (15; 150), 2.943 (20; 341,431), 2.895 (20; 132,312). Unit-cell parameters refined from the powder data with whole-pattern fitting are $a = 16.123(6)$, $b = 16.246(4)$, $c = 7.018(1)$ Å, $V = 1838$ Å³. Single-crystal X-ray data on a crystal of 0.08×0.12×0.12 mm ($R_1 = 0.0358$ for 1185 $F > 2\sigma F$ reflections; $R_{all} = 0.0362$ for 1205 reflections) shows calamaite is orthorhombic, $Ibam$, $a = 16.0989(11)$, $b = 16.2399(9)$, $c = 7.0135(4)$ Å, $V = 833.64$ Å³, $Z = 8$. Calamaite is the second natural titanium sulfate after alcaparrosaite [$K_3TiFe^{3+}(SO_4)_4O \cdot 2H_2O$], but both are quite different in terms of structural topologies. In calamaite TiO_6 octahedra are interconnected via vertices to form infinite chains. The remaining vertices of the TiO_6 octahedron are shared with SO_4 tetrahedra, thus forming one-dimensional $[TiO(SO_4)_2]$ units. Heteropolyhedral chains topologically identical to those in calamaite were previously described in sideronatrite, $Na_2Fe^{3+}(OH)(SO_4)_2 \cdot 3H_2O$ and metasideronatrite, $Na_2Fe^{3+}(OH)(SO_4)_2 \cdot H_2O$. However, in sideronatrite Na atoms connect these chains into layers. Calamaite is the first sulfate mineral with a tetravalent cation octahedrally coordinated by O^{2-} but not OH⁻ anions, whereas natural sulfates with $M^{4+}(OH)_6$ octahedra (M^{4+} = Si, Ge, Mn, Sn) are known in two structurally related mineral groups. Calamaite is named after the Calama commune, in which its type locality is situated, and the Calama city, the capital of El Loa province. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **F.C.**

FLUORLAMPROPHYLLITE*

M.B. Andrade, H. Yang, R.T. Downs, G. Färber, R.R. Contreira Filho, S.H. Evans, C.W. Loehn and B.N. Schumer (2018) Fluorlamprophyllite, $Na_3(SrNa)Ti_3(Si_2O_7)_2O_2F_2$, a new mineral from Poços de Caldas alkaline massif, Morro do Serrote, Minas Gerais, Brazil. Mineralogical Magazine, 82(1), 121–131.

Fluorlamprophyllite (IMA 2013-102), $Na_3(SrNa)Ti_3(Si_2O_7)_2O_2F_2$, monoclinic, is a new mineral species, F-analogue of lamprophyllite. It has been discovered in Morro do Serrote, Minas Gerais, Brazil (21°53′05″S, 46°38′45″W). The nepheline syenite at Morro do Serrote is an intrusive body (9 km², 60–65 Ma) in phonolites, located in the central-western portion of the subcircular Mid-Cretaceous Poços de Caldas alkaline massif (800 km²). Fluorlamprophyllite found embedded in nepheline syenite associating with aegirine, analcime, natrolite, nepheline, and microcline. Fluorlamprophyllite forms brownish-orange transparent bladed crystals up to 3×0.3×0.2 mm with a pale-yellow streak and an adamantine luster. It is brittle, has a perfect cleavage on {100} and no parting. Mohs hardness is ~3. The density was not measured; $D_{calc} = 3.484$ g/cm³. In plane-polarized light the mineral is pleochroic X = yellow–green, Y= yellow–brown, Z = brown. It is optically biaxial (+), $\alpha = 1.735(7)$, $\beta = 1.749(7)$, $\gamma = 1.775(9)$ (white light), $2V_{meas} = 72(3)°$, $2V_{calc} = 74°$; X ⊥ b, Z $\wedge c \cong 5°$. The Raman spectrum of fluorlamprophyllite is very similar to those of lamprophyllite. The major bands (cm⁻¹) are: 3550–3700 (O–H, stretching), 750–1200 (Si–O stretching of SiO_4 groups, 690 Si–O–Si bending of Si_2O_7 groups), 590 (Ti–O stretching in TiO_5 and TiO_6 groups, <500 lattice modes). The average of 9 points electron probe WDS analysis [wt% (deviation) is Na_2O 10.63(30), K_2O 0.47(3), SiO_2 30.51(13), SrO 18.30(24), MgO 0.81(17), Al_2O_3 0.23(2), CaO 1.11(7), MnO 5.03(38), TiO_2 27.41(87), Fe_2O_3 2.45(37), F 2.86(23), H_2O 1.00 (added to bring the total close to 100%), –O=F –1.20, total 99.61. The elements Nb and Ba were sought but appeared to be below detection limits. The empirical formula calculated on the basis of 18 (O+F) apfu. The addition of 1.00 wt% H_2O brought [F+(OH)] = 2 pfu, yielding $(Na_{2.63}Sr_{1.35}Mn_{0.54}Ca_{0.15}Mg_{0.15}$ $K_{0.08})_{\Sigma4.90}(Ti_{2.63}Fe_{0.24}Al_{0.04})_{\Sigma2.91}Si_{3.89}O_{16}[F_{1.15}(OH)_{0.85}]_{\Sigma2.00}$. The strongest lines of the powder X-ray diffraction pattern are [d Å (I%; hkl)]: 4.722 (7; 400,310), 4.120 (63; 111), 3.704 (40; $\overline{3}$11), 3.363 (22; 311,510,220,401), 3.185 (23; 600), 2.857 (26; $\overline{6}$01,420), 2.762 (100; 221,511), 2.655 (25; $\overline{2}$02), 2.587 (24; 601,$\overline{4}$21,710), 2.126 (33; multiple). The single-crystal study shows fluorlamprophyllite is monoclinic 2M polytype, space group $C2/m$, $a = 19.255(2)$, $b = 7.0715(7)$, $c = 5.3807(6)$ Å, $\beta = 96.794(2)°$, $V = 727.5$ Å³, $Z = 2$. The crystal structure solved and refined to $R_1 = 0.023$ for 1202 independent $I > 2\sigma(I)$ reflections. The O atoms are arranged in well-defined, though not necessarily close-packed layers. The structure is very similar to that of lamprophyllite. The idealized chemical-structural formula can be written as $(SrNa)[(Na_3Ti)F_2][Ti_2(Si_2O_7)_2O_2]$, setting the large interlayer cations before the cations of the layer. The holotype and part of the co-type sample have been deposited at the University of Arizona Mineral Museum and the RRUFF Project. **D.B.**

Comment: According to the approved classification of the seidorzerite supergroup of minerals (Sokolova and Cámara 2017), the ideal structural formula of fluorlamprophyllite must be written as (SrNa) $Ti_2Na_3Ti(Si_2O_7)_2O_2F_2$.

References cited

Sokolova, E., and Cámara, F. (2017) The seidozerite supergroup of TS-block minerals: nomenclature and classification, with change of the following names: rinkite to rinkite-(Ce), mosandrite to mosandrite-(Ce), hainite to hainite-(Y) and innelite-1T to innelite-1A. Mineralogical Magazine, 81(6), 1457–1484.

HONZAITE*

J. Sejkora, J. Plášil and A.R. Kampf (2018) Honzaite, $(Ni,Co)_2(AsO_3OH)_2(H_2O)_5$, a new Ni-dominant analogue of burgessite, from Jáchymov, Czech Republic. European Journal of Mineralogy, 30(5), 989–997.

Honzaite (IMA 2014-105), $(Ni,Co)_2(AsO_3OH)_2(H_2O)_5$, monoclinic, is a new supergene mineral from the Jáchymov (formerly St. Joachimsthal) ore district, Czech Republic. The Jáchymov ore district is a classic example of Ag+As+Co+Ni+Bi and U vein-type hydrothermal mineralization. Honzaite was found in association with arsenolite, zeunerite,

Ni-rich burgessite, and a red amorphous phase with the approximate composition $(Co,Ni,Cu)_2(AsO_3OH)_2 \cdot 2H_2O$. Honzaite formed during weathering of primary nickelskutterudite and tennantite disseminated in gangue, under strongly acidic conditions. It occurs as irregular to hemispherical microcrystalline aggregates up to 5 mm in diameter on strongly weathered ore gangue. Honzaite has pale pink color, sometimes with purplish or violet tints. It has a pale pink streak and a vitreous luster. It does not fluoresce under either short- or long-wave ultraviolet light. Cleavage on {010} is good, the Mohs hardness is ~3, and the mineral is brittle with an irregular fracture. $D_{calc} = 2.993$ g/cm³. Honzaite is optically biaxial (+), with α = 1.601(2), β = 1.608(2), and γ = 1.629(2) (white light), $2V_{meas} = 60(1)°$, $2V_{calc} = 60.6°$. Honzaite exhibits no noticeable dispersion nor pleochroism. The partially determined optical orientation is X = **b**. Assuming that the crystals are elongated on [100], $Z \wedge$ **a** ≈ 20°, although it is uncertain if it is acute or obtuse angle β. If acute, it would be consistent with burgessite $[Co_2(AsO_3OH)_2(H_2O)_5]$. The ATR FTIR spectra show as main bands (cm⁻¹) at: 3582 [ν OH stretching vibration of the weakly bonded hydroxyl ion of the (AsO_3OH) units] 3366, 3177, 1640 (hydroxyl ions in the structure), 1233, 1147, 1082 (δ As–OH vibrations and overtones and combination bands), 828, 801 [$ν_3$ asymmetric stretching mode and $ν_1$ symmetric stretching of (AsO_3OH) groups], 720 (As–OH stretching vibrations), 604 (libration modes or As-OH bending vibrations), 495 [$ν_4$ bending mode of (AsO_3OH) groups], and 412. Raman spectrum shows main shifts (in wavenumbers) at: 1598, 853, 813, 742, 452, 386, 364, 326, 222, 174, 129, and 61 cm⁻¹. The average of 23 electron microprobe WDS analyses is [wt% (range)]: MgO 0.24 (0.04–0.54), CaO 0.10 (0.00–0.33), FeO 0.21 (0.00–0.67), NiO 16.51 (14.77–18.08), CoO 12.71 (11.05–14.16), CuO 0.55 (0.13–1.16), ZnO 0.84 (0.20–1.65), P_2O_5 0.26 (0.00–0.61), As_2O_5 45.82 (43.60–48.62), SO_3 0.52 (0.08–1.26), H_2O (calculated from structure) 22.15, total 99.91. The empirical formula of honzaite based on 13 O atoms per formula unit is $(Ni_{1.08}Co_{0.83}Zn_{0.05}Cu_{0.03}Mg_{0.03}Fe_{0.01}Ca_{0.01})_{\Sigma 2.04}(AsO_3OH)_{1.94}(SO_4)_{0.03}$ $(PO_3OH)_{0.02} \cdot 5H_2O$. The strongest lines in the powder X-ray diffraction pattern are [d Å (I%; hkl)]: 7.431 (100; 011), 6.215 (18; 002), 3.717 (9; 022), 3.254 (7; 12$\bar{1}$), 3.078 (7; 121), 3.005 (5; 031), and 2.568 (7; 130). Unit-cell parameters refined from the powder data are a = 4.670(1), b = 9.282(2), c = 12.594(3) Å, β = 99.14(1)°, and V = 539.0 Å³. The crystal structure was refined using the Rietveld method with the structure model of burgessite (R_p = 0.0116, R_{wp} = 0.0174, R_{exp} = 0.0056, R_F = 0.0557). Refined unit-cell data for the monoclinic space group $P2_1/n$ are a = 4.6736(6), b = 9.296(1), c = 12.592(1) Å, β = 99.115(8)°, and V = 540.2 Å³. Honzaite is isostructural with the mineral burgessite. The pink color of honzaite is probably due to substantial, but subordinate, Co content; the pure Ni end-member would be green. Honzaite is named in honor of the prominent Czech mineralogist and famous collector of minerals from the Jáchymov ore district, Jan "Honza" Hloušek (1950–2014). The holotype specimen is deposited in the Department of Mineralogy and Petrology of the National Museum in Prague, Czech Republic, catalog number P1N 38.099. **F.C.**

Katerinopoulosite*

N.V. Chukanov, I.V. Pekov, D.I. Belakovskiy, S.N. Britvin, V. Stergiou, P. Voudouris and A. Magganas (2018) Katerinopoulosite, $(NH_4)_2Zn(SO_4)_2 \cdot 6H_2O$, a new mineral from the Esperanza mine, Lavrion, Greece. European Journal of Mineralogy, 30(4), 821–826.

Katerinopoulosite (IMA2017-004), ideally $(NH_4)_2Zn(SO_4)_2 \cdot 6H_2O$, monoclinic, is a new picromerite-group mineral, discovered in the Esperanza mine, Lavrion District, Attikí Prefecture, Greece. Associated minerals are chalcanthite, nickelboussingaultite, ammoniojarosite, aurichalcite, and goethite. Katerinopoulosite is a supergene mineral formed in the oxidation zone of a sphalerite-rich orebody situated in the contact zone between calcite marble and mica schist. The new min-

eral occurs as vermiform polycrystalline aggregates, in fact, anthodite crusts with separate anthodites up to 3 cm long and up to 5 mm thick. The new mineral is colorless, pale blue, or pale green and has vitreous luster. Small fragments are transparent. The streak is white. Katerinopoulosite is brittle, with uneven fracture. Neither cleavage nor parting is observed. $D_{meas} = 1.97(2)$ g/cm³, $D_{calc} = 1.986$ g/cm³. Mohs hardness is 2½. Katerinopoulosite is non-fluorescent under short- and long-wave UV light. In transmitted light katerinopoulosite is colorless, non-pleochroic. It is optically biaxial (+), α = 1.492(2), β = 1.496(2), γ = 1.502(2) (589 nm); $2V_{meas} = 80(5)°$, $2V_{calc} = 79°$. Dispersion of optical axes is weak, $r < v$. The FTIR spectra show as main bands (cm⁻¹; s = strong band, w = weak band, sh = shoulder): 3565sh, 3475sh (O–H-stretching vibrations of H_2O molecules), 3278s (overlapping bands of O–H-stretching vibrations of H_2O molecules and N–H-stretching vibrations of NH_4^+ cations), 3070sh, 2920sh, 2850 (N–H-stretching vibrations of NH_4^+ cations), 2215w (stretching vibrations of acid OH groups), 2130w, 2050w (overtone and combination mode corresponding to S–O stretching vibrations), 1685, 1640sh (bending vibrations of H_2O molecules), 1468, 1433 (bending vibrations of NH_4^+ cations), 1144s, 1086s [$ν_3(F_2)$ asymmetric stretching vibrations of SO_4^{2-} ions], 981 [$ν_1(A_1)$ symmetric stretching vibrations of SO_4^{2-} ions], 835sh, 743, 710sh (NH_4^+ librational modes), 627, 615 [$ν_4(F_2)$ – asymmetric bending vibrations of SO_4^{2-} ions], 552w, 519w, 500sh, 459w, 368w [lattice modes involving Zn–O stretching vibrations, librational vibrations of H_2O molecules and $ν_2(E)$ symmetric bending vibrations of SO_4^{2-} ions]. The average of five EDS electron probe analyses is [wt% (range)]: SO_3* 38.33, $(NH_4)_2O$* 11.9 (* by gas chromatography), H_2O (rest of hydrogen after subtraction of H in NH_4^+ cations; H content determined by gas chromatography is 5.1 wt%) 29.4, NiO 1.82 (0–4.54), CuO 0.37 (0–0.96), ZnO 16.83 (13.03–18.95), total 98.65. The empirical formula of katerinopoulosite based on 2 S apfu is $H_{0.13}(NH_4)_{1.91}(Zn_{0.86}Ni_{0.10}Cu_{0.02})(SO_4)_{2.00} \cdot 6.75H_2O$. The strongest lines of the powder X-ray diffraction pattern [d Å (I%; hkl)] are: 5.400 (37; 011), 4.411 (19; 200), 4.314 (19; 021), 4.229 (24; 12$\bar{1}$), 4.161 (100; 20$\bar{1}$,210,111), 3.749 (53; 130), 3.034 (29; 211,11$\bar{2}$). The monoclinic unit-cell parameters calculated from the powder data are: a = 9.230(6), b = 12.476(4), c = 6.249(4) Å, β = 106.79(5)°, V = 688.9 Å³, and Z = 2. Single-crystal data was not obtained. Space group was assigned by analogy with picromerite-group minerals, with general formula $A_2^+M^{2+}(SO_4)_2 \cdot 6H_2O$ where A are large univalent cations like NH_4 and K, and M = Mg, Fe²⁺, Cu²⁺, or Ni. The new mineral is named in honor of the prominent Greek geologist and mineralogist Athanassios Katerinopoulos (born 1950), the director of the Museum of Mineralogy and Petrology and of the Laboratory of Museum Studies of the National and Kapodistrian University of Athens. He is a specialist in regional geology of Greece, who has made a significant contribution to the geology and mineralogy of the Lavrion mining district. He is also a co-author of several new mineral discoveries from the Lavrion district. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **F.C.**

Meitnerite*

A.R. Kampf, J. Plášil, B.P. Nash and J. Marty (2018) Meitnerite, $(NH_4)(UO_2)(SO_4)(OH) \cdot 2H_2O$, a new uranyl-sulfate mineral with a sheet structure. European Journal of Mineralogy, 30(5), 999–1006.

Meitnerite (IMA 2017-065), ideally $(NH_4)(UO_2)(SO_4)(OH) \cdot 2H_2O$, triclinic, is a new mineral, which was discovered in a specimen from the underground Green Lizard Mine, White Canyon mining district, San Juan County, Utah, U.S.A. After the mine closure, oxidation of primary uranium ores in the humid underground environment produced a variety of secondary minerals, most commonly sulfates, as efflorescent crusts on the mine walls. The NH_4^+ ion occurs in meitnerite and a few other secondary phases and is thought to be derived from the organic matter that acted as a redundant in the primary mineralizing process. Meitnerite

is quite rare and occurs on quartz in association with beshtauite and gypsum. The new mineral occurs as intergrowths of tabular crystals up to about 80 μm in diameter and 30 μm thick. Crystals are flattened on $\{01\bar{1}\}$. Other observed forms are $\{001\}$, and supposedly $\{100\}$, $\{101\}$, and $\{10\bar{1}\}$. No twinning was observed. Meitnerite is slightly greenish yellow, transparent, with a vitreous luster and a pale-yellow streak. The mineral fluoresces greenish-white under 405 nm UV light. Meitnerite is brittle, has an irregular fracture and a perfect $\{01\bar{1}\}$ cleavage. The Mohs hardness is estimated to be ~2. The density was not measured due to small size of crystals soluble in Clerici solution; D_{calc} = 3.320 g/cm^3. Meitnerite is soluble in water at room temperature and is rapidly soluble in dilute HCl. In transmitted light meitnerite is pleochroic: X = nearly colorless, Z = pale green yellow, Y = light green yellow. It is optically biaxial (–), α = 1.568(2), β = 1.589(2) and γ = 1.607(2) (white light); $2V_{meas}$ = 84(1)°; $2V_{calc}$ = 84.5°; $X \wedge \mathbf{b}$ = 26, $Y \wedge \mathbf{a}$ =15, $Z \wedge \mathbf{c}$ = 53°. The dispersion of an optical axes is $r > v$, moderate. The electron probe WDS analysis (1 reported point) is (wt%): $(NH_4)_2O$ 5.53, Na_2O 0.41, SO_3 17.44, UO_3 58.40, H_2O 10.29 (by structure), total 92.07. The empirical formula is $(NH_4)_{1.01}Na_{0.07}(U_{0.97}O_2)(S_{1.03}O_4)[(OH)_{0.93}O_{0.07}]\cdot2H_2O$ based on 9 O atoms pfu. The strongest lines of the powder X-ray diffraction pattern are [d Å (I%; hkl)]: 7.15 (100; 011); 6.36 (30; 100); 5.85 (36; 101); 5.038 (21; 111); 4.483 (15; 111); 4.085 (15; 002); 3.569 (19; 022); 3.451 (18; 020); 3.340 (20; 210); 3.257 (17; 201); 3.075 (21; 111). Meitnerite is triclinic, $P\bar{1}$, a = 6.7964(2), b = 8.0738(3), c = 9.2997(7) Å, α = 113.284(8), β = 99.065(7), γ = 105.289(7)°, V = 431.96 Å^3, Z = 2. The crystal structure was refined to R_1 = 1.3%. It is based on $[(UO_2)_2(SO_4)_2(OH)_2]^{2-}$ sheets running parallel to $\{01\bar{1}\}$. These sheets are built from (UO_7) pentagonal bipyramids that share common edges and form dimers. The dimers, in turn, are linked into the sheets by (SO_4) groups. The interlayers between the sheets contain (NH_4) and (H_2O) groups. The (NH_4) groups are coordinated by eight O sites: six O sites from the adjacent $[(UO_2)_2(SO_4)_2(OH)_2]^{2-}$ sheets and two from the interlayer (H_2O) groups. The NH_4–O bonds and hydrogen bonds link the uranyl-sulfate sheets to each other. The new mineral is named for Austrian-Swedish physicist Lise Meitner (1878–1968) who, together with Otto Hahn and Fritz Strabmann, discovered nuclear fission of uranium in 1938 and explained the physical process. The holotype specimen is deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. **Yu.U.**

MELCHERITE*

M.B. Andrade, D. Atencio, L.A.D. Menezes Filho and J. Spratt (2018) Melcherite, trigonal $Ba_2Na_2Mg[Nb_6O_{19}]\cdot6H_2O$, the second natural hexaniobate, from Cajati, São Paulo, Brazil: Description and crystal structure. Mineralogical Magazine, 82(1), 111–120.

A new mineral melcherite (IMA 2015-018), ideally $Ba_2Na_2Mg[Nb_6O_{19}]\cdot6H_2O$, trigonal, was discovered in a vug in the carbonatite of the Jacupiranga mine, Cajati county, São Paulo state,

Brazil, which is also the type locality for zirkelite, quintinite, menezesite, and pauloabibite. Melcherite found in so-called "intermediate zone," characterized by a high dolomite and slightly anomalous "pyrochlore" content. Other associated minerals are calcite, magnetite, pyrrhotite, tochilinite, pyrite, and fluorapatite. Quintinite, menezesite, and pauloabibite are also found in that zone but were not observed in direct association with melcherite. Melcherite forms beige transparent vitreous irregular tabular crystals up to 200 μm with a white streak. No twinning noticed. It does not fluoresce under short (254 nm) and long (366 nm) UV radiation. The mineral has perfect cleavage on $\{001\}$ with no parting and no specific fracture. The Mohs hardness, density and refractive indexes were not measured due to the paucity of material; D_{calc} = 3.733 g/cm^3; n_{calc} = 1.924. No other physical properties reported. The averages of electron probe WDS analyses for brighter (4 points)/ darker (8 points) areas of zonal crystals are [wt% (ranges)]: K_2O 0.70 (0.61–0.89) / 3.88 (3.71–4.07), Na_2O 4.30 (3.76–4.68) / 2.60 (2.41–2.76), BaO 20.66 (20.29–20.92) / 12.44 (12.13–12.91), CaO 0.83 (0.70–0.97) / 4.41 (4.20–4.60), MgO 3.00 (2.90–3.06) / 3.15 (3.07–3.23), MnO 0.09 (0.06–0.13) / 0.28 (0.22–0.38), Al_2O_3 0.08 (0.07–0.10) / 0.02 (0.00–0.08), Nb_2O_5 61.74 (61.21–62.21) / 65.79 (65.22–66.27), SiO_2 0.02 (0.00–0.06) / 0, H_2O 8.35 / 8.90, total 99.77 / 101.47. Empirical formulae based on O=19 are respectively: $(Ba_{1.75}K_{0.19})_{\Sigma1.94}(Na_{1.80}Ca_{0.19})_{\Sigma1.99}(Mg_{0.96}Mn_{0.02}Al_{0.02})_{\Sigma1.00}Nb_{6.02}O_{19}\cdot6H_2O$ / $(Ba_{0.99}K_{1.00})_{\Sigma1.99}(Na_{1.02}Ca_{0.96})_{\Sigma1.98}(Mg_{0.95}Mn_{0.05})_{\Sigma1.00}Nb_{6.02}O_{19}\cdot6H_2O$. The enrichment in Ba is coupled to the enrichment in Na and depletion of K and Ca. No analyses correspond to predominant K and/ or Ca were obtained. The chemical composition varies between $Ba_2Na_2Mg[Nb_6O_{19}]\cdot6H_2O$ and $(BaK)(NaCa)Mg[Nb_6O_{19}]\cdot6H_2O$. The strongest lines of the powder X-ray diffraction pattern are [d Å (I%; hkl)]: 11.34 (6; 002), 7.81 (100; 003), 7.41 (14; 101), 4.508 (10; 110), 3.904 (22; $2\bar{1}3,113,006$), 3.852 (21; 021), 3.250 (33; 024), 2.952 (13; $116,2\bar{1}6$), 2.165 (30; 306,036), 2.160 (12; $131,\bar{1}41$). Unit-cell parameters refined from the powder data are a = 9.022(2), c = 23.410(6) Å, V = 1650.2 Å^3 [a = 9.0117(6), c = 23.3986(16) Å, V = 1645.64 Å^3 obtained from a single-crystal data]. The mineral is trigonal, space group $R\bar{3}$, Z = 3. The crystal structure was refined to $R1$ = 0.017 for 1319 independent $I > 2σ(I)$ reflections. Melcherite is a hexaniobate with a crystal structure built by layers of $[(Ba,K)(O,H_2O)_9]$ polyhedra and the $[Nb_6O_{19}]^{8-}$ superoctahedron (Lindqvist anion) interconnected by $[(Na,Ca)O_6]$ polyhedra. Cations of Mg^{2+} are bonded to six water molecules each and are not associated with Lindqvist oxygen ions. The structural layers are parallel to the x-y plane and stack along the c axis with simultaneous 1/3 [110] displacement producing an R lattice. The mineral name honors Geraldo Conrado Melcher (1924–2011), professor at the Department of Mining Engineering at the Polytechnic School, University of São Paulo and a pioneer in Jacupiranga carbonatite studies. Type material is deposited in the Museu de Geociências, Instituto de Geociências, Universidade de São Paulo, Brazil. Part of the cotype has been deposited at the University of Arizona Mineral Museum, RRUFF Project. **D.B.**