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New Mineral Names*,†

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ALUMOVESUVIANITE*

T.L. Panikorovskii, N.V. Chukanov, S.M. Aksenov, A.S. Mazur, E.Yu. Avdontseva, V.V. Shilovskikh, and S.V. Krivovichev (2017) Alumovesuvianite, $Ca_{19}Al(Al,Mg)_{12}Si_{18}O_{69}(OH)_9$, a new vesuvianite-group member from the Jeffrey mine, asbestos, Estrie region, Québec, Canada. Mineralogy and Petrology, 111(6), 833–842.

Alumovesuvianite (IMA 2016-014), ideally $Ca_{19}Al(Al,Mg)_{12}Si_{18}O_{69}(OH)_9$, is a new vesuvianite-group member (with Al dominant at the at the Y1 site) discovered in the rodingites at the contact of a gabbroid rock with host serpentinite in the abandoned Jeffrey mine, Asbestos, Estrie Region, Québec, Canada. Associated minerals are diopside, grossular, and prehnite. Alumovesuvianite forms colorless to light pink transparent, vitreous prismatic tetragonal crystals up to 4 × 4 × 6 mm encrusting walls of cavities in a granular diopside. The dominant crystal forms are {100}, {110}, {210}, {111}, {101}, and {001}; sometimes {112} and/or {221}. Crystals are elongated parallel to [001] with striations at the same direction. Cleavage was not observed. The Mohs hardness is 6.5. D_{meas} = 3.31(1), D_{calc} = 3.36 g/cm^3. In plane-polarized light alumovesuvianite is colorless non-pleochroic. It is optically uniaxial (–), ω = 1.725(2), ε = 1.722(2) (white light). The TGA and DSC study was performed by heating up to 1100 °C. The single endothermic effect at 1035 °C is assigned to the dehydroxylation. Total weight loss 2.61% is in good agreement with the calculated H_2O content of 2.82%. The ^{27}Al MAS NMR spectrum exhibits two main peaks: strong at 7.96 ppm (assigned to an octahedrally coordinated Al at the Y2 and Y3 sites) and a weak at 39.15 ppm (Al in Y1 site). The IR spectrum was obtained in the range 360–3800 cm^{-1}. The bands (cm^{-1}) are: 3671, 3632, 3527, 3407, 3212, and 3051 (O–H-stretching vibrations of differently coordinated OH^- groups); 1890 weak (overtone or combination mode of Si–O-stretching); strong bands at 1070–860 (Si–O-stretching as well as Si–O–Si and O– Si–O bending vibrations, partly combined with stretching vibrations of Y-centered polyhedra (below 630 cm^{-1}); 810–690 (bending vibrations of OH^- groups. The absence of absorption bands in the range 1100–1500 cm^{-1} indicates the absence of boron-bearing groups. The average of electron probe WDS analysis (number not given) is [wt% (range)]: SiO_2 37.08 (36.22–37.68), Al_2O_3 18.82 (18.72–19.29), CaO 36.57 (34.99–37.07), MgO 2.48 (1.60–2.84), Mn_2O_3 0.67 (0.37–0.86), Fe_2O_3 0.22 (0–0.80), H_2O (by TGA) 2.61, total 98.45. The empirical formula calculated on the basis of 19 Ca apfu assuming trivalent Mn and Fe for stoichiometry and considering the MAS-NMR data, is: $Ca_{19.00}(Al_{0.92}Fe^{3+}_{0.08})_{\Sigma1.00}(Al_{9.83}Mg_{1.80}Mn^{3+}_{0.25})_{\Sigma11.88}Si_{17.98}O_{69.16}(OH)_{8.44}$. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 2.96 (22; 004), 2.761 (100; 432), 2.612 (61; 224), 2.593 (25; 600), 1.7658 (20; 831), 1.6672 (20; 734), 1.6247 (21; 912), 1.3443 (22; 880). The unit-cell parameters refined from the powder data are a = 15.5603(5) Å, c = 11.8467(4) Å, V = 2868.3 Å^3. The single-crystal X-ray diffraction data refined to R_1 = 0.036 for 3098 unique observed $|F_o| \geq 4\sigma_F$ reflections shows alumovesuvianite is tetragonal, space group $P4/n$, Z = 2; a = 15.5103(2) Å, c = 11.8096(2) Å, and V = 2841.05 Å^3. The general crystal-chemical formula of vesuvianite-group minerals (Z = 2) is: $X_{16}X1_2X4Y1Y2_4Y3_8T_{0–5}[(ZO_4)_{10–x}(H_4O_4)_x](Z_2O_7)_4(W)_{10–12}$ (x < 3), where X are sevenfold- to ninefold-coordinated sites occupied by Ca and subordinate Na, K, Fe^{2+}, and REE. Sites X1 and X4 (Ca, Na) are in a square antiprism coordination; Y1 (Fe^{3+}, Mg, Al, Fe^{2+}, Cu^{2+}) is in a square pyramidal coordination; Y2 and Y3 (Al, Mg, Zn, Fe^{2+}, Fe^{3+}, Mn^{2+}, Mn^{3+}, Ti, Cr) have octahedral coordination; T (B, Fe, Al) is the additional site with a triangular and/or tetrahedral coordination; ZO_4 and Z_2O_7 are ortho- and ditorthosilicate groups, respectively, and W = OH or O, F, Cl. Alumovesuvianite is a new member of the vesuvianite group with Al^{3+} as a dominant cation in the *Y*1 site. That fact is highlighted in its name. The type specimens are deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

CANOSIOITE*

F. Cámara, E. Bittarello, M.E. Ciriotti, F. Nestola, F. Radica, F. Massimi, C. Balestra, and R. Bracco (2017) As-bearing new mineral species from Valletta mine, Maira Valley, Piedmont, Italy: III. Canosioite, $Ba_2Fe^{3+}(AsO_4)_2(OH)$, description and crystal structure. Mineralogical Magazine, 81(2), 305–317.

Canosioite (IMA 2015-030), ideally $Ba_2Fe^{3+}(AsO_4)_2(OH)$, is a new mineral from the Maira Valley, Cuneo Province, Piedmont, Italy. The new mineral was found in the dump of the Valletta mine which consists of dispersed quartzites with quartz veins that contain a large variety of mineral phases rich in arsenic, vanadium, barium, and strontium. Canosioite probably originates from the reaction between ore minerals and hydrothermal fluids. Associated minerals are baryte, colorless to brownish aegirine, calcite, hematite, bronze Mn-bearing muscovite, unidentified Mn oxides, and unidentified Mn arsenates. Only two small specimens (each around 2.5 mm × 1 mm × 1 mm) with glassy opaque reddish-brown subhedral crystals of canosioite were found. Crystals are translucent with a pale-yellow streak and vitreous luster, are brittle, and show no cleavage or parting. No twin-

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* All minerals 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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ning was observed. Hardness measured by nanoindentation corresponds to 6–6½ of Mohs scale. Density was not measured due to small crystal size; D_{calc} = 4.943 g/cm^3. Canosioite is optically biaxial (+) with $2V_{meas}$ = 84(2)°. The refractive indexes were not measured; n_{calc} = 1.9. Canosioite is weakly pleochroic with X = brownish yellow < Y = brown < Z = reddish brown. It does not fluoresce under short- or long-wave UV light. The Raman spectrum shows bands (cm^{-1}) at 133, 147, 163, and 187 (M–O and lattice modes); 234, 282, and 368 (As^{5+}–O bending vibrations); 326 (probably V–O bending vibrations); 457 and 507 (component bands for As–O) and 478 (the same for As–O and V–O); 820 (shoulder probably related to the VO_4 symmetric stretching mode), intense peaks at 838, 862, and 896 [probably $(AsO4)^{3-}$ stretching mode]. No bands are observed in the range 2500–4000 cm^{-1} in the Raman spectrum. However the FTIR spectrum shows a large convoluted absorption peak centered at ~3150 cm^{-1} and the absence of any discernible clear absorption at ~1650 cm^{-1}. This confirms the presence of hydrogen as hydroxyl groups but not the presence of H_2O as reported for arsenbrackebuschite. The FTIR spectrum also shows bands at ~850 cm^{-1}, with a weak shoulder at ~790 cm^{-1}. The average of four electron probe WDS analyses [wt% (range)] is: Na_2O 0.06 (0.00–0.12), MgO 0.43 (0.35–0.56), CaO 0.02 (0.00–0.03), NiO 0.02 (0.00–0.05), CuO 0.03 (0.00–0.08), SrO 0.42 (0.26–0.77), BaO 49.36 (48.86–50.27), PbO 1.69 (1.47–2.02), Al_2O_3 1.25 (1.23–1.27), Mn_2O_3 3.89 (3.65–4.19), Fe_2O_3 6.95 (6.60–7.18), Sb_2O_3 0.01 (0.00–0.04), SiO_2 0.03 (0.01–0.06), P_2O_5 0.02 (0.00–0.08), V_2O_5 10.88 (8.80–9.48), As_2O_5 24.64 (24.06–25.34), SO_3 0.01 (0.00–0.04), F 0.02 (0.00–0.09), H_2O (calculated based on OH+F+H_2O = 1) 1.61 (1.58–1.68), O=F –0.01 (0–0.04), total 101.34. The empirical formula $(Ba_{1.92}Pb_{0.05}Sr_{0.02}Na_{0.01})_{\Sigma 2.00}(Fe^{3+}_{0.52}Mn^{3+}_{0.29}Al_{0.15}Mg_{0.06})_{\Sigma 1.02}[(As_{0.64}V_{0.36})_{\Sigma 1.00}O_4]_2[(OH_{0.92}F_{0.01})(H_2O)_{0.07}]$ based on 9 O apfu. The strongest lines in the X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 3.713 (18; 111), 3.304 (100; $21\bar{1}$), 3.058 (31; 020), 3.047 (59; $10\bar{3}$), 2.801 (73; 112), 2.337 (24; 220), 2.158 (24; $12\bar{3}$). The unit-cell parameters refined from powder-diffraction data are: a = 7.871(3), b = 6.117(2), c = 9.158(5) Å, β = 112.80(3)°, and V = 405.9 Å^3. Single-crystal X-ray diffraction data collected on a crystal of size 0.1 × 0.05 × 0.06 mm refined to R_1 = 0.026 for 1245 $I \geq 4\sigma(I)$ unique reflections shows canosioite is monoclinic, $P2_1/m$, a = 7.8642(4), b = 6.1083(3), c = 9.1670(5) Å, β = 112.874(6)°, V = 405.73 Å^3, and Z = 2. Canosioite belongs to the brackebuschite supergroup and is isostructural to arsenbrackebuschite. The structure consists of chains of $[M^{3+,2+}(T^{5+}O_4)_2X]$ units connected through interstitial divalent cations. Canosioite is named for its type locality, the small municipality of Canosio where the Valletta mine, is situated. The holotype material is deposited in the Museo Regionale di Scienze Naturali di Torino, Sezione di Mineralogia, Petrografia e Geologia, Torino, Italy. **O.C.G.**

CURRIERITE*

A.R. Kampf, S.J. Mills, B.P. Nash, M. Dini, and A.A. Molina Donoso (2017) Currierite, $Na_4Ca_3MgAl_4(AsO_3OH)_{12}\cdot 9H_2O$, a new acid arsenate with ferrinatrite-like heteropolyhedral chains from the Torrecillas mine, Iquique Province, Chile. Mineralogical Magazine, 81(5), 1141–1149.

Currierite (IMA 2016-030), ideally $Na_4Ca_3MgAl_4(AsO_3OH)_{12}\cdot 9H_2O$, is a new mineral discovered at the Torrecillas mine, Salar Grande, Iquique Province, Tarapacá Region, Atacama Desert, Chile (~20°58′13″S, 70°8′17″W). Currierite is the seventh new arsenate recently described from that location. The Torrecillas deposit, in which the new mineral is found, consists of two main veins rich in secondary arsenic and copper minerals that intersect metamorphosed marine shales and lavas and related to andesites and porphyritic lavas of the Jurassic La Negra Formation. Currierite occurs as a secondary alteration phase in association with anhydrite, canutite, chudobaite, halite, lavendulan, magnesiokoritnigite, quartz, scorodite, and torrecillasite. That assemblage resulted from the oxidation of native arsenic and other As-bearing primary phases, followed by later alteration by saline fluids derived from evaporating meteoric water under hyperarid conditions. Currierite forms hexagonal prisms, needles and hair-like fibers up to ~200 μm long, in sprays. The crystal faces are {100} and {001}. Crystals are transparent, with vitreous to silky luster and white streak. The mineral has at least one good cleavage parallel [001] and an irregular fracture. No twinning was observed. Currierite is brittle, but elastic in very thin fibers. The Mohs hardness is ~2. D_{meas} = 3.08(2) and D_{calc} = 3.005 g/cm^3. The mineral is slowly soluble in dilute HCl at room temperature. Currierite is optically, uniaxial (–), ω = 1.614, and ε = 1.613 (white light), non-pleochroic. The average of five electron probe WDS analysis [wt% (range)] is: K_2O 0.17 (0.14–0.20), Na_2O 5.65 (5.16–6.39), CaO 7.10 (6.76–7.54), MgO 2.39 (2.35–2.44), CoO 0.09 (0.04–0.16), CuO 0.47 (0.36–0.58), Fe_2O_3 2.32 (2.13–2.74), Al_2O_3 6.97 (6.70–7.57), Sb_2O_5 2.42 (1.96–3.01), As_2O_5 62.03 (59.69–64.19), Cl 0.07 (0.05–0.12), H_2O (calculated by charge balance, As + Sb = 12 and O + Cl = 57 apfu) 12.82, –O=Cl_2 0.02, total 102.48. The high analytical total is attributed to partial dehydration under vacuum. The empirical formula based on As + Sb = 12 and O + Cl = 57 apfu is $(Na_{3.95}Al_{2.96}Ca_{2.74}Mg_{1.28}Fe^{3+}_{0.63}Cu_{0.13}K_{0.08}Co_{0.03})_{\Sigma 11.80}(As^{5+}_{11.68}Sb^{5+}_{0.32})_{\Sigma 12}(O_{56.96}Cl_{0.04})_{\Sigma 57}H_{30.81}$. The strongest lines in the X-ray powder diffraction pattern [d Å (I%; hkl)] are: 10.63 (100; 100), 6.12 (20; 110), 5.30 (15; 200), 4.61 (24; 002), 4.002 (35; 210), 3.474 (29; 202), 3.021 (96; 212), 1.5227 (29; 440,334,612). Unit-cell parameters refined from the powder data with whole pattern fitting are a = 12.1997(10), c = 9.2019(7) Å, and V = 1186.7 Å^3. Unit-cell parameters obtained from a single crystal X-ray study are: a = 12.2057(9), c = 9.2052(7) Å, V = 1187.7 Å^3. Currierite is hexagonal, $P622$, Z = 1. The crystal structure of currierite was solved and refined to R_1 = 0.0226 for 658 $F_o > 4\sigma F$ reflections. It is based upon a heteropolyhedral chain (identical to that in kaatialaite and a geometrical isomer of that in ferrinatrite) along **c** in which AlO_6 octahedra are triple-linked by sharing corners with AsO_3OH tetrahedra. Chains are linked to one another by eightfold-coordinated Na and Ca polyhedra forming a three-dimensional framework with large cavities occupied by rotationally disordered $Mg(H_2O)_6$ octahedra. The mineral is named in honor of Rock Henry Currier (1940–2015), American mineral collector, dealer, traveler, lecturer, one of Mindat's most dedicated and productive managers. He donated his extensive, one of the world best systematic species collection, to the RRUFF Project. He was always generous in unrelenting effort to benefit the greater mineralogical community. The description is based on one holotype and two cotype specimens that are deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A., with catalogue numbers 66266 (holotype), 64057 (cotype; also the holotype for magnesiokoritnigite) and 64080 (cotype; also a cotype for torrecillasite). **D.B.**

CYPRINE*

T.L. Panikorovskii, V.V. Shilovskikh, E.Yu. Avdontseva, A.A. Zolotarev, I.V. Pekov, S.N. Britvin, U. Hålenius, and S.V. Krivovichev (2017) Cyprine, $Ca_{19}Cu^{2+}(Al,Mg,Mn)_{12}Si_{18}O_{69}(OH)_9$, a new vesuvianite-group mineral from the Wessels mine, South Africa. European Journal of Mineralogy, 29(2), 295–306.

Cyprine (IMA 2015-044), $Ca_{19}Cu^{2+}(Al,Mg,Mn)_{12}Si_{18}O_{69}(OH)_9$, is a new mineral found at the Wessels mine near Hotazel, Kalahari Manganese Field, North Cape province, South Africa. Cyprine is found in association with calcite, apatite, andradite, henritermierite and rhodochrosite. An assemblage containing cyprine and associated Mn- and Ca-bearing minerals was formed as a result of the hydrothermal activity with the main event that led to enrichment of the Mn ore dated at 1048 ± 5.9 Ma. Cyprine occurs in open cavities or are embedded in a coarse-grained colorless calcite. It forms chaotic aggregates up to 5 cm across of prismatic crystals up to 1 cm long and 3 mm thick. Crystals are well-formed, but typically show growth-related distortion. The dominant form is {100} and a minor is {110}, both commonly with striations along [001]. Crystals are terminated by the {331} faces. No twinning was observed. Cyprine is dark red with lilac hue, vitreous, and shows no cleavage. The Mohs hardness is 6.5. D_{meas} = 3.40(3) and D_{calc} = 3.41 g/cm³. The mineral is optically uniaxial (–), ω = 1.744 (2), ε = 1.732(2) (white light). It is strongly pleochroic, ranging from *O* = dark purple to dark reddish brown >> *E* = pale red to pale yellowish brown. The main absorption bands of the IR spectrum (cm^{-1}) are 443 (v_2 symmetric bending vibrations of the Si–O bonds); 490 ($[\text{Me–O}]_6$ vibrations); 574, 604, and 671 (v_4 asymmetric bending vibrations of the Si–O bonds); 814, 905, 972, and 1015 (asymmetric stretching vibrations of the Si–O and Si–O–Si bonds); 3354, 3640 (O–H stretching vibrations). The polarized optical absorption spectra have two strong absorption bands at 415 and 555 nm and a less intense band at 645 nm. Thermogravimetry and differential scanning calorimetry experiments show an endothermic effect at 1018 °C assigned to the dehydroxylation. Two endothermic peaks at 850–900 and 972 °C may correspond to the disappearance of $(H_4O_4)^{4-}$ groups. Total weight loss is 3.30% (theoretical H_2O content is 3.10%). The average of 6/*3* electron probe WDS analyses on two chemically different zones [wt% (range)] are: SiO_2 36.98 (36.85–37.22)/*36.51 (36.44–36.56)*, Al_2O_3 14.98 (14.31–15.83)/*13.70 (13.63–13.73)*, CaO 36.70 (36.48–36.82)/*36.18 (36.09–36.28)*, MgO 3.24 (3.11–3.57)/*1.10 (0.94–1.25)*, Mn_2O_3 2.27 (1.56–2.82)/*6.04 (5.85–6.22)*, CuO 2.39 (1.89–2.76)/*1.86 (1.77–1.96)*, Fe_2O_3 0.62 (0.34–0.83)/*2.50 (2.13–2.84)*, Cr_2O_3 0.23 (0.16–0.33)/*0.04 (0.02–0.05)*, H_2O 3.30/*3.30*, total 100.71 (100.20–101.20)/*101.23 (101.05–101.28)*. The H_2O content was determined by thermogravimetric analysis. The empirical crystal-chemical formulae calculated on the basis 19 Ca apfu with consideration of FTIR, TGA/differential scanning calorimetry, SREF, and optical spectra data are: $Ca_{8.00}Ca_{1.00}(Cu_{0.95}Mg_{0.05})_{\Sigma 1.00}Al_{4.00}(Al_{5.50}Mg_{1.00}Mn^{3+}_{1.19}Fe^{3+}_{0.22}Cr_{0.09})_{\Sigma 8.00}([SiO_4]_{9.91}[H_4O_4]_{0.09})_{\Sigma 10.00}[Si_2O_7]_4[(OH)_9O]_{\Sigma 10.00}$ and $Ca_{18.00}Ca_{1.00}(Cu_{0.90}Mg_{0.10})_{\Sigma 1.00}(Al_{3.22}Mn^{3+}_{0.60}Fe^{3+}_{0.18})_{\Sigma 4.00}(Al_{4.72}Mn^{3+}_{1.20}Fe^{3+}_{1.06}Mn^{2+}_{0.60}Mg_{0.40}Cr_{0.02})_{\Sigma 8.00}([SiO_4]_{9.91}[H_4O_4]_{0.09})_{\Sigma 10.00}[Si_2O_7]_4[(OH)_9O]_{\Sigma 10.00}$ for zone 1 and zone 2, respectively. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 5.89 (12; 002), 3.007 (12; 431), 2.950 (47; 004), 2.75 (100; 432), 2.594 (76; 522), 2.459 (35; 620), 2.324 (10; 144), 1.6224 (28; 672). The unit-cell parameters refined from powder-diffraction data are: *a* = 15.5652(5), *c* = 11.7921(4) Å, *V* = 2863.2 Å³. Single-crystal X-ray diffraction data collected on a crystal of zone 1/ *zone 2* of size 0.15 × 0.14 × 0.12/*0.07 × 0.07 × 0.05* mm refined to R_1 = 0.034/*0.035* for 2848/*2071* unique reflections with $I \geq 4\sigma(I)$ shows cyprine is tetragonal, space group *P*4/*n*, with *a* = 15.5173(4) and *c* = 11.8230(5) Å for zone 1, and *a* = 15.5699(4) and *c* = 11.8042(2) Å for zone 2. Cyprine is as a member of the vesuvianite group, with Cu^{2+} as a dominant cation in the *Y*1 site. “Cyprine” (derived from Latin *cuprum*, copper) was the name given by J.J. Berzelius in 1821 to describe Cu-bearing vesuvianite and is transferred to the new mineral. The holotype specimen is deposited at the Mineralogical Museum of the Department of Mineralogy, St. Petersburg State University, St. Petersburg, Russia. **O.C.G.**

DAGENAISITE*

A.R. Kampf, R.M. Housley, and J. Marthy (2017) Dagenaisite, a new zinc tellurate from the Gold Chain mine.Tintic, Utah, U.S.A. Canadian Mineralogist, 55(5), 867–873.

Dagenaisite (IMA 2017-017), ideally $Zn_3Te^{6+}O_6$, is a new mineral discovered underground from the 300 foot level of the Opohonga stope at the Gold Chain mine, Tintic district, Juab County, Utah, U.S.A. (39°55′44″N 112°6′50″W). The location is in about 2 km SSE of the Centennial Eureka mine famous for discovery of the new Te minerals. The Gold Chain mine exploited a polymetallic (Au-Ag-Cu-Pb-Zn) vein deposit emplaced in dolomite. The upper portion of the deposit is almost completely oxidized. Dagenaisite is a late-stage secondary phase formed by the oxidative alteration of earlier Te- and Zn-bearing minerals, probably hessite and sphalerite. It is associated with cinnabar, dugganite, eurekadumpite, and gold in vugs in a quartz–dolomite matrix with embedded altered remnants, probably of hessite. Other associated minerals include adamite, arseniosiderite, atelestite, baryte, beudantite, conichalcite, hemimorphite, kettnerite, malachite, mimetite, mixite, olivenite, and rosasite. The mineral forms tiny (up to 100 × 1 μm) light greenish-gray platelets, generally intermixed with amorphous material, forming porous masses that are apparently replacements of earlier phases. It is transparent to translucent with a white streak and pearly luster. The plates are flexible with irregular fracture and no cleavage was observed The estimated Mohs hardness is ~2. The density was not measured; D_{calc} = 6.00 g/cm³. At room temperature, the mineral is slowly soluble in dilute HCl and rapidly soluble in concentrated HCl. Due to the thinness of the plates no birefringence was observed viewed perpendicular to them. Retardation observations from plates oriented on-edge indicate that the crystals are biaxial (+). Assuming, that the plate direction is {100}, the $Z \approx \mathbf{a}$. No pleochroism was observed. The refractive indexes were not determined; n_{calc} = 1.99. The Raman spectrum recorded between 4000 and 100 cm^{-1} exhibited no features indicative of OH or H_2O. The main band in the spectrum is centered at 721 cm^{-1}. It is notably broad and exhibits indistinct shoulders at approximately 822, 634, 597, and 565 cm^{-1} assigned to tellurate groups $Te^{6+}O_6$. The bands in the spectrum are poorly resolved due to the poorly crystalline material. The average of six electron probe WDS analyses [wt% (range)] is: CaO 0.70 (0.57–0.84), CuO 6.22 (4.60–7.77), MnO 0.42 (0.29–0.52), ZnO 42.78 (40.11–45.15), SiO_2 0.23 (0.12–0.38), As_2O_5 0.85(0.25–1.57), TeO_3 39.15 (37.38–41.73), total 90.35. No beam damage was observed. The low total is attributed to the thinness of the crystals that form porous aggregates and are intermixed with amorphous phases of similar composition. Small amounts of Ca, Mn, Si, and As are probably due to surrounding material in the pore space. The empirical formula based on 6 O pfu is $Zn_{2.39}Cu_{0.36}Ca_{0.06}Mn_{0.03}As_{0.03}Si_{0.02})_{\Sigma 2.89}Te_{1.02}O_6$. The X-ray powder diffraction pattern of dagenaisite is similar to that of syntetic Zn_3TeO_6. The strongest lines are [*d* Å (*I*%; *hkl*)]: 4.311 (30; 310), 3.085 (22; $\bar{4}02$), 3.029 (44; 222), 2.744 (68; $\bar{3}13$,421), 2.539 (100; $\bar{1}32$, $\bar{4}22$), 1.6568 (48; $\bar{7}32$,350,$\bar{2}44$). The data refined from the powder data with whole-pattern fitting shows the mineral is monoclinic, space group *C*2/*c*, *a* =14.87(2), *b* = 8.88(2), *c* = 10.37(2) Å, β = 93.33(2)°, *V* = 1367 Å³, *Z* = 12. Single-crystal X-ray study was not performed because of the small size and poor quality of the crystals. The mineral is the natural analog of synthetic $Zn_3Te^{6+}O_6$, which has a structure based on an approximate close packing of O atoms in an *hhchhc* sequence along [100]. In the crystal structure of $Zn_3Te^{6+}O_6$ two distinct Te sites have relatively regular octahedral coordinations. Zinc in five distinct sites has very different coordination. The sites Zn1, Zn3, and Zn5 have octahedral coordination where Zn1 and Zn3 octahedra are quite distorted, Zn4 has square pyramidal fivefold-coordination and Zn2 has tetrahedral coordination. The mineral is named in honor of John Dagenais (b. 1945), of Vancouver, British Columbia, Canada, who has been an active mineral field collector for nearly 50 years. He has collected and provided for scientific research a number of new mineral species. Four cotype specimens are housed in the Natural History Museum of Los Angeles County, California, U.S.A. **D.B.**

DRAVERTITE*

I.V. Pekov, N.V. Zubkova, A.A. Agakhanov, V.O. Yapaskurt, N.V. Chukanov, D.I. Belakovskiy, E.G. Sidorov and D.Y. Pushcharovsky (2017) Dravertite, $CuMg(SO_4)_2$, a new mineral species from the Tolbachik volcano, Kamchatka, Russia. European Journal of Mineralogy, 29(2), 323–330.

Dravertite (IMA 2014-104), ideally $CuMg(SO_4)_2$, is a new mineral discovered in two active fumaroles at the Second scoria cone, Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. In sublimates of the Arsenatnaya fumarole (360–370 °C) dravertite overgrows basalt scoria altered by fumarolic gas and is closely associated with dolerophanite, euchlorine, tenorite, hematite, langbeinite, steklite, fedotovite, wulffite, anhydrite, and anglesite. In the Yadovitaya fumarole (290–300 °C), it forms as one of the latest sulfate sublimates in association with euchlorine, chalcocyanite, steklite, alumoklyuchevskite, piypite, parawulffite, cryptochalcite, dolerophanite, hematite, tenorite, vergasovaite, cupromolybdite, yaroshevskite, and ziesite. In the Arsenatnaya fumarole, dravertite forms crude equant crystals up to 0.08 mm across forming compact clusters or spherulitic crusts up to 5 × 5 cm in size and up to 3 mm, rarely up to 1 cm thick. Polysynthetic twins were observed in some grains under the microscope. In the Yadovitaya fumarole, the new mineral forms crusts up to 1–2 cm^2 and up to 1 mm thick, which consist of spherulites up to 1 mm in diameter. It is light-blue to colorless, sometimes with a greenish hue (Arsenatnaya) or light brown (Yadovitaya). Dravertite has a white streak and a vitreous luster. It is transparent in small grains and translucent in aggregates. Dravertite is brittle with uneven fracture and imperfect cleavage. Mohs hardness is ~3½. Density was not measured due to micro-inclusions; $D_{\text{calc}} = 3.508$ g/cm^3. In plane-polarized light, the mineral is non-pleochroic, colorless, or with a slight bluish hue. Dravertite is optically biaxial (–), $\alpha = 1.624(3)$, $\beta = 1.661(3)$, $\gamma = 1.663(3)$ (589 nm), $2V_{\text{meas}} = 35(10)°$, $2V_{\text{calc}} = 26°$. Dispersion of an optical axes is distinct, $r > v$. The main absorption bands of the IR spectrum (cm^{-1}, s = strong, w = weak, sh = shoulder) are: 2228w, 1963w (overtones of S–O stretching modes), 1270sh, 1225sh (overtones of O–S–O bending modes), 1165s, 1142s, 1097s [$\nu_3(F_2)$ = asymmetric stretching vibrations of SO_4^{2-}], 992s [$\nu_1(A_1)$ = symmetric stretching vibrations of SO_4^{2-}), 703, 658, 635w, 607 [$\nu_4(F_2)$ = bending vibrations of SO_4^{2-}], 492, 395sh, 370 [lattice modes involving Cu–O and Mg–O stretching vibrations and/or ν_2(E) bending mode of SO_4^{2-}]. Characteristic bands of BO_3^{3-}, CO_3^{2-}, NO_3^-, and hydrogen-bearing groups are absent in the IR spectrum. The average of 7 electron probe WDS analyses [wt% (range)] is: MgO 11.00 (8.59–13.71), MnO 0.16 (0.13–0.18), CuO 31.18 (27.89–34.80), ZnO 2.62 (2.12–3.08), SO_3 54.76 (53.43–55.90), total 99.72. This gives the empirical formula $Mg_{0.79}Mn_{0.01}Cu_{1.14}Zn_{0.09}S_{1.99}O_8$ based on 8 O apfu. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 4.175 (68; 110), 3.666 (64; $\bar{1}11$), 3.579 (63; 021), 3.443 (59; 111), 2.719 (41; $\bar{1}12$), 2.637 (100; 022), 2.430 (68; 130) and 1.791 (24; 123, $\bar{2}31$, 042). The unit-cell parameters refined from powder-diffraction data are: $a = 4.816(2)$, $b = 8.448(3)$, $c = 6.776(2)$ Å, $\beta = 94.56(3)°$, $V = 274.8$ $Å^3$. Single-crystal X-ray diffraction data collected on a crystal of size 30 × 70 × 80 μm refined to $R_1 = 0.0591$ for 566 unique $I \geq 2\sigma(I)$ reflections shows dravertite is monoclinic, $P2_1/n$, $a = 4.8141(3)$, $b = 8.4443(5)$, $c = 6.7731(4)$ Å, $\beta = 94.598(5)°$, $V = 274.45$ $Å^3$, $Z = 2$. The structure consists of chains of alternating edge-sharing Cu^{2+} and Mg octahedra. The chains are connected via SO_4 tetrahedra to form a pseudo-framework. Dravertite is named in honor of the Russian mineralogist and geologist Petr Lyudovikovich Dravert (1879–1945) for his significant contribution to the mineralogy of Siberia. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **O.C.G.**

FERRORHODONITE*

N.V. Shchipalkina, N.V. Chukanov, I.V. Pekov, S.M. Aksenov, C. McCammon, D.I. Belakovskiy,·S.N. Britvin, N.N. Koshlyakova, C. Schäfer, R. Scholz, and R.K. Rastsvetaeva (2017) Ferrorhodonite, $CaMn_3Fe[Si_5O_{15}]$, a new mineral species from Broken Hill, New South Wales, Australia. Physics and Chemistry of Minerals, 44(5), 323–334.

Ferrorhodonite (IMA 2016-016), ideally $CaMn_3Fe[Si_5O_{15}]$, is a Mn^{2+}–Fe^{2+} ordered analog of rhodonite from the Broken Hill Pb–Zn–Ag deposit, Yancowinna Co., New South Wales, Australia. Broken Hill is a huge sedimentary exhalative lead, zinc, and silver deposit which had been altered by metamorphism of the granulite facies with progressive melting in the range of 600–700 °C. The melting resulted in the enrichment the polymetallic melts in Cu and Pb. Rhodonite in Broken Hill occurs mostly in the primary ores, in a pyroxenoid rock, which consists of bustamite, Mn-rich clinopyroxene, rare wollastonite, calcite, pyroxmangite, and Mn-rich olivine. Ferrorhodonite occurs associated to galena, chalcopyrite, spessartine, and quartz. It forms aggregates composed by thick tabular to short prismatic crystals, with rounded edges, up to 2 cm across. Ferrorhodonite is brown-red to pinkish brown and vitreous with a white strike. The mineral is brittle with stepped fracture. Cleavage is perfect on {201} and good on {021} and {210}. Mohs hardness is 6. $D_{\text{meas}} = 3.71(2)$ g/cm^3 (by hydrostatic weighting), $D_{\text{calc}} = 3.701$ g/cm^3. In plane-polarized light ferrorhodonite is colorless and non-pleochroic. It is optically biaxial (+), $\alpha = 1.731(4)$, $\beta = 1.736(4)$, $\gamma = 1.745(5)$ (589 nm); $2V_{\text{meas}} = 80(10)°$, $2V_{\text{calc}} = 74°$. Dispersion of an optical axes is distinct, $r < v$. It is not fluorescent in UV light. The IR spectrum of ferrorhodonite is very close to that of rhodonite. Bands in the range 3000-4000 cm^{-1} are absent indicating the absence of OH groups. The average of electron probe EDS analysis (4 spots) [wt% (range)] is: SiO_2 46.48 (46.41–46.58), FeO 14.46 (14.39–14.50), MnO 32.32 (32.16–32.45), MgO 0.24 (0.21–0.25), ZnO 0.36 (0.35–0.38), CaO 7.09 (7.04–7.11) , total 100.95. Mössbauer spectroscopy confirmed that all Fe is Fe^{2+}. The empirical formulae calculated on the basis of 15 O pfu and 16 cations is $Ca_{0.81}Mn_{2.92}Fe_{1.29}Mg_{0.04}Zn_{0.03}Si_{4.96}O_{15}$. The strongest lines in the X-ray powder diffraction pattern are [*d* Å (*I*%; *hkl*)]: 3.337 (32; 113), 3.132 (54; 210), 3.091 (41; 023), 2.968 (100; 211), 2.770 (91; 022), 2.223 (34; 204), 2.173 (30; 310). The unit-cell parameters refined from the powder data are: $a = 6.683(2)$, $b = 7.674(2)$, $c = 11.806(2)$ Å, $\alpha = 105.50(3)$, $\beta = 92.26(2)$, $\gamma = 93.93\ (2)°$, $V = 581.0(3)$ $Å^3$. X-ray diffraction intensity data was collected in one single crystal of 0.10 × 0.12 × 0.13 mm. The single crystal unit-cell parameters are: $a = 6.6766(5)$, $b = 7.6754(6)$, $c = 11.803(1)$ Å, $\alpha = 105.501(1)$, $\beta = 92.275(1)$, $\gamma = 93.919(1)°$, $V = 580.44$ $Å^3$, triclinic, $P\bar{1}$, $Z = 1$. The structure refinement and Mössbauer spectroscopy data showed that there are three Mn^{2+}-dominant octahedrally coordinated sites (M1, M2, and M3), whereas Fe^{2+} is dominant at the highly deformed fivefold-coordinated M4 site. Therefore, ferrorhodonite is named as an analog of rhodonite with Fe^{2+} prevailing at the M4 site of the structure. Parts of the holotype specimen of ferrorhodonite are deposited in the Mineralogical Museum of the University of Hamburg, and in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia **F.C.**

FOGOITE-(Y)*

F. Cámara, E. Sokolova, Y.A. Abdu, F.C. Hawthorne, T. Charrier, V. Dorcet, and J.-F. Carpentier (2017) Fogoite-(Y), $Na_3Ca_2Y_2Ti(Si_2O_7)_2OF_3$, a Group I TS-block mineral from the Lagoa do Fogo, the Fogo volcano, São Miguel Island, the Azores: Description and crystal structure. Mineralogical Magazine, 81(2), 369–381.

Fogoite-(Y) (IMA 2014-98), ideally $Na_3Ca_2Y_2Ti(Si_2O_7)_2OF_3$, is a new mineral from Lagoa do Fogo, São Miguel Island, the Azores. Fogoite-(Y) was found in a syenite xenolith in the bed of the upper part of the Ribeira Grande river near the ruins of Lombadas. The new mineral is associated with sanidine, astrophyllite, fluornatropyrochlore, ferrokentbrooksite, quartz, and ferro-katophorite. Fogoite-(Y) occurs in cavities as acicular [001] prisms with equant cross-sections, up to 2000 μm long and 50 μm × 50 μm across. Crystals are often parallel, grouped in radiating aggregates, or isolated. The main crystal forms are {100} and {010}. Macroscopically, individual crystals do not show twinning. Fogoite-(Y) is generally creamy white with white streak, but very thin crystals are colorless. It is transparent to translucent with vitreous luster. The mineral is brittle with a splintery fracture and no parting. The cleavage is very good on {100}. Mohs hardness is ~5 and $D_{\text{calc}} = 3.523$ g/cm^3. Fogoite-(Y) does not fluoresce under UV light or cathode rays. It is non-pleochroic, optically biaxial (+) with $\alpha = 1.686(2)$, $\beta = 1.690(2)$, $\gamma = 1.702(5)$ (590 nm), $2V_{\text{meas}} = 57(1)°$, $2V_{\text{calc}} = 60$. The main absorption bands of the IR spectrum (cm^{-1}) are 1088, 1000, and 803 (Si–O stretching vibrations of the Si_2O_7 groups) and 677 (stretching vibrations of the Si–O–Si bridges of Si_2O_7

groups). No bands were observed in the OH-stretching region of the FTIR spectrum suggesting the absence of OH and H_2O groups in the structure. The average of 10 electron probe WDS analyses [wt% (range)] is: Ta_2O_5 0.24 (0.23–0.25), Nb_2O_5 3.73 (3.50–3.89), ZrO_2 1.72 (1.51–1.89), TiO_2 7.48 (7.35–7.60), SiO_2 29.81 (29.40–29.85), Lu_2O_3 0.29 (0.14–0.43), Yb_2O_3 0.87 (0.72–0.98), Er_2O_3 1.17 (1.17–1.18), Dy_2O_3 1.78 (1.64–1.97), Gd_2O_3 1.74 (1.43–1.90), Sm_2O_3 0.41 (0.32–0.50), Nd_2O_3 0.72 (0.52–0.85), Ce_2O_3 0.62 (0.57–0.66), La_2O_3 0.18 (0.17–0.19), Y_2O_3 16.74 (16.53–16.95), FeO 0.64 (0.61–0.67), MnO 2.74 (2.71–2.77), CaO 13.89 (13.75–13.96), Na_2O 10.80 (10.72–10.95), F 6.74 (6.31–7.04), $-O{=}F_2$ 2.84, total 99.47. This gives the empirical formula $(Na_{2.74}Mn_{0.15})_{\Sigma 2.89}Ca_2[Y_{1.21}(La_{0.01}Ce_{0.03}Nd_{0.03}Sm_{0.02}Gd_{0.08}Dy_{0.08}Er_{0.05}Yb_{0.04}Lu_{0.01})_{\Sigma 0.35}Mn_{0.16}Zr_{0.11}Na_{0.09}Fe^{2+}_{0.07}Ca_{0.01}]_{\Sigma 2}(Ti_{0.76}Nb_{0.23}Ta_{0.01})_{\Sigma 1}(Si_{4.03}O_{14})O_{1.12}F_{2.88}$, based on 18 (O+F). The strongest lines in the X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 2.954 (100; $\bar{1}\bar{1}2,\bar{3}10$), 3.069 (42; $300,0\bar{1}2$), 2.486 (24; $310,2\bar{1}2$), 3.960 (23; $\bar{1}\bar{1}1,\bar{2}10$), 2.626 (21; $\bar{2}20$), 1.820 (20; $\bar{1}04$). Single-crystal X-ray diffraction data collected on a twinned crystal of size 0.10 × 0.02 × 0.02 mm refined to $R_1 = 0.0281$ for 2157 unique $I \geq 4\sigma(I)$ reflections. Fogoite-(Y) is triclinic, space group $P\bar{1}$, $a = 9.575(6)$, $b = 5.685(4)$, $c = 7.279(5)$ Å, $\alpha = 89.985(6)$, $\beta = 100.933(4)$, $\gamma = 101.300(5)°$, $V = 381.2$ Å^3, $Z = 1$. Fogoite-(Y) is a framework of titanium silicate (TS) blocks, which consist of HOH sheets (H = heteropolyhedral, O = octahedral) parallel to (100). The new mineral is isostructural with götzenite and hainite. Fogoite-(Y) is named after the type locality, the Fogo volcano. The holotype is deposited in the Museo Regionale di Scienze Naturali di Torino, Torino, Italy, and in the Royal Ontario Museum, Toronto, Ontario, Canada. Another specimen from the same locality is deposited at the Muséum National d'Histoire Naturelle, Paris, France. **O.C.G.**

MANGANICELADONITE*

G.O. Lepore, L. Bindi, F. Di Benedetto, E. Mugnaioli, C. Viti, A. Zanetti, M.E. Ciriotti, and P. Bonazzi (2017) A multimethodic approach for the characterization of manganiceladonite, a new member of the celadonite family from Cerchiara mine, Eastern Liguria, Italy. Mineralogical Magazine, 81(1), 167–173.

Manganiceladonite (IMA 2015-052), ideally $KMn^{3+}MgSi_4O_{10}(OH)_2$, is a new mineral discovered at the Cerchiara mine, Eastern Liguria, Italy (~44°11′58″N; 9°42′1″E). It was found in manganesiferous ores in the metacherts of the ophiolitic sequences at Cerchiara mine associated with calcite, hematite and braunite. The ore was produced by precipitation from submarine hydrothermal vents and reworked by turbiditic resedimentation. Manganiceladonite is orange-brown with micaceous appearance and forms thin and extremely elongated lamellae in radial aggregates. Crystals are transparent with silky luster and perfect cleavage on {001}. The density was not measured; $D_{calc} = 3.042$ g/cm^3. Manganiceladonite is moderately pleochroic, from orange to greenish yellow. No other optical properties are given. The Raman spectrum shows a distinct peak in the OH stretching region (3738 cm^{-1}) that indicates the presence of OH groups in the structure. The mean of electron probe WDS analyses (number not given) [wt% (range)] is: SiO_2 55.90 (54.34–56.84), Al_2O_3 1.20 (0.37–2.66), Mn_2O_3 21.50 (17.77–26.46), MgO 7.75 (5.56–9.10), Fe_2O_3 0.47 (0.24–0.72), K_2O 9.37 (8.48–9.85), Li_2O (by LA-ICP-MS) 0.71 (0.61–0.78), F 0.35 (0.25–0.52), $-O{=}F_2$ 0.15, H_2O (estimated) 4.14, total 101.24. Electron paramagnetic resonance spectroscopic shows Mn occurs primarily as Mn^{3+} with a subordinate amount of Mn^{4+}. This gives the empirical formula $(K_{0.83}\square_{0.17})(Mn^{3+}_{1.14}Mg_{0.80}Li_{0.20}Fe^{3+}_{0.02})(Si_{3.89}Al_{0.10})O_{10}[(OH)_{1.92}F_{0.08}]$ based on 23 negative charges pfu. The strongest lines in the X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 10.06 (100; 001), 3.359 (60; 003), 3.328 (49; 022), 3.034 (19; 112), and 2.015 (15; $\bar{2}23$). The unit-cell parameters refined from powder-diffraction data are: $a = 5.149(1)$, $b = 8.915(1)$, $c = 10.304(1)$ Å, $\beta = 102.03(1)°$, space group $C2$ or $C2/m$. Single-crystal X-ray diffraction experiments were unsuccessful; TEM images show that manganiceladonite crystals tend to fray in bended lamellae that can be as thin as 20 nm. High resolution transmission electron microscopy and electron diffraction tomography studies confirm that the mineral belongs to the mica group. The sum of the octahedral cations indicates a transitional character between a di- and a tri-octahedral structure. Manganiceladonite is named as the Mn-dominant version of celadonite. The holotype material is deposited in the Museo di Storia Naturale, Università di Firenze, Italy. **O.C.G.**

PUNINITE* AND NEW DATA ON ALUMOKLYUCHEVSKITE AND KAMCHATKITE

O.I. Siidra, E.V. Nazarchuk, A.N. Zaitsev, E.A. Lukina, E.Y. Avdontseva, L.P. Vergasova, N.S. Vlasenko, S.K. Filatov, R. Turner, and G.A. Karpov (2017) Copper oxosulphates from fumaroles of Tolbachik volcano: puninite, $Na_2Cu_3O(SO_4)_3$—a new mineral species and structure refinements of kamchatkite and alumoklyuchevskite. European Journal of Mineralogy, 29(3), 499–510.

Puninite (IMA 2015-012), ideally $Na_2Cu_3O(SO_4)_3$, is a new mineral discovered in sublimates of the Glavnaya Tenoritovaya fumarole on the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. Gas temperature in the sampling location was ~320 °C. Associated minerals are: lammerite-β, tenorite, hematite, and anhydrite. Puninite forms crystalline crusts with individual crystals up to 10 × 30 × 50 μm (usually from 5 to 20 μm in size) and irregularly shaped grains. Puninite is emerald-green with greenish streak and vitreous luster. It is brittle with uneven fracture and perfect cleavage on {100}. Mohs hardness is 2–3. The density was not measured due to the paucity of material; $D_{calc} = 3.284$ g/cm^3. No fluorescence observed. Puninite is optically biaxial (+), $\alpha = 1.587(2)$, $\beta = 1.611(2)$, $\gamma = 1.649(2)$ (589 nm), $2V_{calc} = 80.7°$, and is pale green with very weak pleochroism. The mineral is water soluble. The average of 10 electron probe WDS analyses [wt% (range)] is: Na_2O 9.98 (8.04–10.85), K_2O 0.63 (0.55–0.71), CuO 43.21 (42.50–44.57), ZnO 0.66 (0.56–0.81), SO_3 44.33 (43.03–44.85), total 98.81. This gives the empirical formula $(Na_{1.76}K_{0.08})_{\Sigma 1.84}(Cu_{2.97}Zn_{0.04})_{\Sigma 3.01}(SO_4)_{3.02}O_{0.92}$ based on 13 O apfu. The strongest lines in the X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 8.058 (100; 200), 6.675 (19; $00\bar{2}$), 6.466 (28; $20\bar{2}$), 4.398 (14; 202), 4.247 (17; $11\bar{3}$) 3.839 (34; $02\bar{2}$), 2.854 (29; $22\bar{4}$), 2.724 (15; 024). The unit-cell parameters refined from powder-diffraction data are: $a = 17.41(1)$, $b = 9.39(1)$, $c = 14.40(1)$ Å, $\beta = 112.04(7)°$, $V = 2183$ Å^3, $Z = 8$, and space group $C2/c$. Single-crystal X-ray diffraction data collected on a crystal of size 0.16 × 0.12 × 0.14 mm refined to $R_1 = 0.0349$ for 1923 unique $I \geq 4\sigma(I)$ reflections shows puninite is monoclinic, $C2/c$, with $a = 17.3885(13)$, $b = 9.4009(8)$, $c = 14.4045(11)$ Å, $\beta = 112.039(2)°$, $V = 2182.6$ Å^3, and $Z = 8$. The structure of puninite is based on oxocentered $[O_2Cu_6]^{8+}$ dimers. Four sulfate tetrahedra attach to the dimers, and the other sulfate tetrahedral groups link them in two dimensions. The resulting layers of $\{Cu_3O(SO_4)_3\}^{2-}$ are interlinked by the alkali ions. Puninite is structurally related to euchlorine, $NaKCu_3O(SO_4)_3$ and to fedotovite, $K_2Cu_3O(SO_4)_3$. Puninite is named in honor of Yurii Olegovich Punin (1941–2014) who worked for 45 years at Department of Crystallography, St. Petersburg State University, Russia. Type material is deposited in the Mineralogical Museum of Mineralogy Department, St. Petersburg State University, St. Petersburg, Russia.

New data on alumoklyuchevskite $K_3Cu_3AlO_2(SO_4)_4$ and kamchatkite $KCu_3O(SO_4)_2Cl$

Fresh alumoklyuchevskite and kamchatkite samples, collected at the Glavnaya Tenoritovaya fumarole along with puninite in 2014–2015, allowed re-refinement of their crystal structures. For the alumo klyuchevskite with average (n = 5, electron microprobe) chemical composition [wt% (range)]: K_2O 18.18 (17.99–18.44), Rb_2O 0.54 (0.48–0.61), CuO 31.47 (30.72–32.06), Al_2O_3 4.90 (4.72–5.06), Fe_2O_3 2.73 (2.38–3.03), SO_3 42.44 (42.29–42.70), total 100.26. [empirical formula based on 18 O apfu is $(K_{2.92},Rb_{0.04})Cu_{3.00}(Al_{0.73},Fe^{3+}_{0.26})O_{1.96}(SO_4)_{4.01}]$ the crystal structure refined (R_1 = 0.049) in triclinic space group $P\overline{1}$, a = 4.952(3), b = 11.978(6), c = 14.626(12) Å, α = 87.119(9), β = 80.251(9), γ = 78.070(9)°, V = 836.3 Å^3. In contrast to previously reported (Krivovichev et al. 2009) monoclinic space group $I2$ with a = 18.772(7), b = 4.967(2), c = 18.468(7) Å, β = 101.66(1), V = 1686 Å^3, Z = 4. The number of symmetrically independent atoms remains the same. For kamchatkite with average (n = 13, electron microprobe) chemical composition [wt% (range)]: K_2O 9.64 (9.41–9.95), CuO 50.61 (49.19–51.93), ZnO 0.35 (0.22–0.49), SO_3 34.34 (33.73–35.19), Cl 7.44 (7.23–7.58) –O=Cl_2 1.68, total 100.70. Empirical formula based on 10 anions pfu is $K_{0.96}(Cu_{2.98},Zn_{0.02})O_{0.96}(SO_4)_{2.01}Cl_{0.98}$. The crystal structure refined (R_1 = 0.021) in an orthorhombic space group $Pnma$, a = 9.755(2), b = 7.0152(15), c = 12.886(3) Å, V = 881.8 Å^3. In contrast to to previously reported (Varaksina et al. 1990) space group $Pna2_1$, a = 9.741(5), b = 12.858(6), c = 7.001(3) Å, V = 877(1) Å^3, Z = 4. Coordination environments of atoms in kamchatkite and alumoklyuchevskite are very similar to those described earlier. **O.C.G., D.B.**

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WAMPENITE*

S.J. Mills, A.R. Kampf, F. Nestola, P.A. Williams, P. Leverett, L. Hejazi, D.E. Hibbs, M. Mrorsko, M. Alvaro, and A.V. Kasatkin (2017) Wampenite, $C_{18}H_{16}$, a new organic mineral from the fossil conifer locality at Wampen, Bavaria, Germany. European Journal of Mineralogy, 29(3), 511–515.

Wampenite (IMA 2015-061), ideally $C_{18}H_{16}$, is a new mineral from Wampen, Fichtelgebirge, Bavaria, Germany. It is an organic mineral observed on fossilized conifer wood. Wampenite occurs as pale amber-colored tablets flattened on {001}, and blades elongated parallel to [100] up to about 0.4 mm in size. The only prominent form is {001}. Twinning on {001}is ubiquitous. Crystals of wampenite are transparent with a greasy to vitreous luster, are brittle with an irregular fracture, and have distinct and easy cleavage on {001}. Additional indistinct cleavages may exist on {010} and {110}. The estimated Mohs hardness is <1. D_{meas} = 1.15(1), D_{calc} = 1.12 g/cm^3. Wampenite is pleochroic X = Y (pale amber) < Z (amber). It is optically biaxial (+). Refraction indices were not measured due to dissolution of the material in immersion liquids. α ≈ 1.58 (est.), β ≈ 1.66 (calc.), γ ≈1.79 (calc.), $2V_{meas}$ = 82(2)° in white light; X = **b**; Z ^ **c** ≈ 20°. No dispersion (sense not given) was observed. The main absorption bands of the IR spectrum (cm^{-1}) are: 3000–3300 (C-H stretching), 2884–3000 (CH_3 stretching), 1361–1446, and 1523–1623 (C=C modes). As high-resolution mass spectrometry confirmed the molecular formula $C_{18}H_{16}$, the presence of a broad band at 3400 cm^{-1} is probably due to adsorbed water. An automatic CHN analyzer gave C = 92.5, H = 7.6, N= 0.0, total 100.1 wt%, in agreement with formula $C_{18}H_{16}$ within error. The strongest lines in the X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 4.88 (100; $11\overline{2}$,112), 11.92 (49; 002), 5.32 (43; 110), 3.504 (33; 024,$12\overline{2}$), 4.366 (28; 020), 3.656 (23; 120,121,$11\overline{5}$). The unit-cell parameters refined from powder-diffraction data are: a = 6.744(4), b = 8.719(4), c = 23.720(3) Å, β = 90.61(3)°, V = 1394.7 Å^3, and Z = 4. Single-crystal X-ray diffraction data collected on a crystal of size 0.45 × 0.21 × 0.04 mm refined to R_1 = 0.1088 shows wampenite is monoclinic, space group $P2_1/a$, with a = 6.7331(19), b = 8.689(3), c = 23.709(7) Å, β = 90.118(6)°, V = 1387.0 Å^3 and Z = 4. The structure solution revealed the molecular nature of the mineral where an aromatic phenanthrene moiety has an axial methyl group at one end and a disordered propen-2-yl (methylvinyl) terminal group at the other end. Wampenite is named for its locality. The type specimen was deposited in the Natural History Museum of Los Angeles County, California, U.S.A. **O.C.G.**

Zincoberaunite*

N.V. Chukanov, I.V. Pekov, I.E. Grey, J.R. Price, S.N. Britvin, M.G. Krzhizhanovskaya, A.R. Kampf, B. Dünkel, E. Keck, D.I. Belakovskiy, and C.M. MacRae (2017) Zincoberaunite, $ZnFe^{3+}_5(PO_4)_4(OH)_5{\cdot}6H_2O$, a new mineral from the Hagendorf South pegmatite, Germany. Mineralogy and Petrology, 111(3), 351–361.

Zincoberaunite (IMA 2015-117), ideally $ZnFe^{3+}_5(PO_4)_4(OH)_5{\cdot}6H_2O$, the Zn analog of beraunite, occurs in the abandoned Cornelia Mine Open Cut at the Hagendorf South granitic pegmatite, Hagendorf, Bavaria, Germany (49°39′1″N, 12°27′35″E). In the holotype specimen, zincoberaunite forms pale gray (with silky luster) radial aggregates up to 3 mm consisting of flexible fibers up to 1.5 mm long and up to 3 μm thick, and is associated to potassium feldspar, quartz, jungite, phosphophyllite, and mitridatite. In the cotype specimen zincoberaunite occurs as silvery white (with silky luster) mats of thin needles ranging from ~100 nm up to 2 μm in diameter, with lengths up to 200 μm, and is in close association with the new schoonerite-related mineral flurlite. Aggregates of the mineral sit on mounds of densely packed needles of plimerite. The three minerals occur on mitridatite, associated to Zn-bearing beraunite, schoonerite, parascholzite/scholzite, robertsite, and altered phosphophyllite. The needles of zincoberaunite are elongated along [010] and somewhat flattened on {100}. Cleavage is good on {100} and the fracture is splintery. Hardness is not reported. D_{calc} = 2.92 g/cm^3. No fluorescence in UV light was observed. Zincoberaunite is pleochroic X = Y (pale beige) < Z (light orange-brown). It is optically biaxial (–), α = 1.745(5), β = 1.760(5), γ = 1.770(5) (white light); $2V_{meas}$ = 80(5)°, $2V_{calc}$ = 78°; Y = b, Z ≈ **c**. Dispersion of optical axes is intermediate, $r < v$. Absorption bands in the IR spectrum are (cm^{-1}; s = strong band, sh = shoulder): 3562, 3515w, 3276, 2990sh (O–H stretching vibrations of OH^- anions and H_2O molecules), 1645sh, 1625 (bending vibrations of H_2O molecules), 1140sh, 1070s, 1032s, 990s, 970sh [$v_3(F_2)$ = asymmetric P–O stretching vibrations of PO_4^{3-} anions], 940sh [$v_1(A_1)$ = symmetric P–O stretching vibrations of PO_4^{3-} anions], 885sh, 798w ($Fe^{3+}{\cdots}O–H$ and $Zn{\cdots}O–H$ bending vibrations), 665sh, 603, 580 [triply degenerate $v_4(F_2)$ O–P–O bending mode of PO_4^{3-} anions], 466, 440, 405sh, 368 [lattice modes involving Fe^{3+}–O stretching and $v_2(E)$ O–P–O bending vibrations, possibly combined with libration modes of H_2O molecules]. The electron probe WDS analysis (average of 5 analyses of the holotype/7 analyses of the *cotype*) [wt% (range)] are: MgO 0.28 (0–0.58)/*bdl* (below detection limits), CaO 0.47 (0.24–0.78)/*bdl*, MnO bdl/*0.28 (0.12–0.44)*, ZnO 7.36 (6.58–7.83)/*6.3 (4.30–8.88)*, Al_2O_3 0.88 (0.42–1.23)/*bdl*, Fe_2O_3 (from crystal-chemical considerations and by analogy with another beraunite-group minerals) 42.42 (41.84–43.48)/*43.7 (39.6–47.8)*, P_2O_5 31.63 (30.47–32.70)/*30.2 (28.0–31.7)*, H_2O (by chromatography) 16.2(5)/(assuming 5 OH and 6 H_2O pfu) *16.5*, total 99.24/*97.0*. The empirical formula of the holotype based on 27 O apfu is $(Zn_{0.83}Ca_{0.08}Mg_{0.06})_{\Sigma0.97}(Fe^{3+}_{4.88}Al_{0.16})_{\Sigma5.04}(PO_4)_{4.09}(OH)_{4.78}{\cdot}5.86H_2O$ and the one of cotype based on 4 P apfu (because H_2O was calculated) is $(Zn_{0.73}Mn^{2+}_{0.04}Fe^{3+}_{0.16})_{\Sigma0.93}Fe^{3+}_5(PO_4)_4(OH)_{5.02}{\cdot}5.98H_2O$. The strongest lines in the X-ray powder diffraction pattern of the holotype are [d Å (I%; hkl)]: 10.37 (100: 200), 9.58 (32; 002), 7.24 (26; $20\overline{2}$), 4.817 (22; 111), 4.409 (13; 112), 3.483 (14; $11\overline{4}$,600), 3.431 (14; 404), 3.194 (15; 006,$31\overline{4}$), 3.079 (33; 314). The unit-cell parameters refined from the powder data are: a = 20.837(2), b = 5.1624(4), c = 19.250(1) Å, β = 93.252(5)°, V = 2067.3 Å^3. A needle measuring 2 μm in diameter by 40 μm long was used for collecting single crystal data set of the cotype sample using synchrotron radiation (λ = 0.7100 Å) at 100 K. The single-crystal unit-cell parameters are: a = 20.836(4), b = 5.148(1), c = 19.228(4) Å, β = 93.21(3)°, V = 2059.2 Å^3, monoclinic, $C2/c$, Z = 4. The crystal structure of zincoberaunite was refined starting from the model of beraunite by Moore and Kampf (1992), and yielded R_{exp} =

0.0047 (Rietveld method) $R_1 = 0.0797$ for 1900 unique reflections. The crystal structure of zincoberaunite is built up by heteropolyhedral slabs coplanar to (100) containing PO_4 tetrahedra and M(1,2,3) octahedra. In zincoberaunite Zn is dominant in the internal M1 octahedron. The slabs are interconnected via corner-sharing with $M4O_2(OH)_2(H_2O)_2$ octahedra to form a 3D framework containing large 10-sided channels along [010]. The water molecules Ow3 are located in the channels and are held by H-bonding to the framework atoms O6 and Ow2. The hydrogen bonding scheme found is the same as reported for tvrdýite, a beraunite-group member with Al > Fe^{3+}. Zincoberaunite is the fourth member of the beraunite group. The general crystal-chemical formula of beraunite-group minerals may be written as follows: $M1M2M3_2M4_2(PO_4)_4(OH,O)(OH)_4 \cdot 6H_2O$ where M1 = Fe^{2+}, Fe^{3+}, Mn^{2+}, Zn, Mg; M2, M3, and M4 = Fe^{3+}, Al, and minor Cr. The sites M3 and M4 can contain minor amounts of Zn. Zincoberaunite is named as the analog of beraunite $Fe^{2+}Fe^{3+}_5(PO_4)_4(OH)_5 \cdot 6H_2O$ with Zn predominant among bivalent cations. The holotype material is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. The cotype specimen is deposited in the Museum Victoria, Australia. **F.C.**

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ZINCOSTRUNZITE*

A.R. Kampf, I.E. Grey, P. Alves, S.J. Mills, B.P. Nash, C.M. MacRae, and E. Keck (2017) Zincostrunzite, $ZnFe^{3+}_2(PO_4)_2(OH)_2 \cdot 6.5H_2O$, a new mineral from the Sitio do Castelo mine, Portugal, and the Hagendorf-Süd pegmatite, Germany. European Journal of Mineralogy, 29(2), 315–322.

Zincostrunzite (IMA 2016-023), ideally $ZnFe^{3+}_2(PO_4)_2(OH)_2 \cdot 6.5H_2O$, is a new mineral from the Sitio do Castelo tungsten mine in Portugal, and the Hagendorf-Süd pegmatite in Germany. At the Sitio do Castelo mine, zincostrunzite occurs in vugs of a secondary phosphate assemblage resulting from the alteration of triplite–zwieselite, on a matrix composed of triplite–zwieselite, fluorapatite, and cryptomelane. Other minerals found in direct association with zincostrunzite are cacoxenite, plimerite, strengite, strunzite, and isokite. At Hagendorf-Süd, zincostrunzite was found in a nodule of former triphylite that had been replaced by phosphophyllite and minor apatite. Zincostrunzite has been found as single crystals as well as strunzite crystals with zincostrunzite rims. At Sitio do Castelo, zincostrunzite forms prisms up to 2 mm in length. At Hagendorf-Süd, the mineral makes up portions of needles that are up to about 5 mm in length. Crystals are elongated on [001] with forms {010} and $\{1\bar{1}0\}$ and poorly formed terminations, probably {001}. There is ubiquitous twinning by 180° rotation on [010] with compositional plane $\{1\bar{2}0\}$. Crystals from Sitio do Castelo are light brownish yellow, and those from Hagendorf-Süd are silvery white. They are transparent with a vitreous to silky luster and a white streak. Zincostrunzite is brittle with irregular, splintery fracture, and at least one perfect cleavage parallel to [001], probably either {110} or {100}. The Mohs hardness is ~2½. For the Sitio do Castelo sample, $D_{meas} = 2.66(1)$ and $D_{calc} = 2.655$ g/cm^3. The mineral slowly dissolves in dilute HCl (minutes) and rapidly dissolve in concentrated HCl at room temperature. Zincostrunzite is pleochroic X = nearly colourless < Y = light brownish yellow < Z = darker brownish yellow optically biaxial (–), $\alpha = 1.620(2)$, $\beta = 1.672(2)$, $\gamma = 1.720(2)$, $2V_{meas} = 89.5(5)°$, $2V_{calc} = 85.1°$; $Z \wedge \mathbf{c} = 3°$; $X \approx \mathbf{a}$. The averages of 9 (Sitio do Castelo)/*4 (Hagendorf-Süd)* electron probe WDS analyses [wt% (range)] are: ZnO 12.07 (10.38–13.63)/*15.13 (14.46–15.83)*, MnO 3.28 (1.02–4.70)/*3.74 (0.00–7.36)*, Fe_2O_3 32.00 (31.20–32.63)/*29.23 (22.97–32.97)*, P_2O_5 28.53 (27.77–29.05)/*28.24 (27.57–29.27)*, H_2O 27.30/*27.02*, total 103.18/*103.39*. H_2O was calculated on the basis of P = 2, charge balance, and 16.5 O apfu. This gives the empirical formula $(Zn_{0.74}Mn^{2+}_{0.23})_{\Sigma 0.97}Fe^{3+}_{1.99}(PO_4)_2(OH)_2 \cdot 6.5H_2O$ (Sitio do Castelo) and $(Zn_{0.93}Mn^{2+}_{0.08})_{\Sigma 1.01}(Fe^{3+}_{1.84}Mn^{2+}_{0.19})_{\Sigma 2.03}(PO_4)_2(OH)_2 \cdot 6.5H_2O$ (Hagendorf-Süd) based on 16.5 O apfu. The strongest lines in the X-ray powder-diffraction pattern [d Å (I%; hkl)] are: 8.87 (100; 100,010,$\bar{1}10$), 5.32 (95; $1\bar{1}1$,011), 4.457 (30; 200), 4.287 (41; 020,$\bar{2}20$), 3.310 (29; 120,$\bar{2}\bar{1}1$), 3.220 (75; multiple), 1.9116 (25; multiple), and 1.6222 (32; multiple). The unit-cell parameters refined from powder-diffraction data are: $a = 10.190(10)$, $b = 9.778(10)$, $c = 7.338(11)$ Å, $\alpha = 91.21(2)°$, $\beta = 97.96(2)°$, $\gamma = 116.99(4)°$, and $V = 642.3$ Å^3. Single-crystal X-ray diffraction data collected on a crystal from Sitio do Castelo of size 0.27 × 0.55 × 0.30 mm refined to $R_1 = 0.0715$ for 3243 unique $I \geq 4\sigma(I)$ reflections shows zincostrunzite is triclinic, $P\bar{1}$, $a = 10.1736(6)$, $b = 9.7999(5)$, $c = 7.3296(2)$ Å, $\alpha = 91.325(4)$, $\beta = 97.895(6)$, $\gamma = 116.948(4)°$, $V = 642.22$ Å^3, and $Z = 2$. The new mineral is isostructural with other members of the strunzite group but have an additional split H_2O site. Zincostrunzite is named as the Zn analog of strunzite where it substitutes Mn^{2+}. Two cotypes from the Sitio do Castelo mine are housed in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A., and one cotype from Hagendorf-Süd is housed in the Museum Victoria, Melbourne, Australia. **O.C.G.**