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New Mineral Names*,†

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This New Mineral Names has entries for 13 new minerals, including alwilkinsite-(Y), chinleite-(Y), gazeevite, iyoite, klaprothite, kyawthuite, misakiite, natropalermoite, ottohahnite, péligotite, sulfhydrylbystrite, whiteite-(CaMgMg), wilhelmgümbelite, and new data on bystrite.

ALWILKINSITE-(Y)*

A.R. Kampf, J. Plášil, J. Čejka, J. Marty, R. Škoda and L. Lapčák (2017) Alwilkinsite-(Y), a new rare-earth uranyl sulfate mineral from the Blue Lizard mine, San Juan County, Utah, USA. Mineralogical Magazine, 81(4), 895–907.

Alwilkinsite-(Y) (IMA 2015-097), ideally $Y(H_2O)_7[(UO_2)_3(SO_4)_2O(OH)_3]\cdot 7H_2O$, is a new mineral discovered in the only specimen from the Blue Lizard mine, San Juan County, Utah, U.S.A. It is secondary alteration mineral directly associated with calcite, dickite, gypsum, johannite, natrozippeite, and zinczippeite (for origin and general association see the abstract for klaprothite below). It is the second known rare-earth uranyl sulfate mineral. Alwilkinsite-(Y) forms yellowish-green needles up to 0.5 mm, elongated by [010], with domatic terminations. The crystal forms are {102}, {301}, and {124}. The crystals are transparent, slightly flexible before brittle failure with splintery fracture and perfect cleavage parallel to [010] (probably {102}). The streak is pale yellow green. The mineral fluoresces greenish gray under 405 nm laser. The Mohs hardness is ~2–2½. Density was not measured due to solubility of the mineral in Clerici solution; D_{calc} = 3.371 g/cm^3. At room temperature the mineral is insoluble in H_2O, but easily soluble in dilute HCl. Alwilkinsite-(Y) is non-pleochroic in transmitted light, optically biaxial (+), α = 1.573, β = 1.581, γ = 1.601 (white light), $2V$ = 65.3°, $2V_{calc}$ = 65.3°; X = **c**, Y = **a**, Z = **b**. The dispersion of an optical axes is $r < v$ weak. The Raman spectrum was obtained using 780 nm laser due to strong fluorescence caused by the presence of Y and REEs. The broad bands at ~1600 cm^{-1} are the result of the fluorescence and it was not possible to acquire the O–H stretching region of the spectrum. The other bands (cm^{-1}; s = strong, m = medium, b = broad, w = weak) are: 1265mb, 1135–1080w (ν_3 antisymmetric stretching of the SO_4 tetrahedra), 1325w (overtone or a combination band); 1035, 1015 and 990w (ν_1 symmetric stretchings of SO_4 tetrahedra); 900w (ν_3 antisymmetric stretching of the uranyl ion); 840s (ν_1 symmetric stretching of the uranyl ion); 605, 555, 530mw (antisymmetric stretching of the SO_4 tetrahedra); 465, 455w and ~380b (SO_4 bending); suite of overlapping bands 320, 288, 268, 240 (bending vibrations of the uranyl ion); 200, 170 (U–O_{eq}–ligand stretching); 145, 135, 108, 90, 72, 60w (–O_{eq}–U–O_{eq} bending and unclassified lattice modes). The average of 7 electron probe WDS analyses [wt% (range)] is: CaO 0.01 (0–0.07), Y_2O_3 5.49 (5.11–5.69), Ce_2O_3 0.15 (0.12–0.17), Nd_2O_3 0.38 (0.33–0.42), Sm_2O_3 0.29 (0.20–0.36), Gd_2O_3 0.76 (0.61–0.94), Dy_2O_3 1.11 (1.10–1.17), Er_2O_3 0.67 (0.45–0.76), Yb_2O_3 0.37 (0.27–0.50), SO_3 11.97 (10.31–12.41), UO_3 63.25 (61.06–64.94), H_2O (by stoichiometry) 20.59, total 105.04. The empirical formula calculated on the basis of 3 U and 32 O atoms pfu is $(Y_{0.66}Dy_{0.08}Gd_{0.06}Er_{0.05}Nd_{0.03}Yb_{0.03}Sm_{0.02}Ce_{0.01})_{\Sigma 0.94}(H_2O)_7[(UO_2)_3(S_{1.01}O_4)_2O(OH)_3]\cdot 7H_2O$. The strongest powder X-ray diffraction lines are [d Å (I%; hkl)]: 9.88 (100; 101,002), 7.47 (13; 102), 5.621 (17; 103,201), 4.483 (18; 104), 3.886 (14; 130,222), 3.322 (46; multiple), 3.223 (13; multiple), 3.145 (16; 034). The unit-cell parameters refined from the powder data with whole pattern fitting are: a = 11.5874(10), b = 12.4171(10), c = 19.4242(17) Å, V = 2794.8 Å^3. The single crystal data are a = 11.6194(5), b = 12.4250(6), c = 19.4495(14) Å, V = 2807.9 Å^3. Alwilkinsite-(Y) is orthorhombic, $P2_12_12_1$, Z = 4. The crystal structure was refined to R_1 = 0.042 for 4244 $F_o > 4\sigma F$ unique reflections. It contains edge-sharing chains of uranyl bipyramids with outlying SO_4 tetrahedra that are similar to the chain linkages within the uranyl sulfate sheets of zippeite. Short segments of the uranyl sulfate chains in the alwilkinsite-(Y) structure have the same topology as portions of the uranyl sulfate linkages in uranopilite. Alwilkinsite-(Y) is named for Alan (Al) J. Wilkins (b. 1955), the discoverer of the mineral. The holotype specimen deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. **D.B.**

CHINLEITE-(Y)*

A.R. Kampf, B.P. Nash and J. Marty (2017) Chinleite-(Y), $NaY(SO_4)_2\cdot H_2O$, a new rare-earth sulfate mineral structurally related to bassanite. Mineralogical Magazine, 81(4), 909–916.

Chinleite-(Y) (IMA 2016-017), ideally $NaY(SO_4)_2\cdot H_2O$, is a new mineral discovered at the Blue Lizard mine, San Juan County, Utah, U.S.A. It is one of many new secondary sulfates discovered at that location recently (for origin and general association see the abstract for klaprothite below). It occurs in efflorescent crusts directly associating with gypsum, hexahydrite, johannite, metauranospinite, natrojarosite, and other potentially new minerals. Chinleite-(Y) forms thin hexagonal {100} prisms up to 0.3 mm long with pyramidal terminations {101} and {011}. Prisms are usually intergrown in divergent sprays, bow-tie aggregates or subparallel intergrowths. The mineral is colorless, transparent with a vitreous luster and a white streak. No fluorescence was observed. Crystals are brittle with at least one good cleavage parallel to [001], probably

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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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{100}, and have splintery fracture. The Mohs hardness is ~2½–3. The density was not measured due to solubility of the mineral in Clerici solution; $D_{calc} = 3.385$ g/cm^3. The mineral is slowly dissolves in H_2O at room temperature. The mineral is non-pleochroic, optically uniaxial (+), $\omega = 1.565$, $\varepsilon = 1.603$ (white light). The average of 7 electron probe WDS analyses [wt% (range)] is: Na_2O 4.36 (3.50–5.28), CaO 4.44 (3.31–5.57), Y_2O_3 28.17 (23.68–31.56), Ce_2O_3 0.44 (0.15–0.82), Pr_2O_3 0.12 (0–0.45), Nd_2O_3 0.64 (0.14–1.32), Sm_2O_3 0.40 (0.02–0.95), Eu_2O_3 0.24 (0–0.52), Gd_2O_3 1.84 (0.72–3.76), Dy_2O_3 5.67 (4.79–7.22), Ho_2O_3 1.10 (0.93–1.26), Er_2O_3 2.79 (2.39–3.36), Yb_2O_3 0.73 (0–1.07), SO_3 44.41 (40.18–47.32), H_2O (by structure) 3.50, total 98.95. The empirical formula based on 9 O apfu is $(Na_{0.51}Ca_{0.29}Y_{0.18})_{\Sigma 0.97}(Y_{0.72}Dy_{0.11}Er_{0.05}Gd_{0.04}Ho_{0.02}Yb_{0.01}Nd_{0.01}Eu_{0.01}Sm_{0.01}Ce_{0.01}Pr_{<0.01}La_{<0.01})_{\Sigma 1.00}(SO_4)_2{\cdot}H_{1.40}O$. The strongest powder X-ray diffraction lines are [d Å (I%; hkl)]: 6.01 (59; 100), 5.43 (63; 011), 3.457 (46; 110), 3.010 (100; 200), 2.826 (95; 014), 2.137 (39; 006,122), 1.849 (67; 214), 1.690 (28; 125,034). The unit-cell parameters refined from the powder data with whole pattern fitting are: $a = 6.9118(16)$, $c = 12.792(3)$ Å, $V = 529.2$ Å^3. The single-crystal data are $a = 6.890(2)$, $c = 12.767(2)$ Å, $V = 524.9$ Å^3. Chinleite-(Y) is trigonal, $P3_221$, $Z = 3$. The crystal structure of chinleite-(Y) was refined to $R_1 = 0.0444$ for 303 $F_o > 4\sigma F$ unique reflections. Chinleite-(Y) is isostructural with the synthetic Na-REE ternary sulfate monohydrates, $NaREE(SO_4){\cdot}H_2O$. The structure is a three-dimensional framework consisting of SO_4 groups, irregular NaO_8 polyhedra and YO_9 distorted tricapped trigonal prisms, and is similar to the structure of basanite in which Ca is both eightfold and ninefold coordinated. In chinleite-(Y), NaO_8 polyhedra share edges only with YO_9 polyhedra and vice versa, while in the bassanite structure the linkages of CaO_8 and CaO_9 polyhedra are different. In the structures of both chinleite-(Y) and bassanite, one vertex of the ninefold-coordinated polyhedra is an H_2O group and is unshared with any other polyhedra. The mineral is named for the Chinle Formation of Upper Triassic age, in which the deposit exploited by the Blue Lizard mine occurs. The description is based on three cotype specimens deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. **D.B.**

GAZEEVITE*

E.V. Galuskin, F. Gfeller, I.O. Galuskina, T. Armbruster, A. Krzątała, Y. Vapnik, J. Kusz, M. Dulski, M. Gardocki, A.G. Gurbanov and P. Dzierżanowski (2017) New minerals with a modular structure derived from hatrurite from the pyrometamorphic rocks. Part III. Gazeevite, $BaCa_6(SiO_4)_2(SO_4)_2O$, from Israel and the Palestine Autonomy, South Levant, and from South Ossetia, Greater Caucasus. Mineralogical Magazine, 81(3), 499–513.

Gazeevite (IMA 2015-037), ideally $BaCa_6(SiO_4)_2(SO_4)_2O$, is a new mineral discovered in an altered carbonate-silicate xenolith in rhyodacites of the Shadil-Khokh volcano, Great Caucasus Mt. Range, Southern Ossetia, and at three other localities in larnite nodules from pseudo-conglomerates of pyrometamorphic rocks of the Hatrurim Complex: Nahal Darga and Jabel Harmun, Judean Mountains, Palestinian Autonomy; and Har Parsa, Negev Desert, Israel. In pyrometamorphic rocks of the Hatrurim Complex a great number of new mineral species has been discovered during the last few years, in particular at localities characterized by the presence of gazeevite. At the Shadil-Khokh volcano gazeevite occurs as xenomorphic metacrysts up to 30–50 µm, sometimes with hexagonal outlines and is concentrated on the boundary between merwinite and spurrite zones. Srebrodolskite-brownmillerite, spinel-magnesioferrite, baryte, lakargiite, kerimasite, and periclase are noted in both those zones. In the spurrite zone, minerals of fluorellestadite-“chlorellestadite”, chlormayenite-chlorkyuygenite series, and secondary ettringite-thaumasite, hydrocalumite and calcite are widespread. Minerals of the gehlenite-akermanite and wadalite–chlormayenite series, rondorfite, monticellite, bredigite, and larnite are characteristic of the merwinite zone. In cracks, rusinovite, eltyubyuite, cuspidine, ternesite, jasmundite, and its chorine analog known as artificial “alinite” were identified. At the Hatrurim Complex gazeevite forms aggregates of grain size up to 40 µm (Jabel Harmun), spherulitic aggregates (Nahal-Darga) or xenomorphic poikiloblasts (Har Parsa), all in larnite rocks. The typical minerals in these associations are: brownmillerite, shulamitite, fluorellestadite-fluorapatite, fluormayenite-fluorkyuygenite, ye’elimite, gehlenite, ternesite, nabimusaite-dargaite, vapnikite, baryte, periclase, and oldhamite. In both types of rocks gazeevite substituting fluorellestadite and/or larnite. Gazeevite along with nabimusaite–dargaite and ternesite are thought to be a product of the reaction of melts (fluids) generated by volcanic activity or combustion processes with earlier minerals of a typical “clinker association,” fluorellestadite, larnite, oldhamite, and others. Gazeevite is colorless, transparent with white streak and vitreous luster. No fluorescence in UV light was observed. It is brittle with pronounced parting and imperfect cleavage on {001}. The indentation hardness $VHN_{50} = 417$ (353–473) kg/mm^2 corresponds to ~4½ of Mohs scale. The density was not measured because of abundant, tiny inclusions; $D_{calc} = 3.39$ g/cm^3. Gazeevite is non-pleochroic, optically uniaxial (–), $\omega = 1.640(3)$, $\varepsilon = 1.636(2)$ (589 nm). The Raman spectrum shows bands at 160, 213, 266 and 315 (lattice mode, O–Ba–O and O–Ca–O vibration), 413 [$\nu_2(SiO_4^{4-})$],468 [$\nu_2(SO_4^{2-})$], 529 [$\nu_4(SiO_4^{4-})$], 638 [$\nu_4(SO_4^{2-})$], 870 [$\nu_1(SiO_4^{4-})$], 1000 [$\nu_1(SO_4^{2-})$], 1099 and 1135 [$\nu_3(SO_4^{2-})$]. The average of 16 electron probe analyses of gazeevite from the Shadil-Khokh/*Jabel Harmun* (14 analyses) is [wt% (range)]: SO_3 20.77 (20.02–21.63)/*19.49 (18.80–19.92)*, P_2O_5 0.09 (0–0.23)/*2.70 (1.60–3.51)*, TiO_2 n.d./*0.09 (0.03–0.21)*, SiO_2 15.87 (15.64–16.15)/*14.35 (13.51–15.03)*, Al_2O_3 0.04 (0–0.08)/*0.28 (0.14–1.07)*, BaO 16.49 (15.29–17.48)/*17.20 (16.02–18.26)*, SrO 0.99 (0.59–1.36)/*0.22 (0.06–0.39)*, CaO 44.04 (43.62–44.77)/*44.09 (43.90–44.65)*, K_2O 0.73 (0.50–0.93)/*0.76 (0.57–0.93)*, Na_2O 0.05 (0.03–0.07)/*0.09 (0.05–0.15)*, F 0.23 (0.12–0.40)/*0.28 (0.22–0.42)*, –O=F 0.10/*0.12*, total 99.20/*99.43*. The empirical formulae based on 17 O+F are: $(Ba_{0.82}K_{0.12}Sr_{0.07})(Ca_{5.99}Na_{0.01})[(Si_{1.01}Al_{<0.01})O_4]_2[(S_{0.99}P_{0.01})O_4]_2O_{0.87}F_{0.09}$/*$(Ba_{0.85}K_{0.12}Sr_{0.02})(Ca_{5.99}Na_{0.02})[(Si_{0.91}Al_{0.02})O_4]_2[(S_{0.93}P_{0.07})O_4]_2O_{0.84}F_{0.11}$*. The strongest lines in the calculated X-ray powder-diffraction pattern [d_{calc} Å (I_{calc}%; hkl)] are: 3.58 (100; 110), 3.07 (91; 021), 2.76 (47; 116), 1.789 (73; 220), 3.29 (60; 113), 2.78 (36; 024), 2.12 (25; 125), 2.21 (21; 208). Single-crystal X-ray diffraction data collected on a crystal (0.04 × 0.03 × 0.02 mm) from the Shadil-Khokh refined to $R_1 = 0.0303$ for 437 unique $I \geq 2\sigma(I)$ reflections shows gazeevite is trigonal, space group $R\bar{3}m$, $a = 7.1540(1)$, $c = 25.1242(5)$ Å, $V = 1113.58$ Å^3, $Z = 3$. Gazeevite is isostructural with zadovite and aradite, built from a characteristic intercalation of antiperovskite-like $\{[XCa_6](TO_4)_2\}$ and $Ba(TO_4)_2$ layers, where X refers to O^{2-} in gazeevite and F^- in zadovite and aradite. Gazeevite was named in honor of Viktor Magalimovich Gazeev (b. 1954), research staff member of the Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry of the Russian Academy of Sciences, Moscow, and of the Vladikavkaz Scientific Centre of the Russian Academy of Sciences, Vladikavkaz, Republic of North Ossetia-Alania, Russia, for his discovery of unique xenoliths within the Upper Chegem Caldera that lead to the description of over 20 new mineral species. The parts of the holotype (Jabel Harmun) were deposited in the Museum of Natural History in Bern, Switzerland, and in the Fersman Mineralogical Museum Russian Academy of Sciences, Moscow, Russia. The cotypes from all described localities were deposited in the latter. **O.C.G.**

IYOITE* AND MISAKIITE*

D. Nishio-Hamane, K. Momma, M. Ohnishi, N. Shimobayashi, R. Miyawaki, N. Tomita, R. Okuma, A.R. Kampf and T. Minakawa (2017) Iyoite, $MnCuCl(OH)_3$ and misakiite, $Cu_3Mn(OH)_6Cl_2$: new members of the atacamite family from Sadamisaki Peninsula, Ehime Prefecture, Japan. Mineralogical Magazine, 81(3), 485–498.

Iyoite (IMA 2013-130), ideally $MnCuCl(OH)_3$, and misakiite (IMA 2013-131), $Cu_3Mn(OH)_6Cl_2$, are new minerals from the Sadamisaki Peninsula, Ehime Prefecture, Japan. The new minerals are members of the atacamite family. The small copper-manganese deposits in the area belong to the Sambagawa metamorphic belt and were formed as volcanogenic massive sulfide deposits on the deep-sea floor. Manganese ore occurs in the stratum consisting of the greenschist with piemontite schists which continues into the sea. Rocks including masses of ore of varying size were scattered on the beach and were exposed to seawater. The primary ore minerals are hausmannite, tephroite, alleghanyite, rhodonite, rhodochrosite, native copper, and chalcocite. The ore has been altered by reaction with seawater to produce secondary minerals: cuprite, kutnohorite, malachite, chrysocolla, and iyoite in close association with misakiite in manganese ore crevices. Iyoite forms pale green radial and dendritic aggregates consisting of bladed crystals {001}, {100}, {010}, and {110}, flattened on [001], and elongated parallel to [010], typically 100–200 μm long. The crystals are transparent with a vitreous luster. The mineral is brittle and has uneven fracture. The density was not measured. In transmitted light iyoite is pleochroic *X* (light bluish green) < *Y* (bluish green) ≈ *Z* (bluish green). It is optically biaxial (–), $\alpha = 1.698(2)$, $\beta = 1.725(3)$, $\gamma = 1.737(3)$ (white light), $2V_{meas} = 66(2)°$, and $2V_{calc} = 66.5°$. Dispersion of an optical axes is strong, $r > v$; $Y = \mathbf{b}$ and $X \wedge \mathbf{c} = 26°$. Misakiite occurs as emerald green hexagonal plates 20–50 μm in diameter, flattened on {001} and bounded by {110} and as bladed crystals elongated parallel to [100] often found at the ends of iyoite dendrites. The crystals are transparent with a vitreous luster. The mineral is brittle and has uneven fracture. The density was not measured; $D_{calc} = 3.42$ g/cm^3. In transmitted light misakiite is slightly pleochroic *O* (green-blue) > *E* (light green-blue). It is optically uniaxial (–), $\omega = 1.770(3)$, $\varepsilon = 1.750(3)$ (white light). The Raman spectra of misakiite is practically identical to its synthetic analog. The peaks at 265, 321, 397s, and 470 cm^{-1} are probably due to metal–anion stretching vibrations (iyoite shows the only peak with maxima 438 and 458 in the region below 500 cm^{-1}). Peaks at 3460s, 3505, and 3552 cm^{-1} are attributed to O–H stretching (iyoite peaks in that area are 3513, 3521s, and 3558). No peaks were found in the 1200–1800 cm^{-1} region for both minerals, indicating the absence of H–O–H bending vibrations. An average electron probe EDS analyses on 7 crystals of iyoite is [wt% (range)]: MnO 37.78 (36.79–40.86), CuO 35.74 (32.09–36.13), Cl 18.42 (17.90–18.93), H_2O 13.01 (by stoichiometry), O=Cl –4.16, total 100.79. This gives the empirical formula $Mn_{1.085}Cu_{0.915}Cl_{1.058}(OH)_{2.942}$ based on 4 anions pfu. An average electron probe EDS analyses on 7 crystals of misakiite is [wt% (range)]: MnO 19.82 (18.32–20.26), CuO 53.49 (53.30–55.30), Cl 17.72 (17.48–17.83), H_2O 12.65 (by stoichiometry), O=Cl –4.00, total 99.68. This gives the empirical formula $Cu_{2.826}Mn_{1.174}(OH)_{5.900}Cl_{2.100}$ based on 8 anions pfu. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] of iyoite are: 5.7155 (100; 100), 2.5596 (62; 121,102), 2.4929 (37; 102), 2.8432 (28; 021), 2.8547 (22; 120,200). For misakiite they are: 5.7024 (100; 001), 2.4971 (76; 021,201), 1.9892 (27; 202,022), 2.7779 (24; 200), 1.5439 (20; 221). The unit-cell parameters refined from powder-diffraction data are $a = 5.717(2)$, $b = 6.586(2)$, $c = 5.623(3)$ Å, $\beta = 88.45(3)°$, and $V = 211.63$ Å^3 for iyoite, and $a = 6.4156(4)$, $c = 5.7026(5)$ Å, and $V = 203.27$ Å^3 for misakiite. Single-crystal X-ray diffraction data collected on a crystal of size 0.07 × 0.02 × 0.01 mm refined to $R_1 = 0.019$ for 595 unique $I \geq 2\sigma(I)$ reflections shows iyoite is monoclinic, space group $P2_1/m$, $a = 5.717(2)$, $b = 6.586(2)$, $c = 5.623(3)$ Å, $\beta = 88.45(3)°$, and $V = 211.63$ Å^3. Analogous data collected on a crystal of size 0.06 × 0.06 × 0.03 mm refined to $R_1 = 0.025$ for 228 unique $I \geq 2\sigma(I)$ reflections shows misakiite is trigonal, space group $P\bar{3}m1$, with $a = 6.4156(4)$, $c = 5.7026(5)$ Å, and $V = 203.27$ Å^3. Iyoite is Mn-Cu ordered analog of botallackite $Cu_2(OH)_3Cl$, while misakiite corresponds to Mn-rich analog of kapellasite $Cu_3Zn(OH)_6Cl_2$. Their structure is based on brucite-like sheets parallel to {100} and built from edge-sharing, distorted $Mn(OH)_5Cl$ [$Mn(OH)_6$ for misakiite] and Jahn-Teller distorted $Cu(OH)_4Cl_2$ octahedra. Sheets are connected via weak interplanar O–H···Cl bonds for both minerals. The new minerals are named after the Sea of Iyo and the Sea of Misaki of the Sadamisaki Peninsula, Japan. Holotype specimen containing both minerals is deposited in the National Museum of Nature and Science, Japan, and a cotype specimen is deposited in the Mineral Sciences Department, Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. **O.C.G.**

KLAPROTHITE*, PÉLIGOTITE*, AND OTTOHAHNITE*

A.R. Kampf, J. Plášil, A.V. Kasatkin, J. Marty and J. Čejka (2017) Klaprothite, péligotite and ottohahnite, three new minerals with bidentate UO_7–SO_4 linkages from the Blue Lizard mine, San Juan County, Utah, USA. Mineralogical Magazine, 81(4), 753–779.

The new minerals klaprothite (IMA 2015-087), monoclinic $Na_6(UO_2)(SO_4)_4(H_2O)_4$, péligotite (IMA 2015-088), triclinic $Na_6(UO_2)(SO_4)_4(H_2O)_4$, and ottohahnite (IMA 2015-098), triclinic $Na_6(UO_2)_2(SO_4)_5(H_2O)_7 \cdot 1.5H_2O$, were discovered in the underground Blue Lizard mine, Red Canyon, White Canyon District, San Juan County, Utah, U.S.A., where they occur together as a products of the secondary post-mining hydration–oxidation weathering of primary uranium minerals (mainly uraninite), by acidic solutions derived from the decomposition of associated sulfides. Primary uranium minerals were deposited as replacements of wood and other organic material and as disseminations in the mineralized channels in enclosing sandstones of the Shinarump member of the Chinle Formation. A number of new uranyl sulfates were recently discovered in that association at the Blue Lizard and nearby Green Lizard and Giveaway-Simplot mines. Those include alwilkinsite-(Y), belakovskiite, bluelizardite, bobcookite, fermiite, meisserite, oppenheimerite, plášilite, shumwayite, and wetherillite. Other secondary minerals found in this association are aluminocoquimbite, atacamite, blödite, boyleite, brochantite, calcite, chalcanthite, cobaltoblödite, copiapite, coquimbite, cyanotrichite, d'ansite-(Mn), dickite, dietrichite, epsomite, ferrinatrite, gerhardtite, gordaite, gypsum, halite, hexahydrite, johannite, kaolinite, kieserite, konyaite, kröhnkite, lishizhenite, manganoblödite, metavoltine, natrozippeite, pickeringite, pseudojohannite, rhomboclase, römerite, rozenite, sideronatrite, tamarugite, thérèsemagnanite, and potentially new minerals currently under investigation. Klaprothite, péligotite, and ottohahnite occurs as efflorescent crusts on the surfaces of mine walls and form yellowish-green to greenish-yellow crystals with a vitreous luster, pale yellow green streak and bright bluish-green fluorescence under UV light. Crystals are brittle with irregular fracture, Mohs hardness ~2½. They all are easily soluble in H_2O at room temperature.

Klaprothite forms equant to prismatic blocky crystals up to ~1 mm with skeletal or rounded edges and in parallel intergrowths. Prisms are elongated on [010]; the forms are {100}, {001}, {110}, {011}, and {012}. No twinning was observed. The cleavage is perfect on {100} and {001}. The density is 2.90(2); $D_{calc} = 2.923$ g/cm^3. The mineral is pleochroic *X* (colorless) < *Y* (light yellowish green) ≈ *Z* (light yellowish green). It is optically biaxial (–), $\alpha = 1.497$, $\beta = 1.517$, $\gamma = 1.519$ (white light), $2V = 34(1)°$; $2V_{calc} = 34.7°$; $Y = \mathbf{b}$, $X \wedge \mathbf{c} = 10°$ in obtuse angle β. Dispersion of an optical axes is $r > v$, distinct. The mean of 11 electron probe EDS analysis [wt% (range)] is: Na_2O 21.06 (19.67–22.85), UO_3 33.14 (31.07–36.92), SO_3 35.93 (33.15–38.40). H_2O (by stoichiometry) 8.15, total 98.28. The empirical formula based on 22 O pfu is $Na_{6.01}(U_{1.03}O_2)(S_{0.99}O_4)_4(H_2O)_4$. The strongest lines of the X-ray powder diffraction pattern are [*d* Å (*I*%; *hkl*)]: 10.27 (30; 002), 9.72 (68; 100), 7.09 (97; 012), 5.158 (77; 004), 4.330 (58; 120,$\bar{1}21$), 3.434 (100; $\bar{2}21$,$\bar{1}24$), 3.082 (65; 214,$\bar{3}11$,106), 3.012 (61, $\bar{3}12$,131,$\bar{2}24$), 1.914 (48; 051,$\bar{5}12$,341). Klaprothite is monoclinic, $P2_1/c$, $a = 9.8271(4)$, $b = 9.7452(3)$, $c = 20.8725(15)$ Å, $\beta = 98.743(7)°$, $V = 1975.66$ Å^3, and $Z = 4$.

Péligotite forms equant concave rhombs with rounded edges up to ~0.5 mm and their subparallel aggregates or drusy intergrowths. Crystals forms are {001}, {110}, and {110}. No twinning was observed. Crystals are slightly sectile with no cleavage. The density is 2.88(2); D_{calc} = 2.878 g/cm^3. It is optically biaxial (–), α = 1.493, β = 1.511, γ = 1.515 (white light). $2V$ = 50(1)°; $2V_{calc}$ = 50.0°; $X \wedge \mathbf{c}$ = 3°, $Y \wedge \mathbf{b}$ = 43°, $Z \wedge \mathbf{a}$ = 40°. Dispersion of an optical axes is $r > v$, distinct. The mineral is pleochroic X (colorless) < Y (light yellowish green) ≈ Z (light yellowish green). The mean of 8 electron probe EDS analysis [wt% (range)] is: Na_2O 20.55 (18.98–22.56), UO_3 33.27 (29.61–38.14), SO_3 36.60 (33.88–39.20), H_2O (by stoichiometry) 8.22, total 98.64. The empirical formula based on 22 O pfu is $Na_{5.82}(U_{1.02}O_2)(S_{1.00}O_4)4(H_2O)_4$. The strongest lines of the X-ray powder diffraction pattern are [d Å (I%; hkl)]: 10.19 (39; 001), 9.51 (48; 100), 7.11 (100; 011,$0\bar{1}1$), 5.14 (63; 002), 4.54 (43; 112,012), 4.307 (53; $\bar{1}20$,211), 3.418 (73; 220,$2\bar{2}1$,$\bar{2}20$), 3.121 (74; 130,311). Péligotite is triclinic, $P\bar{1}$, a = 9.81511(18), b = 9.9575(2), c = 10.6289(8) Å, α = 88.680(6)°, β = 73.990(5)°, γ = 89.205(6)°, V = 998.22 Å^3, and Z = 2.

Ottohahnite forms equant crystals up to ~0.1 mm typically intergrown with tamarugite, Faces and edges often rounded. No twinning was observed. Crystals are slightly sectile with no cleavage. Density was not measured due to the lack of pure material; D_{calc} = 2.858 g/cm^3. It is optically biaxial (–), with α = 1.511, β = 1.514, γ = 1.537 (white light), $2V$ = 42(2)°; $2V_{calc}$ = 40.2°; $X \wedge \mathbf{a}$ = 43°, $Y \wedge \mathbf{b}$ = 11°, $Z \wedge \mathbf{c}$ = 29°. Dispersion of an optical axes is $r > v$, strong. Pleochroism: Y (colorless) < X (light yellowish green) < Z = (yellowish-green). The mean of 12 electron probe EDS analysis [wt% (range)] is: Na_2O 13.73 (12.92–15.66), UO_3 42.68 (41.01–44.39), SO_3 30.44 (28.86–31.45), H_2O (by stoichiometry) 11.55, total 98.40. The empirical formula based on 32.5 O pfu is $Na_{5.88}(U_{0.99}O_2)_2(S_{1.01}O_4)_5(H_2O)_{8.5}$. The strongest lines of the X-ray powder diffraction pattern are [d Å (I%; hkl)]: 7.64 (32; $\bar{1}10$), 6.81 (41; 011), 6.21 (100; $\bar{1}\bar{1}2$), 4.650 (39; 102,$\bar{1}12$), 3.462 (52; $\bar{1}\bar{3}1$,$\bar{1}30$), 3.156 (35; $\bar{2}22$), 2.977 (63; $\bar{3}\bar{1}3$,$1\bar{1}4$), 2.913 (42; $0\bar{4}2$,221), 1.908 (35; $1\bar{6}3$,$4\bar{4}1$). Ottohahnite is triclinic, $P\bar{1}$, a = 9.97562(19), b = 11.6741(2), c = 14.290(1) Å, α = 113.518(8)°, β = 104.282(7)°, γ = 91.400(6)°, V = 1464.59 Å^3, and Z = 2.

Raman spectra of klaprothite, péligotite, and ottohahnite are generally similar and are attributed as follows (cm^{-1}): very broad and low-intensity bands at ~3650–3300 (O–H stretching); very weak bands at ~1650 [$\nu_2(\delta)$ H–O–H bending mode of the H_2O molecules]; 1250 – [$\nu_3(SO_4)$ antisymmetric stretching]; multiple bands in the range ~1080 to ~960 [$\nu_1(SO_4)$ symmetric stretching vibration of symmetrically non-equivalent SO_4 groups]; very low intensity bands at ~960 to ~920 [ν_3 antisymmetric stretching vibration of the $(UO_2)^{2+}$]; very strong bands at ~830 [ν_1 symmetric stretching vibration of the uranyl ion]; medium-weak bands at ~650 [$\nu_4(\delta)$ triply degenerated antisymmetric stretching vibrations of SO_4 tetrahedra] and at ~450 [split $\nu_2(\delta)$ doubly degenerate bending vibrations of the SO_4 groups]; very weak bands at ~550 and ~500 [probably (U-O$_{ligand}$) vibrations]; weak bands with shoulders at ~280 [Na–O stretching vibrations or ν (U-O$_{ligand}$) stretching]; medium intensity bands at ~250 [$\nu_2(\delta)$ doubly degenerate bending vibrations of $(UO_2)^{2+}$]; weak bands at ~150 [O$_{eq}$-U-O$_{eq}$-bending vibrations] and the bands below 100 cm^{-1} are related to the lattice modes. The structures of klaprothite (R_1 = 2.22%) and péligotite (R_1 = 2.28%) both contain $[(UO_2)(SO_4)_4]^{6-}$ clusters in which one SO_4 group has a bidentate linkage with the UO_7 polyhedron; Na-O polyhedra link clusters into thick heteropolyhedral layers and link layers into frameworks; the structures differ in the configuration of Na-O polyhedra that link the layers. The structure of ottohahnite (R_1 = 2.65%) contains $[(UO_2)_4(SO_4)_{10}]^{12-}$ clusters in which each UO_7 polyhedron has a bidentate linkage with one SO_4 group; Na-O polyhedra link clusters into a thin heteropolyhedral slice and also link the slices into a framework. The minerals are named for German chemist Martin Heinrich Klaproth (1743–1817) the discoverer of uranium, zirconium, and cerium, French chemist Eugène-Melchior Péligot (1811–1890) who isolated the first sample of uranium metal and German chemist Otto Hahn (1879–1968) who discovered nuclear fission of uranium. The description of each mineral is based on five cotype specimens. Those are deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. and (one cotype of each) in Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia. **D.B.**

KYAWTHUITE*

A.R. Kampf, G.R. Rossman, C. Ma and P.A. Williams (2017) Kyawthuite, $Bi^{3+}Sb^{5+}O_4$, a new gem mineral from Mogok, Burma (Myanmar). Mineralogical Magazine, 81(4), 753–779.

Kyawthuite (IMA 2015-078), ideally $Bi^{3+}Sb^{5+}O_4$, is a new mineral found as a single waterworn gem crystal in alluvium at Chaung-gyiah-le-ywa in the Chaung-gyi valley, near Mogok, Burma (Myanmar). It was faceted (from roughly rectangular prism of 3.66 carat) into a 1.61 carat gemstone before it was recognized as new species. Crystals of $BiSbO_4$ up to 2 × 4 × 18 mm are known as a synthetic material grown hydrothermally in the range of 450–520 °C. Based on small amount of Ta, trace amounts of Ti, Nb, W, and U, and types of inclusions in the faceted stone it was suggested that the material has natural (probably pegmatite) origin. Kyawthuite is reddish orange, transparent with a white streak and adamantine luster. It does not fluoresce under UV light. The mineral is brittle with a conchoidal fracture, perfect cleavage on {001} and good on {110} and {$\bar{1}10$}. No twinning was observed. The Mohs hardness is 5½; D_{meas} = 8.256(5) and D_{calc} = 8.127 g/cm^3. It does not react with room temperature concentrated HCl, H_2SO_4, and HNO_3. The mineral is optically biaxial with $2V_{meas}$ = 90(2)°; $X = \mathbf{b}$; $Y \approx \mathbf{c}$; $Z \approx \mathbf{a}$. No dispersion was observed, and pleochroism is imperceptible. The refractive indexes calculated based on Gladstone-Dale relationship (2.271), birefringence measured with a Berek compensator (0.156) and $2V$ value are: α = 2.194, β = 2.268, γ = 2.350. Prominent features of Raman spectrum are (cm^{-1}): 793, 736, 453, 396, 322, 258, 173, being similar to those of the pure synthetic $BiSbO_4$. Small peak positions displacements and intensity differences are consistent with the partial substitution of antimony into the bismuth site confirmed by structural study. A reflectance FTIR spectrum shows distinct maxima at 685 and 722 cm^{-1}, a broader band in the 430–510 cm^{-1} region, but no features in the OH region. Additionally, shoulders appear at approximately 760, 641, and 527 cm^{-1}. Transmission FTIR spectrum shows a trace amount of OH/H_2O. The average of electron probe WDS analyses [wt% (range)] is: Bi_2O_3 50.64 (50.34–50.96), Sb_2O_5 50.10 (49.85–50.57) [apportioned as Sb_2O_3 6.90 and Sb_2O_5 42.44, based on the structural data], Ta_2O_5 0.52 (0.33–0.67), total 100.50. The empirical formula based on 4 O pfu is $(Bi^{3+}_{0.82}Sb^{3+}_{0.18})_{\Sigma 1.00}(Sb^{5+}_{0.99}Ta^{5+}_{0.01})_{\Sigma 1.00}O_4$. The strongest lines of the X-ray powder diffraction pattern are [d Å (I%; hkl)]: 3.266 (100; $\bar{1}12$), 2.900 (66; 112), 2.678 (24; 200), 2.437 (22; 020,$\bar{1}14$), 1.866 (21; 024), 1.803 (43; $\bar{1}16$,220,204), 1.6264 (23; $\bar{2}24$,116), 1.5288 (28; 312,$\bar{1}32$). The unit-cell parameters refined from the powder data are: a = 5.430(2), b = 4.854(2), c = 11.762(2) Å, β = 101.271(7)°, V = 304.03(18) Å^3. Single-crystal X-ray data confirms kyawthuite is monoclinic, space group $I2/c$. The unit cell is a = 5.4624(4), b = 4.8852(2), c = 11.8520(8) Å, β = 101.195(7)°, V = 310.25 Å^3, Z = 4. In the structure of kyawthuite (refined to R_1 = 0.0269 for 593 $F_o > 4\sigma F$ reflections), $Sb^{5+}O_6$ octahedra share corners to form chequerboard-like sheets parallel to {001}. Atoms of Bi^{3+}, located above and below the open squares in the sheets, form bonds to the O atoms in the sheets, thereby linking adjacent sheets into a framework. The Bi^{3+} atom is in lopsided eightfold coordination, typical of a cation with stereoactive lone electron pairs. Kyawthuite is isostructural with synthetic β-Sb_2O_4 and clinocervantite (natural β-Sb_2O_4). The mineral was named in honor of Kyaw Thu (b. 1973), a Burmese mineralogist-petrologist-gemologist of from Yangon University who obtained the specimen and provided it for the study. The holotype specimen, a 1.61 carat faceted gem, is deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. **D.B.**

NATROPALERMOITE*

B.N. Schumer, H. Yang and R.T. Downs (2017) Natropalermoite, $Na_2SrAl_4(PO_4)_4(OH)_4$, a new mineral isostructural with palermoite, from the Palermo No. 1 mine, Groton, New Hampshire, USA. Mineralogical Magazine, 81(4), 833–840.

Natropalermoite, (IMA 2013-118), ideally $Na_2SrAl_4(PO_4)_4(OH)_4$, the Na-analog of palermoite [$Li_2SrAl_4(PO_4)_4(OH)_4$], is a new mineral from the Palermo No. 1 mine, Groton, New Hampshire, U.S.A. It is a secondary mineral, formed as a result of hydrothermal alteration of primary triphylite pods in the core-margin zone of the granite pegmatite and is associated with palermoite, childrenite, lefontite, mixed iron oxides, and quartz. Palermoite shows cores of near end-member composition with rims richer in Na, indicating that natropalermoite forms later than palermoite. Natropalermoite crystals are prismatic, up to 200 μm × 50 μm × 45 μm in size, elongated and striated along the **a** axis. The mineral is colorless, transparent with a white streak and vitreous luster and is visually indistinguishable from palermoite. In transmitted light, natropalermoite is colorless and transparent. It is brittle, has perfect cleavage on {001}, fair on {100}. No parting was observed. Fracture is sub-conchoidal to fibrous. Mohs hardness estimated as 5½ by analogy with palermoite. Density was not measured due to the paucity of crystals; D_{calc} = 3.502 g/cm^3. Natropalermoite is nonpleochroic, optically biaxial (–), α = 1.624(1), β = 1.641(1), γ = 1.643(1) (589 nm), $2V_{meas}$ = 43(4)°, $2V_{calc}$ = 38°, dispersion of an optical axes $v > r$, medium to weak. Natropalermoite is insoluble in water and acetone. The Raman spectrum of natropalermoite shows a band at 3215 cm^{-1} (attributed to O–H stretching vibrations), bands between 1142 and 524 cm^{-1} (P–O stretching and bending vibrations), bands between 295 and 462 cm^{-1} (metal-oxygen stretching vibrations), and broad bands below 295 cm^{-1} (translational lattice vibrations). The Raman spectra of natropalermoite and palermoite are virtually indistinguishable. The electron probe WDS analysis average of 10 spots [wt% (range)] is: Al_2O_3 28.6 (28.39–28.95), Mn_2O_3 0.36 (0.17–0.50), Fe_2O_3 0.35 (0.31–0.41), Na_2O 7.68 (7.56–7.87), Li_2O 0.69 (calculated from structure), MgO 0.26 (0.22–0.31), CaO 0.16 (0.11–0.20), SrO 14.5 (14.23–15.29), BaO 0.14 (0.10–0.21), P_2O_5 42.28 (42.06–42.46), H_2O 5.29 (calculated from structure), total 100.29. The empirical formula based on 20 O pfu, is $(Na_{1.69}Li_{0.31})_{\Sigma 2.00}(Sr_{0.95}Mg_{0.04}Ca_{0.02}Ba_{0.01})_{\Sigma 1.02}(Al_{3.82}Mn_{0.03}Fe_{0.03})_{\Sigma 3.88}(P_{1.01}O_4)_4(OH)_4$. The strongest lines in the calculated X-ray powder diffraction pattern are [d_{calc} Å (I_{calc}%; *hkl*)]: 4.907 (68; 121), 4.689 (45; 220), 3.327 (48; 022), 3.128 (100; 321), 3.078 (45; 202), 2.636 (35; 411), 2.453 (38; 242), 2.174 (35; 422). X-ray diffraction intensity data was collected in one single crystal of unreported dimensions. The single crystal unit-cell parameters are: a = 11.4849(6), b = 16.2490(7), c = 7.2927(4) Å, V = 1360.95 Å^3, orthorhombic, space group *Imcb*, Z = 4. The crystal structure of natropalermoite was refined to R_1 = 0.021 for 1257 observed $F_o > 4\sigma F_o$ reflections. Natropalermoite is isostructural with palermoite The natropalermoite structure contains five non-H cation sites: one each for Sr^{2+}, Na^+, Al^{3+}, and two for P^{5+} (P1 and P2), and two nonequivalent H atoms. Two $AlO_4(OH)_2$ octahedra form edge-sharing $Al_2O_7(OH)_3$ dimers. These dimers are corner-linked to one another through $(OH)_2$, forming infinite zigzag chains along [100], which are interconnected by PO_4 groups, which share all four O atoms with Al. Na and Sr atoms are sevenfold and eightfold coordinated, respectively, and are located in two distinct types of channels parallel to [100]. Most remarkably, due to the substitution of Na for Li, the unit-cell b dimension of natropalermoite is significantly longer than that of palermoite: the larger Na atoms increase the width of their accommodating channels in the [010] direction, lengthening the overall b dimension of the unit cell. Natropalermoite is structurally related to carminite, $PbFe_2^{3+}(AsO_4)_2(OH)_2$. The name reflects the presence of sodium (natrium) and the structural isomorphism to palermoite. The holotype sample is deposited in the Mineral Museum of the University of Arizona, Tucson, Arizona, U.S.A. **F.C.**

SULFHYDRYLBYSTRITE*; NEW DATA ON BYSTRITE

A.N. Sapozhnikov, E.V. Kaneva, L.F. Suvorova, V.I. Levitsky and L.A. Ivanova (2017) Sulfhydrylbystrite, $Na_5K_2Ca(Al_6Si_6O_{24})(S_5)(SH)$, a new mineral with the LOS framework, and re-interpretation of bystrite: cancrinite-group minerals with novel extra-framework anions. Mineralogical Magazine, 81(2), 383–402.

Sulfhydrylbystrite, (IMA 2015-010), ideally $Na_5K_2Ca(Al_6Si_6O_{24})(S_5)(SH)$, is a new mineral of the cancrinite group, discovered at Malaya Bystraya lazurite deposit, ~6 km above the confluence of Malaya Bystraya river and Lazurnyi creek, ~25 km from town of Sludyanka, near Lake Baikal, Russia, the same locality where another cancrinite-group mineral bystrite was earlier discovered by Sapozhnikov et. al. (1991) with an ideal formula $(Na,K)_7Ca(Al_6Si_6O_{24})(S^{2-})_3\cdot H_2O$. The rock containing sulfhydrylbystrite is found in a dolomite marble body reaching 90 m in thickness, crumpled in a NE-trending synclinal fold and separated by faults from adjacent alkali granite and syenite bodies. The body contains two lazurite-bearing zones of metasomatic origin, which consist of a series of lenses and vein-shaped bodies of calciphyres with boudins of granites and with lazurite. The feldspathoids of Malaya Bystraya formed in the presence of H_2S-rich fluids, which also caused the syngenetic and later precipitation of pyrite and its subsequent replacement by pyrrhotite. The finding of sulfhydrylbystrite and inconsistencies between the formulae of bystrite obtained from chemical analyses [$(Na_{5.17}K_{1.80}Ca_{1.01})_{\Sigma 7.98}(Si_{6.17}Al_{5.83})_{\Sigma 12}O_{24}(CO_3)_{0.08}(S_3)^{2-}_{1.39}(SO_4)_{0.07}Cl_{0.08}\cdot 1H_2O$], and from the structural data $(Ca_{0.94}Na_{6.40})_{\Sigma 7.34}(Si,Al)_{12}O_{24}(S_3)^{2-}_{1.18}Cl_{0.48}(H_2O)_{0.48}$ (Sapozhnikov et al. 1991; Pobedimskaya et al. 1991) lead the authors to reanalyze the material and provide an upgraded chemistry and structural data on bystrite. Sulfhydrylbystrite occurs as small platy crystals up to 5 mm in elongation, intimately intergrown with lazurite, diopside and calcite with pyrite. Rarely it forms irregularly shaped individual grains ~3 mm in size or their aggregates. The mineral develops at the contact with lazurite, replacing it in some areas where content of sulfhydrylbystrite reaching up to 15–20% of the volume. Bystrite sample studied was found in a partially recrystallized lazurite-bearing calciphyre, where its crystals coexist with lazurite without no reaction relationship. Sulfhydrylbystrite is translucent, yellow, yellow-brown, orange-yellow, or orange, with a yellow streak and vitreous luster. It is brittle with good cleavage on {100} and poor parting on {001}, and it has a conchoidal fracture. The indentation hardness VHS_{100} = 598 (554–657) corresponds to 4½–5 of Mohs scale. D_{meas} = 2.391(1) g/cm^3 (by using a 45 cm long thermogradient tube), D_{calc} = 2.368 g/cm^3. Sulfhydrylbystrite is strongly pleochroic from deep yellow or orange to pale yellow (directions not given). It is optically uniaxial (+), ω = 1.661(2), and ε = 1.584(2) (wavelength not given). The mineral is unstable even in dilute acids, where it quickly discolor and decompose under H_2S evolution. FTIR spectrum of sulfhydrylbystrite powder shows a group of well-defined bands at 462, 501, 534, 583, 619, 673, 712 cm^{-1} (bending vibrations of the tetrahedral framework), a peak observed at 876 cm^{-1} (bending vibration of CO_3), a very intense absorption in the 1100–900 cm^{-1} region (stretching vibrations of the tetrahedral framework), bands at 1798 and 1419 cm^{-1} (stretching vibrations of a CO_3 group), a weak absorption around 2514 cm^{-1} (stretching mode of the SH-group), a broad band at 3436 cm^{-1} (stretching vibrations of water molecules, absorbed by the sample with characteristic bending vibration modes at 1634 cm^{-1}). The average electron probe WDS analyses of 16 spots in one single crystal of sulfhydrylbystrite and (in italics) 12 spots in one single crystal of bystrite [wt% (range)] are: SiO_2 32.0 (32.94–31.28)/*32.9 (33.50–31.03)* Al_2O_3 27.2 (28.42–25.65)/*27.2 (27.75–26.79)*, CaO 4.9 (5.01–4.57)/*5.1 (5.21–4.89)*, Na_2O 14.3 (15.40–12.89)/*19.5 (20.48–19.51)*, K_2O 7.8 (9.03–6.86)/*0.18 (0.35–0.11)*, S 14.7 (15.30–13.94)/*13.8 (14.26–12.81)*, Cl 0.2 (0.46–0.08)/*2.79 (2.79–2.47)*, O=S –1.82/*–1.38*, O=Cl –0.05/*–0.63*, total 99.28/*99.46*. The empirical formula on the basis of (Si+Al) = 12 is $Na_{5.17}K_{1.87}Ca_{0.99}$

$[Al_{6.01}Si_{5.99}O_{24}](S_5)^{2-}_{0.86}(SH^-_{0.86}Cl^-_{0.07})$ for sulfhydrylbystrite and $Na_{7.03}K_{0.04}Ca_{1.01}[Si_{6.04}Al_{5.96}O_{24}](S_5)^{2-}_{0.94}(Cl^-_{0.88}SH^-_{0.12})$ for bystrite. The strongest lines in the X-ray powder diffraction pattern of sulfhydrilbystrite/*bystrite* are [*d* Å (*I*%) *hkl*/*d* Å (*I*%) *hkl*] 4.857 (48)/*4.821 (32) 102*; 3.948 (38)/*3.915 (38) 211*; 3.739 (94)/*3.712 (100) 300*; 3.417 (25)/*3.394 (16) 103*; 3.331 (100)/*3.307 (50) 212*; 2.805 (25)/*2.782 (18) 400*; 2.715 (32)/*2.692 (22) 401*; 2.692 (56)/*2.673 (30) 004*. The unit-cell parameters refined from the powder data are: a = 12.958(1) Å, c = 10.765(1) Å, V = 1565.38 Å^3 for sulfhydrylbystrite and a = 12.852(1) Å, c = 10.692(1) Å, V = 1529.39 Å^3 for bystrite. X-ray diffraction intensity data was collected in one single crystals of 0.140 × 0.100 × 0.067 mm (sulfhydrylbystrite) and 0.350 × 0.320 × 0.250 mm (bystrite). The single crystal unit-cell parameters are accordingly: a = 12.9567(6), c = 10.7711(5) Å, V = 1566.0 Å^3, and a = 12.8257(6), c = 10.6907(5) Å, V = 1529.4 Å^3. Both minerals are trigonal, space group $P31c$, $Z = 2$. The crystal structure of sulfhydrylbystrite was refined to $R_1 = 0.026$ for 2295 observed $I_o > 3\sigma I_o$ reflections while for bystrite it was refined to $R_1 = 0.030$ for 2358 observed $I_o > 3\sigma I_o$ reflections. The crystal structures of both minerals may be described as an ABAC stacking of six-membered rings of SiO_4 and AlO_4 tetrahedra and extra-framework cations and anions located within structural cages. There are two types of cages, cancrinite and losod, stacked into chains at (0, 0, z) and (⅔, ⅓, z), respectively. The cancrinite cage hosts Ca^{2+} and $(SH)^-$ ions, whereas the $(S_5)^{2-}$ polyanion is in the losod cage associated with Na^+ and K^+ cations. Sulfhydrylbystrite is a member of the cancrinite group, chemically related to bystrite and carbobystrite and topologically isotypic with them. Sulfhydrylbystrite differentiates from bystrite in that bystrite has chlorine in cancrinite cages, whereas sulfhydrylbystrite has hydrosulfide in that position. They both have S_5^{2-} polyanions in losod cage. Thus the ideal formula of bystrite is $Na_7Ca(Al_6Si_6O_{24})(S_5)(Cl)$. The name sulfhydrylbystrite comes from the chemical relationship with bystrite and carbobystrite. The holotype specimen of sulfhydrylbystrite is deposited at the Mineralogical Museum of Saint-Petersburg State University. **F.C.**

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Sapozhnikov, A.N., Ivanov, V.G., Piskunova, L.F., Kashaev, A.A., Terentieva, L.E., and Pobedimskaya, E.A. (1991) Bystrite $Ca(Na,K)_7(Si_6Al_6O_{24})(S_3)_{1.5}H_2O$—a new cancrinite-like mineral. Zapiski Vsesouznogo Mineralogicheskogo Obshchestva 120(3), 97–100 (in Russian).

WHITEITE-(CAMGMG)*

A.R. Kampf, P.M. Adams and B.P. Nash (2016) Whiteite-(CaMgMg), $CaMg_3Al_2(PO_4)_4(OH)_2 \cdot 8H_2O$, a new jahnsite-group mineral from the Northern Belle Mine, Candelaria, Nevada, U.S.A. Canadian Mineralogist, 54(6), 1513–1523.

Whiteite-(CaMgMg), IMA 2016-001, ideally $CaMgMg_2Al_2(OH)_2(H_2O)_8[PO_4]_4$, is a new member of the whiteite-jahnsite group from the Northern Belle mine (also known as Argentum mine), Candelaria district, Mineral County, Nevada, U.S.A. It is a low-temperature secondary mineral presumed to have formed as a result of hydrothermal alteration of phosphate nodules derived from the sediments. The mineral occurs in seams in dark-colored massive quartz with embedded pyrite. Other secondary minerals in direct association with whiteite-(CaMgMg) are crandallite, fluorwavellite, montgomeryite, and variscite/metavariscite. The secondary species in the same general assemblage include collinsite, gordonite, overite, and whitlockite. Whiteite-(CaMgMg) occurs as colorless tapering blades, elongated parallel to [100], flattened on {001}, and exhibiting the forms {100}, {010}, {001}, $\{11\bar{1}\}$, and $\{13\bar{1}\}$. The streak is white and the luster is vitreous. It does not fluoresce under SW or LW ultraviolet light. Cleavage is perfect on {001}. Tenacity is brittle and the fracture is irregular and stepped. Mohs hardness is ~4. D_{meas} = 2.48(1) g/cm^3 (by flotation in sodium polytungstate-water mixture), D_{calc} = 2.477 g/cm^3. At room temperature, the mineral is insoluble in H_2O, very slowly soluble in dilute HCl (hours), and slowly soluble in concentrated HCl (minutes). It is optically biaxial (+), α =1.564, β = 1.565, γ = 1.575, $2V_{meas}$ = 24.1°, $2V_{calc}$ = 35.3° (white light). $X = \mathbf{b}$; $Z \wedge \mathbf{a} = 41°$ in obtuse β. No dispersion or pleochroism were observed. The Raman spectrum shows peaks (in cm^{-1}) at 982, 969 (ν_1 PO_4 symmetric stretch); 580 (ν_4 PO_4 asymmetric bend); 484, 430 (ν_2 PO_4 and H_2PO_4 bending modes); and 366, 286, and 234 (metal-oxygen stretch). The FTIR spectrum has a broad peak (in cm^{-1}) at 3426 from (OH) stretch and a broad band at 3195 from H_2O stretch. The H_2O bending mode was observed at 1637 along with the $\nu_3(PO_4)$ antisymmetric and $\nu_1(PO_4)$ symmetric stretch modes at 1123, 1024, and 994, respectively. The electron probe WDS analysis average of 7 spots on two crystals [wt% (range)] is: CaO 8.18 (7.78–8.64), MgO 16.47 (15.94–17.05), FeO 0.13 (0.12–0.16), Al_2O_3 13.35 (13.11–13.60), P_2O_5 38.84 (38.24–39.69), H_2O (by structure) 22.32, total 99.29. The empirical formula based on 26 O pfu is $(Ca_{1.07}Mg_{2.99}Fe^{2+}_{0.01}Al_{1.91}P_4O_{26}H_{18.11}$. The strongest lines in the X-ray powder diffraction pattern are [*d* Å (*I*%; *hkl*)]: 9.20 (82; 001), 4.88 (64; $210,21\bar{1},111$), 2.936 (40; 401), 2.849 (45; $40\bar{3}$), 2.805 (100; 022). The unit-cell parameters refined from the powder data are: a = 14.852(12), b = 7.053(12), c = 9.979(12) Å, β = 110.17(2)°, and V = 981 Å^3. X-ray diffraction intensity data was collected in one single crystal of 0.110 × 0.060 × 0.010 mm. The single crystal unit-cell parameters are: a = 14.8237(19), b = 7.0302(3), c = 9.946(3) Å, β = 110.115(12)°, V = 973.3 Å^3. The mineral is monoclinic, space group $P2/a$, $Z = 2$. The crystal structure of whiteite-(CaMgMg) was refined to R_1 = 0.0436 for 1402 observed $F_o > 4\sigma F_o$ reflections. Whiteite-(CaMgMg) is isostructural with other minerals of the jahnsite-whiteite group. Minerals of that group have the general formula $XM1M2_2M3_2(PO_4)_4(OH)_2 \cdot 8H_2O$. In whitetite-(CaMgMg), $M3$ = 2Al; X = Ca; $M1$ and $M2$ sites are occupied by Mg^{2+} and $2Mg^{2+}$. The structure of whiteite-(CaMgMg) contains chains of corner-sharing $M3^{3+}$ octahedra linked by sharing *trans*-OH corners with one another and further linked by sharing corners of PO_4 groups. The name is in accord with the naming scheme of Moore and Ito (1978): the whiteite root name signifies that the $M3$ site is occupied by Al^{3+} and the suffix is based upon the dominance of Ca at the X site and Mg at both the $M1$ and $M2$ sites. Two cotype specimens are housed in the Mineral Sciences Department, Natural History Museum of Los Angeles County, California, U.S.A. **F.C.**

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WILHELMGÜMBELITE*

I.E. Grey, E. Keck, A.R. Kampf, C.M. Macrae, A.M. Glenn and J.R. Price (2017) Wilhelmgümbelite, $[ZnFe^{2+}Fe^{3+}_3(PO_4)_3(OH)_4(H_2O)_5] \cdot 2H_2O$, a new schoonerite-related mineral from the Hagendorf Süd pegmatite, Bavaria. Mineralogical Magazine, 81(2), 287–296.

Wilhelmgümbelite (IMA 2015-072) ideally $[ZnFe^{2+}Fe^{3+}_3(PO_4)_3(OH)_4(H_2O)_5] \cdot 2H_2O$, is a new secondary phosphate mineral related closely to schoonerite, $[ZnMnFe^{2+}_2Fe^{3+}(PO_4)_3(OH)_2(H_2O)_7] \cdot 2H_2O$. It occurs at the 67 m level of the Cornelia open cut mine in oxidized zones of the Hagendorf-Süd pegmatite, Hagendorf, Oberpfalz, Bavaria, Germany (49°39′1″N, 12°27′35″E). Since 1984 the mine has been flooded and no further specimens can be collected. Wilhelmgümbelite is intimately associated with altered phosphophyllite, partially transformed to steinmetzite. Other associated minerals are albite, Sr-bearing apatite, chalcophanite, jahnsite, mitridatite, muscovite, and quartz. Wilhelmgümbelite forms radiating sprays of needle-like rectangular laths, up to 0.2 mm long with light yellow brown to orange red color, pale yellow brown streak, and dull luster. Cleavage is perfect on {010} and no parting is observed. The crystals are brittle; fracture is uneven. Mohs hardness has not been reported. $D_{\text{meas}} = 2.89$ g/cm^3 (by floatation in bromoform), $D_{\text{calc}} = 2.82$ g/cm^3. Wilhelmgümbelite is weakly pleochroic Z (orange brown) >> Y (yellow brown) > X (light yellow brown). It is optically biaxial (+), $\alpha = 1.560(2)$, $\beta = 1.669(2)$, $\gamma = 1.718(2)$ (white light), $2V_{\text{meas}} = 63(1)°$, $2V_{\text{calc}} = 65°$, $X = \mathbf{b}$, $Y = \mathbf{c}$, $Z = \mathbf{a}$, dispersion of an optical axes is weak $v > r$. Attenuated total reflection infrared spectroscopy on crushed crystals shows a peak at 970 cm^{-1} (P–O stretching vibrations of the PO_4 groups), another peak at 1635 cm^{-1} (H–O–H bending vibration) and a broad featureless peak centered at 3200 cm^{-1} (O–H stretching of H-bonded water molecules). The average of the electron probe WDS analysis of 7 separate crystals [wt% (range)] is: ZnO 16.4 (15.4–17.2), MnO 2.6 (2.4–2.8), $Fe_2O_{3(\text{total})}$ 31.4 (29.9–34.3), [FeO 5.8, Fe_2O_3 25.0 (from structure)], P_2O_5 28.7 (27.6–29.3), H_2O (from structure) 23.4, total 101.9. The empirical formula based on 3 P pfu, with Fe^{2+} and Fe^{3+} consistent with bond lengths and bond valence sums, is $Zn_{1.50}Mn^{2+}_{0.27}Fe^{2+}_{0.60}Fe^{3+}_{2.33}(PO_4)_3(OH)_{2.73}(H_2O)_{8.27}$. The strongest lines in the X-ray powder diffraction pattern are [d Å (I%; hkl)]: 12.65 (100; 020), 8.339 (5; 120), 6.421 (14; 001), 6.228 (8; 011), 4.223 (30; 120), 2.111 (7; 0.12.0). The unit-cell parameters refined from the powder data are: $a = 11.099(5)$, $b = 25.338(4)$, $c = 6.425(2)$ Å, $V = 1806.9$ Å^3. X-ray diffraction intensity data was collected in the macromolecular beam line MX2 of the Australian Synchrotron using one single crystal of 0.18 × 0.05 × 0.03 mm. The single crystal unit-cell parameters are: $a = 10.987(7)$, $b = 25.378(13)$, $c = 6.387(6)$ Å, $V = 1781$ Å^3. The mineral is orthorhombic, space group $Pmab$, $Z = 4$. The crystal structure of wilhelmgümbelite was refined to $R_1 = 0.072$ for 869 observed $I_o > 2\sigma I_o$ reflections. Wilhelmgümbelite is isostructural with schoonerite, with Mn^{2+} replaced principally by Fe^{3+}, and has the Zn partitioned between two different sites 1 Å apart: one fivefold-coordinated as in schoonerite and another tetrahedrally coordinated. Wilhelmgümbelite also differs structurally from schoonerite in having partial occupation of one of the Fe sites, which appears to be correlated with the Zn partitioning. The name is for Carl Wilhelm von Gümbel (1823–1898), who was appointed by King Maximilian II to lead the geological studies of the kingdom of Bavaria and provided essential contributions to the mineralogical and geological investigation of pegmatites and their minerals in the northeastern parts of Bavaria. The name wilhelmgümbelite was chosen to avoid confusion with the obsolete name gümbelite that still appears in the literature as a synonym for illite-2M_2. The holotype specimen of wilhelmgümbelite is housed in the Museum Victoria, Melbourne, Victoria, Australia. **F.C.**

Erratum

We apologize for an error in the list of authors for the mineral Ilyukhinite (August 2017, vol. 102, issue 8, New Mineral Names). It was published as:

N.V. Chukanov, R.K. Rastsvetaeva, K.A. Rozeneberg, S.M. Aksenov, I.V. Pekov, D.I. Belakovskiy and K.V. Van (2016) Ilyukhinite $(H_3O,Na)_{14}Ca_6Mn_2Zr_3Si_{26}O_{72}(OH)_2\cdot 3H_2O$—a new mineral of eudialyte group. Zapiski RMO (Proceedings of the Russian Mineralogical Society),145(2), 44–57 (in Russian).

It should be:

N.V. Chukanov, R.K. Rastsvetaeva, K.A. Rozeneberg, S.M. Aksenov, I.V. Pekov, D.I. Belakovskiy, R. Kristiansen and K.V. Van (2016) Ilyukhinite $(H_3O,Na)_{14}Ca_6Mn_2Zr_3Si_{26}O_{72}(OH)_2\cdot 3H_2O$—a new mineral of eudialyte group. Zapiski RMO (Proceedings of the Russian Mineralogical Society),145(2), 44–57 (in Russian).

Erratum

Kiglapait mineralogy V: Feldspars in a hot, dry magma by S.A. Morse (October, vol. 102, p. 2084–2095, 2017. Article DOI: http://dx.doi.org/10.2138/am-2017-6098; Erratum DOI: http://dx.doi.org/10.2138/am-2017-E1021127.)

In Table 1 of this paper (p. 2087), in the Traverse column, the C_P should be CP for Caplin-Patsy.