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New Mineral Names*

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NEW MINERALS

BRAITHWAITEITE*

W.H. Parr, M.A. Cooper, F.C. Hawthorne, E. Moffat, M.E. Gunther, A.C. Roberts, and P.J. Dunn (2009) Braithwaiteite, $NaCu_5(TiSb)O_2(AsO_4)_4[AsO_3(OH)]_2(H_2O)_8$, a new mineral species from Laurani, Bolivia, Can. Mineral., 47, 947–953.

F.C. Hawthorne, M.A. Cooper, and W.H. Parr (2008) The crystal structure of braithwaiteite. J. Coord. Chem., 61, 15–29.

Braithwaiteite was discovered as several small crystals in a sample of silicified volcanic rock from Laurani in the Bolivian Ag-Sn belt. The exact origin of the sample could not be verified but it is strongly likely that it originated in the supergene portion of the “Veta Negra” vein. The sample consists of interlocking quartz grains, oligoclase partly converted to white mica, “chlorite,” anatase after rutile, small laths of enargite, pyrite, and trace covellite. Secondary minerals associated with braithwaiteite are lammerite (for which this is the type specimen) and lavendulan-lemanskiite.

Braithwaiteite is transparent, sky-blue in color with a very pale blue streak and a vitreous luster. The Mohs hardness is ~2. The measured density is 3.44(2) g/cm^3 and the calculated density is 3.753 g/cm^3, which the authors believe is closer to the actual value by analogy with lavendulan and lemanskiite. Braithwaiteite has a perfect cleavage parallel to {001} and is brittle. The following pinacoids were determined: {001} dominant, {010} less prominent, {100}, $\{10\overline{3}\}$, and {203} subordinate. Optically braithwaiteite is biaxial negative with $\alpha = 1.698(2)$, $\beta = 1.757(5)$, $\gamma = 1.783(5)$ (Na light at 589.3 nm). It is weakly pleochroic with X and Y pale blue, Z greenish blue, and absorption is X = Y < Z. Using the calculated density the compatibility index is excellent.

Chemical analysis of braithwaiteite gave the following results: Na_2O 1.7, CuO 25.8, ZnO trace, FeO 0.2, TiO_2 4.5, Sb_2O5 11.7, As_2O_5 42.3, and H_2O (calc.) 10.17, for a total of 96.37 wt%. This gives an empirical formula of $Na_{0.87}Cu^{2+}_{5.17}Fe_{0.04}(Ti^{4+}_{0.90}Sb^{5+}_{1.15})_{\Sigma 2.05}O_2(As^{5+}_{0.98}O_4)_4[As^{5+}_{0.98}O_3(OH)]_2{\cdot}8H_2O$ [on the basis of 34 anions + 2(OH) + $8H_2O$]. The authors believe the low analytical total is the result of beam damage and possibly an incorrect value for As_2O_5.

An FT-infrared spectrum of braithwaiteite shows the following features: broad absorption maxima at 3586, 3555, 3414, 3223, and 3104 cm^{-1} are attributed to OH stretching and absorption at 1619 cm^{-1} is attributed to H-O-H bending. Overlapping bands attributed to As-O stretching are observed at 865, 843, and 812 cm^{-1}; weak absorption bands at 2338 cm^{-1} are assigned to ν(O-H) stretching and bands at 1189 and 1156 cm^{-1} are possibly O-H in-plane banding.

A powder X-ray diffraction pattern was obtained using Cu*K*α radiation and a Debye-Scherrer camera. The strongest seven lines in the pattern are [d_{hkl} in Å(I_{obs}%,*hkl*)] 9.825(100,001), 5.887(50,011), $4.635(30,\overline{1}02)$, $3.354(30,1\overline{2}2)$, $3.232(30,\overline{2}\,\overline{1}1)$, 2.947(60,022), $2.736(30,\overline{2}\,\overline{2}2)$. The crystal structure was determined using direct methods with a R_1 of 0.025 for 3584 observed reflections. Braithwaiteite is triclinic, space group $P\overline{1}$, $a = 7.0308(4)$, $b = 9.8823(5)$, $c = 10.6754(6)$ Å, $\alpha = 106.973(1)$, $\beta = 104.274(1)$, $\gamma = 93.839(1)°$, $V = 679.76(11)$ Å^3, $Z = 1$, and $a{:}b{:}c = 0.7115{:}1{:}1.0803$.

The main feature of the structure of braithwaiteite is a $[(SbTi)(AsO_4)_4O_2]$ chain formed from a chain of (Sb,TiO_6) octahedra decorated with (AsO_4) tetrahedra. These chains extend in the *a* direction and are cross linked in the *b* direction by chains of edge-sharing (CuO_6) octahedra decorated with arsenate tetrahedra to form $[Cu_2(AsO_4OH)_2O_4]$ chains. The $[(SbTi)(AsO_4)_4O_2]$ and $[Cu_2(AsO_4OH)_2O_4]$ chains link to form layers parallel to (001), which are linked by (CuO_6) and (NaO_6) octahedra and a network of hydrogen bonds.

The name is named for Richard S.W. Braithwaite, chemist and mineralogist at the University of Manchester. A holotype sample has been deposited in the collection of the Canadian Museum of Nature (CMNMC 86085). **G.P.**

ELDFELLITE*

T. Balić-Žunić, A. Garavelli, P. Acquafredda, E. Leonardsen, and S.P. Jakobsson (2009) Eldfellite, $NaFe(SO_4)_2$, a new fumarolic mineral from Eldfell volcano, Iceland. Mineral. Mag., 73, 51–57.

Eldfellite was discovered at surface on the northeastern Eldfell volcano crater rim. Eldfell is a scoria cone of alkalic andesitic composition, the result of eruptive volcanic activity on Heimaey, the largest island in the Vestmannaeyjar archipelago, off the south coast of Iceland. Eldfellite occurs as encrustations on altered hawaiite scoria, associated with abundant sulfates and halogenides: anhydrite, gypsum, hematite, ralstonite, salammoniac, cryptohalite, bassanite, and chessexite. Eldfellite occurs as a frothy crust, 2–3 cm thick, intergrown with tamarugite and a

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* All minerals marked with an asterisk have been approved by the IMA CNMMC.

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potentially new mineral with formula $Na_3Fe(SO_4)_3$. The mineral is yellowish-green to greenish-white, has a white streak, is vitreous, and transparent to translucent. Crystals are platy, 10–20 μm across and 2–3 μm thick, flattened parallel to {001}, with good to perfect cleavage parallel to {001}, and form rosettes on the surface of the scoria.

The chemical composition of eldfellite was determined by EDS on a S3600 Cambridge SEM with an Oxford-Link Ge ISIS ED spectrometer. The average of four analyses (range) gave: SO_3 62.37(60.71–66.14), P_2O_5 1.79(0.97–2.62), TiO_2 0.50 (0.31–0.69), Al_2O_3 0.69(0.53–0.95), Fe_2O_3 25.36(23.83–27.59), MnO 0.22(0.00–0.35), MgO 1.24(0.00–2.72), Na_2O 9.20(8.05–11.62), K_2O 0.24(0.00–0.57), total 101.60 (100.28–103.76) wt%. The empirical formula of eldfellite, based on eight O atoms, is $(Na_{0.77}K_{0.01})_{\Sigma 0.78}(Fe_{0.82}Mg_{0.08}Al_{0.03}Mn_{0.01}Ti_{0.02})_{\Sigma 0.96}(S_{2.01}P_{0.07})_{\Sigma 2.08}O_{8.00}$, and the simplified formula is $NaFe(SO_4)_2$, which requires Na_2O 11.44, Fe_2O_3 29.47, and SO_3 59.09 wt%.

Powder X-ray diffraction data were collected on a Philips PW3710 diffractometer (Cu$K\alpha_1$ radiation). The strongest lines on the pattern [d_{hkl} Å(I_{obs}%,hkl_{obs}), an asterisk (*) designates combined intensity with admixed tamarugite] include: 7.10(11.9,001), 4.00(11.4,200), 3.72(75.6,$11\bar{1}$), 3.64(54.1*,111), 3.55(26.3,$20\bar{1}$), 3.43(53.9,201), 2.77(100,$11\bar{2}$), 2.72(56.9,$20\bar{2}$,020), 2.57(31.1*,020), 2.370(63.1*,003,310), 2.101(12.3,$11\bar{3}$), 2.082(28.2,022), 2.061(18.9,113), 2.007(20.4,$31\bar{2}$), 1.863(21.0,$22\bar{2}$), 1.832(15.5,222), 1.776(13.7,$40\bar{2}$), 1.720(18.6,402), 1.650(32.0,313,$20\bar{4}$), 1.633(24.8,114,$13\bar{1}$), and 1.615(16.3,$22\bar{3}$). The crystal structure of eldfellite was determined by Rietveld methods, using starting parameters from yavapaiite, $R_{wp} = 0.16$ and $R_{Bragg} = 0.11$. Eldfellite is monoclinic, $C2/m$, $a = 8.043(4)$, $b = 5.139(2)$, $c = 7.115(4)$ Å, $\beta = 92.13(2)°$, $V = 293.9(2)$ Å^3, $Z = 2$, $D_{calc} = 3.062$ g/cm^3. Eldfellite is isostructural with yavapaiite, $KFe(SO_4)_2$. The structure is comprised of layers of FeO_6 octahedra parallel to (001), linked by SO_4 tetrahedra, with Na atoms between the layers in a distorted octahedral (elongated trigional antiprism) coordination. It is a member of the yavapaiite group.

The mineral is named for its type locality, the Eldfell volcano, Iceland (IMA no. 2007-051). Type material has been deposited in the mineral collection at the Icelandic Institute of Natural History, Reykjavick, Iceland (catalog no. NI 13556).

Discussion: A high-temperature fumarolic phase with identical formula was discovered in sublimates deposited between September 1965 and February 1967 at the Santiaguto Volcano, Guatemala, but was never described as a new mineral species. **P.C.P.**

FLUORO-POTASSICHASTINGSITE*

M.V. Lupulescu, J. Rakovan, D.M. Dyar, G.W. Robinson, and J.M. Hughes (2009) Fluoro-potassichastingsite from the Greenwood mine, Orange County, New York: a new end-member calcic amphibole. Can. Mineral., 47, 909–916.

Fluoro-potassichastingsite was found in the waste dumps of the Greenwood (Patterson) iron mine. The mine, located in Hudson Highlands, in Harriman State Park, Town of Tuxedo, Orange County, New York. It forms compact aggregates of crystals up to 1 cm in diameter and appears to have formed from the replacement of hastingsite and diopside. Associated minerals are magnetite, diopside, enstatite, pyrrhotite, chalcopyrite, pyrite, and, rarely, phlogopite. Iron mines in the area are part of a belt of deposits extending from the Hudson Highlands into the Reading Prong of Pennsylvania and New Jersey. They are hosted in a sequence of Proterozoic gneisses, amphibolites and marbles that were metamorphosed and sheared during the Grenvillian orogeny. The shear zones acted as conduits for halogen and potassium-rich fluids that formed the fluoro-potassichastingsite.

Crystals of fluoro-potassichastingsite occur as brittle, black, prismatic crystals. It is green and transparent in very thin pieces, with a greenish gray streak, vitreous luster, and a Mohs hardness of 6. D_{obs} and D_{calc} are 3.289 and 3.37 g/cm^3, respectively. There is a perfect cleavage on {110} and the fracture is conchoidal. Optically fluoro-potassichastingsite is biaxial negative with $\alpha = 1.668(2)$, $\beta = 1.688(2)$, $\gamma = 1.698(2)$ and $2V_{obs} = 40–70°$ ($2V_{calc} = 70°$). It is pleochroic with X = bluish green, Y = greenish to brownish green, and Z = blue to light blue. Dispersion is weak, $r < v$, and the optical orientation is $Y = b$ with $Z \wedge c \approx 23°$. There is no fluorescence in ultraviolet light. The Gladstone-Dale compatibility index is superior.

The chemistry of fluoro-potassichastingsite was determined by electron microprobe (major and minor elements), ICP-MS (trace elements), hydrogen extraction (H_2O) and Mössbauer spectroscopy (FeO and Fe_2O_3). The average of 12 analyses (ranges in parentheses) is SiO_2 40.49 (40.13–41.17), TiO_2 0.11 (0.01–0.19), Al_2O_3 10.29 (10.16–10.58), V_2O_3 0.03 (0.004–0.10), Cr_2O_3 0.01 (0.00–0.02), Fe_2O_3 4.49, FeO 19.80 (FeO_{tot} 23.38–24.38), CaO 11.13 (11.05–11.27), MgO 6.68 (6.53–6.82), MnO 0.20 (0.17–0.22), K_2O 2.93 (2.82–3.05), Na_2O 1.24 (1.19–1.33), F 2.23 (2.04–2.31), Cl 0.61 (0.57–0.67), H_2O 0.70, O=(F+Cl) –1.08, sum 99.86 wt%. The empirical formula based on 24 [O+(OH)+F+Cl] is:

$$^{A}(K_{0.59}Na_{0.25})_{\Sigma 0.84}{}^{B}(Ca_{1.87}Na_{0.13})_{\Sigma 2.00}{}^{C}(Fe^{2+}_{2.60}Mg_{1.56}Fe^{3+}_{0.53}Al_{0.26}Mn_{0.03}Ti_{0.01})_{\Sigma 4.99}{}^{T}(Si_{6.36}Al_{1.64})_{\Sigma 8.00}O_{22.68}{}^{O3}[F_{1.11}(OH)_{0.73}Cl_{0.16}]_{\Sigma 2.00}$$

or, ideally, $KCa_2(Fe^{2+}_4Fe^{3+})Si_6Al_2O_{22}F_2$.

A powder X-ray diffraction pattern was obtained using Cu$K\alpha$ radiation. The strongest nine peaks [d_{obs} Å(I_{obs}%, hkl)] include 8.499(100,110), 3.151(76,310), 2.830 (53,330), 3.299(32,240), 2.722(23,151), 2.402(17,350), 3.401(11,131), 1.661(10,461), and 1.453(10,$0\bar{1}\bar{2}1$). The crystal structure of fluoro-potassichastingsite was determined using a 175 × 155 × 52 μm fragment on a Bruker Apex CCD diffractometer with Mo$K\alpha$ radiation. $R_1 = 0.0242$ for 1137 reflections where $F_o > 4\sigma(F_o)$. Fluoro-potassichastingsite is monoclinic with space group C2/m, $a = 9.9480(3)$, $b = 18.1777(6)$, $c = 5.3302(2)$ Å, $\beta = 105.140(1)°$, $V = 930.41(8)$ Å^3, and $Z = 2$.

The name is for the chemical composition and type material is held in the mineral collection of the New York State Museum (catalog no. 21205). **G.P.**

MAVLYANOVITE*

R.G. Yusupov, C.J. Stanley, M.D. Welch, J. Spratt, G. Cressey, M.S. Rumsey, R. Seltmann, and E. Gamberdiev (2009) Mavlyanovite, Mn_5Si_3: a new mineral species from a lamproite diatreme, Chatkal Ridge, Uzbekistan. Mineral. Mag., 73, 43–50.

Mavlyanovite is a new manganese silicide discovered in a lamproite diatreme on the right bank of the upper reaches of the Koshmansay river, Chatkal ridge, Uzbekistan. It occurs with suessite, native iron, moissanite, diamond, chromitel, an unnamed manganese silicicarbide, an unnamed manganese siliciphosphide, khamrabaevite, alabandite and other high-pressure/high-temperature minerals. It occurs together with the two unnamed manganese silicicarbide and siliciphosphide minerals in spherical to ovoid segregations (up to 10 cm in diameter) in volcanic glass. Hexagonal, prismatic crystals of mavlyanovite up to 1–2 mm across occur in the interstices in the matrix. Inclusions of alabandite and khamrabaevite (1–2 μm) occur within the mavlyanovite. The mineral is opaque, metallic, has a dark-gray streak, is brittle with a conchoidal fracture, and has a near-perfect basal cleavage. In plane-polarized light, it is pale brownish-gray and weakly birefringent, non-pleochroic, and displays moderate anisotropy with grayish-brown rotation colors and no internal reflections. In cross-polarized light, the mineral does not display parallel extinction.

The chemical composition of mavlyanovite was determined by WDS methods (Cameca SX100), with the average of 19 analyses (range) giving: Mn 70.84 (70.48–71.1), Fe 6.12 (5.93–6.42), Si 22.57 (22.51–22.68), Ti 0.15 (0.09–0.19), P 0.18 (0.15–0.21), total 98.86 wt%. The empirical formula, based on 8 apfu, is $(Mn_{4.66}Fe_{0.40})_{\Sigma 5.06}(Si_{2.91}Ti_{0.01}P_{0.02})_{\Sigma 2.94}$, and the ideal formula is Mn_5Si_3, which requires Mn 76.52 and Si 23.48 wt%.

The crystal structure of mavlyanovite was determined by direct methods on a 0.025 × 0.040 × 0.285 mm crystal, R_1 = 0.017, wR_2 = 0.044 for $I > 2\sigma(I)$, GooF on F^2 = 1.16 for 124 independent reflections (2070 total reflections). Mavlyanovite is hexagonal, $P6_3/mcm$, a = 6.8971(7), c = 4.8075(4) Å, V = 198.05(3) Å^3, Z = 2, D_{calc} = 6.06 g/cm^3. It was not possible to collect powder X-ray diffraction data; the strongest lines on the calculated pattern [d_{hkl} Å(I_{calc}%,hkl_{calc})] include: 2.258(44,210), 2.230(29,102), 2.044(100,211), 1.991(30,300), 1.972(67,112), and 1.307(22,213). Mavlyanovite is the naturally occurring analogue of synthetic Mn_5Si_3, and the Mn-dominant analogue of xifengite, Fe_5Si_3, which is of extraterrestrial origin. Xifengite is considered as one of the possible lower-mantle phases; the presence of mavlyanovite in mantle rocks, the lamproite, is consistent with high-pressure stability. The structure of mavlyanovite is comprised of 9-coordinated $SiMn_9$ polyhedra, which share faces to form six-membered rings. In the center of each ring is an octahedral void space, thought to contain additional carbon. Sheets of six-membered rings are stacked along the 6_3 screw axis to form a tunnel-like structure parallel to [001].

Mavlyanovite is named for Gani Arifkhanovich Mavlyanov (1910–1988) and his contribution to the geology of Uzbekistan. The mineral and name have been approved by the IMA CNMNC (IMA no. 2008-026) and type material has been deposited in the Geological Museum of the State Committee on Geology and Mineral Resources, Tashkent, Uzbekistan, and at the Natural History Museum, London, U.K. (catalog no. BM 2008,31). **P.C.P.**

MONIPITE*

C. Ma, J.R. Beckett, and G.R. Rossman (2009) Discovery of a new phosphide mineral, monipite (MoNiP), in an Allende type B1 CAI. 72nd Annual Meeting of the Meteoritical Society Abstracts.

One grain of monipite was found in a melilite-rich mantle of a B1 CAI from Allende meteorite. The grain (1.3 × 2.0 μm) is in contact with apatite, tugarovinite (MoO_2), and a Ru-Mo-Ni Grain. Other phases in the mantle are V-rich magnetite, kamiokite ($Fe_2Mo_3O_8$), a Mo-Fe oxide with Mo/Fe ~2, and Nb-rich oxide [$(Nb,V,Fe)O_2$]. Microprobe analysis of monipite gives an empirical formula of $(Mo_{0.84}Fe_{0.06}Co_{0.04}Rh_{0.03})_{\Sigma 0.97}(Ni_{0.89}Ru_{0.09})_{\Sigma 0.98}P$. The best fit to an electron diffraction backscatter pattern was synthetic MoNiP with $P\overline{6}2m$, a = 5.861, c = 3.704 Å, V = 110.19 Å^3, Z = 3. D_{calc} = 8.27 g/cm^3. No other physical data was provided.

The authors believe monipite formed from the oxidation of a Mo + P alloy during alteration that mobilized Ca, Mo, Fe, and Ni. The name is for the chemistry. Type material is cataloged as USNM 7554. **G.P.**

PLIMERITE*

P. Elliott, U. Kolitsch, G. Giester, E. Libowitzky, C. McCammon, A. Pring, W.D. Birch, and J. Brugger (2009) Description and crystal structure of a new mineral—plimerite, $ZnFe^{3+}_4(PO_4)_3(OH)_5$—the Zn-analogue of rockbridgeite and frondelite, from Broken Hill, New South Wales, Australia. Mineral. Mag., 73, 131–148.

Plimerite is a new Zn-analogue of rockbridgeite and frondelite, discovered at the Block 14 Opencut, Broken Hill Pb-Zn-Ag deposit in western New South Wales, Australia. The Block 14 Opencut contains phosphate-rich zones derived from the weathering of primary fluorapatite, a common accessory mineral in the sulfide orebody. Plimerite occurs in seams and cavities in quartz-garnet-goethite-rich rocks from the Block 14 Opencut. On the type specimen, it is associated with hinsdalite-plumbogummite, calcian pyromorphite, libethenite, brochantite, and malachite. On other specimens, it is also associated with tsumebite and strengite. Plimerite occurs as pale green to dark olive-green, hemispherical aggregates of radiating acicular crystals. It also occurs, less commonly, as pale olive-green to dark green-black, acicular-to-elgongated, bladed and prismatic crystals as either individual crystals or as hemispherical radiating sprays and aggregates. Crystals are up to 0.5 mm in length, with aggregates up to ~3 mm across. Individual crystals are elongate along [001], with the dominant forms {100}, {010}, and {001}. Plimerite is translucent, has a pale grayish-green streak, a vitreous luster, non-fluorescent, has excellent cleavage parallel to {100}, is brittle with an uneven fracture, Mohs hardness of 3.5 to 4, D_{meas} = 3.67(5) g/cm^3, D_{calc} = 3.62 g/cm^3. Optically, plimerite is biaxial negative (–), α = 1.765(5) β = 1.764(4), γ = 1.767(4), $2V_{calc}$ = –63°, XYZ = cab, with pleochroism Z = pale bluish-green, Y = pale brown, Z = pale bluish-green, and absorption $Z > X > Y$.

Both Raman and FTIR spectroscopy were performed on plimerite. The Raman spectrum shows bands at 3585 and ~3050 to ~3460 cm^{-1} (OH stretching), 1110, 1055, 1018, and 965 cm^{-1} (ν_1 and ν_3 PO_4 vibrations), and 631, 584, 474, 390, and 297 cm^{-1} [overlapping bands of ν_4 and ν_2 PO_4 vibrations and vibrations from the $Fe(O,OH)_6$ and $(Zn,Fe)(O,OH)_6$ octahedra]. The FTIR spectrum of plimerite shows bands at 3720 and 2910 cm^{-1} (OH stretching), 1020 and 1060 cm^{-1} (ν_3 antisymmetric stretching of PO_4), 966 cm^{-1} (ν_1 symmetric stretching of PO_4), and 550 and 450 cm^{-1} (ν_4 and ν_2 bending of PO_4).

The chemical composition of plimerite was determined by WDS methods on a Cameca SX51 electron microprobe. Listed here is the analysis of the type specimen (G32005) used for single-crystal X-ray structure determination: P_2O_5 32.37, As_2O_5 0.09, Al_2O_3 4.48, Fe_2O_3 29.82, FeO 2.98, MnO 0.02, MgO 0.00, CaO 0.17, CuO 0.00, ZnO 20.17, PbO 0.36, H_2O_{calc} 6.84, total 97.30 wt%, corresponding to the empirical formula (based on 17 oxygen atoms) $Fe^{3+}_{2.53}Zn_{1.68}Al_{0.60}Fe^{2+}_{0.28}Ca_{0.02}Pb_{0.01}P_{3.09}As_{0.01}O_{17}H_{5.15}$. The ideal formula for plimerite is $ZnFe^{3+}_4(PO_4)_3(OH)_5$, which requires ZnO 12.35, Fe_2O_3 48.49, P_2O_5 32.32, H_2O 6.84, total 100.00 wt%.

A Mössbauer spectrum of plimerite was obtained at room-temperature in transmission mode, constant acceleration, using a ^{57}Co source in a 6 μm Rh matrix. The spectrum is dominated by a single quadrupole doublet with additional minor contributions with a wider splitting. The spectrum was fitted with three doublets: one for Fe^{2+} in octahedral coordination, and two for Fe^{3+} with identical center shifts but varied quadrupole splittings, also attributable to Fe^{3+} in octahedral coordination. Calculation of the ratio of Fe^{2+}/Fe^{3+} reveals 89% of the Fe_{tot} to be Fe^{3+} in octahedral coordination.

The crystal structure of plimerite was determined on a 0.11 × 0.02 × 0.016 mm crystal (G32005). The structure was solved by direct methods and refined on F^2, with 9305 total reflections measured, 790 unique reflections, 735 reflections with $F^2_o > 4s(F^2_o)$, R_1 [$F^2_o > 4s(F^2_o)$] = 0.0964, wR_2 for all F^2_o = 0.1987, GooF = 1.095. Plimerite is orthorhombic, *Bbmm*, *a* = 13.811(3), *b* = 16.718(3), *c* = 5.141(10) Å, *V* = 1187.0(4) Å^3, *Z* = 4. Powder X-ray diffraction data were collected on a Guinier-Hägg camera (100 mm in diameter, Cr*K*α radiation). The strongest lines on the diffraction pattern [d_{hkl} Å(I_{obs}%,hkl_{obs})] include: 6.922(30,020), 4.638(50,111), 4.194(15,004,112), 3.651(35,113), 3.579(30,024), 3.433(35,130,040), 3.388(50,041), 3.369(55,131), 3.168(100,132,114), 2.753(60,115), 2.575(90,200), 2.414(75,116,151,220,045), 2.400(50,135,221), 2.263(15,061), 2.143(25,117), 2.049(20,241), 1.957(40,225), 1.893(20,206), 1.826(20,226), and 1.643(15,049). The refined unit-cell parameters from the powder X-ray diffraction data are given as *a* = 13.804(4), *b* = 16.736(4), *c* = 5.145(5) Å, *V* = 1188.6(6) Å^3.

The crystal structure of plimerite contains three M sites in a distorted octahedral environment, and two P sites coordinated by four O in tetrahedral arrangement. The substitution of Zn^{2+} in plimerite for both Fe^{2+} and Fe^{3+} in rockbridgeite results in a deficiency in positive charge. The mineral is isotypic with rockbridgeite, consisting of face-sharing trimers of $M\phi_6$ octahedra that are linked by edge-sharing to form chains parallel to the b direction. These chains link to clusters of pairs of corner-sharing $M\phi_6$ octahedra that further link to PO_4 tetrahedra, forming sheets parallel to (001). The sheets link via octahedra and tetrahedra corners into a heteropolyhedral framework structure.

Plimerite is named for Ian Plimer, Professor of Mining Geology, the University of Adelaide and Emeritus Professor of Earth Sciences, University of Melbourne, in recognition of his contributions to the geology of ore deposits, in particular the Broken Hill deposit. The mineral and name have been approved by the IMA CNMNC (IMA no. 2008-013). Type material has been deposited in the Department of Mineralogy, South Australian Museum, Adelaide, South Australia (catalog no. G32005). **P.C.P.**

STETINDITE*

J. Schlüter, T. Malcherek, and T.A. Husdal (2009) The new mineral stetindite, $CeSiO_4$, a cerium end-member of the zircon group. Neus Jb. Mineral. Abh., 186, 195–200.

Stetindite was discovered in vugs in massive yttrian fluorite in the Stetind pegmatite, Tysfjord, 135 km NE of Bodø, Norway. The mineral occurs in cavities in massive yttrian fluorite, a product of a F-rich fluid formed via liquid immiscibility during the cooling of the pegmatite magma. REE have a strong affinity for this phase of the pegmatite, and 25 REE minerals have been found as inclusions in this yttrian fluorite, stetindite being one of them. It occurs as diverging aggregates of acicular, often tapered, crystals, up to 1.5 mm in length and 0.05 mm thick. Observed forms include the tetragonal prism {100} or {110}, the pinacoid {001} and an unidentified pyramid. Associated species include hematite, hundholmenite-(Y), quartz, törnebohmite-(Ce), vyuntspakhkite-(Y), calcioancylite-(Nd), kozoite-(Nd), Nd-rich bastnåsite, and a new Ca-Y-Al-F silicate phase. An unidentified Y-Al-F carbonate phase often encrusts the stetindite as globular aggregates. Other associated phases include allanite-(Ce), bastnåsite-(Ce), F-rich britholite-(Y), calcioancylite-(Ce), keiviite-(Y), keiviite-(Yb), kuliokite-(Y), rowlandite-(Y), fluorthalénite-(Y), thorite, uraninite, uranophane-beta, yttrialite-(Y), and zircon. Stetindite is pale yellow to colorless, has a white streak, no observable fluorescence, is transparent, has an adamantine luster, is brittle with uneven fracture, and no apparent cleavage. The Vickers microhardness is VHN25/50 = 354 kg/mm^2, corresponding to a Mohs hardness of 4 to 5, D_{calc} = 5.03 g/cm^3. The mineral is uniaxial positive (+) with a calculated main refractive index of 2.01.

The chemical composition of stetindite was determined by WDS methods (Cameca SX100 electron microprobe). The average of 39 analyses gave: CeO_2 65.17, Y_2O_3 6.35, Gd_2O_3 1.32, SiO_2 25.94, F 0.69, O≡F–0.29, total 99.18 wt%, giving an empirical formula based on four anions pfu of $(Ce_{0.87}Y_{0.13}Gd_{0.02})_{\Sigma 1.01}Si_{1.00}(O_{3.92}F_{0.08})_{\Sigma 4.00}$, with an ideal formula of $CeSiO_4$, which requires CeO_2 74.13, SiO_2 25.87, total 100.00 wt%. A Raman spectrum shows weak OH bands between 3200 and 3700 cm^{-1}, confirming the presence of OH^- in stetindite.

Single-crystal X-ray diffraction data were collected on a 0.1 × 0.01 × 0.01 mm crystal of stetindite. The structure was solved and refined on F^2 with 2007/198/184 measured/unique/observed reflections, respectively, *R* for $I > 3\sigma(I)$ = 0.028, w*R* = 0.07, GooF = 0.96. Stetindite is tetragonal, $I4_1/amd$, *a* = 6.9746(7), *c* = 6.2055(8) Å, *V* = 301.87(6) Å^3. Powder X-ray diffraction data were collected on a Philips X'Pert diffractometer (Cu*K*α radiation). The strongest lines on the pattern [d_{hkl} Å(I_{obs}%,hkl_{obs})] include: 4.616(30,101), 3.478(100,200), 2.766(13,211), 2.617(30,112), 2.451(18,220), 2.167(20,301), 1.839(13,321), 1.789(39,312), and 1.731(14,400). Stetindite has a zircon-type structure, and is the Ce^{4+}-analogue of both zircon and hafnon.

The mineral is named for the type locality, the Stetind pegmatite, Tysfjord, Norway. Both the mineral and name have been approved by the IMA CNMNC (IMA no. 2008-035), with holotype material deposited in the collection at the Mineralogical Museum of the University of Hamburg, Germany (catalog no. NO-001/08). **P.C.P.**

STEVERUSTITE*

M.A. Cooper, F.C. Hawthorne, and E. Moffatt (2009) Steverustite, $Pb_5^{2+}(OH)_5[Cu^+(S^{6+}O_3S^{2-})_3](H_2O)_2$, a new thiosulfate mineral from the Frongoch Mine Dump, Devils Bridge, Ceredigion, Wales: description and crystal structure. Mineral. Mag., 73, 235–250.

Steverustite was discovered in the mine dumps at the Frongoch Pb-Zn mine, Pontryhydrygroes, Upper Llanfihangell-y-Creudyn, Ceredigion, Wales. The principal ore minerals in the mine are galena and sphalerite, which occur in a discontinuous series of veins associated with faults that cut through Silurian mudstones, shales, and arenites of the Devils Bridge formation. Steverustite occurs in small cavities (up to a few millimeters across) in quartz veins and is associated with galena, covellite, cerussite, anglesite, hemimorphite, sussannite, bechererite, and caledonite. It is a late-stage mineral, forming after caledonite and bechererite by the late-stage oxidation of galena. Crystals are fibrous to acicular, <0.75 mm long, forming fan-like bundles >1.5 mm across, elongated along [010], bounded by ($h0l$) faces. Steverustite is colorless to white, transparent, has a white streak, a vitreous luster, is brittle with a splintery fracture, and does not fluoresce under UV light. The D_{calc} = 5.150 g/cm^3, and the calculated mean refractive index is 1.94.

The chemical composition of steverustite was determined by WDS methods on a Cameca SX 100 with the analysis giving PbO 72.59, SO_3 15.78, Cu_2O 4.47, S^{2-} 6.32, H_2O 4.83 $O{\equiv}S^{2-}$–3.15, total 100.84 wt%, resulting in the empirical formula, based on $O+(OH)+(H_2O)+S^{2-}$ = 18.67 apfu (from crystal structure determination), $Pb^{2+}_{4.99}Cu^{+}_{0.96}(S^{6+}O_3S^{2-})_{3.03}(OH)_{4.88}(H_2O)_{1.67}$, and the ideal formula $Pb_5^{2+}(OH)_5[Cu^+(S^{6+}O_3S^{2-})_3](H_2O)_2$, which requires PbO 71.95, SO_3 15.49, Cu_2O 4.61, S^{2-} 6.20, H_2O 4.84, $O{\equiv}S^{2-}$–3.09, total 100.00 wt%. The FTIR spectrum of steverustite contains strong absorption bands at 3587 and 3507 cm^{-1} (OH stretching), a broad band at 3368 and prominent band at 1646 cm^{-1} (H_2O bending), and strong bands at 1120–1140 and 988 cm^{-1} (tetrahedrally coordinated S^{6+}).

Single-crystal X-ray structure data were collected on a crystal of steverustite (6 × 40 × 180 μm). The structure was solved by direct methods and refined to R_1 = 0.027, wR_2 = 0.061, GooF = 1.222, for 3366 independent reflections with $|F_o| > 4\sigma|F|$. Steverustite is monoclinic, $P2_1/n$, a = 12.5631(7), 8.8963(5), c = 18.0132(11) Å, β = 96.459(1)°, V = 2000.5(3) Å^3, Z = 4. Powder X-ray diffraction data were collected on a 114.6 mm Debye-Scherrer camera with a Gandolfi attachment (Cu$K\alpha$ radiation), with intensities visually estimated. The strongest lines on the pattern [d_{hkl} Å(I_{obs}%,hkl_{obs})] include 6.897(80,$\bar{1}$11), 6.211(60,200), 4.797(60,211), 3.943(100,$\bar{1}$14), 3.741(20,122), 3.556(20,023), 3.482(20,221), 3.348(70,$\bar{3}$13), 3.178(20,$\bar{2}$23), 3.026(60,$\bar{3}$14), and 2.837(50,016). Unit-cell parameters refined by the powder data are a = 12.51(3), b = 8.859(16), c = 18.08(4) Å, β = 96.33(19)°, V = 1992(5) Å^3. The structure contains five distinct Pb^{2+} cations (8 to 11 coordinated), all of which show lone-pair behavior and form a strongly bonded cluster of composition $[Pb_5(OH)_5]$. There is one Cu^+ triangularly coordinated by three S^{2-} that belong to three thiosulfate groups, forming a $Cu^+(S^{6+}O_3S^{2-})$ group. The $[Pb_5(OH)_5]$ units and $[Cu(S_2O_3)_3]$ groups form layers of composition $[Pb_5(OH)_5Cu(S_2O_3)_3]$ parallel to (010), which are linked by weaker bonds. Steverustite is chemically similar to sidpietersite, $Pb_4^{2+}(S^{6+}O_3S^{2-})O_2(OH)_2$, the only other thiosulfate mineral with a known structure to date.

Steverustite is named after Stephen Andrew Rust (b.1952), a collector of UK minerals and who discovered the mineral at the Frongoch mine. The mineral and name have been approved by the IMA CNMNC (IMA no. 2008-021). Holotype material has been deposited at the Canadian Museum of Nature (catalog no. CMNMC 86053). **P.C.P.**

NEW DATA

HASTITE

F.N. Keustch, H.-J. Förster, C.J. Stanley, and D. Rhede (2009) The discreditation of hastite, the orthorhombic dimorph of $CoSe_2$ and observations on trogtalite, cubic $CoSe_2$, from the type locality. Can. Mineral., 47, 969–976.

Hastite, proposed as the orthorhombic dimorph of $CoSe_2$ by Ramdohr and Schmitt (1955), is discredited after a chemical analysis of material from the type sample proved it to be ferroselite ($FeSe_2$). Hastite was initially identified on the basis of its X-ray diffraction pattern, its violet to reddish-brown color (thought to be indicative of cobalt-bearing minerals) and the presence of cobalt in the associated selenium ores from the Trogtal Quarry near Lautenthal, Harz Mountains, Germany. No chemical analysis was possible due to the size of the mineral.

Examination of ores from the Trotgal quarry led to a re-examination of the holotype sample (Smithsonian National Museum of National History no. 112811). Electron microprobe analyses of the holotype samples demonstrated that the "hastite" was in fact ferroselite with an empirical formula of $(Fe_{0.99}Cu_{0.01})_{\Sigma1.00}Se_{1.99}$. XRD and reflectance data confirm the identity of "hastite" as ferroselite. The discreditation of hastite has been approved by the IMA CNMNC (IMA no. 07-E). **G.P.**