New Mineral Names*†

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This new mineral names has entries for 12 new minerals, including belakovskiite, ekplexite, forêtite, grigorievite, kaskasite, koksharovite, leonardsenite, manganokaskasite, rickturnerite, rumseyite, tondiite, and whiteite-(CaMnMn).

BELAKOVSKIITE*


Belakovskiite (IMA 2013-075), ideally Na₇(UO₂)₄(SO₄)₄(SO₃OH)(H₂O)₃, is a new uranyl sulphate mineral from the Blue Lizard Mine, Red Canyon, White Canyon district, San Juan Co., Utah, U.S.A. (37°33′26″N 110°17′44″W). This underground U mine is host to a large number of rare Na-bearing secondary uranyl minerals related to the post-mining oxidation of primary uraninite, pyrite, chalcopyrite, bornite, and covellite deposited as replacement of wood and other organic material and as disseminations in the enclosing medium-to-coarse-grained sandstone of the Shinarump Member of the Chinle Formation (Upper Triassic age). The genesis of the main ore is related to percolated ore solutions in permeable sandstone between less permeable siltstone and claystone. The new mineral occurs in efflorescence on sandstone in permeable sandstone between less permeable siltstone and claystone. The new mineral is opaque to white light; 2V ≈ 90°. The empirical formula calculated on the basis of 25 O apfu is Na₇(U₁.0₄O₂)(SO₄)₄(SO₃OH)(H₂O)₃. The strongest lines of the X-ray powder diffraction pattern are [d, Å (I, %); hkl]: 8.96 (35; 002), 8.46 (29; 011), 5.19 (100; 010), 4.66 (58; 013, T02, T00, 110), 3.568 (37; 120, 023, 005, 033), 3.057 (59; 076, 1T5, T31), 2.930 (27; 075, 125, 026, 105, T31, T32, 173, 124), 1.8320 (29; 162, 2T6, 2T4, 075, 101, 177, 164, 058, 054). The crystal structure of belakovskiite was solved by direct methods and refined to R = 5.39%. The mineral is triclinic, P₅, a = 5.4581(3), b = 11.3288(6), c = 18.4163(13) Å, α = 104.786(7), β = 90.092(6), γ = 96.767(7), V = 1092.76 Å³, and Z = 2. The crystal structure of belakovskiite is based on a 3D framework that is unique among known uranyl sulphates structures. The framework consists of uranyl groups linked to four [SO₄] tetrahedral and a H₂O molecule forming [(UO₂)(SO₄)₄(H₂O)]⁶⁻ clusters linked to each other via an extensive network of Na-O bonds and hydroxyl groups involving eight Na sites, three other (H₂O) sites, and the (SO₄OH) group. The mineral was named in honor of Dmitry Ilyich Belakovskiy (b. 1957), a prominent Russian mineralogist and Curator of the Fersman Mineralogical Museum in Moscow, Russia. The cotype specimen is deposited in the collections of the Natural History Museum of Los Angeles County. Another cotype is at the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Yu.U.

EKPLEXITE*, KASKASITE*, AND MANGANOKASKASITE*


Ekplexite (IMA 2011-082), ideally (Nb,Mo)S₂·(Mgₓ,Al)ₙ(OH)₂ₓ, kaskasite (IMA 2013-025), ideally (Mo,Nb)S₂·(Mgₓ,Al)ₙ(OH)₂ₓ, and manganokaskasite (IMA 2013-026), ideally (Mo,Nb)S₂·(Mnₓ,Al)ₙ(OH)₂ₓ, are new minerals from the Mt. Kaskasnychornch, Khibiny alkaline complex, Kola Peninsula, Russia. The minerals are of hydrothermal origin, and occur in fenites formed by the influence of a peralkaline fluid acting as a source of Nb on a large xenolith of alumina-rich metamorphic rocks (metapelites) located inside a huge intrusion of agpaitic nepheline syenite. The minerals are associated with orthoclase, anorthoclase, and nepheline with fluorophlogopite, corundum,

* All minerals and names marked with an asterisk have been approved by the IMA CNMMNC.
† For a complete listing of all IMA-validated unnamed minerals and their codes, see http://pubsites.uws.edu.au/ima-cnmnc/.
pyrrhotite, pyrite, rutile, monazite-(Ce), graphite, edgarite, molybdenite, tungstenite, alabandite, and others. Ekplexite was initially found as isolated, lenticular nests up to 0.2 x 1 x 1 mm in a nepheline-feldspar fenite. It occurs as near-paralleled, radiating or chaotic aggregates of mica-like, corrugated flakes no more than 0.1 mm across and 0.01 mm thick. Ekplexite was later found as flakes up to 0.02 x 0.5 x 0.7 mm epitaxially overgrowing Ti-bearing pyrrhotite, as are kaskasite and manganokaskasite. Kaskasite generally occurs as separate lamellar or flaky, mica-like crystals flattened on {001} with their (near-) parallel “stacks” up to 1 x 1.5 mm across and 0.03 mm in thickness. The {001} faces of kaskasite are coplanar to the {001} faces of pyrrhotite. Lamellae of kaskasite are usually irregularly shaped, but fragments of a crude hexagonal shape have been observed. Striations on the {001} faces are typical; three systems of streaks cross at 60°. Manganokaskasite also forms lamellar to flaky crystal up to 0.5 x 1 mm across and 0.03 mm in thickness. It also forms internal reflections and are strongly anisotropic. Bireflectance values (589 nm) are ΔR = 10.2 (ekplexite), 12.4 (kaskasite), and 14.1% (manganokaskasite). All three are also strongly pleochroic, from light gray to dark gray for ekplexite, from light gray with a yellowish hue to gray for kaskasite, and from light yellowish to blue gray for manganokaskasite. Reflectance values were measured between 400 and 700 nm in 20 nm intervals. The values for (COM) wavelengths [Rₜₐₚ, Rₐₜₐ, % (0.1 mm in mm)] in air are: 8.7, 18.9 (470); 8.7, 19.4 (546); 8.8, 19.0 (589); 8.6, 19.2 (650) for ekplexite, 8.6, 21.5 (470); 9.2, 21.6 (546); 9.2, 21.5 (589); 8.9, 21.3 (650) for kaskasite, and 10.4, 25.6 (470); 10.5, 25.0 (546); 10.6, 24.7 (589); 10.6, 24.5 (650) for manganokaskasite. The Ramster spectrum of ekplexite shows two distinct absorption bands at 3530 and 3326 cm⁻¹ (O-H stretching vibrations), a wide band at 2113 cm⁻¹ (M-OH bending vibrations), and narrow bands at 526 and 438 cm⁻¹ (Al···O and Mg···O stretching vibrations). The absence of absorption bands in the range 1200–1700 cm⁻¹ indicates the absence of H₂O molecules as well as other H-bearing groups in ekplexite. The absence of bands in the range 750–1300 cm⁻¹ indicates the absence of S-O, Mo-O, and Nb-O bonds. The average of 5 electron probe WDS analyses on the holotype of ekplexite gave [wt% (range)]: Mg 6.25 (5.91–6.82), Al 4.31 (3.89–4.73), Ca 0.00, V 0.86 (0.57–1.10), Mn 0.00, Fe 0.44 (0.18–0.82), Nb 18.17 (17.04–19.23), Mo 15.89 (15.07–16.28), W 8.13 (7.56–8.64), S 27.68 (26.30–28.91), O 16.33 (15.02–17.37), and H (calc. on the basis that all O are O-H) 1.03, total 99.09 wt%. The average of 5 electron probe WDS analyses on the holotype of ekplexite gave [wt% (range)]: Mg 5.94 (5.76–6.10), Al 3.67 (3.44–4.26), Ca 0.04 (0.00–0.14), V 0.16 (0.05–0.45), Mn 0.23 (0.00–0.46), Fe 1.44 (0.66–2.61), Nb 13.39 (12.14–13.77), Mo 23.18 (21.70–26.49), W 7.59 (0.88–10.05), S 27.09 (26.08–28.14), O 15.66 (14.46–16.93), and H (calc.) 0.99, total 99.08 wt%. The average of 3 electron probe WDS analyses on the holotype of manganokaskasite gave [wt% (range)]: Mg 0.06 (0.00–0.14), Al 3.00 (2.75–3.28), Ca 0.00, V 0.15 (0.09–0.24), Mn 11.44 (10.77–12.08), Fe 2.06 (1.35–2.92), Nb 14.15 (13.16–14.76), Mo 20.08 (19.46–20.65), W 9.12 (8.68–9.55), S 24.84 (24.66–25.00), O 13.36 (12.84–14.13), and H (calc.) 0.89, total 99.15 wt%. On the basis of 2 S pfu, the empirical formulas are: (Nb₀.₄,Mo₀.₃,Wₐ₀.₃)O₂₃S₀.₃Fe₂ₒ.₀₂₋₀.₉₉(ΟΗ₂),₃ for ekplexite, (Mo₀.₅₇,Nb₀.₃₂,W₀.₃₀)O₂₀.₀₁₋₁.₂₁S₀.₇₄ for manganokaskasite, and (Mo₀.₅₅,Nb₀.₃₈,W₀.₃₁)O₁₉.₀₀₋₂.₁₀S₀.₇₅(Mo₀.₅₄,Al₀.₂₅,Fₐ₀.₁₉)Mₐ₀.₁₉(OΗ₂),₃ for manganokaskasite. The strongest lines in the X-RAY powder-diffraction pattern [dₐₜ, Å (Iₐₜ%)] are: 11.40 (100; 001), 5.65 (56; 002), 2.812 (21; 100) and 1.622 (11; 110,111) for ekplexite, 5.72 (100; 002), 11.46 (97; 001), 2.786 (51; 100), 1.613 (33; 111) and 1.557 (10; 106,112) for kaskasite, and 5.66 (100; 002), 11.39 (85; 001), 2.769 (43; 100,101), 2.663 (25; unassigned), 1.608 (23; 111), 2.455 (18; unassigned), and 1.559 (13; 112). All three minerals are trigonal, space group P₃m₁, P₃₃₁, or P321, one-layer polytypes (Z = 1). The unit-cell parameters refined from powder-diffraction data for the sulfide sub-lattice are: a = 3.262(2), c = 11.44(2) Å, V = 105.4 Å³ for ekplexite, a = 3.220(2), c = 11.47(2) Å, V = 102.8 Å³ for kaskasite, and a = 3.243(3), c = 11.61(1) Å, V = 105.8 Å³ for manganokaskasite. The unit-cell parameters for the hydroxide sub-lattice are: a = 3.066(2), c = 11.52(2) Å, V = 93.8 Å³ for ekplexite, a = 3.073(2), c = 11.50(2) Å, V = 94.0(4) Å³ for kaskasite, and a = 3.118(2), c = 11.62(1) Å, V = 97.9(2) Å³ for manganokaskasite. The curved and flaky nature of the crystals of the three minerals prevented their analysis by single-crystal X-ray diffraction. Partial success was achieved for a crystal of kaskasite, although the crystal was imperfect and the data of poor quality. This data showed kaskasite is trigonal, a = 3.27(3), c = 11.96(12) Å, V = 111.2 Å³. Ekplexite, kaskasite, and manganokaskasite are members of the vallerite-group minerals and are close to other members in terms of general stoichiometry, symmetry, X-ray diffraction patterns, morphology, physical properties, and optical data. Their structures are non-commensurate and consist of the MoS₆-type (Mo = Nb, Mo, W) sulfide modules and the brucite-type hydroxide modules. The combination of Nb and Mo at the same position in the structure in these minerals is noteworthy. Ekplexite is named after the Greek word έκπληξη meaning surprise, for its exotic combination of major chemical constituents. Kaskasite is named after the type locality, Mount Kaskasnyunchorr, in Khibiny, and manganokaskasite is named as a manganese analog of kaskasite. All type specimens are deposited in the systematic collection of the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. O.C.G.

**FORÉTITE***


Forétite (IMA2011-100), ideally Cu₆Al₆(AsO₄)(OH,OH,HO)₉, is a new secondary arsenate mineral from the Cap Garonne mine,
Koksharovite* and Grigorievite*

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(2014) Koksharovite, CaMgFe₂³⁺(VO₄)₆, and grigorievite, CuFe³⁺Al₃(VO₄)₉, two new howarddevansite-group minerals from volcanic exhalations. European Journal of Mineralogy, 26(5), 667–677.

Koksharovite (IMA 2012-092), ideally CaMgFe²⁺₃⁺(VO₄)₆, and grigorievite (IMA 2012-047), ideally CuFe³⁺Al₃(VO₄)₉, are two new minerals of the howarddevansite group discovered in exhalations of fumaroles of 2 volcanoes at Kamchatka Peninsula, Russia. Koksharovite was found in a single specimen at the Bezmyannyi volcano (55°58’N; 160°36’E), and grigorievite, at the apical part of the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano (55°41’N; 160°14’E).

Koksharovite forms equant to prismatic typically hoper crystals, up to 30 × 70 μm (usually 5 × 15 μm) or their groups on the andesite scoria in association with fibrous bannermanite and 2 uncharacterized Fe-Al and Ca vanadates. It also occurs as aggregates up to 80 μm in the products of alteration of porous scoria by fumarolic gas forming along with biotite, quartz, and (Ti,V)-rich magnetite pseudomorphs after an unknown mineral significantly replaced by bannermanite. Koksharovite is yellowish- to reddish-brown, translucent, with an adamantine luster and yellowish-brown streak. The mean micro-indentation hardness VHN₉₀ = 368 (272–458) kg/mm² corresponding to ~4½ of Mohs scale; Dₐ₀ = 3.39 g/cm³. Like grigorievite, koksharovite is brittle, with no cleavage or parting, and uneven fracture. In reflected light koksharovite is light gray with distinct yellow-brown to red internal reflections, and is weakly anisotropic. The reflectance values measured in air with a 20 nm interval are gradually decreasing 17.5–13.2 (Rₖ) and 16.5–12.5 (Rₐ) from 700 to 400 nm. The data for COM wavelengths [Rₖ, Rₐ (∙ in nm)] are: 15.3, 16.8 (470), 14.1, 15.9 (546), 13.8, 15.3 (589), 13.4, 14.8 (650). The average of 3 electron probe WDS analyses gave: Na₂O 0.76 (0.74–0.78), K₂O 0.05 (0.03–0.08), MgO 0.43 (0.38–0.48), CaO 0.44 (0.41–0.47), TiO₂ 0.02 (0.01–0.03), Fe₂O₃ 0.46 (0.44–0.48), MnO 0.11 (0.09–0.12), Al₂O₃ 0.04 (0.02–0.06), and SiO₂ 0.34 (0.30–0.36). The average X-ray powder diffraction patterns [dₐ₀ Å (Iₐ₀% h k l)] are: 7.307 (100; 010.070), 3.141 (24; 240.200), 2.818 (24; 240.270), 4.519 (23; 111), 2.343 (22; 131). The unit-cell parameters obtained from the powder-diffraction experiment are a = 9.6969(9), b = 7.7676(9), c = 8.5911 (Å), α = 82.01(9), β = 71.68(8), γ = 102.68(8)°, V = 415 Å³, triclinic, space group P T and Z = 2. The low quality of the powder diffraction pattern did not allow solving the crystal structure. Koksharovite is named in honor of Jean-Paul Forêt (b. 1943), a retired engineer of the French Ministry of Equipment, who worked as geologist-in-charge of major risks and the environment. He was a co-founder of the project which turned the Cap Garonne mine into a nationally protected site and museum in 1994 (Musée de la Mine de Cap Garonne), and is since then a museum scientific advisor. Cotyype specimens are deposited in the collections of the Natural History Museum of Los Angeles County (catalog numbers 63573, 63574, 63575, 63576, and 63577); Museum Victoria, Melbourne, Australia (registration number MS1746); Muséum National d’Histoire Naturelle, Paris, France (catalog number 211.58).

References cited


Grigorievite is triclinic, space group P1̅1̅. The [MIIO₅] octahedra share edges and form dimeric clusters isolated from each other, which are white with a white streak. Many physical properties could not be determined due to the small size of the crystals. D_{calc} = 3.67 g/cm². The calculated refractive index is 1.38. The average of 6 electron probe EDS analyses is [wt% (range)]: Mg 14.66 (13.74–15.14), Al 16.16 (15.10–16.84), F 52.98 (51.37–54.21), O 15.888 (15.13–16.40), and H 1.78 (calculated from the OH required for charge neutrality plus remaining O as H₂O), total 101.46 wt%. The empirical formula based on two cations pfu is Mg₀.₁₀Al₀.₉₀[Fe₀.₆₄(OH)₀.₃₆]₀.₆₄(OH)₀.₃₆. The strongest lines in the X-ray powder-diffraction pattern [d_{min}, Å (I_{min}, %); hkl] are: 5.66 (100; 011), 4.92 (29; 101), 3.53 (27; 200), 3.03 (31; 031), 3.00 (38; 211), 2.30 (16; 231), 1.77 (19; 400) and 1.76 (24; 242). Leonardsenite is orthorhombic, space group Imma. The unit-cell parameters refined from powder-diffraction data are: a = 7.055(1) Å, b = 10.117(2) Å, c = 6.813(1) Å, V = 486.3 Å³, and Z = 4. Leonardsenite is identical to the synthetic phase MgAlF₄(H₂O)₂ (Weil and Werner, 2001). The structure contains infinite chains of [AlF₆] octahedra along the c-axis which are connected via common fluoride atoms to isolated [MgFe₂(H₂O)₆] octahedra. The mineral is named after Erik Leonardsen (b. 1934), the former leader of the X-ray Diffraction Laboratory of the Geological Institute, University of Copenhagen, for his work on the diffraction characterization of the fumarolic minerals from Icelandic volcanoes as well as his contribution to definition of a number of new minerals. The holotype and cotype specimens are deposited in the mineral collection of the Icelandic Institute of Natural History, Gardabaer, Iceland. Part of holotype is in the “C.L. Garavelli” Museum, Dipartimento di Scienze della Terra e Geoambientali, Università di Bari, Italy. O.C.G.

References cited

Leonardsenite*  


Leonardsenite (IMA2011-059), ideally MgAlF₄(H₂O)₂, is a new mineral found as a post-eruptional fumarolic encrustation collected at the northeast rim of the main crater of the Eldfell volcano, Heimaey island, Iceland subsequent to the 1973 eruption in association with jakobssonite and anhydrite, ralstonite, jarosite, anhydrous AlF₃, opal-A, and oskarssonite. The subsurface temperature measured at the time of the last sampling in 1995 was less than 100 °C. Leonardsenite has also been found in a fumarole field along the fissure above the eastern main crater of the 1991 eruption of Hekla volcano (Iceland) associated with ralstonite, opal-A, jakobssonite, malladrite, fluorite, and other unidentified minerals. The ground temperature where leonardsenite was collected ranged from 170 to 190 °C. Leonardsenite was first reported as a potentially new mineral under the name “mineral HR” by Jakobsson et al. (2008). It was listed as the valid unnamed mineral UM2008-288-F:AIHMgO (Smith and Nickel 2007). Leonardsenite forms soft and fragile white earthy crusts of granular and columnar crystals up to 20 μm in length, with the most common forms {011} and {101}. Crystals are white with a white streak. Many physical properties could not be determined due to the small size of the crystals. D_{calc} = 2.31 g/cm³. The calculated refractive index is 1.38. The average of 6 electron probe EDS analyses is [wt% (range)]: Mg 14.66 (13.74–15.14), Al 16.16 (15.10–16.84), F 52.98 (51.37–54.21), O 15.888 (15.13–16.40), and H 1.78 (calculated from the OH required for charge neutrality plus remaining O as H₂O), total 101.46 wt%. The empirical formula based on two cations pfu is Mg₀.₁₀Al₀.₉₀[Fe₀.₆₄(OH)₀.₃₆]₀.₆₄(OH)₀.₃₆. The strongest lines in the X-ray powder-diffraction pattern [d_{min}, Å (I_{min}, %); hkl] are: 5.66 (100; 011), 4.92 (29; 101), 3.53 (27; 200), 3.03 (31; 031), 3.00 (38; 211), 2.30 (16; 231), 1.77 (19; 400) and 1.76 (24; 242). Leonardsenite is orthorhombic, space group Imma. The unit-cell parameters refined from powder-diffraction data are: a = 7.055(1) Å, b = 10.117(2) Å, c = 6.813(1) Å, V = 486.3 Å³, and Z = 4. Leonardsenite is identical to the synthetic phase MgAlF₄(H₂O)₂ (Weil and Werner, 2001). The structure contains infinite chains of [AlF₆] octahedra along the c-axis which are connected via common fluoride atoms to isolated [MgFe₂(H₂O)₆] octahedra. The mineral is named after Erik Leonardsen (b. 1934), the former leader of the X-ray Diffraction Laboratory of the Geological Institute, University of Copenhagen, for his work on the diffraction characterization of the fumarolic minerals from Icelandic volcanoes as well as his contribution to definition of a number of new minerals. The holotype and cotype specimens are deposited in the mineral collection of the Icelandic Institute of Natural History, Gardabaer, Iceland. Part of holotype is in the “C.L. Garavelli” Museum, Dipartimento di Scienze della Terra e Geoambientali, Università di Bari, Italy. O.C.G.

References cited

Rickturnerite*  

Rickturnerite (IMA 2010-034), ideally PbO$_4$(Mg(OH))$_3$(OH) Cl$_3$, is a new mineral from the Torr Works (Merehead) quarry, near the village of Cranmore in Somerset, U.K. Rickturnerite occurs in cavities inside a manganite and pyrolusite pod, as pale emerald green to grey porous aggregates of disordered interwoven minute fibrous crystals (typically less than 5 μm wide and 200 μm long; occasionally 40 × 100 μm in cross section and over 1 mm in length). It is associated with mereheadite, cerussite, calcite, aragonite, mimetite, hydrocerussite, “plumbonacrite,” and an uncharacterized lead oxychloride. Rickturnerite is pale emerald green and translucent, with white streak and vitreous luster. Mohs hardness is ~3. Needles are brittle with an indistinct cleavage, breaking with a splintery fracture. $D_{calc} = 6.886$ g/cm$^3$. The average of electron probe WDS analyses gave: PbO 87.70 (86.80–88.40), MgO 1.79 (1.63–1.99), CuO 0.14 (0.10–0.16), Cl 6.62 (6.43–6.88), H$_2$O 2.27 (from structure data), $-\text{O}=\text{Cl}$ 1.50; total 97.02 wt%. On the basis of 12 anions pfu, the empirical chemical formula is Pb$_{7.16}$ Mg$_{0.84}$Cu$_{0.16}$H$_{4.02}$F$_{0.60}$Cl$_{1.51}$·1.15 H$_2$O. The strongest lines in the X-ray powder-diffraction pattern [d]$_h$ Å ([f00]; kkl) are: 6.474 (100; 400), 3.233 (73; 107), 2.867 (57; 705), 5.636 (44; 011), 3.112 (31; 802). The unit-cell parameters obtained from the powder-diffraction experiment are $a = 5.82(1)$, $b = 22.80(3)$, $c = 25.88(2)$ Å. Single crystal X-ray diffraction analysis revealed orthorhombic symmetry with space group $Pnam$, $a = 5.8024(6)$, $b = 22.717(2)$, $c = 25.879(3)$ Å, $V = 3411.2$ Å$^3$, and $Z = 8$. The diffraction pattern contains strong reflections that define a subcell with $a = 5.8034(5)$, $b = 11.3574(9)$, $c = 12.939(2)$ Å, and $V = 852.9$ Å$^3$ (space group $Pmn2$) which is related to the real unit cell by the transformation matrix $[100/020/002]$ and weak reflections that correspond to doubled $b$ and $c$ parameters. The crystal structure was solved by direct methods and refined using 1318 unique reflections to $R_I = 0.063$. The structure is composed of a fully ordered part consisting of double [O$_4$Pb$_2$]$_2$ chains of oxocentred [OPlb] tetrahedra extended along the $b$-axis, which together with Cl ions form two-dimensional blocks parallel to (001). In between these blocks, there is a disordered region containing ordered [Mg(OH)$_2$]$^{4+}$ octahedra and low-occupancy Pb and OH sites with a slight degree of ordering; these produce the weak supercell reflections. Rickturnerite is named in honor of its discoverer, geologist and mineral collector Rick Turner. The holotype specimen of is deposited at the Natural History Museum in London, U.K., under the registered number BM 2008,100, where a probe block (P15150) and several cotype specimens are also registered. F.C.

**Rumseyite**


Rumseyite (IMA 2011-091), ideally [Pb$_2$OF]Cl, is a new mineral from Merehead quarry, Somerset, England. Rumseyite occurs in a single cavity (~1.5 × 1 × 1 mm) in one of manganese oxide pods irregularly distributed in Carboniferous Limestone at the Merehead (also known as Torr Works) quarry. Rumseyite is found enclosed in a platy mass of hydrocerussite with characteristic foliated appearance, off-white color with a distinct greenish tinge, and pearly luster. Rumseyite forms an irregular crystalline mass, which SEM examination shows to be composed of aggregates of minute tabular to prismatic crystallites with pyramidal terminations. No twinning has been observed. The small size of the micro-crystals precludes direct measurement but they show forms that appear to be {100} prisms, with {111} pyramid and rarely, small {001} pinacoid terminations. Associated minerals (not in direct contact) are calcite, cerussite, diaboleite, and undifferentiated Mn oxides, typically a mixture of manganite and pyrolusite. Rumseyite is translucent pale orange-brown with a white streak and vitreous luster. It is brittle with perfect {100} cleavage. Hardness and density could not be determined. $D_{calc} = 7.72$ g/cm$^3$. In reflected light rumseyite is gray with abundant pale-yellow internal reflections; it is not pleochroic and has no birefringence. Any anisotropy is masked by the internal reflections. The calculated mean refractive index for 589 nm is 2.15. The average of 25 electron probe WDS analyses gave: PbO 90.63 (90.73–92.44), F 3.53 (3.05–3.75), Cl 7.15 (6.89–7.33), $-\text{O}=\text{F}\{\text{Cl}\}$ 3.23; total 99.08 wt%. On the basis of 3 anions pfu, the empirical chemical formula is Pb$_2$O$_6$F$_{0.71}$Cl$_{0.29}$. A single, well-formed 250 × 80 × 80 μm in size was used for single-crystal and powder-diffraction analysis. Single-crystal analysis revealed tetragonal symmetry, $I4/mmm$, $a = 4.065(1)$, $c = 12.631(7)$ Å, $V = 208.7$ Å$^3$, $Z = 2$. The crystal structure was solved by direct methods and refined using 64 unique reflections to $R_I = 0.072$. The crystal structure of rumseyite is based on alternating [OFPb$_2$] and Cl layers. Rumseyite is related to other layered Pb oxyhalides. Fluorine and oxygen are statistically disordered over one crystallographic site. After crushing the crystal fragment used for single crystal work, an X-ray powder-diffraction pattern was collected showing the following strongest lines [d] Å ([f00]; kkl): 2.923 (100; 013), 2.875 (68; 110), 3.848 (41; 011), 6.306 (17; 002), 1.680 (14; 123), 2.110 (12; 006). Refinement in the tetragonal space group $I4/mmm$ produced $a = 4.07(1)$, $c = 12.61(1)$ Å, $V = 208.4$ Å$^3$, with $Z = 2$. Rumseyite is named in honor of its discoverer, Michael Scott (Mike) Rumsey (b. 1980), Curator and Collections Manager at the Natural History Museum in London, U.K., where the holotype specimen of rumseyite is deposited. Mike is noted for his work on the mineralogy of the Mendip Hills and Kombat mine (Namibia), and in particular for studies of Pb oxychlorides and related Pb secondary minerals, which have already led to the description of several new minerals. F.C.

**Tondiite**


Tondiite (IMA 2013-077), ideally Cu$_3$Mg(OH)$_6$Cl$_2$, is a new supergene mineral found in phonolitic tephrite of Vesuvius volcano, Italy, and (associated with haydeeite) in the Santo Domingo Cu Mine, Caleta Vitor district, Arica Province, Chile (18°45′51″S; 70°18′16″W). The specimen considered to be a holotype was found in the Collezione Vesuviana of the Real Museo Mineralogico, Università di Napoli, Italy (catalog no. 1178R), labeled as “1906 lava.” In this phonolitic-tephrite-vesicular lava erupted from Vesuvius, tondiite occurs in millimeter-sized vesicles in association with leucite, sodalite, nepheline, sanidine, and Fe oxides and hydrox-
ides. Tondiite from Santo Domingo mine occurs with haydeeite, anhydrite, and atacamite as an alteration product of chalcolite, bornite, and chalcoprite from veins embedded in andesitic porphyric lavas and lava tuff, banded by calcareous limestone. This cotype specimen is deposited in the Mineralogical Museum, University of Hamburg, Germany. The tondiite crystals reach by estimation from the photo) at least up to 200 μm. The main habit forms are {101} and {012}. The mineral is emerald-green, transparent, vitreous. Mohs hardness is 3–3.5; $D_{\text{calc}} = 3.503 \text{g/cm}^3$. It is optically uniaxial (+), $\alpha = 1.749(6)$, and $\varepsilon = 1.766(7)$ (589 nm). Tondiite is slightly pleochroic from green to faintly green (absorption scheme not given). The average of 15 electron probe WDS analysis on the holotype and 20 on the cotype gave: CuO 65.90 (62.74–67.98), MnO 0.94 (0.58–1.92), MgO 6.61 (5.34–9.20), Cl 16.79 (15.88–17.63), H$_2$O 13.84, $-\delta$Cl 3.79, total 100.29 wt% (holotype), and CuO 66.78 (65.11–68.57), MgO 6.12 (4.54–6.79), Cl 17.05 (16.76–17.34), H$_2$O 13.52, $-\delta$Cl 3.85, total 99.62 wt% (cotype). (H$_2$O is calculated from stoichiometry assuming Cl– and OH – as the only anions). On the basis of 8 anions pfu the empirical formulas are respectively: Cu$_{2.26}$Mg$_{0.03}$Mn$_{0.03}$[OH$_{1.55}$Cl$_{0.45}$]$\text{Cl}_9$ and Cu$_{2.34}$Mg$_{0.02}$[OH$_{1.58}$Cl$_{0.42}$]$_9$. Raman spectra of the tondiite holotype identified due to very weak signal only 5 well-distinguished peaks between 300 and 1200 cm$^{-1}$: 942 and 695 cm$^{-1}$ (metal-oxygen deformations); 363, 395, and 503 cm$^{-1}$ (stretching vibrations). The strongest lines of the calculated powder X-ray diffraction pattern $|d_{\text{calc}}| (I_{\text{calc}}; hkl)$ are: 5.50 (101), 4.29 (112), 3.94 (100), 2.88 (110), 2.76 (112), 2.59 (200), 2.26 (52), and 1.82 (100). The crystal structure was refined to $R_w = 6.4\%$ based on 491 unique reflections with $F^2 > 4\sigma(F)$. Tondiite is trigonal, space group $R\bar{3}m$, with $a = 6.8377(7)$ Å, $V = 570.4 \text{Å}^3$, for the holotype specimen and with $a = 6.8345(2) / 6.8384(2)$ Å, $c = 14.00(7)/14.0103(5)$ Å, $V = 566.42 / 567.4 \text{Å}^3$ for 2 crystals of the cotype specimen (the second crystal was later used for microprobe analysis). The crystal structure is similar to that of the herbertsmithite. In tondiite, Cu atoms are [6]-coordinated by O and Cl atoms, and Cu octahedra form layers of 6-memebred rings (the interlapper). Copper kagome layers are connected through Mg atoms occupying the interlayer space. The new mineral is named in honor of Matteo Tondi (1762–1835), an eminent Italian mineralogist co-author with R.J. Haüy of the classic Traité de Minéralogie. Yu.U.

**WHITEITE-(CaMnMn)**


Whiteite-(CaMnMn) (IMA 2011-002), ideally CaMnMn$_2$Al$_3$[PO$_4$]$_3$(OH); 8H$_2$O, is a new hydrous phosphate from the Hagendorf-Süd granitic pegmatite no. 25 (49°39′1″N, 12°27′35″E) (Germany), the type locality for 10 other secondary phosphate species. Primary phosphates in this pegmatite include triphylite, minerals of the zwieselite-triplite series, wolfeite, hagendorfite, sarsenite, scorzalite, graffonite, arrojadite-(NaFe), and fluorapatite; these have been altered and leached by low-temperature oxidizing hydrothermal solutions to produce numerous secondary phosphates including bassette, barbosalite, benyacarite, bemerinite, childrenite, ferrisickerite, flueelite, hureaulite, jahnsite-(CaMnMn), koninckite, kryzhanovskite, lipscombite, mitridatite, morinite, paravauxite, phosphophyllite, phosphoferrite, reddingite, rockbridgeite, stewartite, vivianite, whitmoreite, jungite, keckite, laueite, lehnerite, nardouite, parascholzite, pseudolauite, scholzite, strunzite, and wilhelmi-vierlingite. Associated minerals which are characteristic of this deposit include arsenopyrite, bismuth, bismuthinite, chalcoprite, columbite-(Fe), covellite, greenockite, hematite, molybdenite, muscovite, pyrite, pyrrhotite, sphalerite, uraninite, and zircon.

Whiteite-(CaMnMn) is colorless to pale yellow, depending on its Fe$^{3+}$ content, and has a vitreous luster. It forms bar-shaped crystals elongated along [100] and tabular on [010]. The crystals are either simply or polysynthetically twinned on [010], with dominant pinacoidal {100}, {010}, {001}, and {101} faces. The mineral is transparent, with a white streak, perfect cleavage on {010} and a stepped fracture. It is brittle with Mohs hardness $~3.5$, $D_{\text{meas}} = 2.70(3) \text{g/cm}^3$ and $D_{\text{calc}} = 2.768 \text{g/cm}^3$. In transmitted light, the mineral is colorless and nonpleochroic. It is optically biaxial positive, with $\alpha = 1.589(2)$, $\beta = 1.592(2)$, $\gamma = 1.601(2)$ (589 nm); $\psi_{\text{meas}} = 60(10)^\circ$, $\psi_{\text{calc}} = 60.3^\circ$. No dispersion was observed. The optical orientation is $X = b$, $Z^* = a = 5^\circ$. The average of electron probe WDS analyses on 13 crystals (5–6 analyses per crystal) gave: Na$_2$O 0.53 (0.00–1.03), MgO 0.88 (0.56–1.41), Al$_2$O$_3$ 11.66 (7.78–13.32), P$_2$O$_5$ 34.58 (33.84–35.14), CaO 4.29 (3.68–4.90), MnO 17.32 (15.21–18.93), FeO 8.32 (5.87–13.71), ZnO 2.60 (1.74–4.14), H$_2$O 2.27 (by the Penfield method), total 99.68 wt%.

On the basis of 4 P apfu (Fe$^{3+}$ calculated to maintain charge balance) the empirical chemical formula is (Ca$_{0.65}$Zn$_{0.26}$Na$_{0.14}$)$_{20}$Mn$_{0.60}$Fe$^{3+}_{0.40}$O$_{12}$[PO$_4$]$_3$(OH)$_2$7.89H$_2$O. The mineral is easily soluble in 10% HCl at room temperature. The strongest lines in the X-ray powder-diffraction pattern $|d_{\text{obs}}| (I_{\text{obs}}; hkl)$ are: 9.443 (65; 001), 5.596 (25; 011), 4.929 (80; 210), 4.719 (47; 100), 3.949 (46; 400), 2.7958 (100; 022). The unit-cell parameters obtained from the powder-diffraction experiment are $a = 15.02(2)$, $b = 6.95(1)$, $c = 10.13(3)$ Å, $\beta = 111.6(1)^\circ$, $V = 983.3 \text{Å}^3$, and $Z = 2$. Single-crystal analysis revealed monoclinic symmetry with space group $P2_1/a$, $a = 15.02(5)$, $b = 6.959(2)$, $c = 10.13(7)$ Å, $\beta = 111.47(4)^\circ$, $V = 983.3 \text{Å}^3$. The crystal structure was refined to $R_w = 0.063$. The structure is similar to that of other whiteite group members. The mineral is named for the chemical composition, in accordance with whiteite group nomenclature. Type material is deposited in the collections of the Mineralogical Museum of St. Petersburg State University, Russia; catalog number 1/19470. F.C.