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New Mineral Names*,†

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AMMONIOMAGNESIOVOLTAITE*

S. Szakáll, I. Sajó, B. Fehér, and S. Bigi (2012) Ammoniomagnesiovoltaite, a new voltaite-related mineral species from Pécs-Vasas, Hungary. Canadian Mineralogist, 50(1), 65–72.

Ammoniomagnesiovoltaite (IMA-2009-040), ideally $(NH_4)_2Mg_5Fe^{3+}_3Al(SO_4)_{12}\cdot18H_2O$, is a new mineral found in an open coal pit near the Köves Hill, Pécs-Vasas, Mecsek Mountains, Southern Hungary. It is associated with tschermigite, sabieite, kieserite, pickeringite, and hexahydrite. Other ammonium minerals (salammoniac, mascagnite, clairite, boussingaultite, efremovite, koktaite, mohrite, ammoniojarosite, godovikovite, letovicite) as well as native sulfur, millosevichite, alunogen, metavoltine, voltaite, gypsum, anhydrite, halotrichite, butlerite, jarosite, and copiapite are also found nearby. The mineral formed as the result of the interaction of organic matter with oxidizing pyrite and marcasite. Ammoniomagnesiovoltaite forms crusts of pale-yellow to yellow-brown vitreous translucent cubo-octahedral and octahedral crystals up to 0.05 mm in size with a white streak. The mineral has a Mohs hardness of 2–3, is brittle with an uneven fracture, has no cleavage and dissolves in water. $D_{meas} = 2.55(1)$, $D_{calc} = 2.351$ g/cm^3. Ammoniomagnesiovoltaite shows no fluorescence and is optically isotropic with $n = 1.60(1)$. The main absorption bands of IR spectrum (cm^{-1}, br = broad, sh = shoulder, sp = split, w = weak) are: 3423br and 3263sh (O-H stretching), 1641 (H-O-H bending), 1431 (presence of NH_4^+), 1122sp and 1065sp (SO_4^{2-} asymmetric stretch), 1014w (SO_4^{2-} symmetric stretch), 594 (SO_4^{2-} asymmetric bend), and 474 (SO_4^{2-} symmetric bend). The average of 5 electron-microprobe analysis (WDS) gave [wt% (range)]: SO_3 47.56 (46.59–48.75), Al_2O_3 3.31 (3.25–3.36), FeO (total) 16.99 (15.99–18.11), [Fe_2O_3 (calc) 12.28, FeO (calc) 5.94], MnO 1.18 (1.11–1.25), MgO 7.02 (6.87–7.27), K_2O 0.05 (0.05–0.06), $(NH_4)_2O$ (by spectrophotometry) 3.11, and H_2O (calc) 17.72, total 98.17 wt%. Weight percent for Fe^{2+} and Fe^{3+} are determined assuming $(Mg + Fe^{2+} + Mn^{2+})/(Fe^{3+} + Al) = 5/4$, and by stoichiometry for H_2O. This leads to the empirical formula $[(NH_4)_{2.18}K_{0.02}]_{\Sigma2.20}(Mg_{3.19}Fe^{2+}_{1.51}Mn_{0.30})_{\Sigma5.00}(Fe^{3+}_{2.81}Al_{1.19})_{\Sigma4.00}S_{10.87}O_{44.70}\cdot18H_2O$ on the basis of $(Mg + Mn + Fe + Al) = 9$ apfu. The strongest lines in the X-ray powder-diffraction pattern [d_{obs} Å (I_{obs}%; *hkl*)], collected from a synthetic crystal of ammoniomagnesiovoltaite due to paucity of the material, are: 5.59 (100; 422), 3.420 (72; 800), 3.562 (66; 731), 1.7836 (25; 15.3.1), 1.5582 (25; 16.6.4), and 6.85 (24; 400). X-ray powder-diffraction data indexed on the basis of a cubic lattice yields space group $Fd\bar{3}c$, $a = 27.260(2)$ Å, $V = 20257$ Å^3, $Z = 16$. Single-crystal X-ray studies were not possible due to the small size of the crystals. Ammoniomagnesiovoltaite is a member of the voltaite-group minerals, with ammonium as the dominant monovalent cation, and the mineral is named for the dominance of ammonium and magnesium in its composition. Type materials are deposited in the collections of the Herman Ottó Museum, Miskolc, under catalog number 2008.233, and at the Department of Mineralogy and Petrology, Hungarian Natural History Museum, Budapest, catalog number Gyn.1590. **O.C.G.**

ARANGASITE*

G.N. Gamyanin, N.V. Zayakina, and L.T. Galenchikova (2013) Arangasite, $Al_2(PO_4)(SO_4)F\cdot7.5H_2O$, a new mineral from Alyaskitovoye deposit (Eastern Yakutia, Russia). Zapiski Rossiyskogo Mineralogicheskogo Obshchestva, 142(5), 21–30 (in Russian, English abstract).

A new mineral arangasite (IMA 2012-018), ideally $Al_2(PO_4)(SO_4)F\cdot7.5H_2O$ was discovered at Alyaskitovoye Sn-W deposit in the lower part of Arangas Stream, the tributary of Elga River, Indigirka River Basin, Eastern Yakutiya, Russia (64°39 N; 142°70 E). The mineral is named after its locality. The stock of leucocratic Li-F porphyry granites (100 ± 3 Ma) hosting Alaskitovoye deposit is intensively greisenized and crosscut by quartz-muscovite-tourmaline-sulphides veins 0.2–0.8 m thick

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* All minerals (and their names) 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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with muscovite-tourmaline-apatite-fluorite greisens in their selvages. Beryl, molibdenite, wolframite, cassiterite, pyrite, arsenopyrite, chalcopyrite, galena, sphalerite, triplite, Ag-Bi sulphosalts, and hubnerite were precipitated during a few stages of primary mineralization. The upper part of the deposit is significantly altered. Arangasite was found in the cavities in veins and greisens with iron hydroxides, scorodite, anglesite, malachite, stibikonite, and valentinite replacing primary minerals or forming recrystalized aggregates. The mineral forms white dense chalky aggregates up to 3 cm in big cavities or fibrous aggregates in small cavities. Individual crystals are up to 1 × 100–200 μm. Arangasite has dull to silky luster, white streak, and Mohs hardness of 1–2. It is not water soluble and is not fluorescent. $D_{\text{meas}} = 2.01(1)$, $D_{\text{calc}} = 2.001$ g/cm^3. In transmitted light the mineral is colorless, nonpleochroic. It is optically biaxial (supposed to be positive by analogy with sanjuanite) with $\alpha = 1.485(5)$, $\gamma = 1.493(5)$ ($\lambda = 589$ nm); $2V$ and β were not determined. Fibrous crystals show extinction at the angle of 45°. X is parallel to crystal elongation and Z is perpendicular to that. The main absorption bands of IR spectrum (cm^{-1}) are: 3399, 3211 (H_2O molecules); 2510; 1655 (bending vibration of H_2O); 1086, 828, 589, 488 (SO_4^{2-} and PO_4^{3-} anions). TGA-DTA analysis (in Ar atmosphere) shows endothermic effects at 115, 151, 193, 250, 809 °C and one exothermic at 657 °C. The weight loss while heating up to 500 °C is 34.73 wt%. The total weight loss after heating to 1000 °C is 53.47 wt%. The IR spectrum and TGA-DTA data show the basic similarity to sanjuanite. The data on chemical compositions were obtained by wet chemical analysis and EMPA (EDS). The average of 2 wet chemical analysis/6 EMPA analyses (EDS) (H_2O by Penfield method) is: Al_2O_3 26.64/25.36, P_2O_5 17.20/18.50, SO_3 19.10/20.55, F 4.58/5.22, $-O{=}F_2$ 1.92, H_2O 34.24, total 99.83 wt%. The content of As up to 1 wt% was observed in a few grains. The empirical formula calculated on the basis of 16.5 anions pfu is: $Al_{2.09}(P_{0.97}O_4)(S_{0.95}O_4)F_{0.96}{\cdot}H_{15.2}O_{7.54}$. The strongest lines of the X-ray powder diffraction pattern [d_{obs} Å (I_{obs}%; hkl)] are: 10.57 (36; 001), 9.60 (100; 100), 7.123 (23; 021), 5.295 (34; 002), 4.191 (29; $\bar{2}21$), 3.218 (50, 060), 2.870 (20, $\bar{3}31$). The powder X-ray pattern was indexed in monoclinic unit-cell with $a = 9.740(5)$, $b = 19.31(1)$, $c = 10.688(5)$ Å, $\beta = 98.65(8)$, $V = 1987$ Å^3, $Z = 6$, and the reflections conditions agreed with the space groups $P2_1$ or $P2_1/m$. The single crystal study could not be performed due to the crystals quality. The powder X-ray data obtained from the same (powdered) sample after 1 year in dry conditions show the change of the intensities of some reflections and appearance of the new reflection at 8.3 Å. The X-ray data obtained after exposure that sample in a humid environment appeared to be identical to the original pattern. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

ATELISITE-(Y)*

T. Malcherek, B. Mihailova, J. Schlüter, and T. Husdal (2012) Atelisite-(Y), a new rare earth defect silicate of the KDP structure type. European Journal of Mineralogy, 24(6), 1053–1060.

Atelisite-(Y) (IMA 2010-065), ideally $Y_4Si_3O_8(OH)_8$, is a new mineral discovered in a granitic pegmatite at the Stetind quarry, Tysfjord, Norway (68°10′15.20″N 16°33′10.6″E). The Tysfjord granite with its niobium-yttrium-fluorine (NYF) type pegmatites is a well-known source for rare minerals in Norway: about 150 different species have been identified from these pegmatites, out of which 43 are REE minerals, mainly formed in association with Y-bearing fluorite. The granite has been dated to 1742±46 Ma, and is interpreted to originate from the partial melting of continental crust during crystallization of the older mangerites of Hamarøy and Lofoten, and later deformed during the early stages of the Caledonian orogenic cycle. The following species have been identified from this rock, either as euhedral microcrystals in small voids or as grains embedded in the fluorite: allanite-(Y), allanite-(Ce), bastnäsite-(Ce), britholite-(Y) and/or fluorbritholite-(Y), calcioancylite-(Ce), calcioancylite-(Nd), fluorthalénite-(Y), hematite, hundholmenite-(Y), kainosite-(Y), keiviite-(Y), keiviite-(Yb), kozoite-(Nd), kuliokite-(Y), muscovite, quartz, rowlandite-(Y), stetindite, synchysite-(Y), thalénite-(Y), thorite, törnebohmite-(Ce), uraninite, uranophane-β, vyuntspakhkite-(Y), xenotime-(Y), yttrialite-(Y), and zircon. Atelisite-(Y) was found in a remarkably pure fluorite, with a few scattered grains of bastnäsite-(Ce) being the only inclusions. The new mineral is a late, hydrothermally formed phase in dissolution cavities in fluorite, associated with xenotime-(Y), calcioancylite-(Nd), and La-dominant calcioancylite. Atelisite-(Y) forms transparent crystals of dipyramidally terminated, short-prismatic habit with up to 0.3 mm. Displayed forms are {101}, {100}, and rarely {001}. The crystals are colorless to pale brown, with colorless streak and vitreous luster. They are optically uniaxial (+), $\omega = 1.727$ ($\lambda = 589$ nm) and $\varepsilon > 1.8$. $D_{\text{calc}} = 4.26$ g/cm^3. Electron microprobe analyses (WDS) yielded the average composition (mean of 25 analyses, wt%): SiO_2 18.73, Y_2O_3 45.67, Yb_2O_3 11.81, Gd_2O_3 2.09, Tb_2O_3 0.54, Dy_2O_3 2.61, Ho_2O_3 0.62, Er_2O_3 4.72, H_2O 12.2 (calculated in order to charge balance a formula unit containing 4 REE atoms), total 98.99, providing the following empirical formula (based on 16 O): $(Y_{3.11}Yb_{0.46}Er_{0.19}Dy_{0.11}Gd_{0.09}Ho_{0.01}Tb_{0.02})_{\Sigma 3.99}Si_{2.4}O_{16}H_{10.42}$. There is a clear Si deficit with respect to a hypothetical composition $(REE)SiO_3(OH)$. The deviation from an idealized composition $(REE)_4Si_3O_8(OH)_8$ can be attributed to an excess of OH groups in combination with Si vacancies, suggesting the additional presence of hydrogrossular-type defects in this sample, which is clearer when the empirical formula is rearranged to become: $(Y_{3.11}Yb_{0.46}Er_{0.19}Dy_{0.11}Gd_{0.09}Ho_{0.01}Tb_{0.02})_{\Sigma 3.99}(Si_{2.4}[H_4^+]_{0.605})_{\Sigma 3.01}O_8(OH)_8$. Polarized Raman spectra of atelisite-(Y) were collected, showing clear indication for the presence of OH groups in the structure as revealed by the broad Raman scattering centered near 3225 cm^{-1} (O-H bond stretching). Several crystals of the new mineral have been examined by single-crystal X-ray diffraction using a Nonius Kappa CCD diffractometer and graphite monochromated Mo$K\alpha$-radiation. The diffraction pattern was indexed with a tetragonal cell with: $a = 6.947(4)$, $c = 6.133(3)$, $V = 295.98$ Å^3, $Z = 1$, space group: $I\bar{4}2d$. The structure was solved and refined to $R_1 = 2.08\%$. The strongest X-ray powder diffraction lines are [d_{obs} Å (I_{obs}%; hkl)]: 3.474 (100; 200), 2.601 (73; $1\bar{1}2$,112), 1.786 (68; 312,$3\bar{1}2$), 4.598 (57; 101). The crystal structure of atelisite-(Y) shows structural homologies with those of zircon and xenotime, but is distinguished from by a characteristic alternating rotation of the SiO_4-tetrahedra about [001]. The name of atelisite-(Y) is from Greek “atels” (ατελησ), meaning deficient, based on the Si-deficiency of the mineral. The holotype is preserved in the collection of the Mineralogical

Museum of the University of Hamburg, Germany, under catalog number NO-004. **G.D.G and F.C.**

BOSCARDINITE*

P. Orlandi, C. Biagioni, E. Bonaccorsi, Y. Moëlo, and W.H. Paar (2012) Lead-antimony sulfosalts from Tucsany (Italy). XII. Boscardinite, $TlPb_4(Sb_7As_2)_{\Sigma 9}S_{18}$, a new mineral species from the Monte Arsiccio mine: occurrence and crystal structure. Canadian Mineralogist, 50(2), 235–251.

Boscardinite (IMA 2010-079), ideally $TlPb_4(Sb_7As_2)_{\Sigma 9}S_{18}$, is a new mineral found in the barite–pyrite–iron oxides deposit of Monte Arsiccio, near Sant'Anna di Stazzema, in the Apuan Alps, Tuscany, Italy. Boscardinite was found at Sant'Olga level (525 m) as a millimeter-sized lead-gray mass in a quartz vein embedded in a dolostone, associated with zinkenite. Other sulphosalts in this vein are boulangerite, chabourneite, jamesonite, robinsonite, and an Hg-rich andorite-like mineral. Boscardinite is gray, metallic. It is brittle with conchoidal fracture and has a black streak. Mohs hardness and density could not be measured due to paucity of material; D_{calc} = 5.355 g/cm^3. In reflected light boscardinite is white without internal reflections and no discernible pleochroism. It is anisotropic with rotation tints showing shades of gray and distinctly bireflectant. All crystals show well-developed polysynthetic twinning. The values for COM wavelengths in air [R_{min}, R_{max} % (λ in nm)] are: 33.8, 39.3 (470); 32.1, 38.0 (546); 31.2, 36.9 (589); 29.7, 35.3 (650). The average of 5 electron-microprobe analysis (WDS) on two crystals gave (wt%, crystal1/crystal2): Ag 1.48(4)/1.37(7), Tl 9.72(26)/8.96(19), Pb 23.36(20)/25.74(20), Sb 35.25(60)/33.46(32), As 5.78(10)/6.54(8), S 22.14(45)/22.08(29), Se 0.04(1)/0.01(1), total 97.77/98.16. The empirical formulae are $Ag_{0.36}Tl_{1.23}Pb_{2.92}(Sb_{7.50}As_{2.00})_{\Sigma 9.50}S_{17.88}Se_{0.01}$ and $Ag_{0.33}Tl_{1.13}Pb_{3.20}(Sb_{7.09}As_{2.25})_{\Sigma 9.34}S_{17.76}$, respectively, on the basis of ΣMe = 14 apfu. The strongest lines in the X-ray powder-diffraction pattern [d_{obs} Å (I_{obs}), vs = very strong, s = strong, s = medium strong, m = medium] are: 3.705 (ms), 3.540 (ms), 3.479 (m), 3.085 (m), 2.977 (ms), 2.824 (vs), 2.707 (s), 2.324 (ms), and 2.176 (ms). Cell parameters were not refined from the X-ray powder diffraction pattern due to the very high degree of peak overlap. Single-crystal X-ray diffraction data were collected on a crystal of size 0.27 × 0.16 × 0.16 mm and the structure was refined to R_1 = 0.045 for 4319 unique reflections with $I \geq 4\sigma(I)$, solved by direct methods, shows boscardinite is triclinic, space group $P\overline{1}$, with a = 8.0929(4), b = 8.7610(5), c = 22.4971(11) Å, α = 90.868(4), β = 97.247(4), γ = 90.793(4)°, V = 1582.0 Å^3 and Z = 2. Boscardinite is the Tl–Sb homeotype of baumhauerite and belongs to the sartorite homologous series as a 1:1 alternation of sartorite-type and dufrénoysite-type layers. The mineral is named in honor of Matteo Boscardin (b. 1939) for his contribution to knowledge of the regional mineralogy of Italy. The holotype specimen of boscardinite is deposited in the mineralogical collection of the Museo di Storia Naturale e del Territorio, Università di Pisa, Italy, under catalog number 19349. **O.C.G.**

CARLGIESECKEITE-(ND)*

I.V. Pekov, N.V. Zubkova, T.A. Husdal, N.N. Kononkova, A.A. Agakhanov, A.E. Zadov, and D.Yu. Puscharovsky (2012) Carlgieseckeite-(Nd), $NaNdCa_3(PO_4)_3F$, a new belovite-group mineral species from the Ilímaussaq alkaline complex, South Greenland. Canadian Mineralogist, 50(2), 571–580.

Carlgieseckeite-(Nd) (IMA 2010-036), ideally $NaNdCa_3(PO_4)_3F$, is a new mineral species of the belovite group (apatite supergroup) found at the Kuannersuit (Kvanefjeld) Plateau, Ilímaussaq alkaline complex, South Greenland. It was found with analcime and fluoroapatite in small cavities in veins of white sugar-like albite cross-cutting augite syenite. The mineral is transparent vitreous and shows a color-change effect typical of Nd compounds from almost colorless with a greenish hue in daylight to pink in yellow electric light. Crystals up to 0.25 × 1 × 1.3 mm are tabular hexagonal with pinacoidal {001} and prismatic {hk0} faces, the later striated along [001]. Parallel intergrowths of these crystals up to 0.7 × 3 × 1.3 mm epitactically overgrow prismatic crystals of Sr-bearing fluorapatite. Carlgieseckeite-(Nd) is brittle, with an uneven fracture; no cleavage observed. Mohs hardness is 5 and D_{calc} = 3.91 g/cm^3. The mineral is optically negative, with ω = 1.655(3) and ε = 1.632(2) for uniaxial crystals, while some individuals show anomalous biaxiality typical for apatite-group minerals. The sample with maximum birefringence has α = 1.632(2), β = 1.654(3), γ = 1.656(3), $2V_{meas}$ = 15(5)°, and $2V_{calc}$ = 33°. In thin section, carlgieseckeite-(Nd) is colorless and nonpleochroic. The average of 10 electron-microprobe analysis (WDS) gave [wt% (range)]: Na_2O 5.68 (5.4–6.4), CaO 18.53 (17.8–19.1), SrO 7.55 (6.9–8.0), BaO 0.14 (0.0–0.3), La_2O_3 1.32 (0.6–1.9), Ce_2O_3 10.60 (8.1–12.4), Pr_2O_3 2.62 (2.4–2.9), Nd_2O_3 15.08 (13.6–17.7), Sm_2O_3 2.89 (2.1–3.7), Gd_2O_3 0.52 (0.3–0.7), SiO_2 0.56 (0.4–0.7), P_2O_5 32.72 (31.8–33.2), F 2.80 (2.6–2.9), Cl 0.06 (0.0–0.1), $-O=(F,Cl)_2$ 1.19, total 99.88 wt%. Neither H_2O nor CO_2 were determined because of paucity of material. The empirical formula $Na_{1.17}Ca_{2.11}Sr_{0.46}Ba_{0.01}La_{0.05}Ce_{0.41}Pr_{0.10}Nd_{0.57}Sm_{0.11}Gd_{0.02}Si_{0.06}P_{2.94}O_{12.05}F_{0.94}Cl_{0.01}$ calculated on the basis of 13 O + F + Cl apfu. The strongest lines in the X-ray powder-diffraction pattern [d_{obs} Å (I_{obs}%; hkl)] are: 7.02 (22; 001), 5.33 (18; 101), 3.923 (27; 111), 3.463 (23; 002), 3.095 (19; 210), 2.815 (100; 211,112), 2.727 (42; 300). The unit-cell parameters refined from powder-diffraction data are: a = 9.451(5) and c = 6.974(7) Å, V = 539 Å^3, and Z = 2. Single-crystal X-ray diffraction data collected on a crystal of size 0.10 × 0.13 × 0.25 mm refined to R_1 = 0.0218 for 1520 unique reflections with $I \geq 4\sigma(I)$, solved by direct methods, shows carlgieseckeite-(Nd) is trigonal, space group $P\overline{3}$, a = 9.4553(1), c = 6.9825(1) Å, V = 540.62 Å^3, and Z = 2. Carlgieseckeite-(Nd) is the isostructural Ca- and Nd-dominant analog of belovite-(Ce) and belovite-(La). The mineral is named in honor of Carl Ludwig Giesecke (1761–1833) for his pioneering research in the mineralogy of Greenland, while suffix (-Nd) reflects the dominance of Nd over other REE in the mineral. The holotype material of carlgieseckeite-(Nd) is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow. **O.C.G.**

CUPROMOLYBDITE*

M.E. Zelenski, N.V. Zubkova, I.V. Pekov, Y.S. Polekhovsky, and D.Yu. Pushcharovsky (2012) Cupromolybdite, $Cu_3O(MoO_4)_2$, a new fumarolic mineral from the Tolbachik volcano, Kamchatka Peninsula, Russia. European Journal of Mineralogy, 24(4), 749–757.

Cupromolybdite (IMA 2011-005), ideally $Cu_3O(MoO_4)_2$, is a new fumarolic mineral from the Tolbachik volcano, Kamchatka Peninsula, Russia, where it was discovered in association with piypite, fedotovite, vergasovite, hematite, magnetite, aphthitalite, langbeinite, palmierite, As-bearing orthoclase, lammerite, klyuchevskite, alumoklyuchevskite, euchlorine, lyonsite, pseudolyonsite, averievite, rutile, and native gold. The mineral occurs in the Yadovitaya (poisonous) fumarole, at Second Scoria Cone where the temperature was ca. 340 °C (in the year 2010) and volcanic gases are highly oxidized. Cupromolybdite is one of the new mineral species formed during post-volcanic degassing, and was named after its chemical composition. The mineral forms either yellow to dark brown prismatic crystals 30 to 150 μm long and or bright yellow radiating aggregates of acicular crystals. Cupromolybdite is translucent, has a yellow streak, adamantine luster, Mohs hardness is ~3; $D_{calc} = 4.512$ g/cm^3. Cupromolybdite has two varieties that are not only different morphologically, but also have different colors and show variations in their chemical composition. Prismatic cupromolybdite was reported as a holotype for the new species. In reflected light, cupromolybdite is gray with a weak bluish hue. It is non-pleochroic, distinctly anisotropic and has weak bireflectance ($\Delta R = 1.4\%$, 589 nm). The reflectances in air interpolated for the COM wavelengths are [R_{min}, R_{max} (nm)]: 14.95, 16.3 (470); 13.4, 14.85 (546); 12.73, 14.16 (589); 12.0, 13.35 (650). The average of 7 electron microprobe analyses (wt%) of the prismatic and acicular variety (in parentheses) gave: MoO_3 54.48 (50.3), SO_3 0.71 (2.16), V_2O_5 0.28 (0.91), SiO_2 0.04 (0.10), CuO 43.03 (37.8), FeO 0.08 (0.09), ZnO 0.53 (8.48), total 99.15 (99.87). The empirical formula calculated on the basis of 9 O is $(Cu_{2.83}Zn_{0.03}Fe_{0.01})_{\Sigma 2.87}(Mo_{1.98}S_{0.05}V_{0.02})_{\Sigma 2.05}O_9$ (prismatic variety) and $(Cu_{2.46}Zn_{0.54}Fe_{0.01})_{\Sigma 3.01}(Mo_{1.81}S_{0.14}V_{0.05})_{\Sigma 2.00}O_9$ (acicular variety). The strongest lines of the powder diffraction pattern [d_{obs} Å (I_{obs}; *hkl*)] are: 7.312 (67; 002), 3.518 (55; 113), 3.436 (100; 020), 3.301 (99; 210,104), 3.065 (79; 121), 2.556 (62; 220), 2.506 (66; 301,024). The crystal structure of prismatic cupromolybdite was solved by direct methods and refined to $R_1 = 3.14$ for 1223 unique reflections. The mineral is orthorhombic, *Pnma*, $a = 7.6638(1)$, $b = 6.8670(1)$, $c = 14.5554(2)$ Å, $V = 766.01$ Å^3, and $Z = 4$. The acicular variety has slightly smaller unit-cell parameters due to the substitution of Mo^{6+} by S^{6+}: $a = 7.618(11)$, $b = 6.85(2)$, $c = 14.45(3)$ Å. The crystal structure of cupromolybdite contains bands of corner sharing Cu octahedra and square pyramids extending along [010]. [MoO_4] tetrahedra share corners with Cu octahedra. Cupromolybdite is isostructural with vergasovite, $Cu_3O[(Mo,S)O_4][SO_4]$, in which tetrahedra are occupied by both Mo and S. Type material is deposited in the collections of the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **Yu.U.**

HEZUOLINITE*

Z. Yang, G. Giester, K. Ding, and E. Tillmanns (2012) Hezuolinite, $(Sr,REE)_4Zr(Ti,Fe^{3+},Fe^{2+})_2Ti_2O_8(Si_2O_7)_2$, a new mineral species of the chevkinite group from Saima alkaline complex, Liaoning Province, NE China. European Journal of Mineralogy, 24(1), 189–196.

Hezuolinite (IMA 2010-045), ideally $Sr_2REE_2Zr(Fe^{2+})Ti_3O_8(Si_2O_7)_2$, is a new mineral discovered in the Saima alkaline complex, Fengcheng County, Liaoning Province, China (124°12′E, 41°N). The Saima alkaline complex is composed of alkaline volcanic and intrusive rocks, including dyke, and derived from cognate alkaline magma, with the intrusive rocks comprising the major part. Alkaline volcanic rocks contain leucitophyre and pseudo-leucite phonolite, which formed prior to the intrusive rocks according to the intersection relationship. The intrusive rocks are classified into two intrusive phases. Biotite-nepheline syenite is the first intrusive phase, consisting of orthoclase, nepheline, biotite, augite, and andradite. Green-aegirine nepheline syenite is the second intrusive phase, consisting of microcline, nepheline, green aegirine and minor biotite, eudialyte, and rinkite. Hezuolinite occurs in the second intrusive phase. Hezuolinite is found in anhedral crystals, several hundred micrometers in size. The mineral is black with dark-brown streak. It is translucent with a resinous luster. No fluorescence in long- or short-wave ultraviolet radiation was observed. Cleavage or parting was not observed. It is brittle with a conchoidal fracture. The hardness is VHN_{100} 683–964 kg/mm^2 (5.5–6 on Mohs scale). $D_{meas} = 4.28$ and $D_{calc} = 4.30$ g/cm^3. Optically, hezuolinite is biaxial (–), with $n > 1.8$ and $2V = 75°$. The dispersion of optical axes is strong, $r > v$. The mineral shows a strong pleochroism; X = pale brown, Y = brown, Z = dark brown. Electron microprobe analyses (WDS) yielded the average composition (mean of 25 analyses, in wt%): SiO_2 21.90, TiO_2 24.42, Al_2O_3 0.16, FeO 1.84, Fe_2O_3 2.61, MnO 0.07, MgO 0.01, Nb_2O_5 0.28, ZrO_2 9.18, HfO_2 0.39, SrO 20.12, CaO 2.46, Na_2O 0.35, ThO_2 0.80, UO_2 0.01, La_2O_3 7.12, Ce_2O_3 8.16, Pr_2O_3 0.45, Nd_2O_3 1.34, Sm_2O_3 0.10, Eu_2O_3 0.16, Gd_2O_3 0.06, total 101.99, providing the following empirical formula (based on 22 O): $(Sr_{2.15}Ce_{0.55}La_{0.49}Ca_{0.49}Na_{0.12}Nd_{0.09}Pr_{0.03}Th_{0.03}Sm_{0.01}Eu_{0.01})_{\Sigma 3.98}(Zr_{0.82}Fe^{2+}_{0.14}Hf_{0.02}Mn_{0.01})_{\Sigma 1.00}(Ti_{1.38}Fe^{3+}_{0.36}Fe^{2+}_{0.14}Al_{0.04}Nb_{0.02})_{\Sigma 1.94}Ti_2O_8(Si_{2.01}O_7)_2$. The oxidation ratio for iron was obtained by Mössbauer spectroscopy. The simplified formula is $(Sr,REE)_4Zr(Ti,Fe^{3+},Fe^{2+})_2Ti_2O_8(Si_2O_7)_2$. X-ray powder diffraction data were collected using a Debye-Scherrer camera, with Cu*K*α-radiation. The diffraction pattern was successfully indexed with a monoclinic unit-cell: $a = 13.90(2)$, $b = 5.672(2)$, $c = 11.91(2)$ Å, $\beta = 114.1(1)°$, $V = 856.8$ Å^3, and $Z = 2$. The strongest reflections in the X-ray powder-diffraction pattern [d_{obs} Å (I_{obs} %; *hkl*)] are: 2.98 (100; $\bar{2}04$), 3.02 (90; $\bar{3}13$), 1.96 (90; 024), 2.84 (70; 020), 2.18 (40; $\bar{4}22$). The crystal structure was determined from single-crystal X-ray data (collected with an Enraf Nonius diffractometer equipped with CCD and monochromatized Mo*K*α-radiation). The single crystal parameters of the monoclinic unit cell are: $a = 13.973(3)$, $b = 5.6984(11)$, $c = 11.988(2)$ Å, $\beta = 114.10(1)°$, space group *C*2/*m*. The structure was solved by direct methods and refined to $R_1 = 4.99\%$. The crystal structure of hezuolinite is basically similar to that of rengeite. The framework in hezuolinite structure consists of sheets of TiO_6 octahedra, ZrO_6 octahedra, and Si_2O_7 disilicate groups. The TiO_6 octahedra form chains by edge-sharing connections parallel to the *b* axis. The chains form sheets parallel to (001) via shared corners. The ZrO_6 octahedra and Si_2O_7 disilicate groups connect two sheets of TiO_6 octahedra via shared corners, while the Sr atoms occupy the framework cavities. Hezuolinite correspond to the previously discredited "saimaite". The mineral has been named in honor of He Zuolin (1900–1967), who graduated from the University of Innsbruck in 1938 and worked at the University of Leipzig in 1939, in recognition of his contributions to optical mineralogy and rare-earths mineralogy in China. The type specimen of hezuolinite is deposited at the Museum of Institute of Geology and Geophysics, Chinese Academy of Sciences with registration number KDX016. **G.D.G and F.C.**

Comment: Hezuolinite was described on the material that was originally described by Peng et al. (1963) as "saimaite", and powder diffraction and chemistry were provided by Ding et al. (1984) as $(Sr,REE)_4(Fe^{2+})(Ti,Zr)_2Ti_2O_8(Si_2O_7)_2$, but the mineral was not approved by IMA. On the basis of the analysis of Mössbauer spectroscopy, Song et al. (1999) provided the simplified formula as $(Sr,REE)_4(Zr,Fe^{2+})(Ti,Fe^{3+},Ca)_2Ti_2O_8(Si_2O_7)_2$. However, the structure remained unknown and the mineral not confirmed. Jambor et al. (2000), on the basis of its formula, suggested that "saimaite" was the equivalent of strontiochevkinite and later on, in 2006, "saimaite" was discredited by CNMNC (Burke, 2006). After then, it was mentioned under different names and last time as REE, Fe polymorph of rengeite by Yang et al. (2010).

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Jacutingaite*

A. Vymazalová, F. Laufek, M. Drábek, A.R. Cabral, J. Haloda, T. Sidorinová, B. Lehmann, H.F. Galbiatti, and J. Drahokoupil (2012) Jacutingaite, Pt_2HgSe_3, a new platinum-group mineral species from the Cauê iron-ore deposit, Itabira District, Minas Gerais, Brazil. Canadian Mineralogist, 50(2), 431–440.

M. Drábek, A. Vymazalová, and A.R. Cabral (2012) The system Hg-Pt-Se at 400°C: phase relations involving jacutingaite. Canadian Mineralogist, 50(2), 441–446.

Jacutingaite (IMA 2010-078), ideally Pt_2HgSe_3, is a new platinum-group mineral species discovered in heavy-mineral concentrate from a friable, hematite-rich auriferous vein at the Cauê iron-ore deposit, Itabira District, Minas Gerais, Brazil. It was previously mentioned as the unnamed phase Pt_2HgSe_3 (Cabral et al. 2008; UM2008-01-Se:HgPt). Jacutingaite was found as a single grain 50 μm in size, in an athenite-potarite-hematite aggregate of ~2 mm in polished section. The mineral is partly altered to a Pt-O phase. Due to a minute amount of material, synthetic analog for jacutingaite was prepared. The identity between the synthetic phase and jacutingaite was thoroughly checked and confirmed by EBSD, chemical and optical analyses. For the characterization of a new mineral species, both natural jacutingaite (optical properties, chemistry), and its synthetic analog (crystallographic and structural properties, optical properties, density, and physical properties) were used. The mineral is gray, opaque, with a metallic luster and a gray streak. It is brittle, has a very good {001} cleavage. For synthetic material VHN_{10} = 169 (119–245) kg/mm^2 corresponding to Mohs hardness ~3½, D_{meas} = 10.9 and D_{calc} = 10.35 g/cm^3. In plane-polarized light, jacutingaite is bireflectant, anisotropic, and pleochroic from bluish gray to rusty brown. No internal reflections were observed. The reflectance curves of the mineral have one maximum at ~490 nm. The interpolated values (in air) for COM wavelengths [R_{min}, R_{max} (nm)] are: 47.4, 51.1 (470); 48.2, 50.5 (546); 48.0, 49.6 (589); 47.1, 47.8 (650). The mean of 3 electron-microprobe analyses gave (wt%): Pt 37.3, Pd 5.91, Hg 25.72, Ag 0.16, Cu 0.82, Se 31.48, total 101.39, corresponding to $(Pt_{1.46}Pd_{0.42}Cu_{0.10}Ag_{0.01})_{\Sigma1.99}Hg_{0.98}Se_{3.04}$. Jacutingaite is trigonal, $P\bar{3}m1$, with a = 7.3477(2), c = 5.2955(1) Å, V = 247.59 Å^3, and Z = 2. The strongest X-ray powder-diffraction lines [d_{obs} Å (I_{obs}; hkl)] are: 5.292 (100; 001), 2.727 (16; 201), 2.444 (10; 012), 2.035 (18; 022), 1.765 (37; 003), 1.324 (11; 004), 1.0448 (11; 015), 1.0449 (11; 025). The crystal structure was refined by the Rietveld method from the powder XRD data using the starting model for the synthetic $Pt_4Tl_2Se_6$ phase, which has similar unit-cell parameters and stoichiometry, to R_1 = 4.4%. There are two Pt, one Hg and one Se positions. Pt(1) atoms have octahedral coordination with Se atoms, and Pt(2) atoms are surrounded by four Se atoms in a square planar coordination and by two Hg atoms, thus having an elongated octahedral coordination. Octahedra share common edges forming sheets perpendicular to (001). Experimental studies in the system Pt-Hg-Se in the temperature range 400–800 °C show that jacutingaite (Pt_2HgSe_3) forms stable assemblages with sudovikovite ($PtSe_2$), luberoite (Pt_5Se_4), and tiemannite (HgSe). The mineral is named after the specular-hematite-rich vein type gold mineralization locally known as "jacutinga". The holotype specimen is deposited in the collections of GeoMuseum "Geosammlung" at the Technical University of Clausthal, Germany, under catalog number 26580. **Yu.U.**

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Laptevite-(Ce)*

A.A. Agakhanov, L.A. Pautov, Yu.A. Uvarova, E.V. Sokolova, F.C. Hawthorne, and V.Yu. Karpenko (2013) Laptevite-(Ce) $NaFe^{2+}(REE_7Ca_5Y_3)(SiO_4)_4(Si_3B_2PO_{18})(BO_3)F_{11}$—a new vicanite-group mineral from Darai-Pioz alkaline massif. Novye dannye o mineralakh (New data on minerals), 48, 5–11 (in Russian).

Y.A. Uvarova, E. Sokolova, F.C. Hawthorne, A.A. Agakhanov, V.Y. Karpenko, and L.A. Pautov (2013) The crystal structure of laptevite-(Ce), $NaFe^{2+}(REE_7Ca_5Y_3)(SiO_4)_4(Si_3B_2PO_{18})(BO_3)F_{11}$, a new mineral species from the Darai-Pioz alkaline massif, Northern Tajikistan. Zeitschrift für Kristallographie B, 228, 550–557.

A new vicanite-group mineral laptevite-(Ce) (IMA 2011-081), ideally $NaFe^{2+}(REE_7Ca_5Y_3)(SiO_4)_4(Si_3B_2PO_{18})(BO_3)F_{11}$ was discovered in moraine boulder at the Upper Darai-Pioz alkaline massif, at the junction of Turkestan, Zeravshan, and Alay Mt.

Ranges, Tajikistan. This massif consists of various syenites and granitoids and is abundant with pegmatites, hydrotermalites, carbonatites, and albitites of different composition and age. The most of intruded phases are enriched with boron and contain a number of minerals containing B and REE. Laptevite-(Ce) was found in leucocratic coarse-grained calcite-bafertisite-aegirine-microcline rock with quartz, fluorite, polylithionite, and albite and most often occurs in intergrowths with bafertisite, “*calcybeborosilite-(Y)*” and stillwellite-(Ce). The mineral forms brown vitreous to greasy crystals of irregular shape up to 1 cm in size. It is translucent to transparent in small flakes. The central parts of crystals are usually metamict and have a yellowish tint. The fracture is uneven with no cleavage observed. Mohs hardness is 4–4.5; VHN_{50} 453 (443–485) kg/mm^2. D_{meas} = 4.61(2), D_{calc} = 4.619 g/cm^3. Laptevite-(Ce) is optically uniaxial, negative, ω = 1.741(3), ε = 1.720(3) for λ = 589 nm. It is slightly soluble in HCl (1:1) solution at room temperature. The major absorption bands of IR spectrum are (cm^{-1}): 1623, 1437, 1300, 945, 930, 877shoulder, 758, 637, 570, 531. Chemical composition was determined by EMPA (EDS and WDS). The Li and Be contents were measured by ICP-OES and found only in trace amounts. The concentrations of B and REE obtained by ICP-OES are very close to those obtained by EMPA. The average of 42 analyses performed on 8 grains (in parentheses is the analysis for the grain used for single-crystal X-ray study) yielding to (wt%): SiO_2 15.67 (15.58), TiO_2 0.28 (0.30), ZrO_2 0.01 (0.10), ThO_2 0.38 (0.43), UO_2 0.65 (0.70), FeO 1.48 (1.59), CaO 11.64 (11.83), MnO 1.02 (0.84), SrO 0.95 (1.46), Y_2O_3 11.30 (11.21), La_2O_3 14.54 (13.86), Ce_2O_3 16.93 (17.58), Pr_2O_3 2.76 (2.90), Nd_2O_3 5.16 (5.10), Sm_2O_3 0.98 (1.03), Eu_2O_3 0.10 (0.16), Gd_2O_3 1.56 (1.40), Dy_2O_3 1.37 (1.47), Tm_2O_3 0.17 (0.13), Yb_2O_3 0.28 (0.35), B_2O_3 4.98 (4.71), P_2O_5 1.51 (1.47), Na_2O 1.05 (0.98), F 8.53 (8.44), $-O=F_2$ –3.59 (–3.55), total 99.71 (100.28). The empirical formula, calculated on the basis (O + F) = 48 pfu is: $(Na_{0.88}REE_{0.12})_{\Sigma 1.00}(Fe_{0.54}Mn_{0.37}Ti_{0.09})_{\Sigma 1.00}(REE_{6.79}Ca_{5.40}Y_{2.60}Sr_{0.24}U_{0.06}Th_{0.04})_{\Sigma 15.13}(SiO_4)_4(Si_{2.78}B_{2.68}P_{0.55}O_{17.33}F_{0.67})(B_{1.05}O_3)F_{11}$. Where REE = $Ce_{2.68}La_{2.32}Nd_{0.80}Pr_{0.44}Gd_{0.22}Dy_{0.19}Sm_{0.15}U_{0.06}Yb_{0.04}Tb_{0.04}Tm_{0.02}Eu_{0.01}$. The strongest lines of the X-ray powder diffraction pattern [d_{obs} Å (I_{obs}%; *hkl*)] are: 7.70 (19; 012); 4.41 (29; 202), 3.13 (26; 214), 3.03 (100; 027), 2.982 (85; 125), 2.954 (60; 033), 2.689 (40; $\bar{2}40$), 1.979 (31; 330), 1.770 (21; $\bar{5}55$). The diffraction pattern was indexed in hexagonal unit cell with *a* = 10.779(2), *c* = 27.864(4) Å, and *V* = 2803.6 $Å^3$. The grains selected for single-crystal X-ray study appeared to be metamict and were heated in argon atmosphere at 800 °C. Laptevite-(Ce) is trigonal, space group *R*3*m*, *a* = 10.804 (2), *c* = 27.726(6) Å, *V* = 2802.6 $Å^3$, and *Z* = 3. The crystal structure was solved on the basis of 924 unique ($F_o > 4\sigma F$) reflections, refined to R_1 = 3.87% and appeared to be basically similar of that of vicanite. It is characterized by three layers within a heteropolyhedral framework: A ($z \sim 0$), B ($z \sim 0.13$), and C ($z \sim 0.23$). In layer A, tetrahedra form a three-membered rings $(B_2P)O_9$, each tetrahedron shares a corner with one SiO_4 tetrahedron, forming a complex polyanion $(Si_3B_2PO_{18})^{13-}$. The Fe^{2+} dominant octahedron shares corners with six SiO_4 tetrahedra. This layer also includes the REE-dominant 9-coordinated polyhedral, which share corners and edges with tetrahedra. In layer B, isolated SiO_4 tetrahedra and BO_3 groups connect via REE-dominant 10-coordinated and Ca-dominant 8-coordinated polyhedra. The C-layer consists of the Ca-dominant 7-coordinated, Y-dominant 8-coordinated, and Na-dominant 10-coordinated polyhedra. The mineral was named after Tatyana Mikhailovna Lapteva, a Russian geologist and petrologist who worked on the geology of Central Asia. The holotype specimen has been deposited at the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow. **D.B.**

LAVOISIERITE*

P. Orlandi, C. Biagioni, M. Pasero, and M. Mellini (2013) Lavoisierite, $Mn^{2+}_8[Al_{10}(Mn^{3+}Mg)][Si_{11}P]O_{44}(OH)_{12}$, a new mineral from Piedmont, Italy: the link between “ardennite” and sursassite. Physics and Chemistry of Minerals, 40, 239–249.

Lavoisierite (IMA 2012-009), ideally $Mn^{2+}_8[Al_{10}(Mn^{3+}Mg)][Si_{11}P]O_{44}(OH)_{12}$, is a new mineral discovered in piemontite-bearing micaschists belonging to the Piedmontese Nappe from Punta Gensane, Viù Valley, Western Alps, Italy. The new mineral has been named in honor of the French chemist and biologist Antoine-Laurent de Lavoisier (1743–1794), considered to be one of the fathers of the modern chemistry. The crystallization of lavoisierite is related to the Alpine tectono-metamorphic events involving (Mn,Al)-rich metasediments. Associated minerals are quartz, “mica”, sursassite, piemontite, spessartine, braunite, and “tourmaline”. Lavoisierite occurs as acicular and prismatic-tabular crystals, elongated on [010] and flattened on {001}, up to a few millimeters in length. It is yellow-orange, vitreous with a white streak. Lavoisierite is brittle; no cleavage or parting was observed. Hardness could not be measured, due to the small size of crystals. In plane-polarized transmitted light, lavoisierite is transparent and pleochroic, pale yellow parallel to [010] and yellow-orange normal to this direction. With crossed polarizers, the mineral shows parallel extinction, with positive elongation parallel to [010]. Birefringence is moderate. Refractive indices measured along [010] and normal to this direction are >1.69. The mean refractive index *n* of lavoisierite was calculated as 1.750. Density was not measured, due to the difficult in separating lavoisierite from the admixed phases and the small crystal size; D_{calc} = 3.576 g/cm^3. Electron microprobe analyses (WDS) yielded the average composition (mean of 3 analyses, in wt%): P_2O_5 2.08, V_2O_5 0.37, SiO_2 34.81, TiO_2 0.13, Al_2O_3 22.92, Cr_2O_3 0.32, Fe_2O_3 0.86, MgO 5.73, MnO 25.31, CaO 1.94, Na_2O 0.01, H_2O 5.45 (so as to give 56 anions pfu and an O/OH ratio so as to achieve the charge balance), for a sum of 100.63, providing the following empirical formula (based on 56 anions): $(Mn^{2+}_{5.34}Mg_{1.81}Ca_{0.69}Na_{0.01})_{\Sigma 7.85}(Al_{8.92}Mn^{3+}_{1.74}Mg_{1.01}Fe^{3+}_{0.21}Cr_{0.08}Ti_{0.03})_{\Sigma 11.99}(Si_{11.50}P_{0.58}V_{0.08})_{\Sigma 12.16}O_{44.00}(OH)_{12.00}$. The oxidation ratio for Mn was allocated to yield 32 total non-H cations per formula unit (pfu) and 100 positive charges. The O/OH ratio was adjusted by the charge balance. The simplified formula is $(Mn^{2+}_5Mg_2Ca)_{\Sigma 8}(Al_9Mn^{3+}_2Mg)_{\Sigma 12}(Si_{11}P)O_{44}(OH)_{12}$. The X-ray powder diffraction pattern on lavoisierite was obtained using a 114.6 mm Gandolfi camera and Ni-filtered Cu*K*α radiation. The strongest reflections in the X-ray powder-diffraction pattern [d_{obs} Å (I_{obs}; *hkl*) relative intensities are visually estimated: vs very strong, s strong, ms medium-strong, m medium] are: 4.62 (m; 112), 2.931 (vs; 1 1 10), 2.765 (s; 1 1 11), 2.598 (s;

310), 2.448 (ms; 028). Single-crystal X-ray data collected with an Oxford Diffraction Xcalibur diffractometer with a Sapphire 3 CCD detector, and monochromated Mo*K*α-radiation were indexed with an orthorhombic unit cell: a = 8.6891(10), b = 5.7755(3), c = 36.9504(20) Å, V = 1854.3 Å^3, Z = 2, and space group *Pnmm*. The structure was solved by direct methods and refined to R_1 = 4.64 %. The crystal structure of lavoisierite shows 8 sixfold- and sevenfold-coordinated sites, 7 tetrahedral sites, and 23 anion sites. Lavoisierite is chemically and structurally related to sursassite and "ardennite"; repeats along **a** and **b** are similar for all these minerals, whereas $c_{(\mathrm{Lav})} = c_{(\mathrm{Ard})} + 2c_{(\mathrm{Srs})}\sin\beta$. In sursassite, chains of edge-sharing octahedra are connected to each other through SiO_4 and Si_2O_7 groups; in "ardennite", columns of edge-sharing octahedra are bonded by means of SiO_4 and Si_3O_{10} groups. In lavoisierite, both modes of connection are present: there are slabs with SiO_4 and Si_2O_7 groups (sursassite-type slab) and slabs with SiO_4 and Si_3O_{10} groups (ardennite-type slab). The regular alternation, along [001], of sursassite-type and ardennite-type slabs, in 1:1 ratio, gives rise to the crystal structure of lavoisierite. The type material is deposited in the mineralogical collections of the Museo di Storia Naturale, University of Pisa, Italy, under the catalog number 19637. A cotype specimen is kept in the mineralogical collections of the Museo Regionale di Scienze Naturali, Torino, Italy, with catalog number M/U 16359. **F.C. and G.D.G.**

PASEROITE*

S.J. Mills, L. Bindi, M. Cadoni, A.R. Kampf, M.E. Ciriotti, and G. Ferraris (2012) Paseroite, $PbMn^{2+}(Mn^{2+},Fe^{2+})_2(V^{5+},Ti,Fe^{3+},\square)_{18}O_{38}$, a new member of the crichtonite group. European Journal of Mineralogy, 24(6), 1061–1067.

Paseroite (IMA 2011-069), ideally $PbMn^{2+}(Mn^{2+},Fe^{2+})_2(V^{5+},Ti,Fe^{3+},\square)_{18}O_{38}$, is a new mineral discovered in micro-cavities and fractures in a piece of fossilized wood trunk, which was found partially embedded in gray chert, in the upper part of the Molinello mine, Val Graveglia, Italy. The new mineral has been named for Marco Pasero (b. 1958), Professor of Mineralogy at the University of Pisa, Italy, in honor of his contributions to mineralogy and crystallography in general, and especially in recognition of his contributions to Italian mineralogy. Paseroite is commonly found in direct association with quartz, chalcocite, and volborthite, and more rarely with metatyuyamunite and pyrophanite. Paseroite occurs as submetallic, dark gray to black, elongated scalenohedral crystals between 50 and 100 μm in length. Crystals are usually isolated and may be zoned between paseroite and V-rich senaite. The main forms observed are {001} and {102}. It is brittle with a conchoidal fracture a black streak. The hardness is VHN_{500} 847 (834–865) kg/mm^2 (6–6.5 on Mohs scale) D_{calc} = 4.315 g/cm^3. In plane-polarized incident light, paseroite is grayish in color, weakly bireflectant and non-pleochroic, with absence of internal reflections. Paseroite is anisotropic. Reflectance value measured in air yielding [$R_{\max}$, $R_{\min}$ % (nm)]: 18.4, 18.2 (471.1); 17.9, 17.7 (548.3); 17.6, 17.3 (586.6); 17.0, 16.8 (652.3). By analogy with senaite, paseroite may be biaxial (–). Electron microprobe analyses (WDS) yielded the average composition (mean of 11 analyses, in wt%): Na_2O 0.35, MgO 0.05, MnO 7.70, ZnO 1.15, SrO 2.36, PbO 8.01, FeO 2.80, Fe_2O_3 1.71, La_2O_3 0.02, Ce_2O_3 0.03, TiO_2 32.78, ThO_2 0.05, UO_3 0.36, V_2O_5 41.27, total 98.64, providing the following empirical formula (based on 38 O): $(Pb_{0.61}Sr_{0.39})_{\Sigma 1.00}(V^{5+}_{7.78}Ti^{4+}_{7.03}Mn^{2+}_{1.86}Fe^{2+}_{0.67}Fe^{3+}_{0.37}Zn_{0.24}Na_{0.19}U_{0.02}Mg_{0.02}\square_{2.82})_{\Sigma 21.00}O_{38}$. The oxidation ratio for iron was based on site distributions from crystal structure. The X-ray powder diffraction data were collected on a Rigaku R-Axis Rapid II curved–imaging-plate microdiffractometer utilizing monochromatized Mo*K*α radiation. The diffraction pattern was indexed with a hexagonal unit cell with a = 10.434(1), c = 20.895(2) Å, V = 1970.29 Å^3, and Z = 3. The strongest reflections in the X-ray powder-diffraction pattern [d Å (I_{obs} %; *hkl*)] are: 3.417 (100; 024), 3.012 (21; 300), 2.896 (61; $2\bar{1}6$), 2.858 (36; 214), 2.765 (27; 303), 2.260 (85; $\bar{1}44$), 2.149 (65; $4\bar{1}5$) and 1.809 (57; $4\bar{1}8$). Single-crystal X-ray data (collected with a Oxford Diffraction Xcalibur 3 CCD diffractometer, and monochromated Mo*K*α-radiation) were indexed with a hexagonal cell with a = 10.3894(5), c = 20.8709(8) Å, V = 1950.98 Å^3, space group $R\bar{3}$. The structure was refined to R_1 = 2.34%. The crystal structure of paseroite is consistent with that reported for senaite and crichtonite. Their chemical composition is represented by the general formula ${}^{XII}A{}^{VI}B{}^{IV}T_2{}^{VI}C_{18}O_{38}$ (A = Ba, K, Pb, Sr, La, Ce, Na, or Ca; B = Mn, Y, U, Fe, Zr, or Sc; T = Fe, Mn, Mg, or Zn; and C = Ti^{4+}, Fe^{3+}, Cr, Nb, V^{5+}, Mn^{3+}, or Al). For paseroite, both the EMPA and structure refinement show the sum of $A + B + T + C$ cations to be substantially lower than the ideal value of 22 pfu required by the formula, and lead to the generalized crystal-chemical formula: ${}^{XII}A{}^{VI}B{}^{IV}T_{2-y}{}^{VI}C_{18-x}O_{38}$, allowing for the flexibility needed to accommodate a high amounts of V^{5+}. Assuming only pentavalent cations in C, and $Mn^{2+} > Fe^{2+}$ in T, the paseroite stoichiometric end–member would thus be: $PbMn^{2+}Mn^{2+}V^{5+}_{14}O_{38}$. Cotype material is deposited in the mineralogical collections of the Museo di Storia Naturale, Sezione di Mineralogia e Litologia, Firenze, catalog number 3111/I, and in the mineralogical collections of the Museo Regionale di Scienze Naturali, Torino, catalog number 15900. **F.C. and G.D.G.**

POSTITE*

A.R. Kampf, J.M. Hughes, J. Marty, and B. Nash (2012) Postite, $Mg(H_2O)_6Al_2(OH)_2(H_2O)_8(V_{10}O_{28})\cdot 13H_2O$, a new mineral species from the La Sal mining district, Utah: crystal structure and descriptive mineralogy. Canadian Mineralogist, 50(1), 45–53.

Postite (IMA 2011-060), ideally $Mg(H_2O)_6Al_2(OH)_2(H_2O)_8(V_{10}O_{28})\cdot 13H_2O$, is a new mineral from the Vanadium Queen mine, La Sal Creek Canyon, and the Blue Cap mine, Lyon Canyon Creek, San Juan County, Utah, U.S.A. It is found in close association with corvusite and montroseite. Nearby minerals include barite, calcite, clausthalite, devilline, dickthomssenite, hewettite, lasalite, magnesiopascoite, martyite, natrozippeite, navajoite, paramontroseite, pascoite, pyrite, rossite, selenium, sherwoodite, sulfur, tyuyamunite, uranopilite, and zeunerite. Postite occurs as very thin, needle-like prisms up to 1 mm long and 50 μm thick with pyramidal terminations, and generally grows parallel in divergent and "jackstraw" masses. Postite is golden-yellow, transparent, subadamantine with a yellow streak. It is brittle, has a splintery fracture and a Mohs hardness of 2; D_{calc} = 2.226 g/cm^3. The mineral has one good cleavage on {001} and at least two perfect cleavages parallel to [001], possibly {100} and {010}. Crystals dissolve rapidly in dilute HCl but not in distilled water, and do not fluoresce in short- or long-wave ultraviolet radiation. Postite is optically biaxial (+) with $2V = 71°$ with $\alpha = 1.727(3)$, $\beta = 1.733(3)$, and $\gamma = 1.745(3)$; $X = c$, $Y = b$, $Z = a$. Dispersion of optical axes was not observed and pleochroism is not perceptible. The average of 10 electron-microprobe analysis (WDS) from 8 partially dehydrated crystals of postite gave (wt%): Na_2O 0.15(0.16), K_2O 0.03(0.02), MgO 3.04(0.12), CaO 0.16(0.02), SrO 0.10(0.08), Al_2O_3 7.71(0.29) V_2O_5 71.00(1.20), H_2O (by stoichiometry) 17.81, total 100.00. This leads to the empirical formula $(Mg_{0.97}Na_{0.06}Ca_{0.04}Sr_{0.01}K_{0.01})_{\Sigma1.09}Al_{1.94}[(OH)_{1.92}(H_2O)_{0.08}]_{\Sigma2.00}(V_{10}O_{28})\cdot27H_2O$ on the basis of O = 57 apfu. The strongest lines in the X-ray powder-diffraction pattern [d_{obs} Å (I_{obs}%; *hkl*)] are: 8.937 (100; 111), 12.190 (90; 020), 3.771 (24; 113), and 8.248 (22; 200). Single-crystal X-ray diffraction data collected on a crystal of size 0.01 × 0.01 × 0.16 mm refined to $R_1 = 0.0358$ for 1583 unique reflections with $I \geq 2\sigma(I)$, solved by direct methods, shows postite is orthorhombic, space group *Pccn*, with $a = 16.3357(6)$, $b = 24.2434(17)$, $c = 11.7343(4)$ Å, $V = 4647.2$ Å^3, and $Z = 4$. Postite is a member of the pascoite family, and has a structural unit that consists of a decavanadate polyanion, $[V_{10}O_{28}]^{6-}$, and an interstitial unit that consists of $[Mg(H_2O)_6Al_2(OH)_2(H_2O)_8\cdot13H_2O]^{6+}$. The interstitial unit consists of a $[Mg(H_2O)_6]^{2+}$ monomer, $[Al_2(OH)_2(H_2O)_8]^{4+}$ edge-sharing dimer, and 13 additional H_2O molecules, where the units are held together through hydrogen bonding of oxygen atoms of the structural unit, and hydrogen atoms of both the dimer and isolated water molecules of the interstitial unit. The mineral is named in honor of Jeffrey E. Post (b. 1954), Curator-in-Charge of the National Gem and Mineral Collection, U.S. National Museum of Natural History (Smithsonian Institution), for his contributions to mineralogy, crystallography and geochemistry, and particularly to the scientific understanding of manganese oxide minerals. The cotype specimens of postite are deposited in the mineral collection of the Natural History Museum of Los Angeles County, under catalog numbers 63564 (Vanadium Queen mine) and 63563 (Blue Cap mine). **O.C.G.**

TARBAGATAITE*

A.V. Stepanov, G.K. Bekenova, V.L. Levin, E. Sokolova, F.C. Hawthorne, and E.A. Dobrovol'skaya (2012) Tarbagataite, $(K,\square)_2(Ca,Na)(Fe^{2+},Mn)_7Ti_2(Si_4O_{12})_2O_2(OH)_4(OH,F)$, a new astrophyllite-group mineral species from the Verkhnee Espe deposit, Akjailyautas Mountains, Kazakhstan: Description and crystal structure. Canadian Mineralogist, 50(1), 159–168.

Tarbagataite (IMA2010-048), ideally $(K,\square)_2(Ca,Na)(Fe^{2+},Mn)_7Ti_2(Si_4O_{12})_2O_2(OH)_4(OH,F)$, is a new astrophyllite-group mineral from the Verkhnee Espe deposit in Akjailyautas Mountains, Kazakhstan. The mineral is named after the Tarbagatai mountain range where the Verkhnee Espe deposit is located. Tarbagataite was discovered in a quartz-feldspar pegmatitic vein in association with astrophyllite, microcline, albite, quartz, aegirine, kupletskite, zircon, thorite, xenotime, fergusonite, fersmite, euxenite-(Y), ilmenite, columbite-(Mn), zinc pyrophanite, keiviite, thalenite-(Y), cappelenite-(Y), eudialyte, jinshajiangite, milarite, helvite, bertrandite, and bavenite. The mineral is closely associated with astrophyllite as lamellar intergrowths up to 10 × 3 × 0.2 mm. Tarbagataite is brown to golden brown, has colorless to pale yellow streak, and vitreous to pearly luster. Large grains of tarbagataite are opaque, whereas thin flakes are transparent. The mineral is non-fluorescent, has a perfect cleavage on {001} and moderate cleavage on {010}, Mohs hardness of 3, and $D_{calc} = 3.263$ g/cm^3. Tarbagataite is biaxial (+), $\alpha = 1.710(3)$, $\beta = 1.715(3)$, $\gamma = 1.745(3)$ ($\lambda = 589$ nm), $2V_{meas} = 37(3)°$, $2V_{calc} = 45°$. Optical orientation and dispersion could not be measured due to excessive light absorption. It is pleochroic with X = yellow brown, Y = orange red, Z = yellow orange; $X < Z < Y$. The IR spectrum has a few sharp peaks between 3656 and 3277 cm^{-1} (principal OH-stretching region), and a few bands at 1637, 1436, 950, 698, 656, 570, 531, and 455 cm^{-1}. The strongest lines in the X-ray powder-diffraction pattern [d_{obs} Å (I_{obs}; *hkl*)] are: 4.095 (80; 021), 3.735 (30; $0\bar{2}3$), 3.497 (50; 030), 3.258 (100; $\bar{1}\bar{1}3$), 2.858 (80; $0\bar{1}4$), 2.761 (70; $1\bar{4}2$), 2.646 (30; $\bar{2}11$), 2.560 (50; 130). The crystal structure of tarbagataite was refined on the basis of atom coordinates for Sn-rich astrophyllite to $R_1 = 5.8\%$ based on 7434 reflections. The mineral is triclinic, $P\bar{1}$, $a = 5.3868(6)$, $b = 11.9141(6)$, $c = 11.7171(2)$ Å, $\alpha = 112.978(2)$, $\beta = 94.641(2)$, $\gamma = 103.189(2)°$, $V = 661.84$ Å^3, $Z = 1$. The averaged electron microprobe analysis gave (wt%): Nb_2O_5 2.98, SnO_2 1.20, ZrO_2 0.32, TiO_2 9.29, SiO_2 36.11, Al_2O_3 0.12, ZnO 0.12, FeO 18.71, MnO 15.48, MgO 0.83, CaO 2.58, K_2O 2.67, Cs_2O 0.38, Rb_2O 1.28, Na_2O 1.14, F 0.49, $-O{=}F_2$ 0.21, H_2O (by crystal-structure analysis) 3.11, total 96.60. The empirical formula based on O+F = 31 pfu is $(K_{0.76}Rb_{0.18}Na_{0.12}Cs_{0.04}\square_{0.90})_{\Sigma2}(Ca_{0.62}Na_{0.38})_{\Sigma1}(Fe^{2+}_{3.51}Mn_{2.94}Mg_{0.28}Zr_{0.02}Zn_{0.02}\square_{0.23})_{\Sigma7}(Ti_{1.57}Nb_{0.30}Sn_{0.11}Zr_{0.02})_{\Sigma2}(Si_{8.09}Al_{0.03})_{\Sigma8.12}O_{30.65}H_{4.65}F_{0.35}$, that can be simplified to the structural formula of $A_2BC_7D_2(T_4O_{12})_2O_2(OH)_4(OH,F)$. The structure of tarbagataite is identical to that of astrophyllite. It is based on the HOH layer comprised of H sheets and one O sheet. The O sheet is formed by close-packed *C* octahedra, occupied dominantly by Fe^{2+} and Mn, whereas two adjacent H sheets of [5]- and [6]-coordinated *D* polyhedral are occupied by Ti with minor Nb. The heteropolyhedral sheets are formed by the (T_4O_{12}) astrophyllite ribbons sharing common vertices with *D* octahedra. In between adjacent HOH layers there are *A* and *B* sites, which are occupied by K and Ca in tarbagataite. The holotype specimen of tarbagataite is deposited in the mineral collection of the Geological Museum of the Satpaev Institute of Geological Sciences, Almaty, Kazakhstan. **Yu.U.**

ZAVALÍAITE*

F. Hatert, E. Roda-Robles, P. De Parseval, and J. Wouters (2012) Zavalíaite, $(Mn^{2+},Fe^{2+},Mg)_3(PO_4)_2$, a new member of the sarcopside group from the La Empleada pegmatite, San Luis Province, Argentina. Canadian Mineralogist, 50(6), 1445–1452.

Zavalíaite (IMA 2011-012), ideally $(Mn^{2+},Fe^{2+},Mg)_3(PO_4)_2$, is a Mn^{2+} analog of sarcopside discovered in the La Empleada granitic pegmatite (beryl-columbite-phosphate subtype), Totoral pegmatite field, San Luis Province, Argentina. It is named after María Florencia de Fátima Márquez Zavalía, a prominent Argentinean scientist. The mineral occurs in large lithiophilite nodules as colorless and transparent exsolution lamellae up to 70 × 1.5 µm and partially hydrates to reddingite, $(Mn^{2+},Fe^{2+})_3(PO_4)_2\cdot3H_2O$.

Zavalíaite is colorless with a white streak, vitreous to resinous, displays perfect cleavage along {100} and {001}, brittle, has Mohs hardness of 4. Zavalíaite is biaxial (–), $2V_{meas} = 15(5)°$. Only the mean refraction index of 1.66 is given. One of the cleavage planes shows the angle of ~45° with lamellae's elongation. X is perpendicular to that plane. The mineral is non-pleochroic, non-fluorescent. $D_{calc} = 3.68$ g/cm^3. The averaged electron microprobe analyses (27 points) gave: MgO 6.09, MnO 27.08, FeO 24.94, P_2O_5 41.38, total 99.49 wt%. No other elements detectable by EMPA were found. The absence of CO_2 and H_2O was confirmed by structural data. The empirical formula calculated on the basis of 8 O atoms is $(Mn^{2+}_{1.31}Fe^{2+}_{1.19}Mg_{0.52})_{\Sigma 3.02}(P_{1.00}O_4)_2$. The strongest lines of the powder X-ray pattern are [d_{obs} Å (I_{obs}%; hkl)]: 6.75 (58; 100), 3.54 (100; $11\overline{1}$,012), 2.964 (38; 200), 2.816 (81; 013), 2.537 (20; $11\overline{3}$), 1.848 (20; 311), 1.774 (53; 222,$22\overline{2}$), 1.652 (27; 313,$31\overline{3}$). Unit-cell parameters refined from the powder data are $a = 6.13(1)$, $b = 4.80(1)$, $c = 10.38(4)$ Å, $\beta = 89.9(2)°$; $V = 305.4$ Å^3. The crystal structure of zavalíaite was refined on the basis of single-crystal diffraction data starting with the atom coordinates of chopinite to $R_1 = 3.83\%$ for 724 reflections, $F_o > 2\sigma F$. The mineral is monoclinic, $P2_1/c$, $a = 6.088(1)$, $b = 4.814(2)$, $c = 10.484(2)$ Å, $\beta = 89.42(3)$, $V = 307.21$ Å^3, and $Z = 2$. The crystal structure of zavalíaite is similar to olivine (with Si replaced by P). It is based on chains of distorted octahedra M1 and M2 (where Fe^{2+} is dominant in M1 and Mn^{2+} in M2) and connected through [PO_4] tetrahedra. The holotype specimen is deposited in the collections of the Laboratory of Mineralogy, University of Liège under catalog number 20384. **Yu.U.**