New Mineral Names* †

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AMMONIOMAGNESIOVOLTAITE*†


Ammoniomagnesiogalvanneita (IMA-2009-040), ideally (NH4)2MgFe2+Al(SO4)2·18H2O, is a new mineral found in an open coal pit near the Köves Hill, Pécs-Vasas, Mecsek Mountains, Southern Hungary. It is associated with tschermigate, sabbieite, kieserite, pickeringite, and hexahydrate. Other ammonium minerals (salammoniac, mascagnite, clairite, boussingaultite, efremovite, koksitite, mohrite, ammoniojarosite, godovikovite, letovicite) as well as native sulfur, millosevichite, alunogen, metavolinite, 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. Ammoniomagnesiogalvanneita forms crusts of pale-yellow to yellowish violet 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. Dmeas = 2.55(1), Dcalc = 2.351 g/cm³. Ammoniomagnesiogalvanneita 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 NH4), 1122sp and 1065sp (SO42⁻ asymmetric stretch), 1014w (SO42⁻ symmetric stretch), 594 (SO42⁻ asymmetric bend), and 474 (SO32⁻ symmetric bend). The average of 5 electron-microprobe analysis (WDS) gave [wt% (range)]: SO4: 47.56 (46.59–48.75), Al2O3: 3.31 (3.25–3.36), FeO (total) 16.99 (15.99–18.11), [Fe2O3 (calc) 12.28, FeO (calc) 5.94], MnO: 1.18 (1.11–1.25), MgO: 7.02 (6.87–7.27), K2O: 0.05 (0.05–0.06), (NH4)2O (by spectrophotometry) 3.11, and H2O (calc) 17.72, total 98.17 wt%. Weight percent for Fe2⁺ and Fe3⁺ are determined assuming (Mg + Fe2⁺ + Mn2⁺)/(Fe2⁺ + Al) = 5/4, and by stoichiometry for H2O. This leads to the empirical formula [(NH4)2.1K0.02Fe1.05Mg0.02Mn0.25O2.18H2O on the basis of (Mg + Mn + Fe + Al)] = 9 apfu. The strongest lines in the X-ray powder-diffraction pattern [d(hkl) Å (Icalc %; lfull)] collected from a synthetic crystal of ammoniomagnesiogalvanneita 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 Fd3c, a = 27.260(2) Å, V = 20257 Å³, Z = 16. Single-crystal X-ray studies were not possible due to the small size of the crystals. Ammoniomagnesiogalvanneita is a member of the volitate-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 Herren 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*


A new mineral arangasite (IMA 2012-018), ideally Al2(PO4)(SO4)F·7.5H2O was discovered at Alyaskitovoye Sn-W deposit in the lower part of Arangas Stream, the tributary of Elga River, Indigirka River Basin, Eastern Yakutia, 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 Alyaskitovoye deposit is intensively greisenized and crosscut by quartz-muscovite-tourmaline-sulphides veins 0.2–0.8 m thick.
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, stibonite, 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 = 2.01(1), D_{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 sanjuaquite) with α = 1.485(5), γ = 1.493(5) (λ = 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 (H₂O molecules); 2510; 1655 (bending vibration of H₂O); 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 sanjuaquite. 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) (H₂O by Penfield method) is: AIsO₂₆, 26.64/35.36, P₂O₅, 17.20/18.50, SO₃, 19.10/20.55, F 4.58/5.22, -O=F₂ 1.92, H₂O 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: AIs₂₁,O₂₂(P₀₉,₇O₁₃)(S₀₉,₈O₁₄)F₀₉,₆H₁₅,₂O₁₄. The strongest lines of the X-ray powder diffraction pattern [d_{hkl}, λ (I_{obs} %; hkl)]: 10.57 (36; 001), 9.60 (100; 100), 7.123 (23; 021), 5.295 (34; 002), 4.191 (29; 221), 3.218 (50, 060), 2.870 (20, 731). 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, β = 98.65(8), V = 1987 Å³, Z = 6, and the reflections conditions agreed with the space groups P²₁ or P₂₁/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)**


Atelisite-(Y) (IMA 2010-065), ideally Y₂Si₁₀O₃₀(OH)₆, 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 Hamaroy and Lofoten, and later deformed during the early stages of the Caledonian orogene 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), caleoanclysite-(Ce), caleoanclysite-(Nd), fluorhalénite-(Y), hema- toite, hundholmenite-(Y), kainosite-(Y), keiviite-(Yb), kozosite-(Nd), kuliokite-(Y), muscovite, quartz, rowlandite-(Y), stetindite, synchysite-(Y), thalénite-(Y), thorite, törnebohmit- e-(Ce), uraninite, uranothéte-β, yuventpakhkite-(Y), xenotime-(Y), ytrirvite-(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), caleoanclysite-(Nd), and La-dominant caleoanclysite. Atelisite-(Y) forms transparent crystals of dipyramidal 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 (+), ω = 1.727 (λ = 589 nm) and ε > 1.8. D = 4.26 g/cm³. Electron microprobe analyses (WDS) yielded the average composition (mean of 25 analyses, wt%): SiO₂ 18.73, Y₂O₃ 45.67, Yb₂O₃ 11.81, Gd₂O₃ 2.09, Tb₂O₃ 0.53, Dy₂O₃ 2.57, Ho₂O₃ 0.62, Er₂O₃ 4.72, H₂O 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): (Y₃.₁₁Yb₁.₄₀Er₁.₉₉Dy₁.₉₃Ho₁.₀₁Gd₁.₁₁Tb₁.₀₂Sc₁.₉₉Si₁₁O₃₂⇒H₄.₄₂. There is a clear Si deficit with respect to a hypothetical composition (REE)₂SiO₄(OH). The deviation from an idealized composition (REE)₂SiO₄(OH)₃ 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: (Y₃.₁₁Yb₁.₄₀Er₁.₉₉Dy₁.₉₃Ho₁.₀₁Gd₁.₁₁Tb₁.₀₂Sc₁.₉₉Si₁₁O₃₄(OH)₆. 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 MoKα-radiation. The diffraction pattern was indexed with a tetragonal cell with: a = 6.947(4), c = 6.133(3), V = 2959.98 Å³, Z = 1, space group: 42d. The structure was solved and refined to R₁ = 2.08%. The strongest X-ray powder diffraction lines are [d_{hkl}, λ (I_{obs} %; hkl)]: 3.474 (100; 200), 2.601 (73; 1T2,112), 1.786 (68; 312,3T2), 4.598 (57; 101). The crystal structure of atelisite-(Y) shows structural homologies with those of zircon and xenotime, but is distinguished from a characteristic alternating rotation of the SiO₄-tetrahedra about [001]. The name of atelisite-(Y) is from Greek “atels” (ατηλος), meaning deficient, based on the Si-deficiency of the mineral. The holotype is preserved in the collection of the Mineralogical
BOSCARDINITE*  

Boscardinite (IMA 2010-079), ideally TIPb₂(As₂S₆)₃S₉₀₈, 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 sulfosalts in this vein are boulangerite, chabournite, 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 = 3.95 g/cm³. 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 bireflective. All crystals show well-developed polysynthetic twinning. The values for COM wavelengths in air [R₁, R₂, % (λ in mm)] 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%): 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), Se 0.04(1)/0.01(1), total 97.77/98.16. The crystallographic data are: Z = 2. Single-crystal X-ray diffraction data collected on a crystal of size 0.10 × 0.13 × 0.25 mm refined to a crystal of size 0.27 × 0.16 × 0.16 mm and the structure was solved by direct methods, shows boscardinite is triclinic, space group P̅1̅, 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 Å³ and Z = 2. Boscardinite is the Ti–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 the knowledge of the regional mineralogy of Italy. The holotype material 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)*  

Carlgieseckeite-(Nd) (IMA 2010-036), ideally NaNdCa₃(PO₄)₆F, is a new mineral species of the belovite group (apate supergroup) found at the Kuannersuit (Kvæfjörd) Plateau, Ilímaussaq alkaline complex, South Greenland. It was found with analcime and fluoroapatite in small cavities in veins of white sugar-like albitic 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 × 1.3 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 × 3.3 mm epitaxially overgrow prismatic crystals of Sr-bearing fluoroapatite. Carlgieseckeite-(Nd) is brittle, with an uneven fracture; no cleavage observed. Mohs hardness is 5 and D = 3.91 g/cm³. 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), 2Vmeas = 15.5°, and 2Vcalc = 33°. In thin section, carlgieseckeite-(Nd) is colorless and nonpleochroic. The average of 10 electron-microprobe analysis (WDS) gave [wt% (range)]: Na₂O 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), La₂O₃ 1.32 (0.6–1.9), Ce₂O₃ 10.60 (8.1–12.4), Pr₂O₃ 2.62 (2.4–2.9), Nd₂O₃ 15.08 (13.6–17.7), Sm₂O₃ 2.89 (2.1–3.7), Gd₂O₃ 0.52 (0.3–0.7), SiO₂ 0.56 (0.4–0.7), P₂O₅ 32.72 (31.8–33.2), F 2.80 (2.6–2.9), Cl 0.06 (0.0–0.1), O(C=Cl) 1.19, total 99.88 wt%. Neither H₂O nor CO₂ were determined because of paucity of material. The empirical formula Na₁₁₋ₓCa₄₋ₓSr₄₋ₓBaₓNdₓCe₄₋ₓPrₓ₀.₁₀Ndₓ₀₅₋ₓSmₓ₁₀Gdₓ₁₀Sbₓ₁₀P₂ₓ₋₀.₀₅S₉₀₁₂₋₀.₀₅P₂₀ₓ₀₅Fₓ₋₀.₁₀Caₓ₁₀Clₓ₁₀ calculated on the basis of 13 O + F + Cl apfu. The strongest lines in the X-ray powder-diffraction pattern [d [Å], Δd (%) (hk0)] 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) Å and c = 6.974(7) Å, V = 539 Å³, and Z = 2. Single-crystal X-ray diffraction data collected on a crystal of size 0.10 × 0.13 × 0.25 mm refined to R₁ = 0.0218 for 1520 unique reflections with I ≥ 4σ(I), solved by direct methods, shows carlgieseckeite-(Nd) is trigonal, space group P̅3₃, a = 9.4553(1) Å, c = 6.9829(7) Å, V = 540.62 Å³, 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.

CUPROMOLYBDATE*  
Cupromolybdite (IMA 2011-005), ideally CuO(TiO₄), is a new fumarolic mineral from the Tolbachik volcano, Kamchatka Peninsula, Russia, where it was discovered in association with pyrite, gedrite, perovskite, hematite, magnetite, aphanite, langbeinite, palmierite, As-bearing orthoclase, lammerite, klyuchevskite, aluminoklyuchevskite, euchlorite, lyonsite, pseudolystnitzite, averietite, 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/cm³. 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 by Yu.U.


Heuzolinite (IMA 2010-045), ideally Sr₂REE₂Zr(Fe²⁺;Fe³⁺)TiO₄(Si₂O₇), 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. Heuzolinite occurs in the second intrusive phase. Heuzolinite 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 VHN₁₀₀₀ = 6547–6924 kg/mm² (5.5–6 on Mohs scale). D(calc) = 4.28 and D(calc) = 4.30 g/cm³. Optically, heuzolinite is biaxial (−), 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%): SiO₂ 21.90, TiO₂ 24.42, Al₂O₃ 0.16, FeO 1.84, Fe₂O₃ 2.61, MnO 0.07, MgO 0.01, Nb₂O₅ 0.28, ZrO₂ 9.18, HfO₂ 0.39, SrO 20.12, CaO 2.46, Na₂O 0.35, ThO₂ 0.80, UO₂ 0.01, La₂O₃ 7.12, Ce₂O₃ 8.16, Pr₂O₅ 0.45, Nd₂O₃ 1.34, Sm₂O₃ 0.10, Eu₂O₃ 0.16, Gd₂O₃ 0.06, total 101.99, providing the following empirical formula (based on 22 O): (Sr₁.₁₁Ce₀.₅⁵La₀.₄⁶Ca₀.₄⁹Na₀.₁₂Nd₀.₀₉Pr₀.₀₃Ti₀.₀₇Zr₀.₅⁵Fe₀.₄⁵Hf₀.₁⁶Mn₀.₁₂H₁.₀₈(Fe₁.₃⁸Fe₃.₅₄Mn₀.₀₄)

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NEW MINERAL NAMES
tions 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 “saimaitae”, and powder diffraction and chemistry were provided by Ding et al. (1984) as (Sr,REE)(Fe2+)(Ti,Zr)2Ti4O8(Si2O7)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)(Zr,Fe3+)(Ti,Fe3+),Ca2)Ti4O8(Si2O7)2. However, the structure remained unknown and the mineral not confirmed. Jambor et al. (2000), on the basis of its formula, suggested that “saimaitae” was the equivalent of strontiochevikinite and later on, in 2006, “saimaitae” was discredited by CNMNC (Burke, 2006). After then, it was mentioned under different names and last time as REE, Fe polymorph of reneite by Yang et al. (2010).

References cited

JACUTINGAITE*


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,HgSe, 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,HgSe (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{01} = 169 (119–245) kg/mm² corresponding to Mohs hardness ~3½, D_{min} = 10.9 and D_{max} = 10.35 g/cm³. 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 (Pt1.4,Pd0.6,Ag0.1)Hg0.93Se3.02. Jacutingaite is trigonal, P3m1, with a = 7.3477(2), c = 5.2955(1) Å, V = 247.59 Å³, and Z = 2. The strongest X-ray powder-diffraction lines [d_{hkl} Å (I_{obs}; I_{calc})] 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 Pt1.4Se3.02 phase, which has similar unit-cell parameters and stoichiometry, to R = 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,HgSe) forms stable assemblages with sudovikovite (PtSe3) and cuboaluminate (PtSe3), 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 Techni-University of Clausthal, Germany, under catalog number 26580. Yu.U.

References cited

LAPTEVITE-(Ce)*


A new vicanite-group mineral laptevite-(Ce) (IMA 2011-081), ideally NaFe3+(REE,Ca,Y)3(SiO3)4(SiB2PO4)8(BO3)F11, was discovered in moraine boulder at the Upper Darai-Pioz alkaline massif, at the junction of Turkest, Zeravshan, and Alay Mt.
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Ranges, Tajikistan. This massif consists of various syenites and granitoids and is abundant with pegmatites, hydrothermalites, carbonatites, and albites 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, polyphonite, and albite and most often occurs in intergrowths with bafertisiite, “calcy-beerosilit-(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$^2$. $D_{calc} = 4.61(2), D_{obs} = 4.619$ g/cm$^3$. Laptevite-(Ce) is optically uniaxial, negative, $\omega = 1.741(3), \epsilon = 1.720(3)$ for $\lambda = 589$ nm. It is slightly soluble in HCI (1:1) solution at room temperature. The major absorption bands of IR spectrum are (cm$^{-1}$): 1623, 1437, 1300, 945, 930, 877. Single-crystal X-ray study appeared to be metamict and were characterized by three powder diffraction patterns. The strongest lines of the X-ray powder diffraction pattern are: 1623, 1437, 1300, 945, 930, 877. The powder diffraction pattern on lavoisierite was obtained using an O/OH ratio so as to achieve the charge balance, for a sum of 100.63, providing the following empirical formula (based on an O/OH ratio so as to give 56 anions pfu and 100 positive charges): $\text{Na}_8\text{Al}_2\text{Mn}_{12}\text{B}_3\text{Si}_{34}\text{P}_8\text{O}_{120}\text{SiO}_{100}\text{F}_{10}$, where $\text{REE} = \text{Ce}$.

The strongest lines of the X-ray powder diffraction pattern are: $d_{min}$ Å ($|I_{obs}|/hkl$) are: 7.70 (19; 012); 4.41 (29; 202), 3.13 (26; 512), 2.931 (vs; 1 1 10), 2.765 (s; 1 1 11), 2.598 (s; 1 1 12), 2.395 (s; 1 1 13), 2.239 (vs; 0 1 0), 2.155 (m; 1 1 20), 2.052 (s; 1 2 0), 1.979 (111; 012), 1.770 (211; 202). The diffraction pattern was indexed in hexagonal unit cell with $a = 10.772(2), c = 27.864(4)$ Å, and $V = 2803.6$ Å$^3$. The K-values selected for single-crystal X-ray study appeared to be metamict and were heated in argon atmosphere at 800 °C. Laptevite-(Ce) is triclinic, space group $R3m$, $a = 10.804$(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 $(F>\alpha F)$ reflections, refined to $R_I = 3.87\%$ and appeared to be basically similar of that of vicanite. It is characterized by three layers within a heteropolyhedral framework: A ($z = 0$), B ($z = 0.13$), and C ($z = 0.23$). In layer A, tetrahedra form a three-membered rings (B$_3$P$_2$O$_{10}$), each tetrahedron shares a corner with one SiO$_4$ tetrahedron, forming a complex polyion $\text{Si}_8\text{B}_6\text{P}_4\text{O}_{24}$ (31). The Fe$^{6+}$-dominant octahedron shares corners with six SiO$_4$ tetrahedra. This layer also includes the REE-dominant 9-coordinated polyhedra, 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 Tatiana 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.

**Lavoisierite**

P. Orlandi, C. Biagioni, M. Pasero, and M. Mellini (2013) Lavoisierite, Mn$_{3}$[Al$_{10}$Mn$_{3}$Si$_{18}$O$_{49}$]Si$_{1}$P$_{1}$O$_{12}$I$_{1}$, 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$_{3}$[Al$_{10}$Mn$_{3}$Si$_{18}$O$_{49}$]Si$_{1}$P$_{1}$O$_{12}$I$_{1}$, is a new mineral discovered in piemontite-bearing micaschists belonging to the Piedmontese Nappe from Punta Gensane, Ivù 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 {011}, 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$_2$O$_5$ 2.08, V$_2$O$_5$ 0.37, SiO$_2$ 34.81, TiO$_2$ 0.13, Al$_2$O$_3$ 22.92, Cr$_2$O$_3$ 0.32, Fe$_2$O$_3$ 0.86, MgO 5.73, MnO 25.31, CaO 1.94, Na$_2$O 0.01, H$_2$O 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): $\text{Mn}_{3.24}\text{Al}_{10.86}\text{Cr}_{0.69}\text{V}_{0.01}\text{Fe}_{10.21}\text{C}_{0.06}\text{Ti}_{0.03}\text{Mg}_{0.90}\text{Si}_{1}\text{P}_{1}\text{O}_{12}$I$_{1}$. 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: $\text{Mn}_{3}\text{Mg}_{2}\text{Ca}_{2}\text{Al}_{10}\text{Mn}_{3}\text{Mg}_{14}\text{Si}_{1}\text{P}_{1}\text{O}_{12}$I$_{1}$. The X-ray powder diffraction pattern on lavoisierite was obtained using a 114.6 mm Gandolfi camera and Ni-filtered CuK$\alpha$ radiation. The strongest reflections in the X-ray powder-diffraction pattern $d_{min}$ 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;
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310), 2.448 (ms; 028). Single-crystal X-ray data collected with an Oxford Diffraction Xcalibur diffractometer with a Sapphire 3 CCD detector, and monocromated MoKα-radiation were indexed with an orthorhombic unit cell: \(a = 8.6891(10)\), \(b = 5.7755(3)\), \(c = 39.9504(20)\) \(\AA\), \(V = 1854.3\) \(\AA^3\), \(Z = 2\), and space group \(Pnnm\). 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 “ardinite”; repeats along \(a\) and \(b\) are similar for all these minerals, whereas \(c_{(Lav)} = c_{(Ard)} + 2c_{(Srs)}\) (Mn6). In sursassite, chains of edge-sharing octahedra are connected to each other through \(\text{Si}_4\) and \(\text{Si}_6\) groups; in “ardinite”, columns of edge-sharing octahedra arebonded by means of \(\text{Si}_4\) and \(\text{Si}_6\) groups. In lavoisierite, both modes of connection are present: there are slabs with \(\text{Si}_4\) and \(\text{Si}_6\) groups (sursassite-type slab) and slabs with \(\text{Si}_4\) and \(\text{Si}_6\) groups (ardinite-type slab). The regular alternation, along \(\{001\}\), of sursassite-type and ardentinite-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.


Paserite (IMA 2011-069), ideally \(\text{PbMn}^{2+}\)(\(\text{Mn}^{3+},\text{Fe}^{3+}\))\(_2\)(\(\text{V}^{5+}\),\(\text{Ti},\text{Fe}^{2+}\))\(_{10}\)\(_{O}_{35}\), 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 Gravaglia, 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. Paserite is commonly found in direct association with quartz, chalcolite, and volborite, and more rarely with metatyuyamunite and pyrophanite. Nearby minerals include barite, calcite, clausthalite, devilline, dickthomssenite, hewettite, lasalite, magnesiopascoite, martyite, natrozippeite, sherwoodite, sulfur, tuyumamite, uranopilute, and zeunerite. Paserite occurs as very thin, needle-like prisms up to 1 mm long and 50 \(\mu\)m 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; \(D_{\text{calc}} = 2.226\) 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 α = 1.727(3), β = 1.733(3), and γ = 1.745(3); X = ε, 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%): Na2O 0.15(0.16), K2O 0.03(0.02), MgO 3.04(0.12), CaO 0.16(0.02), SrO 0.10(0.08), Al2O3 7.71(0.29) V2O5 71.00(1.20), H2O (by stoichiometry) 17.81, total 100.00. This leads to the empirical formula (Mg0.07Na0.06Ca0.04Sr0.01K0.01)2δ+10 Al14.3357(6), H2O 27H2O on the basis of O = 57 apfu. The strongest lines in the X-ray-powder-diffraction pattern [d(Å), Ω(°, 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 with α = 1.727(3), β = 1.733(3), and γ = 1.745(3); X̅ = 1.710(3), β̅ = 1.715(3), γ̅ = 1.745(3) (λ = 589 nm). 2Vmeas = 37(3)°, 2Vcalc = 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, 657, 531, and 455 cm⁻¹. The strongest lines in the X-ray-powder-diffraction pattern [d(Å), Ω(°, hkl)] are: 4.095 (80; 021), 3.735 (30; 023), 3.497 (50; 030), 3.258 (100; 023), 2.858 (80; 0T4), 2.761 (70; 142), 2.646 (30; 211), 2.560 (50; 130). The crystal structure of tarbagataite was refined on the basis of atom coordinates for Sn-rich astrophyllite to R1 = 5.8% based on 7434 reflections. The mineral is triclinic, P̅T, a = 5.3868(6), b = 11.9141(6), c = 11.7171(2) Å, α = 112.978(2), β = 94.641(2), γ = 103.189(2)°, V = 661.84 Å³; Z = 1. The averaged electron microprobe analysis gave (wt%): Nb2O5 2.98, SnO 1.30, ZrO2 0.32, TiO2 9.29, SiO2 36.11, Al2O3 0.12, ZnO 0.12, FeO 18.71, MnO 15.48, MgO 0.83, CaO 2.58, K2O 2.67, Cs2O 0.38, Rb2O 1.28, Na2O 1.14, F 0.49, O = F = 0.21, H2O (by crystal-structure analysis) 3.11, total 96.60. The empirical formula based on O+F = 31 pfu is (K0.76Rb0.18Na0.12Cs0.04Ca0.02Fe0.12Tl0.03Na0.01)2δ+10(Ca42.86Na33.82Fe5.13Mn2.94Mg2.82Zr0.02Zn0.02O)28(C21Ca42O28H17O635H2O, that can be simplified to the structural formula A2BC2D3(T1O5)12O4(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 Fe2+ 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 (T1O5)2+ 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*


Zavalíaite (IMA 2011-012), ideally (Mn2+Fe3+Mg)(PO4)3, is a Mn2+ analog of saccopside 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 Zavallía, a prominent Argentinean scientist. The mineral occurs in large lithophilitic nodules as colorless and transparent exsolution lamellae up to 70 × 1.5 μm and partially hydrated to redrigeite, (Mn2+Fe3+)3(PO4)3·3H2O.
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 (−), \(2V_{\text{meas}} = 15(5)°\). Only the mean refraction index of 1.66 is given. One of the cleavage planes shows the angle of \(\sim 45°\) with lamellae’s elongation. \(X\) is perpendicular to that plane. The mineral is non-pleochroic, non-fluorescent. \(D_{\text{calc}} = 3.68\) g/cm\(^3\). The averaged electron microprobe analyses (27 points) gave: MgO 6.09, MnO 27.08, FeO 24.94, P\(_2\)O\(_5\) 41.38, total 99.49 wt%. No other elements detectable by EMPA were found. The absence of CO\(_2\) and H\(_2\)O was confirmed by structural data. The empirical formula calculated on the basis of 8 O atoms is (Mn\(_{1.31}\)Fe\(_{2.19}\)Mg\(_{0.52}\))\(2(\text{P}_{1.00}\text{O}_{4})_2\). The strongest lines of the powder X-ray pattern are \([d_{\text{obs}}\,\text{Å} (I_{\text{obs}}\%\, hkl)]: 6.75 (58; 100), 3.54 (100; 11\overline{2}012), 2.964 (38; 200), 2.816 (81; 013), 2.537 (20; 11\overline{7}), 1.848 (20; 311), 1.774 (53; 222,\overline{2}2\overline{2}), 1.652 (27; 313,\overline{3}1\overline{3}).\) Unit-cell parameters refined from the powder data are \(a = 6.13(1), b = 4.80(1), c = 10.38(4)\,\text{Å}, \beta = 89.9(2)°; V = 305.4\,\text{Å}^3.\) 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, \(P2_1/c, a = 6.088(1), b = 4.814(2), c = 10.484(2)\,\text{Å}, \beta = 89.42(3), V = 307.21\,\text{Å}^3,\) 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 \([\text{PO}_4]\) tetrahedra. The holotype specimen is deposited in the collections of the Laboratory of Mineralogy, University of Liège under catalog number 20384. Yu.U.