**New Mineral Names***†

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**IN THIS ISSUE**

This New Mineral Names has entries for nine new minerals, including cayalsite-(Y), engelhauptite, flurrite, hydroniumpharmacoaluminite, mambertiite, parádsasvárite, perettite-(Y), shuvalovite, and suscauriniugite.

**CAYALSITE-(Y)**


The new mineral cayalsite-(Y) (IMA 2011-094), ideally CaY3Al7Si8O26F2, was found in cavities of Y-fluorite in two granitic NYPpegmatites hosted by 1742 ± 46 Ma granitic gneiss in Tysfjord, Nordland, Norway: Stetind (68°10′15.20″N 16°33′10.65″E) and Øvre Lapplægeret (68°02′3.26″N 16°00′14.98″E). At both localities, cayalsite-(Y) occurs as a late-stage mineral forming colorless to faintly pink vitreous prismatic crystals up to 1.2 × 0.4 mm or radiating aggregates. CAYALSITE-(Y) was found in Stetind and Øvre Lapplægeret (68°02′3.26″N 16°00′14.98″E). At both localities, cayalsite-(Y) occurs as a late-stage mineral forming colorless to faintly pink vitreous prismatic crystals up to 1.2 × 0.4 mm or radiating aggregates. Observed crystal forms are: prisms [011], [012], [110], [210], [211], dipipyramids [221], [312], and pinacoids [100], [010], [001]. Closely associated minerals at both localities are bastnäsite-(Ce), hematite and vuntasparikhite-(Y). Hundholmenite-(Y) and a montmorillonite-like polytype of three non-equivalent layers.

**Engelhauptite**


A new copper vanadate engelhauptite (IMA 2013-009), ideally KCu4(V18O43)(OH)Cl, was discovered in the Late Pleistocene vol-
Engelhauptite is a new mineral from the Hagendorf-Süd pegmatite, Hagendorf, I.E. Grey, E. Keck, W.G. Mumme, A. Pring, C.M. Macrae, R.W. Gable, Moscow, Russia. Fersman Mineralogical Museum of the Russian Academy of Sciences, replacement of H from the powder data are based on 10 (O+OH+Cl) apfu, is K V 0.29 (0.08–0.46), CuO 46.11 (45.04–46.88), Al [wt%, (range)] is: K (O–V–O bending vibrations of V = pale yellow, T = pale orange, Z = orange brown. Hardness has not been reported. D calc = 2.89 g/cm³ (heavy liquids) and D meas = 2.84 g/cm³. Average of 7 electron probe WDS analyses is [wt% (range)]: ZnO 25.40 (23.4–27.2), MnO 5.28 (4.26–7.23), MgO 0.52 (0.25–0.63), FeO 18.50 (15.8–24.0) [Fe₂O₃ 10.30 on the basis of 1 Fe³⁺ pfu, FeO 7.40], P₂O₅ 27.20 (25.6–28.3), H₂O 23.10 (on the basis of 20 H pfu), total 99.20. The empirical formula, calculated on the basis of 3 Fe³⁺ apfu is: (Zn₃Mn₄Fe₆Mg₂₆)₄(O₇)(PO₄)(OH)₉·H₂O. The strongest X-ray powder diffraction lines [d Å (P; hkl)] are: 12.900 (100; 001), 8.375 (10; 011), 6.072 (14; 010); 5.567 (8; 012), 4.297 (21; 003), 2.763 (35; 404). The monoclinic unit-cell parameters refined from the powder data are: a = 6.392(3), b = 11.047(2), c = 13.067(3) Å, β = 99.42(3)°, V = 910.3 Å³. X-ray single-crystal diffraction study showed that all tested crystal presented severe streaking parallel to c*. Refinement of data collected at the MX2 beamline at the Australian Synchrotron on an ultrathin crystal (20 × 20 × 3 μm) showing less severe streaking yielded R I = 0.057 for 935 unique F > 4σ(F) reflections. Flurite is monoclinic, 2/m, with unit-cell parameters (at 100 K) of a = 6.3710(13), b = 11.020(2), c = 13.016(3) Å, β = 99.34(4)°, V = 901.7 Å³, Z = 2. Flurite has a heteropolygonal layer structure, with layers parallel to 001 and packed with water molecules between the layers. The slabs are built up by chains of Zn-centered edge sharing octahedra running parallel to [100] and by chains of Fe³⁺-centered octahedra sharing their apices along [100] with dimers of Zn-centered trigonal bipyramids sharing edge and with a PO₄ group. Both chains are linked along [010] sharing octahedra and PO₄ group apices. Further PO₄ groups and Mn-centered octahedra complete the slabs. The structure of flurite is related to the structure of schoenite, which has the same layer dimensions 6.4 × 11.1 Å, although a different symmetry (orthorhombic, Pmnb) and a different topology of the layers. The name flurite honors Mathias von Fluri (1756–1823), the founder of mineralogy and geology studies in Bavaria and author of the first geological map of Bavaria. Type material is deposited in the Museum Victoria, Melbourne, Victoria, Australia, with registration numbers M53238. F.C.

FLURLITE*
I.E. Grey, E. Keck, W.G. Mumme, A. Pring, C.M. Macrae, R.W. Gable, and J.R. Price (2015) Flurite, ZnMn²⁺Fe⁴⁺(PO₄)₉(OH)₉·H₂O, is a new mineral from the Hagendorf-Süd pegmatite, Bavaria, Germany (49°39’1”N 12°27’35”E). Flurite occurs on green mitridate and is closely associated with plimerite. It is also associated with beraunite, schoeninite, parasholzite, robersite, and occasionally with an altered phosphophylite. Flurite is a secondary phosphate mineral probably formed from the hydrothermal reaction of zinc-bearing fluids with primary Fe-Mn phosphate(s) (triphyllite or zwieselite). It occurs as ultratiny (<1 μm) translucent platelets forming characteristic twisted accordion-like aggregates. Flurite color varies from bright orange-red to a dark maroon-red. The luster is pearly, and the streak is buff. Crystals are brittle; parting is not observed and cleavage is excellent on {001}. Flurite is optically biaxial (+) with α = 1.600(1), β = 1.65(1), γ = 1.685(1) (white light); 2V not measured, 2V calc = 74°. Pleochroism is weak, X = pale yellow, Y = pale orange, Z = orange brown. Hardness has not been reported. D calc = 2.89 g/cm³ (heavy liquids) and D meas = 2.84 g/cm³. Average of 7 electron probe WDS analyses is [wt% (range)]: ZnO 25.40 (23.4–27.2), MnO 5.28 (4.26–7.23), MgO 0.52 (0.25–0.63), FeO 18.50 (15.8–24.0) [Fe₂O₃ 10.30 on the basis of 1 Fe³⁺ pfu, FeO 7.40], P₂O₅ 27.20 (25.6–28.3), H₂O 23.10 (on the basis of 20 H pfu), total 99.20. The empirical formula, calculated on the basis of 3 Fe³⁺ apfu is: (Zn₃Mn₄Fe₆Mg₂₆)₄(O₇)(PO₄)(OH)₉·H₂O. The strongest X-ray powder diffraction lines [d Å (P; hkl)] are: 12.900 (100; 001), 8.375 (10; 011), 6.072 (14; 010); 5.567 (8; 012), 4.297 (21; 003), 2.763 (35; 404). The monoclinic unit-cell parameters refined from the powder data are: a = 6.392(3), b = 11.047(2), c = 13.067(3) Å, β = 99.42(3)°, V = 910.3 Å³. X-ray single-crystal diffraction study showed that all tested crystal presented severe streaking parallel to c*. Refinement of data collected at the MX2 beamline at the Australian Synchrotron on an ultrathin crystal (20 × 20 × 3 μm) showing less severe streaking yielded R I = 0.057 for 935 unique F > 4σ(F) reflections. Flurite is monoclinic, 2/m, with unit-cell parameters (at 100 K) of a = 6.3710(13), b = 11.020(2), c = 13.016(3) Å, β = 99.34(4)°, V = 901.7 Å³, Z = 2. Flurite has a heteropolygonal layer structure, with layers parallel to 001 and packed with water molecules between the layers. The slabs are built up by chains of Zn-centered edge sharing octahedra running parallel to [100] and by chains of Fe³⁺-centered octahedra sharing their apices along [100] with dimers of Zn-centered trigonal bipyramids sharing edge and with a PO₄ group. Both chains are linked along [010] sharing octahedra and PO₄ group apices. Further PO₄ groups and Mn-centered octahedra complete the slabs. The structure of flurite is related to the structure of schoenite, which has the same layer dimensions 6.4 × 11.1 Å, although a different symmetry (orthorhombic, Pmnb) and a different topology of the layers. The name flurite honors Mathias von Fluri (1756–1823), the founder of mineralogy and geology studies in Bavaria and author of the first geological map of Bavaria. Type material is deposited in the Museum Victoria, Melbourne, Victoria, Australia, with registration numbers M53238. F.C.

HYDRONIUMPHARMACOALUMINITE*

Hydroniumpharmacocidum (IMA 2012-050), ideally (H₃O⁺)(Al₄(OH)₁₄(AsO₄)₄)·5H₂O, is a new mineral discovered at the Maria Josefa gold mine, near the town of Rodalquilar, Andalusia region, Spain. It is a secondary alteration product of arsenic-bearing ore minerals in fractures of aluminitized gold-bearing volcanic rocks. Other associated minerals are pharmacocidum, pharmacosiderite, natriopharmacocidum, hydroniumpharmacocidum, natriopharmacocidum, jarosite, and schorlomite.
The strongest lines of the X-ray powder diffraction pattern are \[(56.09–61.03), \text{Bi}\].

The average of electron probe EDS analyses is [wt%, (range)]: Mo, secondary minerals: bismite, bismoclite, bismutite, cannonite, scorodite, arseniosiderite, yukonite, chlorargyrite, miersite, lavendulan, and goethite. Hydroniumpharmacoalumite forms patches up to 1 mm of colorless to white, intergrown cubic crystals up to 0.1 mm on edge, but typically smaller. When in direct contact with natropharmacoalumite crystals, hydroniumpharmacoalumite is always the younger generation. The mineral is transparent with a vitreous to adamantine luster and a white streak. It is brittle with an irregular fracture and no cleavage. The fluorescence was not observed. The Mohs hardness is ~2.5. Due to the paucity of pure material the density was not measured: \(D_{\text{calc}} = 2.486 \text{g/cm}^3\). The mineral is isotropic with \(n = 1.55 (589 \text{nm})\). No IR data given. The average of electron probe WDS analyses (number not given) is [wt\% (range)]: Na\text{O} 0.43 (0.42–0.44), K\text{O} 0.10 (0.09–0.11), Al\text{O}_3 30.50 (30.09–30.81), Fe\text{O}_3 0.36 (0.23–0.54), As\text{O}_3 52.01 (51.71–52.26), H\text{O} (by difference) 16.60, total 100.00. The elements P, S, Ti, Cu, Ba, Ca, Fe, Mn, Zn, Sr, and Si were below detection limits.

The empirical formula based on 3 As apfu and H\text{O} \(\text{Na}_{10.99(2)}\text{K}_{0.01(3)}\text{Al}_{15.52(1)}\text{Fe}_{0.00(2)}\text{Fe}_{0.00(2)}\text{As}_{0.99(1)}\text{O}_{30.00(1)}\text{O(H)}\)2.75H\text{O}. The strongest lines in the X-ray powder diffraction pattern are \([\theta \text{ Å}, (\%); \text{hk}]: 7.727 (100; 100), 4.461 (10; 111), 3.863 (40; 200), 2.732 (12; 220), 1.932 (46; 200). Hydroniumpharmacoalumite is cubic, space group Pm\text{3}m, with \(a = 7.72692(2) \text{ Å}, V = 461.33 \text{ Å}^3\). The crystal structure refined to \(R = 2.13\%\) for all 7702 observed reflections and is consistent with the general pharmacoisiderite structure type, with hydronium (oxonium) as the dominant cation in cavities of strongly distorted Al octahedra and As tetrahedra and especially with the structure refined to \(a = 9.174(3), b = 5.174(3), c = 7.702(1) \text{ Å}, \alpha = 113.63(2), \beta = 102.23(1), \gamma = 90.38(2)\text{°}, V = 366.6 \text{ Å}^3\). The crystal structure was solved by direct methods and refined to \(R = 0.050\) on the basis of 2019 unique \(F \geq 4\sigma(F)\) reflections. Mambertiite is triclinic, space group PT, with single crystal unit-cell parameters \(a = 5.854(2), b = 9.050(3), c = 7.637(3) \text{ Å}, \alpha = 112.85(1), \beta = 102.58(1), \gamma = 90.04(1), V = 362.3 \text{ Å}^3, Z = 2\). Mambertiite crystal structure is composed of eightfold-coordinated Bi polyhedra and five independent Mo octahedra of which two are completely occupied by Mo, and other three are only partially occupied. The structure has nine anion sites. There are two kinds of alternating (10\text{T}) layers: one is composed by Bi-centered distorted bicapped trigonal prisms and partially occupied Mo(4) and Mo(5) octahedra, and another is formed by the zigzag chains of the fully occupied Mo(1) and Mo(2) distorted octahedra, and the partially occupied Mo(3) sites. The structural relationship between mambertiite and to gelosaite, BiMo\text{O}_3(OH)_2 are discussed based on the OD theory. The mineral name is given for the Italian mineral collector Marzio Mamberti (b. 1959) for his contribution to the knowledge of the Sardinian mineralogy. The holotype specimen of mambertiite is deposited in the Museo di Storia Naturale, Università di Pisa, Pisa, Italy. D.B.

**PARÁDASSAVÁRITE**


The new Zn-dominant malachite-rosasite group species parádsassvárite (IMA 2012-077) with a general formula \((\text{Zn,Cu})\text{Zn}(\text{CO}_3\text{O})\text{(OH)}\); was described from the Nagy-Lápafő area, Parádsassvár, Mátra Mountains, Hungary. The Zn-dominant mineral under the name zircosassvárite was originally mentioned by Strunz (1959) from Tsumeb, Namibia, without description (only Zn/Cu ratio 58.6/51.9 was given). Since then zircosassvárite was reported worldwide in at least 24 localities (http://www.minDat.org) while on the official IMA list of minerals it was and is still is (http://nrmima.nrm.se/IMA_Master_List_2016-03.pdf) marked with status Q (questionable). Very few chemical analyses of zircosassvárite with Zn > Cu were published (Pauliśi et al. 2005), but no confirmation of Zn dominancy in both Me sites of rosasite structure was provided besides probably the mineral from Rudabánya, Hungary (Feher et al. 2008) with empirical formula \((\text{Zn}_{0.6}\text{Cu}_{0.4}\text{Fe}_{0.01})\text{Zn}(\text{CO}_3\text{O})\text{(OH)}\). In Nagy-Lápafő area the new mineral occurs as an alteration product of sphalerite and chalcopyrite in small cavities in a few decimeters thick calcite veins hosted by argillized and pyritized andesites. Veins contain fluorite, pyargorskite, quartz, dolomite, anatase, and disseminated sulfides. The other secondary minerals in the order of its abundance decreasing are: smithsonite, hydrozincite, hemimorphite, auralchalcite, rosasite, malachite, chalcophanite, azurite, cerussite, anglesite, deviline, and linarite. Parádsassváriates forms pale beige, globular aggregates up to 0.2 mm on calcite. The globules consist of radial aggregates of bladed crystals up to 80 × 5 μm. Parádsassváriate is white, sometimes with a weak bluish tint, translucent with a weakly vitreous, dull or silky luster and a white streak. It does not show any fluorescence under UV light. Mohs hardness is ~2–3. The mineral is brittle with a finely fibrous fracture; cleavage or parting were not observed. Due to the scarcity of material the density was not measured; \(D = 4.175 \text{g/cm}^3\).

Optical properties were not obtained besides the pleochroism (colorless to very pale green); \(n_{\text{avg}} = 1.764\). The FTIR spectrum was obtained for the regions 500–2000 and 2500–4000 cm\(^{-1}\), and it is similar to other members of the malachite-rosasite group with the main bands (cm\(^{-1}\)): 661, 738, 792, and 1097 (bending modes of CO\(_3^\text{−}\) groups), 993 (OH deformation mode), 1379, 1514 (CO\(_3^\text{−}\) stretching), 3272, 3473 (OH

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**MAMBERTIITE**


The new mineral mambertiite (IMA 2013-098), BiMo\text{O}_8\text{O}_3(OH), was identified in only two specimens in Su Seinargiu, Sarroch, Cagliari, Sardinia, Italy. It occurs along with ferrimolybdate, muscovite, sardinegite, and wulfenite in small veins in veins composed by quartz and molybdenite with minor bismuthinite and bismuth, hosted by leucogranite porphyry, embedded in low-metamorphic-grade shales of Ordovician-Silurian age. The location is unusually rich with Bi and Mo secondary minerals: bismite, bismoclite, bismutite, cannonite, ferrimolybdate, wulfenite, and six new minerals recently discovered here: ichnusaite, nuragheite, tancaite-(Ce), gelosaite, koechlinite, vistreraite (IMA 2012-077) with a general formula (Zn,Cu)Zn(CO\(_3\)O)(OH).

The holotype specimen and the corresponding EMPA sample are deposited in the Mineralogical State Collection Munich, Germany. D.B.

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**NEW MINERAL NAMES**
stretching). Observed bands at 1637 and weak 3647 are assigned to the H₂O absorbed on the mineral surface. The average of nine electron-probe WDS analyses [wt% (range)] is: ZnO 58.08 (55.00–63.08), CuO 12.60 (8.76–15.18), PbO 1.27 (0.55–1.65), CO₂ (by stoichiometry) 19.50, H₂O (by stoichiometry) 7.94, total 99.39; corresponding to the empirical formula \( \text{Zn}_0.98 \text{Cu}_{0.02} \text{Pb}_{0.01} \text{Mg}_{0.02} \text{CO}_{3} \text{(OH)}_{1} \). The shortest lines in the X-ray powder diffraction pattern are \( d (\AA; \text{hk}l); 6.054 (67; 200), 5.085 (100; 210), 3.703 (87; 310,220), 3.021 (25; 400,130), 2.971 (25; 111,001), 2.603 (62, 212), 2.539 (36; 420). \) X-ray powder data and unit-cell parameters of parádsasvárite are very close to that of rosasite. The mineral is monoclinic, space group \( P2_1/a \), \( a = 12.92(1), b = 9.372(2), c = 3.159(4) \AA, \beta = 110.4(1)^\circ, V = 358.5 \AA^3, Z = 4. \) The single-crystal X-ray study was not performed due to microcrystalline habit. X-ray powder pattern for parádsasvárite calculated based on crystal structure of rosasite (Perchiazzi 2006) assuming Me1 site occupied by 0.63Zn + 0.36Cu + 0.01Pb and Me2 site occupied entirely by Zn is in a good agreement with an experimental data. Parádsasvárites was named after the type locality Parádsasvár, in the Mátra Mountains of Hungary. The holotype specimen is deposited in the collection of the Herman Ottó Museum, Miskolc, Hungary. D.B.

References cited

PERETTIIITE-(Y)*

The new mineral perettiite-(Y), (IMA 2014-109), ideally \( \text{Y}^{3+}\text{Mn}^{2+}\text{Fe}^{2+}\text{[Si}B\text{O}_4]_2 \) has been discovered in the region of Momeik, north of Mogok, Myanmar. It was found as inclusions in perfect gemmy colorless transparent phenakite crystals originated from isolated pegmatite pockets of granitic pegmatite intruding large peridotite body. Of the stock of ~10000 phenakite centimeter-sized crystals only 15 were containing inclusions of perettiite-(Y). Other inclusions in phenakite are scolih, tussioline, columbite-(Mn), albite, fluorapatite, and lazulite. Phenakite crystals found in pockets with quartz, feldspar, and schorl. Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \) Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambegrite, petalite, beryl \( (\text{aquamarine and morganite}, \) pollucite, danburite, topaz, almandine-spessartine, and botryoidal tourmalines, hambergite, petalite, beryl \( (\text{aquamarine and schorl}. \)

SHUVALOVITE*

The new mineral shuvalovite (IMA 2014-057), ideally \( \text{K}_3\text{Ca}_2\text{Na}(\text{SO}_4)_2\text{F} \), was discovered in only one specimen in sublites of the Arsenatnaya fumarole at the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. The temperature in fumarole pocket contained shuvalovite immediately after its uncovering was 370(10) °C. The major associated minerals in the pocket are tenorite, hematite, orthoclase, fluorophlogopite, langbeinite, aphthitalite, anhydrite, lammerite, johellite, and tilasite. Krasheninnikovite, euchlorine, alumoklyuchevskite, calcian millennium, vanthoffite, arcancite, wulfite, fluorobrite, urusovite, svabite, lammerite-β, bradaczeite, erlaxman-
ite, kozyrevskite, popovite, alarite, halite, Cu-gahnite, corundum, and fluorite are subordinate or rare. The new mineral was most likely formed through gas–rock interaction where basalt served as a source of metals. Shuvalovite forms coarse lamellar to tabular [100], rectangular, octagonal or irregular crystals up to 0.05 × 0.7 × 0.9 mm combined in open-work aggregates or crusts up to 1 × 1 cm on basalt scoria. The latter overgrowing along with calcioantheinite and tenorite the surface of basalt scoria “sprinkled” with small crystals of hematite, orthoclase, and fluorophlogopite. It also occurs as imperfect, pillow-like individuals occasionally overgrown by tiny distorted cubo-octahedra of fluorite. Shuvalovite is one of the second generation forms long prismatic to acicular, typically divergent microcrystals up to 0.05 mm × 3 μm, and dendrite-like aggregates. The mineral is transparent, colorless, vitreous, with no fluorescence under UV light or an electron beam. It is brittle, with Mohs hardness ~3. Cleavage was not observed; the fracture is uneven. Attempts to measure the density failed due to the micro-cavernous character of the crystals; \( \rho_{\text{calc}} = 2.64 \text{ g/cm}^3 \). In plane-polarized light shuvalovite is colorless nonpleochroic. It is optically biaxial (–), \( \alpha = 1.493(1), \beta = 1.498(1), \gamma = 1.498(1) \) (589 nm) and 2\( \chi \) max ≤ 20°; dispersion of the optical axes was not observed. The IR spectrum of shuvalovite is similar to that of the apatite-supergroup (see mambertiite abstract above D.B.) and closely associated with wulfenite. Suseinargiuite forms hemispherical aggregates (up to 0.2–0.3 mm in diameter) of acicular crystals, up to a few micrometers long. It is colorless, transparent with a pearly to adamantine luster. The mineral is brittle. Hardness and density were not measured due to a small crystal size; \( \rho_{\text{calc}} = 5.597 \text{ g/cm}^3 \) (for an ideal formula). In transmitted light suseinargiuite is transparent, colorless. It has straight extinction and high birefringence. Other optical properties were not determined; \( n_{\text{calc}} = 2.11 \) (for an ideal formula). Micro-Raman spectra collected in the region 100–2000 cm\(^{-1}\) on the grain used for chemical tests show the following bands (cm\(^{-1}\)): 131, 188, 319, 376, 772, and 876; all corresponding to vibration modes of MoO\(_4^2-\) groups. The averages of electron probe WDS analyses for outer (12) / inner (14) zones [wt% / wt% (range)] are: MoO\(_4^2-\) 49.03±45.59 (43.49–51.14), Bi\(_2\)O\(_4\) 42.97±34.47 (32.77–37.49), PbO 2.89±12.04 (1.36–13.82), Na\(_2\)O 3.69±3.03 (2.76–4.39), total 98.58±95.13. No other elements with atomic numbers higher than carbon are below their detection limits.

Shuvalovite is named in honor of the general formula \( M(\text{SO}_4)X \) (shuvalovite, krasheninnikovite, and apatite-type compounds) is discussed. Shuvalovite is named in honor of the Russian statesman Ivan Ivanovich Shuvalov (1727–1797), an enthusiastic patron of the sciences, arts and literature, one of the founders of the Moscow University in 1755. The holotype specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. D.B.

**SUSEINARGIUITE**


Suseinargiuite, \((\text{Na}_4\text{Bi}_3\text{Mo}_4)\text{MoO}_4\)_x \((\text{Na}-\text{Bi}\)-analogue of wulfenite, from Su Seinargiu, Sardinia, Italy. European Journal of Mineralogy, 27(5), 695–699.

The new mineral species suseinargiuite (IMA 2014-089), ideally \((\text{Na}_4\text{Bi}_3\text{Mo}_4)\text{MoO}_4\), has been discovered in the Mo-Bi occurrence of Su Seinargiu, Sarroch, Cagliari, Sardinia, Italy. It occurs in small vugs in quartz-molybdenite veins among minerals formed by hydrothermal and/or supergene alteration of the primary Mo-Bi mineral assemblage (see mambertiite abstract above D.B.) and closely associated with wulfenite. Suseinargiuite forms hemispherical aggregates (up to 0.2–0.3 mm in diameter) of acicular crystals, up to a few micrometers long. It is colorless, transparent with a pearly to adamantine luster. The mineral is brittle. Hardness and density were not measured due to a small crystal size; \( \rho_{\text{calc}} = 5.597 \text{ g/cm}^3 \) (for an ideal formula). In transmitted light suseinargiuite is transparent, colorless. It has straight extinction and high birefringence. Other optical properties were not determined; \( n_{\text{calc}} = 2.11 \) (for an ideal formula). Micro-Raman spectra collected in the region 100–2000 cm\(^{-1}\) on the grain used for chemical tests show the following bands (cm\(^{-1}\)): 131, 188, 319, 376, 772, and 876; all corresponding to vibration modes of MoO\(_4^2-\) groups. The averages of electron probe WDS analyses for outer (12) / inner (14) zones [wt% / wt% (range)] are: MoO\(_4^2-\) 49.03±45.59 (43.49–51.14), Bi\(_2\)O\(_4\) 42.97±34.47 (32.77–37.49), PbO 2.89±12.04 (1.36–13.82), Na\(_2\)O 3.69±3.03 (2.76–4.39), total 98.58±95.13. No other elements with atomic numbers higher than carbon are below their detection limits. The low totals are assigned to the porosity of microcrystalline aggregates. The empirical formulas based on 4 O apfu is: \((\text{Na}_{14}\text{K}_{16}\text{Ca}_{48}\text{Si}_{12}\text{O}_{14}2\text{F}_{0.2})\). The strongest reflections of the powder X-ray diffraction pattern \([d \text{ Å} (\%\% ; hkl)]\) are: 7.44 (27; 101), 7.22 (22; 200), 4.245 (45; 102, 121), 3.963 (62; 301), 3.281 (100; 122), 3.210 (30; 031), 3.144 (84; 302, 321), 3.112 (67; 131, 401), 3.016 (78; 222), 2.785 (52; 420). The orthorhombic unit-cell parameters refined from the powder data are: \( a = 13.248(3), b = 10.306(3), c = 8.989(3) \) Å, \( V = 1227.2 \) Å\(^3\). The crystal structure was solved by direct methods and refined using 1379 \( F > 2\sigma(F) \) unique reflections to \( R_l = 0.067 \) in space group \( Pnna \), with \( a = 13.2383(4), b = 10.3023(3), c = 8.9909(4) \) Å, \( V = 1226.22 \) Å\(^3\), \( Z = 4 \). The crystal structure contains two different isolated SO\(_4\) tetrahedra. The disordered arrangement of coordinating O atoms of S(2) site defines two possible orientations of the S(2)O\(_4\) tetrahedra. The Ca(1) cations occupy CaO\(_4\)F polyhedra, whereas Ca(2) cations occupy CaO\(_4\)F or CaO\(_4\)F polyhedra, depending on the presence or absence of the half-occupied O(6) site split around the mirror plane. The K(1) and K(2) sites are ninefold coordinated. All Ca and K sites contain admixed Na, the majority of which is located in the Ca(2) site. The comparative crystal chemistry of structurally different sulfates with the general formula \( M(\text{SO}_4)X \) (shuvalovite, krasheninnikovite, and apatite-type compounds) is discussed. Shuvalovite is named in honor of the Russian statesman Ivan Ivanovich Shuvalov (1727–1797), an enthusiastic patron of the sciences, arts and literature, one of the founders of the Moscow University in 1755. The holotype specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. D.B.