

New Mineral Names*†

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This New Mineral Names has entries for nine new minerals, including cayalsite-(Y), engelhauptite, flurlite, hydroniumpharmacoalumite, mambertiite, parádsasvárite, perettiite-(Y), shuvalovite, and suseinargiuite.

CAYALSITE-(Y)*

T. Malcherek, J. Schlüter, M. Cooper, N. Ball, and T. Husdal (2015)

Cayalsite-(Y), a new rare-earth calcium aluminium fluorosilicate with OD character. *European Journal of Mineralogy*, 27(5), 683–694.

The new mineral cayalsite-(Y) (IMA 2011-094), ideally $\text{CaY}_6\text{Al}_2\text{Si}_4\text{O}_{18}\text{F}_6$ was found in cavities of Y-fluorite in two granitic NYF-pegmatites hosted by 1742 ± 46 Ma granitic gneiss in Tysfjord, Nordland, Norway: Stetind ($68^\circ 10' 15.20''\text{N}$ $16^\circ 33' 10.65''\text{E}$) and Øvre Lapplægeret ($68^\circ 02' 3.26''\text{N}$ $16^\circ 00' 14.98''\text{E}$). 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}, {201}; dipyramids {221}, {312}; and pinacoids {100}, {010}, {001}. Closely associated minerals at both localities are bastnásite-(Ce), hematite and vyuntspakhkrite-(Y). Hundholmenite-(Y) and a montmorillonite-like mineral are found in Stetind. Cayalsite-(Y) has been found in two polytypes (1M and 1O). Both polytypes occur as intergrown crystals in Stetind while only the 1O-polytype has been clearly identified at Øvre Lapplægeret. Cayalsite-(Y) has a white streak, vitreous luster, and does not show any fluorescence. It is brittle with uneven fracture and no observed cleavage. The micro-indentation hardness of 1O polytype (the load weight not given) $\text{VHN} = 1049 \text{ kg/mm}^2$ (10390.7 MPa) corresponds to $\sim 6\frac{1}{2}$ of Mohs scale. The density was not measured. The optical data was obtained only for cayalsite-(Y)-1O which is biaxial (+), $\alpha = 1.730(5)$, $\beta = 1.740(5)$, $\gamma = 1.760(5)$ (590 nm), $2V_{\text{meas}} = 56(5)^\circ$, $2V_{\text{calc}} = 71.2^\circ$; $X = c$, $Y = b$, $Z = a$. Dispersion is not reported. In the FTIR spectrum the region $2800\text{--}3800 \text{ cm}^{-1}$ is dominated by absorption bands assigned to Dy $f\text{-}f$ electronic transitions with the most intense signal at 3529 cm^{-1} . The OH-stretching bands normally located in this region are absent or masked. The possible minor OH-content is discussed based on crystal structure data. The exact maxima locations and assignment for the absorption bands in the regions $\sim 1600\text{--}2000$ and $\sim 700\text{--}1400 \text{ cm}^{-1}$ on the provided IR spectrum are not given. The averages of the WDS electron probe analyses (wt% for 13 points for the sample from Stetind / wt% for 50 points for the sample from Øvre Lapplægeret) along with the ranges for all samples analyses (in parentheses) are: CaO 4.46/4.49 (4.29–5.88), Na₂O n.d./n.d. (0–0.12), Y₂O₃ 37.90/41.15 (35.85–43.41), Ce₂O₃ 0.46/0.04 (0–0.72), Nd₂O₃ 1.84/0.19 (0.02–2.35), Sm₂O₃ 2.16/0.03 (0–2.77), Gd₂O₃ 5.79/4.78 (0.96–6.25), Tb₂O₃ n.d./n.d. (0–1.13), Dy₂O₃ 4.93/6.19 (4.04–8.16), Er₂O₃ 3.74/4.54 (3.03–5.70), Yb₂O₃ 4.00/3.32 (2.28–5.73), Al₂O₃ 7.31/7.35 (7.10–8.35), SiO₂ 18.70/18.65 (18.35–18.99), F 9.26/8.90 (8.25–9.85), $-\text{O}=\text{F}_2$ 3.90/3.75, total 96.65/95.83. Besides Tb only

Ln with even Z number have been detected. The empirical formulae based on (O+F)=24 apfu are respectively: $\text{Ca}_{1.03}(\text{Y}_{4.35}\text{Nd}_{0.14}\text{Gd}_{0.41}\text{Dy}_{0.34}\text{Er}_{0.25}\text{Yb}_{0.26})_{\Sigma 5.75}\text{Al}_{1.86}\text{Si}_{4.03}(\text{F}_{6.32}\text{O}_{17.68})_{\Sigma 24}$ and $\text{Ca}_{1.03}(\text{Y}_{4.73}\text{Nd}_{0.02}\text{Gd}_{0.34}\text{Dy}_{0.43}\text{Er}_{0.31}\text{Yb}_{0.22})_{\Sigma 6.05}\text{Al}_{1.87}\text{Si}_{4.03}(\text{F}_{6.08}\text{O}_{17.92})_{\Sigma 24}$ with $D_{\text{calc}} = 4.86$ and 4.83 g/cm^3 . An explanation for the throughout low totals is not given. The strongest lines in the X-ray powder diffraction pattern obtained by Gandolfi-type measurements on mixed 1M/1O crystal [$d \text{ \AA}$ (%); hkl , polytype] are: 5.221 (43; 110, 1O), 5.133 (51; 001, 1M), 4.914 (53; 111, 1M), 3.873 (33; $\bar{2}11, \bar{2}12$, 1M), 3.562 (67; 013, 1M and 311, 1O), 3.002 (100; $\bar{3}13, 113$, 1M and 312, 1O), 2.756 (41; 020, 1M and 113, 1O), 2.662 (41; 206, 1M). The calculated X-ray powder diffraction patterns for each polytype are provided, but their intensities do not perfectly match with experimental data. The crystal structure of two maximum degree of order (MDO) polytypes has been solved based on the single-crystal X-ray diffraction data. The orthorhombic MDO polytype 1O, has unit-cell parameters $a = 15.993(1)$, $b = 5.5306(3)$, $c = 9.6590(7) \text{ \AA}$, $V = 854.35 \text{ \AA}^3$, space group Pbn , and refined to $R = 0.022$ on the basis of 1486 unique $I > 3\sigma(I)$ reflections. The monoclinic MDO polytype 1M has: $a = 11.0602(7)$, $b = 5.5280(2)$, $c = 16.0195(9) \text{ \AA}$, $\beta = 118.925(3)^\circ$, $V = 857.26 \text{ \AA}^3$, space group $P2/c$, and refined to $R = 0.035$ in a mixture with cayalsite-(Y)-1O on the basis of 2994 unique $I > 3\sigma(I)$ reflections. The crystal structure of cayalsite-(Y) is composed of three non-equivalent layers. Layer 1 contains parallel chains of edge sharing $[\text{AlO}_6]$ octahedra along [010]. The polar layer 2 is formed by isolated $[\text{SiO}_4]$ tetrahedra, F anions and REE cations and each $[\text{SiO}_4]$ unit in this layer can occur in two orientations, with the two Si positions placed 0.95 \AA apart. Complete $[\text{SiO}_4]$ tetrahedra are achieved by bonding to corner oxygen atoms of the $[\text{AlO}_6]$ octahedra of layer 1. Layer 3 formed by REE and Ca-cations in eightfold coordination by O and F. The layers are stacked in sequence ...1–2–3–2'–1... The polar layers 2 and 2' are upside down to each other. Lateral shift of layer 2' by $\mathbf{a}_{10}/3$ relative to layer 2 causes the formation of the described polytypes. Apart from substitutional disorder of REE and Ca atoms, the cayalsite-(Y) structure is characterized by substitutional and positional disorder affecting the local position of $[\text{SiO}_4]$ tetrahedra in the layer 2. The possible interplay of layer stacking and cation ordering is discussed. The name cayalsite-(Y) derives from the chemistry of the mineral (Ca-Y-Al-Si). Type specimens are in the Mineralogical Museum of the University of Hamburg, Germany. **D.B.**

ENGELHAUPTITE*

I.V. Pekov, O.I. Siidra, N.V. Chukanov, V.O. Yapaskurt, S.N. Britvin, S.V. Krivovichev, W. Schüller, and B. Ternes (2015) Engelhauptite, $\text{KCu}_3(\text{V}_2\text{O}_7)(\text{OH})_2\text{Cl}$, a new mineral species from Eifel, Germany. *Mineralogy and Petrology*, 109(6), 705–711.

A new copper vanadate engelhauptite (IMA 2013-009), ideally $\text{KCu}_3(\text{V}_2\text{O}_7)(\text{OH})_2\text{Cl}$, was discovered in the Late Pleistocene vol-

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

† For a complete listing of all IMA-validated unnamed minerals and their codes, see <http://pubsites.uws.edu.au/ima-cnmmc/>.

canic rocks at the Auf'mKopp quarry ("Schlackenkegel der Höhe 636 südöstlich Neroth"), Daun, Eifel region, Rheinland-Pfalz, Germany. It occurs as one of the last minerals within the cavities in nepheline basalts closely associated with volborthite and allophane. All these minerals overgrew crystalline crusts consisting mainly of augite, sanidine, nepheline, leucite, phlogopite-oxyplogopite, fluorapatite and magnetite of the primary, high-temperature paragenesis. In the neighboring cavities, other late-hydrated copper minerals are found: malachite, tangeite, and chrysocolla. Engelhauptite forms spherulites up to 0.2 mm in diameter and bunches consisting of rough spindle-shaped crystals elongated by [001]. The aggregates are usually divergent, with a blocky surface and round (rarely nearly hexagonal) cross-sections. The individual crystals are usually about 0.01×0.05 mm and up to 0.12×0.04 mm with habit forms {100} and {110} and rare {001} terminations. Engelhauptite is transparent to translucent in aggregates, yellow-brown to brown with an olive green hue with a yellow streak and a vitreous luster. It is brittle with uneven fracture; cleavage was not observed. Hardness and density were not determined due to small size of the grains and porous nature of an aggregate; $D_{\text{calc}} = 3.86$ g/cm³. Engelhauptite is optically uniaxial (+), $\omega = 1.978(4)$, $\epsilon = 2.021(4)$ (589 nm). It is weakly pleochroic ω (brownish yellow) $> \epsilon$ (light yellow). The IR spectrum of engelhauptite is unique. The main absorption bands (cm⁻¹; s = strong, w = weak, sh = shoulder) are: 3482w, 3312w, 2810 (O–H stretching vibrations), 1150sh, 1060w, 990sh, (S–O stretching vibrations), 964, 901, 838 s, 779 s, 735sh (V–O stretching vibrations combined with bending vibrations of Cu···OH groups), 570sh, 545, 520sh, 471 (O–V–O bending vibrations of V₂O₇²⁻). The absence of absorption bands in the range 1500–1700 cm⁻¹ confirms the absence of any substantial amounts of H₂O. The average of 10 electron probe WDS analyses [wt%, (range)] is: K₂O 9.63 (9.21–10.02), FeO 0.05 (0–0.19), NiO 0.29 (0.08–0.46), CuO 46.11 (45.04–46.88), Al₂O₃ 0.24 (0.07–0.38), V₂O₅ 34.92 (33.23–36.07), SO₃ 0.79 (0.42–1.09), Cl 5.94 (5.32–6.34), H₂O (by difference) 3.37, –O=Cl₂ 1.34, total 100.00. Contents of other elements with $Z > 6$ are below detection limits. The empirical formula, based on 10 (O+OH+Cl) apfu, is $K_{1.05}(Cu_{2.97}Al_{0.02}Ni_{0.02})_{\Sigma 3.01}(V_{1.97}S_{0.05})_{\Sigma 2.02}O_{7.23}(OH)_{1.91}Cl_{0.86}$. The strongest lines of the powder X-ray diffraction pattern [d Å (%; hkl)] are: 7.32 (98; 002), 4.224 (17; 102), 2.979 (100; 104, 110), 2.759 (19; 112), 2.565 (18; 200), 2.424 (18; 202), 1.765 (16; 206), 1.481 (14; 208, 220). The hexagonal unit-cell parameters refined from the powder data are $a = 5.928(4)$, $c = 14.54(1)$ Å, $V = 442.6$ Å³. The single-crystal X-ray study shows engelhauptite is hexagonal, $P6_3/mmc$, $a = 5.922(2)$, $c = 14.513(5)$ Å, $V = 440.78$ Å³, $Z = 2$. Due to poor quality of the crystals the crystal structure of has been refined to $R_1 = 0.090$ on the basis of 135 unique $F > 4\sigma(F)$ reflections. The structure is based upon the $[Cu_3^{2+}(V_2O_7)(OH)_2]^0$ framework formed by the linkage of deficient brucite-like layers of Jahn-Teller distorted Cu(O,OH)₆ octahedra via V₂O₇ groups. The framework contains large channels occupied by K⁺ cations and Cl⁻ anions. Engelhauptite is closely related to volborthite, Cu₃(V₂O₇)(OH)₂·2H₂O, and can be considered as its analog resulting from the replacement of H₂O molecules by the equal amounts of K⁺ and Cl⁻ ions. The mineral is named in honor of the German amateur mineralogist and mineral collector Bernd Engelhaupt (b. 1946) for his contributions to the mineralogy of the Eifel region. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

FLURLITE*

I.E. Grey, E. Keck, W.G. Mumme, A. Pring, C.M. Macrae, R.W. Gable, and J.R. Price (2015) Flurlite, Zn₃Mn²⁺Fe³⁺(PO₄)₃(OH)₂·9H₂O, a new mineral from the Hagendorf Süd pegmatite, Bavaria, with a schoonerite-related structure. *Mineralogical Magazine*, 79(5), 1175–1184.

Flurlite (IMA 2014-064), ideally Zn₃Mn²⁺Fe³⁺(PO₄)₃(OH)₂·9H₂O, is a new mineral from the Hagendorf-Süd pegmatite, Hagendorf,

Oberpfalz, Bavaria, Germany (49°39'1"N 12°27'35"E). Flurlite occurs on green mitridatite and is closely associated with plimerite. It is also associated with beraunite, schoonerite, parascholzite, robertsite, and occasionally with an altered phosphophyllite. Flurlite is a secondary phosphate mineral probably formed from the hydrothermal reaction of zinc-bearing fluids with primary Fe-Mn phosphate(s) (triphylite or zwieselite). It occurs as ultrathin (<1 μm) translucent platelets forming characteristic twisted accordion-like aggregates. Flurlite 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}. Flurlite is optically biaxial (–) with $\alpha = 1.60(1)$, $\beta = 1.65(1)$, $\gamma = 1.68(1)$ (white light); $2V$ not measured, $2V_{\text{calc}} = 74^\circ$. Pleochroism is weak, $X =$ pale yellow, $Y =$ pale orange, $Z =$ orange brown. Hardness has not been reported. $D_{\text{meas}} = 2.89$ g/cm³ (heavy liquids) and $D_{\text{calc}} = 2.84$ 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), Fe₂O₃ 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 P apfu is: $(Zn_{2.3}Mn_{0.6}^{2+}Fe_{0.8}^{2+}Mg_{0.1})_{\Sigma 4.0}Fe^{3+}(PO_4)_3(OH)_2 \cdot 9H_2O$. The strongest X-ray powder diffraction lines [d Å (%; hkl)] are: 12.900 (100; 001), 8.375 (10; 011), 6.072 (14; 101); 5.567 (8; 012), 4.297 (21; 003), 2.763 (35; 040). The monoclinic unit-cell parameters refined from the powder data are: $a = 6.392(3)$, $b = 11.047(2)$, $c = 13.067(3)$ Å, $\beta = 99.42(3)^\circ$, $V = 910.3$ 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 a ultrathin crystal ($20 \times 20 \times 3$ μm) showing less severe streaking yielded $R_1 = 0.057$ for 935 unique $F > 4\sigma(F)$ reflections. Flurlite is monoclinic, $P2_1/m$, with unit-cell parameters (at 100 K) of $a = 6.3710(13)$, $b = 11.020(2)$, $c = 13.016(3)$ Å, $\beta = 99.34(3)^\circ$, $V = 901.7$ Å³, $Z = 2$. Flurlite has a heteropolyhedral 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 and edge with a PO₄ group. Both chains are linked along [010] sharing octahedra and PO₄ group apexes. Further PO₄ groups and Mn-centered octahedra complete the slabs. The structure of flurlite is related to the structure of schoonerite, which has the same layer dimensions 6.4×11.1 Å, although a different symmetry (orthorhombic, $Pmab$) and a different topology of the layers. The name flurlite honors Mathias von Flurl (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.**

HYDRONIUMPHARMACOALUMITE*

R. Hochleitner, K.T. Fehr, M. Kaliwoda, A. Günther, C. Rewitzer, W.W. Schmahl, and S. Park (2015) Hydroniumpharmacoalumite, (H₃O)Al₄[(OH)₄(AsO₄)₃]·5H₂O, a new mineral of the pharmacosiderite supergroup from Rodalquilar, Spain. *Neues Jahrbuch für Mineralogie-Abhandlungen (Journal of Mineralogy and Geochemistry)*, 192/2, 169–176.

Hydroniumpharmacoalumite (IMA 2012-050), ideally (H₃O)Al₄[(OH)₄(AsO₄)₃]·4–5 H₂O, 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 alunitized gold-bearing volcanic rocks. Other associated minerals are pharmacoalumite, pharmacosiderite, natropharmacosiderite, hydroniumpharmacosiderite, natropharmacoalumite, jarosite,

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 nm). No IR data given. The average of electron probe WDS analyses (number not given) is [wt% (range)]: Na₂O 0.43 (0.42–0.44), K₂O 0.10 (0.09–0.11), Al₂O₃ 30.50 (30.09–30.81), Fe₂O₃ 0.36 (0.23–0.54), As₂O₅ 52.01 (51.71–52.26), H₂O (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 H₃O+Na+K = 1.00 is [(H₃O)_{0.90}Na_{0.09}K_{0.01}]_{Σ1.00}(Al_{3.97}Fe_{0.03})_{Σ4.00}(AsO₄)₃(OH)₄·2.75H₂O. The strongest lines in the X-ray powder diffraction pattern are [$d \text{ \AA}$, ($I\%$; hkl)]: 7.727 (100; 100), 4.461 (10; 111), 3.863 (40; 200), 2.732 (12; 220), 1.932 (16; 400). Hydroniumpharmacoalumite is cubic, space group $P\bar{4}3m$, with $a = 7.7269(2) \text{ \AA}$, $V = 461.33 \text{ \AA}^3$, $Z = 1$. The crystal structure refined to $R = 2.13\%$ for all 7706 observed reflections and is consistent with the general pharmacosiderite structure type, with hydronium (oxonium) as the dominant cation in cavities of strongly distorted Al octahedra and As tetrahedra and especially with the structure of the iron analogue hydroniumpharmacosiderite. The name is in allusion to the cation dominance of hydronium and Al. The holotype specimen and the corresponding EMPA sample are deposited in the Mineralogical State Collection Munich, Germany. **D.B.**

MAMBERTIITE*

P. Orlandi, C. Biagioni, M. Pasero, F. Demartin, I. Camprostrini, and S. Merlini (2015) Mambertiite, BiMo_{2.80}O₈(OH), a new mineral from Su Seinargiu, Sardinia, Italy: occurrence, crystal structure, and relationships with gelosaite. *European Journal of Mineralogy*, 27(3), 405–415.

The new mineral mambertiite (IMA 2013-098), BiMo_{2.80}O₈(OH), was identified in only two specimens in Su Seinargiu, Sarroch, Cagliari, Sardinia, Italy. It occurs along with ferrimolybdate, muscovite, sardignite, and wulfenite in small vugs 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, bismoelite, bismutite, cannonite, ferrimolybdate, wulfenite, and six new minerals recently discovered here: ichnusaite, nuragheite, tancaite-(Ce), gelosaite, koechlinite, sardignite. Mambertiite forms pale yellow tabular {001} crystals, up to 1 mm in length and a few micrometers thick, with white streak and an adamantine luster. It is brittle, with a conchoidal fracture and no visible cleavage. Due to the scarcity of material the hardness, density, and optical properties were not measured; $D_{\text{calc}} = 5.720 \text{ g/cm}^3$ and $n_{\text{calc}} = 2.20$. The IR spectrum shows a broad band ~3400 cm⁻¹ consistent with the presence of H₂O or OH⁻ groups. Other absorption bands of the given IR spectrum chart are not specified or discussed. The average of 12 electron probe EDS analyses is [wt%, (range)]: Mo₂O₃ 59.59 (56.09–61.03), Bi₂O₃ 36.96 (34.69–38.66), WO₃ 2.03 (1.60–2.53), H₂O (by stoichiometry and charge balance) 1.48, total 100.06. Molybdenum is given as Mo⁵⁺ to maintain the electrostatic neutrality. On the basis of 9 O apfu, the empirical formula is Bi_{0.95}(Mo_{2.74}W_{0.05})_{Σ2.79}O_{7.97}(OH)_{1.03}. The strongest lines of the X-ray powder diffraction pattern are [$d \text{ \AA}$ (I ; hkl)] ($vs =$ very strong, $ms =$ medium strong): 8.3 (ms; 010), 6.80 (s; 001,011), 5.66 (m; 100), 4.92 (s; $\bar{1}10$), 3.417 (vs ; 002), 3.136 (ms; 122),

2.850 (ms; 200, $\bar{1}1\bar{2}$), 2.772 (s; 030,03 $\bar{2}$,012, $\bar{1}12$), 2.088 (ms; $\bar{2}30,23\bar{2}$). The unit-cell parameters refined from the powder data are: $a = 5.825(1)$, $b = 9.174(3)$, $c = 7.702(1) \text{ \AA}$, $\alpha = 113.63(2)$, $\beta = 102.23(1)$, $\gamma = 90.38(2)^\circ$, $V = 366.6 \text{ \AA}^3$. The crystal structure was solved by direct methods and refined to $R_1 = 0.050$ on the basis of 2019 unique $F_o > 4\sigma(F_o)$ reflections. Mambertiite is triclinic, space group $P\bar{1}$, with single crystal unit-cell parameters $a = 5.854(2)$, $b = 9.050(3)$, $c = 7.637(3) \text{ \AA}$, $\alpha = 112.85(1)$, $\beta = 102.58(1)$, $\gamma = 90.04(1)$, $V = 362.3 \text{ \AA}^3$, $Z = 2$. 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 $\bar{1}$) 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, BiMo₂O₈(OH)·H₂O 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.**

PARÁDSASVÁRITE*

B. Fehér, S. Szakáll, N. Zajzon, and J. Mihály (2015) Parádsasvárite, a new member of the malachite-rosasite group from Parádsasvár, Mátra Mountains, Hungary. *Mineralogy and Petrology*, 109(4), 405–411.

The new Zn-dominant malachite-rosasite group species parádsasvárite (IMA 2012-077) with a general formula (Zn,Cu)Zn(CO₃)(OH)₂ was described from the Nagy-Lápafő area, Parádsasvár, Mátra Mountains, Hungary. The Zn-dominant mineral under the name zincosasite was originally mentioned by Strunz (1959) from Tsumeb, Namibia, without description (only Zn/Cu ratio 58.6/51.9 was given). Since then zincosasite was reported worldwide in at least 24 localities (<http://www.mindat.org>) while on the official IMA list of minerals it was and still is (http://nrmima.nrm.se/IMA_Master_List_2016-03.pdf) marked with status Q (questionable). Very few chemical analyses of zincosasite with Zn > Cu were published (Pauliš et al. 2005), but no confirmation of Zn dominance in both *Me* sites of rosasite structure was provided besides probably the mineral from Rudabánya, Hungary (Fehér et al. 2008) with empirical formula (Zn_{1.52}Cu_{0.47}Fe_{0.01})(CO₃)(OH)₂. 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, palygorskite, quartz, dolomite, anatase, and disseminated sulfides. The other secondary minerals in the order of its abundance decreasing are: smithsonite, hydrozincite, hemimorphite, aurichalcite, rosasite, malachite, chalcophanite, azurite, cerussite, anglesite, deviline, and linarite. Parádsasvárite 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. Parádsasvárite 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; $D_{\text{calc}} = 4.175 \text{ g/cm}^3$. Optical properties were not obtain besides the pleochroism (colorless to very pale green); $n_{\text{calc}} = 1.764$. 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 CO₃²⁻ groups), 993 (δOH deformation mode), 1379, 1514 (CO₃²⁻ stretching), 3272, 3473 (OH

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 (Zn_{0.62}Cu_{0.36}Pb_{0.01})_{Σ0.99}Zn_{1.00}(CO₃)(OH)₂. The strongest lines in the X-ray powder diffraction pattern are [*d* Å (*I*%; *hkl*)] 6.054 (67; 200), 5.085 (100; 210), 3.703 (87; 310,220), 3.021 (25; 400,130), 2.971 (25; 211,001), 2.603 (62; 221), 2.539 (36; 420). X-ray powder data and unit-cell parameters of parásasváríte are very close to that of rosasite. The mineral is monoclinic, space group *P2₁/a*, *a* = 12.92(1), *b* = 9.372(7), *c* = 3.159(4) Å, β = 110.4(1)°, *V* = 358.5 Å³, *Z* = 4. The single-crystal X-ray study was not performed due to microcrystalline habit. X-ray powder pattern for parásasváríte 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. Parásasváríte was named after the type locality Parásasvár, 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

- Fehér, B., Szakáll, S., and Bigi, S. (2008) Minerals of the rosasite-zincrosasite series from the Andrásy-I. mine, Rudabánya, Hungary: the zincrosasite problem [abstract]. Second Central-European Mineralogical Conference, Szklarska Poreba, Poland, Mineralogia-Special Papers 32, 65.
- Pauliš, P., Novák, F., and Janák, P. (2005) Serpierite and zincrosasite from Herlíkovice near the town of Vrchlabí (Czech Republic). *Opera Corcontica*, 42, 73–77 (in Czech with English abstract).
- Perchiazzi, N. (2006) Crystal structure determination and Rietveld refinement of rosasite and mcguinnessite. *Zeitschrift für Kristallographie, Suppl.*, 23, 505–510.
- Strunz, H. (1959) Tsumeb, seine Erze und Sekundärminerale, insbesondere der neu aufgeschlossenen zweiten Oxydationszone. *Fortschritte Der Mineralogie*, 37, 87–90.

PERETTIITE-(Y)*

R.M. Danisi, T. Armbruster, E. Libowitzky, H.A.O. Wang, D. Günther, M. Nagashima, E. Reusser, and W. Bieri (2015) Perettiite-(Y), Y₃³⁺Mn₄²⁺Fe²⁺[Si₂B₈O₂₄], a new mineral from Momeik, Myanmar. *European Journal of Mineralogy*, 27(6), 793–803.

The new mineral perettiite-(Y), (IMA 2014-109), ideally Y₃³⁺Mn₄²⁺Fe²⁺[Si₂B₈O₂₄] 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 pegmatites intruding large peridotite body. Of the stock of ~10 000 phenakite centimeter-sized crystals only 15 were containing inclusions of perettiite-(Y). Other inclusions in phenakite are schorl, tusionite, columbite-(Mn), albite, fluorapatite, and lazulite. Phenakite crystals found in pockets with quartz, feldspar, and schorl. Neighborhood pegmatites contain famous mushroom and botryoidal tourmalines, hambergite, petalite, beryl (aquamarine and morganite), pollucite, danburite, topaz, almandine-spessartine, biotite, magnetite, lepidolite, hubnerite-ferberite, and cassiterite. Perettiite-(Y) forms yellow needles elongated by [010] up to a few millimeters long and up to 0.2 mm thick. Observed crystal forms are {100} and {001}. Crystals are intimately twinned. The mineral has white streak and vitreous luster. It is brittle, with irregular fracture and good {010} cleavage. The micro-indentation hardness is VHN₃₀₀ = 100 (100–110) kg/mm² corresponding to ~7 of Mohs scale. Density was not measured due to intergrowth with phenakite; *D*_{calc} = 4.533 g/cm³. Perettiite-(Y) is optically biaxial, α = 1.82(1), γ = 1.84(1) (589 nm). Due to intimate twinning, the crystal appears conoscopically uniaxial with diffuse isogyre cross, thus the optical character 2*V*' and β could not be estimated. Under crossed polars the mineral shows on

(010) sections a characteristic hourglass pattern (similar to apophyllite) with undulatory extinction. Single crystal Raman spectra (488 nm Ar-ion laser) exhibit multiple and intense luminescence emission lines (1200–1600 and 1800–2700 cm⁻¹) probably related to lanthanoids content. A long term exposure allow to identify vibrations at ~1000, 700–800, and <500 cm⁻¹ assigned to common borosilicate stretching, bending and lattice modes. The absence of bands at 3000–3700 cm⁻¹ do not confirm the presence of H₂O/OH. Single-crystal FTIR spectra exhibit an intense O–H stretching band at 2750–3750 cm⁻¹. Quantitative calculation yields a maximum hydroxyl/water content equivalent to 0.1 wt% of H₂O. The chemical data by LA-ICP-MS [wt% (range)] are followed (where determined) by electron probe WDS data (bolded) for 2 samples: Li₂O 0.32 (0.24–0.38); BeO 0.75 (0.66–0.82); B₂O₃ 24.86 (24.61–25.12); MgO 0.27 (0.23–0.29) **0.56, 0.44**; Al₂O₃ 0.56 (0.48–0.62); SiO₂ 11.26 (10.42–12.02), **11.88, 11.94**; CaO 2.02 (1.82–2.27), **1.66, 2.00**; MnO 22.06 (21.04–23.56), **22.95, 21.20**; FeO 4.89 (4.62–5.15), **4.62, 4.52**; Y₂O₃ 22.32 (21.81–23.04), **19.00, 20.99**; ZrO₂ 0.19 (0.17–0.20); Sm₂O₃ 0.24 (0.23–0.27); Gd₂O₃ 0.71 (0.66–0.80), **n.d., 1.42**; Tb₂O₃ 0.29 (0.28–0.31); Dy₂O₃ 2.62 (2.45–2.75), **n.d., 2.14**; Ho₂O₃ 0.53 (0.50–0.55); Er₂O₃ 1.78 (1.73–1.92), **n.d., 1.71**; Tm₂O₃ 0.33 (0.32–0.37); Yb₂O₃ 2.85 (2.59–3.24), **n.d., 2.68**; Lu₂O₃ 0.38 (0.35–0.42); ThO₂ 0.33 (0.30–0.41); total 99.56. The empirical formula based on 24 O pfu is Y_{2.06}Ln_{0.53}Zr_{0.02}Th_{0.01}Mn_{3.24}Ca_{0.38}Fe_{0.71}Mg_{0.07}Al_{0.11}Li_{0.22}Si_{1.95}B_{7.44}Be_{0.31}O₂₄. The strongest lines in the X-ray powder pattern [*d* Å (*I*%; *hkl*)] are 4.63 (52; 010), 4.08 (28; 301,103), 3.74 (20; 210), 3.05 (100; 113,311,303), 2.64 (67; 410,014), 2.54 (60; 313), 2.12 (23; 600,006), 1.87 (33; 420,024), 1.84 (52; 415,323), 1.57 (20; 026,620), 1.44 (25; 133,331). The single-crystal X-ray study show a tetragonal X-ray diffraction pattern, but the structure could only be solved as a 50/50 pseudo-merohedral orthorhombic twin with the *a* = *c*. The structure was solved by direct methods and refined to *R*₁ = 0.017 on the basis of 1814 unique *I* > 2σ(*I*) reflections in space group *Pmna* with *a* = 12.8252(5), *b* = 4.6187(2), *c* = 12.8252(5) Å, *V* = 759.71 Å³, *Z* = 2. The crystal structure of perettiite-(Y) has two eightfold-coordinated sites: one dominated by Y and Ln and the other by Mn²⁺ (with additional Ca²⁺ and Y³⁺). An octahedral site is occupied by (Fe²⁺, Mg) with additional Li⁺. These cation sites form an interlayer between two borosilicate tetrahedral Si₂B₈O₂₄ sheets parallel to (010) formed by 4-, 5- and 8-membered rings. B shows minor replacement by Be. The structural relationships with other species with similar tetrahedral sheets are discussed. The mineral was named after the mineralogist and gemologist Adolf Peretti (b. 1957), mineralogist and head of GRS Gemresearch Swisslab, who first recognized inclusions in phenakite. Holotype specimen is deposited in the Museum of Natural History Bern, Switzerland. **D.B.**

SHUVALOVITE*

I.V. Pekov, N.V. Zubkova, S.N. Britvin, N.V. Chukanov, V.O. Yapaskurt, E.G. Sidorov, and D.Y. Pushcharovsky (2016) Shuvalovite, K₂(Ca₂Na)(SO₄)₃F, a new mineral from the Tolbachik volcano, Kamchatka, Russia. *European Journal of Mineralogy*, 28(1), 53–62.

The new mineral shuvalovite (IMA 2014-057), ideally K₂(Ca₂Na)(SO₄)₃F, was discovered in only one specimen in sublimates 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, apthitalite, anhydrite, lammerite, johillerite, and tilasite. Krashennikovite, euchlorine, alumoklyuchevskite, calciolangbeinite, vanthoffite, arcanite, wulfite, fluorborite, urusovite, svabite, lammerite-β, bradaczekite, ericlxman-

ite, kozyrevskite, popovite, alarsite, 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 $0.05 \times 0.7 \times 0.9$ mm combined in open-work aggregates or crusts up to 1×1 cm on basalt scoria. The latter overgrowing along with calciolangbeinite 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 of the second generation forms long prismatic to acicular, typically divergent microcrystals up to $0.05 \text{ mm} \times 3 \text{ }\mu\text{m}$, 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; $D_{\text{calc}} = 2.64 \text{ g/cm}^3$. 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 $2V_{\text{meas}} \leq 20^\circ$; dispersion of the optical axes was not observed. The IR spectrum of shuvalovite is similar to that of the apatite-supergroup sulfate mineral cesanite, $\text{Ca}_2\text{Na}_3(\text{SO}_4)_3(\text{OH})$. The main bands are: (cm^{-1} , s – strong band, w – weak band, sh – shoulder): 1165sh, 1125s [$\nu_3(F_2) = \text{asymmetric stretching of SO}_4^{2-}$], 993w [$\nu_1(A_1) = \text{symmetric stretching of SO}_4^{2-}$], 643, 627, 612 [$\nu_4(F_2) = \text{bending of SO}_4^{2-}$], 474w (overtone or librational vibrations of SO_4^{2-}). Characteristic bands of B-, C-, N-, and H-bearing groups are absent. The average of 22 electron probe WDS analyses [wt% (range)] is: Na_2O 7.37 (4.70–9.09), K_2O 19.33 (18.01–20.19), CaO 21.39 (20.26–23.21), SO_3 49.49 (47.90–50.98), F 3.78 (3.41–4.33), $-\text{O}=\text{F}_2$ 1.59, total 99.77. Contents of other elements with atomic numbers higher than carbon are below their detection limits. The empirical formula calculated on the basis of 13 (O+F) apfu is: $\text{Na}_{1.16}\text{K}_{2.01}\text{Ca}_{1.86}\text{S}_{3.02}\text{O}_{12.03}\text{F}_{0.97}$. The strongest reflections of the powder X-ray diffraction pattern [d Å ($I\%$; 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: $a = 13.2383(4)$, $b = 10.3023(3)$, $c = 8.9899(3)$ Å, $V = 1227.2$ Å³. The crystal structure was solved by direct methods and refined using 1379 $I > 2\sigma(I)$ unique reflections to $R_1 = 0.067$ in space group $Pnma$, with $a = 13.2383(4)$, $b = 10.3023(3)$, $c = 8.9909(4)$ Å, $V = 1226.22$ Å³, $Z = 4$. The crystal structure contains two different isolated SO_4 tetrahedra. 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_7F polyhedra, whereas Ca(2) cations occupy CaO_5F or CaO_6F 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) cations 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 $\text{M}_2(\text{SO}_4)_3\text{X}$ (shuvalovite, krashennikovite, 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.**

SUSEINARGIUTE*

P. Orlandi, C. Biagioni, Y. Moëlo, J. Langlade, and E. Faulques (2015) Suseinargiute, $(\text{Na}_{0.5}\text{Bi}_{0.5})\text{MoO}_4$, the Na-Bi analogue of wulfenite, from Su Seinariu, Sardinia, Italy. *European Journal of Mineralogy*, 27(5), 695–699.

The new mineral species suseinargiute (IMA 2014-089), ideally $(\text{Na}_{0.5}\text{Bi}_{0.5})\text{MoO}_4$, has been discovered in the Mo-Bi occurrence of Su Seinariu, 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. Suseinargiute 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; $D_{\text{calc}} = 5.597 \text{ g/cm}^3$ (for an ideal formula). In transmitted light suseinargiute 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_3 49.03/45.59 (43.49–51.14), Bi_2O_3 42.97/34.47 (32.77–37.49), PbO 2.89/12.04 (1.36–13.82), Na_2O 3.69/3.03 (2.76–4.39), total 98.58/95.13. No other elements with $Z > 9$ were detected. The low totals are assigned to the porosity of micro-crystalline aggregates. The empirical formulas based on 4 O apfu for outer and inner zones respectively are: $(\text{Na}_{0.35}\text{Bi}_{0.54}\text{Pb}_{0.04})_{\Sigma 0.93}\text{Mo}_{0.99}\text{O}_4$ and $(\text{Na}_{0.31}\text{Bi}_{0.46}\text{Pb}_{0.17})_{\Sigma 0.94}\text{Mo}_{0.99}\text{O}_4$. The strongest lines in the X-ray powder pattern are [d Å ($I\%$; hkl)]: 3.146 (100; 112), 2.912 (13; 004), 2.652 (18; 200), 1.964 (34; 204), 1.875 (15; 220), 1.728 (19; 116), 1.616 (28; 312,132). Tetragonal unit-cell parameters, refined from the powder X-ray diffraction data are $a = 5.296(1)$, $c = 11.673(2)$ Å, $V = 327.4$ Å³, space group $I4_1/a$, $Z = 4$. Due to the lack of suitable crystals, the crystal structure of suseinargiute was not solved. X-ray powder diffraction data, micro-Raman spectra, and chemical analysis, show the close similarity of suseinargiute to synthetic $(\text{Na}_{0.5}\text{Bi}_{0.5})\text{MoO}_4$, which has a scheelite-type structure. Thus suseinargiute is the Na-Bi analog of wulfenite. The presence of vacancies in synthetic $(\text{Na}_{0.5}\text{Bi}_{0.5})\text{MoO}_4$ allow to suggest two possible substitution schemes: $\text{Na}^+ + \text{Bi}^{3+} = 2\text{Pb}^{2+}$, with a strong increase of the unit-cell volume or $3\text{Na}^+ = \text{Bi}^{3+} + 2\text{Pb}^{2+}$. The formula of suseinargiute could be written as $(\text{Na}_{0.5-x-y}\text{Bi}_{0.5+x/3-y}\text{Pb}_{2x/3})\text{MoO}_4$. The outer and the inner zones of the analyzed grains correspond to $x \sim 0.13$, $y \sim 0.02$ and $x \sim 0.10$, $y \sim 0.09$, respectively. Suseinargiute was named, for its type locality. The holotype specimen is deposited in the Museo di Storia Naturale, Università di Pisa, Pisa, Italy. **D.B.**