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New Mineral Names*,†

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This New Mineral Names has entries for 14 new minerals, including bohseite, dachiardite-K, ilyukhinite, jahnsite-(CaFeMg), ježekite, karpenkoite, khesinite, mesaite, norilskite, plavnoite, raygrantite, shumwayite, steinmetzite, and tinnunculite.

BOHSEITE*

E. Szełęg, B. Zuzens, F.C. Hawthorne, A. Pieczka, A. Szuszkiewicz, K. Turniak, K. Nejbert, S.S. Ilnicki, H. Friis, E. Makovicky, M.T. Weller and M.-H. Lemée-Cailleau (2017) Bohseite, ideally $Ca_4Be_4Si_9O_{24}(OH)_4$, from the Piława Górna quarry, the Góry Sowie Block, SW Poland. Mineralogical Magazine, 81(1), 35–46.

Bohseite (IMA 2010-026) is a new orthorhombic calcium beryllium aluminosilicate isostructural with bavenite. It has variable Al content and an end-member formula $Ca_4Be_4Si_9O_{24}(OH)_4$. Bohseite was originally approved by CNMNC IMA on the material from Ilímaussaq alkaline complex, South Greenland, with an end-member composition of $Ca_4Be_3AlSi_9O_{25}(OH)_3$ (Friis et. al. 2010), but subsequent discovery of compositions with Be > 3.0 apfu led to redefinition of its end-member composition, and the holotype specimen locality to the Piława Górna quarry in the eastern part of the Góry Sowie Block, NE part of the Bohemian massif, ~50 km southwest of Wrocław, SW Poland (50°42′11.77″N; 16°44′12.36″E). At that location bohseite occurs in the zoned anatectic (NYF-LCT) pegmatite dikes that cut amphibolites, in close association with microcline, Cs-rich beryl, phenakite, helvite, lepidolite, bertrandite, and unidentified Be-containing mica as alteration products after a primary Be mineral, probably beryl. No data on bohseite from Ilímaussaq is reported. At Piława Górna quarry bohseite forms fan-like or parallel aggregates (up to 0.7 cm) of white platy striated crystals up to 2 mm long. No twinning was found. It is translucent, white with a white streak and a vitreous luster. No fluorescence under UV light was observed. The cleavage is perfect on {001} and fair on {010}, with no parting. Bohseite is brittle with a splintery fracture and Mohs hardness of 5–6. The density was not measured due to the paucity of material and its high degree of chemical zoning; D_{calc} = 2.719 g/cm³. The mineral is optically biaxial (+), $\alpha = 1.579(2)$, $\beta = 1.580(2)$, $\gamma = 1.597(2)$°; $2V = 24(3)$° (590 nm); $2V_{calc} = 27$°. Dispersion of an optical axes is weak, $r < v$. The optical orientation (determined by transferring the optics crystal from the spindle stage to a single-crystal diffractometer) is X ^ **a**= 16°, Y ^ **b** = 16°, *Z* // **c**. FTIR spectra were collected on two grains of bohseite from 4000 to 600 cm^{-1} but the data provided only for 3690–3470 cm^{-1} interval with two relatively sharp absorptions at 3620 and 3550 cm^{-1} related to the occurrence of $(OH)^-$. The average of 17 representative compositions of bohseite [wt% (range)] along with the average of 10 electron probe WDS analysis (in bold) on the crystal used for the collection of the XRD data are: SiO_2 58.83 (58.04–59.47) / **57.41 (54.69–60.02)**, Al_2O_3 3.51 (1.87–6.49) / **3.51 (2.91–4.17)**, CaO 24.61 (24.45–24.96) / **23.75 (23.53–23.91)**, Na_2O 0.07 (0.01–0.13) / **0.18 (0.16–0.19)**, F_2 0.45 (0.20–0.69) / **0.55 (0.39–0.75)**, BeO_{calc} 9.31 (7.75–10.24) / **9.07**, H_2O_{calc} 3.12 (2.68–3.42) / **3.05**, $O{=}F_2$ 0.19 / **0.23**, total 99.71 / **97.29**. The empirical formulae, calculated on the basis of 28 anions with BeO and H_2O iterated by stoichiometry to Be = 13 – (Si+Al) and Ca+Na = Al+Be, are accordingly: $(Ca_{4.02}Na_{0.02})_{\Sigma4.04}(Be_{3.41}Al_{0.59})_{\Sigma4.00}(Si_{8.96}Al_{0.04})_{\Sigma9.00}O_{24.22}[(OH)_{3.17}F_{0.22}O_{0.61}]_{\Sigma4.00}$ and $(Ca_{3.97}Na_{0.05})_{\Sigma4.02}(Be_{3.40}Al_{0.60})_{\Sigma4.00}(Si_{8.96}Al_{0.04})_{\Sigma9.00}O_{24.27}[(OH)_{3.17}F_{0.27}O_{0.56}]_{\Sigma4.00}$. The content of Be is in the range 2.84 < Be < 3.77 apfu suggesting the complete solid solution from bavenite to close to the end-member composition of bohseite. The powder X-ray diffraction data were not obtained due to the compositional heterogeneity of the material. The strongest lines in the calculated X-ray powder diffraction pattern are [d_{calc} Å (I_{calc}%; *hkl*)]: 4.166 (38; 310), 3.383 (44; 510), 3.723 (51; 404), 3.334 (100; 511), 3.236 (28; 006), 3.196 (25; 512), 3.027 (37; 115), 2.553 (31; 316). The structure of bohseite was refined to R_1 = 2.17% assuming full occupancy for all sites in the space group *Cmcm* despite the optical data shows lower symmetry. The attempts to merge the data in monoclinic symmetry did not led to a lower R_{int} value. The extensive crystal-structure work on bavenite has all been done in orthorhombic symmetry, while bavenites from different localities have been reported with orthorhombic and monoclinic optics. The unit-cell parameters are: $a = 23.204(6)$, $b = 4.9442(9)$, $c = 19.418(6)$ Å, $V = 2227.7$ Å³, $Z = 4$. In the crystal structure four-membered rings of alternating $(Si,Be)O_4$ and $(Si,Al)O_4$ tetrahedra and six-membered rings of SiO_4 tetrahedra form chains extending in the **a** direction. Adjacent chains link through linear BeO_4–SiO_4–BeO_4 groups to form sheets that stack in the **b** direction with T(4) (Si+Al) tetrahedra linking the sheets and [7]-coordinated interstitial Ca occupying interstices in the resulting framework. The solid solution in bavenite–bohseite is according to the scheme $^{O(2)}OH^- + {}^{T(4)}Si^{4+} + {}^{T(3)}Be^{2+} \leftrightarrow {}^{O(2)}O^{2-} + {}^{T(4)}Al^{3+} + {}^{T(3)}Si^{4+}$, and a general formula for the series may be written as $Ca_4Be_xSi_9Al_{4-x}O_{28-x}(OH)_x$, where x ranges from 2–4 apfu: $Ca_4Be_2Si_9Al_2O_{26}(OH)_2$ (bavenite) to $Ca_4Be_4Si_9O_{24}(OH)_4$ (bohseite). The name is in honor of the Danish geologist Hennning Bohse (b. 1942) who has worked for more than 40 years on the mineralogy and geology of the Ilímaussaq alkaline complex. Holotype and cotype specimens are deposited at the Mineralogical Museum, University of Wrocław, Poland. The original material from the Ilímaussaq alkaline complex is stored at the Natural History Museum in Copenhagen, Denmark (Friis et al. 2010). This material was investigated by Petersen et al. (1995) and Armstrong et al. (2010). **D.B.**

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* All minerals marked with an asterisk have been approved by the IMA CNMMC.
† For a complete listing of all IMA-validated unnamed minerals and their codes, see http://pubsites.uws.edu.au/ima-cnmnc/.

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Friis, H., Makovicky, E., Weller, M.T., and Lemée-Cailleau, M.-H. (2010) Bohseite, IMA 2010-026. CNMNC Newsletter, 2010, page 800; Mineralogical Magazine, 74, 797–800.

Petersen, O.V., Micheelsen, H.I., and Leonardsen, E.S. (1995) Bavenite, $Ca_4Be_3Al[Si_9O_{25}(OH)_3]$, from the Ilímaussaq Alkaline Complex, South Greenland. Neues Jahrbuch für Mineralogie Monatshefte, 7, 321–335.

DACHIARDITE-K*

N.V. Chukanov, S. Encheva, P. Petrov, I.V. Pekov, D.I. Belakovskiy, S.N. Britvin and S.M. Aksenov (2016) Dachiardite-K, $(K_2Ca)(Al_4Si_{20}O_{48})·13H_2O$, a new zeolite from Eastern Rhodopes, Bulgaria. Zapiski RMO (Proceedings of the Russian Mineralogical Society), 145(1), 68–79 (in Russian); Geology of Ore Deposits, 58(8), 666–673 (English translation).

Dachiardite-K (2015-041; nomenclature voting proposal 15-B), ideally $(K_2Ca)(Al_4Si_{20}O_{48})·13H_2O$, was discovered in hydrothermally altered rocks of the Zvezdel paleovolcanic complex in the Eastern Rhodopes, Bulgaria. It belongs to the dachiardite series of zeolites and is a K-dominant analogue of dachiardite. The new mineral forms radiated aggregates up to 8 mm in diameter which consist of slightly flattened acicular split crystals, and occurs on the walls of veinlets composed mainly of chalcedony and opal. Other associated minerals are dachiardite-Ca, dachiardite-Na, ferrierite-Mg, ferrierite-K, clinoptilolite-Ca, clinoptilolite-K, mordenite, smectite, celadonite, calcite, and barite. Dachiardite-K is white, some individual crystals are colorless and transparent. It has white streak and a vitreous luster. The mineral is brittle with Mohs hardness of 4; $D_{meas} = 2.18(2)$ g/cm^3, $D_{calc} = 2.169$ g/cm^3. The cleavage is perfect on {100} and the fracture is stepped. In transmitted light dachiardite-K is colorless and non-pleochroic. It is optically biaxial (+), $\alpha = 1.477$ (calc), $\beta = 1.478(2)$, $\gamma = 1.481(2)°$ (589 nm), and $2V_{meas} = 65(10)°$. Dispersion of an optical axes is distinct, $r < v$. The Y coincides with **b**, and crystals are elongated in this direction. The YZ plane coincides with a cleavage plane and the mineral shows straight extinction in this plane. The bands in the IR spectrum are (cm^{-1}; s = strong, w = weak, sh = shoulder): 3629, 3450, 3250sh (O-H stretching vibrations of H_2O molecules), 1640w (bending vibrations of H_2O molecules), 1215s, 1063s (stretching vibrations of the tetrahedral framework), 780w, 726w, 665sh, 631, 570sh, 558, 523 (mixed vibrations of the tetrahedral framework), and 442s (lattice modes involving Si-O-Si bending vibrations). The averaged 6 point EDS electron probe analyses gave [wt% (range)]: K_2O 4.51 (3.95–4.89), CaO 3.27 (2.93–3.54), BaO 0.41 (0.28–0.60), Al_2O_3 10.36 (10.03–10.68), SiO_2 67.90 (67.47–68.51), H_2O 13.2(5) (by thermogravimetry), total 99.65. The empirical formula based on 61 O apfu is $H_{26.23}K_{1.71}Ca_{1.04}Ba_{0.05}Al_{3.64}Si_{20.24}O_{61}$. The strongest lines of the powder X-ray diffraction pattern are [*d* Å (*I*%; *hkl*)]: 9.76 (24; 001), 8.85 (58; 200), 4.870 (59; $0\underline{0}2$), 3.807 (16; 202), 3.768 (20; 112,020), 3.457 (100; 220), 2.966 (17; $\bar{6}02$). The crystal structure of dachiardite-K was not refined due to the absence of suitable crystals. The new mineral is monoclinic, *C*2/*m*, *Cm*, or *C*2, $a = 18.670(8)$, $b = 7.511(3)$, $c = 10.231(4)$ Å, $\beta = 107.79(3)°$, $V = 1366$ Å^3, and $Z = 1$. The crystal structure of dachiardite-group minerals including the new one is based on the 3D tetrahedral framework consisting of chains of five- and four-membered aluminosilicate rings, with K atoms locating in framework voids. The type specimen of is deposited in the Earth and Man National Museum, Sofia, Bulgaria. **Yu.U.**

ILYUKHINITE*

N.V. Chukanov, R.K. Rastsvetaeva, K.A. Rozeneberg, S.M. Aksenov, I.V. Pekov, D.I. Belakovskiy and K.V. Van (2016) Ilyukhinite $(H_3O,Na)_{14}Ca_6Mn_2Zr_3Si_{26}O_{72}(OH)_2·3H_2O$—a new mineral of eudialyte group. Zapiski Rossiyskogo mineralogicheskogo obschestva (Proceedings of the Russian Mineralogical Society), 145(2), 44–57 (in Russian).

Ilyukhinite (IMA 2015-065), $(H_3O,Na)_{14}Ca_6Mn_2Zr_3Si_{26}O_{72}(OH)_2·3H_2O$, was discovered in a peralkaline pegmatite at the Mount Kukisvumchorr, Khibiny alkaline massif, Kola Peninsula, Russia. It was named after the outstanding Russian crystallographer Vladimir V. Ilyukhin (1934–1982). The new mineral occurs in a hydrothermally altered peralkaline rock, in association with aegirine, murmanite, albite, microcline, rhabdophane-(Ce), fluorite, sphalerite, and molybdenite. Ilyukhinite forms anhedral grains up to 1 mm across in size. It is brownish-orange in color, transparent, with a vitreous luster and a white streak. Mohs hardness is 5. No cleavage was observed. $D_{meas} = 2.67(2)$ g/cm^3, $D_{calc} = 2.703$ g/cm^3. Ilyukhinite is optically uniaxial (–), $\omega = 1.585(2)$, $\varepsilon = 1.584(2)$ (589 nm). It is weakly pleochroic: O (orange) > E (grayish pink). The bands in the IR spectrum of ilyukhinite are (cm^{-1}; s = strong, w = weak, sh = shoulder): 3426, 3250sh (O-H stretching); 1635 (bending H-O-H); 1140sh (S-O stretching); 1060sh, 1004s (Si-O stretching vibrations of the Si-tetrahedra forming $\{Si_3O_9\}$ and $\{Si_9O_{27}\}$ rings); 924s (Si-O stretching vibrations of $[M(3)O_4]$ and $[M(4)O_4]$ tetrahedra); 741, 696, 651 (combined modes of $\{Si_3O_9\}$ and $\{Si_9O_{27}\}$); 520sh [^{V}(Mn,Fe)-O vibrations of the $[M(2)O_5]$ pyramid]; 475s, 450s (bending vibrations of Si-O-Si bonds); 366 (lattice H_2O vibrations possibly combined with Ca-O mode vibrations). The average of 5 point EDS analyses is [wt% (range)]: Na_2O 3.07 (3.63–4.43), K_2O 0.32 (0.28–0.52), CaO 10.63 (10.26–10.90), MnO 3.06 (2.74–3.22), FeO 1.15 (0.93–1.37), La_2O_3 0.79 (0.51–0.89), Ce_2O_3 1.21 (0.97–1.44), Nd_2O_3 0.41 (0.30–0.56), TiO_2 0.90 (0.77–1.12), ZrO_2 10.94 (10.15–11.21), Nb_2O_5 1.40 (0.76–1.68), SiO_2 51.24 (49.98–52.28), SO_3 1.14 (0.89–1.37), Cl 0.27 (0.19–0.38), H_2O 10.9(5) (by gas chromatography), $–O{=}Cl_2$ 0.06, total 98.27. The empirical formula is: $H_{36.04}(Na_{3.82}K_{0.20})(Ca_{5.65}Ce_{0.22}La_{0.14}Nd_{0.07})(Mn_{1.285}Fe_{0.48})(Zr_{2.645}Ti_{0.34})Nb_{0.31}Si_{25.41}S_{0.42}Cl_{0.23}O_{86.82}$, based on the Si = 25.41 apfu (calculated by charge balance from the structure constraints). The strongest lines in the powder X-ray diffraction pattern are [*d* Å (*I*%; *hkl*)]: 11.44 (82; 101), 7.09 (70; 110), 6.02 (44; 021), 4.371 (89; 205), 3.805 (47; 303,033), 3.376 (41; 131), 2.985 (100; 315,128), 2.852 (92; 404). The crystal structure of ilyukhinite was solved on the basis of the structure of aqualite and refined to $R = 4.6\%$. The new mineral is trigonal, *R*3*m*, $a = 14.1695(6)$ Å, $c = 31.026(1)$ Å, $V = 5394.7(7)$ Å^3, $Z = 3$. Ilyukhinite belongs to the eudialyte group of minerals, and is the first Mn-dominant oxonium end-member. The type specimen is deposited in the Geological Museum, Natural History Museum, University of Oslo, Norway. **Yu.U.**

JAHNSITE-(CAFEMG)*

P. Elliot (2016) Jahnsite-(CaFeMg), a new mineral from Tom's quarry, South Australia: description and crystal structure. European Journal of Mineralogy, 28(6), 991–996.

Jahnsite-(CaFeMg), (IMA 2013-111), ideally $CaFe^{2+}Mg_2Fe^{3+}_2(OH)_2(H_2O)_8[PO_4]_4$, is a new member of the whiteite–jahnsite group from Tom's Quarry, Kapunda, South Australia, Australia where it occurs as a low-temperature secondary mineral. The deposit contains low-grade highly ferruginous phosphorites derived by leaching of weakly phosphatic limestones or low-grade primary phosphorites during the late Tertiary and the Quaternary. Deposition of secondary phosphates has occurred near the surface and has been mostly controlled by the availability of cations in groundwaters. Jahnsite-(CaFeMg) forms blocky to short prismatic crystals up to 0.2 × 0.15 mm, lining small cavities and as intergrowths with jahnsite-(NaFeMg) filling veins in a matrix comprising goethite and minor fluorapatite. The mineral is brownish orange, transparent with a white streak and a vitreous luster. It does not fluoresce in UV light. The cleavage on {001} is good. It is brittle with a splintery fracture. Mohs hardness is ~4. D_{meas} = 2.76(4) g/cm^3 (by flotation in sodium polytungstate–water mixture), D_{calc} = 2.772 g/cm^3. Jahnsite-(CaFeMg) is optically biaxial (–), α =1.629(4), β = 1.658(4), γ = 1.677(4), 2V_{calc} = 76.8° (λ not reported). Pleochroism is weak: *Y* – orange-pink > *Z* – pale orange > *X* – very pale gray. The average of 17 spots electron probe EDS analysis [wt% (range)] is: Na_2O 0.65 (0.20–1.23), CaO 4.74 (3.67–6.19), MgO 6.47 (5.73–7.63), MnO 5.02 (4.08–5.55), FeO 9.85 (5.87–12.52), Fe_2O_3 (on the basis of crystal-chemical constraints) 20.18 (18.82–23.36), Al_2O_3 0.06 (0–0.20), P_2O_5 34.41 (33.27–36.16), H_2O (by structure) 19.46, total 100.84. The empirical formula based on 26 O pfu is $(Ca_{0.70}Na_{0.17}Mn^{2+}0.16)_{\Sigma1.03}Fe^{2+}_{1.00}(Mg_{1.33}Mn^{2+}_{0.43}Fe^{3+}_{0.24})_{\Sigma2.00}(Fe^{3+}_{1.99}Al_{0.01})_{\Sigma2.00}(PO_4)_{4.01}(OH)_{2.10}H_2O_{7.88}$. The strongest lines in the X-ray powder diffraction pattern are [*d* Å (*I*%; *hkl*)]: 9.339 (100; 001), 4.923 (20; $21\bar{1}$, 111, 310), 3.562 (20; 400), 3.518 (20; 112, $40\bar{2}$), 3.453 (20; 202), 2.965 (20; 221), 2.839 (35; $5\bar{1}\bar{1}$), 2.592 (20; 203). The unit-cell parameters refined from the powder data are: *a* = 14.985(2), *b* = 7.150(1), *c* = 9.877(2) Å, β = 110.583(3)°, and *V* = 990.8 Å^3. X-ray diffraction intensity data was collected from a single crystal of 0.06 × 0.035 × 0.03 mm twined on {001}. The single-crystal unit-cell parameters are: *a* = 14.975(5), *b* = 7.1645(14), *c* = 9.928(2) Å, β = 110.65(3)°, *V* = 996.7 Å^3, monoclinic, *P*2/*a*, *Z* = 2. The crystal structure of jahnsite-(CaFeMg) was refined to R_1 = 0.0517 for 1616 observed [$F_o > 4\sigma F_o$] reflections. Minerals of the whiteite–jahnsite group have the general formula $XM1M2_2M3_2(PO_4)_4(OH)_2·8H_2O$, where M3 = Fe^{3+} and Al (for the jahnsite and whiteite end-members, respectively); X = Ca, Na, and Mn and the M1 and M2 sites are occupied by Mn, Fe, Mg, and Zn. In jahnsite-(CaFeMg), chains of corner-sharing M3 octahedra (Fe2 and Fe3), which are decorated by bridging $P1O_4$ and $P2O_4$ groups, extend in the **b**-direction; the chains are linked in the **a**-direction by X polyhedra, forming slabs parallel to (100); the Fe1 (M1) octahedron shares edges with two $P1O_4$ tetrahedra; slabs link in the **c**-direction via Mg (M2) octahedra, which share corners with $P1O_4$ and $P2O_4$ tetrahedra and by hydrogen bonding. The X site is occupied dominantly by Ca. The name of the minerals reflects the composition of M1,2 and X sites. The holotype specimen is housed in the South Australian Museum, Adelaide, South Australia (registration number G34045). **F.C.**

JEŽEKITE*

J. Plášil, J. Hloušek, A.V. Kasatkin, D.I. Belakovskiy, J. Čejka and D. Chernyshov (2015) Ježekite, $Na_8[(UO_2)(CO_3)_3](SO_4)_2·3H_2O$, a new uranyl mineral from Jáchymov, Czech Republic. Journal of Geosciences, 60(4), 259–267.

Ježekite (IMA 2014-079), ideally $Na_8[(UO_2)(CO_3)_3](SO_4)_2·3H_2O$, is a new uranyl carbonate-sulfate mineral discovered on two specimens collected in the 1990s at the Geschieber vein in the Svornost mine (10th level), Jáchymov, Western Bohemia, Czech Republic. The occurence is a classic example of the Variscan hydrothermal vein type of deposit, so-called five-elements (Ag–Bi–Co–Ni–U) formation. Ježekite forms crystalline crust composed of thin, pale to sulfuric yellow, bladed or acicular prismatic crystals up to 0.2 mm long (tightly packed in isolated aggregates up to 0.5 mm) on a gangue along with andersonite, čejkaite, schröckingerite, andersonite, natrozippeite, and gypsum. It is a supergene, low-temperature mineral formed due to alteration of uraninite during post-mining processes. Crystals are elongated on [001] and have forms: {001}, {$1\bar{1}1$}, {100}, {010}. Twinning is commonly on (001). The luster is vitreous to pearly and the streak is pale yellow. Ježekite fluoresces bright greenish white under long- and short-wave UV. The cleavage is perfect on {001} and good by {100}. The mineral is brittle with uneven fracture and Mohs hardness is ~2. Density was not measured; D_{calc} = 2.966 g/cm^3. Ježekite is slightly soluble in a cold H_2O and readily soluble in 10% HCl. In transmitted light ježekite is non-pleochroic but shows noticeable pseudo-absorption due to the high birefringence. It is optically uniaxial (+), ω = 1.484(2), ε = 1.547(2) (589 nm). The elongation of the acicular crystals is negative. The bands on the Raman spectrum are (cm^{-1}): 3620 and 3380 (ν O–H vibrations of symmetrically non-equivalent H_2O); 2740 and 1710 (overtones or combination bands); 1656 and 1600 [ν_2 (δ) bending vibrations of structurally non-equivalent H_2O molecules]; 1600–1300 weak bands [split doubly degenerate ν_3 $(CO_3)^{2-}$ antisymmetric stretching vibrations]; 1195, 1130, and 1110 [triply degenerate ν_3 (SO_4) antisymmetric stretching]; 1060 and 1050 [ν_1 (CO_3) symmetric stretching]. 996 [ν_1 (SO_4) symmetric stretching]; 896 weak [ν_3 $(UO_2)^{2+}$ antisymmetric stretching]; 825 strong [ν_1 $(UO_2)^{2+}$ symmetric stretching]; weak 731 and 715 [ν_4 (δ) doubly degenerate (CO_3) in-plane bending vibrations]; 688, 629, and 622 [triply degenerate ν_4(δ) (SO_4) bending]; 458 and 379 [doubly degenerate ν_2 (δ) (SO_4) bending]; 277 and 248 [doubly degenerate ν_2 (δ) $(UO_2)^{2+}$ bending]; 188, 161, and 85 [ν ($U–O_{ligand}$) stretching, δ ($O_{ligand}UO_{ligand}$), and δ (OUO_{ligand}) bending vibrations]. The average of 9 electron microprobe EDS analysis (using a rastered 8 × 8 μm beam) is [wt% (range)]: Na_2O 27.92 (27.12–28.46), SO_3 18.49 (17.62–19.47), UO_3 32.85 (32.38–33.63), CO_2(calc) 15.08, H_2O(calc) 6.17, total 100.51. The CO_2 and H_2O content was calculated by stoichiometry based on structure model. The empirical formula based on 22 O pfu is $Na_{7.88}(UO_2)(CO_3)_3(S_{1.01}O_4)_2·3H_2O$. The strongest powder X-ray diffraction lines are [*d* Å (*I*%; (*hkl*)]: 7.861 (59; 100), 6.925 (20; 001), 5.193 (100; 101), 4.534 (44; 110), 3.415 (23; 201), 2.751 (17; 112), 2.728 (20; 211), 2.618 (25; 300). The unit-cell parameters refined from powder XRD data are *a* = 9.072(2), *c* = 6.9182(1) Å, *V* = 493.1 Å^3. The X-ray single-crystal data shows ježekite is hexagonal, space group $P\bar{6}2m$, *a* = 9.0664(11), *c* =6.9110(6) Å, *V* = 491.97 Å^3, *Z* = 1. The crystal structure was refined to *R* = 0.0426 for 444 [$I_{obs} > 3\sigma(I)$] reflections. In the crystal structure of ježekite the UO_8 hexagonal bipyramids (single U site) are chelated by three planar CO_3 groups (one symmetrically unique C site) forming a typical finite uranyl tricarbonate clusters (UTC)-$[(UO_2)(CO_3)_3]^{4-}$ linked through the Na(1)–O bonds to form sheets of the composition $\{Na_2[(UO_2)(CO_3)_3]\}^{2-}$ parallel to (001). The adjacent sheets are also linked through Na–O bonds to the six Na(2) atoms and highly disordered sheets of composition $\{[(SO_4)_2(H_2O)_3]\}^{4-}$ into a sandwich-like structure. The structure of ježekite is unique. The similarities to the structures of schröckingerite $NaCa_3(UO_2)(CO_3)_3(SO_4)F·10H_2O$ and syntetic trigonal $Na_4[(UO_2)(CO_3)_3]$ are discussed. The mineral is named in honor of Bohuslav Ježek (1877–1950), a prominent Czech mineralogist and crystallographer, professor of both Charles University in Prague and Technical University of Mining in Příbram. The holotype specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

KARPENKOITE*

A.V. Kasatkin, J. Plášil, I.V. Pekov, D.I. Belakovskiy, F. Nestola, J. Čejka, M.F. Vigasina, F. Zorzi and B. Thorne (2015) Karpenkoite, $Co_3(V_2O_7)(OH)_2·2H_2O$, a cobalt analogue of martyite from the Little Eva mine, Grand County, Utah, USA. Journal of Geosciences, 60(4), 251–257.

Karpenkoite (IMA 2014-092), ideally $Co_3(V_2O_7)(OH)_2·2H_2O$, is a new divanadate mineral species, the cobalt analogue of martyite $[Zn_3(V_2O_7)(OH)_2·_2H_2O]$, discovered at the Little Eva mine, Yellow Cat District, Grand County, Utah, U.S.A. (38°50′17″N, 109°31′35″W). The mine has been worked intensively for uranium and vanadium between 1940s and 1970s. Karpenkoite was found on sandstone blocks in close association with its zinc analogue martyite, quartz, abundant gypsum, baryte, roscoelite, and an unidentified Al vanadate. It is a secondary mineral formed during the post-mining oxidation of corvusite and montroseite in a moist environment at ambient temperatures. Other associating supergene minerals include andersonite, ansermetite, calciodelrioite, calcite, carnotite, cobaltomenite, dickthomssenite, ferroselite, huemulite, hughesite, lasalite, melanovanadite, metarossite, nashite, native selenium, natrozippeite, nestolaite, orschallite, pascoite, rossite, schröckingerite, sherwoodite, tyuyamunite, and secondary uraninite. Karpenkoite forms lamellar crystals up to 0.05 mm, coarsely hexagonal or irregular and typically curved. The crystals are combined in rose-like clusters or globular aggregates up to 0.2 mm across. The mineral is orange with pale yellow-orange streak and a vitreous luster. It is non-fluorescent under UV radiation nor in cathode rays. The cleavage is perfect on {001}. Karpenkoite is brittle, with laminated fracture; Mohs hardness is estimated as ~3. The density was not measured due to the paucity of pure material; D_{calc} = 3.415 g/cm³. Karpenkoite is insoluble in H_2O but easily soluble in cold diluted HCl or HNO_3. In transmitted light karpenkoite is reddish-brown, non-pleochroic. It is optically uniaxial (+), $\omega = 1.827(8)$, $\varepsilon = 1.843(8)$ (589 nm). Raman spectra of karpenkoite and marthyite were obtained on polycrystalline aggregates and are quite similar. The main bands are (cm^{-1}): broad 3450–3530 (O–H stretching), broad 1670–1660 (H_2O bending), 823 for karpenkoite, and 844 for marthyite (V^{5+}–O symmetric stretching vibrations), 500–300 ($V^{5+}O_3$ bending), <300 = lattice modes. No bands indicating C–O, C–H, N–O, N–H, and B–O bonds were observed for both minerals. The average of 12 electron microprobe EDS analysis [wt% (range)] is: MgO 0.05 (0–0.47), CaO 0.26 (0–0.70), MnO 1.39 (0–3.53), CoO 33.22 (23.05–45.23), NiO 2.02 (0.98–3.85), CuO 0.28 (0–0.82), ZnO 12.66 (1.58–21.59), V_2O_5 38.70 (37.48–39.92), H_2O (by stoichiometry) 11.61, total 100.19. The empirical formula, calculated on the basis of 11 O pfu, is $(Co_{2.06}Zn_{0.72}Ni_{0.13}Mn_{0.09}Ca_{0.02}Cu_{0.02}Mg_{0.01})_{\Sigma 3.05}V_{1.98}O_7(OH)_2\cdot 2H_2O$. The Co-richest and Zn-poorest point has the composition $(Co_{2.80}Zn_{0.09}Ni_{0.07}Ca_{0.05}Mn_{0.02}Cu_{0.02})_{\Sigma 3.05}V_{1.98}O_7(OH)_2\cdot 2H_2O$, while the composition of Co-poorest and Zn-richest one is $(Co_{1.46}Zn_{1.15}Mn_{0.21}Ni_{0.20})_{\Sigma 3.02}V_{1.99}O_7(OH)_2\cdot 2H_2O$. On other studied specimens from the Little Eva mine, karpenkoite and martyite occur together forming a nearly continuous solid-solution series. The strongest lines in the X-ray powder diffraction pattern are [*d* Å (*I*%; *hkl*)]: 7.15 (100; 001), 5.19 (18; 010), 4.20 (25; 101,011), 3.59 (21; 002), 2.95 (54; 012,102), 2.77 (21; 111), 2.60 (36; 200), 2.44 (33; 201,021). The mineral is trigonal, the most probable space group is $P\bar{3}m1$ (by analogy with martyite). The refined unit-cell parameters are a = 6.016(4), c = 7.234(6) Å, V = 226.7 Å³, Z = 1. The single-crystal X-ray data was not obtained due to imperfection of the very thin and divergent crystals. The conclusion that karpenkoite is the cobalt analogue of martyite and its synthetic analog is based on similarity of chemical and optical properties, and powder XRD and Raman data. The mineral is named in honor of the Russian mineralogist Vladimir Yu. Karpenko (b. 1965), an expert on the mineralogy of vanadium. The holotype specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

KHESINITE*

I.O. Galuskina, E.V. Galuskin, A.S. Pakhomova, R. Widmer, Th. Armbruster, B. Krüger, E.S. Grew, Y. Vapnik, P. Dzierażanowski and M. Murashko (2017) Khesinite, $Ca_4Mg_2Fe^{3+}_{10}O_4[(Fe^{3+}_{10}Si_2)O_{36}]$, a new rhönite-group (sapphirine supergroup) mineral from the Negev Desert, Israel—natural analogue of the SFCA phase. European Journal of Mineralogy, 29(1), 101–116.

Khesinite, (IMA 2014-033), ideally $Ca_4Mg_2Fe^{3+}_{10}O_4[(Fe^{3+}_{10}Si_2)O_{36}]$, is a new member of the rhönite group of the sapphirine supergroup. It was discovered in thin veins of paralavas within fine-grained gehlenite rocks (hornfels) of the Hatrurim Complex collected at the Gurim anticline located near Arad city in the Negev Desert, Israel (31°09′N 35°17′E). Paralavas are composed of rankinite, pseudowollastonite (rarely wollastonite), flamite, kalsilite, cuspidine and members of the solid-solution series: schorlomite–andradite, gehlenite–ackermanite–"Fe^{3+}-gehlenite", magnesioferrite–spinel, and fluorapatite–fluorellestadite. Accessory and rare minerals are baryte, walstromite, fresnoite, vorlanite, barioferrite, hematite, perovskite, gurimite, zadovite, aradite, and hexacelsian. Khesinite grains generally do not exceed 200 μm in size and are characterized by an irregular outline, although a few crystal faces are usually present. Rarely, khesinite grains attain a length of 400 μm or cluster in aggregates. Khesinite is black and translucent with a dark-brown color in very thin edges. It has a semi-metallic luster and does not show fluorescence in UV radiation. Cleavage and parting are not observed; fracture is irregular. Micro indentation hardness is VHN_{50} = 943(44) kg/mm² corresponding to 6 of Mohs scale; D_{calc} = 4.097 g/cm³. In reflected light, khesinite shows gray color and weak brown internal reflections; pleochroism is very weak, birefringence and anisotropy are weak. Reflectance values were measured between 400 and 700 nm. The values for COM wavelengths [R_{min}, R_{max} % (λ in nm)] in air are: 12.73, 14.05 (470); 12.08, 13.17 (546); 11.76, 12.78 (589); 11.55, 12.48 (650); 11.42, 12.32 (700). The Raman spectrum of khesinite (532 nm) shows the following main bands (cm^{-1}): overtones 1638, 1495, 1403, 1132; TO_4 stretching 947 $(SiO_4)^{4-}$, 814 and 749 $(AlO_4)^{5-}$, 696 $(Fe^{3+}O_4)^{5-}$; MO_6 stretching, T–O–T stretching and bending modes, TO_4 bending modes 610, 522, 481; MO_6 bending, TO_4 bending, and TO_4 rotation modes 310, 256; Ca-related vibrations 159, 121. The average of 11 spots electron probe WDS analysis [wt% (range)] is: TiO_2 1.39 (0.69–2.15), SiO_2 8.29 (7.71–9.17), Fe_2O_3 63.44 (60.93–65.76), Cr_2O_3 0.52 (0.15–0.72), Al_2O_3 6.61 (3.89–8.88), CaO 14.21 (13.38–14.82), NiO 0.84 (0.65–1.13), FeO 0.36 (by stoichiometry) MnO 0.57 (0.45–0.80), MgO 3.41 (2.87–4.12), total 99.64. The empirical formula based on 40 O pfu, is $Ca_4(Fe^{3+}_{8.528}Mg_{1.635}Ca_{0.898}Ti^{4+}_{0.336}Ni^{2+}_{0.217}Mn^{2+}_{0.155}Cr^{3+}_{0.132}Fe^{2+}_{0.098})_{\Sigma 12}O_4[(Fe^{3+}_{6.827}Al_{2.506}Si_{2.667})_{\Sigma 12}O_{36}]$. The strongest lines in the calculated X-ray powder diffraction pattern are [d_{calc} Å (I_{calc}%; *hkl*)]: 7.5746 (61; $0\bar{1}1$), 2.9945 (67; $0\bar{3}1$), 2.9941 (71; $0\bar{1}3$), 2.7279 (75; $20\bar{3}$), 2.7278 (75; $2\bar{4}1$), 2.5901 (69; $4\bar{2}0$,$2\bar{4}0$), 2.5837 (100; $21\bar{3}$), 2.5859 (94; $2\bar{4}2$). X-ray diffraction intensity data was collected in one single crystal of 0.06 × 0.06 × 0.15 mm. The single-crystal unit-cell parameters are: a = 10.5363(1), b = 10.9242(2), c = 9.0612(1) Å, α = 106.340(1), β = 95.765(1), γ =124.373(1)°, V = 780.54 Å³, triclinic, $P\bar{1}$, Z = 1. The crystal structure of khesinite was refined to R_1 = 0.035 for 7230 observed [$I_o > 2\sigma I_o$] reflections. The general formula of sapphirine supergroup is $Ca_4M_{12}O_4[T_{12}O_{36}]$. In khesinite, Fe^{3+} is dominant in both T and M sites. The tetrahedral site T4 is dominated by Si, while T1 site has about 70% (Al+Si) with additional 30% Fe. The T2 and T3 sites are occupied by about equal amounts of Al+Si and Fe^{3+}, and 30% (Al+Si) and 70% Fe^{3+}, respectively. The T5 and T6 tetrahedra are dominated (>95%) by Fe^{3+}. The octahedrally coordinated M1 to M7 sites are dominated by Fe^{3+} except the largest site M5, at which excess 0.45 Ca (according to results of chemical analyses) was fixed, and the remaining scattering power was modelled with Mg and Fe scattering factors. Ca1 and Ca2 are occupied exclusively by Ca. The name khesinite is given in honour of the USSR and Israeli geophysicist Boris Emmanuilovich Khesin (1932–2010), a leading geophysicist in Azerbaijan and since 1991, at the Ben-Gurion University of the Negev, Beer-Sheva, Israel. Type material is deposited in the the Museum of Natural History in Bern, Switzerland, catalogue number NMBE 4717. **F.C.**

MESAITE*

A.R. Kampf, B.P. Nash, J. Marty and J.M. Hughes (2017) Mesaite, $CaMn^{2+}_5(V_2O_7)_3\cdot 12H_2O$, a new vanadate mineral from the Packrat mine, near Gateway, Mesa County, Colorado, USA. Mineralogical Magazine, 81(2), 319–327

Mesaite (IMA 2015-069), ideally $CaMn^{2+}_5(V_2O_7)_3\cdot 12H_2O$, is a new mineral from the Packrat mine, Gateway district, Mesa County, Colorado, U.S.A. The mineral was found on asphaltum blocks associated with montroseite- and corvusite-bearing sandstone in close association with mesaite are ansermetite, kegginite, martyite, morrisonite, rossite/metarossite, and sherwoodite. It forms as a result of the oxidation of montroseite-corvusite assemblages in a moist environment. Mesaite occurs as blades up to 0.1 mm × ~10 μm in divergent sprays. Crystals are transparent, orangish red with light pinkish orange streak, and a vitreous luster. The mineral has perfect cleavage on {010}, irregular fracture, and shows no parting nor twinning. It is brittle with Mohs hardness ~2. D_{meas} = 2.74(1), D_{calc} = 2.744 g/cm³. Mesaite is insoluble in H_2O and easily dissolves in dilute HCl at room temperature. It is optically biaxial (–), α (calc) = 1.760, β = 1.780(5), γ = 1.795(5), $2V_{meas}$ = 81(2)°; X = **b**, Z ^ **a** = 58° in obtuse angle β. Dispersion of an optical axes is strong, $r < v$ and pleochroism is present in shades of brownish orange, $X < Y < Z$. The average of 11 electron probe WDS analyses on 4 crystals is [wt% (range)]: CaO 2.76 (2.11–3.33), MnO 33.41 (32.04–34.35), ZnO 2.26 (1.30–2.85), V_2O_5 47.91 (46.95–49.11), As_2O_5 0.45 (0.18–0.91), H_2O 18.82 (based on the structure determination), total 105.58. The high total may be due to the weakly held H_2O resulting in partial dehydration under vacuum. This gives the empirical formula $Mn_{5.32}Ca_{0.56}Zn_{0.31}V_{5.96}As_{0.04}O_{33}H_{23.61}$ based on 33 O apfu. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 10.47 (100; 010), 2.881 (25; 132,$\bar{3}$12,033,310), 3.568 (24; $\bar{1}$14,$\bar{1}$23,$\bar{2}$13), 3.067 (17; $\bar{1}$24,$\bar{1}$32,$\bar{2}$23). The unit-cell parameters refined from powder-diffraction data are: a = 9.135(2), b = 10.427(2), c = 15.530(2) Å, β = 102.650(6)°, V = 1443.3 Å³. Single-crystal X-ray diffraction data collected on a crystal of size 80 × 40 × 10 μm refined to R_1 = 0.06 for 883 unique $I \geq 4\sigma(I)$ reflections shows mesaite is monoclinic, $P2/n$, with a = 9.146(2), b = 10.424(3), c = 15.532(4) Å, β = 102.653(7)°, and V = 1444.7 Å³. The crystal structure consists of zigzag octahedral chains of edge-sharing $Mn^{2+}O_6$ octahedra that link with adjacent V_2O_7 groups to form {010} heteropolyhedral layers. The interlayer region contains Ca atoms and H_2O groups. The name is after Mesa County, Colorado, U.S.A., where the Packrat mine is located. Five cotype specimens of mesaite are deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. **O.C.G.**

NORILSKITE*

A. Vymazalová, F. Laufek, S.F. Sluzhenikin and C.J. Stanley (2017) Norilskite, $(Pd,Ag)_7Pb_4$, a new mineral from Noril'sk-Talnakh deposit, Russia. Mineralogical Magazine, 81(3), 329–338

Norilskite (IMA 2015-008), ideally $(Pd,Ag)_7Pb_4$, is a new PGE mineral discovered in the Mayak mine of the Talnakh deposit, Noril'sk district, Russia, where it occurs in massive pentlandite-cubanite-talnakhite ore. The phase with the corresponding chemical composition, described as unnamed $(Pd,Ag)_2Pb$, has been observed in the massive pentlandite-cubanite-talnakhite ore in the Komsomolsky mine of the Talnakh deposit and in the massive pentlandite-talnakhite ore in Zapolyarny mine of the Noril'sk I deposit (Sluzhenikin and Mokhov 2015). Earlier the mineral name norilskite was proposed for an alloy of Pt-Pd-Fe-Ni-Cu found in Noril'sk area by Zviagincev (1940). Genkin (1968) proved that it was a mixture of several PGE minerals. Norilskite formed in post magmatic conditions, with decreasing temperature, most likely below 400 °C. The new mineral forms anhedral grains (~10–20 and up to ~400 μm) in aggregates with polarite, zvyagintsevite, Pd-rich tetra-auricupride, Pd-Pt-bearing auricupride, Ag-Au alloys, (Pb,As,Sb)-bearing atokite, mayakite, Bi-Pb-rich kotulskite, and sperrylite. Norilskite is opaque, has a metallic luster, and a gray streak (color not given). It is brittle. The microindentation hardness VHN_{20} =310 (296 – 342) kg/mm² corresponding to a Mohs hardness of ~4. D_{calc} = 12.99 g/cm³. In plane polarized reflected light, norilskite is orange brownish pink, has moderate to strong bireflectance, strong pleochroism from orange-pink (R_o) to grayish orange-pink (R'_e), and strong anisotropy with rotation tints from dull yellow to dull blue in partially crossed polars. No internal reflections are observed. Norilskite is uniaxial (–). Reflectance values were measured between 400 and 700 nm in 20 nm intervals. The values for COM wavelengths [R_o, R'_e % (λ in nm)] in air are: 51.1, 48.8 (470); 56.8, 52.2 (546); 59.9, 53.5 (589); 64.7, 55.5 (650). The average of 16 electron probe WDS analyses on 3 grains is [wt% (range)]: Pd 44.33 (43.56–45.01), Ag 2.68 (2.31–3.20), Bi 0.33 (0.12–0.44), Pb 52.34 (50.53–53.21), total 99.68. This gives the empirical formula $(Pd_{6.56}Ag_{0.39})_{\Sigma 6.95}(Pb_{3.97}Bi_{0.03})_{\Sigma 4.00}$ based on 4 Pb+Bi apfu. The strongest lines in the X-ray powder-diffraction pattern of the synthetic analogue of norilskite [*d* Å (*I*%; *hkl*)] are: 3.220 (29; 023,203), 2.313 (91; 026,206), 2.241 (100; 220), 1.610 (28; 046,406), 1.308 (38; 246,462), 1.294 (18; 600), 1.212 (37; 22.12,12.13), 0.9626 (44; 06.12,60.12). The unit-cell parameters refined from powder-diffraction data are: a = 8.9656(4), c = 17.2801(8) Å, V = 1202.92 Å³, and Z = 6. The mineral is trigonal, space group $P3_121$. The intergrowhs of norilskite with polarite and other minerals prevented extraction of grains suitable for single-crystal diffraction study, nor the crystals of norilskite syntetic analogue were found suitable as well. The crystal structure was solved and refined from the powder X-ray diffraction data of synthetic $(Pd_{6.25}Ag_{0.56})_{\Sigma 6.81}Pb_{4.00}$. The structural identity between the synthetic and the natural material was confirmed by EBSD. Norilskite crystallizes in the $Ni_{13}Ga_3Ge_6$ structure type and is related to nickeline in which the As atoms form a hexagonal close packed arrangement and Ni atoms occupy the octahedral interstices. In norilskite all octahedral voids are occupied, and only 75% of available trigonal-bipyramidal voids are occupied resulting in a ratio of (Pd+Ag)/Pb = 1.75. Norilskite is named for the locality. Holotype is deposited at the Department of Earth Sciences of the Natural History Museum, London, U.K., and cotype at the Fersman Mineralogical Museum, Moscow, Russia. **O.C.G.**

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PLAVNOITE*

J. Plášil, P. Škácha, J. Sejkora, A.R. Kampf, R. Škoda, J. Čejka, J. Hloušek, A.V. Kasatkin, R. Pavlíček and K. Babka (2017) Plavnoite, a new K–Mn member of the zippeite group from Jáchymov, Czech Republic. European Journal of Mineralogy, 29(1), 117–128.

Plavnoite (IMA 2015-059), $K_{0.8}Mn_{0.6}[(UO_2)_2O_2(SO_4)]\cdot 3.5H_2O$, is a new monoclinic K-Mn member of the zippeite group. It was discovered in the vein no. 13 at the second level of the Vladimír shaft of Plavno mine, in the eastern part of the Jáchymov ore district, Western Bohemia, Czech Republic, and was named for its type locality. The deposits of Jáchymov district are of hydrothermal vein type and belong to so-called five-element (Ag–Bi–Co–Ni–U) formation. Hundreds of isolated crystal aggregates of plavnoite, marécottite, blatonite, and magnesiozippeite were found in cracks within the highly hematitized dark reddish-brown clayey material (a mixture of a mica, quartz, hematite, and gypsum) and in surrounding rocks. Plavnoite is a supergene alteration mineral formed by hydration–oxidation weathering of uraninite. The mineral forms reddish to reddish-orange thin blades up to 50 μm, elongated on [001] and flattened on {010}, which are tightly packed to a globular aggregates up to 0.5 mm. The crystal forms include {100}, {010}, {011} and {0$\bar{1}$1}. Twinning is common on {100}. Crystals are transparent with a vitreous to silky luster. The streak is pale orange. Plavnoite is non-fluorescent under UV radiation. The cleavage is perfect on {010} The mineral is brittle with an uneven fracture and Mohs hardness ~2. The density was not measured; D_{calc} = 4.926 g/cm³. In transmitted light, the mineral is non-pleochroic (color not given). It is optically biaxial (+), α = 1.740(5), β = 1.770(5), γ = 1.850(5) (white light); 2V = 65°; $2V_{calc}$= 65°. Dispersion was not observed. The main bands of the Raman spectrum (cm⁻¹) are: 3533 and 3385 (νO–H stretching vibrations of symmetrically non-equivalent hydrogen-bonded H_2O molecules); 1630 weak (δ H–O–H bending); 1106 and 1027 (ν_3 SO_4^{2-} triply degenerate antisymmetric stretching and ν_1 SO_4^{2-} symmetric stretching vibrations, respectively); 817 strongest ($\nu_1 UO_2^{2+}$ symmetric stretching); 502, 475, and 435 (split doubly degenerate ν_2 SO_4^{2-} bending); 377 and 348 (stretching $U–O_{ligand}$); 292 and 267 [split doubly degenerate ν_2 (δ) UO_2^{2+} bending]; 229, 164, 129, 106 (lattice modes). The average of 5 spot electron microprobe WDS analysis (using defocused beam) on the type specimen [wt% (range)] is: K_2O 3.77 (3.64–4.00), MnO 3.75 (3.43–4.21), NiO 0.21 (0–0.40), ZnO 0.35 (0.09–0.52), MgO 0.08 (0.01–0.18), SiO_2 1.52 (0.23–2.81), SO_3 7.93 (7.27–8.61), UO_3 59.29 (56.59–61.74), H_2O (based on charge balance and 3.5 H_2O pfu) 7.40, total 84.30. The empirical formula based on 2 U apfu is $K_{0.77}(Mn_{0.51}Zn_{0.04}Ni_{0.03}Mg_{0.02})_{\Sigma0.60}[(UO_2)_2O_{1.08}(OH)_{0.92}(SO_4)_{0.96}(SiO_4)_{0.24}](H_2O)_{3.50}$. Large range (77.03–96.65 wt%) of analytical totals thought to be related to the size of analyzed groups of plavnoite crystals. The elevated Si contents may be a contribution by the sample matrix. The K and Mn contents ranges from $K_{0.53}Mn_{0.57}$ to $K_{0.8}Mn_{0.58}$. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 8.59 (27; 002), 7.133 (100; 020), 5.489 (13; 022), 3.565 (25; 040), 3.446 (36; 202,$\bar{2}04$), 3.104 (47; 222,$\bar{2}24$), 2.865 (14; 006), 2.658 (15; 026). Unit-cell parameters refined from the powder pattern are a = 8.629(1), b = 14.276(1), c = 18.720(1) Å, β = 104.040(4)°, V = 2117 Å^3. The single-crystal XRD data shows the mineral is monoclinic, space group $C2/c$, a = 8.6254 (16), b = 14.258(3), c = 17.703(4) Å, β = 104.052(18)°, V = 2122 Å^3, Z = 8. The crystal structure was refined to R_1 = 4.99% for 989 [$I > 3\sigma(I)$] reflections. It contains 2 independent U, 2 S, 2 Mn, and 14 O sites, including 1 mixed site occupied by K and O. The UO_7 pentagonal bipyramids and SO_4 tetrahedra are forming the zippeite type uranyl oxo-sulfate sheets $[(UO_2)_2O_2(SO_4)]^{2-}$. The interlayer region contains infinite zigzag chains of corner-sharing $Mn^{2+}\Phi_6$ octahedra ($\Phi = O,H_2O$) with K-centred polyhedra. The K atom sits at the partially occupied, mixed K/O site, the non-shared corner of the Mn2 octahedron. Plavnoite and zippeite group structural and crystal-chemical features are discussed. Three cotype specimens are deposited in the National Museum in Prague, Department of Mineralogy and Petrology, Czech Republic, in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A., and in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

RAYGRANTITE*

H. Yang, M.B. Andrade, R.T. Downs, R.B. Gibbs, and R.A. Jenkins (2016): Raygrantite, $Pb_{10}Zn(SO_4)_6(SiO_4)_2(OH)_2$, a new mineral isostructural with iranite, from Big Horn Mountains, Maricopa County, Arizona, USA. Canadian Mineralogist, 54(3), 625–634.

Raygrantite (IMA 2013-001), ideally $Pb_{10}Zn(SO_4)_6(SiO_4)_2(OH)_2$, is new member of iranite group. It has been discovered at in the Evening Star mine (former underground Cu-V-Pb-Au-Ag-W mine, previously called Old Queen Group or Silver Queen mine), Big Horn Mountains, Maricopa County, Arizona, U.S.A. The crystals of raygrantite were found within a small cavity in a massive galena. Associated minerals include anglesite, cerussite, lanarkite, leadhillite, mattheddleite, alamosite, hydrocerussite, caledonite, diaboleite, fornacite, iranite, phoenicochroite, cerussite, and murdochite. The mineral resulted from an alteration of sulfides in hydrothermal quartz-sulfide vein. Raygrantite forms colorless bladed and elongated (by **c** axes) crystals with striations parallel to the elongation. Twinning (fish-tail type) is pervasive on (121). The mineral has a white streak and a vitreous luster. The cleavage is good on {120}; no parting observed. It is brittle with an uneven fractures and Mohs hardness ~3. Density was not measured; D_{calc} = 6.374 g/cm^3. Raygrantite is insoluble in water, acetone, or hydrochloric acid. In transmitted light, the mineral is reported colorless with absorption $Z > Y > X$. It is optically biaxial (+), α = 1.915(7), β = 1.981(7), γ = 2.068(9); $2V_{meas}$ = 76(2)°, $2V_{calc}$ = 85°. Dispersion of an optical axes is $r > v$, strong. The main bands on the Raman spectrum collected on a randomly oriented crystal (cm^{-1}) are: 3515 broad (O–H stretching); 1200–800 (stretching vibrations in the SO_4 and SiO_4 tetrahedra); 660–380 (mainly O–S–O and O–Si–O bending); below 350 (mostly rotational and translational modes of SO_4 and SiO_4 tetrahedra, Zn–O interactions, and the lattice modes). The average of 18 poins electron microprobe WDS analysis [wt% (deviation)] is: SiO_2 4.30(19), SO_3 16.49(33), PbO 74.91(34), ZnO 2.59(11), H_2O 0.62 (by structure constrains), total 98.81. Other elements with $Z > 8$ were below detection limits. The empirical based on 34 O apfu is $Pb_{9.81}Zn_{0.93}(S_{1.00}O_4)_6(Si_{1.05}O_4)_2(OH)_2$. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 4.753 (56; 120), 4.608 (26; $\bar{1}\bar{2}2$), 4.288 (32; 220), 3.492 (27; $2\bar{2}2$), 3.362 (25; $\bar{1}\bar{2}3$), 3.267 (63; $1\bar{2}2$), 3.102 (100; 103), 2.851 (35; 021), 2.783 (31; $\bar{2}\bar{4}2$), 2.707 (31; $\bar{2}\bar{2}3$). The single-crystal XRD data shows the mineral is triclinic, space group $P\bar{1}$, a = 9.3175(4), b = 11.1973(5), c = 10.8318(5) Å, α = 120.374(2), β = 90.511(2), γ = 56.471°(2), V = 753.13 Å^3. The crystal structure was refined to R_1 = 0.031 for 4543 [$I > 2\sigma(I)$] reflections. Raygrantite is isotypic with iranite $Pb_{10}Cu(CrO_4)_6(SiO_4)_2(OH)_2$ and hemihedrite $Pb_{10}Zn(CrO_4)_6(SiO_4)_2F_2$ indicating that, in addition to complete OH–F and Cu–Zn substitutions, there is also a complete substitution between $(CrO_4)^{2-}$ and $(SO_4)^{2-}$ in the iranite group. The structure of raygrantite contains 10 symmetrically independent non-H cation sites. Five of them occupied by Pb^{2+}, three by S^{6+}, one by Si^{4+}, and one by Zn^{2+}. The SO_4 and SiO_4 tetrahedra and $ZnO_4(OH)_2$ octahedra form layers parallel to (120), which are linked together by Pb^{2+} cations displaying a wide range of Pb–O bond distances. The $ZnO_4(OH)_2$ octahedra are corner-linked to two symmetrically equivalent SO_4 and two SiO_4 tetrahedra, while two additional nonequivalent SO_4 groups are isolated. The mineral is named in honor of Raymond W. Grant, retired professor of geology at Mesa Community College in Arizona. Part of the cotype samples has been deposited in the University of Arizona Mineral Museum and in the collection of the RRUFF Project, Tucson, Arizona, U.S.A. **D.B.**

SHUMWAYITE*

A.R. Kampf, J. Plášil, A.V. Kasatkin, J. Marty, J. Čejka and L. Lapčák (2017) Shumwayite, $[(UO_2)(SO_4)(H_2O)_2]_2{\cdot}H_2O$, a new uranyl sulfate mineral from Red Canyon, San Juan County, Utah, USA. Mineralogical Magazine, 81(2), 273–285.

Shumwayite (IMA 2015-058), ideally $[(UO_2)(SO_4)(H_2O)_2]_2{\cdot}H_2O$, is a new hydrous uranyl sulfate discovered in the Green Lizard mine (37°34′37.10″N; 110°17′52.80″W), and later underground in the Giveaway-Simplot mine (37°33′09.80″N 110°16′58.50″W), ~3 km SSE of the Green Lizard mine, White Canyon district, San Juan County, Utah, U.S.A. Primary U minerals were deposited as replacements of wood and other organic material and as disseminations in the enclosing sandstone. Shumwayite is a product of the secondary postmining hydration–oxidation weathering of primary uranium minerals (mainly uraninite), by acidic solutions derived from the decomposition of associated sulfides. Along with a variety of secondary minerals (mainly sulfates), shumwayite occurs as efflorescent crusts on the surfaces of mine walls. At the Green Lizard mine, it is found in association with calcite, gypsum, plášilite, pyrite, rozenite, sulfur, beshtauite, boussingaultite, fermiite, johannite, natrozippeite, oppenheimerite, wetherillite, and several other potentially new uranyl sulfate minerals, currently under study. At the Giveaway-Simplot mine, shumwayite usually found on asphaltum and is associated with rietveldite, rhomboclase and römerite. The mineral form pale greenish-yellow monoclinic prisms, elongated on [100] up to ~0.3 mm long and commonly in subparallel to random intergrowths. The prism forms include {010}, {001}, {011}, {012}, and {021}. Shumwayite is transparent with a vitreous luster and a white streak. It fluoresces bright greenish white under both long- and short-wave UV radiation. The cleavage is perfect on {011}. Crystals are brittle with an irregular fracture and

Mohs hardness of ~2. The mineral is slightly deliquescent and is easily soluble in room-temperature H_2O. The density was not measured; D_{calc} = 3.844 g/cm^3. In transmitted light shumwayite is colorless, non-pleochroic. It is optically biaxial (+/–), $\alpha = 1.581(1)$, $\beta = 1.588(1)$, $\gamma = 1.595(1)$ (white light); $2V = 90°$; $2V_{calc} = 89°$; $X = \mathbf{b}$, $Y \approx \mathbf{c}$, $Z \approx \mathbf{a}$. Dispersion of optical axes is strong (sense is not defined). FTIR spectrum (4000–600 cm^{-1}) and Raman spectrum (2000–50 cm^{-1}) were obtained. Main bands (cm^{-1}, s = strong, w = weak, m = medium, sh = shoulder; FTIR lines are in bold) are: **3500**s, **3425**s, **3230**sh (ν O–H stretching vibrations of the H_2O molecules); **1635**w, **1615**w [ν_2 (δ) bending vibrations of structurally non-equivalent H_2O molecules]; **1435**w, **1400**w (splitting of the H_2O bending mode); **1365**w, **1295**w (overtones and combination modes); 1185w, 1155w, 1100ms, 1073s, 1050ms, **1202**, **1143**, **1110**, **1055** (split triply degenerate ν_3 antisymmetric stretching of the SO_4 tetrahedra); 1035ms, 1015w, **1015**w (ν_1 symmetric stretching of SO_4 tetrahedra); 930w, **951**s, **927**s (ν_3 antisymmetric stretching of the UO^{2+}); 865vs, 850s, **868**w, **854**w (ν_1 symmetric stretching vibration of the UO^{2+}); **810**w, **795**w, **730**w (probably libration modes of H_2O molecules); 645w, 615w, **670**ms, **655**ms [ν_4 (δ) triply degenerate antisymmetric stretching vibrations of SO_4 tetrahedra]; 470w, 430w [split ν_2 (δ) doubly degenerate bending vibrations of the SO_4 tetrahedra]. The average of 7 electron microprobe EDS analysis on crystal from Green Lizard mine [wt% (range)] is: UO_3 70.49 (70.06–70.73), SO_3 19.45 (18.98–19.90), H_2O 11.02 (by structure), total 100.96. The empirical formula based on 17 O apfu is $U_{2.01}S_{1.99}O_{12.00}\cdot 5H_2O$. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 6.97 (39; 012), 5.88 (26; 110,021), 5.58 (48; $\bar{1}11$,111), 5.11 (100; 013), 4.86 (44; $\bar{1}12$,112), 4.40 (38; $\bar{1}21$,121), 4.04 (47; 031), 3.373 (50; 200). Unit-cell parameters refined from the powder data are: a = 6.726(6), b = 12.493(7), c = 16.888(7) Å, β = 91.01°(4), V = 1418.8 Å^3. The single-crystal XRD data shows shumwayite is monoclinic, $P2_1/c$, a = 6.7475(1), b = 12.5026(3), c = 16.9032(12) Å, β = 90.919°(6), V = 1425.8 Å^3, Z = 4. The crystal structure refined to R_1 = 1.88% for 2936 ($F > 4\sigma F$) reflections. The structure contains UO_7 pentagonal bipyramids and SO_4 tetrahedra that link by corner-sharing to form $[(UO_2)(SO_4)(H_2O)_2]$ chains along [100]. The chains and isolated H_2O groups between them are linked together only by hydrogen bonds. The name in honor of the Shumway family, whose members account for the discovery and mining of hundreds of uranium deposits on the Colorado Plateau. Arah E. Shumway (1891–1968) prospected Red Canyon during the 1920s. Dan Shumway (b. 1946) was one of the claimers for the Green Lizard mine. Gary L. Shumway (b. 1938), Professor Emeritus of history of the University of California at Fullerton, is well known for his research and publications on uranium mining and exploration. Four cotype specimens are deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. One cotype specimen from the Green Lizard mine is housed in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

STEINMETZITE*

I.E. Grey, E. Keck, A.R. Kampf, W.G. Mumme, C.M. Macrae, R.W. Gable, A.M. Glenn and C.J. Davidson (2017) Steinmetzite, $Zn_2Fe^{3+}(PO_4)_2(OH)\cdot 3H_2O$, a new mineral formed from alteration of phosphophyllite at the Hagendorf Süd pegmatite, Bavaria. Mineralogical Magazine, 81(2), 329–338.

Steinmetzite (IMA 2015-081), ideally $Zn_2Fe^{3+}(PO_4)_2(OH)\cdot 3H_2O$, is a new mineral from the Hagendorf-Süd pegmatite, Hagendorf, Oberpfalz, Bavaria, Germany. It was found in Cornelia mine at depths of 60–67 m in a highly oxidized zone and was formed by alteration of phosphophyllite, which involves the oxidation of the iron and some replacement of Zn by Fe. The new mineral occurs as lamellae only a few micrometers thick and up to ~50 μm in size within altered phosphophyllite crystals, where it is intergrown with amorphous Fe-rich phosphate. Steinmetzite associated with albite, apatite, chalcophanite, jahnsite, mitridatite, muscovite, quartz, wilhelmgümbelite, goethite, and cryptomelane. The phosphophyllite pseudomorphs have a milky opaque appearance, often with a glazed yellow to orange weathering rind and with lengths ranging from sub-millimeter to 1 cm. Steinmetzite crystals are flattened on {010} and elongated on [001]. The streak is white. It is non-fluorescent in UV radiation.The mineral is brittle, has a good cleavage on {010}, and uneven fracture. The density was not measured because of the fine intergrowths with the amorphous phase; D_{calc} = 2.96 g/cm^3. Steinmetzite is optically biaxial (–), $\alpha = 1.642(2)$, $\beta = 1.659$ (calc), $\gamma = 1.660(2)$, $2V_{meas} = 27(1)°$; $Y \approx \mathbf{b}$, $X \wedge \mathbf{c} \approx 27°$. Pleochroism shows shades of pale brown; $Y > X \approx Z$. The average of 7 electron probe WDS analyses on 7 crystals is [wt% (range)]: ZnO 31.1 (25.6–34.6), MnO 1.74 (1.52–2.01), CaO 0.45 (0.25–0.67), Fe_2O_3 21.9 (19.6–25.2), Al_2O_3 0.26 (0.13–0.48), P_2O_5 32.9 (31.7–34.9), H_2O 14.1, total 102.45. This gives the empirical formula $Zn_{1.65}Fe^{3+}_{1.19}Mn^{2+}_{0.11}Ca_{0.03}Al_{0.02}(PO_4)_2(OH)_{1.21}\cdot 2.79H_2O$ based on 2 P and 12 O pfu, assuming all iron as ferric and adjusting OH^- for charge balance. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 9.313 (65; 100), 5.077 (38; 010), 4.726 (47; 002), 4.657 (100; 200), 3.365 (55; $\bar{3}02$), 3.071 (54; $1\bar{1}2$), 2.735 (48; $\bar{3}\bar{1}2$). The unit-cell parameters refined from powder-diffraction data are: a = 10.4319(7), b = 5.1041(3), c = 10.5330(6) Å, α = 91.222(4), β = 115.984(4), γ = 94.352(4)°, V = 501.76 Å^3. Single-crystal X-ray diffraction data collected on a crystal of size 0.37 × 0.31 × 0.23 mm refined to R_1 = 0.128 for 492 unique reflections with $I \geq 2\sigma(I)$ shows steinmetzite is triclinic, $P\bar{1}$, with unit-cell parameters a = 10.438(2), b = 5.102(1), c = 10.546(2) Å, α = 91.37(2), β = 115.93(2), γ = 94.20(2)°, V = 502.7 Å^3, and Z = 2. The structure of steinmetzite is related to that of phosphophyllite and is composed of (100) layers of corner-connected ZnO_4 and PO_4 tetrahedra interconnected via *trans*-connected $Fe^{3+}O_2(H_2O,OH)_4$ octahedra. The name is named in honor of Hermann Steinmetz (1879–1964), curator of Mineralogy at the Munich museum Sammlung des Bayerischen Staates from 1923 to 1928, and Professor of Mineralogy and Geology at the Technische Hochschule, Munich, from 1928 to 1950. The holotype specimen is located at Museum Victoria, Melbourne, Australia. **O.C.G.**

TINNUNCULITE*

I.V. Pekov, N.V. Chukanov, V.O. Yapaskurt, D.I. Belakovskiy, I.S. Lykova, N.V. Zubkova, E.P. Shcherbakova, S.N. Britvin and A.D. Chervonniy (2016) Tinnunculite, $C_5H_4N_4O_3\cdot 2H_2O$: finds at Kola Peninsula, redefinition and validation as a mineral species. Zapiski RMO (Proceedings of the Russian Mineralogical Society), 145(4), 20–35 (in Russian).

Tinnunculite (IMA 2015-021a), ideally $C_5H_4N_4O_3\cdot 2H_2O$, was found at the Khibiny (Mt. Rasvumchorr, the holotype specimen) and the Lovozero (Mts. Alluaiv and Vavdbed) complexes, Kola Peninsula, Russia. Originally the full description of that phase under the name tinnunkulite was given by Chesnokov et al. (1989) on the material from the small cave at the burning slagheap of the coal shaft #44 in town of Kopeisk near Chelyabinsk city, South Urals, Russia, where it was formed as a result of interaction of the warm (30–40 °C) gases from the lower burning part of the slagheap with the excrements of the bird species *Falco tinnunculus L*. That is the origin of the suggested name. The chemical formula was given as $C_{10}H_{12}N_8O_8$. Later, the same phase was found in similar environment at the slagheap of the coal shaft Baturinskaya near town of Emanzhelinsk, South Urals, Russia (Chesnokov et al. 1998). That time the phase was not approved as a mineral by Commission on New Mineral Names IMA due to its semi-technogenical origin. Same phase was found during field work in 2011 and 2012 in the Khibiny-Lovozero Complex. It was considered to be a result of crystallization of uric acid in birds' excrements in cold and humid climate of Arctic tundra of Kola Peninsula. The reinvestigation of the original materials of B.V. Chesnokov from both above-mentioned locations confirmed that it is identical to those from the Kola Peninsula. It was suggested to validate the original name tinnunculite for that mineral. At Khibiny, tinnunculite found on the surface of a pegmatite composed on K-feldspar, nepheline, pyroxene, and astrophyllite; whereas at Lovozero, it occurs on the surface of aegirine-nepheline-microcline pegmatite, containing some amounts of eudialyte, murmanite, and manganoneptunite. Tinnunculite forms prismatic or tabular crystals up to 0.01 × 0.1 × 0.2 mm and their clusters, as well as crystalline or micro-globular crusts. It is transparent or translucent, colorless, white, yellowish, reddish, or pale lilac, and has a vitreous luster. The mineral is soft and brittle, with distinct {010} cleavage. The attempts to measure the density failed due to porous nature of available material; D_{calc} = 1.68 g/cm^3 (holotype). Tinnunculite is optically biaxial (–), α = 1.503(3), β = 1.712(3), γ = 1.74(1) (589 nm), $2V_{meas}$ = 40(10)°. Dispersion of an optical axes is medium, $r > v$. The bands in the IR spectrum are (cm^{-1}; s = strong, w = weak, sh = shoulder): 3489s, 3338s (O-H stretching vibrations of the H_2O groups); 3190, 3028, 2920sh, 2811, 2705sh, 2650sh (N-H stretching vibrations); 1676s (C=O stretching); 1588 (C=C and C=O stretcing); 1486w, 1427, 1405, 1377w, 1331, 1289w (H-N-C bending); 1160w, 1118, 1060, 1037, 994, 898w (H-N-C bending and C-C and N-C stretching vibrations); 784, 747, 706, 663w, 622, 576 (modes of C,N-heterocycles); 518, 476, 399w (C-C-N, N-C-N, and C-N-C bending). The average of 4 point EDS electron probe analyses is [wt% (range)]: O 37.5 (36.9–38.7), C 28.4 (27.8–28.8), N 27.0 (26.9–27.1), H 3.8 (by stoichiometry), total 96.7. The empirical formula is $C_{4.99}H_8N_{4.07}O_{4.94}$ based on (C+N+O) = 14 apfu. The strongest lines of the powder X-ray diffraction pattern are [d Å (I%; hkl)]: 8.82 (84; 002), 5.97 (15; 011), 5.63 (24; $10\bar{2}$,102), 4.22 (22; 112), 3.24 (27; $11\bar{4}$,114), 3.18 (100; 210), 3.12 (44; $21\bar{1}$,211), 2.576 (14; 024). Tinnunculite is monoclinic, $P2_1/c$, a = 7.37(4), b = 6.326(16), c = 17.59(4) Å, β = 90º(1), V = 820 Å^3, Z = 4. The crystal structure of tinnunculite was not solved due to poor quality of its single crystals. However, its unit cell is identical to that of biogenic and synthetic uric acid dihydrate. The holotype specimen (Mt. Rasvumchorr, Khibiny) is deposited in the Fersman Mineralogical Museum, Russian Academy of Science, Moscow, Russia. **Yu.U.**

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