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New Mineral Names*,†

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IN THIS ISSUE

This New Mineral Names has entries for 16 new minerals, including backite, bluestreakite, carducciite, chrysothallite, eckerite, emmerichite, ferribushmakinite, ferro-ferri-nybøite, galloplumbogummite, hlousěkite, hydroxylwagnerite, ishiharaite, mellizinkalite, peterandresenite, popovite, and yurmarinite.

BACKITE*

K.T. Tait, V. Dicecco, N.A. Ball, F.C. Hawthorne, and A.R. Kampf (2014) Backite, $Pb_2Al(TeO_6)Cl$, a new tellurate mineral from the Grand Central Mine, Tombstone Hills, Cochise County, Arizona: Description and crystal structure. Canadian Mineralogist, 52(6), 935–942.

Backite (IMA 2013-113), ideally $Pb_2Al(TeO_6)Cl$, is a new tellurate mineral discovered at the Grand Central mine located ¾ mile south of Tombstone, Arizona, U.S.A. Oxidized Ag- and Au-bearing galena and minor copper and zinc ores occur in faulted and fractured parts of a dike, and in brecciated footwall zones of the dike. Backite forms dark to pale blue-gray rosettes up to 0.15 mm consisting of hexagonal plates up to 0.08 mm exhibiting the forms {100}, {010}, and {001}. The rosettes are perched on microcrystalline quartz and associated with schieffelinite, oboyerite, rodalquilarite, cerussite, jarosite, and a new Pb-Cu tellurate-sulfate. Backite is moderately transparent with opacity increasing with intensity of color, has a very pale bluish-gray streak and adamantine luster. It has a perfect micaceous cleavage on {001}, is brittle with a splintery fracture and has a Mohs hardness of ~2–3. The density was not measured due to the lack of material; $D_{calc} = 5.573$ g/cm^3. The mineral does not fluoresce under UV light. Backite is optically uniaxial (–). The indices of refraction are greater than 1.80. Available liquids with higher refraction were reacting with the mineral; $n_{calc} = 1.878$. Backite is pleochroic with O = bluish gray > E = colorless. The Raman spectra show bands at (cm^{-1}): 625 and 733 (symmetric and antisymmetric $Te^{6+}–O_6$ stretching modes, respectively), 425 ($Te^{6+}–O_6$ bending), 350 (Pb–Cl stretching), 120 (Cl–Pb–Cl bending), 967 (weak combination band). The average of 3 electron probe WDS analyses is [wt% (range)]: TeO_3 24.05 (23.91–24.26), Al_2O_3 7.07 6.97–7.15), PbO 63.74 (63.39–64.30), S 1.15 (1.07–1.24), Cl 2.28 (2.11–2.43), –O=Cl_2 1.09, total 97.20. The valence states of Te, Pb, and S were determined by crystal-structure analysis. The empirical formula based on 6 O apfu is $Pb_{2.05}Al_{1.00}Te_{0.98}O_6(Cl_{0.46}S_{0.26})$. The general formula is $Pb^{2+}_2AlTe^{6+}O_6(Cl^-,S^{2-},\square)$. The strongest lines of the X-ray powder diffraction pattern are: [d Å, (I%; hkl)]: 4.363 (55; 010), 3.193 (100; 012), 2.521 (55; 110); 2.187 (17; 020), 1.978 (28; 022), 1.715 (20; 015,$\bar{1}$24,114), 1.555 (35; $\bar{1}$32,122). Backite is trigonal, space group $P312$, $Z = 1$. The unit-cell parameters refined from the powder data are $a = 5.043(1)$, $c = 9.346(5)$ Å. Those obtained from a single-crystal X-ray data are $a = 5.0441(7)$, $c = 9.4210(5)$ Å, $V = 207.58$ Å^3. The crystal structure of backite was solved by direct methods and refined to $R_1 = 4.43\%$ based on 422 unique reflections with $F_o > 4\sigma F$. The layers of Te and Al octahedra parallel to (001) in which Te and Al occupy the vertices of a 6^3 net and each octahedron shares three edges with three adjacent octahedra alternate along the **c** and are linked by a thick slab of lone-pair stereoactive Pb^{2+} cations and Cl^- anions. The slab consists of a central layer of Cl^- anions and two sandwiching layers of Pb^{2+} cations. Each Pb^{2+} cation bonds to 3 O^{2-} anions of octahedra layers at short distances on one side, and to 6 Cl^- anions at long distances on the other side. Weak Pb–Cl bonds are accounting for the perfect {001} cleavage. The mineral is named in honor of Malcolm A. Back (b. 1951), Department of Natural History (Mineralogy), Royal Ontario Museum, Toronto, Ontario. The holotype is deposited in the Royal Ontario Museum, Toronto, Canada, and two cotypes are in the Natural History Museum of Los Angeles County, California, U.S.A. **D.B.**

BLUESTREAKITE*

A.R. Kampf, J.M. Hughes, J. Marty, B.P. Nash, Yu-S. Chen, and I.M. Steele (2014) Bluestreakite, $K_4Mg_2(V^{4+}_2V^{5+}_8O_{28})\cdot14H_2O$, a new mixed-valence decavanadate mineral from the Blue Streak Mine, Montrose County, Colorado: crystal structure and descriptive mineralogy. Canadian Mineralogist, 52(6), 1007–1018.

Bluestreakite (IMA 2014-047), ideally $K_4Mg_2(V^{4+}_2V^{5+}_8O_{28})\cdot14H_2O$, is a new decavanadate mineral discovered at the Blue Streak mine, Bull Canyon, Montrose County, Colorado, U.S.A. It is the second known mixed-valence decavanadate. All 14 known decavanadate minerals occur in the mines of the Uravan Mineral Belt, which sits astride the Colorado-Utah border and consists of bedded or roll-front U-V deposits in the sandstone of the Salt Wash member of the Jurassic Morrison Formation. There U and V transported by weakly alkaline, moderately reducing, CO^{2-}-rich ground water, were deposited largely as uraninite and montroseite. Subsequent exposure of these deposits to more oxidizing near-surface aqueous solutions (which in turn react with sulfides) has resulted in a variety of secondary phases. Depending on prevailing Eh and pH, a variety of V-bearing oxy-anions may be present in these mineralizing solutions including a mixed-valence decavanadate anions, $[(V^{4+}_xV^{5+}_{10-x})O_{28}]^{(6+x)-}$. Bluestreakite was found on corvusite–montroseite-bearing sandstone blocks as irregular very dark greenish blue polycrystalline coatings on rounded quartz grains or masses of montroseite. It is intimately associated with gypsum, huemulite, hummerite, metamunirite, and munirite. Rare distinct bluestreakite crystals (up to 0.3 mm) are tablets or blades flattened on {10$\bar{1}$}, elongated on [010] and exhibiting the forms {101}, {10$\bar{1}$}, and {120}. The mineral is transparent, with a subadamantine

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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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luster and a light blue streak. Bluestreakite has an irregular fracture with no cleavage or parting, is brittle. Mohs hardness is ~2. The density was not measured because the mineral dissolves in aqueous density liquids; D_{calc} = 2.350 g/cm^3. Bluestreakite is very slowly soluble in H_2O (days) and easily soluble in dilute HCl with immediate loss of color. It does not fluoresce under UV radiation. The mineral is optically biaxial (–), α = 1.750, β = 1.800, γ = 1.829 (calc, since mineral reacts with index liquids with n > 1.8) (white light); $2V_{meas}$ = 73(3)°; Z = **b** (X and Y not determined). The pleochroism is weak, with $X < Y \approx Z$ all dark greenish blue. The average of 42 (on 17 crystals) electron probe WDS analysis is [wt% (range)]: Na_2O 0.34 (0.08–0.77), K_2O 11.45 (10.50–12.49), MgO 5.64 (5.23–6.06), V_2O_5 65.61 (62.13–68.00) [VO_2 8.38 and V_2O_5 56.42 are apportioned according to the structure solution], H_2O (by structure refinement) 18.20, total 100.43. The empirical formula based on 42 O apfu is $(K_{3.37}Na_{0.15})_{\Sigma 3.52}Mg_{1.94}(V^{4+}_{1.40}V^{5+}_{8.60})O_{28}\cdot 14H_2O$. The strongest lines of the X-ray diffraction powder pattern are [d Å (I%; hkl)]: 10.34 (57; $\bar{1}01$), 8.27 (100; 011,101), 7.90 (21; 110), 2.781 (15; 133), 2.266 (16; 430), 1.735 (15; 236,060), 1.981 (22; $\bar{1}17,\bar{2}17$). Bluestreakite is monoclinic, space group $P2_1/n$. The unit-cell parameters refined from the powder data are: a = 12.241(2), b = 10.377(2), c = 14.181(2) Å, β = 103.076(4)°, V = 1754.6 Å^3; Z = 2. The single crystal unit-cell parameters are a = 12.2383(7), b = 10.3834(4), c = 14.1945(6) Å, β = 103.008(2)°, V = 1757.48 Å^3. The crystal structure was solved by direct methods and refined to R_1 = 0.0339 for 5403 independent reflections with $F_o > 4\sigma(F)$. The structure consists of two distinct parts, a structural unit and an interstitial complex. The structural unit is a partially reduced decavanadate group $[(V^{4+}_{x}V^{5+}_{10-x})O_{28}]^{(6+x)-}$, modification of the decavanadate polyanion $(V^{5+}_{10}O_{28})^{6-}$ (blue color of bluestreakite is an indicator of the mixed-valence of vanadium opposed to the yellow-orange color of the pure pentavalent phases). The interstitial complex $[K_4Mg_2\cdot 14H_2O]^{8+}$ is formed by two irregular polyhedra $K[O_4(H_2O)_4]$ and $K[O_6(H_2O)_3]$ and a $Mg(H_2O)_6$ octahedron. The K atoms of the interstitial complex are directly bonded with the oxygen atoms of the structural unit. There is also extensive hydrogen bonding between the interstitial complex and the structural unit. The charge balance is maintained by the coupled substitution $\square + V^{5+} \leftrightarrow K^+ + V^{4+}$ and the general formula can be written as $K_{4-x}Mg_2(V^{4+}_{2-x}V^{5+}_{8+x})O_{28}\cdot 14H_2O$ where x ≈ 0 to 1 (the range 0.16 to 0.80 is provided by the EMPA). Bluestreakite is named for the place of its discovery. Two cotype specimens are deposited in the Natural History Museum of Los Angeles County, Los Angeles, California, U.S.A. **D.B.**

CARDUCCIITE*

C. Biagioni, P. Orlandi, Y. Moëlo, and L. Bindi (2014) Lead-antimony sulfosalts from Tuscany (Italy). XVI. Carducciite, $(AgSb)Pb_6(As,Sb)_8S_{20}$, a new Sb-rich derivative of rathite from the Pollone mine, Valdicastello Carducci: occurrence and crystal structure. Mineralogical Magazine, 78(7), 1775–1793.

Carducciite (IMA 2013-006), ideally $(AgSb)Pb_6(As,Sb)_8S_{20}$, is a new mineral found at the Pollone mine, near Valdicastello Carducci, Apuan Alps, Tuscany, Italy. It was discovered in a barite-pyrite-(Pb-Ag-Zn) deposit in Palaeozoic to possibly Early Triassic metavolcanic-metasedimentary sequence metamorphosed to greenschist facies. Carducciite was observed embedded in saccharoidal barite or rarely in small vugs in association with pyrite and sterryite. Carducciite occurs as prismatic crystals up to 0.5 × 0.2 mm, striated parallel to the elongation. Crystals are black with black streak, metallic luster, are brittle, with a conchoidal fracture. The microhardness is VHN_{10} = 61 (52–66) kg/mm^2 corresponding to a Mohs hardness of ~2½–3. The density could not be measured; D_{calc} = 5.56 g/cm^3. In plane-polarized incident light, carducciite is dark gray, moderately bireflectant and pleochroic from light gray to a slightly greenish gray. Carducciite is anisotropic with grayish to light-blue rotation tints. Very weak internal reflections are deep red. Reflectance values for COM wavelengths in air [R_{min}, R_{max} % (λ nm)] are: 35.8, 40.8 (471.1); 33.7, 39.0 (548.3); 32.7, 37.6 (586.6); and 30.4, 35.1 (652.3). The average of 6 electron probe analyses is [wt% (range)]: Ag 3.55 (3.33–3.66), Tl 0.13 (0.11–0.18), Pb 41.90 (41.55–42.62), Sb 17.79 (17.56–18.13), As 12.41 (12.27–12.59), S 22.10 (21.96–22.37), total 97.87 (low total is due to poor quality of polished surface). This gives the empirical formula $Ag_{0.96}Tl_{0.02}Pb_{5.91}As_{4.84}Sb_{4.27}S_{20.14}$ based on ΣMe = 16 apfu. The strongest lines in the X-ray powder-diffraction pattern [d Å (I%; hkl)] are (s = strong, vs = very strong): 3.689 (s; 016), 3.416 (s; 212,024), 3.125 (s; 025,008), 2.989 (s; $\bar{2}16$,214), 2.894 (s; $\bar{2}21,\bar{1}18,\bar{2}22$,220,026), 2.753 (vs; 215, $\bar{2}24$,222), 2.250 (s; $\bar{2}32$,230,036,$\bar{2}1.10$). Single-crystal X-ray diffraction data collected on a crystal of size 0.27 × 0.16 × 0.16 mm refined to R_1 = 0.063 for 4137 unique reflections with $I \geq 4\sigma(I)$ shows carducciite is monoclinic, space group $P2_1/c$, with a = 8.4909(3), b = 8.0227(3), c = 25.3957(9) Å, β = 100.382(2)°, V = 1701.63 Å^3, Z = 2. The structure of carducciite can be described within the framework of the sartorite homologous series, as being formed by chemically twinned layers of the dufrénoysite type; carducciite is an (Ag,Sb)-rich homeotype of dufrénoysite, stabilized by the complete coupled substitution 2 $Pb^{2+} = Ag^+ + Sb^{3+}$ at a specific site of the crystal structure. Together with barikaite, it belongs to the rathite sub-group of $P2_1/c$ homeotypes of dufrénoysite. The distribution of Ag, coupled with As or Sb at specific sites, appears to be the main criterion for the distinction between the three species of this sub-group. Carducciite is named for the type locality. The holotype specimen of carducciite is deposited in the Museo di Storia Naturale, Università di Pisa, Pisa, Italy. **O.C.G.**

CHRYSOTHALLITE*

I.V. Pekov, N.V. Zubkova, D.I. Belakovskiy, V.O. Yapaskurt, M.F. Vigasina, I.S. Lykova, E.G. Sidorov, and D.Yu. Pushcharovsky (2015) Chrysothallite $K_6Cu_6Tl^{3+}Cl_{17}(OH)_4\cdot H_2O$, a new mineral species from the Tolbachik volcano, Kamchatka, Russia. Mineralogical Magazine, 79(2), 365–376.

Chrysothallite (IMA 2013-008), ideally $K_6Cu_6Tl^{3+}Cl_{17}(OH)_4\cdot H_2O$, is a new mineral found in an active fumaroles Glavnaya Tenoritovaya and Pyatno at the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. The mineral was found in the outer, moderately hot parts of fumaroles associated with belloite, avdoninite, chlorothionite, sanguite, eriochalcite, mitscherlichite, sylvite, carnallite, and kainite at Glavnaya Tenoritovaya and with belloite, avdoninite, chlorothionite, eriochalcite, atacamite, halite, kröhnkite, natrochalcite, gypsum, and antlerite at Pyatno. Chrysothallite seems to be a product of the interactions involving high-temperature sublimate minerals, fumarolic gas and atmospheric water vapor at temperatures not higher than 150 °C. Chrysothallite forms equant to thick tabular crystals commonly up to 0.02 and rarely up to 0.05 mm. The crystals show combinations of the pinacoid {001}, tetragonal prisms {100}, and {110} and tetragonal dipyramids {101} and {102}, although some crystals are simpler in shape (up to pseudocubic). Crystals are usually combined in clusters up to 0.2 mm across or in thin crusts up to 1 mm thick. The mineral is bright golden-yellow in larger crystals to light yellow in finely crystalline aggregates, transparent with a vitreous luster and a yellow streak. It shows no cleavage or parting, is brittle and has a Mohs hardness of ~3. D_{meas} = 2.95(2); D_{calc} = 2.97 g/cm^3. Chrysothallite hydrolyses at room temperature. In transmitted light the mineral is yellow with a very weak pleochroism $O > E$ in yellow tones. The mineral is optically uniaxial (+), ω = 1.720(5), ε = 1.732(5) (589 nm); the elongation is positive. The Raman spectrum shows bands at (cm^{-1}): 3443 intense (O–H stretching vibrations), 1580 weak broad (bending vibrations of H_2O molecules), 944 and 902 (O–H libration), 465 (Cu^{2+}–O stretching vibrations, as well as, probably, the band with a maximum at 320). Several intense, narrow bands with frequencies below 300 cm^{-1} correspond to lattice modes involving Cu^{2+}–Cl, Tl^{3+}–Cl, and K–Cl vibrations. An absence of distinct absorption bands in the regions 1000–1500 and 1700–3000 cm^{-1} indicates the absence of isolated H^+ cations and groups with C–O, C–H, N–O, and B–O bonds. The average of 4 electron probe WDS analyses is [wt% (range)]: K 15.92 (15.33–16.39), Cu 24.56 (24.17–24.91), Zn 1.38 (1.03–1.68), Tl 13.28 (12.98–13.66), Cl 40.32 (39.92–40.69), H_2O (calc. from structure refinement) 3.49, total 98.95. The empirical formula based on 17 Cl + 5 O apfu is $K_{6.09}(Cu_{5.78}Zn_{0.32})_{\Sigma 6.10}Tl_{0.97}Cl_{17}[(OH)_{3.80}O_{0.20}]\cdot H_2O$. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 13.20 (44; 002), 6.88 (100; 112), 5.16 (30; 202,114), 4.027 (25; 220), 3.471 (28; 206), 3.153 (30; 314), 3.075 (47; 305), 2.771 (38; 316). The unit-cell parameters refined from powder-diffraction data are: a = 11.366(6), c = 26.22(2) Å, V = 3387 $Å^3$. Single-crystal X-ray diffraction data collected on a crystal of size 0.04 × 0.05 × 0.06 mm refined to R_1 = 0.0898 for 1005 unique reflections with $I \geq 2\sigma(I)$ shows chrysothallite is tetragonal, *I*4/*mmm*, a = 11.3689(7), c = 26.207(2) Å, V = 3387.3 $Å^3$, Z = 4. The structure of chrysothallite is unique, and is based on a (001) structural unit layer of edge-sharing distorted $CuCl_4(OH)_2$ octahedra. Two Tl^{3+} cations occupy the center of isolated $TlCl_6$ and $TlCl_4(H_2O)_2$ octahedra that are connected to each other and to the Cu polyhedral layers via KCl_6 and KCl_9 polyhedra. Chrysothallite is the second known mineral with species-defining trivalent thallium. Chrysothallite is named for its bright golden-yellow color (from the Greek χρυσός, gold) and the presence of thallium as a species-defining constituent. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow. **O.C.G.**

ECKERITE*

L. Bindi, F. Nestola, S. Graeser, P. Tropper, and T. Raber (2015) Eckerite, Ag_2CuAsS_3, a new Cu-bearing sulfosalt from Lengenbach quarry, Binn Valley, Switzerland: description and crystal structure. Mineralogical Magazine, 79(3), 687–694.

Eckerite (IMA 2014-063), ideally Ag_2CuAsS_3, is a new mineral from the Lengenbach quarry in the Binn Valley, Valais, Switzerland. Eckerite is associated with realgar, sinnerite, hatchite, trechmannite and yellow, fibrous smithite. It occurs as very rare euhedral crystals growing on dolomite (sometimes on smithite or sinnerite), subhedral to anhedral grains up to 300 μm with no inclusions or intergrowths. In thin plates, the mineral is red and transparent with adamantine luster, whereas in thick sections it is opaque and exhibits a metallic luster. The streak is orange-red. No cleavage is observed and the fracture is irregular. The microhardness is VHN_{25} = 70 (64–78) kg/mm^2 corresponding to a Mohs hardness of ~2½–3. The density could not be measured due to the small grain size; D_{calc} = 5.313 g/cm^3. Eckerite is moderately bireflectant and weakly pleochroic from light gray to a slightly bluish gray, and shows no internal reflections. It is weakly anisotropic with grayish to light-blue rotation tints. Reflectance values for COM wavelengths in air [R_{min}, R_{max} % (λ nm)] are: 27.6, 31.7 (471.1); 22.8, 26.1 (548.3); 21.5, 24.5 (586.6); and 19.4, 22.3 (652.3). The average of 5 electron probe WDS analyses is [wt% (range)]: Ag 52.08 (50.63–52.83), Cu 11.18 (10.73–11.82), Pb 0.04 (0–0.10), Sb 0.29 (0.22–0.34), As 15.28 (15.15–15.63), S 20.73 (20.30–21.05), total 99.60. The empirical formula based on 7 apfu is $Ag_{2.24}Cu_{0.82}As_{0.94}Sb_{0.01}S_{2.99}$. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 3.336 (70; $\bar{3}12$), 2.941 (100; $\bar{3}14$,114), 2.776 (80; 400,$\bar{2}06$), 2.677 (40; 312), 2.134 (50; $\bar{4}21$), 2.084 (40; $\bar{2}08$,206), 2.076 (40; 420), 1.738 (40; $\bar{2}28$,226). The unit-cell parameters refined from powder-diffraction data are: a = 11.871(6), b = 6.2251(3), c = 16.635(7) Å, β = 110.89(2)°, V = 1158.6 $Å^3$. Single-crystal X-ray diffraction data collected on a crystal of size 0.08 × 0.09 × 0.11 mm refined to R_1 = 0.0769 for 1606 unique reflections with $I \geq 4\sigma(I)$ shows eckerite is monoclinic, space group *C*2/*c*, with a = 11.8643(3), b = 6.2338(1), c = 16.6785(4) Å, β = 110.842(3)°, V = 1152.81 $Å^3$, Z = 8. Eckerite is topologically identical to xanthoconite and pyrostilpnite. The structure consists of AsS_3 pyramids joined by AgS_3 triangles to form double sheets parallel to (001), where the sheets are linked by Cu(Ag) atoms in a quasi-tetrahedral coordination. Eckerite is named in honor of Markus Ecker (b. 1966), a well-known mineral expert on the Lengenbach minerals. The holotype is in the Museo di Storia Naturale, Università degli Studi di Firenze, Italy, and at the Natural History Museum, University of Basel, Switzerland. **O.C.G.**

EMMERICHITE*

N.V. Chukanov, R.K. Rastsvetaeva, D.M. Aksenov, G. Blass, I.V. Pekov, D.I. Belakovskiy, J. Tschörtner, W. Schüller, and B. Ternes (2014) Emmerichite, $Ba_2Na(Na,Fe^{2+})_2(Fe^{3+},Mg)Ti_2(Si_2O_7)_2O_2F_2$, a new lamprophyllite-group mineral from the Eifel volcanic region, Germany. New Data on Minerals, 49, 5–13 (in Russian; English version on CD).

S.M. Aksenov, R.K. Rastsvetaeva, and N.V. Chukanov (2014) The crystal structure of emmerichite $Ba_2Na_3Fe^{3+}Ti_2(Si_2O_7)_2O_2F_2$, a new lamprophyllite-group mineral. Zeitschrift für Kristallographie, 229(1), 1–7.

Emmerichite (IMA 2013-064), with ideal formula $Ba_2Na_3Fe^{3+}Ti_2(Si_2O_7)_2O_2F_2$, is a new mineral found in alkaline basalts at the mountain Rother Kopf, near Gerolstein, Eifel Mountains (Rheinland-Pfalz, Germany). Associated minerals are the high-temperature pneumatolitic (partly altered in late hydrothermal processes) minerals: nepheline, leucite, augite, phlogopite, fluorapatite, götzenite, åkermanite, günterblassite, magnetite, and perovskite. It is found as lamellar (often plank-like) crystals up to 0.05 × 0.3 × 0.5 mm and clusters up to 1 mm across. The mineral is brown and vitreous with a white streak. It is brittle, the Mohs hardness is 3–4; cleavage is perfect on {100}. D_{calc} = 3.864 g/cm^3. Optically emmerichite is biaxial (+) with α = 1.725(4), β = 1.728(4), γ = 1.759(4), $2V_{meas}$ = 80(5)°, $2V_{calc}$ = 79° (589 nm). Dispersion is $r > v$, medium; X = **a**; Y and Z parallel to (100), Y is parallel to the elongation of the crystals. Pleochroism is moderate: Z (brown) ≥ Y (light brown) > X (greenish gray). The mineral shows no fluorescence in the UV wavelength range. IR spectrum shows the absence of O–H bonds and the following band assignments: (cm^{-1}, s = strong, w = weak, and sh = shoulder): 1055sh, 1038s, 954s, 907s, 853s (Si–O stretching vibrations), 686w, 658w (O–Si–O bending vibrations of Si_2O_7 groups), 580sh, 536 (combinations of stretching vibrations of TiO_5 and $Fe^{3+}O_6$ polyhedra), and 458s, 400s (combinations of Si–O–Si bending vibrations and stretching vibrations of MO_6, octahedra). The average of 5 electron probe WDS analyses is [wt% (range)]: Na_2O 5.44 (5.20–5.78), K_2O 1.03 (0.95–1.13), CaO 1.98 (1.86–2.07), SrO 3.23 (3.02–3.48), BaO 25.94 (25.50–26.23), MgO 3.13 (3.05–3.28), MnO 2.22 (2.04–2.43), FeO total 10.91 (10.75–11.16) [FeO 4.85 and Fe_2O_3 6.73 (from structural refinement)], TiO_2 15.21 (15.05–15.45), ZrO_2 0.52 (0.33–0.78), Nb_2O_5 1.32 (1.04–1.53), SiO_2 27.13 (26.92–27.38), F 3.54 (3.35–3.74), $–O{=}F_2$ 1.49, total 100.78. The empirical formula calculated on the basis of 18 (O+F) pfu is: $Ba_{1.49}Sr_{0.27}K_{0.19}Na_{1.54}Ca_{0.31}Mn_{0.28}Mg_{0.68}Fe^{2+}_{0.59}Fe^{3+}_{0.74}Ti_{1.67}Zr_{0.04}Nb_{0.09}Si_{3.97}O_{16.36}F_{1.64}$. The strongest X-ray powder diffraction (Gandolfi method) lines [*d* Å (*I*%; *hkl*)] are: 9.97 (55; 200), 3.461 (65; 510,311,401), 3.312 (40; 220,600), 2.882 (38; $22\bar{1}$,420), 2.792 (100; 221,511), 2.670 (56; 002,601,$20\bar{2}$), 2.629 (45; 710,$42\bar{1}$), 2.140 (57; 131,022,621,$22\bar{2}$). The X-ray powder diffraction pattern was indexed in monoclinic unit cell with a = 19.93(3), b = 7.11(1), c = 5.407(8) Å, β = 96.5(1)°, V = 760 $Å^3$. X-ray single-crystal diffraction study [refined to R_1 = 0.0457 for 4400 unique $F_o > 4\sigma(F)$ reflections] on a crystal fragment 220 × 200 × 50 μm shows the mineral is monoclinic, space group *C*2/*m*, Z = 2. Emmerichite structure is similar to lamprophyllite $(Sr,Na)Na_3Ti_3(Si_2O_7)_2O_2(OH)_2$. It is based on *HOH* modules: the O sheet contains large *M*1 and *M*2 octahedra, occupied dominantly by Na, and the *M*3 octahedron, which is occupied dominantly by Fe^{3+} (+Mg), being the distinct feature of emmerichite; the *H* sheets are built by $[Si_2O_7]$ groups and titanium in fivefold coordination. According to Sokolova (2006) the linkage of *O* and *H* sheets is linkage 1 where two

[Si_2O_7] groups link to the trans edges of the same octahedron of the O sheet. Large cations (Ba, Sr, K) fill the interlayer space between adjacent *HOH*-modules. The holotype of emmerichite is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow. **F.C.**

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FERRIBUSHMAKINITE*

A.R. Kampf, P.M. Adams, B.P. Nash, and J. Marty (2015) Ferribushmakinite, $Pb_2Fe^{3+}(PO_4)(VO_4)(OH)$, the Fe^{3+} analog of bushmakinite from the Silver Coin mine, Valmy, Nevada. Mineralogical Magazine, 79(3), 661–669.

Ferribushmakinite (IMA 2014-055), ideally $Pb_2Fe^{3+}(PO_4)(VO_4)(OH)$, is a new mineral found at the Silver Coin mine, Valmy, Iron Point district, Humboldt County, Nevada, U.S.A. Quartz veins in the mine containing Ag-galena, sphalerite and pyrite were emplaced along the faults in phosphatic argillites. The oxidized sulfides produced acidic fluids that leached P and Al from the wall rocks. Ferribushmakinite occurs in the phosphate stop of the mine as a low-temperature secondary mineral, in association with plumbogummite, mottramite, Br-rich chlorargyrite, and barite on massive quartz. It forms slightly flattened prisms, elongated on [010] up to 0.2 mm and exhibiting the crystal forms {001}, {$10\bar{1}$}, and {$1\bar{1}0$}. Crystals are ubiquitously twinned, typically forming interpenetrated X-shape [twin plane (223)] and sixling twins. The mineral is translucent, yellow with a pale yellow streak and an adamantine luster, is brittle, has one or two fair cleavages in the [010] zone, irregular to splintery fracture and a Mohs hardness of ~2. The density was not measured due to the paucity of material; D_{calc} = 6.154 g/cm^3. Ferribushmakinite is easily soluble in room-temperature dilute HCl and does not fluoresce in UV light. The optical study was interfered by the low translucency of crystals and high refractive index (n_{calc} = 2.127). The optical orientation is partially provided as $Y = \mathbf{b}$. The average of 4 electron probe WDS analyses [wt% (range)] is: PbO 56.47 (55.14–58.45), CaO 0.06 (0.05–0.07), CuO 0.98 (0.80–1.15), Fe_2O_3 6.77 (6.51–7.12), Al_2O_3 1.45 (0.96–1.71), V_2O_5 11.22 (10.61–11.54), As_2O_5 2.74 (2.29–3.16), P_2O_5 7.65 (7.23–8.28), H_2O 1.33 (by structure refinement), total 88.67 (low totals were due to the rough surfaces). This gives the empirical formula $(Pb_{1.99}Ca_{0.01})_{\Sigma2.00}(Fe_{0.66}Al_{0.22}Cu_{0.10})_{\Sigma0.98}(V_{0.97}P_{0.85}As_{0.19})_{\Sigma2.01}O_{7.84}(OH)_{1.16}$ based on 9 O apfu. The strongest lines in the X-ray powder-diffraction pattern [*d* Å (*I*%; *hkl*)] are: 4.794 (46; 011), 3.245 (84; $\bar{2}11$), 2.947 (100; 020,$\bar{2}12$,$\bar{1}03$), 2.743 (49; 112), 2.288 (30; 220), 1.8532 (27; $\bar{3}14$,$\bar{4}03$), 1.8084 (27; multiple), 1.7204 (28; 312,114,321). The unit-cell parameters refined from powder-diffraction data are: a = 7.776(2), b = 5.914(2), c = 8.797(2) Å, β = 111.582(8)°, V = 376.19 Å^3. Single-crystal X-ray diffraction data collected on a crystal of size 50 × 10 × 2 μm refined to R_1 = 0.0383 for 577 unique reflections with $I \geq 4\sigma(I)$ shows ferribushmakinite is monoclinic, $P2_1/m$, a = 7.7719(10), b = 5.9060(7), c = 8.7929(12) Å, β = 111.604(8)°, V = 375.24 Å^3, Z = 2. Ferribushmakinite is a member of the brackebuschite supergroup. Its structure consists of edge-sharing chains of $Fe^{3+}O_6$ octahedra along [010] that are decorated with PO_4 and VO_4 tetrahedra, yielding $Fe^{3+}(PO_4)(VO_4)(OH)$ structural units that are linked together via bonds to two different Pb atoms. The name ferribushmakinite is based on the mineral being the Fe^{3+} analog of bushmakinite. The holotype specimen is housed in the Natural History Museum of Los Angeles County, Los Angeles, U.S.A. **O.C.G.**

FERRO-FERRI-NYBØITE*

A.J. Lussier, F.C. Hawthorne, Y.A. Abdu, N.A. Ball, K.T. Tait, M.E. Back, A.H. Steede, R. Taylor, and A.M. McDonald (2014) Ferro-Ferri-Nybøite, $NaNa_2(Fe^{2+}_3Fe^{3+}_2)(Si_7Al)O_{22}(OH)_2$, a new clinoamphibole from Mont Saint-Hilaire, Québec, Canada: description and crystal structure. Canadian Mineralogist, 52(6), 1019–1026.

Ferro-ferri-nybøite (IMA 2013-072), ideally $NaNa_2(Fe^{2+}_3Fe^{3+}_2)(Si_7Al)O_{22}(OH)_2$, is a new mineral of the amphibole group discovered at Poudrette quarry, Mont Saint-Hilaire, La Vallée-du-Richelieu RCM, Montérégie (formerly Rouville County), Québec, Canada. Amphibole compositions approximating $NaNa_2(Mg_3Al_2)(Si_7Al)O_{22}(OH)_2$ were reported by Ungaretti et al. (1981) from the Nybø eclogite pod, Norway. The current IMA amphibole classification gives the root-name nybøite ("nyböite" in previous IMA amphibole classification) to this composition (Hawthorne et al. 2012). A sample from Mont Saint-Hilaire, was found chemically close to nybøite with a dominance of Fe^{2+} and Fe^{3+} substituting Mg and Al respectively. The name was given according new amphibole classification (Hawthorne et al. 2012). Ferro-ferri-nybøite is the earliest mineral in an igneous microbreccia, often overgrown with a nepheline and associated with albite and a minerals of eudialyte and astrophyllite groups. It forms anhedral to subhedral, stubby crystals up to 3 × 3 cm (0.5 × 0.5 cm in average) in a blocky aggregates. Crystals are prismatic parallel to [001] with {100} and {110} forms and cleavage surfaces, and the prism direction is terminated by irregular fractures. Ferro-ferri-nybøite is jet-black with a grayish-green to black streak and a vitreous luster. It is brittle, has perfect {110} cleavage (planes intersecting at ~56°), splintery fracture, and no observable parting. The Mohs hardness of ~6. Density was not measured; D_{calc} = 3.424 g/cm^3. No fluorescence was observed. The extreme optical absorption (even on grains ~5 μm) due to intervalence charge transfer inhibited the measurement of optical properties. In tiny grains and on the thin edges of larger grains, the amphibole shows strong pleochroism in shades of dark greenish blue to black. The average of 10 electron probe WDS analysis on a single grain (Fe^{3+}/Fe_{total} = 0.30 by Mössbauer spectroscopy) is (wt%) SiO_2 45.80, Al_2O_3 3.11, TiO_2 0.50, Fe_2O_3 11.18, FeO 23.45, MnO 2.28, ZnO 0.12, MgO 0.23, CaO 0.99, Na_2O 8.01, K_2O 1.30, F 0.81, H_2O_{calc} 1.47, $-O{=}F_2$ 0.34, total 98.91. The empirical formula based on 24 (O + OH + F) with (OH + F) = 2 apfu is $(Na_{0.66}K_{0.27})_{\Sigma0.93}(Na_{1.83}Ca_{0.17})_{\Sigma2.00}(Mg_{0.06}Fe^{2+}_{3.15}Mn_{0.31}Zn_{0.01}Fe^{3+}_{1.38}Ti_{0.06}Al_{0.03})_{\Sigma5.00}(Si_{7.35}Al_{0.65})_{\Sigma8.00}O_{22}(OH_{1.58}F_{0.42})_{\Sigma2.00}$. The strongest lines in the powder X-ray diffraction pattern [*d* Å (*I*%; *hkl*)] are: 8.520 (100; 110), 3.298 (7; 240), 3.162 (55; 310), 2.834 (24; 330), 2.732 (10; 151), 2.606 (6; 061), 2.552 (10; $\bar{2}02$), 2.344 (9; $\bar{3}51$), 1.671 (19; 461), 1.446 (6; $\bar{6}61$,4.10.0). The monoclinic unit-cell parameters refined from the powder data are: a = 9.918(1), b = 18.087(2), c = 5.342(1) Å, β = 103.81(1)°. The crystal structure of ferro-ferri-nybøite was refined in space group $C2/m$ to R_1 = 3.14% for 1382 unique reflections with $I_o > 4\sigma I$. The single-crystal unit-cell parameters are: a = 9.9190(5), b = 18.0885(8), c = 5.3440(3) Å, β = 103.813(1)°, V = 931.09 Å^3, Z = 2. The holotype is deposited in the Royal Ontario Museum, Toronto, Ontario, Canada. **D.B.**

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Ungaretti, L., Smith, D.C., and Rossi, G. (1981) Crystal-chemistry by X-ray structure refinement and electron microprobe analysis of a series of sodic-calcic to alkali amphiboles from the Nybö eclogite pod, Norway. Bulletin de la Société Française Minéralogie et de Cristallographie, 104, 400–412.

GALLOPLUMBOGUMMITE*

J. Schlüter, T. Malcherek, and B. Mihailova (2014) Galloplumbogummite from Tsumeb, Namibia, a new member of the alunite group with tetravalent charge balance. Neues Jahrbuch für Mineralogie—Abhandlungen, 191/3, 301–309.

Galloplumbogummite (IMA 2010-088), $Pb(Ga,Al)_{3-x}Ge_xH_{1-x}(PO_4)_2(OH)_6$ $0 \leq x \leq 1$, is a new supergene mineral from the Tsumeb deposit, Tsumeb, Namibia. It formed by alteration of Ge-Ga minerals in the second oxidized zone of a dolostone-hosted, polymetallic, hydrothermal ore. The mineral was found in millimeter-sized vugs in massive germanite-renierite ore associated with chalcocite, Cd-rich sphalerite, galena, and pyrite. It occurs as colorless rhombohedral crystals up to 0.15 mm with a white streak. Its forms are dominated by {*h*0*l*} with additional {*hkl*} or {0*kl*} and {001}. No twinning is observed. Hardness, density, and optical properties were not measured due to the small grain size; D_{calc} = 4.62 g/cm^3. Optically galloplumbogummite is uniaxial (+) based on its trigonal symmetry and an analogy with Ga-rich plumbogummite; n_{calc} = 1.82. An increase of refractive index from plumbogummite (ε = 1.675, ω = 1.653) to galloplumbogummite is in agreement with its higher Ga content. No fluorescence in UV wavelength range was observed. The average of 14 electron probe WDS analyses [wt% (range)] is: PbO 34.45 (31.94–37.12), CaO 0.42 (0.06–1.09), Al_2O_3 10.19 (5.31–14.25), Ga_2O_3 19.64 (11.07–26.03), GeO_2 5.93 (1.56–10.93), Fe_2O_3 0.20 (0.07– 0.35), P_2O_5 20.04 (18.75–21.33), SO_3 1.71 (1.42–2.61), H_2O (by difference) 7.42, total 100.00. The empirical formula calculated on the basis of 14 O pfu is: $(Pb_{1.04}Ca_{0.05})_{\Sigma1.09}(Ga_{1.41}Al_{1.35}Ge_{0.38}Fe_{0.02})_{\Sigma3.16}(P_{1.91}S_{0.14})_{\Sigma2.05}O_{8.44}(OH)_{5.56}$. The crystals of galloplumpohummite show strong chemical zonation with substituting of Al/Ga/Ge, Pb/Ca, and P/S, The strongest X-ray powder diffraction (Gandolfi method) lines [*d* Å (*I*%; *hkl*)] are: 5.730 (100, 101), 2.983 (78, $2\bar{1}3$), 3.528 (24, $2\bar{1}0$), and 2.225 (19, $3\bar{2}2$). X-ray single-crystal diffraction study [refined to $R_1 = 0.0282$ for 362 unique $I > 3\sigma(I)$ reflections] on a crystal fragment 90 × 70 × 70 μm shows the mineral is trigonal, space group $R\bar{3}m$, $Z = 3$. Galloplumbogummite belongs to the plumbogummite subgroup of the alunite supergroup. Raman spectroscopy show the presence of two bands at 55 and 85 cm^{-1} indicating local structural distortions due to off-center shifts of the Pb atoms in the A sites, confirming observations from single crystal XRD analysis. Bands at 3252 and 3377 cm^{-1} confirm the presence of OH groups. The Ga-dominant plumbogummite was discovered in 2003 in a suite of ore samples from the Tsumeb deposit hosted in Mineralogical Museum, University of Hamburg, Germany. The original sample was bequeathed to that collection by Hermann Rose (1883–1976). Galloplumbogummite is named for its chemistry and its structural relation to plumbogummite. The holotype is deposited in the Mineralogical Museum, University of Hamburg, Germany, inventory number TS 531. **F.C.**

HLOUSĚKITE*

J. Plášil, J. Sejkora, R. Škoda, M. Novák, A.V. Kasatkin, P. Škácha, F. Veselovský, K. Fejfarová, and P. Ondruš (2014) Hlousěkite, (Ni,Co) $Cu_4(AsO_4)_2(AsO_3OH)_2(H_2O)_9$, a new member of the lindackerite supergroup from Jáchymov, Czech Republic. Mineralogical Magazine, 78(5), 1341–1353.

Hlousěkite (IMA 2013-048), ideally $NiCu_4(AsO_4)_2(AsO_3OH)_2(H_2O)_9$, is a new supergene arsenate from the Geister vein, Jáchymov (St Joachimsthal), Western Bohemia, Czech Republic. It was found in old workings located on the Geister vein in third Geister level in the Rovnost (formerly Werner) mine, where it occurs as a constituent of the coatings (along with veselovskýite, pradetite, lavendulan, arsenolite, babánekite, and gypsum) on altered surfaces of highly oxidized ore fragments containing dominant tennantite, chalcopyrite, and Ni-Co-arsenides disseminated in quartz gangue. Thin lath-like locally elongated crystals of hlousěkite usually form complex intergrowths and radial aggregates up to 3 mm across. Hlousěkite is transparent, pale green with a grayish-white streak and a vitreous luster. It is very brittle with an uneven fracture and shows perfect cleavage on {010}. Mohs hardness is 2–3. D_{calc} = 3.295 g/cm^3. The mineral does not fluoresce under UV light. Hlousěkite is optically biaxial with α′ = 1.653(2) and γ′ = 1.73. The estimated optical orientation is Z' ^ **c** (elongation) = 14°. In large grains hlousěkite is weakly to moderately pleochroic *X* (colorless) < *Z* (pale green to green). Other optical properties and density were not determined due to small size of grains and intimate intergrowths; n_{calc} = 1.651. The average of 12 electron probe WDS analyses is [wt% (range)]: MgO 0.20 (0.13–0.24), FeO 0.10 (0–0.42), NiO 5.79 (5.06–6.47), CoO 1.80 (1.46–2.17), CuO 29.53 (27.79–31.24), ZnO 0.66 (0.36–1.01), Al_2O_3 0.14 (0.05–0.27), P_2O_5 0.11 (0.05–0.20), As_2O_5 45.01 (40.72–48.84), H_2O 17.71 (based on the theoretical content of $9H_2O$ + 2OH), total 101.05. The empirical formula, calculated by stoichiometry ($9H_2O$ + 2OH), is: $(Ni_{0.79}Co_{0.25})_{\Sigma1.04}(Cu_{3.78}Zn_{0.08}Mg_{0.05}Al_{0.03}Fe_{0.01})_{\Sigma3.95}(AsO_4)_{1.98}(PO_4)_{0.02}(AsO_3OH)_{2.00}(H_2O)_{9.00}$. The strongest lines of the X-ray powder diffraction pattern [*d* Å (*I*%; *hkl*)] are: 10.211 (100; 001), 7.974 (9; 010), 3.984 (6; 020), 3.656 (5; $1\bar{1}2$), 3.631 (5; $0\bar{2}1$), 3.241 (5; 022), 3.145 (5; 200), 3.006 (5; 210). X-ray single-crystal diffraction study [refined to $R_1 = 0.0599$ for 1441 unique $I > 3\sigma(I)$ reflections] on a crystal fragment 300 × 140 × 60 μm shows the mineral is triclinic, space group $P\bar{1}$; with unit-cell parameters $a = 6.4010(6)$, $b = 8.0041(6)$, $c = 10.3969(14)$ Å, $\alpha = 85.824(8)$, $\beta = 79.873(9)$, $\gamma = 84.655(7)$°, $V = 521.23$ Å^3; $Z = 1$. Hlousěkite is isostructural with lindackerite. The crystal structure consist of adjacent sheets of $Cu^{2+}\Phi_6$ polyhedra ($\Phi = O,OH,H_2O$) and AsO_4/AsO_3OH tetrahedra linked via metal ($Ni/Co\Phi_{10}$) polyhedra in the interlayer, along with H_2O groups not bonded directly to any cation. Hlousěkite is a new member of the lindackerite group (also including lindackerite, pradetite and veselovskýite) of the lindackerite supergroup. The name is in honor of Jan Hloušek (1950–2014) a prominent Czech mineralogist and famous collector of Jáchymov minerals. The holotype specimen is deposited in the Department of Mineralogy and Petrology of the National Museum in Prague, Czech Republic. **F.C.**

HYDROXYLWAGNERITE*

C. Chopin, T. Armbruster, E.S. Grew, A. Baronnet, C. Leyx, and O. Medenbach (2014) The triplite-triploidite supergroup: structural modulation in wagnerite, discreditation of magniotriplite, and the new mineral hydroxylwagnerite. European Journal of Mineralogy, 26(4), 553–565.

Hydroxylwagnerite (IMA 2004-009), ideally $Mg_2PO_4(OH)$, is a new species discovered as an accessory rock-forming mineral in quartz-rich pyrope–kyanite–phengite schist lenses within metagranite in the ultrahigh-pressure metamorphic unit of the Dora-Maira Massif, western Alps, Vallone di Gilba, Val Varaita, Piemonte, Italy. The new mineral forms isolated anhedral crystals up to 400 mm in pyrope metablasts with talc, clinochlore, kyanite, rutile, and secondary apatite. Hydroxylwagnerite is creamy white, transparent with a vitreous luster and a white streak, and is non-fluorescent. Mohs hardness was not determined, but is likely ~5 by analogy with wagnerite. Hydroxylwagnerite is brittle, has an uneven fracture, and no cleavage in most sections, but two poor, nearly perpendicular cleavages were observed in one section perpendicular to an optical axis. Density was not measured because of small grain size and paucity of material; D_{calc} = 3.074 g/cm^3. Hydroxylwagnerite is optically biaxial (+), a = 1.584(1), b = 1.586(1), g = 1.587(1) (589 nm), $2V_{obs}$ = 43(2)°; *Y* = **b**, non pleochroic. The average of 4 electron probe WDS analyses of holo-type and analyze of the crystal with lowest F content [wt%$_{holotype}$ (range); {wt%$_{low\text{-}F\ sample}$}] are: P_2O_5 44.1 (43.7–44.7) {43.99}, SiO_2 0.28 (0.26–0.30) {0.02}, TiO_2 0.20 (0.13–0.25) {0.16}, Al_2O_3 0.06 (0.02–0.11) {0.03}, MgO 48.8 (48.5–49.1) {49.12}, FeO 0.33 (0.23–0.44) {0.48}, MnO 0.01 (0–0.03) {0.02}, CaO 0.12 (0.10–0.15) {0.10}, Na_2O 0.01 (0–0.02) {–}, F 5.6 (4.67–6.00) {4.67}, $-O=F_2$ 2.35 {1.97}, H_2O 2.94 (by stoichiometry) {3.36}, total 100.14 {99.98}. The empirical formulae calculated on the basis of 4.5 O apfu are: $(Mg_{1.95}Fe_{0.01}Ti_{<0.01}Ca_{<0.01}Al_{<0.01}Na_{<0.01})_{\Sigma1.97}(P_{1.00}Si_{0.01})_{\Sigma1.01}O_4(OH_{0.53}F_{0.47})_{\Sigma1.00}$ for the holotype and $(Mg_{1.97}Fe_{0.01}Ti_{<0.01}Ca_{<0.01}Al_{<0.01})_{\Sigma1.99}(P_{1.00}Si_{<0.01})_{\Sigma1.00}O_4(OH_{0.60}F_{0.40})_{\Sigma1.00}$ for low-F sample. Single-crystal X-ray diffraction data indicate that the mineral is monoclinic, $P2_1/c$, $a = 9.646(3)$, $b = 12.7314(16)$, $c = 11.980(4)$ Å, β = 108.38(4)°, $V = 1396.2$ Å^3, $Z = 16$. The crystal structure was not solved or refined due to poor quality of the available crystals. Hydroxylwagnerite is the (OH)-dominant analog of wagnerite, β-$Mg_2PO_4(OH)$, as apparent from its name. It is also a high-pressure polymorph of althausite, holtedahlite, and α- and ε-$Mg_2PO_4(OH)$. The authors propose to classify minerals related to wagnerite, triplite and triploidite into a triplite–triploidite supergroup that can be divided into F-dominant phosphates (triplite group), OH-dominant phosphates (triploidite group), O-dominant phosphates (staněkite group) and OH-dominant arsenate (sarkinite). The distinction among the three groups and a potential fourth group is based on occupancy of anion or cation sites. The structures of these minerals are all based on the average triplite structure, with a modulation along **b** controlled by the ratio of Mg, Fe^{2+}, Fe^{3+}, and Mn^{2+} ionic radii to (O,OH,F) ionic radii. Modulation may be commensurate with (2b periodicity) or incommensurate but generally close to integer values (~3b, ~5b, ~7b, ~9b), i.e., close to polytypic behavior. As a result, the Mg- and F-dominant minerals magniotriplite and wagnerite can no longer be considered polymorphs of Mg_2PO_4F, since there is no basis for recognizing them as distinct species. Wagnerite has priority (1821 vs. 1951) so the name magniotriplite should be discarded in favor of wagnerite. The holotype of hydroxylwagnerite has been deposited at the Musée de Minéralogie, Ecole des Mines de Paris, France. The fragment of the holotype used for optical measurements is in the Institut für Geologie, Mineralogie und Geophysik, Ruhr-Universität Bochum, Germany. **Yu.U.**

ISHIHARAITE*

M.F. Márquez-Zavalía, M.Á. Galliski, M. Drábek, A. Vymazalová, Y. Watanabe, H. Murakami, and H.-J. Bernhardt (2014) Ishiharaite, (Cu,Ga,Fe,In,Zn)S, a new mineral from the Capillitas Mine, Northwestern Argentina. Canadian Mineralogist, 52(6), 969–980.

Ishiharaite (IMA 2013-119) a new sulfide mineral, (Cu,Ga,Fe,In,Zn)S, discovered in a single specimen from the Nueva Esperanza vein, Capillitas mine (27°20′43″ S, 66°23′17″ W, 3290 mosl) an epithermal precious- and base-metal vein deposit at the Farallón Negro Volcanic Complex located along the eastern slope of the Capillitas Range, in Catamarca province, NW Argentina. The Capillitas mine is well known for pink-banded rhodochrosite, the main gangue mineral in some of the veins. The Nueva Esperanza vein ~100 m long and 0.3 m thick is hosted by the granites. It contains sphalerite, pyrite, tennantite, chalcopyrite, enargite, galena, gold, stannoidite, stannite, and hübnerite, with chalcocite and covellite as secondary minerals in a quartz gangue. Ishiharaite forms subhedral, equidimensional, individual grains 20–50 μm in size included in tennantite and surrounded by discontinuous rims of chalcopyrite. The mineral is a dark gray, metallic, opaque, non-fluorescent. Due to the small grain size the microhardness and density were not measured. The hardness is higher compare to tennantite and the mineral acquires a good polish; D_{calc} = 4.343 g/cm³. In reflected light ishiharaite is burgundy brown with a faint violet hue in air and violet-burgundy in oil. No internal reflections were observed. The mineral is isotropic. The reflectance values were measured in 400–700 nm interval with a 20 nm step and varies from 19.86 to 25.77 (in air) and from 6.70 to 11.11 in oil. The COM values are [R_{air}/R_{oil} % (λ nm)]: 18.27/6.77 (470); 20.10/7.91 (546); 21.74/8.96 (589); 23.94/10.44 (650). The averages of 22 electron probe WDS analyses of ishiharaite and of 6 WDS analysis of synthesized (CuGaFeInZn)S are [**wt% (range), natural** {wt% (range), synthetic }]: S **30.77 (29.72–31.50)**, {30.73 (30.44–30.90)}, Cu **33.61 (31.72–35.09)**, {28.05 (27.87–28.46)}, Ga **13.31 (10.41–14.57)**, {15.99 (15.82–16.17)}, In **9.48 (8.19–10.93)**, {11.86 (11.78–11.97)}, Zn **5.74 (4.54–9.27)**, {7.37 (7.22–7.50)}, **Fe 6.82 (6.22–7.16)**, {6.13 (5.72–6.30)}, Ge **0.06 (0–0.28)**, {n.d.}, **As 0.06 (0–0.29)**, {n.d.}, Sb **0.06 (0–0.16)**, {n.d.}; total **99.91**, {100.13}. The empirical formulae of ishiharaite and its synthetic analog, based on 2 apfu, are: $(Cu_{0.55}Ga_{0.19}Fe_{0.13}In_{0.08}Zn_{0.08})_{\Sigma1.03}S_{0.97}$ and $(Cu_{0.45}Ga_{0.24}Fe_{0.11}In_{0.11}Zn_{0.11})_{\Sigma1.02}S_{0.98}$. The size of ishiharaite grains did not allow to extract sufficient material for X-ray study. Therefore it was performed on synthesized for that purpose cubic (Cu,Fe,Ga,In,Zn)S. The structural identity between synthetic and natural material was confirmed by EBSD, chemically, and by optical properties. Synthetic ishiharaite is isostructural with sphalerite. The strongest X-ray powder-diffraction lines [*d* Å (I%; *hkl*)] are: 3.096 (100; 111), 2.684 (20; 200), 1.897 (60; 220), 1.620 (40; 311), 1.097 (15; 422). Ishiharaite is cubic, space group $F\bar{4}3m$, a = 5.368(1) Å, V = 154.68 Å³, Z = 4. The mineral is named in honor of Shunso Ishihara (b. 1934), Emeritus Advisor of AIST (Advanced Industrial Science and Technology), Tsukuba, Japan, for his wide contribution to geological sciences. The holotype is deposited at the Mineralogical Museum "Alfred Stelzner" of the Facultad de Ciencias Exactas Físicas y Naturales of the Universidad Nacional de Córdoba, Argentina. **D.B.**

MELLIZINKALITE*

I.V. Pekov, N.V. Zubkova, V.O. Yapaskurt, I.S. Lykova, D.I. Belakovskiy, M.F. Vigasina, E.G. Sidorov, S.N. Britvin, and D.Yu. Pushcharovsky (2015) New zinc and potassium chlorides from fumaroles of the Tolbachik volcano, Kamchatka, Russia: Mineral data and crystal chemistry. I. Mellizinkalite, $K_3Zn_2Cl_7$. European Journal of Mineralogy, 27(2), 247–253.

Mellinzinkalite (IMA 2014-010), ideally $K_3Zn_2Cl_7$, is a new mineral discovered in sublimates of Glavnaya Tenoritovaya fumarole at the Second scoria cone, Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. It is associated with belloite, avdoninite, eriochalcite, sylvite, halite, carnallite, mitscherlichite, sanguite, chrysothallite, romanorlovite, gypsum, chlorothionite, kainite and earlier hematite, tenorite and chalcocyanite. Mellizinkalite is one of the last minerals to form in that assemblage. It forms equant, elongated or flattened, irregular shaped grains up to 0.5 mm across, and their cluster or granular crusts up to 2 × 2 mm in area. The new mineral is yellow-brown to reddish brown, typically honey- or cognac-colored, transparent, has vitreous luster, yellow streak, and uneven fracture. It is moderately brittle, slightly plastic, and has a Mohs hardness of about 2. D_{meas} = 2.46(2) g/cm³ and D_{calc} = 2.49 g/cm³. Mellizinkalite is optically biaxial (–), α = 1.556(5), β = 1.612(5), γ = 1.663(5) (589 nm); $2V_{meas}$ = 85(5)°; $2V_{calc}$ = 85°. Dispersion is $r < v$, distinct. It is strongly pleochroic: Z (brown to reddish brown in thicker grains) >> Y (swamp green) > X (pale swamp green to almost colorless). The new mineral dissolves in H_2O at room temperature in a few seconds. The average of 4 electron probe WDS analyses [wt% (range)] is: K 23.48 (22.87–24.07), Rb 0.52 (0–1.01), Mg 0.47 (0.26–0.85), Cu 1.77 (1.13–3.08), Zn 24.44 (23.11–25.72), Cl 50.02 (49.31–50.47), total 100.70. The empirical formula calculated on the basis of 12 apfu is: $(K_{2.95}Rb_{0.03})_{\Sigma2.98}(Zn_{1.84}Cu_{0.14}Mg_{0.09})_{\Sigma2.07}Cl_{6.95}$. Raman spectroscopy identified the following bands in the mellizinkalite spectrum (cm^{-1}): 310, 274, and 264 (Zn–Cl stretching vibrations); 188 and 128 (lattice modes involving Zn–Cl bending and K–Cl stretching vibrations). The strongest lines of the X-ray powder diffraction pattern [*d* Å (*I*%; *hkl*)] are: 9.20 (69; 001,010,$0\bar{1}1$), 6.40 (100; 100), 5.712 (47; $\bar{1}10,\bar{1}\bar{1}1$), 4.608 (92; 002,020), 3.499 (55; 012), 3.473 (73; $0\bar{1}3,0\bar{3}1,0\bar{2}3$), 3.393 (66; $\bar{2}01$), 3.075 (49; 003). Mellizinkalite is triclinic, space group $P\bar{1}$, a = 6.7737(4), b = 10.5715(13), c = 11.0730(9) Å, α = 117.930(10), β = 106.909(5), γ = 90.389(8)°, V = 660.61 Å³, Z = 2. The crystal structure was solved by direct methods and refined to R_1 = 6.53% accounting for twinning. Mellizinkalite has a novel structure type. Its structure consists of alternating layers of distinct $ZnCl_4$ polyhedra. The Zn(1) cations are located in flat squares which are connected to each other via common Cl–Cl edges to form Zn_2Cl_6 dimers, whereas Zn(2) form isolated tetrahedra. Potassium cations are located between the layers of Zn-centered polyhedra. Mellizinkalite is named from Latin words, mellis (honey), zinkum, and kalium for its color and species defining cations. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **Yu.U.**

PETERANDRESENITE*

H. Friis, A.O. Larsen, A.R. Kampf, R.J. Evans, R.S. Selbekk, A.A. Sánchez, and J. Kihle (2014) Peterandresenite, $Mn_4Nb_6O_{19}\cdot14H_2O$, a new mineral containing the Lindqvist ion from a syenite pegmatite of the Larvik Plutonic Complex, southern Norway. European Journal of Mineralogy, 26(4), 567–576.

Peterandresenite (IMA 2012-084), ideally $Mn_4Nb_6O_{19}\cdot 14H_2O$, is a new mineral found in the AS Granit larvikite quarry in Tvedalen, Larvik, Vestfold, Norway, and is the first naturally occurring hexaniobate. Peterandresenite was found in the miaskitic pegmatite dike within the larvikites of Larvic Plutonic Complex. The primary minerals of the pegmatite are annite, hastingsite, magnetite, microcline, nepheline, pyrochlore, thorite, wöhlerite, and zircon. Peterandresenite formed at hydrothermal stage and found on fracture surfaces and tiny vugs in the center of pegmatite along with analcime, fluorapophyllite-(K), arsenopyrite, behoite, bertrandite, calcite, chiavennite, chlorite, epididymite, Mn^{2+}-rich fayalite, fluorite, galena, gonnardite, hambergite, luinaite-(OH), molybdenite, natrolite, and neotocite. Peterandresenite forms equidimensional, transparent to translucent orange crystals up to 1 mm or aggregates up to 2 mm across; the crystals are often twinned. It has a pale orange streak, a vitreous to resinous luster, and it does not fluoresce. The mineral is brittle with no cleavage and irregular fracture; Mohs hardness is 2–2½. D_{meas} = 3.10(1) g/cm^3; D_{calc} = 3.05 g/cm^3. Peterandresenite easily incongruently dissolves in dilute HCl and HNO_3 with precipitation of $Nb_2O_5\cdot H_2O$, and under vacuum peterandresenite loses water and cracks appear as the mineral becomes yellow and opaque. Peterandresenite is optically biaxial (–), $\alpha = 1.760(5)$, $\beta = 1.795(5)$, $\gamma = 1.800(5)$, $2V_{obs} = 43(2)°$, and $2V_{calc} = 40.7°$, dispersion is $r > v$, strong; $X \approx \mathbf{c}$, $Y \approx \mathbf{a}$, $Z \approx \mathbf{b}$. It is pleochroic: X (colorless) < Z (pale orange) << Y (medium orange). The average of 4 electron probe WDS analyses [wt%] is: Nb_2O_5 56.8(8), SiO_2 0.11(2), MnO 21.5(3), FeO 0.6(2), CaO 0.21(4), Na_2O 0.07(2), H_2O 18.87 (by stoichiometry), total 98.25. The empirical formula calculated on the basis of 10 cations pfu is $(Mn_{3.92}Ca_{0.05}Na_{0.03})_{\Sigma 4.01}(Nb_{5.71}Mn_{0.13}Fe_{0.12}Si_{0.03})_{\Sigma 5.99}O_{18.57}\cdot 14H_2O$. The strongest lines of the X-ray powder diffraction pattern [d Å (I%; hkl)] are: 9.8977 (82; 001), 7.7104 (42; 110), 7.4689 (39; $20\bar{1}$), 7.1026 (63; $11\bar{1}$), 2.9260 (100; $42\bar{2}$). The crystal structure of peterandresenite was solved by direct methods and refined to R_1 = 2.06%. The mineral is monoclinic, $C2/m$, a = 15.3444(3), b = 9.4158(2), c = 11.2858(4) Å, β = 118.632(1)°, V = 1431.18 Å^3, Z = 2. Peterandresenite has a unique structure type. Its structure consists of six edge-sharing Nb-octahedra forming a super octahedron known as a Lindqvist ion. One Mn^{2+} octahedron interconnects three Lindqvist ions to form a two-dimensional layer perpendicular to the **c** axis. A second Mn^{2+} octahedron bridging with the Lindqvist ion protrudes into the adjacent layer along the **c** axis and creates a three-dimensional structure via hydrogen bonds. The name is in honor of Peter Andresen, the mineral collector who first found the mineral. The holotype is in the Natural History Museum, University of Oslo, Norway. A few loose crystals removed from the holo-type are housed in the Natural History Museum of Los Angeles County, California, U.S.A. **Yu.U.**

POPOVITE*

I.V. Pekov, N.V. Zubkova, V.O. Yapaskurt, D.I. Belakovskiy, M.F. Vigasina, E.G. Sidorov, and D.Yu. Pushcharovsky (2015) New arsenate minerals from the Arsenatnaya fumarole. Tolbachik volcano, Kamchatka, Russia. III. Popovite, $Cu_5O_2(AsO_4)_2$. Mineralogical Magazine, 79(1), 133–143.

Popovite (IMA 2013-060), ideally $Cu_5O_2(AsO_4)_2$, was discovered in the sublimates of the Arsenatnaya fumarole at the Second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption, Tolbachik volcano, Kamchatka, Russia. Popovite occurs in association with ericlaxmanite, kozyrevskite, urusovite, lammerite, lammerite-β, johillerite, bradaczekite, tenorite, hematite, aphthitalite, anhydrite, langbeinite, calciolangbeinite, As-bearing orthoclase, anhydrite, langbeinite, calciolangbeinite, arcanite, wulffite, krasheninnikovite, steklite, palmierite, tilasite, svabite, alarsite, Cu-gahnite, and OH-free fluoborite. All these sublimate minerals form complex incrustations, usually up to 1 mm in thickness, on the surface of basalt scoria. Popovite forms prismatic, tabular or, rarely, lamellar crystals, crude or well formed, complex in shape, typically up to 0.03 mm, rarely up to 0.2 mm across. The new mineral is transparent, has vitreous to greasy luster, olive green to dark olive-green in color, and has a light olive green streak. Popovite is brittle, has a Mohs hardness of ~3½, no cleavage and uneven fracture. The density was not measured due to the paucity of pure material; D_{calc} = 5.30 g/cm^3. Optically popovite is biaxial (+), $\alpha = 1.84(1)$, $\beta \approx 1.86$, $\gamma = 1.96(1)$, $2V_{obs} = 50(20)°$. Dispersion is $r < v$, strong. Popovite is pleochroic, with X (green) > Z (olive green with grayish hue). Raman spectroscopy identified two strong bands in the region 800–900 cm^{-1} (As^{5+}–O stretching vibrations of AsO_4^{3-} groups), and bands with frequencies less than 700 cm^{-1} (As^{5+}–O bending vibrations, Cu^{2+}–O stretching vibrations and a lattice modes). The averaged of 5 electron probe WDS analyses [wt% (range)] is: CuO 63.28 (62.94–63.75), ZnO 0.56 (0.41–0.72), V_2O_5 0.12 (0–0.51), As_2O_5 35.80 (35.65–36.07), SO_3 0.27 (0–0.68), total 100.03. The empirical formula based on 10 O apfu is $(Cu_{4.99}Zn_{0.04})_{\Sigma 5.03}(As_{1.95}S_{0.02}V_{0.01})_{\Sigma 1.98}O_{10}$. The strongest lines of the X-ray powder diffraction pattern [d Å (I%; hkl)] are: 3.715 (36; 110, 101), 3.465 (43; $1\bar{1}1$), 2.968 (90; $0\bar{1}2$), 2.927 (100; 111), 2.782 (31; $\bar{1}02$), 2.768 (67; $\bar{1}20$), 2.513(55; $\bar{1}\bar{2}1$), 2.462 (67; $\bar{2}01$). The crystal structure of popovite was solved by direct methods and refined to R = 4.59%. The new mineral is triclinic, $P\bar{1}$, a = 5.1450(3), b = 6.2557(3), c = 6.2766(4) Å, α = 100.064(5), β = 96.351(5), γ = 95.100 (5)°, V = 196.48 Å^3, Z = 1. Popovite has a novel structure type. Its crystal structure is based on (010) layers forming an interrupted framework. The layer consists of $Cu(1)O_6$ octahedra with very strong Jahn-Teller distortion and $Cu(2)O_5$ and $Cu(3)O_5$ polyhedra. The layers of Cu polyhedral are linked by isolated AsO_4 tetrahedra. Popovite named in honor of the Russian mineralogists Vladimir Anatol'evich Popov (b. 1941) and Valentina Ivanovna Popova (b. 1941), a couple research team of the Institute of Mineralogy, Urals Branch of the Russian Academy of Sciences at Miass, Russia. They both have made a great contribution to the mineralogy of Russia, including the discovery of two new mineral species, nabokoite and atlasovite, from the fumaroles of the Tolbachik volcano. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **Yu.U.**

YURMARINITE*

I.V. Pekov, N.V. Zubkova, V.O. Yapaskurt, D.I. Belakovskiy, M.F. Vigasina, E.G. Sidorov, and D.Yu. Pushcharovsky (2014) New arsenate minerals from the Arsenatnaya fumarole, Tolbachik volcano, Kamchatka, Russia. I. Yurmarinite, $Na_7(Fe^{3+},Mg,Cu)_4(AsO_4)_6$. Mineralogical Magazine, 78(4), 905–917.

Yurmarinite (IMA 2013-033), $Na_7(Fe^{3+},Mg,Cu)_4(AsO_4)_6$, is a new mineral found 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, where it occurs associated with hatertite, bradaczekite, johillerite, hematite, tenorite, tilasite, and aphthitalite. Yurmarinite crystals are well shaped, equant or slightly elongated (short prismatic) or flattened (thick tabular) in different directions up to 0.3 mm in size. Crystal forms are {101}, {011}, {100}, {110}, and {001}. Crystals are transparent, pale green or pale yellowish green to colorless. The streak is white and the luster vitreous. It is brittle, with cleavage imperfect and fracture uneven. Mohs hardness ~4½. D_{calc} = 4.001 g/cm^3. The mineral is non-fluorescent under UV irradiation or an electron beam. In transmitted light yurmarinite is colorless, non-pleochroic. It is optically uniaxial (–), $\omega = 1.748(5)$, $\varepsilon = 1.720(5)$ (589 nm). Raman spectroscopy show bands in the region 700–950 cm^{-1}

(As^{5+}–O stretching vibrations of AsO_4^{3-} groups), bands with frequencies between 200 and 500 cm^{-1} (As^{5+}–O bending and Fe^{3+}–O stretching vibrations), and no bands at frequencies >950 cm^{-1}. The average of 5 electron probe WDS analyses is [wt% (range)]: Na_2O 16.85 (16.64–17.23), K_2O 0.97 (0.79–1.11), CaO 1.28 (1.01–1.44), MgO 2.33 (1.95–2.72), MnO 0.05 (0–0.11), CuO 3.17 (2.85–3.59), ZnO 0.97 (0.87–1.07), Al_2O_3 0.99 (0.42–1.69), Fe_2O_3 16.44 (15.03–17.36), TiO_2 0.06 (0–0.17), P_2O_5 0.12 (0–0.18), V_2O_5 0.08 (0–0.12), As_2O_5 56.68 (56.26–57.41), total 99.89. The empirical formula, calculated on the basis of 24 O apfu is: $(Na_{6.55}Ca_{0.28}K_{0.22})_{\Sigma 7.05}(Fe^{3+}_{2.48}Mg_{0.70}Cu_{0.48}Al_{0.23}Zn_{0.14}Ti_{0.01}Mn_{0.01})_{\Sigma 4.05}(As_{5.94}P_{0.02}V_{0.01})_{\Sigma 5.97}O_{24}$. The strongest X-ray powder diffraction (Gandolfi method) lines [*d* Å (*I*%; *hkl*)] are: 7.28 (45; 012); 4.375 (33; 211); 3.440 (35; 220); 3.217 (36; 131,214); 2.999 (30; 223); 2.841 (100; 125); 2.598 (43; 410). The unit-cell parameters refined from the powder data are a = 13.751(2), c = 18.295(3) Å, and V = 2996 Å^3. X-ray single-crystal diffraction study of yurmarinite [refined to R_1 = 0.023 for 1015 unique $F > 4\sigma(F)$ reflections] on a crystal fragment of 180 × 120 × 90 μm shows the mineral is trigonal, space group $R\bar{3}c$, Z = 6. The structure of yurmarinite is unique among minerals but isotypic with several synthetic compounds with the general formula $(Na_{7-x}\square_x)(M^{3+}_{3+x}M^{2+}_{1-x})(T^{5+}O_4)_2$ in which T = As or P, M^{3+} = Fe or Al, M^{2+} = Fe; $0 \leq x \leq 1$. It is based on a 3D heteropolyhedral framework formed by M_4O_{18} clusters ($M = Fe^{3+} > Mg$, Cu) linked with AsO_4 tetrahedra. Sodium atoms occupy two octahedrally coordinated sites in the voids of the framework. The mineral is named in honor of the Russian mineralogist, and specialist in studies of ore deposits, Yuriy Borisovich Marin (b. 1939). The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **F.C.**