New Mineral Names* †

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This New Mineral Names has entries for 21 new minerals, including alexkhomyakovite, andreadinitite, arsenmedane, barwoodite, bodite, cirottiite, clino-oscar kempfite, ferrovorontsovite, ilimneyite, kamenite, magnesiohornblende, merelanite, oyonite, pararaissite, petrichkite, quijarroite, staročeskéite, tantalowodginitite, topseite, tsygankoite, and vorontsovite.

**ALEXKHOMYAKOVITE**


Alexkhomyakovite (IMA 2015-013), ideally K₆(Ca₂Na)(CO₃)₅Cl·6H₂O, was discovered, in a few lumps of the peralkaline pegmatite in the south part of the Koashva open pit (Vostochnyi mine), Mt. Koasha, Khibiny alkaline complex in Kola peninsula. Alexkhomyakovite is a hydrothermal mineral and occurs associated with villiaumite, natrite, potassic feldspar, pectolite, sodalite, biotite, lamprophyllite, titane, fluorapatite, wadeite, burbankite, ramsivmite, djerfshite, molybdenate, and incompletely characterized Na-Ca silicate. The white powdery aggregates of thermonatrite, villiaumite, fluorite, and sylvite are products of the supergene alteration of natrite, alexkhomyakovite, and primary villiaumite, which are unstable on the air.

Most commonly alexkhomyakovite found as a part (up to 40 vol%) of massive polymineralic pseudomorphs after large (up to 3 × 5 × 15 cm) delhayelite crystals where it forms massive fine-grained aggregates (up to 2 × 4 cm) intimately intergrown with other minerals (monomineralic area up to 10 × 20 μm). It also found as main part of veinlets up to 2 cm × 1 mm at the border of delhayelite pseudomorphs with natrite nests, and as grains up to 0.2 mm with their clusters with micro inclusions of pectolite, lamprophyllite, and/or villiaumite within massive natrite. Alexkhomyakovite is transparent to translucent, colorless, white or gray, with vitreous to greasy luster and a white streak. No cleavage or parting is observed; the fracture is uneven. Alexkhomyakovite is brittle or gray, with vitreous to greasy luster and a white streak. No cleavage or parting is observed; the fracture is uneven.

The crystal structure of alexkhomyakovite was solved by direct methods and refined to R = 5.78%. The new mineral is hexagonal, P63/mcm, a = 9.2691(2), c/1 = 15.8419(4) Å, V = 1178.72 Å³, Z = 2. Its structure is unique and is based on (001) heteropolylayered crystals of pentagonal bipyramids (Ca₆Na₅)(CO₃)₅Cl·17Cl·6H₂O based on 9 metal cations pfu. The strongest lines of the powder X-ray diffraction pattern are [d Å (%h k l)]

<table>
<thead>
<tr>
<th>Component</th>
<th>wt%</th>
<th>(range/standard deviation)</th>
</tr>
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<tbody>
<tr>
<td>Na₂O</td>
<td>4.09</td>
<td>(3.73–4.48/0.19)</td>
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<tr>
<td>K₂O</td>
<td>35.72</td>
<td>(35.20–36.33/0.33)</td>
</tr>
<tr>
<td>CO₂</td>
<td>2.28</td>
<td>(2.23–2.33/0.06)</td>
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<tr>
<td>H₂O</td>
<td>13.90</td>
<td>(13.80–14.00/0.06)</td>
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</tbody>
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**ANDREADINITITE**


Andreadinitite (IMA 2014-049), ideally Cu₄Ag₂Hg₆Pb₇Sb₂₄S₄₈, is a new +4/L homologue belonging to the andorite sub-series of Sb-rich members within the lillianite homologous series. It was discov-
erred in a quartz vein embedded in dark gray metadolostone, enriched with microcrystalline pyrite from the Sant’Olga tunnel, Monte Arscicco mine, Stazzema, Apuan Alps, Tuscany, Italy (43°58′46″N, 10°17′03″E). The Monte Arscicco mine exploited a pyrite ± baryte ± iron oxide ore deposit located at the contact between the Paleozoic basement, formed by a metavolcanic-metasiliclastic sequence, and the Triassic metadolostone belonging to the Grezzoni Formation. Andreadiniite forms millimeter-sized lead-gray compact masses associated with sphalerite and stibnite. In the same vein, the thallium sulfosalts boscardinite, protochabournèite, and nouthierite were identified, associated with Hg-rich tetrahedrite.

The crystallization of this sulfosalts assemblage could be related to the circulation of (Pb, Tl)Ag,Hg,Hg,Sb,As)-rich hydrothermal fluids in the fractures of the metadolostone during the Tertiary Alpino tectono-metamorphic events. The mineral has a metallic luster and is brittle, with a conchoidal to uneven fracture. The indentation hardness VHN, = 223 (218–229) kg/mm², corresponding to ~3.5 of a Mohs scale. Density was not measured, because of the scarcity of homogeneous material; D, = 5.36 g/cm³. In plane-polarized incident light, andreadiniite is white with a slight yellow bronze tint. No internal reflections, and no pleochroism were observed. Birefringence is extremely weak. In crossed polars, it is weakly anisotropic, in shades of gray to bluish gray. Twinning was not observed but revealed by the X-ray study. The reflectance values in air [R, (nm) = 100x. Homeotypes with n = 100x. Homeotypes with [

**NEW MINERAL NAMES**


Arsenmedaite (IMA 2016-099), ideally Mn₆[As²⁺SiO₄(OH)](OH), monoclinic, is a new mineral discovered in the Molinello mine, Gravèglia Valley, Ne, Genova, Liguria, Italy (~N 44°40′24″; E 9°27′32″) in small quartz veinlets, a few millimeters in thickness, cutting the braunite ore bodies hosted by Jurassic metacherts (“Diaspri di Monte Alpe” Formation). The ore contains polyphase mineral assemblages of manganese, metamorphosed under prehnite–pumpellyite facies (P = 0.25 ± 0.05 GPa, T = 275 ± 25 °C) followed by hydrothermal mobilization along fractures under decreasing thermobaric conditions, which led to further concentration of dispersed elements such as As, V, and Te in extensional fractures. Arsenmedaite has been found associated with braunite, quartz, calcite, As-rich medaite, calcian rhodochrosite, talc, and gonanphylite. The mineral forms orange-reddish prismatic crystals, up to 200 μm, with a vitreous luster and a white streak. Arsenmedaite is brittle, with a good {100} cleavage and a parting normal to the elongation; fracture is irregular. Hardness, density, and optical properties were not measured due to small amount of available material; D, = 3.772 g/cm³ and n, = 1.766. The Raman spectra (between 200 and 1200 cm⁻¹) is, within experimental uncertainties, very similar to that of medaite. It shows bands (cm⁻¹): 355 (overlapping of the symmetrical bending of AsO₄ groups and the Mn–O stretching and bending vibrations), 650 (bending modes of Q²Si-centered tetrahedra), 853s and 875s (symmetrical stretching of AsO₄ groups and Q¹Si-centered tetrahedra), 771s (antisymmetrical stretching of the AsO₄ groups). Weak bands between 922 and 995 cm⁻¹ could be related to the symmetrical stretching of Q¹Si-centered tetrahedra. The average of 10 WDS electron probe analyses [wt%, (range)] is: V₂O₅ 1.84 (1.26–2.40), As₂O₅ 6.81 (5.30–9.54), SiO₂ 38.75 (37.73–39.41), CaO 0.70 (0.62–0.76), MnO 50.28 (50.04–50.63), H₂O 1.42 (1.18–1.55) [by electroneutrality], total 99.80. The empirical formula based on 12 cations pfu (except H⁺) is (Mn₆₃₄Ca₈₃₆Mg₃₄Fe₃₄V₃₄Si₅₄O₁₇₆(OH)₁₃₄)O₅₁₄(OH)₁₃₄. Gandolfi camera test was unsuccessful. The strongest lines in the calculated X-ray powder diffraction pattern are [d, Å (i; hkl)]: 3.719 (ms; 241, 21), 3.406 (s; 341, 231), 3.277 (s; 502, 502), 2.885 (s; 243, 243), 2.740 (ms; 343, 343), 2.131 (ms; 800), 2.055 (s; 841, 841), 1.788 (s; 582, 582). The single-crystal X-ray data shows andreadiniite has monoclinic pseudo-orthorhombic unit cell, space group P2₁/c, a = 19.0982(14), b = 17.0903(11), c = 13.0008(10) Å, β = 90.083(4)°, V = 4423.3 Å³, Z = 2. The crystal structure was refined to R, = 0.067 for 9756 F,=4n(F) reflections. The structure contains 20 independent cation sites and 24 S sites, a fourfold superstructure with respect to the short 4 A axis of the substructure and can be described as formed by alternation of (311)ₙₙₙ slabs, four octahedra thick along (100)ₙₙₙ and unit-cell twinned by reflection on (311)ₙₙₙ planes. Two kinds of (311)ₙₙₙ slabs indicated as “central” (C) and “marginal” (M) owing to its positions in the unit-cell. Small chemical differences between the two slabs induce the monoclinic symmetry of with a small β angle, favoring twinning and OD phenomena related to slab stacking. The crystal-chemical formula Cu₂₋₄Ag₃₋₄H₂O₆(Pb⁺₂ ± Sb₂₋₄As₂₋₄)ₙ₋₄Si₅.₃₄O₁₇.₆(OH)₁₃₄·H₂O obtained through the crystal-structure refinement is in good agreement with chemical data. The holotype specimen is deposited in the Museo di Storia Naturale, Università di Pisa, Italy. D.B.

**arsenmedaite**
Si in excess over 5 apfu and (As+V) apfu, showing that the finding of Si-dominant medaite cannot be excluded. The mineral is named owing to this chemical relationship with medaite. The holotype fragments are deposited in the of the Museo di Storia Naturale, Università di Pisa, Italy, and in the collection of the Dipartimento di Scienze della Terra, dell’Ambiente e della Vita (DISTAV), Università degli Studi di Genova, Genova, Italy. F.C.

BARWOODITE*

Barwoodite (IMA 2017-046), Mn₂(Nb⁵⁺, V⁴⁺)(SiO₄)₂(O,OH), trigonal, is a new member of the welinite group. It was discovered by Henry L. Barwood and Robert W. Stevens around 2005 at the Big Rock quarry (also known as the 3M quarry), Granite Mountain, Little Rock, Pulaski County, Arkansas (34°41′27″N, 92°17′17″W). Barwoodite is interpreted as crystallizing from pegmatitic fluids. The mineral is found in microlitic cavities in pegmatite in association with aegirine, albite, alnico, chamosite–pennantite, egglestonite, kulpetskite, muscovite, natrolite, orthoclase, quartz, and zircon. It occurs as plates to about 3 mm in diameter and 0.5 mm thick, in small vugs and only rarely exhibit hexagonal outlines with the forms {100}, {010}, and {001}. The mineral is brownish red with light orange streak and is non-fluorescent. Crystals are transparent and have vitreous luster. The mineral is brittle, with Mohs hardness ~3½. The crystal structure was solved by direct methods and refined to R = 8.2319(10), c = 4.8117(4) Å, V = 281.14 Å³; space group P3, Z = 1. The crystal structure was solved by direct methods and refined to R = 0.0246 for 7466 I > 2σ(I) reflections. The structure is based on the hexagonal close-packing of oxygen atoms with the layer sequence ABABABAB ABABABAB [001], with a AB layer pair per unit cell. The close-packed arrangement contains four different voids that can be occupied by cations in octahedral coordination (M₁a, M₁b, M₂a, and M₂b) and two different voids that can be occupied by Si in tetrahedral coordination (Si₁ and Si₂). Whereas M₁a and M₁b sites alternate along [001], yielding a chain of face-sharing octahedra, the M₂a and M₂b octahedra are each grouped in edge-sharing trimers; a single SiO₄ tetrahedron above the center of each trimer shares edges with each of the octahedra in the trimer, yielding a heteropolyhedral [M₂O₆(OH)₂(SiO₄)] unit. These units link to one another by sharing octahedra–octahedra and octahedra–tetrahedra corners and they link to M₁ octahedra in the chain by sharing octahedral edges, thereby forming a 3D framework. Barwoodite, is isostructural with welinite [Mn₂(Nb⁵⁺, Mg⁺)(SiO₄)₂(O,OH)], franciscanite Mn₂(V⁴⁺)₂[(SiO₄)₂(O,OH)₆]₆ and orebite [Mn₂(Sb⁺Fe⁺)₂(SiO₄)₂O₇]. The mineral name honors Dr. Henry ("Bumpi") L. Barwood (1947–2016), an American clay mineralogist (M.S., Auburn University) and surface chemist (Ph.D., Virginia Polytechnic Institute and State University, 1980). The four cotype specimens deposited in the collections of the Natural History Museum of Los Angeles County, California, U.S.A. F.C.

BODIEITE*

Bodieite (IMA 2017-117), ideally Bi₄(As⁴⁺,V⁴⁺)₂(SiO₄)₂, monoclinic, was first discovered in a sample collected from ore dump in the about 0.2 km west of the North Star mine (but can originate from other nearby mines: Carisa, Boss Tweed, or Red Rose), Tintic district, Juab Co., Utah, U.S.A. It was later also discovered in the dump of the Pittsburg-Liberty mine located in ~19 km NNW of the town of Bodie in the Bodie Hills volcanic field, Masonic district, Mono Co., California, U.S.A. The mineral is named for its type locality. The minerals of the Tintic district exposed polymetallic (Au-Ag-Cu-Pb) vein deposits emplaced in contact-metamorphosed dolomite. At that area the mineral occurs in vugs in quartz-baryte matrix in association with mixite, pyrite, and bismuthinite. In the Pittsburg-Liberty former gold mine (exploited a volcanogenic fault-breccia deposit emplaced in granodiorite), bodieite also occurs in vugs in quartz with embedded crystals of goldfieldite, bismuthinite, famatinite-luzonite, is closely associated with baryte, mixite, richeldsorite, and a poorly crystalline phase containing variable amounts of Cu, Fe, Bi, Te, Sb, and O. Bodieite is an oxidation-zone mineral. It shows a variety of habits. In specimen from Tintic it forms olive green blades 0.3 mm in length. In the specimens from the Pittsburg-Liberty mine, bodieite forms acicular crystals, occasionally steep pyramidal, or stepped tabular. They are elongated on [001], and show the forms: [001], [110], [111], [11T]. No twinning was observed. The crystals are transparent to translucent, colorless to yellow to green, with subadamantine to greasy luster and a white streak. Bodieite is non-fluorescent under long- and short-wave UV light. The Mohs hardness is 2. It is brittle with stepped, irregular fracture and a fair cleavage on [001]. The density was not measured due to the material was too scarce; Dₘₐₓ = 6.465 g/cm³ (6.554 for an ideal formula). Bodieite is soluble in dilute HCl at room temperature. It is biaxial (-); all refractive indices are over 2; 2Vₑₐₚ = 71.5°. The Raman spectra bands (cm⁻¹; w = weak, s = strong, sh = shoulder): 1071w, 1071w, and 978s (corresponding to SO₄ groups), 761s (TeO₃ symmetric stretching mode), 688s, 650s, 631s, 600w, 469s, 440s, 412s, 364s, 273s, 228s, 210w, 187w, 153s, 132s, 119sh (stretching and bending modes of SO₄; TeO₃; and BiO₄) groups. All spectra were featureless in the region from 4000 to 12000 indicating no evidence of OH or H₂O groups. The average of 6 electron probe WDS analyses is [wt%, (range/standard deviation)]: As₂O₃ 1.58 (1.50–1.75/0.11), Sb₂O₃ 0.25 (0.09–0.33/0.09), Bi₂O₃ 52.14 (51.51–52.62/0.40), TeO₂ 9.49 (9.22–9.56/0.15), total 97.89%. Bodieite is soluble in dilute HCl at room temperature. It is biaxial (-); all refractive indices are over 2; 2Vₑₐₚ = 71.5°. The Raman spectra bands (cm⁻¹; w = weak, s = strong, sh = shoulder): 1071w, 1071w, and 978s (corresponding to SO₄ groups), 761s (TeO₃ symmetric stretching mode), 688s, 650s, 631s, 600w, 469s, 440s, 412s, 364s, 273s, 228s, 210s, 187w, 153s, 132s, 119sh (stretching and bending modes of SO₄; TeO₃; and BiO₄) groups. All spectra were featureless in the region from 4000 to 12000 indicating no evidence of OH or H₂O groups. The average of 6 electron probe WDS analyses is [wt%, (range/standard deviation)]: As₂O₃ 1.58 (1.50–1.75/0.11), Sb₂O₃ 0.25 (0.09–0.33/0.09), Bi₂O₃ 52.14 (51.51–52.62/0.40), TeO₂ 34.52 (34.22–34.80/0.22), SO₃ 9.49 (9.22–9.56/0.15), total 97.89%. The empirical formula is (Bi₂₂₋₈,Fe₄₋₁₂,As₈₋₁₂,Te₈₋₁₂,Sb₈₋₁₂,Sn₂₋₈,Sn₂₋₈)₂(SiO₄)₂O₇ based on 10 O apfu. The strongest X-ray powder diffraction lines are [d Å (%)]: 3.125 (95; 11T), 2.858 (56; 021), 2.688 (57; 210), 2.349 (81; 300), 1.7930 (100; 212), 1.5505 (75; 140,32T), 1.4405 (59; 126,31T). The crystal structure was solved by direct methods and refined to R = 0.0246 for 7466 I > 2σ(I) reflections.
NEW MINERAL NAMES

CIROITTIITE*  
L. Bindi, C. Biagioni, B. Martini, and A. Salvetti (2016) Ciriottiite, Cu(Cu,Ag)Pb0.9(Sb,As)0.1(SAs)S50, the Cu-analogue of sterryite from the Tavagnoasco Mining District, Piedmont, Italy. Minerals 2016, 6(1), 1.

The new mineral ciriottiite (IMA 2015-027), Cu analogue of sterryite, Cu(Cu,Ag)Pb0.9(Sb,As)0.1(SAs)S50, monoclínico, has been discovered in one specimen collected at the Esperance superiore tunnel in the Tavagnoasco Pb-Bi-Zn-As-Fe-Cu hydrothermal ore district, ~50 km N of Turin, Piedmont, Italy (45.5416 N; 7.8134 E). It was found in a complex sulfide assemblage with chalcopyrite, arsenopyrite, galena, minor amounts of bismuthinite, sulfosalts (cosalite, izoklakeite-giesseiite), bismuth, and gold. Secondary alteration minerals include anglesite, azurite, langite, and parasterryite. In the holotype specimen, ciriottiite is associated with arsenopyrite and a kobellite-like mineral, within a vug of a quartz vein. Ciriottiite forms black tubular crystals, up to 150 μm and few micrometers thick with a black streak and metallic luster. It is brittle. The indentation hardness VHN50 = 203 (190–219) kg/mm², corresponding to ~3–3½ of Mohs scale. No other physical properties are given; Dcalc = 5.948 g/cm³. In reflected light, ciriottiite is light gray, distinctly anisotropic with brownish to greenish rotation tints. Internal reflections were not observed and there is no optical evidence of zonation. The reflectance values in air (Rmax/Rmin % (nm)) for COM wavelengths are: 37.8/33.2 (471.1); 35.3/31.8 (548.3), 34.7/31.0 (586.6); 32.5/27.9 (652.3). Reflectance curves for sterryite and parasterryite are similar to those of ciriottiite, but reflectance values are lower for the latter. The average of 5 spot electron probe WDS analyses [wt% (range)] is: Cu 2.33 (2.22–2.41), Ag 0.53 (0.48–0.60), Pb 0.54 (0.52–0.56), Sb 23.90 (23.77–24.05), Bi 1.75 (1.65–1.83), S 20.37 (20.07–20.22). The stoichiometry of ciriottiite is Cu0.80(Cu1.93Hg0.47Ag0.40Bi0.20)Pb0.19Sb0.09Bi0.04As0.06S50, the Cu-analogue of sterryite. Cu(Cu,Ag)Pb11(Sb,As)14, the Cu-analogue of sterryite from the Tavagnoasco Mining District, Piedmont, Italy. Minerals 2016, 6(1), 1.

CILO-OSCARKEMPFFITE*  
E. Makovicky, D. Tropa, and W.H. Paar (2018) The definition and crystal structure of clino-oscarkempffite, Ag2Pb5Sb6Bi1S26, the Cu-analogue of clino-oscarkempffite from the Tavagnoasco Mining District, Piedmont, Italy. European Journal of Mineralogy, 30(3), 569–589.

Clino-oscarkempffite (IMA 2012-086), simplified chemical formula Ag2Pb5Sb6Bi1S26 (Z = 12) or Ag2Pb5Sb6Bi1S26 (Z = 1), is a new monoclinic N = 4 member of the illimitate holomorphous series discovered in the old specimens originating from the 264 level of the Colorado vein, Animas mine, Chocaya Province, Department of Potosi, Sur Chichas, Bolivia, collected by the expeditions of W. Vaux in 1929–1930. The deposit is a typical for the hydrothermal Ag–Sn formation of Bolivia. In the upper parts of the Colorado vein, cassiterite is associated with freibergite and stannite–kësterite family members. Ore textures indicated open space filling by crystalization of ore minerals and telescoping of mineral assemblages. Clino-oscarkempffite is associated with aramaraye, oscarkempffite, arsenopyrite, ferrokësterite, freibergite, miargyrite, pyrite, and quartz. It occurs in close intergrowth with oscarkempffite forming discrete anhedral grains with different Sb/Bi ratios and aggregate portions (at least up to 1 mm) with continuous changes in this ratio. Physical and optical properties are practically indiscernible from those of oscarkempffite (Topa et al. 2016). Clino-oscarkempffite is grayish black, opaque, with metallic luster and dark gray streak. It is brittle, with irregular fracture and no observable cleavage. Indentation hardness VHN50 = 200 (189–208) kg/mm² corresponding to 3–3½ of Mohs scale. Density was not measured; Dcalc = 6.04 g/cm³. In reflected light, the mineral is grayish white, with distinct pleochroism between white and gray tones. Anisotropism is distinct with rotation tints in shades of gray. The reflectance values in air (Rmax/Rmin % (nm)) for COM wavelengths (bolded) are: 47.5/43.0 (400); 44.9/38.4 (420); 43.3/37.3 (440); 40.3/37.3 (460); 44.1/37.4 (470); 43.9/37.4 (480); 43.0/37.2 (500); 42.9/36.9 (520); 42.9/36.3 (540); 42.7/36.2 (546); 42.5/36.2 (560); 42.2/36.1 (580); 42.1/36.1 (589); 41.8/35.9 (600); 43.2/36.0 (620); 41.8/35.7 (640); 40.2/35.6 (650); 41.7/35.5 (660); 42.1/35.2 (680); 41.7/35.3 (700). The Rmax values for a bismuth-rich phase are higher by ~3% compared to oscarkempffite, with the difference varying by a wavelength. Opposite is true for the Rmin values, explained by the orientations of the optically analyzed oscarkempffite grains being far from giving maximum Δ. The average of six point WDS electron probe analyses [wt% (range)] is: Cu 0.08 (0.07–0.13), Ag 14.31 (14.11–14.42), Pb 10.66 (10.42–10.82), Bi 10.66 (10.42–10.82), Sb 21.39 (21.11–21.63), S 20.14 (20.07–20.22).

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is monoclinic, space group $P2_1/c$, $a = 39.811(25)$, $b = 19.280(12)$, $c = 8.278(5)$ Å, $\beta = 96.195(9)^\circ$, $V = 6317$ Å$^3$, $Z = 1$. The crystal structure was solved by direct methods and refined to $R = 0.0704$. It contains 30 independent cation sites and 36 distinct sulfur sites and consists as a general $N = 4$ lillianite homologue of (311)$_{min}$ slabs four octahedra thick along (100)$_{min}$ connected via unit-cell twinning on the (311)$_{min}$ planes. It is a threefold superstructure of the lillianite aristotype, with a doubled 4 Å axis and, uniquely, a triply – 13.3 Å parameter. The structure is of full of mixed cation sites. The central octahedra of the PbS-like slabs are mixed (Bi,Sn), (Sb,Bi), and Sn sites in alternation along the 8.3 Å direction, whereas in the marginal octahedral (Sn,Bi) positions alternate with distorted tetrahedra of Ag. The bicapped trigonal prisms on meeting planes of two octahedral slabs are occupied by mixed (Pb,Sn) sites. Cation occupation schemes result in blocks with monoclinic overall symmetry which alternate along [100] with blocks with orthorhombic overall symmetry. The order-disorder implications of this division are discussed. The substantial difference between formula obtained from structure refinement, $\text{Ag}_{12-2x}\text{Sn}_{2x}(\text{Pb,Sn})_x\text{S}_{72}$, and chemical data might be related to variations in Sn/Pb ratio of deeper portion of the X-rayed sample and the analyzed surface as well as to the partial, variable overlap of cation positions. The name is given because of structural and chemical similarity to orthorhombic oscarckempfite.

The holotype specimen is deposited in the Natural History Museum Vienna, Austria. D.B.

References cited
Topa, D., Makovicky, E., Paar, W.H., Stanley, C.J., and Roberts, A.C. (2016) Oscarckempfite, $\text{Ag}_{12-2x}\text{Bi}_{2x}(\text{Pb,Sn})_x\text{S}_{72}$, a new Sn-Bi member of the lillianite homologous series. Mineralogical Magazine, 80, 807–817.

ILIRNEYITE* I.V. Pekov, O.I. Siidra, Yu.S. Polekhovsky, and A.V. Apel'tan (2018) Ilirneyite, $\text{Mg}_{35}\{\text{ZnMn}^{3+}\{\text{Te}^{4+}\text{O}_3\}_3\}] \cdot 4.5\text{H}_2\text{O}$, a new mineral from Chukotka, Russia. Canadian Mineralogist, 56 (6), 913-921.

Ilirneyite (IMA 2015-046), ideally $\text{Mg}_{35}\{\text{ZnMn}\^{3+}\{\text{Te}^{4+}\text{O}_3\}_3\}] \cdot 4.5\text{H}_2\text{O}$, was discovered at the gold-silver Sentyabar'skoe deposit, Ilirney ore district, Western Chukotka, Russia. The new mineral was named for its locality, near the village of Ilirney, the Ilirney Lakes and Ilirneyveem river. Ilirneyite was found in the oxidation zone of sulfide- and telluride-bearing veins in association with gypsum, malachite, azurite, cerasite, anglesite, brochantite, linarite, postjakite, chlorargyrite, acanthite, gold, goethite, coronadite, paratellurite, raisite, and xocomeatellite. Ilirneyite occurs in intimate association with gypsum, in cracks and small cavities close to veins enriched with telluride minerals. Aggregates of the new mineral overgrow quartz, muscovite, hessite, petzite, and gold.

Most typically ilirneyite occurs as earthy films. Intertwined coatings are up to $1.5 \times 2.5$ cm and usually not thicker than 0.01 mm. Occasionally, ilirneyite forms perfect, well-terminated long prismatic hexagonal crystals (up to $0.2 \times 0.05$ mm) [100] + [101] combined in sprays or open-work chaotic groups. More commonly, it is found as moss-like, soft, friable aggregates consisting of tiny acicular to hair-like (to 0.03 $\times$ 2 μm) crystals. Ilirneyite is reddish-brown to dark brownish-red (brown to light brown in moss-like aggregates), transparent in crystals and translucent in aggregates. The streak is brown. The luster is adamantine to semi-metalllic in crystals and silky in aggregates. The micro indentation hardness VHN$_{0.2}$ = 132 (122–142) kg/mm$^2$ corresponding to $\sim 3$ of Mohs scale. The mineral is brittle, with uneven fracture and no cleavage or parting. The density was not measured due to small crystal size; $D_{calc} = 4.205$ g/cm$^3$. In reflected light ilirneyite is dark gray, weakly birefractant, non-pleochroic, and weakly anisotropic with distinct red brown internal reflections. The reflectance values in air (COM wavelengths are bolded) [$R_{min}$/R$_{max}$ (nm)] are: 7.1/8.2 (400), 7.7/8.8 (420), 7.9/9.1 (440), 7.8/9.0 (460), 7.8/9.0 (470), 7.7/8.9 (480), 7.6/8.8 (500), 7.5/8.8 (520), 7.4/8.7 (540), 7.3/8.7 (546), 7.3/8.6 (560), 7.2/8.6 (580), 7.2/8.6 (589), 7.2/8.5 (600), 7.1/8.5 (620), 7.1/8.4 (640), 7.1/8.4 (650), 7.0/8.3 (660), 7.0/8.2 (680), 6.9/8.2 (700). The average of 9 WDS analyses is [wt%, (range)]: CuO 0.58 (0.04–1.65), MgO 0.20 (3.72–8.44), ZnO 11.42 (7.4–14.85), MnO$_{total}$ 8.54 (6.16–12.91) subdivided to MnO 0.13Cu 0.05Zn 1.03Mn$_3^{3+}$, total 100.74. Ilirneyite has a hexagonal, $P6_3/m$ space group and the structure was refined to $R = 4.5%$. Ilirneyite is assigned to the zemannite structural family. Its crystal structure is based on $[\text{Me}_2(\text{TeO}_3)_3]^+$ framework built of $\text{Me}_2\text{O}_4$ dimers sharing common corners with $\text{Te}^{4+}\text{O}_4$ pyramids with the $\text{Te}^{4+}$ cation in the apex pointing into the channel. The dominant cations occupying the $\text{Me}$ sites are $\text{Zn}$ and Mn$^{3+}$ with minor Mn$^{2+}$, Cu and $\text{Te}^{4+}$. The channels in the $[\text{Me}_2(\text{TeO}_3)_3]^+$ framework are filled by chains formed by Mg cations and $\text{H}_2\text{O}$ molecules together with lone electron pairs associated with $\text{Te}^{4+}$. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. Yu.U.


Kannanite (IMA 2015-100), $\text{Ca}_6(\text{Al,Mn}^{3+},\text{Fe}^{3+})_2\text{Mg}_6\text{V}_2\text{O}_{18}$, orthorhombic, is a new Ca-dominant member of the ardenite series. It was discovered in Kannan Mountain, Ozu, Ehime Prefecture, Japan (33°3′02′′N 132°37′58″E). The metamorphic rocks of the Kannan unit consist of metamorphosed basaltic tuff and lava, metagabbro, metadolerite, and metachert, exposed to metamorphism in the pumppelyite–actinolite facies. Kannanite was found in an approximately 50 cm thick layer of iron–manganese ore in the metachert. The ore consists mainly of quartz and hematite, in association with braunite. Kannanite occurs in fine quartz veins crossing the hematite-rich part, associated to ardenite-(V). Both kannanite and ardenite-(V) are considered to be formed by the activities of metamorphic fluid accompanied with the Sanbagawa metamorphism. The mineral forms brownish orange to orange several micrometers (and rarely up to 15 μm) vitreous crystals, fragmented into anhedral grains with tabular and columnar shapes, with frequent voids. No fluorescence in UV range was observed. Cleavage is not observed but expected to be perfect on {010} by analogy with ardenite. Mohs hardness is 6. Density and optical properties were not measured, owing to the small grain size; $D_{calc} = 3.34$ g/cm$^3$, $n_{calc} = 1.788$. Kannanite is weakly pleochroic from orange to brownish orange. Of arseneametadea. In Raman spectrum peaks are evident at 300–1000 and 3000–3700 cm$^{-1}$ and by analogy with ardenite-(As) have been assigned as 371 cm$^{-1}$ (ν$_c$ symmetric bending vibrations), 421 cm$^{-1}$ (ν$_c$ out-of-plane bending modes for VO$_3$ units), 779–881 cm$^{-1}$ (VO$_3$, antisymmetric and symmetric stretching vibrations), and 3400–3600 cm$^{-1}$ (O–H stretching vibrations). The average of 12 WDS electron probe analyses on grains from a single vein [wt% (range)] is: V$_2$O$_3$ 6.04 (5.49–6.53), As$_2$O$_3$ 1.52 (1.16–1.83), Mn$_2$O$_3$ total 8.54 (6.16–12.91) subdivided to MnO 0.13Cu 0.05Zn 1.03Mn$_3^{3+}$, total 100.74. Its crystal structure is based on $\{\text{Mn}_2\text{O}_3\}_2\text{O}_9$, in accordance with structural and chemical similarity to orthorhombic oscarkempfite. The holotype specimen is deposited in the Natural History Museum Vienna, Austria. D.B.
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97.83. The empirical formula based on 28 anions and 16 cations (Si + V + As = 6) is: (Ca0.73Na0.22K0.05)Σ1.00Mo4Pb4VSbS15. The crystal structure was refined to R = 2.72% on 1244 reflections with I > 3σ(I) and Rsµ = 3.15% on 1380 reflections. The refined and analyzed crystal was assigned code 1325 in the amphibole database of the CNR-IGG in Pavia, Italy. In magnesio-hornblende ‘A’ is ordered at the T(1) site, smaller β cations (Mn,Fe,Mg) are ordered at the M(4) site and ‘R’ cations are almost ordered at the M(2) site but for a small amount of Al occurring at M(3). The A cations occur among the Σ(α), Σ(2), and A subset. The holotype material is deposited in the Museo di Mineralogia, Sistema Museale di Ateneo, University of Pavia, Italy. F.C.

References cited


MERELANITE*


Merelaniite (IMA 2016-042), ideally MoPbVSbS₅, is a new mineral species, the first Mo-essential member of the cylindrite homologous series discovered at the tanzanite gem mines in the Merelani hills near the town of Arusha, Lelatema Mountains, Manyara Region, Tanzania (~3°35’0 S, 37°03’0 E). It is named after the township of Merelani, in honor of the local miners, past and present, living and working in the region. Merelaniite might be identical to the mineral from Kayrakty, Kazakhstan (Yunulova and Kosyak 1971) and to “unnamed Pb-Mo sulfide” from the Sätte mine in Sweden (Zakrzewski et al. 1982) later listed as valid unknowns “UM1971-18-S:MoPbSb” and “UM1982-13-S:MoPb” respectively (Smith and Nickel, 2007). At Merelani it was originally noticed as “molybdenate” wires piercing chabazite crystals from (Simmonoff and Wise, 2012, 2014). Organic and vanadium rich sedimentary “black shales” of Merelani region undergone ultra high temperature (granulitic facies) metamorphism at ~1000 °C with pressures up to 10–12 kbar. The formation of large sulfide crystals associated with very crystallized “flake” graphite would suggest a high temperature. The partial coating of the sulfides and later infilling of cracks and voids by lower-grade metamorphic phases such as the zeolites and prehnite indicates these multiple phases of reworking and deformation. Merelaniite growth potentially took place between initial deformation and one or more of the retrograde events. All the specimens with identified merelaniite have been obtained from secondary mineral aggregates and has not been recorded in situ. Most of specimens appeared since the sulfide-rich “zone” with big wurtzite and alabandite crystals was mined at 2011–2013. Merelaniite was formed after alabandite and wurtzite, yet prior to quartz, calcite, prehnite, fluorapatite, zoisite (tanzanite), chabazite, and other zeolites, which have all been observed to fully or partially encapsulate fully formed merelaniite whiskers. Other associated minerals include diopside, graphite, tremolite, titanite, clausenthalite, and pyrite. Merelaniite whiskers also occur in crevices attached to the surfaces of large alabandite crystals, intimately associated with masses of loosely aggregated yet well-formed graphite crystals. Merelaniite metallic dark grey cylindrical whiskers are typically tens (up to 100) of micrometers in diameter and up to a millimeter, rarely up to 12 mm long. SEM study shows it consisting of tightly coiled layers and can be described as “scrolls” terminated in a conical shape. The mineral is opaque, non-fluorescent in UV light. It has dark gray to black streak. Whiskers are malleable, flexible with a splintery fracture. Cleavage is perfect on {001}. Hardness and density were not determined; D₆₉ = 4.895 g/cm³ (for an ideal formula). In reflected light, merelaniite is weakly pleochroic gray to white, strongly bireflectant and strongly anisotropic with pale blue and orange-brown rotation tints. The reflectance values in air [R₁/R₂ (nm)] (interpolated COM wavelengths bolded) are: 37.6/47.6
Oyonite*  
L. Bindi, C. Biagioni, and F.N. Keutsch (2018) Oyonite, AgMn\(_2\)Pb\(_4\)Sb\(_7\)As\(_4\)S\(_{24}\), a New Member of the Lillianite Homologous Series from the Uchucchacua Base-Metal Deposit, Oyon District, Peru. Minerals, 8(5), 192.

Oyonite (IMA 2018-002), ideally Ag\(_3\)Mn\(_2\)Pb\(_4\)Sb\(_7\)As\(_4\)S\(_{24}\), monoclinic, is new mineral species discovered in the specimen obtained at the mineral market, which was collected in 2010 from Nivel 890, Uchucchacua deposit, Oyon district, Catajamba, Lima Department, Peru. The mineral was named for its type locality. Uchucchacua deposit is the type locality for other four Mn-bearing sulfosalts: uchucchacuaite, benavidesite, manganooquantadleite, and menechellite. Oyonite found in association with orpiment, tennantite-tetrahedrite, menechellite, and other minerals of the system Pb-Ag-Sb-Mn-As-S, in calcite matrix. The new mineral occurs as very rare black metallic subhedral to anhedral crystals, up to 100 µm with a black streak. It is brittle with a micro-indentation hardness VHN\(_{0.10}\) = 137 (132–147) kg/mm\(^2\) corresponding to 3–3½ of Mohs scale. Density was not measured; \(D_{\text{calc}} = 5.237\) g/cm\(^3\) (5.275 for ideal formula). In reflected light, oyonite is weakly to moderately bireflectant and weakly pleochroic from dark gray to green. Internal reflections are absent. Reflectance values are provided only for the COM wavelengths \([R_{\text{maj}}, R_{\text{min}}\%] (\text{nm})\) are: 33.9/40.2 (471.1), 32.5/38.9 (548.3), 31.6/38.0 (586.6), 29.8/36.5 (652.3). The average of five electron probe WDS analysis [wt% (range)]: Cu 0.76 (0.50–1.05), Ag 8.39 (8.08–8.91), Mn 3.02 (2.89–3.22), Pb 24.70 (24.55–25.81), As 9.54 (9.11–9.82), Sb 28.87 (28.24–29.61), S 24.30 (23.63–24.71), total 99.98 with other elements below detection limits. The empirical formula based on 20 cations pfu is Cu\(_{0.38}\)Ag\(_{2.48}\)Mn\(_{1.75}\)Pb\(_{3.79}\)Sb\(_{7.55}\)As\(_{4.05}\)S\(_{24.12}\). The main X-ray powder diffraction lines are \([d (\AA; \text{hk}l)]\): 3.34 (40; T12), 3.29 (100; 520), 2.920 (40; T32), 2.860 (30; 620), 2.821 (70; T32), 2.678 (35; 332), 2.045 (50; 004). The unit-cell parameters refined from the powder data are: \(a = 19.175(1)\,\text{Å}, b = 12.7775(9), c = 8.18178(8)\,\text{Å}\). The single crystal X-ray data collected on a crystal 0.045 × 0.055 × 0.070 mm shows oyonite to be monoclinic, space group P2\(_1\)/n, \(a = 19.1806(8), b = 12.7775(14), c = 8.18790(10)\,\text{Å}, \beta = 90.471(11)^\circ\). The crystal structure is refined to a final \(R_{\text{I}} = 0.0317\) for 6272 independent reflections. Oyonite is one of the +L homologous of the lillianite homologous series. Its crystal structure is formed by the alternation of (311)\(_{\text{PF}}\) slabs, four octahedra thick along (100)\(_{\text{PF}}\) and unit-cell twinned by reflection on (311)\(_{\text{PF}}\) planes. There are 10 metal sites and 12 S sites in the unit cell. One of two independent sites with a bicapped trigonal prismatic coordination of cations in these layers. The a and b directions are parallel to the layers, and c is the layer-stacking direction; \(a_0\) is parallel to \(b_0\). The orientation of the a and b directions relative to the whisker axis is currently unknown. The commensurability ratio between \(a_0/b_0\) in merelaniite leads to 13\(\sqrt{3}/14\)H (77.58 Å with a \(\delta 0.165\) Å being the first case of \(n_0 < n_0^g\) owing to small \(H\) pseudo-layer due to Mo presence. The structural formula of merelaniite can be written as \([\text{Mn}_{60}\text{As}_{10}\text{Sb}_{20}]^{2-}\)\(\text{S}_{10}\) yielding a metal to sulfur ratio 2.3 consistent with structural and chemical data. Merelaniite is related to cylindrite and franekite by the substitutions 2S\(_{22}\) + Fe + 2Sb\(_{22}\) → 2Mo\(_{22}\) + V + Sb + and to abromavite by the mechanisms 2Bi →V\(_{22}\) + Sb and 2Sb\(_{22}\) → 4Mo\(_{22}\) + S. Samples from the holotype specimen, all of which were extracted from a single 11 cm alabandite crystal have been deposited in the collections of the: Natural History Museum, London, Great Britain; the American Museum of Natural History, New York, U.S.A.; the Smithsonian Institution’s National Museum of Natural History, Washington, D.C., U.S.A. The crystals used for the X-ray crystallographic investigations are kept at the Department of Earth Sciences, University of Firenze, Italy. D.B.
Pararaisaite*

Pararaisaite (IMA 2017-110), ideally Cu₂⁺Mg[Te⁶⁺O₄(OH)₄]·6H₂O, monoclinic, was discovered in the dumps of North Star mine (exploited polymetallic Au-Ag-Cu-Pb vein deposit), Mammoth, Tintic district, Juab Co., Utah, U.S.A. Pararaisaite is an oxidation-zone mineral, as bodite abstracted in this issue. It occurs in vugs in a massive quartz with embedded crystals of baryte and goldfieldite, with a secondary malachite. The main minerals of the ore zone include galena, cerussite, and enargite. The new mineral forms blue, striated, prismatic crystals up to 0.4 mm elongated on {100}. The forms are: {100}, {001}, {102}, {1102}, {114}. Pararaisaite is transparent, has a white streak and vitreous luster. No twinning was observed. It is nonfluorescent under long- and short-wave UV light. The Mohs hardness is 2.5. The mineral is brittle with a splintery fracture, has the perfect cleavage on {001} and good on {100}.

Pararaisaite has a monoclinic crystal system with cell parameters a = 3.984(2) Å, b = 9.120(5) Å, c = 7.480(1) Å, β = 94.2(2)°. The space group is C2/c. The density is 2.851 g/cm³ for the ideal formula.

The crystal structure of pararaisaite was solved by charge-flipping method and refined to R = 2.59%. The mineral is monoclinic, P2₁/c, a = 9.683(8) Å, b = 5.7515(19) Å, c = 17.639(12) Å, β = 100.553(6)°, V = 982.14 Å³, and Z = 4. The structure is based on [Cu²⁺Te⁶⁺O₄(OH)₄]²⁻ sheets. These sheets are based on the straight edge-sharing chains of alternating Cu²⁺O₄(OH)₂ and Te⁶⁺O₄(OH)₂ octahedra, and the chains link to one another via shared octahedral corners. Adjacent [Cu²⁺Te⁶⁺O₄(OH)₄]²⁻ sheets are linked by Mg(OH)₂, octahedra via hydrogen bonds. The mineral is named for the relation to its

Petříčekite*

Petříčekite (IMA 2015-111), ideally CuSe₂₈, orthorhombic, is a new member of marcasite group discovered at the Předbořice uranium deposit, Central Bohemia Region, Czech Republic. It was also found at El Dragón mine, Potosí, Bolivia and in Sierra de Cacheuta, Mendoza, Argentina. Mineralized fissures Pararaisaite are complicated low-temperature hydrothermal veins up to 25–100 m long, 25–50 m high, and up to 30 cm (max. 1 m) thick, cutting through the metamorphic rocks close to its contact with granitoids of central Bohemian pluton. The main ore mineral is
sample from Sierra de Cacheuta for which wt% data for is not provided). The Cu-richest additionally structurally studied composition from Předbořice is (Cu0.24Fe0.76)2HgBiSe5. The composition most close to endmember from that deposit is (Cu0.5Fe0.5)2HgBi1.5Se10. The composition of the Pd-richest grain is (Cu0.31Fe0.69)Pd0.01Bi0.02Se3.26. The strongest powder-diffraction lines [d Å (hkl)] are: 3.95 (10, 20), 3.26 (20, 40), 2.99 (10, 30), 2.69 (10, 11), 2.56 (85; 120), 1.93 (70; 211), 1.84 (30; 002), 1.76 (25; 033), 1.492 (25; 122). The unit-cell parameters refined from the powder X-ray data are: a = 4.9072(3), b = 6.0101(2), c = 3.6671(5) Å, V = 108.18 Å³. The single-crystal X-ray data collected on the crystal 0.035 × 0.045 × 0.05 mm shows petříčekite is orthorhombic, space group Pmmn, a = 4.918(2), b = 6.001(2), c = 3.670(1) Å, V = 108.31 Å³; Z = 2. The crystal structure refined to R = 0.0336 for 159 F > 4σ (F²) reflections. It is a marcasite-type structure consisting of edge-sharing chains of CuSe₂, octahedra parallel to [011] linked by sharing Se₂ dimers. The Se-Se bonds are all parallel to [001]. The mineral name honors Václav Petříček (b. 1948), Czech crystallographer (Institute of Physics of the Czech Academy of Sciences, Prague), for his outstanding contributions to crystallography. The holotype is deposited in the Mineralogical and Geological Museum at Harvard, U.S.A. D.B.

**Quijarroite**


Quijarroite (IMA 2016-052), ideally Cu₆HgPb₂Bi₄Se₁₂, orthorhombic, is a new species discovered at the El Dragón mine, Antonio Quijarro Province, Department of Potosí, Bolivia and named for its type locality. The almost vertical ore vein is in the center of a 1.5 m wide sheared zone thinly stratified, pyrite-rich black shales and reddish-gray, hematite-bearing silstones of probably Devonian age. Selenium mineralization consisted of a single vein ~15 m long and mostly 0.5 to 2 cm thick and represents a multi-phase assemblage of primary and secondary minerals enriched with Se-bearing species. It is the type locality of eldragónite, Cu₅HgPb₂Bi₄Se₁₀ for which no structural data was provided and might be a polymorph of “Bi-rich petrovicite” Cu₆.₅Hg₀.₉₆Pb₂.ₐ₄Bi₃.₇₂Se₁₂ (Dymkov et al. 1990). Quijarroite mostly forms lath-shaped, thin elongate parallel to [001], Cu₅HgPb₂Bi₄Se₁₀, 3.785 (60; 211), 3.331 (40; 202), 3.291 (90; 222), 3.125 (100; 212), 2.512 (50; 200), 2.078 (35; 214). Unit-cell parameters refined from the powder X-ray data are a = 9.2576(8), b = 9.0176(7), c = 9.6198(8) Å, V = 801.34 Å³. Single crystal X-ray data obtained from a crystal fragment 0.035 × 0.045 × 0.05 mm shows quijarroite is orthorhombic, space group Pnnm, a = 9.2413(8), b = 9.0206(7), c = 9.6219(8) Å, V = 802.1 Å³; Z = 1. The crystal structure refined to R = 0.0276 for 1523 [F² > 4σ(F²)] reflections. It is a galena derivative and its structure can be derived from that of bouronite. Polycrystal by Pb, Bi trigonal pyramids, and Cu tetrahedra share corners and edges to form a three-dimensional network. CuSe₂, tetrahedra share corners to form chains parallel to [001]. In quijarroite only one of the two Pb positions of bouronite (2b Wyckoff position) is occupied by Pb, whereas the second is vacant and replaced by a general position occupied by Cu and Hg (with site population: Cu₂, Hg₀.₆₂Bi₂, showing almost perfect linear coordination. Comparing with bouronite, the structural formula of quijarroite can be written as [Cu₆₋ₓHgx]₆₋ₓ[Cu₅HgPb₂Bi₄Se₁₂] (Z = 4), for which Z = 1 is equivalent to Cu₆HgPb₂Bi₄Se₁₂. The X-rayed crystal fragment is deposited in the Florence Museum, Italy. The polished section, from which the holotype crystal fragment was extracted, is housed in the Natural History Museum, London. The cotype is deposited within the Mineralogische Staatssammlung München, Museum “Reich der Kristalle,” Germany. D.B.

**Staročeskéite**


Staročeskéite (IMA 2016-101), ideally Ag₀.₉₄Pb₀.₆₆Bi₁₃₀.₃₈Sb₁₃₁₀.₃₉S₁₀, orthorhombic is a new member of lillianite homologous series of sulfoarsenates with N = 4. It has been discovered at the medieval mine damps of Staročeské písmo Lode of the Kutná Hora ore district, 60 km east of Prague, Central Bohemia, Czech Republic. Originally compositions corresponding to staročeskéite were detected in 2005. Then it was considered as an intermediate member between gustavite and andorite-group minerals. Later the structure was solved (Pažout and Dušek 2010) but the phase was only recognized as a new mineral species after the description of the other new Bi-Sb member of the lillianite homologous series: terrywallaceite from Huancavelica, Peru (Yang et al., 2013). The Kutná Hora Ag-Pb–Zn ore district contains a hydrothermal vein type mineralization of Variscan age. It was one of the main European producers of silver in the 14th to 16th centuries, with hundreds of mines on twelve major lodes each of those representing a hydrothermally altered zone of several hundred meters to about 3 km long and dozens of meters wide, with the depth range between several hundred meters to 1 km, each consisting of several, usually parallel veins. The new mineral was found in quartz gangue in the rich Ag-Pb–Bi–Sb sulfoarsenate association and was formed in the late-stage Bi-mineralization associated with other lillianite homologues (gustavite, terrywallaceite, vikingite, treasurite, eskimoite, erzweisenite, Bi-rich fízélyite, and Bi-rich ramdohrite) along with Ag- and Bi-bearing galena and Pb–Bi–Sb sulfoarsenates (izoklakeite, cosalite, and Bi-rich jamesonite). The origin of this mineralization is related to the penetration of low-temperature fluids (~100–250 °C) into tectonically opened fractures in older ore vein fillings (pyrite, pyrite, pyrite, pyrite, pyrite, pyrite, pyrite).
arsenopyrite and stannite). Staročeskéite forms lath shaped crystals or anhedral grains up to 80 µm × 70 µm, growing together in aggregates up to 200 µm × 150 µm across. It is steel-gray with a metallic luster. No other data on physical properties is provided; \( D_{\text{calc}} = 6.185 \text{ g/cm}^3 \). In reflected light staročeskéite is grayish white; bireflectance and pleochroism are weak with grayish tints. Anisotropy is weak to medium with gray to bluish gray rotation tints. Internal reflections were not observed. The reflectance values in air \( R_{\text{air}}/R_{\text{calc}} \) (nm) (COM wavelengths bolded) are: 41.6/39.3 (400), 41.7/39.7 (420), 41.6/39.6 (440), 41.0/39.2 (460), 40.8/39.0 (470), 40.5/38.7 (480), 40.2/38.4 (500), 39.8/38.0 (520), 39.5/37.7 (540), 39.4/37.6 (546), 39.2/37.4 (560), 38.9/37.1 (580), 38.8/37.1 (589), 38.7/37.0 (600), 38.5/36.8 (620), 38.4/36.8 (640), 38.3/36.7 (650), 38.4/36.7 (660), 38.3/36.6 (680), 38.1/36.5 (700). The average of five WDS electron probe analyses [wt% (range)] is: Ag 7.02 (6.61 – 7.51), Cu 0.05 (0.04 – 0.07), Fe 0.05 (0.04 – 0.05), Pb 31.09 (29.67 – 31.82), Cd 0.10 (0.08 – 0.12), Bi 0.05 (0.04 – 0.07), Pb 31.09 (29.67 – 31.82), Cd 0.10 (0.08 – 0.12), Bi 0.05 (0.04 – 0.07), Pb 31.09 (29.67 – 31.82), Cd 0.10 (0.08 – 0.12), Bi 0.05 (0.04 – 0.07), Pb 31.09 (29.67 – 31.82), Cd 0.10 (0.08 – 0.12), Bi 0.05 (0.04 – 0.07), Pb 31.09 (29.67 – 31.82), Cd 0.10 (0.08 – 0.12). The holotype specimen has been deposited in the Department of Mineralogy and Petrology of National Museum in Prague, Czech Republic. D.B.

References cited


Topsøeilite*  

Topsøeilte (IMA 2016-113), ideally FeF(H₂O)₃, tetragonal, was discovered in the fumaroles of the Hekla Volcano, Iceland, in the specimen collected in 1992 after the 1991 eruption. The temperature in the fumarole at the time of sampling was 170 °C. A preliminary description was given by Jakobsson et al. (2008) under the name HI (UM2008-30-F:FeHIO). Topsøeilte forms short, pseudocubic tetragonal prisms up to several tens of micrometers, crystal aggregates up to 100 μm, or fractured veins inside up to 3 mm thick yellow to brown crust altered scoria, together with hematite, opal, mallardite, heklaite, ralstonite, and several other not fully characterized minerals. Topsøeilte is yellow with irregular fracture and no prominent cleavage observed. Density and optical properties were not measured due to tiny size of crystals and intimate admixture with other minerals; Dcalc = 2.067 g/cm³. For an ideal formula Dcalc = 2.330 and ncalc = 1.63. The averaged 11 point electron probe EDS analyses on unpolished surface is [wt% (range/standard deviation)]: Fe 38.52 (33.50–42.92/3.34), F 38.23 (33.20–43.67/3.48), Cl 1.03 (0.41–1.64/0.42), O 21.10 (15.29–26.20/4.00), total 98.88. The empirical formula based on one atom of Fe plus Fe₂⁺ is Fe₂⁺₀.₃₅(Fe²⁺₀.₆₅H₂O)ₐₙ₋₁(H₂O)ₙ. The strongest lines of the powder X-ray diffraction pattern are [d Å (R%; hkl)]: 5.55 (100; 110), 3.92 (43; 020), 3.47 (39; 011), 3.17 (22; 111), 2.77 (30; 220), 2.479 (31; 130,310), 1.877 (16; 012), 1.753 (24; 240,420). The crystal structure of topsøeilte was solved and refined by the Rietveld method to Rw = 3.98%. Topsøeilte is tetragonal, P4/mn, a = 7.8381(3), c = 3.8674(1) Å, V = 237.60 Å³, Z = 2. The X-ray data matches well with that of synthetic β-FeF₂(H₂O), the structure consists of straight infinite β-FeF₂(H₂O)₃ octahedra extending along the c axis. The adjacent octahedra share apical F atoms. Four unshared, equatorially positioned H₂O groups is not directly coordinated to Fe atoms but bonded only by hydrogen bonds. That might explain the deficit of the water obtained by the chemical analysis assuming that the crystal structure can be partially dehydrated. Topsøeilte is isostructural with rouxelitite Cu₂HgPb₂2Sb₂₈S₆₄(O,S)₂. It consists of an alternation > 3σ(RI)

References cited

Tsyganokite*  

Tsyganokite (IMA 2017-088), ideally Mn₅TlHg(Sb₄Pb₂Tl)₂S₄₋₁S₅, monoclinic, is a new sulfosalts discovered at the Vorontsovskoe gold deposit, near the settlement of Vorontovka, 13 km south of Krasnotur’insk city, North Urals, Russia. General data on the occurrence and mineral assemblages of the deposit are given in the abstract for other two new minerals recently discovered there: vorontsovite and ferrovorontsovite (see below). Along with these new species tsyganokite was found in the ores of the sulfide-carbonate type and was identified only in three polished sections. Tsyganokite occurs as lath-like elongated crystals up to 0.2 mm embedded in calcite–dolomite–clinoclase matrix. Occasionally it partly replaced with alabandite. The associated minerals also include aktashite, arsenopyrite, barite, cinnabar, fluorapatite, orpiment, pyrite, realgar, routherite, sulphelite, tilasite, and tatanite. The new mineral is black, opaque with a metallic luster and black streak. It is brittle with an uneven fracture and no obvious parting and cleavage. The micro indentation hardness VHN₉₀ = 144 (131–167) kg/mm², corresponding to ~3 of Mohs scale. The density was not measured; Dcalc = 5.450 g/cm³. In reflected light, tsyganokite is white, non-pleochroic. It is weakly bireflectant and strongly anisotropic with rotation tints vary from light gray to dark gray to black. No internal reflections were observed. The reflectance values in air [R̃/R (nm)] (COM wavelengths bolded) are: 33.85/30.53 (400), 36.64/30.94 (420), 32.39/30.72 (440), 32.88/31.56 (460), 33.16/31.67 (470), 33.44/31.78 (480), 33.22/31.71 (500), 32.84/31.49 (520), 32.53/31.26 (540), 32.41/31.11 (546), 32.26/31.00 (560), 31.89/30.54 (580), 31.58/30.18 (589), 31.51/30.14 (600), 30.95/29.83 (620), 30.27/29.10 (640), 29.83/28.73 (650), 29.37/28.39 (660), 28.29/27.58 (680), 27.41/26.74 (700). The average of seven X-ray WDS electroprobe analyses [wt% (range)] is Mn 6.29 (6.15–6.40), Hg 5.42 (5.31–5.58), Ti 26.05 (25.52–25.63), Pb 5.84 (5.01–6.34), As 3.39 (3.15–3.72), Sb 30.89 (30.32–31.39), S 21.87 (21.40–22.40), total 99.75. The empirical formula, based on 90 apfu, is Mn₈.₀₆Tl₈.₉₇Hg₁.₉ₐSb₁₇.₈₆(Al₂S₄₋₁S₅). Certain disagreement with chemical data is explained either by slightly distinct chemistry of the grains used for EMPA and SCXRD or by less perfect resolution of Sb/As and Sb/Pb + As/Pb. Mixed cations were found with either heavier Pb or Tl cations or with arsenic. Embedded in this array is a Tl₃ site, Mn⁺⁺ site, apical to the second array. The simplified formula based on structure refinement is Mn₅TlHg(Sb₄Pb₂Tl)₂S₄₋₁S₅ (Sb₈₈Pb₂Tl₁S₅₋₁S₆₋₁). Certain disagreement with chemical data is explained either by slightly distinct chemistry of the grains used for EMPA and SCXRD or by less perfect resolution of Sb/As and Sb/Pb + Sb/Tl distribution among the Sb sites. The mineral name honors Mikhail Vladimirovich Tsyганенко (b. 1979), a mineral collector from city of Severouralsk, Northern Urals, Russia and founder of the Mineralogical museum in that city. He collected the specimens where the new mineral was discovered along with other specimens where new species vorontsovite and ferrovorontsovite were found. The type specimen is deposited in the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia. D.B.

Vorontsovite® and Ferrovorontsovite®  
A.V. Kasatkin, F. Nestola, A.A. Agakhanov, R. Škoda, V.Y. Karpenko, M.V. Tsyganok, and J. Plášil (2018) Vorontsovite, (Hg₃Cu₂)₂TlAs₂S₄, and ferrovorontsovite, (Fe₃Cu₂)₂TlAs₂S₄. The Tl- and Fe-analogues of galkhaite from the Vorontsovskoe gold deposit, Northern Urals, Russia. Minerals. 8(5), 185.

Two new mineral species, vorontsovite (IMA 2016-076), (Hg₃Cu₂)₂TlAs₂S₄, and ferrovorontsovite (IMA 2017-007), (Fe₃Cu₂)₂TlAs₂S₄, the Tl- and Fe-analogues of galkhaite, have been discovered at the
Vorontsovskoe gold deposit, near the settlement of Vorontsovo, 13 km south of Krasnotur’insk city, North Urals, Russia. The specimens were found in 2016 at the ore stockpile. Earlier, the composition with Tl slightly dominant over Cs pfu, thus corresponding to vorontsovite, was reported (Chen and Szymański 1981) in one spot in the core of zonal galakhite crystal from the Getchel mine, Nevada, U.S.A. It was noted however that peak overlapping and the lack of suitable standards might affect the accuracy of the chemical data. Vorontsovskoe deposit is located in a volcanic-plutonic belt. Ore formation developed in several stages and represented by three main types of primary ores: sulfide-skarn ores, sulfide-silicate ores, and sulfide-carbonate ores. Both new minerals occur in the ores of the third type located in calcite-dolomite limestone breccias with subordinated quartz, feldspar, clinoclure, muscovite, accessory minerals (titanite, apatite, baryte, armenite, scheelite, gold), and sulftid assemblage: abundant pyrite, realgar, stibnite, cinna balance, less common orpiment, Hg-sphalerite, and Zn–Mn-bearing metacinnabar, rare wakabayashiite and coloradoite. Thallium mineralization is presented by relatively common routhierite, dalnegroite-chabournéite and parapierrotite-bertierite series. Other Tl-bearing species are extremely rare and include christite, boccardinite, enneasartorite and heptasartorite. The new minerals form black anhedral grains up to 0.5 mm (vorontsovite) and 0.2 mm (ferrovorontsovite) (usually much smaller with an average size ~0.05 mm) and their segregations up to 1 × 0.5 mm (vorontsovite) and 0.2 mm (ferrovorontsovite) (usually much smaller with an average size ~0.05 mm) and their segregations up to 1 mm embedded in white calcite-dolomite matrix. Both species are opaque, have metallic luster and black streak, are brittle with uneven fracture. Cleavage and parting were not observed. Both are non-fluorescent in UV light, and both are insoluble in 10% HCl. The indentation hardness VHN10 = 172 (166–178) kg/mm2 for vorontsovite and 170 (166–174) kg/mm2 for ferrovorontsovite, corresponding to ~3½ of Mohs scale. Density was not measured; Dcalc = 5.14 and 4.74 g/cm³ respectively. In reflected light both are light gray, isotropic. No bireflectance, pleochroism, and internal reflections were observed. The reflectance values in air [Rvorontsovite/Rferrovorontsovite % (nm)] ([COM wavelengths bolded) are: 25.62/24.90 (400); 25.82/25.02 (420); 25.97/25.21 (440); 26.20/25.43 (460); 26.31/25.54 (470); 26.42/25.64 (480); 26.54/25.87 (500); 26.95/26.11 (520); 27.21/26.41 (540); 27.30/26.49 (546); 27.55/26.71 (560); 27.87/27.06 (580); 28.11/27.26 (589); 28.30/27.47 (600); 28.70/27.52 (620); 29.06/27.83 (640); 29.28/27.90 (650); 29.47/27.98 (660); 29.98/28.39 (680); 30.44/28.83 (700). The averaged electron WDS probe analyses for vorontsovite/ferrovorontsovite (10 spots for each) [wt% (ranges)] are: Hg 35.70 (30.66–38.78)/25.13 (22.03–27.00), Fe 5.36 (3.99–4.86)/9.89 (9.08–10.88), Zn 1.26 (1.16–1.35)/1.16 (0.93–1.43), Cu 3.42 (3.28–3.75)/3.95 (3.84–4.07), Ag 0.64 (0.47–0.85)/0.45 (0.10–0.89), Tl 11.53 (10.93–12.27)/12.93 (12.22–13.55), Cs 0.35 (0–0.67)/0.44 (0.19–0.78), Pb 0.04 (0–0.11)/0.04 (0–0.09), As 15.98 (14.74–17.26)/17.83 (17.13–19.01), Sb 2.35 (1.58–2.79)/2.15 (1.59–2.85), Te 0.41 (0.36–0.49)/0.40 (0.38–0.50), S 22.70 (21.91–24.31)/24.91 (23.90–25.90), Se 0.02 (0–0.08)/0.02 (0–0.08), b.d.l., 99.76/99.28. No other elements with Z > 8 were detected. The empirical formulae, based of 23 apfu, are: [(Hg0.99Fe1.09Zn0.05Cs0.92Ag0.0190.05Sb0.27)24.04(Cu0.01Ag0.02Zn0.003)21.00(As0.135Sb0.27)24.00Sb12.00]−/[(Fe2.75Hg0.14Zn0.07)24.05(Cu0.09Ag0.02Zn0.002)21.03(Tl0.09Cs0.02)24.00(As0.125Sb0.27)24.00Sb12.00]. The strongest lines of the powder X-ray diffraction pattern are \( d_{\text{vorontsovite}} \) Å (p%)/\( d_{\text{ferrovorontsovite}} \) Å (p%, hkl); 7.28 (10)/7.22 (10, 110); 4.198 (79)/4.175 (93, 211); 2.970 (100)/2.952 (100, 222); 2.749 (66)/2.735 (57, 321); 2.572 (22)/2.562 (18, 400); 1.879 (18)/1.869 (11, 521); 1.818 (49)/1.810 (40, 440); 1.550 (31)/1.543 (24, 622). The cubic unit-cell parameters refined from the powder data are \( a = 10.2921(2)/10.2486(2) \) Å. Single-crystal X-ray data obtained from the grains of 0.015 × 0.010 × 0.010 × 0.010 × 0.010 mm confirm the cubic symmetry, space group \( \mathbf{I} \mathbf{\bar{3}}_{\text{m}} \), with \( a = 10.2956(6) \) Å, \( V = 1091.3 \) Å³, Z = 2 (vorontsovite)/10.2390(7) Å, \( V = 1073.43 \) Å³, Z = 2 (ferrovorontsovite). The crystal structures of vorontsovite/ferrovorontsovite were refined to \( R = 0.0376/0.0576 \) for 227/250 observed reflections. Both species are isosstructural with galakhite, being its Tl- and Tl–Fe analogues, respectively, and forming together the galakhite group. Similarly to galakhite, the crystal structures of vorontsovite and ferrovorontsovite are represented by three independent crystallographic sites: Tl and Cs share large 12-fold coordinated cavities; As with Sb and Se are at the top of a trigonal pyramids, the base of which is a triangle formed by S-anions; (Hg,Fe,Zn)S₄ tetrahedra form a three-dimensional framework through corner-sharing. The homovalent substitution Hg²⁺ ↔ Fe²⁺, Zn²⁺ is typical for many sulfosalts thus making possible the existence of potential Zn member of the group. Vorontsovite was named for its type locality, which name consequently honors the mining engineer Vladimir Vasilyevich Vorontsov (1842 – later than 1908). Ferrovorontsovite named as its Fe-analogue. The type specimens of both new minerals are deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. D.B.

Comments: A strong difference in accuracy of the electron probe data depend on the choice of emission lines, standards, beam focus, etc., was noted for galakhite (Chen and Szymański 1981; Pekov and Bryzgalov 2006). Particular, a defocused beam was used to avoid a sample damage. The new species were analyzed at 25 kV and 20 nA with a beam size of 1 µm. No data on the samples behavior under the beam provided. The difference in optical properties between galakhite and isosstructural new minerals seems unusual. The reflectance value for galakhite is gradually decreasing from ~ 27 to ~ 20% with the wavelength increasing from ~470 to ~700 nm and further (Gruzdev et al. 1972), while for vorontsovite/ferrovorontsovite these values are increasing from ~26/25 to ~30/29 % at the same interval. The reason for that might be in Tl behavior in the structure and deserves a special discussion.

References cited
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