

New Mineral Names*†

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This New Mineral Names has entries for nine new minerals, including clinometaborite, hughesite, kirchhoffite, mendeleevite-(Ce), parasterryite (along with new data for sterryite), rusinovite, sveinbergeite, törnroosite, and zaccariniite.

CLINOMETABORITE*

F. Demartin, C.M. Gramaccioli, and I. Camprostrini (2011) Clinometaborite, natural β -metaboric acid, from La Fossa crater, Vulcano, Aeolian Islands, Italy. Canadian Mineralogist, 49, 1273–1279.

Clinometaborite (IMA 2010-022), ideally β -HBO₂, is the monoclinic modification of metaboric acid. The mineral is named after its composition and symmetry. This new species was found as a sublimate in an active medium temperature (~250 °C) intracrater fumarole at La Fossa crater, Vulcano Island, Aeolian archipelago, Sicily, Italy. Clinometaborite forms aggregates of stout crystals up to 2 mm long in an altered pyroclastic breccia, associated with metaborite, sassolite, and adranosite. The unaltered mineral is colorless and translucent, with a vitreous luster; it becomes chalky white after some months of exposure to open air, and it transforms into orthoboric acid. The crystal habit is prismatic; twinning was not observed. The mineral is not fluorescent either under short-wave or long-wave ultraviolet radiation. It is brittle, with a perfect cleavage. The optical properties of the synthetic counterpart were reported: β -HBO₂ is biaxial (–) with $\alpha = 1.434$, $\beta = 1.570$, and $\gamma = 1.588$ ($\lambda = 589$ nm). Analyses of clinometaborite with an electron microprobe in energy-dispersive mode indicate only the presence of oxygen, a trace amount of Na due to contaminant material, and no elements with atomic number greater than 11. The infrared spectrum (recorded on a Jasco IRT-3000 spectrometer), shows absorption bands at 1194 and 1457 cm⁻¹ typical of the E' vibration modes of the BO₂ ion. No other data on chemical composition were provided. X-ray powder-diffraction data (obtained with Philips PW1830 diffractometer, CuK α radiation) provided the following unit-cell parameters: monoclinic unit-cell, space group $P2_1/a$, with $a = 7.1243(6)$, $b = 8.8468(10)$, $c = 6.7699(7)$ Å, $\beta = 93.23(1)^\circ$, $V = 426.00(6)$ Å³, and $Z = 12$. The strongest six lines of the X-ray powder-diffraction pattern [d_{obs} in Å (I_{obs} %; hkl)] are: 6.773(15; 001), 4.193(20; 111), 3.224(8; $\bar{2}01$), 3.078(100; 201), 2.702(8; 031), 2.550(10; $\bar{1}22$). Single-crystal

diffraction data were collected (using a BRUKER Apex II diffractometer, graphite-monochromated MoK α radiation) and the diffraction pattern confirmed the monoclinic lattice, space group $P2_1/a$, with $a = 7.127(2)$, $b = 8.842(3)$, $c = 6.773(2)$ Å, $\beta = 93.21(1)^\circ$, and $V = 426.1(2)$ Å³, values that virtually coincide with those of the synthetic compound. The calculated density is 2.049 g/cm³. The structure was refined to a final R_1 of 0.043 for 977 observed reflections with $I > 2\sigma(I)$. The basic structural units observed in clinometaborite are six-membered B₃O₃ rings containing two three-coordinated boron atoms and an additional boron atom in a distorted tetrahedral coordination, because of interaction with a H₂O molecule. The holotype is deposited in the Reference Collection of Dipartimento di Chimica Strutturale e Stereochimica Inorganica, Università degli Studi di Milano, Italy. **G.D.G. and F.C.**

HUGHESITE*

J. Rakovan, G.R. Schmidt, M.E. Gunter, B. Nash, J. Marty, A.R. Kampf, and W.S. Wise (2011) Hughesite, Na₃Al(V₁₀O₂₈)·22H₂O, a new member of the pascoite family of minerals from the Sunday Mine, San Miguel County, Colorado. Canadian Mineralogist, 49, 1253–1265.

Hughesite (IMA 2009-035a), ideally Na₃AlV₁₀O₂₈·22H₂O, is a new mineral species of the pascoite family from the Sunday mine, Gypsum Valley, San Miguel County, Slick Rock District, Colorado, U.S.A. The Slick Rock mining district was the location of the first uranium production in the Colorado Plateau geological province. Uranium–vanadium ore production within the Sunday mine complex is confined to the Upper Jurassic Wash Member, permeable, carbonaceous fluvial sandstone of the Morrison Formation. Within the Slick Rock district, uranium and vanadium minerals occur in ore deposits, commonly referred to as rolls, or roll-front deposits. Crystals of hughesite occur in efflorescent crusts on the sandstone walls of mine workings and in rock fractures, through the oxidation of the primary vanadium oxides corvusite and montroseite. Hughesite crystals are orange to golden orange, transparent to translucent with a subadamantine luster (upon partial dehydration, they become opaque). Crystals are platy, with one good cleavage on (001), spear-shaped or blocky, averaging 2 mm thick. Hughesite is biaxial (–), with $\alpha = 1.698(5)$, $\beta = 1.740(5)$, and $\gamma = 1.770(5)$; the measured $2V$ is 84(2)° ($\lambda = 589$ nm). It exhibits a strong $r > v$ optical axes disper-

*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-cnmmc/>.

sion, and is pleochroic with $X = Y =$ light golden yellow $< Z =$ dark golden yellow. The electron microprobe analysis (Cameca SX-50; WDS) yielded the average composition (in wt%): Na₂O 8.00, Al₂O₃ 4.63, V₂O₅ 78.51, H₂O (by difference) 8.86, with the following empirical formula (based upon V = 10 apfu and 22 H₂O molecules determined from the crystal-structure solution): Na_{2.99}Al_{1.05}(V₁₀O₂₈)·22H₂O. The density calculated from the empirical formula using the single-crystal unit-cell data is 2.29 g/cm³. A Raman spectral analysis of a single crystal of hughesite was conducted (obtained with a Renishaw InVia Raman microscope, HeNe laser 632 nm). The following intense Raman bands (in cm⁻¹) are observed at: 191.7, 200.5, 218.1, 234.6, 246.6, 269.6, 318.5, 362.8, 470.6, 595.5, 877.1, 945.4, 959.1, 971.9, 994.4, and 1007.1 with the laser beam perpendicular to the (001) cleavage surface, and 181.7, 213.7, 231.3, 259.8, 317.5, 361.8, 468.5, 591.4, 854.2, 971.8, and 999.3 with the laser beam parallel to the cleavage surface. The six strongest observed X-ray powder (MoK α radiation, Rigaku R-Axis Rapid II curved imaging plate microdiffractometer) diffraction lines are [d_{obs} in Å (I_{obs} %; hkl)]: 12.24(100; 00 $\bar{1}$), 9.408(30; 0 $\bar{1}$ 0), 8.994(28; 0 $\bar{1}$ 1), 8.246(38; 100), 3.354(18; 12 $\bar{3}$,2 $\bar{1}$ 2), 2.724(23; 20 $\bar{4}$,3 $\bar{1}$ 2,13 $\bar{3}$). Single-crystal diffraction data (collected with a Bruker APEX diffractometer, graphite-monochromated MoK α radiation) show that hughesite is triclinic, space group $P\bar{1}$, with $a = 8.668(4)$, $b = 10.295(4)$, $c = 12.908(5)$ Å, $\alpha = 105.826(9)$, $\beta = 97.899(9)$, $\gamma = 103.385(9)^\circ$, $V = 1053.0(8)$ Å³, and $Z = 1$. The crystal structure of hughesite was refined to $R_1 = 0.0496$ for 3244 observed reflections with $I > 2\sigma(I)$. It consists of two components: (1) the structural unit, which contains the decavanadate (V₁₀O₂₈)⁶⁻ polyanion, and (2) the fully hydrated interstitial complex, composed of two separate components, a Na₃(OH)₂O₂ trimer with two distinct cation sites, and a Al(OH)₂ monomer. The name of the mineral honors John Michael Hughes (b. 1952), Professor of Mineralogy at the University of Vermont. The holotype specimen, composed of numerous crystals on matrix, is deposited in the collection of the National Museum of Natural History of the Smithsonian Institution, Washington D.C., U.S.A. (NMNH 174253). **G.D.G. and F.C.**

KIRCHHOFFITE*

A.A. Agakhanov, L.A. Pautov, V.Yu. Karpenko, E. Sokolova, and F.C. Hawthorne (2012) Kirchhoffite, CsBSi₂O₆, a new mineral species from the Darai-Pioz alkaline massif, Tajikistan: description and crystal structure. *Canadian Mineralogist*, 50, 523–529.

Kirchhoffite, ideally CsBSi₂O₆, is a new silicate mineral found in the upper reaches of the Darai-Pioz River, in the area of the joint Turkestan, Zeravshan, and Alai ridges, Tajikistan. The mineral is named kirchhoffite after Gustav Robert Kirchhoff (1824–1887), the great German physicist and professor of physics at the universities of Breslau and Berlin in the second half of the 19th century, one of the founders of spectral analysis and co-discoverer (with Robert Bunsen) of cesium and rubidium. Kirchhoffite occurs as equant grains 10 to 80 μm in diameter in pale brown aggregates up to 10 cm across, which occur in quartz, and consist mainly of pectolite, with subordinate quartz, fluorite, sokolovaite, baratovite, aegirine, polyolithionite, stillwellite-(Ce),

neptunite, pekovite, senkevichite, and mendeleevite-(Ce). The mineral is transparent with a white streak and vitreous luster, and does not fluoresce under ultraviolet light. It is brittle with a conchoidal fracture, and no cleavage or parting was observed. The Mohs hardness is 6–6.5. The measured and calculated densities are 3.62(2) (Clerici solution) and 3.639 g/cm³, respectively. The mineral is uniaxial (+) with indices of refraction ($\lambda = 590$ nm) $\omega = 1.592(2)$, $\epsilon = 1.600(2)$. Electron microprobe (EDS) and ion microprobe (for B and Rb; Cameca SIMS 4f) analyses yielded the average composition (in wt%): SiO₂ 40.47, B₂O₃ 11.27, K₂O 0.11, Cs₂O 48.16, Rb₂O 0.09, for a sum of 100.10, providing the following empirical formula (based on 6 O atoms per formula unit) (Cs_{1.02}K_{0.01}) Σ 1.03B_{0.96}Si_{2.02}O₆, $Z = 16$. The six strongest observed X-ray powder (Mn-filtered FeK α X-ray radiation, Debye-Scherrer camera) diffraction lines are [d in Å (I_{obs} %; hkl)]: 3.26(100; 040), 3.48(82; 132), 2.770(67; 332,233), 2.294(41; 044), 2.109(34; 352,253), 5.32(32; 121). Unit-cell parameters, refined from the X-ray powder diffraction data with whole pattern fitting, are: $a = 13.011(2)$, $c = 12.900(2)$ Å, and $V = 2186.3(1)$ Å³. Kirchhoffite is isostructural with pollucite (ANA framework type) and therefore was refined on the basis of single-crystal X-ray diffraction data (Bruker AXS SMART APEX diffractometer with a CCD detector; MoK α radiation) starting from the atom coordinates of tetragonal pollucite in the space group $I4_1/acd$ (origin choice 2) [$a = 13.019(2)$, $c = 12.900(3)$ Å, $V = 2186.3(1)$ Å³] to $R_1 = 3.1\%$ for 487 reflections with $F_o > 4\sigma(F_o)$. In the crystal structure of kirchhoffite, the main structural unit is a framework of SiO₄ and BO₄ tetrahedra identical to that in tetragonal pollucite. In the framework, there are two secondary building units: four-membered rings of Si tetrahedra and six-membered rings of four Si-tetrahedra and two B-tetrahedra. The framework contains additional distorted eight-membered rings. The interstitial Cs atoms occur in the channel formed by six-membered rings along [111]. The new mineral and name have been approved by the CNMNC IMA (IMA 2009-094). The holotype specimen has been deposited in the Fersman Mineralogical Museum, Moscow, Russia. **F.C. and G.D.G.**

MENDELEEVITE-(CE)*

L.A. Pautov, A.A. Agakhanov, V.Yu. Karpenko, E.V. Sokolova, and F.C. Hawthorne (2013) Mendeleevite-(Ce), Cs₆(REE₂₂Ca₆)(Si₇₀O₁₇₅)(OH,F)₁₄(H₂O)₂₁, a new mineral from the Darai-Pioz massif, Tajikistan. *Doklady Akademii Nauk*, 452(4), 441–444 (in Russian). English translation: *Doklady Earth Sciences*, 452(2) 1023–1026.

E. Sokolova, F.C. Hawthorne, L.A. Pautov, A.A. Agakhanov, and V.Yu. Karpenko (2011) The crystal structure and crystal chemistry of mendeleevite-(Ce), (Cs, \square)₆(\square ,Cs)₆(\square ,K)₆(REE,Ca, \square)₃₀(Si₇₀O₁₇₅)(H₂O,OH,F, \square)₃₅, a potential microporous material. *Mineralogical Magazine*, 75(5), 2583–2596.

Mendeleevite-(Ce), ideally (Cs, \square)₆(\square ,Cs)₆(\square ,K)₆(REE,Ca, \square)₃₀(Si₇₀O₁₇₅)(H₂O,OH,F, \square)₃₅, is a new mineral found in the moraine of the Darai-Pioz glacier, at the junction of Alai, Zeravshan, and Turkestan mountain ridges, Tajikistan. The complexity of the structure of this mineral, and its potential as a microporous material, has been acknowledged by naming mendeleevite in honor of Dmitriy Ivanovich Mendeleev

(1834–1907), the eminent Russian chemist who created the Periodic Table of Elements. Mendeleevite-(Ce) was found in nest-like segregations of a polymineral aggregate composed of brownish-gray fine-medium granular pectolite with subordinate amounts of quartz, aegirine, and fluorite, in a quartz-rich rock with sogdianite, stillwellite-(Ce), reedmergnerite, leucosphenite, aegirine, polythionite, microcline, pyrochlore, and turkestanite. Other associated minerals are hyalotectite, sokolovaite, kirchhoffite, pekovite, neptunite, and zeravshanite. Mendeleevite-(Ce) forms usually colorless, but sometimes clear tea color, individual well-formed cubic crystals with a size of 10–30 μm , while relatively large (up to 100 μm) segregations associated with zeravshanite and light-green aegirine are rare. Streak is white. The luster is vitreous. The mineral is fragile with conchoidal fracture, and cleavage was not observed. The Mohs hardness is 5–5.5. The microhardness (average from 10 measurements) is $\text{VHN}_{50} = 613$ (508–655). The measured and calculated densities are 3.12(2) (Clerici solution) and 3.07 g/cm^3 , respectively. The mineral is isotropic with a refractive index of $n = 1.578(2)$. Electron microprobe analyses (EDS), yielded the average composition (in wt%): SiO_2 43.52, Ce_2O_3 19.24, La_2O_3 9.87, Nd_2O_3 5.62, Pr_2O_3 2.63, Sm_2O_3 0.58, Gd_2O_3 0.38, CaO 2.71, SrO 1.07, Cs_2O 8.64, K_2O 1.08, F 1.34, H_2O 4.25, ($\text{O}=\text{F}$ –0.56), total 100.37, providing the following empirical formula (based on $\text{O}+\text{F}$ 120 apfu) $\text{Cs}_{5.94}\text{K}_{2.22}[(\text{Ce}_{11.35}\text{La}_{5.86}\text{Nd}_{3.23}\text{Pr}_{1.54}\text{Sm}_{0.32}\text{Gd}_{0.20})_{\Sigma 22.50}(\text{Ca}_{4.68}\text{Sr}_{1.00})_{\Sigma 5.68}]_{\Sigma 28.18}\text{Si}_{70.12}\text{O}_{203.17}\text{H}_{45.67}\text{F}_{6.83}$, $Z = 2$, with H_2O and OH calculated from structure refinement ($\text{OH} + \text{F} = 17$ pfu; $\text{H}_2\text{O} = 17.75$ pfu). The infrared spectrum of mendeleevite-(Ce) is poorly resolved and in the area of stretching and bending vibrations of silica-oxygen anion has absorption bands at 1013, 978, 693, and 548 cm^{-1} , as well as characteristic absorption bands of molecular H_2O : 3400 (stretching vibrations) and 1610 (bending vibrations) cm^{-1} . The six strongest observed X-ray powder diffraction lines are [d in \AA (I_{obs} %; hkl): 10.95 (100; 002), 3.46 (40; 206,026), 3.097 (50; 345,435,055), 3.068 (40; 155), 2.190 (30; 00 10,608)]. Unit-cell parameters refined from the X-ray powder diffraction data with whole pattern fitting are: $a = 21.909(1)$ \AA , and $V = 10516.4(9)$ \AA^3 . The crystal structure of mendeleevite-(Ce) was solved by direct methods on the basis of single-crystal X-ray diffraction data in the space group $Pm\bar{3}$ [$a = 21.9148(4)$ \AA , $V = 10525(1)$ \AA^3 , $Z = 2$] and refined to $R_1 = 4.15\%$ for 2274 reflections with $F_o > 4\sigma(F_o)$.

The crystal structure of mendeleevite-(Ce) is an intercalation of two independent Si-O radicals and an M framework of (REE,Ca) polyhedra. The Si-O radicals form an $(\text{Si}_{104}\text{O}_{260})^{104-}$ framework and an $(\text{Si}_{36}\text{O}_{90})^{36-}$ cluster that do not link directly. The M framework is located between the Si-O framework and the Si-O clusters. Interstitial cations occupy two types of cages and channels. Cages I and II are 78 and 22% occupied by Cs. Channels along $[100\bar{0}]$ ($\bar{0}$ indicates permutation of indices: 100, 010, 001) contain K atoms and H_2O groups. Mendeleevite-(Ce) has no natural or synthetic structural analogues. Mendeleevite-(Ce) is a framework mineral with large cavities and it has the potential to be used as a model for the synthesis of microporous materials of industrial interest. The mineral and name have been approved by the CNMNC (IMA 2009-092). The holotype is deposited in Fersman Mineralogical Museum RAS, Moscow, Russia. **F.C. and G.D.G.**

PARASTERRYITE*; STERRYITE (NEW DATA)

- Y. Mořlo, P. Orlandi, C. Guillot-Deudon, C. Biagioni, W. Paar, and M. Evain (2011) Lead-antimony sulfosalts from Tuscany (Italy). XI. The new mineral species parasterryite, $\text{Ag}_4\text{Pb}_{20}(\text{Sb}_{14.5}\text{As}_{9.5})_{\Sigma 24}\text{S}_{58}$, and associated sterryite, $\text{Cu}(\text{Ag,Cu})_3\text{Pb}_{19}(\text{Sb,As})_{22}(\text{As-As})\text{S}_{56}$, from the Pollone mine, Tuscany, Italy. *Canadian Mineralogist*, 49, 623–638.
- Y. Mořlo, C. Guillot-Deudon, M. Evain, P. Orlandi, and C. Biagioni (2012) Comparative modular analysis of two complex sulfosalts structures: sterryite, $\text{Cu}(\text{Ag,Cu})_3\text{Pb}_{19}(\text{Sb,As})_{22}(\text{As-As})\text{S}_{56}$, and parasterryite, $\text{Ag}_4\text{Pb}_{20}(\text{Sb,As})_{24}\text{S}_{58}$. *Acta Crystallographica Section B*, 68, 480–492.

Parasterryite (IMA 2010-033), ideally $\text{Ag}_4\text{Pb}_{20}(\text{Sb}_{14.5}\text{As}_{9.5})_{\Sigma 24}\text{S}_{58}$, is a new mineral species from the Pollone barite-pyrite-(Pb-Zn-Ag) deposit at Valdicastello Carducci, near Pietrasanta, Apuan Alps, Tuscany, Italy (43°57' N; 10°16' E). It has been discovered during the study of specimens with sperryite for which it is second world occurrence and this find led to a crystal structure study. Parasterryite was named for the similarity to sterryite. Those minerals are indistinguishable macroscopically nor by their optical properties under reflected light. Both species were found in vugs within barite-quartz veins embedded in barite-pyrite lenses in close association with acanthite, famatinite, geocronite-jordanite, pyrrargyrite-prustite, Sb-rich rathite, sphalerite (overgrowth on sterryite), tetrahedrite, and xanthoconite. Owyheite and boulangerite are also known at the deposit. Parasterryite forms black metallic needles up to 4×0.3 mm elongated and striated along a axes (while sterryite is more common and exceptionally rich up to 3 cm in length). It is brittle, with a conchoidal fracture, and a poor cleavage perpendicular to the elongation. In reflected light the mineral is white with no internal reflections and is weakly pleochroic from grayish white to white. Anisotropism is distinct even in air with gray to dark gray (with brownish and greenish hue) rotation tints. Extinction is oblique (20–30°). Lamellar twinning is present parallel to the elongation (also observed for sterryite). Two Vickers hardness indentations gave $\text{VHN}_{25} = 196$ and one $\text{VHN}_{10} = 238$ kg/mm^2 . That corresponds to Mohs hardness 3–4. The density could not be measured due to the scarcity of the material; D_{calc} (for an ideal formula) is 5.747 g/cm^3 . The reflectance has been measured in air and in oil ($n = 1.515$) on a section parallel to the elongation. The curves slightly decrease with a wavelength increasing (400–700 nm). The reflectance values for (COM) wavelengths [$R_{1\text{air}}$, $R_{2\text{air}}$ and $R_{1\text{oil}}$, $R_{2\text{oil}}$ (%), (nm)] are: 35.1, 40.8 and 19.4, 22.2 (470); 33.5, 39.3 and 19.3, 21.7 (586); 32.7, 38.2 and 18.7, 21.1 (586); 31.4, 36.5 and 17.3, 19.5 (650). The optical data are similar to those of scainiite, pillaitite, and pellouxite. The average (range) of 32 electron microprobe analyses (wt%) is: Cu 0.09 (0.06–0.11), Ag 4.36 (4.22–4.43), Hg 0.15 (0.12–0.18), Pb 47.00 (46.83–47.32), Sb 19.57 (19.25–19.80), As 7.73 (7.59–8.18), S 20.56 (20.48–20.65); total 99.46 (99.20–99.77), which corresponds to $\text{Cu}_{0.13}\text{Ag}_{3.65}\text{Hg}_{0.07}\text{Pb}_{20.41}\text{Sb}_{14.49}\text{As}_{9.25}\text{S}_{57.72}$, based on a total number of cations of 48 apfu. For two samples of sperryite the average (wt%): (1) Sb-rich: Cu 1.27(1), Ag 2.19(11), Hg 0.55(5), Tl 0.56(8), Pb 44.76(25), Bi 0.26(7), Sb 24.71(11), As 5.33(9), S 20.47(11), total 100.10; and (2) Sb-

poor: Cu 0.73(4), Ag 4.12(13), Pb 44.58(16), Sb 20.84(22), As 8.27(12), S 20.92(7), total 99.47 corresponding (based on 47 apfu total cations) to (1) $\text{Cu}_{1.75}\text{Ag}_{1.78}\text{Hg}_{0.24}\text{Tl}_{0.24}\text{Pb}_{18.90}\text{Bi}_{0.11}\text{Sb}_{17.76}\text{As}_{6.23}\text{S}_{55.85}$ and (2) $\text{Cu}_{0.98}\text{Ag}_{3.29}\text{Pb}_{18.51}\text{Sb}_{14.72}\text{As}_{9.50}\text{S}_{56.13}$. Ideally $\text{Cu}(\text{Ag,Cu})_3\text{Pb}_{19}(\text{Sb}_{18-15}\text{As}_{4-7})_{522}(\text{As-As})\text{S}_{56}$. Powder X-ray diffraction pattern of parasperryite was obtained on a single crystal fragment. The strongest lines [d_{obs} in Å (I_{obs} %; hkl)] are: 3.62 (100; 075, 0.1.12, 234, 234), 3.42 (45; 244, 244), 3.35 (95; 0.1.13), 3.23 (65; 078), 3.01(45; 239, 239), 2.945 (85; 088), 2.885 (80; 2.3.10), 1.916 (45; 2.13.0). The general distribution and intensities of diffraction lines of parasterryite and sterryite are similar, however full powder diffraction patterns are significantly different and allow distinguishing those two species univocally. A single-crystal X-ray study of parasterryite indicates monoclinic symmetry, space group $P2_1/c$, with a pseudoorthorhombic unit cell $a = 8.3965(5)$, $b = 27.9540(4)$, $c = 43.8840(13)$ Å, $\beta = 90.061(12)^\circ$, $V = 10300(3)$ Å³, $Z = 4$. The single-crystal X-ray data for Sb-rich sterryite show it is monoclinic (originally described as orthorhombic), space group $P2_1/n$; $a = 8.1891(5)$, $b = 28.5294(13)$, $c = 42.98(2)$ Å, $\beta = 94.896(8)^\circ$, $V = 10005(3)$ Å³, $Z = 4$. Twinning plane (001) is confirmed by X-ray study for both minerals. The structures of parasterryite and sterryite are based on a block, corresponding to a complex column centred on a Pb_6S_{12} pseudotrigonal core and two “arms” (ribbons) of unequal lengths. These structures are topologically very similar, and differ in the configuration and composition of the shorter arm. In sterryite it presents a tetrahedral Cu site, and As-As pair subparallel to the a axis with approximate composition $\text{CuSb}_2\text{Pb}(\text{Pb,Sb})(\text{As-As})\text{S}_8$ (Me_7S_8). This ribbon is a bit longer in parasterryite, with composition $\text{Ag}_2(\text{Pb,As})\text{Sb}(\text{Sb,As})\text{As}_3\text{S}_{10}$ (Me_8S_{10}). The detail structural and compositional comparison of parasterryite, sterryite, owyheeite, rathite, and other lead sulfosalts is provided and discussed with conclusion that parasterryite is a complex homeotypic derivative of sterryite and both are expanded homologues of owyheeite, as their building blocks include the building block of owyheeite. It is suggested that parasterryite could be an intermediate compound between owyheeite and rathite in the phase equilibrium of the pseudoquaternary system $\text{PbS-Sb}_2\text{S}_3\text{-As}_2\text{S}_3\text{-Ag}_2\text{S}$ and Ag-poor owyheeite corresponds to a nanoscale syntactic intergrowth of lamellae of one of these homologous derivatives in a matrix of an ideal, Ag-rich owyheeite. The holotype specimens of parasterryite are deposited in the Museo di Storia Naturale e del Territorio, University of Pisa, Italy, and at the Mineralogy Museum, Ecole des Mines, Paris, France. **D.B.**

RUSINOVITE*

E.V. Galuskin, I.O. Galuskina, B. Lazic, T. Armbruster, A.E. Zadov, T. Krzykowskii, K. Banasik, V.M. Gazeev, and N.N. Pertsev (2011) Rusinovite, $\text{Ca}_{10}(\text{Si}_2\text{O}_7)_3\text{Cl}_2$: a new skarn mineral from the Upper Chegem caldera, Kabardino-Balkaria, Northern Caucasus, Russia. *European Journal of Mineralogy*, 23, 837–844.

The new mineral rusinovite (IMA 2010-072), ideally $\text{Ca}_{10}(\text{Si}_2\text{O}_7)_3\text{Cl}_2$, was discovered within a thin endocontact zone of the altered carbonate-silicate xenolith about 10 m in size enclosed in ignimbrite at Upper Chegem (Verkhnechegemskaya)

Caldera near the Lakargi Mt., Kabardino-Balkaria, Northern Caucasus, Russia. It forms spherulites in a zone composed of the fine-needles and fibrous aggregates of rusinovite, often with numerous wadalite inclusions or relicts of earlier (higher-temperature) skarn minerals: larnite, rondorfite, rankinite, pavlovskyite, cuspidine, tazheranite, baddeleyite, minerals of the kerimasite-kimzeyite-toturite, lakargiite, perovskite, and magnesioferrite. Lower-temperature associated minerals are: hillebrandite, afwillite, tobermorite, hibschite-katoite, hydrocalumite, ettringite-group minerals, trabzonite, and jennite. Rarely rusinovite replaces wollastonite. The mineral is white with a white streak, vitreous to silky, with a good cleavage on (010), and conchoidal fracture. Micro-hardness is $\text{VHN}_{20} = 320$ kg/mm², which correspond to 4–5 of Mohs scale. In thin-section, rusinovite is colorless, transparent, and nonpleochroic. The mineral is optically biaxial (–); $\alpha = 1.645(2)$, $\beta = 1.664(2)$, $\gamma = 1.675(3)$; $2V_{\text{meas}} = 75^\circ$ (10), $2V_{\text{calc}} = 75^\circ$; $X = a$ (or b), $Y = c$, $Z = b$ (or a). $D_{\text{meas}} = 2.93(1)$, $D_{\text{calc}} = 2.931$ g/cm³. The Raman spectrum of rusinovite is similar to that of rankinite. Bands of (Si_2O_7) group vibrations are dominant (cm⁻¹): 1036, 900, 652, 635, 365. The average (range) of the electron microprobe analysis (wt%) yielded: SiO_2 37.16 (36.67–37.52), CaO 57.66 (57.25–57.99), Cl 6.78 (5.56–6.98), $\text{H}_2\text{O}(\text{calc})$ 0.13, $-\text{O}=\text{Cl}$ –1.53, total 100.20 corresponding to $\text{Ca}_{9.99}\text{Si}_{6.01}\text{O}_{21}(\text{Cl}_{1.86}\text{OH}_{0.14})$. The strongest lines of the powder X-ray diffraction pattern (CoK α radiation) are [d_{obs} in Å (I_{obs} %; hkl)]: 8.47 (39; 020), 3.209 (33; 025), 3.134 (25; 130), 3.081 (100; 131), 3.030 (79; 044), 2.946 (43; 132), 2.889 (74; 006), 2.537 (74; 063). A single-crystal X-ray study of rusinovite indicates an orthorhombic unit-cell with: $a = 3.7617(2)$, $b = 16.9385(8)$, $c = 17.3196(9)$ Å, $V = 1103.56$ Å³, $Z = 2$, space group $Cmcm$. The crystal structure was refined to $R_1 = 3.18\%$. Rusinovite has an OD structure and only average structure model could be applied. The average structure exhibits extended parallel to a columns of bow-tie like (Si_2O_7) units linked by sharing of tetrahedral faces parallel to (100). Only half of these (Si_2O_7) units are occupied. The orthorhombic ($a = 3.763$, $b = 34.70$, $c = 16.946$ Å) and monoclinic ($a = 18.656$, $b = 14.112$, $c = 18.139$ Å, $\beta = 111.65^\circ$) synthetic $\text{Ca}_{10}(\text{Si}_2\text{O}_7)_3\text{Cl}_2$ are known. The latter was described (Chesnokov et al. 1994) at burnt dumps of coal mine 42, Kopeisk, Chelyabinsk region, Russia, under the name “chesofiite,” but it was not approved by CNMNC IMA as an antropogenic product. The X-ray powder diffraction pattern of rusinovite is close to those of both orthorhombic and monoclinic artificial phases. The mineral is named in memory of Vladimir L. Rusinov (1935–2007), a Russian petrologist well known for study of thermodynamics of non-equilibrium mineral systems. The holotype of rusinovite is deposited at the Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia. **D.B.**

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SVEINBERGEITE*

A.P. Khomyakov, F. Cámara, E. Sokolova, Y. Abdu, and F.C. Hawthorne (2011) Sveinbergeite, $\text{Ca}(\text{Fe}_6^{2+}\text{Fe}^{3+})\text{Ti}_2(\text{Si}_4\text{O}_{12})_2\text{O}_2(\text{OH})_5(\text{H}_2\text{O})_4$, a new astrophyllite-group mineral

from the Larvik Plutonic Complex, Oslo Region, Norway: Description and crystal structure. *Mineralogical Magazine*, 75, 2687–2702.

A new astrophyllite-group mineral sveinbergeite (IMA 2010-027), ideally $\text{Ca}(\text{Fe}^{2+}\text{Fe}^{3+})\text{Ti}_2(\text{Si}_4\text{O}_{12})_2\text{O}_2(\text{OH})_5(\text{H}_2\text{O})_4$, was discovered at the road-cut of Buer syenite pegmatite of the Larvik plutonic complex, at the Vesterøya peninsula, Sandefjord, Oslo Region, Norway. Previously the mineral was mentioned at the same location as a murmanite-like hydrous Ca-Fe-Ti-silicate under the name UK-8 (Engvoldsen et al. 1991; Andersen et al. 1996). Sveinbergeite was found in cavities in microcline where associated with magnesiokataphorite, aenigmatite, aegirine, albite, calcite, fluorapatite, molybdenite, galena, hochelagaite-like mineral and with amorphous iron and manganese oxides. It forms dark green vitreous to pearly lamellar crystals $0.2\text{--}0.5 \times 5\text{--}10$ mm and $0.01\text{--}0.05$ mm thick, which are forming rosette-like divergent groups and spherical aggregates. It is also found as scaly, radiating bronze-brown masses. The crystals are flexible and are commonly bent. The streak is pale green. The cleavage is perfect on $\{001\}$. Mohs hardness is 3; $D_{\text{calc}} = 3.152$ g/cm³. The mineral is biaxial (+), $\alpha = 1.745(2)$, $\beta = 1.746(2)$, $\gamma = 1.753(2)$ ($\lambda = 589$ nm), $2V_{\text{meas}} = 20(3)^\circ$, $2V_{\text{calc}} = 41.5^\circ$. The elongation is positive. Orientation: $X \perp (001)$, $Y \wedge b = 12^\circ$, $Z = a$. The mineral is pleochroic: $Z = \text{deep green} > X \sim Y = \text{brownish green}$. No fluorescence under 240–400 nm UV radiation was observed. The major absorption bands are (cm⁻¹): 3588 (OH-stretch), ~3398 and ~3204 (H₂O stretches), 1628 (H-O-H bend), 1069, 1009, 942 (Si-O stretches), 702, 655 (Si-O-Si bend), 560 (Si-O-Ti). The average (range) of microprobe (WDS) analysis is (wt%): Nb₂O₅ 0.55 (0.41–0.84), TiO₂ 10.76 (10.24–11.28), ZrO₂ 0.48 (0.13–1.35), SiO₂ 34.41 (33.00–35.4), Al₂O₃ 0.34 (0.00–0.69), Fe₂O₃ 5.57, FeO 29.39 (33.86–34.92 total) (Fe²⁺/Fe³⁺ ratio was calculated from structure refinement in according with Mössbauer spectroscopy data), MnO 1.27 (0.71–1.74), CaO 3.87 (3.10–4.09), MgO 0.52 (0.41–0.67), K₂O 0.49 (0.11–1.53), Na₂O 0.27 (0.10–0.77), F 0.24 (0.03–0.63), H₂O 8.05 (by stoichiometry on the crystal-structure analysis), O=F –0.10, total 96.11. The empirical formula, calculated on the basis of Si+Al = 8 apfu, is $(\text{Ca}_{0.95}\text{Na}_{0.15}\text{K}_{0.14})\text{S}_{1.21}(\text{Fe}_{3.65}^{2+}\text{Fe}_{0.93}^{3+}\text{Mn}_{0.25}\text{Mg}_{0.18})\text{S}_{7.01}(\text{Ti}_{1.86}\text{Nb}_{0.06}\text{Zr}_{0.05}\text{Fe}_{0.03}^{3+})\text{S}_2(\text{Si}_{7.91}\text{Al}_{0.09})\text{S}_8\text{O}_{34.61}\text{H}_{12.34}\text{F}_{0.17}$. X-ray powder diffraction data were obtained by modified Gandolphi method (CuK α radiation). The strongest lines of the diffraction pattern [d_{obs} in Å (I_{obs} %; hkl)] are: 11.395 (100; 001,010), 2.880 (38; 004), 2.640 (31; 210,141), 1.643 (24; 071,072), 2.492 (20; 211), 1.616 (15; 070), 1.573 (14; 322), 2.270 (13; 134), 2.757 (12; 140,132) with refined unit-cell parameters: $a = 5.330(6)$, $b = 11.803(12)$, $c = 11.822(8)$ Å; $\alpha = 99.34(15)^\circ$, $\beta = 98.182(15)^\circ$, $\gamma = 102.05(11)^\circ$; $V = 707.6$ Å³. The unit-cell parameters obtained from single-crystal X-ray data (Bruker AXS SMART APEX diffractometer with a CCD detector, MoK α radiation) are: $a = 5.329(4)$, $b = 11.803(8)$, $c = 11.822(8)$ Å; $\alpha = 101.140(8)^\circ$, $\beta = 98.224(8)^\circ$, $\gamma = 102.442(8)^\circ$; $V = 699.0(8)$ Å³. Sveinbergeite is triclinic, space group $P\bar{1}$; $Z = 1$. The crystal structure of the mineral was solved by direct methods and due to poor quality of crystals could be refined only to $R_1 = 21.81\%$. The main structural unit is HOH layer, which is topologically identical to that in the astrophyllite. The difference from other minerals

of the astrophyllite group is in composition and topology of the interstitial A and B sites and linkage between HOH layers. The structural formula of the mineral is $\text{A}_2\text{B}_2\text{C}_7\text{D}_2(\text{T}_4\text{O}_{12})_2\text{O}_2(\text{OH})_4\text{X}_2$. In sveinbergeite, the A site is occupied mainly by H₂O and minor K. The B site of astrophyllite is split into two sites B(1) and B(2) with an ideal compositions (Ca□) and [(H₂O)□], respectively. The structural formula can be presented as $(\text{H}_2\text{O})_2[\text{Ca}(\text{H}_2\text{O})](\text{Fe}^{2+}\text{Fe}^{3+})(\text{Si}_4\text{O}_{12})_2\text{O}_2(\text{OH})_4[(\text{OH})(\text{H}_2\text{O})]$. The mineral is named in honor of Svein Arne Berge (born 1949), Norwegian amateur mineralogist who observed and collected this mineral and introduced it for study. The type specimen is deposited in the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia. **D.B.**

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TÖRNROOSITE*

K.K. Kojonen, A.M. McDonald, C.J. Stanley, and B. Johanson (2011) Törnroosite, Pd₁₁As₂Te₂, a new mineral species related to isomertierite from Miessijoki, Finnish Lapland, Finland. *Canadian Mineralogist*, 49, 1643–1651.

Törnroosite (IMA 2010-043), ideally Pd₁₁As₂Te₂, is a new mineral species discovered in a single anhedral grain 130×200 μm in polish section during the study of the heavy concentrate from the placer at Miessijoki River, Lemmenjoki area, Inari Commune, Finnish Lapland, Finland (25°42'33"N; 68°42'30"E). The source of the placer PGM minerals is not known but probably related to mafic–ultramafic intrusions of the granulitic complex. The associated minerals in the placer include gold, platinum, sperrylite, cooperite, braggite, irarsite, laurite, isomertierite, mertierite II, atokite, along with Pt-Fe, Pt-Cu, Os-Ir-Ru, Cu-Pt-Pd, Cu-Pd-Pt-Au, Pd-Au, and Au-Ag natural alloys and with pyrite, rutile, uraninite–thorianite, galena, wolframite, magnetite, ilmenite, chromite, hematite, columbite–tantalite, tapiolite, almandine, zircon. Törnroosite is opaque metallic. The streak is black to silvery black. The VHN₂₅ = 519 (509–536) kg/mm², corresponding to Mohs hardness of 5; $D_{\text{calc}} = 11.205$ g/cm³. Törnroosite is yellowish white in reflected light in air; isotropic. The reflectance values measured between 400 and 700 nm in 20 nm intervals are gradually increasing (%) from 43.2 (400 nm) to 59.6 (700 nm). The values for (COM) wavelengths [R% (nm)] are: 45.4 (470), 51 (546), 54.1 (589), 57.5 (650). The reflectance curve is similar to those of isomertierite and miessiiite. The average (range) of 10 electron microprobe (WDS) analyses is: Pd 72.04 (71.47–72.79), Pt 1.75 (1.61–1.90), Sn 2.13 (2.08–2.20), Sb 0.85 (0.81–0.89), As 8.77 (8.63–8.89), Te 13.15 (12.76–13.56), Bi 0.79 (0.70–0.89), total 99.48 wt%, which corresponds to (Pd_{10.85}Pt_{0.14})_{10.99}(As_{1.88}Sb_{0.11})_{1.99}(Te_{1.65}Sn_{0.29}Bi_{0.06})_{2.00}, based on a total of 15 apfu. The X-ray powder diffraction data were obtained using a 114.6 mm diameter Gandolphi camera (filtered CuK α radiation). The strongest lines are [d_{obs} in Å (I_{obs} %; hkl)]: 2.519 (11; 422), 2.376 (90; 511,333), 2.182 (100; 440), 1.862 (13; 622), 1.608 (11; 731,553), 1.544 (14; 800), 1.455 (10; 660,822), 1.295 (10; 931), 1.261 (13; 844). The X-ray data were indexed in the space group

$Fd\bar{3}m$, $a = 12.3530(4) \text{ \AA}$, $V = 1885.03 \text{ \AA}^3$, and $Z = 8$, by analogy with isomertieite ($\text{Pd}_{11}\text{Sb}_2\text{As}_2$) and miessite ($\text{Pd}_{11}\text{Te}_2\text{Se}_2$), given the strong similarity in their X-ray-diffraction patterns. Additional diffraction lines at $7.20(25)$, $6.61(5)$, and $2.98(5) \text{ \AA}$, inconsistent with the aforementioned metrics, are conditionally attributed to kaolinite admixture and unidentified, associated minerals. No data on törnroosite crystal structure were obtained. Chemically similar minerals (with no X-ray data) were mentioned at the placer near Maandagshoek farm, Eastern Bushveld, South Africa (Oberthür et al. 2004), and from the South Sopcha pluton, Monchetundra, Kola Peninsula, Russia (Grokhovskaja et al. 2009). The mineral is named in honor of Ragnar Törnroos (born 1943), University of Helsinki, Finland Helsinki, who first reported a mineral of similar composition at Finnish Lapland (Törnroos et al. 1996). The mineral was also on the list of valid unnamed minerals as UM1996-02 As:PtTe and now moved to the list of invalid unnamed minerals (update 2012-01 at IMA CNMNC website). The holotype is stored in the Natural History Museum, London, U.K. **D.B.**

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ZACCARINIITE*

- A. Vymazalová, F. Laufek, M. Drábek, C.J. Stanley, R.J. Baker, R. Bermejo, G. Garuti, O. Thalhammer, J.A. Proenza, and F. Longo (2012) Zaccariniite, RhNiAs , a new platinum-group mineral from Loma Peguera, Dominican Republic. *Canadian Mineralogist*, 50, 1321–1329.

A new platinum-group mineral zaccariniite (IMA 2011-086), ideally RhNiAs , was discovered in the polish section in an aggregate ($20 \times 40 \text{ \mu m}$ in size) of platinum minerals in chromite, obtained from a heavy-mineral concentrate from the Loma Peguera ophiolitic chromitite, Dominican Republic. It was originally described from the same locality as an unnamed RhNiAs (Zaccarini et al. 2009) in intergrowths with garutiite, hexaferum, and other Ru-Os-Ir-Fe minerals formed at lower temperatures during alteration of the ophiolitic host-rock. Same phase has been previously mentioned from alluvium of the ophiolitic belt of Koryako-Kamchatskiy region, Russia (Rudashevsky et al. 1983), and later by different authors from several different localities in Russia, Burma, South Africa, Canada, Greece, and Kazakhstan. The mineral was also mentioned in the list of valid unnamed

minerals as UM1983-03 As:NiRh and now moved to the list of invalid unnamed minerals (update 2012-01 at IMA CNMNC website). The mineral forms gray (with a gray streak) opaque metallic anhedral grains ($1\text{--}20 \text{ \mu m}$ in size). It is brittle, with no cleavage. Microhardness measured on synthetic RhNiAs is $\text{VHN}_5 = 218(166\text{--}286) \text{ kg/mm}^2$, corresponding to 3.5–4 of Mohs scale. The density measured by weighing RhNiAs in toluene is 10.09 g/cm^3 ; $D_{\text{calc}} = 10.19 \text{ g/cm}^3$. In reflected light zaccariniite is white with brownish to pinkish tints, has moderate to strong bireflectance and strongly pleochroic white to pinkish brownish white. It is strongly anisotropic with rotation tints from orange to blue-green. No internal reflections observed. The reflectance data were measured between 400 and 700 nm at intervals of 0.823 nm. R_1 curve varies (%) from 45 to 60 with the wavelength increasing while R_2 curve is nearly horizontal (varies from 51 to 54%). The reflectance values of zaccariniite for COM wavelengths in air [R_1 , R_2 (%) (nm)] are: 49.4, 52.6 (470); 52.4, 53.2 (546); 54.2, 53.2 (589); 56.6, 53.3 (650). The average of three electron microprobe analyses (wt%) is: Rh 41.77, Os 0.51, Ir 0.64, Ru 0.46, Pd 0.34, Ni 23.75, Fe 0.53, As 27.84, S 0.10, total 96.09 corresponding to the empirical formula $(\text{Rh}_{1.01}\text{Os}_{0.01}\text{Ir}_{0.01}\text{Ru}_{0.01}\text{Pd}_{0.01})_{\Sigma 1.05}(\text{Ni}_{1.00}\text{Fe}_{0.02})_{\Sigma 1.02}(\text{As}_{0.92}\text{S}_{0.01})_{\Sigma 0.93}$ based on total 3 apfu. The compilation of chemical data for zaccariniite like unnamed minerals from different localities is provided. The strongest lines of the X-ray powder-diffraction pattern for synthetic zaccariniite [d_{obs} in \AA (I_{obs} %; hkl)] are: 2.509 (40; 110), 2.325 (100; 111,102), 1.945 (51; 112), 1.776 (80; 103,200), 1.256 (40; 213,220), 1.104 (22; 302,311), 1.055 (23; 312), 0.9730 (42; 215). The mineral is tetragonal, space group $P4/nmm$, unit-cell parameters are: $a = 3.5498(1)$, $c = 6.1573(2) \text{ \AA}$, $V = 77.59 \text{ \AA}^3$, $Z = 2$. The crystal structure was refined using powder X-ray diffraction data by Rietveld refinement for synthetic zaccariniite. It has the Cu_2Sb (or Fe_2As)-type of crystal structure. The As atom is surrounded by four Ni atoms and five Rh atoms. These $(\text{AsNi}_4\text{Rh}_5)$ polyhedra share the Ni–Ni, Ni–Rh, and Rh–Rh edges. The Raman spectra, chemical identity and optical properties confirmed that the natural and synthetic materials are identical. The mineral is named in honor of Federica Zaccarini (born 1962), University of Leoben, Austria, in recognition of her contributions to the mineralogy of platinum-group elements. The holotype is deposited in the Mineralogical Museum of Leoben, Austria. **D.B.**

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