New Mineral Names*†

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

CLINOMETABORITE*

F. Demartin, C.M. Gramaccioli, and I. Campostrini (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 α = 1.434, β = 1.570, and γ = 1.588 (λ = 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 BO₃ ion. No other data on chemical composition were provided. X-ray powder-diffraction data (obtained with Philips PW1830 diffractometer, CuKα radiation) provided the following unit-cell parameters: monoclinic unit-cell, space group P2₁/c, with a = 7.1243(6), b = 8.8468(10), c = 6.7699(7) Å, β = 93.23(1)°, V = 426.00(6) Å³, and Z = 12. The strongest six lines of the X-ray powder-diffraction pattern [d[Å] in Å (I[%], hkl)] are: 6.773(15; 001), 4.193(20; 111), 3.224(8; 201), 3.078(100; 201), 2.702(8; 031), 2.550(10; T22). Single-crystal diffraction data were collected (using a BRUKER Apex II diffractometer, graphite-monochromated MoKα radiation) and the diffraction pattern confirmed the monoclinic lattice, space group P2₁/c, with a = 7.127(2), b = 8.842(3), c = 6.773(2) Å, β = 93.21(1)°, and V = 426.12(1) 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 R₁ of 0.043 for 977 observed reflections with I > 2σ(I). The basic structural units observed in clinometaborite are six-membered BO₃ 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 Stereochemica Inorganica, Università degli Studi di Milano, Italy. G.D.G. and F.C.

HUGHESITE*


Hughesite (IMA 2009-035a), ideally Na₃Al(V₁₀O₂₈)·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 α = 1.698(5), β = 1.740(5), and γ = 1.770(5); the measured 2V is 84(2)° (λ = 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-cnmnc/.
Kirchoffite


Kirchoffite, ideally CsBSiO₆, 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 kirchoffite 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. Kirchoffite 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, sokolovaita, baratovite, aegirine, polylithionite, 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 (λ = 590 nm) ω = 1.592(2), ε = 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. The following empirical formula (based on 6 O atoms per formula unit) (Cs₁₀.₆₃K₀.₃₇)B₈O₂₈Si₂O₆, Z = 16. The six strongest observed X-ray powder (Mn-filtered FeKα X-ray radiation, Debye-Scherrer camera) diffraction lines are [d in Å (Iₘ% ; 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, V = 2186.3(1) Å³. Kirchoffite is isomorphous 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; MoKα radiation) starting from the atom coordinates of tetragonal pollucite in the space group 4/m (origin choice 2) [a = 13.019(2), c = 12.900(3) Å, V = 2186.3(1) Å³] to R₁ = 3.1% for 487 reflections with F > 4σ(F). In the crystal structure of kirchoffite, the main structural unit is a framework of SiO₂ and BO₆ 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.

Mendelevite-(Ce)*


E. Sokolova, F.C. Hawthorne, L.A. Pautov, A.A. Agakhanov, and V.Yu. Karpenko (2011) The crystal structure and crystal chemistry of mendelevite-(Ce), (Cs₈)₁₀(D₁₃Cs₈)₁₀(D₁₃K₈)₆(REE, Ca)₆(Si₁₀O₃₂)(H₂O)₂₁(H,O,OH,F)₆, a potential microporous material. Mineralogical Magazine, 75(5), 2583–2596.

Mendelevite-(Ce), ideally (Cs₈)₁₀(D₁₃Cs₈)₁₀(D₁₃K₈)₆(REE, Ca)₆(Si₁₀O₃₂)(H₂O)₂₁(H,O,OH,F)₆, 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 mendelevite in honor of Dmitriy Ivanovich Mendeleev.
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(1834–1907), the eminent Russian chemist who created the Periodic Table of Elements. Mendeleevite-(Ce) was found in nest-like segregations of a polyminal aggregate composed of brownish-gray fine-medium granular pectolite with subordinate amounts of quartz, aegirine, and fluorite, in a quartz-rich rock with sodianite, stillwellite-(Ce), reedmengerite, leucospHENite, aegirine, polythionite, microcline, pyrochlore, and turkestanite. Other associated minerals are hyaloteicite, sokolovite, kirschhofferite, 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 VHN$_{250} = 613$ (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, CeO$_2$ 19.24, La$_2$O$_3$ 9.87, Nd$_2$O$_3$ 5.62, Pr$_2$O$_3$ 2.63, Sm$_2$O$_3$ 0.58, Gd$_2$O$_3$ 0.38, CaO 2.71, SrO 1.07, Cs$_2$O 8.64, K$_2$O 1.08, F 1.34, H$_2$O 4.25, O = 17.75 pfu). The crystal structure of mendeleevite-(Ce) is an intercalation of a periodic Table of Elements. Mendeleevite-(Ce) was found in vugs within barite–quartz veins embedded in barite–pyrite lenses in close association with acanthite, famatinite, geocronite-jordanite, pyrrargyrite-prusite, Sb-rich rathite, sphalerite, overgrowth on sterryite, tetrahedrite, and xanthoconite. Owlycheite 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 VHN$_{250} = 196$ and one VHN$_{500} = 238$ 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$_{105}$, R$_{214}$, and R$_{340}$ (%), (nm)] are: 35, 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, pillaite, and pellouxite. 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**: sterryrite (new data)

Y. Moëlo, 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, Ag$_5$Pb$_{10}$[(Sb$_8$As$_4$)$_2$]$_{32}$S$_8$, and associated sterryrite, Cu$_4$(Cu$_2$)$_4$Pb$_{10}$[(Sb$_8$As$_4$)$_2$]$_{32}$S$_8$, from the Pollone mine, Tuscany, Italy. Canadian Mineralogist, 49, 623–638.


Parasterryite (IMA 2010-033), ideally Ag$_5$Pb$_{10}$[(Sb$_8$As$_4$)$_2$]$_{32}$S$_8$, is a new mineral species from the Pollone barite–pyrite–(Pb-Zn-Ag) deposit at Valdicastello Carducci, near Pietrasanta, Apuan Alps, Tuscany, Italy (43°57ʹ N; 10°16ʹ E). It has been discovered during the study of specimens with sperryrite for which it is second world occurrence and this find led to a crystal structure study. Parasterryite was named for the similarity to sterryrite. 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-prusite, Sb-rich rathite, sphalerite, overgrowth on sterryite, tetrahedrite, and xanthoconite. Owlycheite 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 sterryrite). Two Vickers hardness indentations gave VHN$_{250} = 196$ and one VHN$_{500} = 238$ 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$_{105}$, R$_{214}$, and R$_{340}$ (%), (nm)] are: 35, 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, pillaite, and pellouxite. 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.
The new mineral rusinovite (IMA 2010-072), ideally Ca$_2$(Si$_2$O$_7$)$_2$Cl, was discovered within a thin endcontact zone of the altered carbonate-silicate xenolith about 10 m in size enclosed in ignimbrite at Upper Chegem (Verkhnechegemskaia 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 wadatite inclusions or relics of earlier (higher-temperature) skarn minerals: larnite, rondorfitat, rankinite, pavlovskite, cupsidine, tazheranite, badderleyite, minerals of the kerimias-kimziey-toturite, lakargite, perovskite, and magnesioferrite. Lower-temperature associated minerals are: hillebrandite, afwilite, tobermorite, hibschatito-katto, hydrocalumite, ettringite-group minerals, trazbonite, and jennie. Rarely rusinovite replaces wollastonite. The mineral is white with a white streak, vitreous to silty, with a good cleavage on (010), and conchoidal fracture. Micro-harness is VHN20 = 320 kg/mm$^2$, which correspond to 4–5 of Mohs scale. In thin-section, rusinovite is colorless, transparent, and nonpleochroic. The mineral is optically biaxial (–); α = 1.645(2), β = 1.664(2), γ = 1.675(3); 2$\nu_{\text{max}}$ = 75° (10), 2$\nu_{\text{calc}}$ = 75°; X = a (or b), Y = c, Z = b (or a). D$_{\text{calc}}$ = 2.93 g/cm$^3$. The Raman spectrum of rusinovite is similar to that of rankinite. Band of (Si-O) group vibrations are dominant (cm$^{-1}$): 1306, 900, 652, 365, 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), H$_2$O(calc) 0.13, –O=Cl –1.53, total 100.20 corresponding to Ca$_{(a)}$Si$_{((b)}$O$_2$$_{(c)}$(Cl$_{(d)}$O$_{(e)}$H$_{(f)}$O$_{(g)}$). The strongest lines of the powder X-ray diffraction pattern (Co Ka radiation) are [d$_{\text{calc}}$ in Å (I$_{\text{obs}}$, %, 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 Å$^3$, 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$_2$O$_7$)$_2$ units linked by sharing of tetrahedral faces parallel to (100). Only half of these (Si$_2$O$_7$)$_2$ 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, β = 111.65°) synthetic Ca$_{(a)}$(Si$_{(b)}$O$_{(c)}$)$_{(d)}$Cl are known. The latter was described (Chesnokov et al. 1994) at burnt dumps of coal mine 42, Kopeisk, Chelyabinsk region, Russia, under the name “chesofite,” 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.

Reference cited
A new astrophyllite-group mineral sveinbergeite (IMA 2010-027), ideally Ca(Fe\textsuperscript{3+}+\textsuperscript{2+})\textsubscript{3}Ti\textsubscript{3}(Si\textsubscript{2}O\textsubscript{6})\textsubscript{2}O\textsubscript{2}(OH\textsubscript{2})\textsubscript{4}O\textsubscript{2}, was discovered at the road-cut of Buer syenite pegmatite of the Larvik plutonic complex, at the Vestreyøya 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 magnesiokatoptyrin, aeginitmate, aegirine, albite, calcite, fluorapatite, molybdenite, galena, hoholaegite-like mineral and with amorphous iron and manganese oxides. It forms dark green vitreous to pearly lamellar crystals 0.2–0.5 × 5–10 mm and 0.01–0.05 mm thick, which are forming rosette-like divergent groups and spherical aggregations. 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 pleochroic: 

- Deep green > brownish green. No fluorescence under 240–400 nm UV radiation was observed.
- The average (range) of microprobe (WDS) analysis is (wt%):
  - Nb\textsubscript{2}O\textsubscript{5} 0.55 (0.41–0.84), TiO\textsubscript{2} 10.76 (10.24–11.28), ZrO\textsubscript{2} 0.48 (0.13–1.35), SiO\textsubscript{2} 34.31 (33.00–35.45), Al\textsubscript{2}O\textsubscript{3} 0.34 (0.00–0.69), Fe\textsubscript{2}O\textsubscript{3} 5.57, FeO 29.39 (33.86–34.92 total) (Fe\textsuperscript{2+}/Fe\textsuperscript{3+} 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), K\textsubscript{2}O 0.49 (0.11–1.53), Na\textsubscript{2}O 0.27 (0.10–0.77), F 0.24 (0.03–0.63), H\textsubscript{2}O 8.65 (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 (Ca\textsubscript{93–93}Na\textsubscript{0.13}K\textsubscript{12–14}Si\textsubscript{2}Fe\textsuperscript{2+}\textsuperscript{2+}0.5Mn\textsubscript{2}O\textsubscript{5}Mg\textsubscript{1}Zr\textsubscript{1}Nb\textsubscript{1}Zr\textsubscript{1}Ti\textsubscript{2}O\textsubscript{2}(Fe\textsuperscript{2+}0.5Fe\textsuperscript{3+}0.5)S\textsubscript{4}(Si\textsubscript{2}Al\textsubscript{1}K\textsubscript{1}O\textsubscript{3}O\textsubscript{1.3}H\textsubscript{1}1.5F\textsubscript{0.5})

- The structural formula can be presented as (H\textsubscript{2}O\textsubscript{2})\textsubscript{3}Ca(H\textsubscript{2}O\textsubscript{2})[Ca(Fe\textsuperscript{2+}Fe\textsuperscript{3+})\textsubscript{3}Si\textsubscript{2}O\textsubscript{4}O\textsubscript{2}(OH\textsubscript{2})\textsubscript{4}O\textsubscript{2}]. 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.

References cited
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 holotype is stored in the Natural History Museum, London, U.K. D.B.

References cited


A new platinum-group mineral zaccariniite (IMA 2011-086), ideally RhNiAs, was discovered in the polish section in an aggregate (20 × 40 μm 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 garutite, hexaferrum, 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 (1–20 μm in size). It is brittle, with no cleavage. Microhardness measured on synthetic RhNiAs is VHN = 218(166–286) kg/mm², corresponding to 3.5–4.0 of Mohs scale. The density measured by weighing RhNiAs in toluene is 10.09 g/cm³; D_{obs} = 10.19 g/cm³. In reflected light zaccariniite is white with brownish to pinkish tints, has moderate to strong birefringence 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 curve varies (%) from 45 to 60 with the wavelength increasing while R curve is nearly horizontal (varies from 51 to 54%). The reflectance values of zaccariniite for COM wavelengths in air \([R_1, R_2 (\% \text{ nm})]\) 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 (Rh_{0.01}Os_{0.01}Fe_{0.01}Ru_{0.01}Pd_{0.01})_3(As_{0.02}Sb_{0.02})_2 based on total 3 apfu. The composition 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 \([d_{obs} \text{ in } Å (I_{obs}, \% \text{ hkl})]\) are: 2.509 (40; 110), 2.325 (100; 111,102), 1.945 (51; 112), 1.776 (80; 103,200), 1.256 (40; 213,220), 1.014 (22; 302,311), 1.055 (23; 312), 0.9730 (42; 215). The mineral is tetragonal, space group P4/nmm, unit-cell parameters are: \(a = 3.5498(1) Å, c = 6.1573(2) Å, V = 77.59 Å^3, Z = 2\). The crystal structure was refined using powder X-ray diffraction data by Rietveld refinement for synthetic zaccariniite. It has the Cu2Sb (or Fe2As)-type of crystal structure. The As atom is surrounded by four Ni atoms and five Rh atoms. These (AsNiRh) polycrystalline share the Ni–Ni, Rh–Rh, and Rh–Ni 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.

References cited
