NEW MINERALS

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Ronneburgite

\[ \text{K}_2\text{MnV}_4\text{O}_{12} \]

**Locality**: The mine dump of the Lichtenberg open-pit at the southwest margin of Ronneburg, Thuringia, Germany.

**Occurrence**: In a uranium deposit in slates and limestones. Associated minerals are: hummerite, gypsum, epsomite, picromerite, hematite and an unidentified K-Mg-Mn vanadate. Sincosite, simplotite and straczekite were found a few meters away. More than 230 species are known from the Ronneburg deposit.

**General appearance**: Crystals of equant, flattened or short prismatic habit (up to 0.5 mm).

**Physical, chemical and crystallographic properties**: Luster: adamantine. Diaphaneity: translucent. Color: reddish brown. Streak: brownish orange. Luminescence: nonfluorescent. Hardness: 3. Tenacity: brittle. Cleavage: indistinct in one direction. Fracture: irregular. Density: 2.84 g/cm\(^3\) (meas.), 2.83 g/cm\(^3\) (calc.). **Crystallography**: Monoclinic, \(P 2_1/n\), \(a = 8.183\), \(b = 9.247\), \(c = 8.651\) Å, \(\beta = 109.74^\circ\), \(V = 611.4\) Å\(^3\). \(Z = 2\), \(a:b:c = 0.8849:1:0.9355\). Morphology: no forms were mentioned. Twinning: none mentioned. **X-ray powder-diffraction data**: 5.509 (32) (\(\bar{1}11\)), 3.701 (55) (\(\bar{2}11\)), 3.336 (100) (121), 3.118 (50) (122), 3.000 (36) (112), 2.878 (64) (103), 2.752 (68) (222). **Optical data**: Biaxial (-), \(\alpha = 1.925\), \(\beta = 1.960\), \(\gamma = 1.988\), \(2V\) (meas.) 82\(^\circ\), \(2V\) (calc.) 82\(^\circ\); dispersion not given; pleochroism: X brownish orange with a distinct reddish tint, Y brownish orange, Z brownish orange; orientation could not be determined. **Chemical analytical data**: Mean of twenty sets of electron-microprobe data: K\(_2\)O 16.93, MgO 0.62, MnO 12.44, V\(_2\)O\(_5\) 68.54, Total 98.53 wt.%. Empirical formula: \(K_{1.91}(Mn_{0.93}Mg_{0.08})V_{4.01}O_{12.00}\). **Relationship to other species**: It is chemically related to fianelite, \(Mn_2V(V,As)O_7\cdot2H_2O\).

**Name**: After the type locality.

**Comments**: IMA No. 1998–069.


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Adamsite-(Y)

NaY(CO₃)₂•6H₂O

**Locality**: Poudrette quarry, Mont Saint-Hilaire, Rouville County, Quebec, Canada.

**Occurrence**: A late-stage, low-temperature hydrothermal phase in cavities in a large alkaline pegmatite dike. Associated minerals are: aegirine, albite, analcime, ancyelite-(Ce), calcite, catapleiite, dawsonite, donnayite-(Y), elpidite, epididymite, eudalyte, eudidymite, fluorite, francoconite, gaidonnayite, galena, genthievite, gmelinite, gonnardite, horváthite-(Y), kuplestkie, leifite, microcline, molybdinite, narsarsukite, natrolite, nenadkevichite, petersenite-(Ce), polylithonite, pyrochlore, quartz, rhodochrosite, rutile, sabinite, sérandite, siderite, sphalerite, thomasclarkite-(Y), zircon and an unidentified Na–REE carbonate (UK91).

**General appearance**: Flat, acicular to fibrous crystals (up to 2.5 cm long). Typically as spherical groups of radiating crystals and rarely as reticulated groups.

**Physical, chemical and crystallographic properties**

- **Luster**: vitreous to pearly.
- **Diaphaneity**: transparent to translucent.
- **Color**: colorless to white, also pale pink and rarely pale purple.
- **Streak**: white.
- **Luminescence**: nonfluorescent.
- **Hardness**: 3.
- **Tenacity**: brittle.
- **Cleavage**: {001} perfect, {100} and {010} good. Fracture not mentioned.
- **Density**: 2.27 g/cm³ (meas.), 2.27 g/cm³ (calc.).
- **Crystallography**: Triclinic, P̅1, a 6.262, b 13.047, c 13.220 Å, α 91.17, β 103.70, γ 89.99°, V 1049.1 Å³, Z = 4, a:b:c = 0.4800:1:1.0133. Morphology: {010} and {001}, elongate on [001]. Twinning: none mentioned.
- **X-ray powder-diffraction data**: 12.81(100)(001), 6.45(70)(002), 4.456 (60)(121,120,120,121), 4.291(60)(003), 2.869(30)(124,123,024), 2.571(60) (005,043), 2.050(50)(125, plus eight others).
- **Optical data**: Biaxial (+), α 1.480, β 1.498, γ 1.571, 2V (meas.) 53°, 2V (calc.) 55°; dispersion not given; nonpleochroic; X = c, Y = b, Z = a + 14° (in obtuse angle β). **Chemical analytical data**: Mean of seven sets of electron-microprobe data: Na₂O 8.64, CaO 0.05, Y₂O₃ 22.88, Ce₂O₃ 0.37, Nd₂O₃ 1.41, Sm₂O₃ 1.02, Gd₂O₃ 1.92, Tb₂O₃ 0.56, Dy₂O₃ 3.28, Ho₂O₃ 0.90, Er₂O₃ 2.83, Tm₂O₃ 0.27, Yb₂O₃ 1.04, CO₂ 25.10, H₂O 29.90, Total 100.17 wt.%. Empirical formula: Na₁.₀₀(¥₀.₇₉Y₀.₂₁D₀.₇₂E₀.₀₉G₀.₀₃Nd₀.₀₁Sm₀.₀₂Yb₀.₀₂H₀.₀₂Tb₀.₀₁Ce₀.₀₁Tm₀.₀₁Ho₀.₃₉(CO₃)₂.₀₃•5.₉₄H₂O. **Relationship to other species**: It is chemically and structurally related to thomasclarkite-(Y), NaY(HCO₃)(OH)₃•4H₂O.

**Name**: After Frank Dawson Adams (1859–1942), geologist and professor at McGill University, Montreal, Canada. Among his numerous contributions to the geology and petrography of Quebec and Ontario is his research on the Monteregian Hills, of which Mont Saint-Hilaire is a member.

**Comments**: IMA No. 1999–020. Information on the structure is provided.

Bradaczekite

NaCu$_4$(AsO$_4$)$_3$

**Locality:** North Breach of the Great fissure eruption, Tolbachik volcano, Kamchatka Peninsula, Russia.

**Occurrence:** In a fumarole. Associated minerals are: hematite, tenorite, lammerite, urusovite, orthoclase and johillerite.

**General appearance:** Aggregates of elongate plates. Individual crystals are about 0.2 mm long and 0.1 to 0.2 mm across.

**Physical, chemical and crystallographic properties:**
- **Luster:** adamantine.
- **Diaphaneity:** transparent in transmitted light.
- **Color:** dark blue.
- **Streak:** light blue to white.
- **Luminescence:** nonfluorescent.
- **Hardness:** not given.
- **Tenacity:** not given.
- **Cleavage:** none observed.
- **Fracture:** not given.
- **Density:** not given, 4.77 g/cm$^3$ (calc.).
- **Crystallography:** Monoclinic, $C_{2}/c$, $a$ 12.051, $b$ 12.434, $c$ 7.2662 Å, $\beta$ 117.942°, $V$ 961.8 Å$^3$, $Z$ = 4, $a:b:c = 0.9692:1:0.5844$. Morphology: {010}, {111}, {112} well-developed; {301}, {001}, {321}, {101}, {100}, {021}, {110}, {131}, {111} and {341} are common. Twinning: none mentioned.
- **X-ray powder-diffraction data:** 6.22(13)(020), 3.60(21)(202), 3.43(100)(112,310), 3.21(35)(002), 2.79(24)(402), 2.69(18)(330), 2.68(30)(240), 2.66(17)(400). **Optical data:** Biaxial (−), $\alpha$ 1.76, $\beta$ 1.92, $\gamma$ 1.96, 2$V$(calc.) $50^\circ$; dispersion not given; strong pleochroism X violet-red, Y green, Z greenish blue; $\tilde{Z} = b$, $X \cap c = 23^\circ$ (in obtuse angle $\beta$), $Z \cap c = 5^\circ$ (in obtuse angle $\beta$). **Chemical analytical data:** Mean of thirty-seven sets of electron-microprobe data: Na$_2$O 5.17, K$_2$O 0.35, CuO 43.13, ZnO 0.79, Fe$_2$O$_3$ 0.38, As$_2$O$_5$ 49.62, V$_2$O$_5$ 0.13, Total 99.57 wt.% (given as 99.55). Empirical formula: (Na$_{1.16}$K$_{0.05}$)$_{12.21}$(Cu$_{3.76}$Zn$_{0.07}$Fe$_{2+0.03}$)$_{3.86}$(As$_{1.00}$O$_{4.00}$)$_{3.00}$. **Relationship to other species:** It is the Na-, Cu- and AsO$_4$-dominant member of the alluaudite group.

**Name:** After Hans Bradaczek (b. 1940), structural crystallographer and former director of the Institute of Crystallography, Freie Universität, Berlin, Germany, and long-time collaborator with the crystallography group at the University of St. Petersburg, Russia.

**Comments:** IMA No. 2000–002.


Carraraite

\[ \text{Ca}_3\text{Ge(OH)}_6(\text{SO}_4)(\text{CO}_3)\cdot12\text{H}_2\text{O} \]

**Locality**: Gioia quarry, Colonnata valley, Carrara basin, Apuan Alps, northern Tuscany, Italy.

**Occurrence**: In calcite vein cavities within the famous Carrara marble. Associated minerals are: azurite and volborthite. It is a product of hydrothermal alteration of copper–vanadium sulfides such as sulvanite and colusite. Crystals of colusite with Ge contents of 1.3 wt.% have been found in the Carrara area.

**General appearance**: Prismatic to tabular submillimetric crystals.

**Physical, chemical and crystallographic properties**:
- **Luster**: vitreous.
- **Diaphaneity**: transparent to translucent.
- **Color**: white.
- **Streak**: white.
- **Luminescence**: not mentioned.
- **Hardness**: not given.
- **Tenacity**: not given.
- **Cleavage**: none observed.
- **Fracture**: not given.
- **Density**: could not be measured because of the small size, 1.97 g/cm³ (calc.).
- **Crystallography**: Hexagonal, \(P_6_3/m\) \(a\) 11.056, \(c\) 10.629 Å, \(V\) 1125.2 Å³, \(Z = 2\), \(c:a = 0.9614\).
- **Morphology**: \{100\}, \{001\}. Twinning: none mentioned.
- **X-ray powder-diffraction data**: 9.57(vs)(100), 5.53(s)(110), 3.83(s)(112), 3.56(ms)(202), 2.74(ms)(302), 2.53(m)(213), 2.38(m)(312), 2.18(m)(223), 2.13(m)(313).
- **Optical data**: Uniaxial (-), \(\omega 1.509, e 1.479\), nonpleochroic.
- **Chemical analytical data**: Mean of seven sets of electron-microprobe data: CaO 35.70, GeO₂ 18.15, SO₃ 16.19, Total 70.04 wt.%. The sample decomposed in the electron beam. Here, 53.75 wt.% H₂O and 8.75 wt.% CO₂ were added to give 15(H₂O) and 1(CO₃); this raises the analytical total to 132.54 wt.%. Recalculation to give 100.00 wt.% gives: CaO 26.94, GeO₂ 13.69, SO₃ 12.22, CO₂ (6.60), H₂O (40.55), Total (100.00) wt.%. Empirical formula: \(\text{Ca}_{3.20}\text{Ge}_{0.87}(\text{OH})_{5.84}(\text{SO}_4)_{1.02}(\text{CO}_3)_{1.00}•12.08\text{H}_2\text{O}\).

**Relationship to other species**: It is a member of the ettringite group.

**Name**: After the Carrara region.

**Comments**: IMA No. 1998–002. Because of the very small size of the crystals, many of the usual physical properties could not be determined. Prof. Merlino kindly supplied additional data. The crystal drawing produced here is based on the SEM image in the paper.


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**Fencooperite**

\[
\text{Ba}_6\text{Fe}^{3+3}\text{Si}_8\text{O}_{23}(\text{CO}_3)\text{Cl}_3\cdot\text{H}_2\text{O}
\]

**Locality:** Trumbull Peak, on the western slope of the Sierra Nevada Range in NE S. 9, T3S, R19E, Mount Diablo Meridian (Lat. 37° 40'58" N, Long. 119° 47'08" W), about 67 km northeast of Merced and 8 km west of El Portal, Mariposa County, California, U.S.A.

**Occurrence:** In barium-silicate-rich lenses in quartzite. Associated minerals are: sanbornite, gillespite, quartz, titantaramellite, anandite and kinoshitalite. The fencooperite occurs in black aggregates that also contain celsian, alforsite, barite, sanbornite, quartz, pyrrhotite and diopside.

**General appearance:** Anhedral to roundish to platy grains (up to 100 μm).

**Physical, chemical and crystallographic properties:** Luster: vitreous to adamantine. Diaphaneity: opaque to translucent. Color: jet black to dirty gray-brown (on very thin edges). Streak: grayish black. Luminance: nonfluorescent. Hardness: VHN10 4.21 kg/mm², Mohs 4½ to 5. Tenacity: brittle. Cleavage: none obvious. Fracture: uneven to subconchoidal. Density could not be measured, 4.21 g/cm³ (calc.). **Crystallography:** Trigonal, P3m1, a 10.74, c 7.095 Å, V 708.7 Å³, Z = 1, c/a = 0.6606. Morphology: no forms were observed. Twinning: none observed. X-ray powder-diffraction data: 3.892(100)(201), 3.148(40)(211), 2.820(90)(202), 2.685(80)(200), 2.329(30)(302,400), 2.208(40)(401), 2.136(40)(222), 2.106(30)(203). **Optical data:** Uniaxial (–), ω 1.723, ε 1.711, strong pleochroism O blue black, E light greenish gray. **Chemical analytical data:** Mean of twelve sets of electron-microprobe data: BaO 50.51, MnO 0.15, Al2O3 1.35, Fe2O3 12.77, P2O5 0.16, H2O (0.98), CO2 (4.81), Cl 3.23, sum 101.34, less O = Cl 0.73. Total (100.61) wt.%. The valence of Fe and the amounts of H2O and CO2 were determined from the crystal-structure analysis. Empirical formula: \[
\text{Ba}_5\text{Fe}^{3+3}\text{Mn}^{0.04}\text{Si}_8\text{O}_{23}\text{Cl}_3\text{CO}_2\text{H}_2\text{O}\]

**Relationship to other species:** None apparent.

**Name:** After Joseph Fenimore ("Fen") Cooper, Jr. (b. 1937), of Santa Cruz, California, who helped collect the samples containing the mineral.

**Comments:** IMA No. 2000–023.


Micheelsenite

\[(\text{Ca}, \text{Y})_3 \text{Al}(\text{PO}_3 \text{OH}, \text{CO}_3)(\text{CO}_3)(\text{OH})_6 \cdot 12\text{H}_2\text{O}\]

Hexagonal

**Locality**: The Poudrette quarry, Mont Saint-Hilaire, Rouville County, Quebec, Canada and the Nanna pegmatite, Narsaarsuup Qaava, South Greenland.

**Occurrence**: Associated minerals at Mont Saint-Hilaire are: aegirine, albite, anclylcite-(Ce), catapleiite, fluorite, microcline, monteregianite-(Y), natrolite, nadinkevichite, rhodonochlorite and sardanite in pegmatites, and natrolite, titanite, calcite and pyrite in hornfels. Associated minerals at Nanna are aegirine, astrophyllite, analcime, calcioanclylcite-(Ce), catapleiite, fluorite, galena, gibbsite, leucophanite, microcline, natrolite, nafertisite, orthoclase, polyphlitonite, sodalite (var. hackmanite) and todiokite.

**General appearance**: Acicular to fibrous crystals (up to 2 mm long) in loosely packed radiating groups (up to 3 mm in diameter) and as matted fibers. Also as rounded plates 0.6 mm in diameter and 0.1 mm thick.

**Physical, chemical and crystallographic properties**

- **Luster**: vitreous.
- **Diaphaneity**: transparent to translucent.
- **Color**: white to colorless.
- **Streak**: white.
- **Luminescence**: nonfluorescent.
- **Hardness**: 3½ to 4.
- **Tenacity**: brittle.
- **Fracture**: splintery.
- **Density**: 2.15 g/cm³ (meas.), 2.17 g/cm³ (calc.).
- **Cleavage**: {100} and {001} good.
- **Crystallography**: Hexagonal, P6₃, a = 10.828 Å, c = 10.516 Å, V = 1067.8 Å³, Z = 2, ca = 0.9712. Morphology: {001} and probably {100}. Twinning: none mentioned.
- **X-ray powder-diffraction data**: 9.38 (100), 4.82 (40) (111), 4.59 (70) (102), 3.77 (50) (112), 3.36 (55) (211), 2.691 (45) (302), 2.491 (80) (213), 2.143 (65) (223).
- **Optical data**: Uniaxial (−), ω 1.532, ε 1.503, nonpleochroic.
- **Chemical analytical data**: Mean of three sets of electron-microprobe data: CaO 16.90, Al₂O₃ 6.70, Y₂O₃ 18.07, Gd₂O₃ 0.84, Dy₂O₃ 2.65, Ho₂O₃ 0.51, Er₂O₃ 1.88, SiO₂ 0.07, P₂O₅ 7.80, SO₃ 0.53, CO₂ (8.38), H₂O (43.01). Total (107.34) wt.%. The presence of CO₂ and H₂O was indicated by infrared and structural data, and their amounts were calculated from the stoichiometry. **Empirical formula**: (Ca₁.₉₆Y₁.₀₄Dy₀.₀₉Er₀.₀₆Gd₀.₀₃Ho₀.₀₂)²⁺[((P₀.₇₁Ca₀.₂₄Si₀.₀₁)²⁻Ο₃OEH₂O)²⁻[(CO₃)²⁺(OH)²⁻]²⁻. **Relationship to other species**: A member of the ettringite group.

**Name**: After Harry Ingvar Micheelsen (b. 1931), Professor Emeritus of Mineralogy, University of Copenhagen, Denmark. Dr. Micheelsen discovered the Nanna pegmatite in 1963.

**Comments**: IMA No. 1999-033. The crystal structure has been solved.

Petterdite

\[ \text{PbCr}_2(\text{CO}_3)_2(\text{OH})_4 \cdot \text{H}_2\text{O} \]

Orthorhombic

Locality: The Red Lead mine, Zeehan–Dundas region (Lat. 41° 53' S, Long. 145° 25' E), northwestern Tasmania, Australia. It also occurs at the Callenberg Nord-1 open cut, near Glauchau, Saxony, Germany.

Occurrence: Associated minerals are: galena, goethite, anglesite, and crocoite. At the German locality, petterdite is associated with crocoite, cerussite, bindheimite, pyromorphite and galena.

General appearance: As thin (up to 0.5 mm) crusts composed of thin, roughly rectangular, platy crystals up to 15 \( \mu \text{m} \) across.

Physical, chemical and crystallographic properties: Luster: earthy to pearly. Diaphaneity: translucent. Color: pale grayish to pinkish violet. Streak: pale violet. Luminescence: nonfluorescent. Hardness: could not be measured but is assumed to be about 2. Tenacity: could not be observed. Cleavage: {100} fair, possibly also {010}. Fracture: could not be observed. Density: could not be measured because of the high porosity of the aggregates. 3.95 g/cm\(^3\) (calc.). Crystallography: Orthorhombic, space group not determined but assumed to be \( \text{Pbnm} \) by analogy with dundasite, \( a = 9.079, b = 16.321, c = 5.786 \) Å, \( V = 857 \) Å\(^3\), \( Z = 4 \). \( a:b:c = 0.5563:1:0.3545 \). Morphology: {010}, flattened on {010} and slightly elongate on [001] or less commonly on [010]. Twinning: none observed.

X-ray powder-diffraction data: 7.937(100)(110), 4.686(50b)(021,111), 3.633(70) (131), 3.270(40)(212), 2.718(40)(022,060,112,151), 2.690(40)(214,301); the broad spacing at 4.686 is resolved into two lines at 4.73 and 4.67 with an automated diffractometer. Optical data: Biaxial (-), \( \alpha = 1.740, \beta = 1.802, \gamma = 1.842 \). 2V could not be measured, 2V (calc.) approximately 62°; dispersion not given; pleochroism \( X = Y = \text{colorless to pale grayish pink}, Z = \text{grayish pink} \); orientation, \( X = a, Y = b, Z = c \).

Chemical analytical data: Mean of four sets of electron-microprobe data (H\(_2\)O calculated by difference): PbO 43.13, SrO 1.40, Al\(_2\)O\(_3\) 3.65, Cr\(_2\)O\(_3\) 22.64, Sb\(_2\)O\(_3\) 0.67, CO\(_2\) 18.3, H\(_2\)O (10.01). Total (100.00) wt.%. Empirical formula: \( \text{Pb}_{0.99}\text{Sr}_{0.07}\text{Cr}_{1.52}\text{Al}_{0.36}\text{Sb}_{0.02}\text{Si}_{0.10}(\text{CO}_3)_{1.12}(\text{OH})_{3.62} \cdot 1.02\text{H}_2\text{O} \).

Relationship to other species: It is the chromium-dominant analogue of dundasite, PbAl\(_2\)(CO\(_3\))\(_2\)(OH)\(_4\) \cdot \text{H}_2\text{O}.

Name: After William Frederick Petterd (1849–1910), an amateur collector who published several significant catalogues on the mineralogy of Tasmania. The name was once used for phosphatian mimetite.

Comments: IMA No. 1999–034.

Polyakovite-(Ce)

\[(\text{Ce,Ca})_4(\text{Mg,Fe}^{2+})(\text{Cr}^{3+},\text{Fe}^{3+})_2(\text{Ti,Nb})_2\text{Si}_4\text{O}_{22}\]

**Locality:** Mine N97, Ilmen Natural Reserve, southern Urals, Russia (Lat. 55°01' N, Long. 11° E).

**Occurrence:** In a carbonatite vein. Associated minerals are: dolomite, fluororichterite, chromite, thorianite, forsterite and phlogopite.

**General appearance:** Anhedral equant grains usually 0.5 to 0.7 cm, but up to 2.5 cm, and as euhedral crystals up to 2 mm.

**Physical, chemical and crystallographic properties**

- **Luster:** given as vitreous, but the optical data indicate adamantine.
- **Diaphaneity:** translucent in thin fragments.
- **Color:** black.
- **Streak:** brown.
- **Luminescence:** nonfluorescent.
- **Hardness:** VHN200 874 kg/mm², Mohs 5½ to 6.
- **Tenacity:** brittle.
- **Cleavage:** none.
- **Fracture:** conchoidal.
- **Density:** 4.75 g/cm³ (meas.), 5.05 g/cm³ (calc.).
- **Crystallography:** Monoclinic, \(C2/m\), \(a = 13.395\, \text{Å}\), \(b = 5.698\, \text{Å}\), \(c = 11.040\, \text{Å}\), \(\beta = 100.55°\), \(V = 828.5\, \text{Å}^3\), \(Z = 2\), \(a:b:c = 2.3508:1:1.9375\). Morphology: {100}, {001}, {201}, {010}, {110}, {111}, {112}, {112}, {302}. Twinning: none mentioned.
- **Optical data:** Isotropic (owing to metamictization), \(n\) between 1.931 and 1.935. In reflected light: gray, nonpleochroic. \(R:\) (11.1%) 480 nm, (10.9%) 540 nm, (10.8%) 580 nm, (10.5%) 640 nm.
- **Chemical analytical data:** Mean of three sets of electron-microprobe data and one set of wet-chemical data: MgO 2.61, CaO 1.06, MnO 0.05, FeO 1.09, Cr₂O₃ 7.42, Fe₂O₃ 4.30, Y₂O₃ 0.38, La₂O₃ 15.94, Ce₂O₃ 24.24, Pr₂O₃ 2.01, Nd₂O₃ 4.76, Sm₂O₃ 0.38, SiO₂ 19.08, TiO₂ 9.49, ThO₂ 2.79, UO₂ 0.03, Nb₂O₅ 3.98, H₂O 0.14, Total 99.75 wt.%. Empirical formula: \(\text{(Ce}^{1.87}\text{La}^{1.24}\text{Nd}^{0.36}\text{Ca}^{0.24}\text{Pr}^{0.15}\text{Th}^{0.13}\text{Y}^{0.04})\Sigma 4.06(\text{Mg}^{0.82}\text{Fe}^{2+}^{0.18}\text{Mn}^{0.01})\Sigma 1.02(\text{Cr}^{1.23}\text{Fe}^{3+}^{0.68}\text{Mn}^{0.19})\Sigma 1.91(\text{Ti}^{1.50}\text{Nb}^{0.33})\Sigma 1.85\text{Si}_{4.01}\Sigma 0.14(\text{OH})_{0.20}\Sigma 22.00.\)

**Relationship to other species:** It is the Mg- and Cr³⁺-dominant analogue of chevkinite-(Ce).

**Name:** After Vladislav Olegovich Polyakov (1950–1993), who contributed greatly to the knowledge of the mineralogy of the Urals.

**Comments:** IMA No. 1998–029. Mössbauer and thermal analytical data are given, and the crystal structure has been solved.

**Sicherite**

**TlAg_2(As,Sb)_3S_6**

**Orthorhombic**

**Locality:** Lengenbach quarry, Binntal, Canton Valais, Switzerland.

**Occurrence:** In dolomitic rock. Associated minerals are: realgar, hutchinsonite, hatchite and jentschite.

**General appearance:** Aggregates (up to 2 mm across) of individual crystals (up to 0.4 mm).

**Physical, chemical and crystallographic properties:**
- **Luster:** metallic.
- **Diaphaneity:** opaque.
- **Color:** dark gray to black.
- **Streak:** dark brown red.
- **Hardness:** VHN_{10} 58.3 kg/mm², Mohs ≤ 3.
- **Tenacity:** not given, but probably brittle.
- **Cleavage:** not observed.
- **Fracture:** uneven to conchoidal.
- **Density:** not measured, 5.26 g/cm³ (calc.).
- **Crystallography:** Orthorhombic, Pmn̄b, a 15.522, b 5.719 Å, V 1107.8 Å³, Z = 4, a:b:c = 0.8040:1.0:0.3684.
- **Morphology:** {141} dominant, with {001}, {010}, {031}, {301} minor. Twinning: none mentioned.
- **Optical data:** In reflected light: pure white, very few dark red internal reflections, extremely weak anisotropism. R₁, R₂; imR₁, imR₂: (31.43, 33.43; 15.98, 18.41%) 470 nm, (28.31, 30.52; 13.48, 15.80%) 546 nm, (27.10, 29.11; 12.54, 4.56%) 589 nm, (25.57, 27.44; 11.36, 13.17%) 650 nm.
- **Chemical analytical data:** Mean of 103 sets of electron-microprobe data: Cu 0.22, Ag 23.98, Tl 23.63, Sb 10.96, As 19.08, S 21.65, Total 99.52 wt.%. Empirical formula: Tl₁_{0.02}(Ag₁_{2.96}Cu₀₀₃)₂₁_{0.99} (As₂₄Sb₀₇₉)Σ₃₀Σ₅₉₅.

**Relationship to other species:** Although the chemical composition and unit cell suggest a possible relationship with the hutchinsonite group of merotypes, no simple structural relationship exists.

**Name:** After Valentin Sicher (b. 1925), an active member of the Lengenbach syndicates since 1963 who contributed greatly to specimen-recovery efforts.

**Comments:** IMA No. 1997-051.


Occurrence: In a manganese–iron deposit in marble. Associated minerals are: hausmannite, calcite, brucite, dolomite, clinohumite, kinoshitalite, copper, barytocalcite, bindheimite and cerussite.

General appearance: Euhedral to subhedral crystals (up to 1 mm across).

Physical, chemical and crystallographic properties: Luster: subadamantine. Diaphaneity: translucent. Color: deep ruby red. Streak: not given. Hardness: not given. Tenacity: not given. Cleavage: none observed. Fracture: conchoidal. Density: could not be measured, 4.58 g/cm³ (calc.). Crystallography: Trigonal, R3 or R-3, a 16.196, c 14.948 Å, V 3395.7 Å³, Z = 42, c/a = 0.9229. Morphology: pseudo-octahedra probably consisting of {001} and {201}. Twinning: the pseudo-octahedra consist of eight twin domains. X-ray powder-diffraction data: 4.98(20)(211,003), 3.052(33)(140,214), 2.608(100)(241,143,125), 2.162(28)(244), 1.6652(30)(363,075), 1.5313(26)(820), 1.5273(29)(428). Optical data: In reflected light: gray, practically isotropic, orange-red internal reflections seen in some cases. R: (10.4%) 470 nm, (10.0%) 546 nm, (9.9%) 589 nm, (9.8%) 650 nm. Chemical analytical data: Mean of 35 sets of electron-microprobe data: MgO 21.83, MnO 25.76, ZnO 2.66, Al₂O₃ 0.76, Mn₂O₃ 8.12, Fe₂O₃ 0.78, SiO₂ 1.70, TiO₂ 1.40, Sb₂O₅ 36.13, Total 99.14 wt.%. Empirical formula: (Mg$_{1.22}$Mn$_{2+0.82}$Zn$_{0.07}$)$_{2+0.50}$Sb$_{5+0.50}$ (Mn$_{3+0.23}$Si$_{0.06}$Ti$_{0.04}$Al$_{0.03}$Fe$^{3+0.02}$)Sb$_{0.03}$O$_{4.00}$. Relationship to other species: It is chemically related to filipstadite, Mn$_{2}$(Sb$_{5+0.05}$Fe$^{3+0.05}$)O$_{4}$, and both are structurally related to spinel.

Name: After Felix Tegengren (1884–1980), a renowned Finnish–Swedish economic geologist who wrote tomes on the ore deposits of Sweden and China.

Comments: IMA No. 1999–002. The drawing given here is based on the probable forms {001} and {201}, which produce a pseudo-octahedron.