NEW MINERALS

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Bigcreekite

BaSi₂O₅•4H₂O

ORTHORHOMBIC

Locality: The type locality is the Esquire #7 claim (Section 27, T11S, R25E, Mount Diablo Meridian, Lat. 36° 55' N, Long. 119° 14'42" W), along the west side of Big Creek, eastern Fresno County, California, U.S.A. Also found along the northwestern slope of Trumbull Peak, Mariposa County, California, U.S.A. (NE¼ Section 9, T3S, R19E, Mount Diablo Meridian).

Occurrence: In fractures in gneissic rocks composed of sanbornite, quartz, diopside, pyrrhotite and barium-bearing minerals. Other minerals from the type locality are: alforsite, walstromite, anandite, bazirite, benitoite, celsian, gillespite, fresnoite, macdonaldite, muirithe, pellyite, titantaramellite and verplanckite.

General appearance: Subhedral crystalline masses mm in length.


Optical data: Biaxial (+), α 1.537, β 1.538, γ 1.541, 2V(meas.) 59.2°, 2V(calc.) 60°; dispersion r < v, moderate; nonpleochroic; orientation, X = b, Y = a, Z = c. Chemical analytical data: Mean of four sets of electron-microprobe data (with H₂O calculated to give 4H₂O): Na₂O 0.11, CaO 0.03, BaO 48.88, SrO 0.02, SiO₂ 38.16, H₂O (22.94), Total (110.14) wt.%. Empirical formula: (Ba₁₀₀Na₀,0₁)Σ₁,₀₁Si₁,₉₉O₅,₀₀•4,₀₀H₂O.

Relationship to other species: Its structure has similarities to those of sanbornite and gillespite.

Name: After the locality.

Comments: IMA No. 1999–015.


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Brandholzite

$\text{Mg}[\text{Sb(OH)}_6]_2 \cdot 6\text{H}_2\text{O}$

**Locality:** The former Brandholz–Goldkronach mining district in the western part of the Fichtelgebirge, Bavaria, Germany. Specifically, it was found in the Schmidten-Schacht and Jakobi-Schacht pits of the master lode.

**Occurrence:** An alteration product of stibnite in the oxidation zone, found in a stibnite matrix with "antimony-ochers".

**General appearance:** Tabular hexagonal crystals up to ~1 mm in diameter (most are <0.5 mm) forming rose-like aggregates.

**Physical, chemical and crystallographic properties:**
- **Luster:** vitreous.
- **Diaphaneity:** transparent.
- **Color:** colorless.
- **Streak:** white.
- **Luminescence:** nonfluorescent.
- **Hardness:** VHN (load not specified) 60 kg/mm², Mohs 2 to 3.
- **Tenacity:** brittle.
- **Cleavage:** none.
- **Fracture:** conchoidal.
- **Density:** 2.65 g/cm³ (meas.), 2.57 g/cm³ (calc.).

**Crystallography:** Trigonal, $P\overline{3}$, $a = 16.119$, $c = 9.868$ Å, $V = 2220.4$ Å³, $Z = 6$, $c:a = 0.6122$. Morphology: the forms are listed as {100} and {001}, but the tabular hexagonal habit requires {010} and {00¯1} also. Twinning: on {100}.

**X-ray powder-diffraction data:** No table of data is given, but the strongest lines are listed as 4.636(100)(300), 3.392(70)(302), 4.946(50)(002), 2.356(40)(332).

**Optical data:** Uniaxial (–), $\omega = 1.570$, $\varepsilon = 1.569$, nonpleochroic.

**Chemical analytical data:** There was insufficient material for a complete analysis, but the synthetic equivalent was analyzed for Sb (by atomic absorption spectroscopy), Mg (by flame emission spectroscopy) and H₂O (by TGA) and gave: MgO 6.7, Sb₂O₅ 55.0, H₂O 39.0, Total 100.7 wt.%. Empirical formula: Mg₀.₉₄[Sb(OH)₆]₁.₉₂•6.₄₉H₂O. **Relationship to other species:** It is the Mg-dominant analogue of bottinoite, Ni[Sb(OH)₆]₂•6H₂O.

**Name:** After the locality.

**Comments:** IMA No. 1998–017. It is unfortunate that the complete set of X-ray powder-diffraction data was not published.

**Friedrich, A., Wildner, M., Tillmanns, E. & Merz, P.L. (2000):** Crystal chemistry of the new mineral brandholzite, Mg(H₂O)₆[Sb(OH)₆]₂, and of the synthetic analogues $\text{M}^{2+}(\text{H}_2\text{O})₆[\text{Sb(OH)}₆]₂$ ($\text{M}^{2+} = \text{Mg, Co}$). American Mineralogist 85, 593-599.
Carmichaelite

\((Ti, Cr)O_{1.5}(OH)_{0.5}\)

**Locality:** Garnet Ridge, Navajo volcanic field, Colorado Plateau, Arizona, U.S.A.

**Occurrence:** In pyrope crystals in an ultramafic diatreme. Associated minerals are: rutile and srilankite. Other minerals in the host crystals are: ilmenite, crichtonite-group minerals, spinel and olivine.

**General appearance:** Anhedral to subhedral elongated platy crystals (up to 30 μm).

**Physical, chemical and crystallographic properties:**
- **Luster:** metallic.
- **Diaphaneity:** opaque; translucent under high magnification.
- **Color:** black, but cinnamon brown in transmitted light.
- **Streak:** not given.
- **Hardness:** ~6, based on its similar polishing quality to rutile.
- **Tenacity:** brittle.
- **Cleavage:** none observed.
- **Fracture:** not given.
- **Density:** not measured, 4.13 g/cm³ (calc.).
- **Crystallography:** Monoclinic, \(P2_1/c\), \(a = 7.706\), \(b = 4.5583\), \(c = 20.187\ \text{Å}\), \(β = 92.334°\), \(V = 708.5\ \text{Å}^3\), \(Z = 22\), \(a:b:c = 1.6905:1:4.4286\). Morphology: no forms were mentioned. Twinning: none observed. X-ray powder-diffraction data: \(3.773(94)(013)\), \(2.842(100)(\overline{1}15)\), \(2.664(70)(213)\), \(1.688(54)(322)\), \(1.679(44)(226)\), \(1.661(44)(\overline{1}28)\), \(1.648(34)(11.11)\). **Optical data:** In reflected light: gray to white. R about 18%.
- **Chemical analytical data:** Mean of six sets of electron-microprobe data: TiO₂ 62.16, Cr₂O₃ 18.43, Al₂O₃ 1.88, FeO 7.61, MgO 2.80, Nb₂O₅ 0.37, V₂O₅ 0.87, H₂O (5.76). Total (99.88) wt.%. The amount of H₂O was calculated by stoichiometry; its presence was confirmed by IR spectroscopy. Empirical formula: \((Ti_{0.62}Cr_{0.19}Fe_{0.08}Mg_{0.06}Al_{0.03}V_{0.01})_{2.99}O_{1.49}(OH)_{0.51}\). **Relationship to other species:** None apparent.

**Name:** After Prof. Ian S.E. Carmichael (b. 1930), University of California, Berkeley, for his contributions to petrology.

**Comments:** IMA No. 1996–062. Details of the crystal structure are given in the paper.

**Chromceladonite**

\[ \text{KCrMg}\text{Si}_{4}\text{O}_{10}\text{OH}_{2} \]

**Locality:** Srednyaya Padma uranium–vanadium deposit, southern Karelia, Russia.

**Occurrence:** In a metasomatic rock. Associated minerals are: dolomite, quartz, roscoelite, chromphyllite, calcite, hematite, uraninite, zincochromite, vanadium oxides, among others.

**General appearance:** Aggregates of thin lamellae (up to 1 cm) and as spherulites and veinlets.

**Physical, chemical and crystallographic properties:**
- **Luster:** vitreous to silky.
- **Diaphaneity:** transparent.
- **Color:** emerald green to dark green.
- **Streak:** light green.
- **Luminescence:** nonfluorescent.
- **Hardness:** 1½ to 2.
- **Tenacity:** flexible but not elastic.
- **Cleavage:** {001} perfect.
- **Fracture:** platy.
- **Density:** 2.90 g/cm\(^3\) (meas.), 2.97 g/cm\(^3\) (calc.).
- **Crystallography:** Monoclinic, \( \text{C}_2 \), \( a = 5.267, b = 9.101, c = 10.162 \text{ Å}, \beta = 100.67^\circ, V = 479 \text{ Å}^3, Z = 2, a:b:c = 0.5787:1:1.1166 \).
- **Optical data:** Biaxial (–), \( \alpha = 1.605, \beta = 1.648, \gamma = 1.654, 2V(\text{meas.}) 12^\circ, 2V(\text{calc.}) 40^\circ; \) dispersion not observed; pleochroism: \( X \) colorless to pale green, \( Y = Z \) green; \( X \perp (001) < 5^\circ \).
- **Chemical analytical data:** Ten electron-microprobe analyses were carried out, with Li, Fe\(^{3+}\) and Fe\(^{2+}\) determined by wet-chemical means. Data for the holotype specimen are: Li\(_2\)O 0.13, Na\(_2\)O 0.14, K\(_2\)O 10.42, MgO 7.82, MnO 0.19, FeO 0.73, ZnO 0.22, Al\(_2\)O\(_3\) 3.25, V\(_2\)O\(_3\) 1.79, Cr\(_2\)O\(_3\) 17.01, Fe\(_2\)O\(_3\) 0.58, SiO\(_2\) 53.20, TiO\(_2\) 0.16, H\(_2\)O 3.38, F 0.57, sum 99.59, less O = F 0.24, Total 99.35 wt.%. Empirical formula: \((\text{K}_{0.95}\text{Na}_{0.02})_{0.97}(\text{Cr}_{0.97}\text{V}_{0.03}\text{Al}_{0.03}\text{Fe}^{3+}_{0.03}\text{Ti}_{0.01})_{2.07} \cdot (\text{Mg}_{0.04}\text{Fe}^{2+}_{0.03}\text{Li}_{0.02}\text{Zn}_{0.02}\text{Mn}_{0.01})_{0.94} \cdot (\text{Si}_{3.82}\text{Al}_{0.18})_{24}\cdot\text{O}_{0.00}\cdot\text{F}_{0.13}\cdot\text{OH}_{0.12}\cdot\text{O}_{0.23}\cdot\text{F}_{0.13}\cdot\text{OH}_{0.12} = \text{KCrMgSi}_{4}\text{O}_{10}\text{OH}_{2} \).

**Relationship to other species:** A member of the mica group.

**Name:** Reflects the composition of the mica and its relationship to celadonite.

**Comments:** IMA No. 1999–024.

Localities: A small prospect pit near the long-abandoned Clear Creek mercury mine, New Idria district, San Benito County, California, U.S.A.

Occurrence: In a brecciated rock consisting mainly of ferroan calcite and quartz. Associated minerals are cinnabar and edoylerite.

General appearance: A small cluster of subhedral crystals (up to 0.17 mm).


Optical data: No data could be measured. Indices of refraction probably are higher than 2.

Chemical analytical data: An electron-microprobe analysis gave Hg₂O 84.65%; values of CO₂ and H₂O of 6.16 and 6.30%, respectively, were calculated from the crystal-structure data, for a total 97.11 wt.%. Empirical formula: Hg₁⁺₃.₉₂(CO₃)₁.₀₁(OH)₀.₉₀•₂.₀₇H₂O.

Relationship to other species: It is the monoclinic polymorph of Hg₁⁺₃(CO₃)(OH)•2H₂O, peterbaylissrite being orthorhombic.

Name: After the locality.

Comments: IMA No. 1999–003. The crystal structure has been solved.

Edgarite

FeNb$_3$S$_6$

**Locality:** Khibina alkaline complex, Kola Peninsula, Russia (Lat. 67° 43’ N, Long. 33° 47’ W).

**Occurrence:** In a fenitized xenolith (approximately 0.2 km across) enclosed by nepheline syenite. Associated minerals are: pyrrhotite (Ti- and V-rich), ferroan alabandite, marcasite (Ti- and V-rich), wurtzite-2H (Mn- and Fe-rich), corundum, phlogopite, rutile, monazite-(Ce) and a graphite-like mineral.

**General appearance:** Platy inclusion (up to 0.15 mm) in pyrrhotite and alabandite and as aggregates of platy grains on pyrrhotite.

**Physical, chemical and crystallographic properties:**
- **Luster:** metallic.
- **Diaphaneity:** opaque.
- **Color:** dark gray.
- **Streak:** not given.
- **Hardness:** VHN$_5$ 135 kg/mm$^2$ and VHN$_{10}$ 205 kg/mm$^2$.
- **Tenacity:** not given.
- **Cleavage:** {001} perfect.
- **Fracture:** not given.
- **Density:** not measured, 4.99 g/cm$^3$ (calc.).
- **Crystallography:** Hexagonal, most probably P6$_3$22, $a$ 5.771 Å, $c$ 12.190 Å, $V$ 351.6 Å$^3$, $Z$ = 2, $c/a$ = 2.1123. Morphology: no forms were observed. Twinning: none mentioned.
- **Optical data:** In reflected light: gray, strong anisotropism from almost white to dark brown, distinct bireflectance, pleochroic from light gray with a bluish tint to gray. $R_1$, $R_2$: $\lambda_{470}$ nm, 28.1, 40.2; $\lambda_{546}$ nm, 27.4, 39.3; $\lambda_{589}$ nm, 27.0, 38.5; $\lambda_{650}$ nm, 27.0, 36.9; 12.4, 20.3%.

**Chemical analytical data:** Mean of four sets of electron-microprobe data: Nb 52.87, Fe 10.12, V 0.36, Mn 0.10, Ti 0.04, S 35.86, Total 99.35 wt.%. Empirical formula: (Fe$_{0.96}$V$_{0.04}$Mn$_{0.01}$)$_2$Si$_{1.01}$Nb$_{3.03}$S$_{5.95}$. **Relationship to other species:** It is the natural analogue of synthetic FeNb$_3$S$_6$.

**Name:** After Prof. Alan D. Edgar (1935–1998), University of Western Ontario, London, Ontario, Canada, in recognition of his important contributions to the petrology and mineralogy of alkaline rocks.

**Comments:** IMA No. 1995–017.

Gladiusite

Fe$_{3+2}$(Fe$^{2+}$,Mg)$_4$(PO$_4$)(OH)$_{11}$$(H_2O)$

**Locality.** The Kovdor alkaline-ultramafic complex, southwestern Kola Peninsula, northwestern Russia (Lat. 67° 35'N, Long. 30° 20'E).

**Occurrence.** In hydrothermal assemblages in vugs in cataclastic and mineralized dolomite carbonatite. Associated minerals are: pyrite, rutile, a ternovite-like phase, catapleiite, rimkorolgite, bobiereite, collinsite, juonniite, strontiowhitlockite, pyrrhotite and strontian collinsite.

**General appearance.** Acicular masses and free-standing radiating clusters (up to 2 mm in diameter) of arrow-head crystals. Crystals have subtly curved faces and a habit similar to a double-edged sword. Acicular crystals are 0.5 to 7 μm thick and 10 to 500 μm long.

**Physical, chemical and crystallographic properties.**

- **Luster:** Vitreous.
- **Diaphaneity:** Opaque in aggregates and translucent in thin needles.
- **Color:** Dark green to almost black.
- **Streak:** Olivine-green, but changes to brownish red in 10 to 12 hours.
- **Luminescence:** Nonfluorescent.
- **Hardness:** VHN$_{20}$ 300 kg/mm$^2$, Mohs 4 to 4½.
- **Tenacity:** Brittle.
- **Cleavage:** Not observed.
- **Fracture:** Uneven.
- **Density:** 3.11 g/cm$^3$ (meas.), 3.10 g/cm$^3$ (calc.).
- **Crystalllography:** Monoclinic, $P2_1/n$, $a$ 16.595, $b$ 11.650, $c$ 6.266 Å, $\beta$ 90.00°, $V$ 1238 Å$^3$, $Z$ = 4, $\alpha: \beta: c$ = 1.4557:1.0537. Morphology: no forms were mentioned. Twinning: extensive on [001], causing pseudo-orthorhombic symmetry.
- **Optical data:** Biaxial (−), $\alpha$ 1.722, $\beta$ 1.730, $\gamma$ 1.737, $2V$ not measured, $2V$ (calc.) 86° (given erroneously as 78.3° in the paper’s abstract); dispersion not given; pleochroism: $X$ olive green, $Y$ grayish blue, $Z$ dark green with a blue tint, absorption $X > Y > Z$; orientation not given.
- **Chemical analytical data:** Means of twenty-three sets of electron-microprobe data: MgO 11.16, MnO 0.78, FeO 25.00, Fe$_2$O$_3$ 29.90, TiO$_2$ 0.04, P$_2$O$_5$ 12.46, H$_2$O 20.18, Total 99.52 wt.%. Empirical formula: Fe$^{3+}_{1.00}$(Fe$^{2+}_{0.00}$Mg$_{0.02}$Si$_{1.46}$Fe$^{3+}_{1.17}$Mn$^{2+}_{0.05}$Si$_{3.86}$)(PO$_{4.0}$)O$_{1.02}$$(OH)_{10.83}$•1.08H$_2$O. **Relationship to other species.** None apparent.

**Name.** Refers to the appearance of the crystals, which resemble double-edged swords (gladius in Latin).

**Comments.** IMA No. 1998–011. The Gladstone–Dale compatibility is given as −0.0062, superior; the actual value is 0.087, poor.

Liferovich, R.P., Sokolova, E.V., Hawthorne, F.C., Laakso, K.Y.O., Gehör, S., Pakhomovsky, Ya.A. & Sorokhtina, N.V. (2000): Gladiusite, Fe$^{3+}_{1.2}$(Fe$^{2+}_{0.0}$Mg$_{0.0}$)(PO$_{4}$)(OH)$_{11}$(H$_2$O), a new hydrothermal mineral species from the phoscorite–carbonatite unit, Kovdor complex, Kola Peninsula, Russia. Canadian Mineralogist 38, 1477-1485.

Sokolova, E.V., Hawthorne, F.C., McCammon, C. & Liferovich, R.P. (2001): The crystal structure of gladiusite, (Fe$^{3+}_{0.00}$Mg$_{0.4}$Fe$^{3+}_{0.17}$)$_{11}$Si$_{3.86}$PO$_{4.0}$(OH)$_{10.83}$•1.08H$_2$O. Canadian Mineralogist 39, 1121-1130.
Kampfite

$\text{Ba}_6[(\text{Si},\text{Al})\text{O}_2]_8(\text{CO}_3)_2\text{Cl}_2(\text{Cl},\text{H}_2\text{O})_2$

**Locality:** Esquire #1 claim, Rush Creek, eastern Fresno County, California, USA (NE¼ NW¼ Section 16, T11S, R25E, Mount Diablo Meridian, Lat. 37° 05’N, Long. 119° 16’20”W). Kampfite has been found also at the Esquire #7 claim, along Big Creek, Fresno County, California, USA (SE¼ SE¼ Section 27, T11S, R25E, Mount Diablo Meridian, Lat. 36° 56’40”N, Long. 119° 14’28”W).

**Occurrence:** In a quartz–sanbornite outcrop. Associated minerals are: celsian, fresnoite, macdonaldite, pyrrhotite, titantaramellite, traskite, witherite, two new minerals and a hydrated form of SiO₂.

**General appearance:** Irregular masses up to 1 cm.

**Physical, chemical and crystallographic properties:**
- **Luster:** vitreous.
- **Diaphaneity:** translucent.
- **Color:** light blue-gray.
- **Streak:** white.
- **Luminescence:** nonfluorescent.
- **Hardness:** 3.
- **Tenacity:** brittle.
- **Cleavage:** {001} well-developed.
- **Fracture:** uneven.
- **Density:** could not be measured because of the presence of numerous inclusions, 3.51 g/cm³ (calc.).

**Crystallography:** Hexagonal, $P_6_3/mmc$, $P\bar{6}_2c$, $P3_1\bar{c}$ or $P\bar{3}_1\bar{c}$, $a$ 5.244, $c$ 29.83 Å, $V$ 710.5 Å³, $Z$ = 1, $c:a$ = 5.6884. Morphology: no forms were observed. Twinning: none observed.


**Optical data:** Uniaxial (−), $\omega$ 1.642, $\varepsilon$ 1.594, nonpleochroic. One grain is biaxial (−), $\alpha$ 1.641, $\beta$ 1.642, $\gamma$(calc.) 1.642, $2V$(meas.) 20°, dispersion $r < v$ slight.

**Chemical analytical data:** Mean of three sets of electron-microprobe data (with CO₂ and H₂O calculated by stoichiometry): Na₂O 0.08, CaO 0.06, BaO 57.72, Al₂O₃ 7.76, CO₂ (5.69), SiO₂ 20.14, H₂O (1.16), Cl 5.60, sum 98.21, less O = Cl 1.27, Total (96.94) wt.%. Empirical formula: $(\text{Ba}_{5.83}\text{Na}_{0.04}\text{Ca}_{0.02})\text{Si}_{5.19}\text{Al}_{2.36}\text{O}_{15.08}(\text{CO}_3)_2\text{Cl}_{2.00}(\text{H}_2\text{O})_{1.06}\text{Cl}_{0.45}\text{H}_{1.45}$.

**Relationship to other species:** The only other barium silicate carbonate mineral is fencooperite, Ba₆Fe³⁺₃Si₆O₂₄( CO₃)₂Cl₃•H₂O.

**Name:** After Anthony Robert Kampf (b. 1948), Curator and Section Head of Minerals, Los Angeles County Museum of Natural History, for his many contributions to the crystallographic study of new and rare minerals.

**Comments:** IMA No. 2000–003.

Londonite

(Cs,K,Rb)Al4Be4(B,Be)12O28

Locality. The type locality is Antandrokomby granitic pegmatite, near Mt. Ibity, south of the Sahatany Valley, Madagascar. Also from the Ampaniana and Antsongombato pegmatites.

Occurrence. In the pocket zone of the pegmatite. Associated minerals are: quartz, albite, red tourmaline, microcline and danburite.

General appearance. Two well-formed crystals 1 cm across (type locality). Also up to 7 cm across at Antsongombato.


Optical data. Isotropic, n = 1.693. Chemical analytical data. Mean of five sets of electron-microprobe data (with BeO and B₂O₃ calculated to give 5.00 Be and 11.00 B, respectively): Li₂O 0.04, Na₂O 0.11, K₂O 0.15, Rb₂O 1.04, BeO (15.49), MgO n.d., CaO 0.14, MnO 0.05, B₂O₃ 47.39, Al₂O₃ 25.10, Fe₂O₃ 0.06, SiO₂ 0.07, Total (100.07) wt.%. Empirical formula: (Cs₀.48K₀.38Rb₀.09Na₀.03Ca₀.02Mn₀.01)(Al₃.97Li₀.02Fe₀.01)H₂₀.01[(B₁₀.99Si₀.01)₂₁₁.₀₀Be₁.₀₀]₁₂₂.₀₀O₂₈.₀₀.

Relationship to other species. It is the Cs-dominant analogue of rhodizite, (K,Cs)Al₄Be₄(B,Be)₁₂O₂₈.

Name. After David London (b. 1953), Professor of Geology and Geophysics at the University of Oklahoma.

Comments. IMA No. 1999–014.

Lulzacite

\[ \text{Sr}_2\text{Fe}^{2+}(\text{Fe}^{2+},\text{Mg})_2\text{Al}_4(\text{PO}_4)_4(\text{OH})_{10} \]

**Locality:** A quartzite quarry near Saint-Aubin-des-Châteaux, about 8 km west of Châteaubriant, Loire-Atlantique, France.

**Occurrence:** In veinlets at the contact between quartzite and pyrite-rich limestone. Associated minerals are: goyazite, “apatite”, siderite, quartz, calcite, marcassite, pyrrhotite and pyrite.

**General appearance:** Anhedral aggregates (up to several cm long); rarely as pseudopyramidal euhedral crystals (up to 4 mm).

**Physical, chemical and crystallographic properties:**
- **Luster:** probably vitreous.
- **Diaphaneity:** transparent to translucent.
- **Color:** dark grayish green to yellowish green.
- **Streak:** not given.
- **Luminescence:** nonfluorescent.
- **Hardness:** 5½ to 6.
- **Tenacity:** not given.
- **Cleavage:** not given.
- **Fracture:** not given.
- **Density:** 3.55 g/cm³ (meas.), 3.56 g/cm³ (calc.).
- **Crystallography:** Triclinic, \( P\bar{1} \), \( a = 5.457, b = 9.131, c = 9.769 \) Å, \( \alpha = 108.47^\circ, \beta = 91.72^\circ, \gamma = 97.44^\circ \), \( V = 465.5 \) Å³, \( Z = 1 \). Morphology: No forms were mentioned. Twinning: none mentioned. **X-ray powder-diffraction data:** 4.47(41)(021), 3.591(50)(111), 3.218(100)(122), 3.132(62)(120), 3.016(56)(122), 2.878(42)(032), 2.8119(58)(113), 2.6526(44)(132), 2.6635(43)(013).
- **Optical data:** Biaxial (-), \( \alpha = 1.654, \beta = 1.674, \gamma = 1.684 \), 2\( V \) (meas.) 45° to 65°, 2\( V \) (calc.) 70°, dispersion \( r < v \); distinct pleochroism from brown-yellow to pale blue-violet; orientation not given.

**Chemical analytical data:** Mean of fifteen sets of electron-microprobe data: MgO 2.97, SrO 21.79, BaO 1.20, FeO 16.13, MgO 2.97, Al₂O₃ 19.16, P₂O₅ 28.50, V₂O₅ 0.64, H₂O 10.29, Total 100.68 wt.%. Empirical formula: \( (\text{Sr}_{2.05}\text{Ba}_{0.08})_2\text{Fe}^{2+}_{1.00}(\text{Fe}^{2+}_{1.18}\text{Mg}_{0.71})_2\text{Al}_4(\text{PO}_4)_{3.91}(\text{VO}_4)_{0.07}\text{OH})_{11.11}. \) The ideal formula requires: MgO 3.31, FeO 16.20, SrO 21.25, Al₂O₃ 20.91, P₂O₅ 29.09, H₂O 9.24, Total 100.00 wt.%. **Relationship to other species:** It is isotypic with jamesite, whose revised formula is \( \text{Pb}_2\text{ZnFe}_{2+}^2(\text{Fe}_{3.17}^3\text{Zn}_{0.83})(\text{AsO}_4)_2(\text{OH})_2[\text{OH}]_{1.2}\text{O}_8 \).

**Name:** After Y. Lulzac (b. 1934), mining geologist of the BRGM, who discovered the mineral.

**Comments:** IMA No. 1998–039. Note that the crystal structure has been solved and published.

**References:**
- LÉONE, P., PALVADEAU, P. & MOÉLO, Y. (2000): Structure cristalline d’un nouvel hydroxyphosphate naturel de strontium, fer et aluminium (lulzacite). \( \text{Sr}_2\text{Fe}^{2+}(\text{Fe}^{2+},\text{Mg}_{0.37})_2\text{Al}_4(\text{PO}_4)_4(\text{OH})_{10} \). Comptes Rendus de l’Académie des Sciences de Paris, Série IIc 3, 301-308.
Nickellotharmeyerite

\[ \text{Ca}(\text{Ni}, \text{Fe}^{3+})_2(\text{AsO}_4)_2(\text{H}_2\text{O}, \text{OH})_2 \]

**Locality:** The Pucher shaft, Schneeberg–Neustädtel, Saxony, Germany.

**Occurrence:** Found in the oxidation zone of the deposit, associated with quartz on the type specimen. Associated minerals on other samples are: lukrahnite, Ni- and Co-bearing ferrillotharmeyerite, mawbyite, arseniosiderite, zeunerite and barium-pharmacosiderite.

**General appearance:** Tiny aggregates (up to 0.5 mm) and crusts grown in small cavities; single crystals are usually less than 50 µm across.

**Physical, chemical and crystallographic properties**

- **Luster:** subadamantine.
- **Diaphaneity:** transparent.
- **Color:** brown to yellow.
- **Streak:** light brown to yellow.
- **Luminescence:** nonfluorescent.
- **Hardness:** VHN25 500 kg/mm², Mohs 4½.
- **Tenacity:** brittle.
- **Cleavage:** none observed.
- **Fracture:** conchoidal.
- **Density:** could not be measured, 4.45 g/cm³ (calc.).
- **Crystallography:** Monoclinic, \( C2/m \), \( a = 9.005 \text{ Å}, b = 6.205 \text{ Å}, c = 7.411 \text{ Å}, \beta = 115.31^\circ \), \( V = 374.4 \text{ Å}^3 \), \( Z = 2 \), \( a:b:c = 1.4512:1:1.1944 \). Morphology: no forms were mentioned. Twinning: none mentioned.
- **Optical data:** Biaxial (+), \( \alpha = 1.80 \text{ (calc.)}, \beta = 1.81, \gamma = 1.87, 2V(\text{meas.}) = 40^\circ \), dispersion not determined; pleochroism strong, \( X \) yellow, \( Y \) brown, \( Z \) pale yellow; \( X \approx c, Y = b, Z \approx a \approx 25^\circ \) in obtuse angle \( \beta \).
- **Chemical analytical data:** Mean of eleven sets of electron-microprobe data: CaO 9.29, NiO 12.86, CoO 3.83, CuO 0.11, ZnO 0.62, PbO 0.90, Al₂O₃ <0.05, Fe₂O₃ 12.88, Bi₂O₃ 8.56, P₂O₅ 0.23, V₂O₅ <0.05, As₂O₃ 45.32, SO₃ 0.12, H₂O (5.35), Total (100.07) wt.%. Empirical formula: \( (\text{Ca}_{0.83}\text{Bi}_{0.18})_{2.01} (\text{Ni}_{0.86}\text{Fe}^{3+}_{0.81}\text{Co}_{0.29}\text{Zn}_{0.04}\text{Pb}_{0.04}\text{Cu}_{0.01})_{2.00} [\text{AsO}_4]_{1.98} [\text{PO}_4]_{0.00} [\text{SO}_4]_{0.01} [\text{H}_2\text{O}]_{1.00} [\text{OH}]_{0.99} [\text{H}_2\text{O}]_{1.00} [\text{OH}]_{0.99} \). **Relationship to other species:** It is a member of the tsumcorite group, specifically, the nickel-dominant analogue of lotharmeyerite.

**Name:** After the relationship with lotharmeyerite.

**Comments:** IMA No. 1999–008.

Obertiite

\[
\text{NaNa}_2(\text{Mg}_3\text{Fe}^{3+}\text{Ti}^{4+})\text{Si}_8\text{O}_{22}\text{O}_2
\]

MONOCLINIC

Locality: The Bellerberg quarry, Laacher See district, Eifel region, Germany.

Occurrence: In cavities in basaltic flows. Associated minerals are: tridymite, fluororichterite, hematite, rutile, aegirine-augite, kinoshitalite and fluorapatite.

General appearance: Elongate blades (up to \(10 \times 40 \times 200 \mu m\)) and divergent aggregates.

Physical, chemical and crystallographic properties:

- Luster: vitreous.
- Diaphaneity: presumably transparent to translucent.
- Color: pale pink.
- Streak: white.
- Luminescence: nonfluorescent.
- Hardness: 5.
- Tenacity: brittle.
- Cleavage: \{110\} perfect.
- Fracture: conchoidal.
- Density: could not be measured, \(3.17 \text{ g/cm}^3\) (calc.).

Crystallography:

- Monoclinic, \(C2/m\), \(a = 9.776, b = 17.919, c = 5.292 \text{ Å}, \beta = 104.05^\circ\), \(V = 899.3 \text{ Å}^3\), \(Z = 2, a:b:c = 0.5456:1:0.2953\).
- Morphology: no forms were mentioned. Twinning: none mentioned.

X-ray powder-diffraction data:


Optical data:

- Biaxial (–), \(\alpha = 1.643, \beta = 1.657, \gamma = 1.670, 2V(\text{meas.}) = 81^\circ, 2V(\text{calc.}) = 87^\circ\) (given as 93°); dispersion not visible; pleochroism slight in shades of pink to red-orange, absorption \(X \approx Y \approx Z\), \(\chi \approx \alpha = 2^\circ\) (in obtuse angle \(\beta\)).

Chemical analytical data:

Mean of ten sets of electron-microprobe data: \(\text{Li}_2\text{O} 0.05, \text{Na}_2\text{O} 9.51, \text{K}_2\text{O} 0.98, \text{MgO} 14.13, \text{CaO} 0.52, \text{FeO} 3.36, \text{ZnO} 0.08, \text{Al}_2\text{O}_3 0.15, \text{Mn}_2\text{O}_3 3.27, \text{Fe}_2\text{O}_3 2.61, \text{SiO}_2 54.53, \text{TiO}_2 7.75, \text{H}_2\text{O} 0.20, \text{F} 0.55\), sum 97.69, less O = F 0.23, Total 97.46 wt.%. The Mn\(^{3+}\):Mn\(^{2+}\) and Fe\(^{3+}\):Fe\(^{2+}\) ratios are not known, so calculations were carried out expressing all manganese as Mn\(^{3+}\) and also as Mn\(^{2+}\). Fe\(^{3+}\) and Fe\(^{2+}\) were adjusted for each of these assumed valence states of manganese, and the site occupancies are based on the crystal-structure refinement. The empirical formula derived in this manner is: \((\text{Na}_{0.82} \text{K}_{0.18})\text{Si}_{8.00}\text{O}_{22.00}(\text{O}_1\text{Na}_1\text{Ca}_{0.08}\text{Fe}^{3+}_{0.06}\text{Fe}^{2+}_{1.90}(\text{Mg}_{1.09}\text{Ti}_{0.86}\text{Mn}_{1.37}\text{Fe}_{0.35}\text{Fe}_{0.30}\text{Al}_{0.03})\text{Si}_{2.00}\text{O}_{22.00}(\text{OH})_{0.20})_{22.00}\).

Relationship to other species: It is the second anhydrous member of the amphibole group; the first is ungarettiite.

Name: After Roberta Oberti (b. 1951), Pavia, Italy, for her contributions to the understanding of the crystal chemistry of the amphibole group.


HAWTHORNE, F.C., COOPER, M.A., GRICE, J.D. & OTTOLINI, L. (2000): A new anhydrous amphibole from the Eifel region, Germany: description and crystal structure of obertiite, \(\text{NaNa}_2(\text{Mg}_3\text{Fe}^{3+}\text{Ti}^{4+})\text{Si}_8\text{O}_{22}\text{O}_2\). American Mineralogist 85, 236-241.
**Orthojoaquinite-(La)**

\[ \text{Ba}_2\text{Na}_2\text{La}_2\text{Fe}^{2+}\text{Ti}_2\text{Si}_8\text{O}_{26}(\text{O,OH})\cdot\text{H}_2\text{O} \]

**Locality**: The Ilimaussaq alkaline complex, on the right bank of the Narsaq River, at the foot of Kvansfeld Mountain, south Greenland.

**Occurrence**: In the intermediate zone of nepheline syenite pegmatites. Associated minerals are: riebeckite, analcime, sodalite and steenstrupine-(Ce).

**General appearance**: Banded gneissic masses (up to 4 × 3 × 1 cm) consisting of bent flakes 1 mm long.

**Physical, chemical and crystallographic properties**: Luster: silky. Diaphaneity: transparent. Color: brown. Streak: unknown. Luminescence: not reported. Hardness: VHN 350–430 kg/mm², Mohs about 5. Tenacity: unknown, probably brittle. Cleavage: {001} good. Fracture: not given. Density: 4.1 g/cm³ (meas.), 4.14 g/cm³ (calc.). **Crystallography**: Orthorhombic, Ccmm, a 10.539, b 9.680, c 22.345 Å, V 2280 Å³, Z = 4, a:b:c = 1.0887:1.2:3.084. Morphology: no forms were mentioned. Twinning: none mentioned. **X-ray powder-diffraction data**: 5.58(67.5)(004), 3.00(8.8)(224), 2.95(17.0)(206), 2.91(10.5)(117), 2.80(100)(313,008,225), 2.232(7.5)(0.0.10), 1.596(12.8)(0.0.14,602). **Optical data**: Biaxial (+), α 1.754, β 1.760, γ 1.797, 2V (meas.) 40°, 2V (calc.) 45°; dispersion not given; pleochroism strong, Z > X; orientation, Z = c. **Chemical analytical data**: A wet-chemical analysis gave: Na₂O 2.41, K₂O 0.22, CaO (+ SrO) 0.03, MnO 0.70, FeO 4.78, BaO 21.46, Fe₂O₃ 0.39, La₂O₃ 10.05, Ce₂O₃ 9.40, Pr₂O₃ 0.99, Nd₂O₃ 2.15, SiO₂ 33.82, TiO₂ 9.20, ThO₂ 0.38, Nb₂O₅ 2.31, H₂O 1.50, F 0.38, sum 100.17, less O = F 0.16, Total 100.01 wt.%. Empirical formula: (Ba₁.₉₉Ca₀.₀₁)₂ₛₒ.₀₀ (Na₁.₃₁K₀.₀₇)₂ₛ₁.₁₆(La₀.₈₆Ce₀.₈₁Nd₀.₁₈Pr₀.₀₉)₂₁.₉₆(Fe²⁺₀.₉₈Mn₀.₁₄)₂₇.₀₉ (Ti₁.₆₄Nb₀.₂₃Fe³⁺₀.₀₇Th₀.₀₂)₂₁.₉₆Si₈.₀₁O₂₆.₈₀[(OH)₀.₃₇F₀.₃₅O₂₆.₉₆]₂₁.₉₆•₁.₀₀H₂O. **Relationship to other species**: A member of the joaquinite group.

**Name**: After the relationship to other members of the joquinite group.

**Comments**: IMA No. 00–D.

Orthominasragrite

\[ V^4+O(SO_4)(H_2O)_5 \]

**Orthorhombic**

**Locality:** The North Mesa mine group (west ½, southwest ¼ of section 35, Township 24 South, Range 11 East), Temple Mountain mining district, Emery County, Utah, U.S.A.

**Occurrence:** In a silicified tree, approximately 46 cm wide by 30 cm high by an undetermined length. Associated minerals are: pyrite, "various iron sulfates", sulfur, minasragrite and an as-yet undescribed vanadium sulfate.

**General appearance:** Rounded aggregates (up to 200 μm across).

**Physical, chemical and crystallographic properties**

- **Luster:** vitreous.
- **Diaphaneity:** not mentioned.
- **Color:** pale blue to bright blue.
- **Streak:** pale blue.
- **Luminescence:** nonfluorescent.
- **Hardness:** approximately 1.
- **Tenacity:** not mentioned.
- **Cleavage:** none observed.
- **Fracture:** not mentioned.
- **Density:** could not be measured, 2.00 g/cm³ (calc.).

**Crystallography:**

<table>
<thead>
<tr>
<th>hkl</th>
<th>0.699(100B)(101)</th>
<th>3.734(20)(021)</th>
<th>3.622(20)(200)</th>
<th>3.322(50)(121)</th>
<th>3.108(20)(002)</th>
<th>2.865(40)(220)</th>
<th>2.602(30)(221)</th>
<th>2.363(20)(230,202)</th>
<th>2.030(20)(321)</th>
</tr>
</thead>
</table>

**Optical data:**

Biaxial (−), α 1.529, β 1.534, γ 1.534, 2V(meas.) +2°, 2V(calc.) 0°; dispersion not mentioned; nonpleochroic; orientation: X = b, Y = c, Z = a.

**Chemical analytical data:**

Electron-microprobe data (with H₂O calculated to give 5 H₂O): V₇.01O₇.04(SO₄)₁.09•5.00H₂O. Total 102.15 wt.%.

**Relationship to other species:** It is the orthorhombic polymorph of \( V^4+O(SO_4)(H_2O)_5 \), minasragrite being monoclinic.

**Name:** After the relationship with minasragrite.

**Comments:** IMA No. 2000–018.

Oswaldpeetersite

\((\text{UO}_2)_2\text{CO}_3(\text{OH})_2\cdot4\text{H}_2\text{O}\)

**Locality:** The Jomac uranium mine, Brown’s Rim, San Juan County, Utah, U.S.A.

**Occurrence:** In the Tertiary Shinarump conglomerate, which is rich in organic material such as black coal-bearing smears and logs of partially petrified wood. Associated minerals are: gypsum, cuprite, antlerite, goethite, lepidocrocite, mbobomkulite, hydrombo-bomkulite, sklodowskite and two undefined uranium minerals.

**General appearance:** Micrometric prismatic crystals (approximately 0.1 \(\times\) 0.01 \(\times\) 0.002 mm) arranged in radiating groups.

**Physical, chemical and crystallographic properties:**
- **Luster:** vitreous.
- **Diaphaneity:** transparent.
- **Color:** canary yellow.
- **Streak:** pale yellow.
- **Luminescence:** nonfluorescent.
- **Hardness:** between 2 and 3.
- **Tenacity:** weak.
- **Cleavage:** parallel to the elongation.
- **Fracture:** uneven.
- **Density:** greater than 4.10 g/cm\(^3\) (meas.), 4.55 g/cm\(^3\) (calc.).

**Crystallography:**
- **Monoclinic:** \(\text{P}_{2}1/c\), \(a = 4.1425\), \(b = 14.098\), \(c = 18.374\) Å, \(\beta = 103.62^\circ\), \(V = 1042.8\) Å\(^3\), \(Z = 4\), \(a:b:c = 0.2938:1:1.3033\).
- **Morphology:** \(\{100\}, \{010\}, \{001\}\), acicular and heavily striated parallel to the length.
- **Twinning:** none mentioned.
- **Optical data:** Biaxial (−), \(\alpha = 1.583\), \(\beta = 1.669\), \(\gamma = 1.712\), 2\(V\) not measured, 2\(V\) (calc.) 67°; dispersion not observed; pleochroism: \(X\) and \(Y\) very pale yellow to colorless, \(Z\) pale yellow; \(Z \approx a\), elongation is positive.

**Chemical analytical data:** Mean of ten sets of electron-microprobe data: \(\text{UO}_3 81.47\), \(\text{H}_2\text{O} 12.30\) (by TGA), \(\text{CO}_2 6.23\) (by difference), Total (100.00) wt.%. Empirical formula: \((\text{UO}_2)_2.03(\text{CO}_3)_{1.01}(\text{OH})_{2.04} \cdot 3.85\text{H}_2\text{O}\). **Relationship to other species:** None apparent.

**Name:** After Maurice Oswald Peeters (b. 1945), structural crystallographer at the University of Leuven, Belgium, and researcher in the field of uranium mineralogy.

**Comments:** IMA No. 2000–034. The mineral was discovered by Patrick Haynes of Cortez, Colorado, U.S.A.

**Vochten, R., Deliens, M. & Medenbach, O.** (2001): Oswaldpeetersite, \((\text{UO}_2)_2\text{CO}_3(\text{OH})_2\cdot4\text{H}_2\text{O}\), a new basic uranyl carbonate mineral from the Jomac uranium mine, San Juan County, Utah, U.S.A. Canadian Mineralogist 39, 1685-1689.
Pararsenolamprite

As

Orthorhombic

Locality: The dump of the Mukuno mine (Lat. 33° 28'47"N, Long. 131° 26'15"E), Yamagacho, Oita Prefecture, Kyushu, Japan.

Occurrence: In a hydrothermal Sb–As–Ag–Au ore deposit. Associated minerals are: arsenic, stibnite and quartz. Other minerals in the deposit are: pyrite, miargyrite, argentian tetraedrite, gold, lollingite, claudetite and kankite.

General appearance: Radial or parallel aggregates of bladed crystals (up to 0.8 mm long).

Physical, chemical and crystallographic properties: Luster: metallic. Diaphaneity: opaque. Color: lead gray. Streak: black. Hardness: VHN25 66 to 91 kg/mm², Mohs 2 to 2½. Tenacity: sectile and brittle. Cleavage: {001} perfect. Fracture: not mentioned. Density: 5.88 g/cm³ (meas.), 5.99 g/cm³ (calc.). Crystallinity: Orthorhombic, Pmn2₁ or P2₁nm, a 3.663, b 10.196, c 10.314 Å, V 382.1 Å³, Z = 18, a:b:c = 0.3563:1:1.0116. Morphology: {001}, elongate on [100] and flattened on {001}. Twinning: none mentioned. X-ray powder-diffraction data: 5.17(100)(002), 4.60(24)(012), 3.259(58)(013), 2.840(27)(032), 2.580(22)(004), 2.299(23)(024), 1.794(26)(105). Optical data: In reflected light: white with a slightly greenish blue tint, strong anisotropism (dark brown, greenish gray), distinct bireflectance (cream parallel to elongation and brown, gray, green perpendicular to elongation). R₁, R₂, imR₁, imR₂: (49.0, 44.0; 33.6, 29.3%) 470 nm, (47.0, 42.1; 31.5, 28.0%) 546 nm, (44.8, 39.9; 29.7, 26.9%) 589 nm, (44.9, 40.3; 29.2, 26.0%) 650 nm. Chemical analytical data: Mean of eight sets of electron-microprobe data: As 91.89, Sb 7.25, S 0.48, Total 99.62 wt.%. Empirical formula: (As₀.₉₄Sb₀.₀₅S₀.₀₁)₁₂₁₀₀. Relationship to other species: It is the third polymorph of As; the others are arsenic (trigonal) and arsenolamprite (orthorhombic).

Name: After the relationship with arsenolamprite.

Comments: IMA No. 1999–047.

Remondite-(La)

**Na₃(La,Ce,Ca)₃(CO₃)₅**

**Locality**: Koashva Mountain, Khibina alkaline massif, Kola Peninsula, Russia.

**Occurrence**: In the aegirine core of a small hyperagpaitic pegmatite. Associated minerals are: cancrisilite, microcline, sodalite, villiaumite, natrolite, pectolite, lomonosovite, barytolamprophyllite, catapleiite, natron, thermonatrite, sazykinaite-(Y), "Nb-rinkite", vitusite-(Ce) and fluorapatite.

**General appearance**: Rough prismatic segregations (up to 2 × 0.8 × 0.5 mm) made up of tiny (up to 5 μm) irregular grains.

**Physical, chemical and crystallographic properties**:
- **Luster**: vitreous.
- **Diaphaneity**: translucent.
- **Color**: bright orange yellow.
- **Streak**: white.
- **Luminescence**: nonfluorescent.
- **Hardness**: ~3.
- **Tenacity**: brittle.
- **Cleavage**: none.
- **Fracture**: conchoidal.
- **Density**: 3.5 g/cm³ (meas.), 3.56 g/cm³ (calc.).

**Chemical analytical data**: Mean of eleven sets of electron-microprobe data: Na₂O 15.48, K₂O 0.58, CaO 5.13, SrO 2.93, BaO 0.18, La₂O₃ 19.75, Ce₂O₃ 16.67, Pr₂O₃ 0.99, Nd₂O₃ 2.27, Sm₂O₃ 0.37, CO₂ 32.97, ThO₂ 1.34, Total 98.66 wt.%. Empirical formula: Na₃.00(La₀.81Ce₀.68Ca₀.61Na₀.33Sr₀.19Nd₀.09Pr₀.04Th₀.03Sm₀.01Ba₀.01)₂.88(CO₃)₄.99.

**Relationship to other species**: The La-dominant analogue of remondite-(Ce).

**Name**: After the relationship with remondite-(Ce).

**Comments**: IMA No. 1999–006. The subscripts derived here for the empirical formula are somewhat different to those given in the paper.

**Pekov, I.V., Chukanov, N.V., Kononkova, N.N., Zadoev, A.E. & Belovitskaya, Yu.V. (2000): Remondite-(La), Na₃(La,Ce,Ca)₃(CO₃)₅ – a new mineral of the burbankite family from the Khibina Massif, Kola Peninsula. Zapiski Vserossiyskogo Mineralogicheskogo Obshchestva 129(1), 53-60 (in Russ.).**
**Theoparacelsite**

\[ \text{Cu}_3(\text{OH})_2\text{As}_2\text{O}_7 \]

**Locality:** The old copper mines of Roua (North and South group) in the upper part of the Var valley (the Daluis gorge) at the western margin of the Barrot dome, Alpes-Maritimes area, about 50 km from Nice, France.

**Occurrence:** Associated minerals are: dolomite, calcite, aragonite, copper, cuprite, domeykite, algodonite, koutekite, gold, silver, olivenite, cornubite, clinopyrolyte, connellite, brochantite, malachite, trippkeite, pharmacosiderite, strashimirite and gilmarite.

**General appearance:** Aggregates in cuprite cavities 1 mm in diameter. The aggregates consist of crystals (up to 0.2 mm), rectangular elongate crystals (up to 90 × 10 × 5 μm), perfect rectangular crystals (10 × 7 × 2 μm), equidimensional crystals (~20 μm), pseudomorphs after thin acicular crystals of olivenite and also as powder.

**Physical, chemical and crystallographic properties:**

- **Luster:** Vitreous to adamantine.
- **Diaphaneity:** Translucent.
- **Color:** Dark pistachio green.
- **Streak:** Yellowish green.
- **Luminescence:** Nonfluorescent.
- **Hardness:** Could not be measured.
- **Tenacity:** Brittle.
- **Cleavage:** Perfect (001).
- **Fracture:** Conchoidal.
- **Density:** Could not be measured, 4.73 g/cm³ (calc.).

**Crystallography:** Orthorhombic, \( \text{Pmm}a \), \( a = 8.3212, b = 2.9377, c = 4.6644 \) Å, \( V = 114.02 \) Å³, \( Z = 2/3 \). Morphology: \{001\}, \{010\}, \{100\}, \{110\} and \{101\}. Twinning: None. *X-ray powder-diffraction data:* 4.065(15)(101), 3.104(100)(201), 2.486(70)(011), 2.400(25)(210), 2.330(15)(002), 1.672(30)(212), 1.596(25)(411), 1.330(25)(601, 221). **Optical data:** Biaxial (+), \( \alpha = 1.81, \beta = 1.82, \gamma = 1.86, 2V(\text{meas.}) = 57°, 2V(\text{calc.}) = 54°, \) dispersion \( r > v \), moderate; pleochroism X light olive green, Y olive green, Z dark pistachio green; orientation, \( X = a, Y = c, Z = b \). **Chemical analytical data:** Mean of five sets of electron-microprobe data (with H2O by difference): CuO 48.77, As2O3 47.68, H2O (3.55), Total (100.00) wt.%. Empirical formula: \( \text{Cu}_{2.99}(\text{OH})_{1.92} \text{As}_{2.02}\text{O}_{7.08} \). **Relationship to other species:** None apparent.

**Name:** After Philippus Aureolus Bombastus von Hohenheim (1493–1541), called Paracelse, which is a Greco-Roman translation of Hohenheim meaning “close to the sky.” Paracelse was an important physician, chemist, alchemist and doctor who also worked in mineralogy (De Mineralibus, De Elemento Aquae & Fructibus eius). He is known in toxicology for having said “All is poison, nothing is poison, it is the dosage which makes the poison.”

**Comments:** IMA No. 1998–012.

**Locality:** The Vuoriyarvi massif on the north shore of Vuoriyarvi Lake, northern Karelia, Murmansk region, Russia.

**Occurrence:** In a sample from a borehole that crosscuts veined dolomite–calcite carbonatites. Associated minerals are: calcite, dolomite, a serpentine-group mineral and pyrite.

**General appearance:** Tabular crystals (up to 0.2 × 1.2 × 2.5 mm).

**Physical, chemical and crystallographic properties:**
- **Luster:** vitreous.
- **Diaphaneity:** transparent to translucent.
- **Color:** colorless to white.
- **Streak:** white.
- **Luminescence:** nonfluorescent.
- **Hardness:** VHN₄₀ 410 kg/mm², Mohs close to 4½.
- **Tenacity:** very brittle.
- **Cleavage:** {100} perfect.
- **Fracture:** uneven.
- **Density:** 2.78 g/cm³ (meas.), 2.77 g/cm³ (calc.).
- **Crystallography:** Monoclinic, \( P2_1/c \), \( a = 9.144, b = 8.818, c = 7.537 \) Å, \( \beta = 113.22^\circ \), \( V = 558.49 \) Å³, \( Z = 2 \), \( a:b:c = 1.037:1:0.8547 \). Morphology: {100}, {h0l}, {hkl}; tabular on {100} and elongate along [001]. Twinning: on {100}.

**X-ray powder-diffraction data:** 

**Optical data:** Biaxial (−), \( \alpha = 1.570, \beta = 1.588, \gamma = 1.594, 2V(\text{meas.}) = 60^\circ, 2V(\text{calc.}) = 59^\circ; \) pleochroism X greenish gray, \( Y = Z \) colorless; \( Y = b, Z \perp c = 3^\circ \).

**Chemical analytical data:** Six crystals were analyzed by electron microprobe (6 to 10 analyses per crystal). The data from one crystal are: Na₂O 13.72, CaO 0.15, MnO <0.02, FeO <0.02, Y₂O₃ <0.1, SiO₂ 52.71, TiO₂ 0.35, ZrO₂ 20.41, SnO₂ 5.73, HFO₂ 0.60, Nb₂O₅ <0.05, H₂O (7.86). Total (101.53) wt.%. The amount of H₂O was calculated to give 2(H₂O). Empirical formula: \( (\text{Na}_{2.03}\text{Ca}_{0.01})\text{Zr}_{0.76}\text{Sn}_{0.17}\text{Ti}_{0.02}\text{Hf}_{0.01})\text{Si}_{4.02}\text{O}_{11.00}\bullet2\text{H}_{2}O \).

**Name:** After the Tumcha River, near the Vuoriyarvi massif.

**Comments:** IMA No. 1999–041.

Zaccagnaite

\[ \text{Zn}_4\text{Al}_2(\text{OH})_{12}(\text{CO}_3)\text{•3H}_2\text{O} \]

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

**Occurrence:** In cavities in calcite veins in the famous Carrara marble. Associated minerals are: hydrozincite and fraipontite. It formed as a product of the alteration of sphalerite by reaction with aluminum-rich hydrothermal fluids.

**General appearance:** Minute hexagonal crystals less than 0.2 mm long and 0.02 to 0.03 mm thick. These are covered by a thin crust of fraipontite and resemble so-called “Brugola” screws (i.e., set-screws).

**Physical, chemical and crystallographic properties:**
- **Luster:** subvitreous.
- **Diaphaneity:** transparent to translucent.
- **Color:** white.
- **Streak:** white.
- **Luminescence:** not given.
- **Hardness:** not given.
- **Tenacity:** not given.
- **Cleavage:** \{001\} perfect.
- **Fracture:** not given.
- **Density:** could not be measured, 2.84 g/cm\(^3\) (calc.).
- **Crystallography:** Hexagonal, \( \text{P}_{6}_3/mmc \), \( a = 3.0725 \), \( c = 15.114 \) Å, \( V = 123.62 \) Å\(^3\), \( Z = \frac{3}{4} \), \( c/a = 4.9191 \). Morphology: no forms were mentioned, but \{001\} and \{100\} probably are present. Twinning: none mentioned. **X-ray powder-diffraction data:** 7.51(vs)(002), 3.794(m)(004), 2.65(w)(100), 2.511(mw)(102), 2.175(mw)(104), 1.890(w)(108), 1.830(mw)(106), 1.542(ms)(108), 1.539(ms)(110). **Optical data:** could not be determined because of the small size, the fragility and the coatings on the crystals. **Chemical analytical data:** Mean of four sets of electron-microprobe data: CuO 0.24, ZnO 56.01, Al\(_2\)O\(_3\) 18.44, SiO\(_2\) 0.09, Total 74.78 wt.%. Here, 28.63 wt.% H\(_2\)O and 7.85 wt.% CO\(_2\) were added to give 9(H\(_2\)O) and 1(CO\(_3\)); this raises the analytical total to 111.12 wt.%. Recalculation to give 100.00 wt.% (and ignoring SiO\(_2\)) gives: CuO 0.22, ZnO 50.40, Al\(_2\)O\(_3\) 16.59, CO\(_2\) (7.02), H\(_2\)O (25.76), Total (100.00) wt.%. Empirical formula: \((\text{Zn}_{3.90}\text{Cu}_{0.02})\text{Al}_{2.05}(\text{OH})_{11.99}(\text{CO}_3)_{1.00}\text{•3.00H}_2\text{O}\). **Relationship to other species:** It is a member of the hydrotalcite group.

**Name:** After the late scholar Domenico Zaccagna (1851–1940), who was born in Carrara and died in Rome. He published the first geological map of the Apuan Alps and was a competent collector of minerals from the Carrara marble. His collection is preserved in Museo di Storia Naturale e del Territorio at the University of Pisa.

**Comments:** IMA No. 1997–019. 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 structure was determined.

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