Raadeite

Mg$_7$(PO$_4$)$_2$(OH)$_8$

**Locality**: Near Tingelstad tjern, Modum district, southern Norway.

**Occurrence**: In nodules of apatite and magnesium phosphates in a serpentinite body. Associated minerals are: althausite, holtedahlite, apatite, magnesite and heneuite.

**General appearance**: Veinlets a few tens of μm wide; rare anhedral inclusions up to 150 μm; as fibrous coronae with apatite, althausite and magnesite replacing cm-size crystals of heneuite.


**Crystallography**: Monoclinic, $P2_1/n$, $a$ 5.250, $b$ 11.647, $c$ 9.655 Å, $\beta$ 95.94°, $V$ 587.2 Å$^3$, $Z$ = 2, $a$:b:c = 0.4508:1:0.8290. Morphology: no forms were observed. Twinning: none mentioned. X-ray powder-diffraction data: 4.436 (75) (111), 3.521 (80) (112, 121), 3.145 (70) (122), 3.087 (70) (013), 2.905 (100) (131), 2.794 (75) (023, 041), 2.199 (80) (142, 202). Optical data: Biaxial (−), $\alpha$ 1.5945, $\beta$ 1.6069, $\gamma$ 1.6088, 2$V$(meas.) 45.6°, 2$V$(calc.) 43°; dispersion $r > v$, strong; nonpleochroic; $Y = b$, $Z$ probably. a. Chemical analytical data: Mean of eight sets of electron-microprobe data (with the amount of H$_2$O calculated to give 8 OH): MgO 55.35, CaO 0.02, MnO 0.30, FeO 0.25, SiO$_2$ 0.05, P$_2$O$_5$ 28.23, As$_2$O$_3$ 0.40, SO$_3$ 0.05, H$_2$O (14.34), Total (98.99) wt.%. Empirical formula: (Mg$_{6.90}$Mn$_{0.02}$Fe$_{0.02}$)$_{\sum6.94}$[(PO$_4$)$_{2.00}$(AsO$_4$)$_{0.02}$]$_{\sum2.02}$ (OH)$_{8.00}$.

**Relationship to other species**: It is the Mg- and PO$_4$-dominant analogue of allactite, Mn$_7$(AsO$_4$)$_2$(OH)$_8$.

**Name**: After Gunnar Raade (b. 1944), Curator of Minerals, Natural History Museum, Oslo, Norway, in recognition of his contribution to the mineralogy of magnesium phosphates.

**Comments**: IMA No. 1996–034. The paper contains details of the crystal structure.

**Radovanite**

\[
\text{Cu}_2\text{Fe}^{3+}(\text{AsO}_4)(\text{As}^{3+}\text{O}_2\text{OH})_2\cdot\text{H}_2\text{O}
\]

**Locality:** The Roua copper deposits, upper Var valley (the Daluis gorge) at the western margin of the Barrot Dome, Alpes-Maritimes, France.

**Occurrence:** In a gangue made up of dolomite, calcite and aragonite, which consists of copper, cuprite, domeykite, algodonite, koutekite, and gold. Associated minerals are: cuprite, copper, malachite, trippkeite, olivenite, and algodonite.

**General appearance:** Aggregates (up to 2 mm in diameter) formed by small crystals up to 0.15 \( \approx 0.08 \approx 0.02 \) mm.

**Physical, chemical and crystallographic properties**
- **Luster:** given as vitreous but the optical data indicate adamantine. **Diaphaneity:** transparent. **Color:** pistachio green. **Streak:** green. **Luminescence:** nonfluorescent. **Hardness:** could not be measured. **Tenacity:** brittle. **Cleavage:** none. **Fracture:** conchoidal. **Density:** 3.9 g/cm\(^3\) (meas.), 3.79 g/cm\(^3\) (calc.).

**Crystallography:** Orthorhombic, \( \text{Pnma} \), \( a = 9.585 \text{ Å}, b = 13.143 \text{ Å}, c = 8.0884 \text{ Å} \), \( V = 1018.9 \text{ Å}^3 \), \( Z = 4 \), \( a:b:c = 0.7293:1:0.6154 \). Morphology: \{101\}, \{011\}, \{001\}, \{010\}, \{hk0\} and \{hkl\}; habit equidimensional or slightly elongate along \{100\} or \{010\}. Twinning: none observed.


**Optical data:** Biaxial (–), \( \alpha = 1.80 \), \( \beta = 1.84 \), \( \gamma = 1.86 \), 2\( V \)(meas.) 65\(^\circ\), 2\( V \)(calc.) 69\(^\circ\); dispersion not mentioned; pleochroism moderate, \( X \) light green to colorless, \( Y \) yellow green, \( Z \) pistachio green; orientation, \( X = c \), \( Y = a \), \( Z = b \).

**Chemical analytical data:** Mean of four sets of electron-microprobe data (with H\(_2\)O by difference): CuO 26.3, Fe\(_2\)O\(_3\) 12.7, Al\(_2\)O\(_3\) 0.04, P\(_2\)O\(_5\) 0.3, As\(_2\)O\(_5\) 19.93, As\(_3\)O\(_9\) 34.32, H\(_2\)O (6.41), Total (100.00) wt.%. Empirical formula: \( \text{Cu}_{1.92}\text{Fe}^{3+}_{0.93}[(\text{AsO}_4)_{1.01}(\text{PO}_4)_{0.02}]_1\text{As}^{3+}\text{O}_2\text{OH}_{2.02}\cdot1.06\text{H}_2\text{O} \). **Relationship to other species:** It has structural motifs similar to those in liroconite, \( \text{Cu}_2\text{Al(AsO}_4)\text{(OH)}_4\cdot4\text{H}_2\text{O} \).

**Name:** After Radovan •Cerný (b. 1957), crystallographer at the University of Geneva, Geneva, Switzerland.

**Comments:** IMA No. 2000–001.

SARP, H. & GUENEE, L. (2002): Radovanite, \( \text{Cu}_2\text{Fe}^{3+}(\text{AsO}_4)(\text{As}^{3+}\text{O}_2\text{OH})_2\cdot\text{H}_2\text{O} \), a new mineral: its description and crystal structure. *Archives des Sciences de Genève* **55**(1), 47-55.
Rappoldite
Pb(\text{Co},\text{Ni})_2(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}

\textbf{Locality:} The dumps of the Rappold mine, near Schneeberg, Saxony, Germany.

\textbf{Occurrence:} On quartz with cobaltlotharmeyerite. Other minerals in the dump material are: cobaltaustinite, scorodite, barium-pharmacosiderite, olivenite, conichalcite, erythrite, arseniosiderite, mimetite, beudantite, silver, bismuth, acanthite, galena, pyrite and skutterudite.

\textbf{General appearance:} Idiomorphic crystals (up to 1 mm long \| 0.3 mm in diameter); also as aggregates of tabular crystals.

\textbf{Physical, chemical and crystallographic properties:} \textit{Luster:} given as vitreous, but the indices of refraction indicate adamantine. \textit{Diaphaneity:} transparent. \textit{Color:} red to red-brown. \textit{Streak:} light yellow brown. \textit{Luminescence:} nonfluorescent. \textit{Hardness:} 4\frac{1}{2}. \textit{Tenacity:} brittle. \textit{Cleavage:} none observed. \textit{Fracture:} conchoidal. \textit{Density:} could not be measured, 5.30 g/cm\(^3\) (calc.). \textit{Crystallography:} Triclinic, \(\text{P}_1\), \(a = 11.190\), \(b = 10.548\), \(c = 7.593\) Å, \(\alpha = 100.38^\circ\), \(\beta = 109.59^\circ\), \(\gamma = 98.96^\circ\), \(V = 807.6\) Å\(^3\), \(Z = 4\). \(a:b:c = 1.0609:1:0.7199\). \textit{Morhology:} \{210\} and \{001\}, habit prismatic \{\[\bar{1}0\}\}. \textit{Twinning:} none mentioned. \textit{X-ray powder-diffraction data:} 4.670 (97) (2\[1\]), 3.256 (100) (022, \[\bar{2}1\]2), 3.072 (56) (2\[1\]1), 2.890 (40) (2\[\bar{3}\]1, \[\bar{2}3\]1), 2.760 (37) (401, 2\[3\]1), 2.568 (46) (022, 4\[0\]2, \[23\]2, 400, 230), 1.731 (38) (0\[6\]1, 4\[4\]1, 004, 42\[\bar{4}\]). \textit{Optical data:} Biaxial (+), \(\alpha = 1.85\) (calc.), \(\beta = 1.87\), \(\gamma = 1.90\), 2\(V\) (meas.) 85\(^\circ\), dispersion \(r > v\), distinct; nonpleochroic; \(Y\). \[\bar{1}0\], \(X\). \textit{Chemical analytical data:} Mean of eleven sets of electron-microprobe data: \(\text{PbO} = 35.27\), \(\text{CaO} = 0.12\), \(\text{CuO} < 0.05\), \(\text{ZnO} = 4.52\), \(\text{CoO} = 11.60\), \(\text{NiO} = 7.31\), \(\text{Al}_2\text{O}_3 < 0.05\), \(\text{Fe}_2\text{O}_3 = 0.28\), \(\text{Bi}_2\text{O}_3 = 0.11\), \(\text{As}_2\text{O}_3 = 35.82\), \(\text{SO}_3 = 0.11\), \(\text{H}_2\text{O} = (5.62)\) Total (100.76) wt.%. \textit{Empirical formula:} \((\text{Pb}_{1.02} \text{Ca}_{0.01})_{\Sigma 1.03} (\text{Co}_{0.98} \text{Ni}_{0.02} \text{Zn}_{0.35} \text{Fe}_{0.02})_{\Sigma 1.97} [(\text{AsO}_4)_{1.98} (\text{SO}_4)_{0.01}]_{\Sigma 1.99} [(\text{OH})_{0.06} (\text{H}_2\text{O})_{1.96}]_{\Sigma 2.02}\). \textit{Relationship to other species:} It is a member of the tsumcorite group, specifically the Co-dominant analogue of helmutwinklerite.

\textbf{Name:} After the discovery locality.

\textbf{Comments:} IMA No. 1998–015. The crystal structure has been solved.

Raslakite

Na$_{15}$Ca$_3$Fe$_3$(Na,Zr)$_3$Zr)$_3$(Si,Nb)(Si$_{25}$O$_{73}$)(OH,H$_2$O)$_3$(Cl,OH)

Trigonal

**Locality:** Mount Karnasurt, Lovozero alkaline massif, Kola Peninsula, Russia.

**Occurrence:** In peralkaline pegmatites. Associated minerals are: microcline, aegirine, nepheline, lamprophyllite, kazakovite, terskite and fluoraphite.

**General appearance:** Grains up to 3 cm.

**Physical, chemical and crystallographic properties:**
- **Luster:** vitreous.
- **Diaphaneity:** transparent.
- **Color:** brownish red.
- **Streak:** white.
- **Luminescence:** nonfluorescent.
- **Hardness:** 5.
- **Tenacity:** brittle.
- **Cleavage:** none.
- **Fracture:** conchoidal.
- **Density:** 2.95 g/cm$^3$ (meas.), 2.92 g/cm$^3$ (calc.).
- **Crystallography:** Trigonal, $R_3$, $a$ 14.229, $c$ 30.019 Å, $V$ 5263.5 Å$^3$, $Z$ = 3, $c:a$ = 2.1097. Morphology: no forms were mentioned. Twinning: none mentioned.

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

**Optical data:**
- Uniaxial (+), $\alpha$ 1.608, $\beta$ 1.611, pleochroism colorless to brown, weak.

**Chemical analytical data:**

Mean of five sets of electron-microprobe data: Na$_2$O 15.97, K$_2$O 0.48, MgO 0.28, CaO 5.64, MnO 2.01, FeO 5.02, SrO 0.69, Al$_2$O$_3$ 0.26, La$_2$O$_3$ 0.44, Ce$_2$O$_3$ 0.87, Nd$_2$O$_3$ 0.42, SiO$_2$ 49.10, TiO$_2$ 0.37, ZrO$_2$ 15.07, HfO$_2$ 0.43, Nb$_2$O$_5$ 0.71, H$_2$O 1.35, Cl 1.34, sum 100.45, less O = Cl 0.30, Total 100.15 wt.%.

**Empirical formula:** Na$_{15.88}$K$_{0.31}$Ca$_{3.10}$Sr$_{0.21}$Mg$_{0.21}$Fe$_{2.15}$Mn$_{0.21}$Ce$_{0.16}$La$_{0.08}$Nd$_{0.08}$Ti$_{0.14}$Zr$_{3.77}$Hf$_{0.06}$Nb$_{0.16}$Al$_{0.16}$Si$_{25.19}$Cl$_{1.11}$H$_{4.62}$O$_{75.83}$.

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

**Name:** After the Raslak cirques near Mount Kedykverpakhk.

**Comments:** IMA No. 2002–067.

Chukanov, N.V., Pekov, I.V., Zadoy, A.E., Korovushkin, V.V., Ekimenkova, I.A. & Rastsvetaeva, R.K. (2003): Ikrinite, (Na$_2$H$_3$O)$_{15}$(Ca,Mn,REE)$_6$Fe$_{3+2}$Zr$_3$(M,Zr) (M,Si)Si$_{25}$O$_{66}$(O,OH,Cl)•nH$_2$O and raslakite,Na$_{15}$Ca$_3$Fe$_3$(Na,Zr)$_3$Zr)$_3$(Si,Nb)(Si$_{25}$O$_{73}$) (OH,H$_2$O)$_3$(Cl,OH), the new eudialyte group minerals from Lovozero massif, Kola Peninsula. Zapiski Vserossiyskogo Mineralogicheskogo Obschestva 132(5), 22-33 (in Russ.).
Reidite

ZrSiO$_4$

Tetragonal

Locality. An impact ejecta layer at three sites on the upper continental slope off New Jersey, USA: Deep Sea Drilling Project Site 612, Ocean Drilling Program Hole 903C and Ocean Drilling Program Hole 904A. Several shocked crystals of zircon containing reidite have been found on the island of Barbados in what is considered to be the same layer of ejecta.

Occurrence. A layer of impact ejecta. Associated minerals are: impact glass, quartz, feldspar, coesite, stishovite, pyrite and glauconite. Heavy-mineral concentrates consist of Fe and Ti oxides (probably mixtures of ilmenorutile and ilmenite), garnet (mostly Fe-rich), staurolite, rutile, epidote, ilmenite, zircon, titanite, Al-rich phases (including kyanite) and tourmaline.

General appearance. Elongate skeletal crystals (up to 10 µm long and 0.3 µm wide) in shocked crystals of zircon (up to 80 µm wide). Physical, chemical and crystallographic properties. See Comments. Luster: vitreous. Diaphaneity: transparent. Color: pale brownish green. Streak: white. Luminescence: nonfluorescent. Hardness: 7 ½. Tenacity: brittle. Cleavage: none observed. Fracture: irregular. Density: could not be measured, ~5.2 g/cm$^3$ (calc.). Crystallography. Tetragonal, $I4_1/a$, $a$ 4.738, $c$ 10.506 Å, $V$ 235.84 Å$^3$, $Z$ = 4, $ca$ = 2.2174. Morphology: no forms were mentioned. Twinning: none mentioned. See Comments. X-ray powder-diffraction data: for synthetic material, 4.30(25)(101), 2.811(100)(112), 2.067(20)(211), 1.754(20)(204), 1.437(20)(132). Optical data: Uniaxial (+), indices of refraction >1.64, nonpleochroic. Chemical analytical data: Mean of five sets of electron-microprobe data: MgO 0.09, FeO 0.09, Al$_2$O$_3$ 0.01, SiO$_2$ 31.44, TiO$_2$ 0.06, ZrO$_2$ 65.92, HfO$_2$ 1.25, Total 98.86 wt.%. Empirical formula: (Zr$_{1.00}$Hf$_{0.01}$)Si$_{0.98}$O$_{4.00}$. Relationship to other species. It is a polymorph of ZrSiO$_4$.

Name. After Allen F. Reid (b. 1931), who first produced this high-pressure phase.

Comments. IMA No. 2001–013. Many of the physical properties listed above are for synthetic material. Reidite has the scheelite structure.

**Remondite-(La)**

$\text{Na}_3(\text{La,Ce,Ca})_3(\text{CO}_3)_5$

**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, barytolumprophyllite, catapleiite, natron, thermonatrite, sazykinaite-(Y), “Nb-rinkite”, vitusite-(Ce) and fluorapatite.

**General appearance:** Rough prismatic segregations (up to 2 $\times$ 0.8 $\times$ 0.5 mm) made up of tiny (up to 5 $\mu$m) 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/cm$^3$ (meas.), 3.56 g/cm$^3$ (calc.).
- **Crystallography:** Monoclinic, $P\overline{2}_1$ (?), $a = 10.49$, $b = 6.417$, $c = 10.50$ Å, $\beta = 119.8^\circ$, $V = 613$ Å$^3$, $Z = 2$, $a:b:c = 1.6347:1:1.6363$. Morphology: no forms were observed. Twinning: none observed. **X-ray powder-diffraction data:** 5.28(5)(101,011, 20$\overline{1}$,110), 3.70(7)(012), 3.036(9)(211,31$\overline{1}$), 2.740(5)(310,121), 2.623(10)(20$\overline{4}$,022, 40$\overline{2}$,220), 2.143(8)(014,410), 2.041(6)(222), 1.985(5)(401,21$\overline{5}$), 1.939(6)(032, 230). **Optical data:** Biaxial (–), $\alpha = 1.615$, $\beta = 1.619$, $\gamma = 1.622$, 2$V$(meas.) 80¹, 2$V$(calc.) 82¹; dispersion not observed; nonpleochroic; orientation not given.

**Chemical analytical data:** Mean of eleven sets of electron-microprobe data: Na$_2$O 15.48, K$_2$O 0.58, CaO 5.13, SrO 2.93, BaO 0.18, La$_2$O$_3$ 19.75, Ce$_2$O$_3$ 16.67, Pr$_2$O$_3$ 0.99, Nd$_2$O$_3$ 2.27, Sm$_2$O$_3$ 0.37, CO$_2$ 32.97, ThO$_2$ 1.34, Total 98.66 wt.%. Empirical formula: Na$_{3.00}$La$_{0.81}$Ce$_{0.68}$Ca$_{0.61}$Na$_{0.33}$Sr$_{0.19}$Nd$_{0.09}$K$_{0.08}$Pr$_{0.04}$Th$_{0.01}$Sm$_{0.01}$Ba$_{0.01}$)$_{52.88}$(CO$_3$)$_{4.99}$.

**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., ZADOV, A.E. & BELOVITSKAYA, YU.V. (2000):** Remondite-(La), Na$_3$(La,Ce,Ca)$_3$(CO$_3$)$_5$ – a new mineral of the burbankite family from the Khibina Massif, Kola Peninsula. *Zapiski Vserossiyskogo Mineralogicheskogo Obshchestva* **129**(1), 53-60 (in Russ.).
Rengeite

Sr₄ZrTi₄Si₄O₂₂

MONOCLINIC

**Locality:** Two localities in the Itoigawa-Ohmi district in the easternmost part of the Renge Belt, Niigata Prefecture, central Japan. The first occurrence is at Oyashirazu shore; it has been found also in the bed of the Kotaki-gawa River.

**Occurrence:** The mineral occurs in blue, lavender or green jade pebbles and boulders. Associated minerals in blue jade are: jadeite, titanian omphacite, sodic amphibole, titanite, rutile, anatase, strontium-apatite and tausonite. In lavender jade, associated minerals are: jadeite, titanian jadeite, rutile, titanite, zircon, natrolite, lamprophyllite, tausonite and an undetermined Sr–Ti silicate. In green jade, it is associated with jadeite, omphacite, titanite and zircon.

**General appearance:** Anhedral grains (up to ~0.5 mm) in blue jade. Fan-shaped aggregate of prismatic crystals (<0.3 mm long) in lavender jade. Elongate aggregates (~9 mm) of anhedral crystals in green jade.

**Physical, chemical and crystallographic properties:**
- **Luster:** adamantine.
- **Diaphaneity:** transparent.
- **Color:** dark greenish brown.
- **Streak:** pale greenish brown.
- **Luminescence:** nonfluorescent.
- **Hardness:** VHN 100 606 to 698 kg/mm², Mohs 5 to 5 ½.
- **Tenacity:** not given but probably brittle.
- **Cleavage:** none.
- **Fracture:** not given.
- **Density:** could not be measured, 4.12 g/cm³ (calc.).
- **Crystallography:** Monoclinic, \( P2_1/a \), \( a = 13.97, b = 5.675, c = 11.98 \) Å, \( \beta = 114.26^\circ \). \( V = 866 \) Å³, \( Z = 2 \). \( a:b:c = 2.4617:1:2.1110 \). Morphology: no forms were observed. Twinning: none mentioned.
- **X-ray powder-diffraction data:** 4.16 (m) (112), 3.13 (s) (403), 3.06 (vvvs) (313), 3.00 (vs) (204), 2.86 (s) (020), 2.79 (m) (401), 2.30 (m) (405), 2.20 (vs) (315).
- **Optical data:** Biaxial (+), indices of refraction are higher than those of titanite and are too high to measure; pleochroism strong from pale green to pale greenish brown; orientation could not be determined.

**Chemical analytical data:** Mean of six sets of electron-microprobe data for REE-poor material gave: CaO 0.43, FeO 0.10, SrO 34.32, BaO 0.13, Al₂O₃ 0.20, Ce₂O₃ 0.38, Pr₂O₃ 0.10, Nd₂O₃ 0.29, Sm₂O₃ 0.04, SiO₂ 22.58, TiO₂ 29.88, ZrO₂ 9.49, Nb₂O₅ 0.24, Ta₂O₅ 0.07, Total 98.25 wt.%. Empirical formula: \((\text{Sr}_{3.62}\text{Ca}_{0.08}\text{Ce}_{0.03}\text{Nd}_{0.02}\text{Ba}_{0.01}\text{Pr}_{0.01})\Sigma 3.77 (\text{Zr}_{0.84}\text{Ti}_{4.00}\text{Si}_{4.11}\text{O}_{22.00})\). **Relationship to other species:** It is the Sr- and Zr-dominant analogue of perrierite.

**Name:** After the type locality.

**Comments:** IMA No. 1998–055.

Rinmanite

\[ \text{Zn}_2\text{Sb}_2\text{Mg}_2\text{Fe}_4\text{O}_{14}(\text{OH})_2 \]

**Locality:** The Garpenberg Norra zinc–lead mine, Hedemora, Dalarna, south-central Sweden.

**Occurrence:** Found in a skarn assemblage within dolomite marble. Associated minerals are: dolomite, calcite, manganoan tremolite, zincian manganocummingtonite, manganoan talc, franklinite, barite and svabite.

**General appearance:** Euhedral prismatic crystals (up to about 0.5 mm).

**Physical, chemical and crystallographic properties**

- **Luster:** submetallic. **Diaphaneity:** opaque.
- **Color:** black. **Streak:** brown. **Hardness:** VHN\(_{100}\) 880 kg/mm\(^2\), Mohs about 6. **Tenacity:** not given. **Cleavage:** \{100\} well developed. **Fracture:** splintery. **Density:** could not be measured, 5.11 g/cm\(^3\) (calc.). **Crystallography:** Hexagonal, \(P6_3mc\), \(a\) 5.9889 Å, \(c\) 9.353 Å, \(V\) 290.53 Å\(^3\), \(Z\) = 1, \(c:a\) = 1.5617. Morphology: no forms were mentioned. Twinning: none mentioned. **X-ray powder-diffraction data:** 3.474\((34)(102)\), 2.994\((43)(110)\), 2.673\((44)(103)\), 2.522\((100)(112)\), 1.6597\((28)(213)\), 1.5170\((33)(205)\), 1.4972\((54)(220)\).

**Optical data:** In reflected light: gray, moderate anisotropism, weak bireflectance, nonpleochroic. \(R_o, R_e\): (13.6, 12.2%) 460 nm, (12.9, 11.8%) 540 nm, (12.7, 11.7%) 580 nm, (12.1, 11.3%) 660 nm. In transmitted light, uniaxial (−), dichroic with O dark red and E orange-red; approximate indices of refraction calculated from reflectance data at 589 nm are \(\bar{T} 2.10, \bar{g}' 2.04\). **Chemical analytical data:** Mean of thirty sets of electron-microprobe data: MgO 8.97, MnO 2.47, ZnO 14.24, Al\(_2\)O\(_3\) 0.82, Fe\(_2\)O\(_3\) 34.33, TiO\(_2\) 0.01, Sb\(_2\)O\(_3\) 36.31, H\(_2\)O 1.99, Total 99.14 wt.%. Empirical formula: \((\text{Zn}_{1.58}\text{Mn}_{0.31}\text{Mg}_{0.06})\Sigma_{2.95}\text{Sb}_{2.03}\text{Al}_{0.15}\Sigma_{2.15}\text{O}_{14.01}(\text{OH})_{1.99}\). **Relationship to other species:** It is isostructural with nolanite, \(V^{3+}\cdot\text{Fe}^{2+}\cdot\text{Fe}^{3+}\cdot\text{Ti}\Sigma_{10}\text{O}_{14}(\text{OH})_2\).

**Name:** After Sven Rinman (1720–1792), mining scientist, metallurgist and chemist who was a member of the Bergskollegium (Board of Mines). He is considered by some the father of the Swedish mineral industry.

**Comments:** IMA No. 2000–036.

Rollandite

\[ \text{Cu}_3(\text{AsO}_4)_2 \cdot 4\text{H}_2\text{O} \]

**Locality:** The South group of the Roua copper occurrences in the upper part of the Var valley (the Daluis gorge) at the western margin of the Barrot Dome, Alpes-Maritimes, France.

**Occurrence:** Associated minerals are: olivenite, conichalcite, clinotyrolite, cornubite, kolfanite, pharmacosiderite, gerhardtite, atacamite, gilmarite, wallkilldellite-(Fe), cuprite, domeykite, algodonite and native copper.

**General appearance:** Aggregates up to 1 mm in diameter made up of crystals (up to 0.5 \( \times \) 0.15 mm).

**Physical, chemical and crystallographic properties:**
- **Luster:** vitreous.
- **Diaphaneity:** transparent.
- **Color:** bottle-green.
- **Streak:** very light green.
- **Luminescence:** nonfluorescent.
- **Hardness:** 4 to 4½.
- **Tenacity:** very brittle.
- **Cleavage:** {001} good.
- **Fracture:** conchoidal.
- **Density:** 3.9 g/cm\(^3\) (meas.), 3.85 g/cm\(^3\) (calc.).
- **Crystallography:** Orthorhombic, \( \text{Pnma} \), \( a = 5.6906 \), \( b = 17.061 \), \( c = 9.732 \text{ Å} \), \( V = 944.9 \text{ Å}^3 \), \( Z = 4 \), \( a:b:c = 0.3335:1:0.5704 \). Morphology: \{010\}, \{011\}, \{001\}; habit elongate of [100] and slightly flattened on [010]. Twinning: none observed.
- **Optical data:** Biaxial (–), \( \alpha = 1.745 \), \( \beta = 1.755 \), \( \gamma = 1.760 \), 2\(V\) (meas.) 71°, 2\(V\) (calc.) 70°; dispersion \( r < v \), strong; nonpleochroic; orientation, \( X = a, Y = c, Z = b \). **Chemical analytical data:** Mean of ten sets of electron-microprobe data: CuO 44.87, As\(_2\)O\(_5\) 42.44, H\(_2\)O (12.69), Total (100.00) wt.%. The amount of H\(_2\)O was calculated by difference. Empirical formula: \( \text{Cu}_3.09(\text{AsO}_4)_{2.02}(\text{OH})_{0.12} \cdot 3.80\text{H}_2\text{O} \).

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

**Name:** After Pierre Rolland (b. 1940), an eminent collector of minerals from the Roua mines.

**Comments:** IMA No. 1998–001. The abstractor drew the crystal drawing produced here with the assistance of Dr. Halil Sarp and Prof. André Lalonde.

**Locality**: A quarry at the Bellerberg volcano lava field, near Ettringen, 2 km north of Mayen, Laacher See region, eastern Eifel area, Germany.

**Occurrence**: In xenoliths in leucite tephrite lava. Associated minerals are: the unnamed natural analogue of Ca$_2$SiO$_4$•0.5H$_2$O, ettringite–thaumasite, mayenite, ternesite, cuspidine, larnite, “calcio-olivine”, tobermorite, portlandite, hydrocalumite, a member of the ellestadite series, and minor amounts of magnetite and hematite.

**General appearance**: Anhedral grains less than 0.3 mm in diameter.

**Physical, chemical and crystallographic properties**: 
- **Luster**: vitreous. 
- **Diaphaneity**: presumably transparent to translucent. 
- **Color**: orange brown to amber. 
- **Streak**: light amber. 
- **Luminescence**: nonfluorescent. 
- **Hardness**: not given. 
- **Tenacity**: brittle. 
- **Cleavage**: none. 
- **Fracture**: conchoidal. 
- **Density**: not measured, 3.03 g/cm$^3$ (calc.).

**Crystallography**: Cubic, Fd$\bar{3}$, $a$ 15.0850 Å, $V$ 3432.7 Å$^3$, $Z$ = 8. Morphology: no forms were observed. Twinning: none mentioned. **X-ray powder-diffraction data**: 2.901(40)(511), 2.666(100) (440), 1.964(30)(553), 1.885(30)(800), 1.777(30)(822), 1.540(50)(844), 1.459(30)(951).

**Optical data**: Isotropic, $n$ 1.676.

**Chemical analytical data**: Mean of eight sets of electron-microprobe data: Na$_2$O 0.07, MgO 4.52, CaO 57.05, FeO 0.54, Al$_2$O$_3$ 0.40, SiO$_2$ 30.51, TiO$_2$ 0.13, Cl 6.71, sum 99.93, less O = Cl 1.52, Total 98.41 wt.%. Empirical formula: (Ca$_{8.09}$Na$_{0.02}$)$_{\Sigma}$8.11 (Mg$_{0.89}$Al$_{0.06}$Fe$_{0.06}$)$_{\Sigma}$1.01 (Si$_{4.04}$Ti$_{0.01}$)$_{\Sigma}$4.05 O$_{16.20}$[Cl$_{1.51}$OH$_{0.29}$]$_{\Sigma}$1.80 (with OH added to give O+Cl+OH = 18). **Relationship to other species**: None apparent.

**Name**: After Alice and Eugen Rondorf, two distinguished mineral collectors, who found the mineral with Bernd Ternes in 1979.

**Comments**: IMA No. 1997–013.

Mihajlović, T., Lengauer, C.L., Ntaflos, T., Kolitsch, U. & Tillmanns, E. (2004): Two new minerals, rondorfite, Ca$_8$Mg(SiO$_4$)$_4$Cl$_2$, and almarudite, K(M,N)$_2$(Mn,Fe,Mg)$_2$(Be,Al)$_3$[Si$_{12}$O$_{30}$]. Neues Jahrbuch für Mineralogie, Abhandlungen 179, 265-294.
**Ronneburgite**  
**K$_2$MnV$_4$O$_{12}$**  
**MONOCLINIC**

**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, $P2_1/n$, $a$ 8.183, $b$ 9.247, $c$ 8.651 Å, $\beta$ 109.74°, $V$ 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) (111), 3.701 (55) (211), 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°, $2V$(calc.) 82°; 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$_{0.08}$)$_{1.01}$V$_{4.01}$O$_{12.00}$.  
**Relationship to other species**: It is chemically related to fianelite, Mn$_2$V(V,As)O$_7$$\cdot$2H$_2$O.

**Name**: After the type locality.

**Comments**: IMA No. 1998–069.

Rouaite

\[ \text{Cu}_2(\text{NO}_3)(\text{OH})_3 \]

**Locality:** The old copper mines at Roua, Alpes Maritimes, France. It has been identified also from the Sterling Hill mine, Ogdensburg, New Jersey, U.S.A.

**Occurrence:** Found in cavities in cuprite. Associated minerals are: cuprite, copper, silver, algondonite, domeykite, malachite, connellite, olivenite, theoparacelsite and gerhardtite.

**General appearance:** As aggregates (up to 0.5 mm in diameter) of equidimensional to elongate crystals (up to 0.1 mm long).

**Physical, chemical and crystallographic properties:** Luster: vitreous. Diaphaneity: transparent. Color: dark emerald green. Streak: green. Luminescence: nonfluorescent. Hardness: could not be measured because of the small size. Tenacity: brittle. Cleavage: \{001\} perfect. Fracture: uneven. Density: 3.38 g/cm\(^3\) (meas.), 3.38 g/cm\(^3\) (calc.). Crystalllography: Monoclinic, \(P_2_1\), \(a = 5.596\), \(b = 6.079\), \(c = 6.925\) Å, \(\beta = 94.67^\circ\), \(V = 234.8\) Å\(^3\), \(Z = 2\), \(a:b:c = 0.9205:1:1.1392\). Morphology: \{001\}, \{100\}, \{110\}, \{1\overline{1}0\}, \{0\overline{1}1\}. Twinning: rare on \{001\}. X-ray powder-diffraction data: 6.91(100)(001), 3.457(90)(111,002), 2.669(80)(120), 2.462(80)(121), 2.250(50)(202), 2.154(40)(013), 2.078(50) (122,103). Optical data: Biaxial (+), \(\alpha = 1.700\), \(\beta = 1.715\), \(\gamma = 1.738\), 2\(V\)(meas.) 81\(^\circ\), 2\(V\)(calc.) 79\(^\circ\); dispersion \(r < v\), strong; pleochroism X dark green blue, Y green blue, Z light green to colorless; \(X \cap a = 5^\circ\) (in obtuse angle \(\beta\)), \(Y = b\), \(Z = c\). Chemical analytical data: Mean of five sets of electron-microprobe data (H\(_2\)O by CHN): CuO 65.50, N\(_2\)O\(_5\) 21.64, H\(_2\)O 11.90, Total 99.04 wt.%. Empirical formula: \(\text{Cu}_{1.99}(\text{NO}_3)_{0.97}(\text{OH})_{3.19}\). Relationship to other species: It has a dimorphic relationship with gerhardtite (orthorhombic).

**Name:** After the type locality.

**Comments:** IMA No. 1999–010.