

# Ungemachite



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**Crystal Data:** Hexagonal. *Point Group:*  $\bar{3}$ . Tabular crystals, to 1 mm, thick on {0001}, bounded by large {0001} and {10 $\bar{1}$ 1}, {01 $\bar{1}$ 2}, {11 $\bar{2}$ 3}, {10 $\bar{1}$ 4}, with more than 20 other modifying forms noted.

**Physical Properties:** *Cleavage:* On {0001}, perfect. *Fracture:* Irregular. *Tenacity:* Brittle. Hardness = 2.5 D(meas.) = 2.287(3) D(calc.) = [2.259]

**Optical Properties:** Transparent. *Color:* Colorless to pale yellow; colorless in transmitted light. *Luster:* Vitreous.

*Optical Class:* Uniaxial (-).  $\omega = 1.502(2)$   $\epsilon = 1.449(2)$

**Cell Data:** *Space Group:*  $R\bar{3}$ .  $a = 10.898(1)$   $c = 24.989(6)$   $Z = 3$

**X-ray Powder Pattern:** Chuquicamata, Chile. (ICDD 20-1326).  
3.43 (100), 8.33 (60), 2.72 (55), 2.59 (35), 8.82 (30), 7.55 (30), 1.880 (25)

## Chemistry:

	(1)	(2)
SO <sub>3</sub>	41.23	41.22
N <sub>2</sub> O <sub>5</sub>	trace	9.27
Fe <sub>2</sub> O <sub>3</sub>	7.88	6.85
Na <sub>2</sub> O	22.15	21.27
K <sub>2</sub> O	11.63	12.12
H <sub>2</sub> O	17.11	9.27
Total	[100.00]	100.00

(1) Chuquicamata, Chile; recalculated to 100% after deduction of 2.07% insoluble, from an original total of 99.64%; stated then to correspond to  $\text{K}_{2.88}\text{Na}_{8.34}\text{Fe}_{1.15}(\text{SO}_4)_{6.01}(\text{OH})_2 \cdot 10\text{H}_2\text{O}$ .

(2)  $\text{K}_3\text{Na}_8\text{Fe}(\text{SO}_4)_6(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  as verified by crystal-structure analysis.

**Occurrence:** Rarely formed by the oxidation of pyrite in an arid climate, in veins and cavities in other massive iron sulfates.

**Association:** Clinoungemachite, jarosite, sideronatrite, metasideronatrite, metavoltine, fibroferrite.

**Distribution:** From Chuquicamata, Antofagasta, Chile.

**Name:** Honors Henri Léon Ungemach (1879–1936), Belgian crystallographer who studied the natural sulfates of Chile.

**Type Material:** Harvard University, Cambridge, Massachusetts, USA, 98282, 98283.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 596–597. (2) Groat, L.A. and F.C. Hawthorne (1986) Structure of  $\text{K}_3\text{Na}_8\text{Fe}^{3+}(\text{SO}_4)_6(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$ , a mixed sulfate-nitrate mineral. *Amer. Mineral.*, 71, 826–829. (3) Peacock, M.A. and M.C. Bandy (1938) Ungemachite and clino-ungemachite: new minerals from Chile. *Amer. Mineral.*, 23, 314–328.