

# Tyrolite

# $\text{CaCu}_5(\text{AsO}_4)_2(\text{CO}_3)(\text{OH})_4 \cdot 6\text{H}_2\text{O}$

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**Crystal Data:** Orthorhombic. *Point Group:*  $2/m\ 2/m\ 2/m$ . Scaly to lathlike crystals, flattened on {010}, to 3 mm; typically foliated to fibrous, in radiating groups and crusts.

**Physical Properties:** *Cleavage:* On {001}, perfect, micaceous. *Tenacity:* Sectile, flexible in thin flakes. Hardness =  $\sim 2$  D(meas.) = 3.25 D(calc.) = 3.27

**Optical Properties:** Translucent. *Color:* Verdigris-green, pale apple-green, may be sky-blue; pale green in transmitted light. *Streak:* Pale green or pale blue. *Luster:* Vitreous, pearly on cleavages.

*Optical Class:* Biaxial (-). *Pleochroism:*  $X = Z$  = pale grass-green;  $Y$  = pale yellowish green. *Orientation:*  $X = b$ ;  $Y = c$ ;  $Z = a$ . *Dispersion:*  $r > v$ , strong.  $\alpha = 1.673\text{--}1.694$   $\beta = 1.690\text{--}1.726$   $\gamma = 1.703\text{--}1.730$   $2V(\text{meas.}) = 36^\circ\text{--}70^\circ$

**Cell Data:** *Space Group:*  $Pmma$ .  $a = 10.21\text{--}10.50$   $b = 54.71\text{--}55.51$   $c = 5.59\text{--}5.60$   
 $Z = 8$

**X-ray Powder Pattern:** Peñamellera, Spain.

28.0 (FFF), 14.1 (F), 2.98 (F), 2.70 (F), 4.85 (mF), 4.44 (m), 5.27 (fm)

## Chemistry:

	(1)	(2)
$\text{As}_2\text{O}_5$	27.07	26.36
$\text{CO}_2$	5.05	5.05
$\text{CuO}$	46.24	45.63
$\text{CaO}$	6.44	6.43
$\text{H}_2\text{O}$	15.68	16.53
Total	100.48	100.00

(1) Falkenstein, Austria. (2)  $\text{CaCu}_5(\text{AsO}_4)_2(\text{CO}_3)(\text{OH})_4 \cdot 6\text{H}_2\text{O}$ .

**Occurrence:** An uncommon secondary mineral in the oxidized zone of hydrothermal copper deposits, typically formed by alteration of tennantite.

**Association:** Tennantite, malachite, azurite, brochantite, chrysocolla.

**Distribution:** Numerous minor localities; a few for good material include: in Austria, in the Tirol, on the Falkenstein, near Schwaz; at Kogel, near Brixlegg; from Rattenberg; and elsewhere. At L'ubietová, near Baňská Bystrica (Libethen, near Neusohl), Slovakia. In the Midezianka copper mine, near Kielce, Poland. In Germany, at Schneeberg, Saxony; from Saalfeld and Stahlberg, Thuringia; at Bieber and Richelsdorf, Hesse. From the Cap Garonne mine, near le Pradet, Var, France. In Spain, rich material from Peñamellera, Oviedo Province; at Villamanin, Léon Province. From the Gortdrum mine, Co. Tipperary, Ireland. In the Gwaithyafon mine, Cwmsymlog, Wales. In Russia, from the Turinsk copper mine, Bogoslovsk, Ural Mountains; at Nerchinsk, Transbaikalia. From the Talmessi mine, 35 km west of Anarak, Iran. In the USA, fine examples from the Centennial Eureka, Mammoth, and other mines, Tintic district, Juab Co., and the Gold Hill mine, Tooele Co., Utah; at the Majuba Hill mine, Antelope district, Pershing Co., and elsewhere in Nevada. From the Kitabira mine, Yamaguchi Prefecture, and Toroku mine, Miyazaki Prefecture, Japan.

**Name:** For its occurrence in the Tirol (Tyrol), Austria.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 925–926. (2) Guillemin, C. (1956) Contribution a la minéralogie des arsénates, phosphates et vanadates de cuivre. I. Arsénates de cuivre. Bull. Soc. fr. Minéral., 59, 7–95, esp. 35–37, 91 (in French).

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