

**Tangdanite****Ca<sub>2</sub>Cu<sub>9</sub>(AsO<sub>4</sub>)<sub>4</sub>(SO<sub>4</sub>)<sub>0.5</sub>(OH)<sub>9</sub>·9H<sub>2</sub>O**

**Crystal Data:** Monoclinic. *Point Group:* 2/m. Crystals to 0.5 mm, tabular on (100) and elongated along [001], form radiating or foliated aggregates to 3 mm. Crystals display {100}, {010}, {001}, and {013}.

**Physical Properties:** *Cleavage:* Perfect on {100}. *Fracture:* n.d. *Tenacity:* Sectile. Hardness = 2-2.5 VHN = 42.8 (50 g load). D(meas.) = 3.22 D(calc.) = 3.32

**Optical Properties:** Translucent. *Color:* Emerald-green to dark green. *Streak:* Light green. *Luster:* Pearly to silky.

*Optical Class:* Biaxial (-).  $\alpha = 1.666$   $\beta = 1.686$   $\gamma = 1.694$   $2V(\text{meas.}) = 65-66^\circ$   $2V(\text{calc.}) = 64^\circ$

*Orientation:*  $Y = b$ ;  $Z \wedge a = 3-4^\circ$ ,  $X \wedge c = 7-8^\circ$ . *Pleochroism:* Weak,  $Z =$  medium green,  $Y =$  yellow-green. *Dispersion:* Weak, both  $r > v$  and  $r < v$ .

**Cell Data:** *Space Group:* C2/c.  $a = 54.490(9)$   $b = 5.5685(9)$   $c = 10.4690(17)$   $\beta = 96.294(3)^\circ$   
 $Z = 4$

**X-ray Powder Pattern:** Tangdan mine, Kunming City Prefecture, Yunnan Province, P. R. China. 4.782 (100), 4.333 (71), 5.263 (54), 3.949 (47), 2.976 (46), 2.631 (41), 2.368 (29)

<b>Chemistry:</b>	(1)	(2)
CaO	7.29	7.14
CuO	45.71	45.57
As <sub>2</sub> O <sub>5</sub>	29.82	29.26
SO <sub>3</sub>	1.60	2.55
<u>H<sub>2</sub>O</u>	<u>[15.58]</u>	<u>15.48</u>
Total	100.00	100.00

(1) Tangdan mine, Kunming City Prefecture, Yunnan Province, P. R. China; average of 10 electron microprobe analyses supplemented by Raman spectroscopy, H<sub>2</sub>O by difference, corresponding to Ca<sub>2.05</sub>Cu<sub>9.08</sub>(As<sub>1.03</sub>O<sub>4</sub>)<sub>4</sub>(S<sub>0.63</sub>O<sub>4</sub>)<sub>0.5</sub>(OH)<sub>9</sub>·9H<sub>2.04</sub>O. (2) Ca<sub>2</sub>Cu<sub>9</sub>(AsO<sub>4</sub>)<sub>4</sub>(SO<sub>4</sub>)<sub>0.5</sub>(OH)<sub>9</sub>·9H<sub>2</sub>O.

**Occurrence:** A secondary mineral in the oxidized zone of an As-bearing Cu sulfide deposit.

**Association:** Chalcopyrite, bornite, chalcocite, covellite, tennantite, enargite, cuprite, malachite, azurite, copper, brochantite.

**Distribution:** From the Tangdan and Nanniping mines, southeast Dongchuan district, Dongchuan County, Kunming City Prefecture, Yunnan Province, P.R. China.

**Name:** For the *Tangdan* mine, the locality that produced the first specimens.

**Type Material:** Geological Museum of China, Beijing, P.R. China (M11802) and in the Canadian Museum of Nature, Gatineau, Quebec, Canada (CMNMC 86550).

**References:** (1) Zhesheng, M., L. Guowu, N.V. Chukanov, G. Poirier, and S. Nicheng (2014) Tangdanite, a new mineral species from the Yunnan Province, China and the discreditation of 'clinotyrolite'. *Mineral. Mag.*, 78(3), 559-569. (2) (2015) *Amer. Mineral.*, 100, 2361-2362 (abs. ref. 1).