

Torbernite**Cu(UO₂)₂(PO₄)₂·8–12H₂O**

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Crystal Data: Tetragonal. *Point Group:* $4/m\ 2/m\ 2/m$. Thin to thick tabular crystals, square or octagonal, with prominent {001}, {011}, {110}, rarely pyramidal {111}, to 2.5 cm. Typically in subparallel aggregates, foliated, micaceous, scaly. *Twinning:* Rare on {110}.

Physical Properties: *Cleavage:* Perfect on {001}, micaceous; indistinct on {100}. *Tenacity:* Brittle. Hardness = 2–2.5 D(meas.) = 3.22 D(calc.) = n.d. Radioactive. H₂O content varies with relative humidity.

Optical Properties: Transparent to translucent. *Color:* Emerald-green, grass-green, leek-green, siskin-green, apple-green. *Streak:* Pale green. *Luster:* Vitreous, subadamantine, waxy, pearly on cleavages; becoming dull on dehydration to metatorbernite. *Optical Class:* Uniaxial (-). *Pleochroism:* *O* = dark green to sky-blue; *E* = green. $\omega = 1.590\text{--}1.592$ $\epsilon = 1.581\text{--}1.582$

Cell Data: *Space Group:* $I4/mmm$. $a = 7.025(5)$ $c = 20.63(2)$ $Z = 2$

X-ray Powder Pattern: Synthetic Cu(UO₂)₂(PO₄)₂·12H₂O. 10.30 (10), 4.94 (9), 3.578 (9), 3.512 (8), 6.61 (4), 4.476 (4), 3.674 (4)

Chemistry:	(1)	(2)
UO ₃	57.03	56.65
P ₂ O ₅	14.50	14.06
SiO ₂	0.59	
CuO	7.73	7.88
H ₂ O	20.30	21.41
<u>Total</u>	<u>100.15</u>	<u>100.00</u>

(1) Leupoldsdorf, Bavaria, Germany. (2) Cu(UO₂)₂(PO₄)₂·12H₂O.

Mineral Group: Autunite group.

Occurrence: An uncommon secondary mineral formed in the oxidized zone of some uraniferous copper deposits.

Association: Metatorbernite, autunite, zeunerite, uraninite.

Distribution: Many localities, but rarely in large amounts. From Jáchymov (Joachimsthal), Czech Republic. In Germany, at Schneeberg, Johanngeorgenstadt, and elsewhere in Saxony. Fine examples from Margabal, Aveyron, and at Les Bois Noirs, Puy-de-Dôme, France. In England, from a number of mines in Cornwall, as Wheal Basset, Stenna Gwyn, etc. From Richelle, near Visé, Belgium. At Sabugal, Portugal. Large crystals especially at the Musonoi mine, near Kolwezi, and as rich specimens from Shinkolobwe, Katanga Province, Congo (Shaba Province, Zaire). On Mt. Painter, Flinders Ranges, South Australia; from the South Alligator Valley, Northern Territories, Australia. In the USA, at Chalk Mountain, near Spruce Pine, Mitchell Co., North Carolina; large crystals from the Majuba Hill mine, Antelope district, Pershing Co., Nevada.

Name: To honor Torbern Olof Bergmann (1735–1784), Swedish chemist and mineralogist, Professor of Chemistry, Uppsala University, Uppsala, Sweden.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 980–984. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 170–177.