

**Crystal Data:** Tetragonal. *Point Group:* 4/m. Typically pseudomorphous after torbernite by stepped dehydration, as square tabular crystals, flattened on {001} and modified by {011}, in lamellar or subparallel to sheaflike aggregates, and as rosettes, to 2 cm.

**Physical Properties:** *Cleavage:* Perfect on {001}; indistinct on {010}. *Tenacity:* Brittle. Hardness = 2.5 D(meas.) = 3.52-3.70 D(calc.) = 3.689 Radioactive.

**Optical Properties:** Transparent to translucent. *Color:* Pale green to dark green. *Luster:* Vitreous, subadamantine, pearly on {001}.

*Optical Class:* Uniaxial (+) or uniaxial (-); anomalously biaxial in sectors.  $\omega = 1.618-1.631$   
 $\varepsilon = 1.622-1.628$  *Pleochroism:* Weak; *O* = green, *E* = pale green to blue. *Absorption:* *O* > *E*.  
*Dispersion:*  $r > v$ , extreme.

**Cell Data:** *Space Group:* P4/n.  $a = 6.9756(5)$   $c = 17.349(2)$   $Z = 2$

**X-ray Powder Pattern:** Schneeberg, Germany.

8.71 (100), 3.678 (100), 3.480 (80), 3.232 (80), 5.44 (75), 4.93 (75), 2.931 (70)

Chemistry:	(1)	(2)
UO <sub>3</sub>	59.67	61.01
P <sub>2</sub> O <sub>5</sub>	14.00	15.14
SiO <sub>2</sub>	0.40	
CuO	8.50	8.48
H <sub>2</sub> O	15.00	15.37
Total	97.57	100.00

(1) Gunnislake mine, England. (2) Cu(UO<sub>2</sub>)<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>·8H<sub>2</sub>O.

**Mineral Group:** Meta-autunite group.

**Occurrence:** Typically a secondary mineral, a dehydration product of torbernite formed during weathering; formed directly above 75 °C.

**Association:** Torbernite, meta-autunite.

**Distribution:** Widespread; probably occurs at all localities for torbernite (q.v.). First described from Schneeberg, Saxony, Germany. Material from the Gunnislake mine, Calstock, Cornwall, England, is thought to be primary.

**Name:** The prefix *meta* indicates the dehydration product of *torbernite*.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 991-992. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 208-211. (3) Ross, M., H.T. Evans, Jr., and D.E. Appleman (1964) Studies of the torbernite minerals (II): the crystal structure of meta-torbernite. Amer. Mineral., 49, 1603-1621. (4) Stergiou, A.C., P.J. Rentzeperis, and S. Sklavounos (1993) Refinement of the crystal structure of metatorbernite. Zeits. Krist., 205, 1-7. (5) Locock, A.J. and P.C. Burns (2003) Crystal structures and synthesis of the copper-dominant members of the autunite and meta-autunite groups: torbernite, zeunerite, metatorbernite and metazeunerite. Can. Mineral., 41, 489-502. (6) (2004) Amer. Mineral., 89(1), 252 (abs. ref. 5). (7) Stubbs, J.E., J.E. Post, D.C. Elbert, P.J. Heaney, and D.R. Veblen (2010) Uranyl phosphate sheet reconstruction during dehydration of metatorbernite [Cu(UO<sub>2</sub>)<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>·8H<sub>2</sub>O]. Amer. Mineral., 95, 1132-1140.