

# Liebigite

# $\text{Ca}_2(\text{UO}_2)(\text{CO}_3)_3 \cdot 11\text{H}_2\text{O}$

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**Crystal Data:** Orthorhombic. *Point Group:*  $mm2$ . Crystals are rare, short prismatic along [001], or equant, rounded with convex or vicinal faces, to 5 mm; scaly or granular, in aggregates, crusts, and films.

**Physical Properties:** *Cleavage:* On {100}. Hardness = 2–3  $D(\text{meas.}) = 2.41$   
 $D(\text{calc.}) = 2.41$  Radioactive; strong green to blue-green fluorescence under SW and LW UV.

**Optical Properties:** Transparent to translucent. *Color:* Apple-green, siskin-green, yellowish green. *Luster:* Vitreous to pearly on cleavages.  
*Optical Class:* Biaxial (+). *Pleochroism:*  $X =$  nearly colorless;  $Y = Z =$  pale yellowish green.  
*Orientation:*  $X = a$ . *Dispersion:*  $r > v$ , moderate.  $\alpha = 1.494\text{--}1.501$   $\beta = 1.498\text{--}1.505$   
 $\gamma = 1.535\text{--}1.542$   $2V(\text{meas.}) = 37^\circ\text{--}42^\circ$

**Cell Data:** *Space Group:*  $Bba2$ .  $a = 16.699(3)$   $b = 17.557(3)$   $c = 13.697(2)$   $Z = 8$

**X-ray Powder Pattern:** Jáchymov, Czech Republic.  
6.81 (10), 8.68 (9), 5.40 (9), 4.55 (6), 3.10 (6), 3.33 (5), 3.31 (5)

Chemistry:	(1)	(2)	(1)	(2)	
$\text{CO}_2$	23.87	18.12	$\text{CaO}$	15.56	15.40
$\text{UO}_2$	37.11		$\text{H}_2\text{O}$	23.35	27.21
$\text{UO}_3$		39.27	Total	99.89	100.00

(1) Jáchymov, Czech Republic. (2)  $\text{Ca}_2(\text{UO}_2)(\text{CO}_3)_3 \cdot 11\text{H}_2\text{O}$ .

**Occurrence:** An uncommon secondary mineral typically formed as an alteration product of uraninite in alkaline carbonate solutions.

**Association:** Uraninite, schröckingerite, uranophane-beta, tyuyamunite, autunite, uranophane, bayleyite, carnotite, gypsum, calcite.

**Distribution:** From Edirne (Adrianople) Province, Turkey. Abundant in a number of mines around Jáchymov (Joachimsthal), Czech Republic. In Germany, from Schneeberg, Saxony; at Eisleben and Hasserode, Saxony-Anhalt; and from Müllenberg, near Baden-Baden, Black Forest. At Schmiedeberg, Poland. From Wheal Basset, Redruth, Cornwall, England. At Tyndrum, Perthshire, Scotland. From the Mas-d'Alary uranium deposit, three km south-southeast of Lodève, Hérault, France. In the USA, at the Midnite mine, Wellpinit, Stevens Co., Washington; in the Schwartzwalder mine, near Golden, Jefferson Co., Colorado; in Wyoming, in the Pumpkin Buttes area, Powder River basin, and at the Silver Cliff mine, Lusk, Niobrara Co., and in the Lucky Mc mine, Wind River basin, Fremont Co.; from the Black Ape mine, Thompsons district, Grand Co., and in the Mi Vida mine, Big Indian district, San Juan Co., Utah; at Ambrosia Lake and Westwater Canyon, Grants district, McKinley Co., New Mexico; from Mt. Pisgah, Jim Thorpe, Carbon Co., Pennsylvania. At Rabbit Lake, Saskatchewan, Canada. In the Tono mine, Gifu Prefecture, Japan. From Shinkolobwe, Katanga Province, Congo (Shaba Province, Zaire).

**Name:** To honor Professor Justus von Liebig (1803–1873), German chemist, University of Munich, Munich, Germany.

**Type Material:** American Museum of Natural History, New York, New York, USA, 16847.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 240–241. (2) Evans, H.T., Jr., and C. Frondel (1950) Studies of uranium minerals (II): liebigite and uranothallite. *Amer. Mineral.*, 35, 251–254. (3) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. *U.S. Geol. Sur. Bull.* 1064, 108–112. (4) Mereiter, K. (1982) The crystal structure of liebigite,  $\text{Ca}_2\text{UO}_2(\text{CO}_3)_3 \cdot \sim 11\text{H}_2\text{O}$ . *Tschermaks Mineral. Petrog. Mitt.*, 30, 277–288.

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