

**Crystal Data:** Monoclinic, pseudo-orthorhombic. *Point Group:*  $2/m$ . As wedge-topped prismatic crystals, elongated along [100] or [001], or equant to pseudo-octahedral, dominant forms include {110}, {011}, {111}, which may be striated, with a number of other forms noted, to 3 cm; in sprays of bladed to acicular crystals, and as druses; may be composite to compact fibrous.

**Physical Properties:** *Cleavage:* Imperfect on {100} and {010}. *Fracture:* Conchoidal to uneven. Hardness = 4 D(meas.) = 3.97 D(calc.) = 3.972

**Optical Properties:** Translucent. *Color:* Light to dark olive-green, dark green, blackish green, black; bluish green to pale green in transmitted light. *Luster:* Vitreous, greasy on fracture surfaces.

*Optical Class:* Biaxial (-). *Pleochroism:* May be faint; X = pale yellowish blue; Z = pale greenish blue. *Orientation:* X = b; Y = c; Z = a. *Dispersion:*  $r > v$ , strong.  $\alpha = 1.701\text{--}1.704$   $\beta = 1.743\text{--}1.747$   $\gamma = 1.787\text{--}1.790$   $2V(\text{meas.}) = \sim 90^\circ$

**Cell Data:** *Space Group:*  $P2_1/n$ .  $a = 8.062(5)$   $b = 8.384(4)$   $c = 5.881(2)$   $\beta = \sim 90^\circ$   $Z = 4$

**X-ray Powder Pattern:** L'ubietová, Slovakia. (ICDD 36-404). 4.820 (100), 5.807 (80), 4.756 (70), 2.627 (60), 3.720 (50), 2.644 (40), 2.412 (30)

**Chemistry:**

|                         | (1)   | (2)   | (3)    |
|-------------------------|-------|-------|--------|
| $\text{P}_2\text{O}_5$  | 29.31 | 26.46 | 29.69  |
| $\text{As}_2\text{O}_5$ |       | 2.30  |        |
| CuO                     | 66.42 | 66.29 | 66.54  |
| $\text{H}_2\text{O}$    | 3.74  | 4.04  | 3.77   |
| Total                   | 99.47 | 99.09 | 100.00 |

(1) Mercedes mine, Coquimbo, Chile. (2) L'ubietová, Slovakia. (3)  $\text{Cu}_2(\text{PO}_4)(\text{OH})$ .

**Occurrence:** An uncommon secondary mineral in the oxidized zone of copper deposits.

**Association:** Pseudomalachite, malachite, azurite, chrysocolla, iron oxides.

**Distribution:** Many minor localities, typically in small amounts. From L'ubietová, near Baňská Bystrica (Libethen, near Neusohl), Slovakia. In England, good crystals at Wheal Phoenix, mines around Calstock, Illogan, and elsewhere in Cornwall. Around Nizhni Tagil, Ural Mountains, Russia. In Portugal, at the Miguel Vacas mine, near Vila Viçosa, and from near Alcoutim. Very large crystals from the Rokana mine, near Kitwe, and at Chingola, Zambia. At Kakanda, Mindouli, and Likasi, Katanga Province, Congo (Shaba Province, Zaire). From the Burra Burra mine, Mount Lofty Ranges, South Australia. In the USA, from the Empire-Nevada and Blue Jay mines, Yerington, Lyon Co., Nevada; at the Castle Dome mine, Globe-Miami, Gila Co., the Old Reliable mine, Copper Creek, Pinal Co., and elsewhere in Arizona; at the Santa Rita mine, Silver City, Grant Co., New Mexico. From Chuquicamata, Antofagasta, Chile.

**Name:** For the locality from which it was first described, L'ubietová, Slovakia (formerly Libethen, Hungary).

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 862–864. (2) Cordsen, A. (1978) A crystal-structure refinement of libethenite. Can. Mineral., 16, 153–157. (3) Keller, P., H. Hess, and F. Zettler (1979) Ladungsbilanzen an den verfeinerten Kristallstrukturen von Libethenit, Adamin und  $\text{Co}_2[\text{OH}/\text{AsO}_4]$  und ihre Wasserstoffbrückenbindungen. Neues Jahrb. Mineral., Abh., 134, 147–156 (in German with English abs.). (4) Burns, P.C. and F.C. Hawthorne (1995) Rietveld refinement of the crystal structure of olivenite: a twinned monoclinic structure. Can. Mineral., 33, 885–888.

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