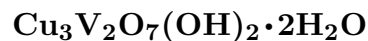


# Volborthite



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**Crystal Data:** Monoclinic, pseudo-hexagonal. *Point Group:*  $2/m$ . Typically as rosettelike aggregates of scaly crystals, which may have a hexagonal or triangular outline, to 5 mm.

**Physical Properties:** *Cleavage:* One, perfect. *Hardness* = 3.5 *D*(meas.) = 3.5–3.8 *D*(calc.) = 3.52

**Optical Properties:** Semitransparent. *Color:* Dark olive-green, green, yellowish green; green to yellowish green in transmitted light. *Luster:* Vitreous, oily, resinous, waxy, pearly on the cleavage.

*Optical Class:* Biaxial (–) or biaxial (+). *Pleochroism:* Faint. *Dispersion:*  $r < v, r > v$ , inclined.  $\alpha = 1.820\text{--}2.01$   $\beta = 1.835\text{--}2.05$   $\gamma = 1.92\text{--}2.07$   $2V$ (meas.) =  $63^\circ\text{--}83^\circ$

**Cell Data:** *Space Group:*  $C2/m$ .  $a = 10.610(2)$   $b = 5.866(1)$   $c = 7.208(1)$   
 $\beta = 95.04(2)^\circ$   $Z = 2$

**X-ray Powder Pattern:** Monument No. 1 mine, Arizona, USA.  
7.16 (10), 2.643 (7), 2.571 (7), 2.389 (7), 4.103 (5), 3.090 (5), 2.998 (5)

| Chemistry:             | (1)   | (2)   | (1)                  | (2)      |        |
|------------------------|-------|-------|----------------------|----------|--------|
| $\text{V}_2\text{O}_5$ | 36.65 | 38.32 | CuO                  | 48.79    | 50.29  |
| $\text{SiO}_2$         | 1.37  |       | $\text{H}_2\text{O}$ | [11.49]  | 11.39  |
| $\text{V}_2\text{O}_3$ | 1.70  |       | Total                | [100.00] | 100.00 |

(1) Scrava mine, Italy; by electron microprobe;  $\text{V}_2\text{O}_3$  assumed for charge balance,  $\text{H}_2\text{O}$  by difference; corresponds to  $\text{Cu}_{2.89}\text{V}_{1.90}^{5+}\text{V}_{0.11}^{3+}\text{Si}_{0.11}\text{O}_7(\text{OH})_2 \cdot 2\text{H}_2\text{O}$ . (2)  $\text{Cu}_3\text{V}_2\text{O}_7(\text{OH})_2 \cdot 2\text{H}_2\text{O}$ .

**Occurrence:** An uncommon secondary mineral in the oxidized zone of vanadium-bearing hydrothermal mineral deposits.

**Association:** Brochantite, malachite, atacamite, tangeite, chrysocolla, barite, gypsum.

**Distribution:** In Russia, originally from an unknown locality; later identified at the Sofronovskii copper mine, near Perm, and at Syssersk and Nizhni Tagil, Ural Mountains. In Uzbekistan, in the Hodzha-Akhmet quarry, near Uch-Kuduk, Kyzylkum desert. From the Uzbekistana district, Fergana Valley, Alai Range, Kyrgyzstan. In the Scrava mine, Val Graveglia, Liguria, Italy. At the Blaby mine, Glen Parva, Leicestershire, England. From Ronneburg, Thuringia, Germany. In the USA, at the Tennessee Queen mine, Richardson, near Thompson, Grand Co., and elsewhere in Utah; in the Radium No. 5 mine, San Juan No. 3 mine, and Cougar mine, Slick Rock district, San Miguel Co., and probably elsewhere in Colorado; from the Gold Quarry mine, near Carlin, Maggie Creek district, and in the Carlin mine, 50 km northwest of Elko, Lynn district, Eureka Co., Nevada; at the Monument No. 1 mine, Monument Valley, Navajo Co., Arizona; in the Green Monster mine, Inyo Co., California. At Menzies Bay, Vancouver Island, British Columbia, Canada. From the Luiswishi copper mine, Lubumbashi, Katanga Province, Congo (Shaba Province, Zaire). At Uris-Bobos, Namibia. There are additional minor localities.

**Name:** To honor Aleksandr Fedorovich von Volborth (1800–1876), Russian paleontologist, who first noticed the mineral.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 818–819. (2) Leonardsen, E.S. and O.V. Petersen (1974) The unit cell of volborthite. *Amer. Mineral.*, 59, 372–373. (3) Basso, R., A. Palenzona, and L. Zefiro (1988) Crystal structure refinement of volborthite from Scrava mine (Eastern Liguria, Italy). *Neues Jahrb. Mineral., Monatsh.*, 385–394. (4) Lafontaine, M.A., A. Le Bail, and G. Férey (1990) Copper-containing minerals – I.  $\text{Cu}_3\text{V}_2\text{O}_7(\text{OH})_2 \cdot 2\text{H}_2\text{O}$ : the synthetic homolog of volborthite; crystal structure determination from X-ray and neutron data; structural correlations. *J. Solid State Chem.*, 85, 220–227. (5) Pekov, I.V. (1998) Minerals first discovered on the territory of the former Soviet Union, 231–232.

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