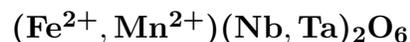


# Ferrocolumbite



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**Crystal Data:** Orthorhombic. *Point Group:*  $2/m\ 2/m\ 2/m$ . Crystals short prismatic or equant, also flat tabular, to 0.75 m. In groups of parallel or subparallel crystals, to 18 t; massive. *Twinning:* Common as heart-shaped contact and penetration twins, on {021} and {023}, may produce pseudo-hexagonal trillings. More rarely on {051} and {15•1•0}.

**Physical Properties:** *Cleavage:* Distinct on {100}, less distinct on {010}. *Fracture:* Subconchoidal to uneven. *Tenacity:* Brittle. Hardness = 6 VHN = 652–739 (100 g load).  $D(\text{meas.}) = 5.20\text{--}6.65$   $D(\text{calc.}) = [5.43]$  Paramagnetic.

**Optical Properties:** Opaque, translucent through thin edges. *Color:* Black to brownish black; reddish brown in transmitted light; in reflected light, grayish white with a brownish tint and reddish internal reflections. *Streak:* Black to dark brown. *Luster:* Submetallic to vitreous, commonly tarnished iridescent.

*Optical Class:* Biaxial (-). *Orientation:*  $X = b; Y = a; Z = c$ . *Dispersion:*  $r < v$ .

*Absorption:* Strong;  $Z > X$ .  $\alpha = \text{n.d.}$   $\beta = 2.29\text{--}2.40$   $\gamma = \text{n.d.}$   $2V(\text{meas.}) = \text{n.d.}$

$R_1\text{--}R_2$ : (400) 18.4–19.1, (420) 17.7–18.6, (440) 17.3–18.2, (460) 17.1–17.9, (480) 16.9–17.7, (500) 16.9–17.6, (520) 16.8–17.5, (540) 16.8–17.4, (560) 16.7–17.3, (580) 16.7–17.2, (600) 16.7–17.2, (620) 16.6–17.1, (640) 16.5–17.1, (660) 16.4–16.9, (680) 16.3–16.8, (700) 16.1–16.8

**Cell Data:** *Space Group:*  $Pbcn$  (synthetic).  $a = 14.266(1)$   $b = 5.7321(4)$   $c = 5.0503(4)$   
 $Z = 4$

**X-ray Powder Pattern:** Tinton (?), South Dakota, USA; similar to wodginite or ixiolite. 2.96 (100), 3.66 (48), 1.721 (22), 1.772 (14), 1.465 (14), 7.13 (12), 2.49 (12)

| <b>Chemistry:</b>              | (1)   | (2)   | (3)   | (1)              | (2)   | (3)    |
|--------------------------------|-------|-------|-------|------------------|-------|--------|
| Nb <sub>2</sub> O <sub>5</sub> | 72.37 | 51.72 | 78.72 | SnO <sub>2</sub> | 0.67  | 0.46   |
| Ta <sub>2</sub> O <sub>5</sub> | 5.26  | 28.68 |       | FeO              | 15.04 | 13.03  |
| WO <sub>3</sub>                |       | 0.28  |       | MnO              | 5.97  | 5.34   |
| TiO <sub>2</sub>               |       | 1.30  |       | CaO              | 0.58  | 0.01   |
|                                |       |       |       | Total            | 99.89 | 100.82 |
|                                |       |       |       |                  |       | 100.00 |

(1) Ånneröd, Norway. (2) Kings Mountain, North Carolina, USA; by electron microprobe, corresponds to  $(\text{Fe}_{0.68}\text{Mn}_{0.28}\text{Ti}_{0.06}\text{Sn}_{0.01}\text{W}_{0.01})_{\Sigma=1.04}(\text{Nb}_{1.50}\text{Ta}_{0.50})_{\Sigma=2.00}\text{O}_6$ . (3) FeNb<sub>2</sub>O<sub>6</sub>.

**Polymorphism & Series:** Forms two series, with ferrotantalite and with manganocolumbite.

**Occurrence:** An accessory constituent of granite pegmatites; rarely in carbonatites; a detrital mineral in placer deposits.

**Association:** Albite, microcline, beryl, lepidolite, muscovite, tourmaline, spodumene, lithiophilite, triphylite, amblygonite, triplite, apatite, samarskite, microlite, cassiterite.

**Distribution:** In the USA, in Connecticut, at Middletown, Portland, and Haddam, Middlesex Co.; large masses from the Beecher Lode, eight km southeast of Custer, Custer Co., and around Keystone, Pennington Co., South Dakota; in the Spruce Pine district, Mitchell Co., and the Foote mine, Kings Mountain, Cleveland Co., North Carolina. At Ånneröd, Tveit, and elsewhere in Norway. In Russia, from Miass, Ilmen Mountains, Southern Ural Mountains. At Craveggia, Val Vigezzo, Piedmont, Italy. Large crystals from Ambatofotsikely and Antsirabe, Madagascar. At Greens Well, Wodgina, Greenbushes, and elsewhere in Western Australia. In the Ishikawa district, Fukushima Prefecture, Japan.

**Name:** For iron (FERRum), and COLUMBia, for America, source of the first specimens.

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**Type Material:** Western Australian Museum, Perth, Australia, S1832c; The Natural History Museum, London, England, 60309.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 780–787. (2) Wise, M.A., A.C. Turnock, and P. Černý (1985) Improved unit cell dimensions for ordered columbite-tantalite end members. *Neues Jahrb. Mineral., Monatsh.*, 372–378. (3) Wenger, M., T. Armbruster, and C.A. Geiger (1991) Cation distribution in partially ordered columbite from the Kings Mountain pegmatite, North Carolina. *Amer. Mineral.*, 76, 1897–1904.