

# Metavoltine



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**Crystal Data:** Hexagonal. *Point Group:*  $\bar{3}$  or 3. Crystals are thick hexagonal plates, to 1 mm, with large {0001}, {10 $\bar{1}$ 0}, modified by a number of minor forms; commonly in granular to scaly aggregates and crusts.

**Physical Properties:** *Cleavage:* Perfect on {0001}. Hardness = 2.5 D(meas.) = 2.51; 2.396 (synthetic). D(calc.) = 2.435 Partly soluble in H<sub>2</sub>O.

**Optical Properties:** Translucent. *Color:* Yellowish brown, orange-brown, greenish brown. *Luster:* Resinous.

*Optical Class:* Uniaxial (-). *Pleochroism:* O = dark brown, brown, dark yellow, dark yellow-orange; E = pale yellow, pale greenish yellow, very pale yellow.  $\omega = 1.588\text{--}1.595$   
 $\epsilon = 1.572\text{--}1.581$

**Cell Data:** *Space Group:*  $P\bar{3}$  or  $P3$ .  $a = 9.575(5)$   $c = 18.17(1)$   $Z = 1$

**X-ray Powder Pattern:** Madeni Zakh, Iran.  
9.12 (100), 3.300 (37), 2.002 (37), 18.28 (33), 2.899 (30), 3.087 (23), 2.375 (23)

<b>Chemistry:</b>	(1)	(2)	(3)		(1)	(2)	(3)
SO <sub>3</sub>	44.22	45.02	45.40	ZnO		0.23	
Fe <sub>2</sub> O <sub>3</sub>	22.55	22.45	22.64	Na <sub>2</sub> O	8.89	8.75	8.79
FeO	2.83	2.22	3.40	K <sub>2</sub> O	4.82	4.36	4.45
CuO		1.18		H <sub>2</sub> O	17.23	15.30	15.32
				Total	100.54	99.51	100.00

(1) La Campania, Chile. (2) Sierra Gorda [district], Chile; corresponds to  $\text{K}_{1.98}\text{Na}_{6.02}(\text{Fe}_{0.66}^{2+}\text{Cu}_{0.32}\text{Zn}_{0.06})_{\Sigma=1.04}\text{Fe}_6^{3+}\text{O}_{2.04}(\text{SO}_4)_{12}\cdot 18.12\text{H}_2\text{O}$ . (3)  $\text{K}_2\text{Na}_6\text{Fe}^{2+}\text{Fe}_6^{3+}\text{O}_2(\text{SO}_4)_{12}\cdot 18\text{H}_2\text{O}$ .

**Occurrence:** Typically an alteration product of pyrite in arid climates; formed as a fumarolic sublimate and solfataric precipitate; may be a post-mining product.

**Association:** Voltaite, botryogen, ferrinatrite, coquimbite, copiapite, sideronatrite, metasideronatrite, jarosite, alunogen, pickeringite, sulfur, gypsum.

**Distribution:** From near Madeni Zakh, Iran. In Italy, on Vesuvius, at the Grotta dello Zolfo, Miseno, and from Solfatara di Pozzuoli, Campi Flegrei, near Naples, Campania; in the Cetine mine, 20 km southwest of Siena, Tuscany; from the Grotto de Faraglione, Port di Levante, Vulcano, Lipari Islands. At volcanoes on the Kamchatka Peninsula, Russia. In England, from Wheal Edward, St. Just, Cornwall, and in the Brigham quarries, Cockermouth, Cumbria. On Tristan da Cunha Island, South Atlantic Ocean. From Hainaut, Belgium. At Cervenica-Dubnik, Slovakia. From Jáchymov (Joachimsthal), Czech Republic. In the USA, in the Sulfur Hole prospect, near Borate, about 10 km northeast of Yermo, Calico Hills, San Bernardino Co., California; at Steamboat Hot Springs, Washoe Co., Nevada; from Bisbee, Cochise Co., Arizona. In Chile, in Antofagasta, at Quetena, west of Calama; Alcaparrosa, near Cerritos Bayos, and Sierra Gorda, both southwest of Calama, and at Chuquicamata. In Argentina, from the Santa Bárbara sulfur mine, El Palmar district, Jujuy Province, and in the Capillitas mine, Catamarca Province.

**Name:** From the Greek for *with* and *voltaite*, as originally associated with that species.

**Type Material:** Institute of Mineralogy and Crystallography, University of Vienna, Vienna, Austria; Natural History Museum, Paris, France, 100.154.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 619–621. (2) Scordari, F., F. Vurro, and S. Menchetti (1975) The metavoltine problem: relationships between metavoltine and Maus' salt. *Tschermaks Mineral. Petrog. Mitt.*, 22, 88–97. (3) Scordari, F. (1977) The metavoltine problem: metavoltine from Madeni Zakh and Chuquicamata, and a related artificial compound. *Mineral. Mag.*, 41, 371–374. (4) Giacobozzo, G., F. Scordari, A. Todisco, and S. Menchetti (1976) Crystal structure model for metavoltine from Sierra Gorda. *Tschermaks Mineral. Petrog. Mitt.*, 23, 155–166. (5) Comunale, G., F. Scordari, P. Bonazzi, and S. Menchetti (1994) Metavoltine from Vesuvius: crystal structure and crystal chemistry. General Meeting of the Int. Mineral. Assoc., 16, 80–81 (abs.).

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