

**Ophirite****Ca<sub>2</sub>Mg<sub>4</sub>[Zn<sub>2</sub>Mn<sup>3+</sup><sub>2</sub>(H<sub>2</sub>O)<sub>2</sub>(Fe<sup>3+</sup>W<sub>9</sub>O<sub>34</sub>)<sub>2</sub>]<sub>2</sub>·46H<sub>2</sub>O**

**Crystal Data:** Triclinic. *Point Group:*  $\bar{1}$ . Crystals are tabular, to 1 mm, displaying {100} and {110}.

**Physical Properties:** *Cleavage:* None. *Fracture:* Irregular. *Tenacity:* Brittle. *Hardness* = ~ 2  
D(meas.) = n.d. D(calc.) = 4.060

**Optical Properties:** Transparent. *Color:* Orange-brown. *Streak:* Pale orange. *Luster:* Vitreous.  
*Optical Class:* Biaxial (+).  $\alpha = 1.730(3)$   $\beta = 1.735(3)$   $\gamma = 1.770(3)$   $2V(\text{meas.}) = 43(2)^\circ$   
 $2V(\text{calc.}) = 42.1^\circ$  *Orientation:*  $Y \wedge b \approx 9^\circ$ , one optic axis  $\perp \{001\}$ . *Dispersion:*  $r > v$ , strong.  
*Absorption:*  $X < Y \ll Z$ . *Pleochroism:*  $X$  = light orange-brown,  $Y$  = light orange-brown,  
 $Z$  = orange-brown.

**Cell Data:** *Space Group:*  $P\bar{1}$ .  $a = 11.9860(2)$   $b = 13.2073(2)$   $c = 17.689(1)$   
 $\alpha = 69.690(5)^\circ$   $\beta = 85.364(6)^\circ$   $\gamma = 64.875(5)^\circ$   $Z = 1$

**X-ray Powder Pattern:** Ophir Hill Consolidated mine, Ophir district, Tooele County, Utah, USA.  
10.169 (100), 11.33 (91), 2.992 (75), 8.27 (55), 2.760 (55), 16.72 (38), 5.44 (33)

<b>Chemistry:</b>	(1)	(2)
CaO	1.68	1.94
MgO	2.79	2.78
ZnO	2.86	2.81
Mn <sub>2</sub> O <sub>3</sub>	2.50	2.73
Fe <sub>2</sub> O <sub>3</sub>	3.25	2.76
Sb <sub>2</sub> O <sub>5</sub>	0.61	
WO <sub>3</sub>	71.94	72.06
H <sub>2</sub> O	[15.24]	14.92
Total	100.87	100.00

(1) Ophir Hill Consolidated mine, Ophir district, Oquirrh Mountains, Tooele County, Utah, USA; average of 14 electron microprobe analyses supplemented by Raman spectroscopy, H<sub>2</sub>O calculated from structure; corresponds to (Ca<sub>1.46</sub>Mg<sub>0.50</sub>Zn<sub>0.04</sub>) $\Sigma=2.00$ (Mg<sub>3.96</sub>Mn<sup>3+</sup><sub>0.04</sub>) $\Sigma=4.00$ [(Zn<sub>1.16</sub>Fe<sup>3+</sup><sub>0.68</sub>Ca<sub>0.14</sub>Sb<sup>5+</sup><sub>0.02</sub>) $\Sigma=2.00$ (Mn<sup>3+</sup><sub>1.42</sub>Sb<sup>5+</sup><sub>0.32</sub>Fe<sup>3+</sup><sub>0.24</sub>W<sub>0.02</sub>) $\Sigma=2.00$ {(H<sub>2</sub>O)<sub>2</sub>[(Fe<sup>3+</sup><sub>0.80</sub>Sb<sup>5+</sup><sub>0.11</sub>Ca<sub>0.07</sub>Mg<sub>0.02</sub>) $\Sigma=1.00$ (W<sub>8.71</sub>Mn<sup>3+</sup><sub>0.29</sub>) $\Sigma=1.00$ ]<sub>2</sub>}]·46H<sub>2</sub>O. (2) Ca<sub>2</sub>Mg<sub>4</sub>[Zn<sub>2</sub>Mn<sup>3+</sup><sub>2</sub>(H<sub>2</sub>O)<sub>2</sub>(Fe<sup>3+</sup>W<sub>9</sub>O<sub>34</sub>)<sub>2</sub>]<sub>2</sub>·46H<sub>2</sub>O.

**Occurrence:** Produced by late acidic and oxidizing hydrothermal solutions reacting with dolomite and scheelite, in the presence of pyrite and calcium-rich hornfels.

**Association:** Scheelite, pyrite, dolomite, sericite, apatite, bournonite, galena, sphalerite, fluorite, sulfur.

**Distribution:** From the Ophir Hill Consolidated mine, Ophir district, Oquirrh Mountains, Tooele County, Utah, USA.

**Name:** For the mine that produced the first specimens.

**Type Material:** Natural History Museum of Los Angeles County, Los Angeles, California, USA (64029 and 64030).

**References:** (1) Kampf, A.R., J.M. Hughes, B.P. Nash, S.E. Wright, G.R. Rossman, and J. Marty (2014) Ophirite, Ca<sub>2</sub>Mg<sub>4</sub>[Zn<sub>2</sub>Mn<sup>3+</sup><sub>2</sub>(H<sub>2</sub>O)<sub>2</sub>(Fe<sup>3+</sup>W<sub>9</sub>O<sub>34</sub>)<sub>2</sub>]<sub>2</sub>·46H<sub>2</sub>O, a new mineral with a heteropolytungstate tri-lacunary Keggin anion. *Amer. Mineral.*, 99, 1045-1051.