

# Lithiophilite

# Li(Mn<sup>2+</sup>, Fe<sup>2+</sup>)PO<sub>4</sub>

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**Crystal Data:** Orthorhombic. *Point Group:*  $2/m\ 2/m\ 2/m$ . Sharply terminated crystals may show {010}, {011}, {021}, {111}, with {100}, {110}, {130}, {140}; commonly as crudely anhedral crystals and cleavages, to 1 m. *Twining:* Rare contact twins on {130}.

**Physical Properties:** *Cleavage:* On {100}, perfect; on {010}, good. *Fracture:* Uneven to subconchoidal. Hardness = 4–5 D(meas.) = 3.445–3.50 D(calc.) = 3.433

**Optical Properties:** Transparent to translucent. *Color:* Clove-brown, yellowish brown, honey-yellow, salmon-pink, blue-gray, gray, typically surficially black from alteration; colorless to pale yellow or pink in transmitted light. *Streak:* White to grayish white. *Luster:* Vitreous to subresinous.

*Optical Class:* Biaxial (+). *Pleochroism:* None to weak; X = deep pink; Y = pale greenish yellow; Z = pale pink. *Orientation:* X = c; Y = a; Z = b. *Dispersion:*  $r < v$ , strong.  $\alpha = 1.663\text{--}1.696$   $\beta = 1.667\text{--}1.700$   $\gamma = 1.674\text{--}1.702$   $2V(\text{meas.}) = 48^\circ\text{--}70^\circ$

**Cell Data:** *Space Group:*  $Pmnb$ .  $a = 6.094(5)$   $b = 10.427(5)$   $c = 4.743(1)$   $Z = 4$

**X-ray Powder Pattern:** Outpost mine, White Picacho district, Arizona, USA. 2.548 (100), 3.051 (89), 3.516 (71), 4.313 (56), 1.762 (29), 5.236 (28), 2.492 (28)

Chemistry:	(1)	(2)	(3)	(1)	(2)	(3)
P <sub>2</sub> O <sub>5</sub>	44.95	44.5	45.11	CaO	trace	
SiO <sub>2</sub>		0.09		Na <sub>2</sub> O	0.24	
Al <sub>2</sub> O <sub>3</sub>		0.07		Li <sub>2</sub> O	9.11	[8.8] 9.50
FeO	2.94	0.16	22.84	H <sub>2</sub> O	0.65	
MnO	42.58	46.4	22.55	insol.	0.16	
				Total	100.63	[100.0] 100.00

(1) Buckfield, Maine, USA. (2) Foote mine, North Carolina, USA; by electron microprobe, total Fe as FeO, total Mn as MnO, Li<sub>2</sub>O by difference. (3) Li(Mn, Fe)PO<sub>4</sub> with Mn:Fe = 1:1.

**Mineral Group:** Forms a series with triphylite.

**Occurrence:** A late-stage mineral in some complex granite pegmatites; usually primary but rarely secondary.

**Association:** Sicklerite, purpurite, huréaulite, numerous Fe–Mn phosphates and oxides.

**Distribution:** In the USA, from Branchville, Fairfield Co., and in the Strickland quarry, Portland, Middlesex Co., Connecticut; at several places in Maine, as Buckfield and Norway, Oxford Co., and Poland, Androscoggin Co.; in the Custer Mountain mine, and elsewhere in Custer Co., South Dakota; good crystals from the Foote mine, near Kings Mountain, Cleveland Co., North Carolina; in the Harding mine, Dixon, Taos Co., New Mexico; in the White Picacho district, Yavapai Co., Arizona; at several mines in the Pala district, San Diego Co., California. In Canada, from the Tanco mine, Bernic Lake, Manitoba. From the Mangualde pegmatite, near Mesquitela, and the Bendada pegmatite, near Guarda, Portugal. In the Viitaniemi pegmatite, near Eräjärvi, Finland. Large masses in the Blesberg mine, Noumas pegmatite, Northern Cape Province, South Africa. From Karibib, Namibia. In the Buranga pegmatite, near Gatumba, Rwanda. At Wodgina, Western Australia. Several other localities are known.

**Name:** For its *lithium* content and the Greek for *friend*.

**Type Material:** Yale University, New Haven, Connecticut, USA, 3.5641, 3.5645.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 665–669. (2) Geller, S. and J.L. Durand (1960) Refinement of the structure of LiMnPO<sub>4</sub>. *Acta Cryst.*, 13, 325–331. (3) Thomssen, R.W. and J.W. Anthony (1977) Lithiophilite crystals from the Foote mine. *Mineral. Record*, 8, 95–97. (4) Blanchard, F.N. (1981) X-ray powder diffraction data for lithiophilite. *Florida Scientist*, 44, 40–53.

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