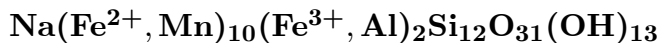


## Howieite



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**Crystal Data:** Triclinic. *Point Group:*  $\bar{1}$  or 1. As bladed crystals, to 1 cm; in plumose aggregates and rosettes.

**Physical Properties:** *Cleavage:* Good on {010}, fair on {100}, poor on {2 $\bar{1}$ 0}.  
Hardness = n.d. D(meas.) = 3.378 D(calc.) = [3.34]

**Optical Properties:** Transparent to translucent. *Color:* Dark green to black.

*Luster:* Greasy.

*Optical Class:* Biaxial (-). *Pleochroism:* Marked; X = golden; Y = dark lilac gray; Z = green.

*Dispersion:*  $r < v$ , strong.  $\alpha = 1.701$   $\beta = 1.720$   $\gamma = 1.734$   $2V(\text{meas.}) = 65^\circ$

**Cell Data:** *Space Group:*  $P\bar{1}$  or  $P1$ .  $a = 10.170(4)$   $b = 9.774(4)$   $c = 9.589(4)$   
 $\alpha = 91.22(5)^\circ$   $\beta = 70.76(5)^\circ$   $\gamma = 108.09(5)^\circ$   $Z = 1$

**X-ray Powder Pattern:** Laytonville, California, USA. (ICDD 19-571).  
9.18 (100), 7.91 (80), 3.25 (65), 2.62 (60), 2.68 (45), 2.78 (40), 3.06 (35)

**Chemistry:** (1) Laytonville district, California, USA; analysis not given, stated to correspond to  $(\text{Na}_{1.03}\text{Ca}_{0.02})_{\Sigma=1.05}(\text{Fe}_{6.41}^{2+}\text{Mn}_{2.98}\text{Mg}_{0.45})_{\Sigma=9.84}(\text{Fe}_{1.57}^{3+}\text{Al}_{0.62})_{\Sigma=2.19}(\text{Si}_{11.96}\text{Ti}_{0.04})_{\Sigma=12.00}[\text{O}_{31.31}(\text{OH})_{12.69}]_{\Sigma=44.00}$ .

**Occurrence:** An essential mineral in some of the metamorphosed shales, siliceous ironstones, and impure limestones of the Franciscan Formation (Laytonville district, California, USA).

**Association:** Deerite, zussmanite, stilpnomelane, spessartine, riebeckite, quartz, aegirine, grunerite, aragonite, manganoan siderite, ferroan kutnohorite (Laytonville district, California, USA).

**Distribution:** In the USA, in California, from the Laytonville quarry, and at Covelo, Mendocino Co.; at Ward Creek, Sonoma Co.; in Panoche Pass, San Benito Co.; at Pacheco Pass, Santa Clara and Merced Cos.; and in the Powers quarry, Coos Co., Oregon. From Brezovica, Yugoslavia. In the Tanemaya mine, Kumamoto Prefecture, Japan.

**Name:** For Professor Robert Andrew Howie (1923–), British mineralogist and petrologist, London University, London, England.

**Type Material:** National Museum of Natural History, Washington, D.C., USA, 109453, 144184; The Natural History Museum, London, England, 1964,544.

**References:** (1) Agrell, S.O., M.G. Bown, and D. McKie (1965) Deerite, howieite and zussmanite, three new minerals from the Franciscan of the Laytonville District, Mendocino Co., California. MSA meeting, Bozeman, Montana, July 26–31, 1964. *Amer. Mineral.*, 50, 278 (abs.). (2) Wenk, H.R. (1974) Howieite, a new type of chain silicate. *Amer. Mineral.*, 59, 86–97. (3) Muir Wood, R. (1979) The iron-rich blueschist facies minerals: 2. Howieite. *Mineral. Mag.*, 43, 363–370.