Howieite

\( \text{Na(Fe}^{2+}, \text{Mn})_{10}(\text{Fe}^{3+}, \text{Al})_{2}\text{Si}_{12}\text{O}_{31}(\text{OH})_{13} \)

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Crystal Data: Triclinic. Point Group: \( \overline{1} \) 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\overline{1}0\}. Hardness = n.d. \( D(\text{meas.}) = 3.378 \quad D(\text{calc.}) = [3.34] \)

Optical Class: Biaxial (−). Pleochroism: Marked; \( X = \) golden; \( Y = \) dark lilac gray; \( Z = \) green. Dispersion: \( r < v \), strong. \( \alpha = 1.701 \quad \beta = 1.720 \quad \gamma = 1.734 \quad 2V(\text{meas.}) = 65^\circ \)

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

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 \( (\text{Na}_{1.03}\text{Ca}_{0.02})_{\Sigma=1.05}(\text{Fe}^{3+}_{6.41}\text{Mn}_{2.98}\text{Mg}_{0.45})_{\Sigma=9.84}(\text{Fe}^{3+}_{1.57}\text{Al}_{0.62})_{\Sigma=2.19} \)
\( \text{(Si}_{11.96}\text{Ti}_{0.04})_{\Sigma=12.00}(\text{O}_{31.31}\text{(OH)}_{12.69})_{\Sigma=44.00} \)

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 Covel, 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.

