Howieite $Na(Fe^{2+},Mn)_{10}(Fe^{3+},Al)_2Si_{12}O_{31}(OH)_{13}$

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(meas.) = 65°

Cell Data: *Space Group:* $P\bar{1}$ or $P1$. $a = 10.170(4)$ $b = 9.774(4)$ $c = 9.589(4)$
$\alpha = 91.22(5)°$ $\beta = 70.76(5)°$ $\gamma = 108.09(5)°$ 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 $(Na_{1.03}Ca_{0.02})_{\Sigma=1.05}(Fe^{2+}_{6.41}Mn_{2.98}Mg_{0.45})_{\Sigma=9.84}(Fe^{3+}_{1.57}Al_{0.62})_{\Sigma=2.19}(Si_{11.96}Ti_{0.04})_{\Sigma=12.00}[O_{31.31}(OH)_{12.69}]_{\Sigma=44.00}$.

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.