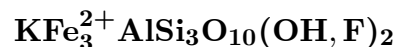


Annite



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Crystal Data: Monoclinic. *Point Group:* $2/m$. Tabular crystals and cleavage fragments with pseudo-hexagonal outlines, to 15 cm. Commonly as foliated masses. *Twinning:* Contact twins with composition surface {001} and twin axis [310].

Physical Properties: *Cleavage:* Perfect on {001}. *Tenacity:* Flexible. Hardness = 2.5–3 D(meas.) = 3.3 D(calc.) = [3.36]

Optical Properties: Translucent to transparent. *Color:* Brown, black. *Luster:* Vitreous. *Optical Class:* Biaxial (-). *Pleochroism:* X = brown; Y = Z = dark brown. *Orientation:* Y = b. *Dispersion:* $r < v$, weak. $\alpha = 1.624$ $\beta = 1.672$ $\gamma = 1.672$ $2V(\text{meas.}) = 0^\circ\text{--}5^\circ$

Cell Data: *Space Group:* $C2/m$. $a = 5.3860(9)$ $b = 9.3241(7)$ $c = 10.2683(9)$
 $\beta = 100.63(1)^\circ$ $Z = 2$

X-ray Powder Pattern: Synthetic; 1M.
10.264 (100), 3.380 (80), 2.654 (70), 2.465 (40), 1.556 (40), 2.199 (20), 1.692 (20)

| Chemistry: | (1) | (2) | (3) |
|--------------------------------|---------|-------|--------|
| SiO ₂ | 34.90 | 32.56 | 35.21 |
| TiO ₂ | 0.00 | 1.48 | |
| Al ₂ O ₃ | 10.90 | 17.24 | 9.96 |
| FeO | 36.19 | 34.25 | 42.11 |
| MnO | 1.77 | 0.03 | |
| MgO | 3.40 | 0.86 | |
| CaO | 0.15 | 0.0 | |
| Na ₂ O | 0.00 | 0.28 | |
| K ₂ O | 8.10 | 8.20 | 9.20 |
| F | 2.22 | | |
| Cl | 0.24 | | |
| H ₂ O | | | 3.52 |
| Total | [97.87] | 94.90 | 100.00 |

(1) Moina skarn, Tasmania; by electron microprobe, original total given as 97.78%. (2) Kawai mine, Japan; by electron microprobe. (3) $\text{KFe}_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$.

Polymorphism & Series: 1M polytype.

Mineral Group: Mica group.

Occurrence: In magnesium-poor igneous and metamorphic rocks.

Association: /Fluorite, zircon (Rockport, Massachusetts, USA).

Distribution: In the USA, from Cape Ann, east of Rockport, Essex Co., Massachusetts, and on Pikes Peak, El Paso Co., Colorado. From Mont Saint-Hilaire, Quebec, Canada. In the Moina tungsten skarn deposit, 40 km southwest of Devonport, Tasmania. From the Kawai mine, Ena, Gifu Prefecture, Japan. In Russia, at Katugin, Siberia, and Sludorudnik, Ural Mountains. From Flowerdale, near Gairloch, Scotland.

Name: For the first-noted occurrence at Cape Ann, Massachusetts, USA.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 634. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 3, sheet silicates, 55–84. (3) Eugster, H.P. and D.R. Wones (1962) Stability relations of the ferruginous biotite, annite. *J. Petrol.*, 3, 82–125. (4) Hazen, R.M. and C.W. Burnham (1973) The crystal structures of one-layer phlogopite and annite. *Amer. Mineral.*, 58, 889–900. (5) Kwak, T.A.P. and P.W. Askins (1981) Geology and genesis of the F-Sn-W(-Be-Zn) skarn (wrigglite) at Moina, Tasmania. *Econ. Geol.*, 76, 439–467.

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