Biotite  \( \text{K(Mg,Fe}^{2+})_3(\text{Al,Fe}^{3+})\text{Si}_3\text{O}_{10}(\text{OH,F})_2 \)

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Crystal Data: Monoclinic. Point Group: \(2/m\). Uncommon in good crystals, tabular or short prismatic, with pseudohexagonal outline, to 3 m. Typically irregular foliated or bent masses; in scalic aggregates or disseminated grains. Twinning: On composition plane \{001\}, twin axis \{310\}.

Physical Properties: Cleavage: \{001\}, perfect. Tenacity: Brittle to flexible, elastic. Hardness = 2.5–3 D(meas.) = 2.7–3.3 D(calc.) = 3.25

Optical Properties: Semitransparent. Color: Dark green, brown, black, reddish brown, light yellow, grayish yellow, brownish green, brown; yellow to reddish brown in thin section. Streak: White. Luster: Splendent to submetallic, vitreous, pearly on cleavage. Optical Class: Biaxial (−). Pleochroism: Strong: \(X\) = gray-yellow, yellow-brown, orange-brown; \(Y = Z = \) dark brown, dark green, dark red-brown. Orientation: \(Y = b; X \wedge c = 0°–3°; Z \wedge a = 0°–9°\). Dispersion: \(r < v, \) Fe-rich; may be \(r > v, \) Mg-rich. Absorption: \(Y \approx Z \gg X.\)

Cell Data: Space Group: \(C2/m\). \(a = 5.3\) \(b = 9.2\) \(c = 10.2\) \(\beta = 100°\) \(Z = 2\)

X-ray Powder Pattern: Edenville, Orange Co., New York, USA. 10.1 (100), 3.37 (100), 2.66 (80), 2.45 (80), 2.18 (80), 2.00 (80), 1.67 (80)

Chemistry:

(1)  
\[
\begin{array}{c}
\text{SiO}_2 & 36.25 \\
\text{TiO}_2 & 3.39 \\
\text{Al}_2\text{O}_3 & 13.90 \\
\text{Fe}_2\text{O}_3 & 6.80 \\
\text{FeO} & 14.81 \\
\text{MnO} & 0.49 \\
\text{MgO} & 11.80 \\
\text{CaO} & 0.00 \\
\text{Li}_2\text{O} & 0.03 \\
\text{Na}_2\text{O} & 0.10 \\
\text{K}_2\text{O} & 9.57 \\
\text{Cl} & 0.06 \\
\text{H}_2\text{O}^+ & 2.80 \\
\text{Total} & 100.00 \\
\end{array}
\]

(1) Vercelli, Italy; by electron microprobe, average of six analyses on one grain, \(\text{Fe}^{3+}\) by a semimicrovolumetric method, \(\text{H}_2\text{O}\) by TGA; corresponds to \((\text{K}_{0.94}\text{Na}_{0.02})\Sigma = 0.96\) \((\text{Mg}_{1.35}\text{Fe}^{2+}_{0.65}\text{Mn}_{0.03})\Sigma = 2.33\) \((\text{Fe}^{3+}_{0.39}\text{Ti}_{0.26}\text{Al}_{0.05}\text{Li}_{0.01})\Sigma = 0.65\) \((\text{Si}_{2.79}\text{Al}_{1.21})\Sigma = 4.00\) \([\text{O}_{1.55}\text{OH}_{1.44}]\Sigma = 12.00\), in the general structural formula \(\text{K(Mg,Fe}^{2+})_3(\text{Al,Fe}^{3+},\text{Ti})_{0–1}\) \((\text{Si}_{3–2.5}\text{Al}_{1–1.5})\Sigma = 4\) \([\text{O}_{10–11}\text{OH,F}_{2–1}]\).

Polymorphism & Series: 1M, 2M1, 3A polytypes.

Mineral Group: Mica group.

Occurrence: An important rock-forming mineral under a wide range of conditions. In regionally metamorphosed schists and gneisses, and in contact metamorphosed rocks; in granites to nepheline syenites; less common in extrusive igneous rocks, from rhyolites to basalts. Characteristic of potassic hydrothermal alteration; in detrital sediments.

Association: Quartz, potassic feldspar, plagioclase, nepheline, muscovite, pyroxenes, amphiboles, andalusite, cordierite, garnet, spinel.


Name: For the French mineralogist and physicist, Jean Baptiste Biot (1774–1862).


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