Freudenbergite

\[ \text{Na}_2(\text{Ti}, \text{Fe}^{3+})\text{O}_{16} \]

Crystal Data: Monoclinic. \textit{Point Group}: \( 2/m, m, \text{or} 2 \). As irregularly shaped grains, to 0.15 mm.

Physical Properties: \textit{Cleavage}: \{001\}, and another prismatic, good. Hardness = \(< 5 \)

\( D(\text{meas.}) = 3.956 \quad D(\text{calc.}) = 3.97 \)


\textit{Optical Class}: Biaxial (+), near uniaxial. \textit{Pleochroism}: Deep brown to pale yellow-brown.

\( n \approx 2.37–2.42 \) (Li). \( 2V(\text{meas.}) = \text{n.d.} \)

Cell Data: \textit{Space Group}: \( C2/m, \text{Cm}, \text{or} C2 \).

\( a = 12.305(5) \quad b = 3.822(2) \quad c = 6.500(3) \)

\( \beta = 107.30(3)^\circ \quad Z = 4 \)

X-ray Powder Pattern: Michelsberg, Germany.

3.63 (100), 1.911 (90), 3.10 (80), 3.02 (80), 2.731 (80), 2.069 (80), 1.596 (80)

Chemistry:

\begin{align*}
\text{Nb}_2\text{O}_5 & \quad 1.24 \quad 1.2 \\
\text{SiO}_2 & \quad < 0.02 \\
\text{TiO}_2 & \quad 70.37 \quad 71.6 \\
\text{ZrO}_2 & \quad 0.1 \\
\text{Al}_2\text{O}_3 & \quad < 0.01 \\
\text{Fe}_2\text{O}_3 & \quad 18.15 \quad 19.1 \\
\text{MnO} & \quad 0.14 \quad 0.1 \\
\text{MgO} & \quad < 0.03 \\
\text{Na}_2\text{O} & \quad 8.73 \quad 8.1 \\
\text{K}_2\text{O} & \quad 0.04 \quad 0.1 \\
\hline
\text{Total} & \quad 98.67 \quad 100.3
\end{align*}

(1) Michelsberg, Germany; by electron microprobe, total Fe as \( \text{Fe}_2\text{O}_3 \); corresponds to \( (\text{Na}_{1.98}\text{Fe}_{0.01})_{\Sigma=1.99}(\text{Ti}_{6.22}\text{Fe}_{1.59}\text{Nb}_{0.07}\text{Mn}_{0.01})_{\Sigma=7.89}\text{O}_{16} \).

(2) Do.; by electron microprobe, total Fe as \( \text{Fe}_2\text{O}_3 \).

Occurrence: A late-stage mineral in an apatite-bearing alkali syenite.

Association: Hematite, högbomite, diopside, apatite, ilmenite, titanite, biotite, sanidine.

Distribution: Found at Michelsberg, on the Katzenbuckel, Odenwald, Baden-Württemberg, Germany.

Name: For Professor Wilhelm Freudenberg (1881–?), who studied Katzenbuckel rocks.

Type Material: n.d.


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