Takanelite \((\text{Mn}^{2+}, \text{Ca})\text{Mn}^{4+}\text{O}_9 \cdot \text{H}_2\text{O}\)

Crystal Data: Hexagonal. Point Group: n.d. Intergrown on a fine scale with other minerals, colloform, banded, nodular massive.

Physical Properties: Tenacity: Friable. Hardness = 2.5–3 VHN = 480 (100 g load). 
\(D(\text{meas.}) = 3.43\) \(D(\text{calc.}) = 3.436\)

Optical Properties: Opaque. Color: Steel-gray to black; yellowish gray in reflected light. 
Streak: Brownish black to dark brown. Luster: Submetallic to dull. 
Optical Class: Uniaxial. Pleochroism: Weak; yellowish white to yellowish light gray. 
Anisotropism: Moderate; yellowish gray to light brownish gray. 
\(R_1-R_2: \) n.d.

Cell Data: Space Group: n.d. 
\(a = 2.830–2.843\) \(c = 7.240–7.53\) \(Z = 1\)

X-ray Powder Pattern: Nomura mine, Japan; close to ranciéite, variable with hydration. 
7.57 (100), 3.765 (25), 2.349 (20), 4.43 (18b), 1.420 (17), 2.462 (15), 2.065 (10)

Chemistry: 
\[
\begin{array}{ccc}
\text{SiO}_2 & 3.61 & \text{CaO} & 2.66 & \text{SiO}_2 \cdot 3.61 \\
\text{TiO}_2 & \text{trace} & \text{BaO} & 0.00 & \text{trace} \\
\text{MnO}_2 & 70.39 & \text{Na}_2\text{O} & 0.05 & 70.39 \\
\text{Al}_2\text{O}_3 & 1.70 & \text{K}_2\text{O} & 0.05 & 1.70 \\
\text{Fe}_2\text{O}_3 & 1.34 & \text{H}_2\text{O}^+ & 4.92 & 1.34 \\
\text{MnO} & 13.06 & \text{H}_2\text{O}^- & 2.22 & 13.06 \\
\text{MgO} & 0.22 & \text{H}_2\text{O} & 11.50 & 0.22 \\
\text{Total} & 100.22 & \text{Total} & 100.75 & \\
\end{array}
\]

(1) Nomura mine, Japan; after subtraction of impurity \(\text{SiO}_2, \text{Al}_2\text{O}_3, \text{Fe}_2\text{O}_3, \text{H}_2\text{O}^-\) and part of \(\text{H}_2\text{O}^+\) as halloysite, goethite, and quartz, corresponds to \((\text{Mn}_{0.89}\text{Ca}_{0.23}\text{Mg}_{0.03})_{\Sigma=1.15}\) \(\text{Mn}_{3.94}\text{O}_9 \cdot 1.3\text{H}_2\text{O}\). (2) Janggun mine, South Korea; by electron microprobe, \(\text{Mn}\) and \(\text{H}_2\text{O}\) by wet methods; corresponds to \((\text{Mn}_{0.68}\text{Ca}_{0.32}\text{Mg}_{0.09}\text{K}_{0.04})_{\Sigma=1.13}\) \(\text{Mn}_{3.96}\text{O}_9 \cdot 2.97\text{H}_2\text{O}\).

Polymorphism & Series: Forms a series with ranciéite.

Occurrence: Formed in the oxide zone of a bedded manganese deposit in metamorphosed cherts (Nomura mine, Japan); a secondary mineral derived from alteration of rhodochrosite in a manganese deposit (Janggun mine, South Korea).

Association: Braunite, todorokite, halloysite, goethite, quartz (Nomura mine, Japan); nsutite, pyrolysite (Janggun mine, South Korea).

Distribution: In the Nomura mine, Ehime Prefecture, Japan. From the Janggun mine, Bonghwa district, South Korea. At the Anson Betts mine, Plainfield, Hampshire Co., Massachusetts, and from Marfa, Presidio Co., Texas, USA.

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