

Pinakiolite

 $(\text{Mg}, \text{Mn}^{2+})_2(\text{Mn}^{3+}, \text{Sb}^{5+})\text{BO}_5$

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Crystal Data: Monoclinic, pseudo-orthorhombic. *Point Group:* $2/m$. Crystals are typically rectangular, to 2 cm, platy on {010}, or short prismatic [001], may be bent. *Twining:* Common on {011}, forming contact and cruciform interpenetration twins.

Physical Properties: *Cleavage:* Good on {010}. *Tenacity:* Very brittle. *Hardness* = 6
D(meas.) = 3.88 D(calc.) = 3.79–4.09

Optical Properties: Opaque to translucent. *Color:* Black, olive-green, yellowish brown; deep reddish brown in transmitted light. *Streak:* Brownish gray. *Luster:* Metallic, brilliant on {010}, to pearly.

Optical Class: Biaxial (-). *Pleochroism:* X = deep reddish brown; Z = reddish yellow.

Orientation: X = b; Y = c; Z = a. *Dispersion:* $r < v$, moderate (?). $\alpha = 1.908(5)$

$\beta = 2.05(1)$ $\gamma = 2.06(10)$ $2V(\text{meas.}) = 32(1)^\circ$

Cell Data: *Space Group:* $C2/m$. $a = 21.773\text{--}21.808$ $b = 5.977\text{--}6.162$ $c = 5.327\text{--}5.341$
 $\beta = 94.37^\circ\text{--}95.83^\circ$ $Z = 8$

X-ray Powder Pattern: Långban, Sweden.

2.51 (10), 2.70 (9), 5.42 (8), 1.986 (6), 2.165 (4), 1.623 (4), 1.496 (4)

Chemistry:

	(1)	(2)
Sb ₂ O ₅		18.09
B ₂ O ₃	16.05	16.61
Fe ₃ O ₄	2.12	
Al ₂ O ₃		0.22
Fe ₂ O ₃		0.06
Mn ₂ O ₃	34.93	22.55
MnO	15.70	11.33
PbO	0.78	
MgO	29.30	32.02
CaO	1.12	
Total	[100.00]	100.88

(1) Långban, Sweden; recalculated to 100% after deduction of SiO₂ 1.21%, H₂O 0.47%. (2) Do.; B₂O₃ by ICP spectroscopy, total Sb as Sb₂O₅, Mn²⁺:Mn³⁺ calculated for charge balance; corresponds to $(\text{Mg}_{1.68}\text{Mn}_{0.32})_{\Sigma=2.00}(\text{Mn}_{0.60}^{3+}\text{Sb}_{0.22}^{5+}\text{Al}_{0.01})_{\Sigma=0.83}\text{BO}_5$.

Occurrence: A rare mineral in banded granular dolomite in a metamorphosed Fe–Mn orebody.

Association: Hausmannite, tephroite, berzeliite, manganophyllite, dolomite, calcite.

Distribution: From Långban, Värmland, Sweden.

Name: From the Greek for a *small tablet*, in allusion to the thin tabular habit.

Type Material: Swedish Museum of Natural History, Stockholm, Sweden, 531826.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 324–325. (2) Moore, P.B. and T. Araki (1974) Pinakiolite, Mg₂Mn³⁺O₂[BO₃]; warwickite, Mg(Mg_{0.5}Ti_{0.5})O[BO₃]; wightmanite, Mg₅(O)(OH)₅[BO₃]•nH₂O: crystal chemistry of complex 3 Å wallpaper structures. *Amer. Mineral.*, 59, 985–1004. (3) Hansen, S., U. Hälenius, and B. Lindqvist (1988) Antimony-rich pinakiolite from Långban, Sweden: a new structural variety. *Neues Jahrb. Mineral., Monatsh.*, 231–239. (4) Norrestam, R. and S. Hansen (1990) Structural investigation of an antimony-rich pinakiolite, Mg_{1.90}Mn_{0.91}Sb_{0.19}O₂BO₃, from Långban, Sweden. *Zeits. Krist.*, 191, 105–116. (5) Cooper, M.A. and F.C. Hawthorne (1998) The crystal structure of blatterite, Sb₃⁵⁺(Mn³⁺, Fe³⁺)₉(Mn²⁺, Mg)₃₅(BO₃)₁₆O₃₂, and structural hierarchy in Mn³⁺-bearing zigzag borates. *Can. Mineral.*, 36, 1171–1193. (6) Thompson, R.M. and J.A. Gower (1954) A magnesium borate from Isère, France and Swift River, Yukon Territory, with X-ray powder data for some anhydrous borates. *Amer. Mineral.*, 39, 522–524.

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