Clino-ferro-suenoite $\square Mn^{2+}_2Fe^{2+}_5Si_8O_{22}(OH)_2$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. Prismatic, fibrous, or columnar to 1 cm.

Physical Properties: *Cleavage*: Perfect on {110}, with intersections at ~55° and ~125°. *Fracture*: n.d. *Tenacity*: [Brittle.] Hardness = [5-6] D(meas.) = 3.34 D(calc.) = 3.41

Optical Properties: Transparent to translucent. *Color*: Yellowish brown, greenish gray, colorless. *Streak*: n.d. *Luster*: Silky to vitreous.
Optical Class: Biaxial (-). $\alpha = 1.666$ $\beta = 1.682$ $\gamma = 1.698$ 2V(meas.) = 88° *Dispersion*: $r < v$. *Pleochroism*: X = red-violet; Y = pale violet; Z = blue. *Orientation*: $Y = b$; $Z \wedge c = 15°$.

Cell Data: Space Group: $C2/m$. $a = 9.618(4)$ $b = 18.28(2)$ $c = 5.335(1)$ $\beta = 102.31(1)°$ Z = 2 (ICDD 38-465).

X-ray Powder Pattern: Brunsjogrovan, Hallefors, Sweden (ICDD 38-465).
8.36 (100), 3.088 (90), 2.755 (40), 3.276 (35), 2.632 (20), 3.454 (18), 9.14 (16)

Chemistry:

	(1)	(2)	(3)		(1)	(2)	(3)
SiO_2	50.74	51.6	49.2	CaO	2.00	0.83	0.90
TiO_2	0.06	0.13		Na_2O	0.22	1.1	0.04
Al_2O_3	0.88	0.65	0.27	K_2O	0.08	0.09	
Fe_2O_3	1.80			F	0.07		
FeO	24.13	23.9	24.97	H_2O^+	1.94		
MnO	7.38	8.1	12.11	H_2O			[4.06]
MgO	10.57	11.1	8.48	Total	99.87	97.5	100.03

(1) Uttersvik, Sweden; corresponds to $(Fe^{2+}_{3.10}Mg_{2.42}Mn_{0.96}Ca_{0.33}Fe^{3+}_{0.21}Na_{0.07}Ti_{0.01}K_{0.01})_{\Sigma=7.11}(Si_{7.80}Al_{0.16})_{\Sigma=7.96}O_{22}[(OH)_{1.99}F_{0.03}]_{\Sigma=2.02}$. (2) Haute-Maurienne, France; by electron microprobe. (3) Brunsjogrovan, Hallefors, Sweden, average of 10 electron microprobe analyses, H_2O by difference (ICDD 38-465).

Polymorphism & Series: Can form a continuous series with cummingtonite and grunerite.

Mineral Group: Amphibole supergroup, magnesium-iron-manganese group.

Occurrence: An uncommon mineral in metamorphosed iron-poor manganiferous rocks.

Association: Calcite, quartz, garnet.

Distribution: From Dannemora, Uppland; Uttersvik and Nävekvarn, Södermanland; in the Brunsjö mine, near Grythyttan, Örebro; at Brunsjogrovan, Hallefors, and at Väster Silfberg, Värmland, Sweden. At Haute-Maurienne, Isère, France. From Guarulhos, São Paulo, Brazil. At Paddy's River mine, Australian Capital Territory, and from Broken Hill, New South Wales, Australia. Some of these need analytical confirmation.

Name: The prefix *clino* indicates a monoclinic structure, the prefix *ferro* indicates that in the C structural site $Fe^{2+} > Mg,Mn^{2+}$. The rootname *suenoite* indicates an amphibole with composition expressed as $^{A}\square^{B}Mn^{2+}{}_2{}^{C}Mg_5{}^{T}Si_8O_{22}{}^{W}(OH)_2$.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 386, 391, 395. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 2, chain silicates, 239. (3) Mottana, A. (1986) Blueschist-facies metamorphism of manganiferous cherts: a review of the alpine occurrences. In: B.W. Evans and E.H. Brown, Eds., Blueschists and eclogites, Geol. Soc. Amer. Memoir 164, 267-299. (4) Oberti, R., M. Boiocchi, F.C. Hawthorne, M.E. Ciriotti, O. Revheim, and R. Bracco (2018) Clino-suenoite, a newly approved magnesium-iron-manganese amphibole from Valmalenco, Sondrio, Italy. Mineral. Mag., 82(1), 189-198. (5) Hawthorne, F.C., R. Oberti, G.E. Harlow, W.V. Maresch, R.F. Martin, J.C. Schumacher, and M.D. Welch, (2012) Nomenclature of the amphibole supergroup. Amer. Mineral., 97, 2031-2048.