Footemineite $Ca_2Mn^{2+}{}_5Be_4(PO_4)_6(OH)_4 \cdot 6H_2O$

Crystal Data: Triclinic. *Point Group*: $\bar{1}$. Prismatic to bladed, rough to curved barrel-shaped crystals to ~1.5 mm. *Twinning*: Simple, by reflection, twin boundaries cross the length of crystals.

Physical Properties: *Cleavage*: Good on {$0\bar{1}$ 1} and {100}. *Fracture*: n.d. *Tenacity*: Brittle. Hardness = 4.5-5 (by analogy to other group members) D(meas.) = n.d. D(calc.) = 2.873

Optical Properties: Transparent. *Color*: Yellow. *Streak*: White. *Luster*: Vitreous to slightly pearly. *Optical Class*: Biaxial (-). α = 1.620(2) β = 1.627(2) γ = 1.634(2) 2V(meas.) = 80° 2V(calc.) = 89.6° *Orientation*: $X \wedge b \approx 12°$, $Y \wedge c \approx 15°$, $Z \wedge a \approx 15°$; elongation along [001]. *Dispersion*: $r > v$ or $r < v$, weak. *Pleochroism*: Y = brownish yellow, $X = Z$ = yellow. *Absorption*: $Y > X = Z$.

Cell Data: *Space Group*: $P\bar{1}$. a = 6.788(2) b = 9.972(3) c = 10.014(2) α = 73.84(2)° β = 85.34(2)° γ = 87.44(2)° Z = 1

X-ray Powder Pattern: Foote Mine, Kings Mountain, Cleveland Co., North Carolina, USA. 5.998 (100), 9.575 (53), 3.192 (44), 2.803 (38), 2.650 (29), 4.848 (26), 3.003 (14)

Chemistry:

	(1)	(2)		(1)	(2)
Li_2O	0.23		FeO	2.77	
BeO	9.54	8.80	Fe_2O_3	0.62	
CaO	9.43	9.87	Al_2O_3	0.14	
SrO	0.23		P_2O_5	36.58	37.46
BaO	0.24		SiO_2	0.42	
MgO	0.18		H_2O	13.1	12.68
MnO	26.16	31.19	Total	99.64	100.00

(1) Foote Mine, Kings Mountain, Cleveland Co., North Carolina, USA; average electron microprobe analysis supplemented by Mössbauer and ICP-OES spectroscopy, H_2O by TGA; corresponds to $(Ca_{1.89}Sr_{0.03}Ba_{0.02})_{\Sigma=1.94}(Mn^{2+}{}_{0.90}\square_{0.10})_{\Sigma=1.00}(\square_{0.78}Li_{0.17}Mg_{0.05})_{\Sigma=1.00}(Mn^{2+}{}_{3.25}Fe^{2+}{}_{0.43}Fe^{3+}{}_{0.09}Al_{0.03})_{\Sigma=3.80}$ $Be_{4.30}(P_{5.81}Si_{0.08}O_{24})[(OH)_{3.64}(H_2O)_{0.36}]_{\Sigma=4.00} \cdot 6.00H_2O$. (2) $Ca_2Mn^{2+}{}_5Be_4(PO_4)_6(OH)_4 \cdot 6H_2O$.

Polymorphism & Series: Dimorphous with roscherite.

Mineral Group: Roscherite group.

Occurrence: On thin fractures crossing quartz-microcline-spodumene pegmatite.

Association: Albite, analcime, eosphorite, siderite/rhodochrosite, fairfieldite, fluorapatite, quartz, milarite, pyrite.

Distribution: From the Foote Lithium Co. mine (Foote mine), Kings Mountain, Cleveland Co., North Carolina, USA.

Name: For the *Foote mine*, source of the first samples.

Type Material: Geology Museum, Geosciences Institute, University of São Paulo, Brazil (DR601) and the Museu de Ciências Naturais Jobas "José Bonifácio de Andrada e Silva," Santos, SP, Brazil.

References: (1) Atencio, D., P.A. Matioli, J.B. Smith, N.V. Chukanov, J.M.V. Coutinho, R.K. Rastsvetaeva, and S. Möckel (2008) Footemineite, the Mn-analog of atencioite, from the Foote mine, Kings Mountain, Cleveland County, North Carolina, U.S.A., and its relationship with other roscherite-group minerals. Amer. Mineral., 93, 1-6. (2) Rastsvetaeva, R.K., N.V. Chukanov, I.A. Verin, and D. Atencio (2007) The crystal structure of footemineite. Dokl. Akad. Nauk, 416(1), 103-106 (in Russian); Dokl. Earth Sci., 416, 1053-1056 (in English). (3) (2009) Amer. Mineral., 94(2-3), 406 (abs. ref. 2).