Ferraioloite $MgMn^{2+}_4(Fe^{2+}_{0.5}Al^{3+}_{0.5})_4Zn_4(PO_4)_8(OH)_4(H_2O)_{20}$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As plates or blades to 0.2 mm, in books or rosettes to 0.4 mm. Crystals display {010}, {100} and {011} and may have curved faces.

Physical Properties: *Cleavage*: Perfect on {100}. *Fracture*: Irregular. *Tenacity*: Flexible. Hardness = ~ 2 D(meas.) = n.d. D(calc.) = 2.59

Optical Properties: Transparent. *Color*: Greenish gray to lemon-yellow. *Streak*: n.d. *Luster*: Vitreous.
Optical Class: Biaxial (-). α = 1.575(calc.) β = 1.5825(5) γ = 1.5835(5) 2V(meas.) = 40(5)°
Dispersion: Weak, $r > v$. *Orientation*: $X \approx a$, $Y = b$, $Z \approx c$. *Absorption*: $Y >> X \approx Z$.
Pleochroism: X, Z = colorless, Y = blue-grey.

Cell Data: *Space Group*: *I*2/*m*. a = 25.333(3) b = 6.299(1) c = 15.161(3) β = 90.93(3)° Z = 2

X-ray Powder Pattern: Foote mine, Kings Mountain district, North Carolina, USA.
2.6648 (100), 2.924 (8), 3.245 (7), 3.499 (5), 2.869 (5), 4.78 (4), 4.22 (4)

Chemistry:	(1)	(2)
CaO	0.65	
MgO	1.09	2.17
MnO	16.05	15.26
ZnO	18.90	17.52
FeO	8.02	7.73
Al_2O_3	5.58	5.48
P_2O_5	30.90	30.54
H_2O	[21.30]	21.30
Total	102.49	100.00

(1) Foote mine, Kings Mountain district, North Carolina, USA; average of 10 electron microprobe analyses, H_2O calculated; corresponds to $Ca_{0.21}Mg_{0.50}Mn^{2+}_{4.16}Fe^{2+}_{2.05}Al^{3+}_{2.01}Zn_{4.27}P_{8.00}H_{43.59}O_{56}$.
(2) $MgMn^{2+}_4(Fe^{2+}_{0.5}Al^{3+}_{0.5})_4Zn_4(PO_4)_8(OH)_4(H_2O)_{20}$.

Occurrence: A secondary phase in sugary pegmatite.

Association: Vivianite, fairfieldite/messelite, phosphophyllite, scholzite/parascholzite, rittmannite, mangangordonite, kingsmountite, kastningite, metaswitzerite.

Distribution: At the Foote Lithium Company mine, Kings Mountain district, Cleveland County, North Carolina, USA.

Name: Honors James (Jim) Anthony Ferraiolo (1947-2014), author of *A Systematic Classification of Nonsilicate Minerals* (Bulletin 172 of the American Museum of Natural History, 1982).

Type Material: Museum Victoria, Melbourne, Australia (M53492 and M53493) and the Natural History Museum of Los Angeles County, Los Angeles, California, USA (65593 and 65594).

References: (1) Mills, S.J., I.E. Grey, A.R. Kampf, C.M. Macrae, J.B. Smith, C.J. Davidson, and A.M. Glenn (2016) Ferraioloite, $MgMn^{2+}_4(Fe^{2+}_{0.5}Al^{3+}_{0.5})_4Zn_4(PO_4)_8(OH)_4(H_2O)_{20}$, a new secondary phosphate mineral from the Foote mine, USA. Eur. J. Mineral., 28(3), 655-661. (2) (2016) Amer. Mineral., 101, 2779 (abs. ref. 1).