Ferroalluaudite $NaCaFe^{2+}(Fe^{3+},Mn^{2+},Fe^{2+})_2(PO_4)_3$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Very fine-grained, massive.

Physical Properties: Hardness = [5] D(meas.) = n.d. D(calc.) = [3.67]

Optical Properties: Semitransparent. *Color:* Blue-green.
Optical Class: Biaxial (+). *Pleochroism:* Strong; X = dull green to pale blue; $Y = Z$ = bright green with a bluish tinge. *Dispersion:* $r < v$, strong. $n = 1.775(5)$ 2V(meas.) = Large.

Cell Data: *Space Group:* $[C2/c]$ (by analogy to alluaudite). $a = 11.898(2)$ $b = 12.541(2)$ $c = 6.434(1)$ $\beta = 114°6(1)'$ Z = 4

X-ray Powder Pattern: Helen Beryl mine, Custer, South Dakota, USA. (ICDD 39-377).
2.718 (100), 6.28 (68), 3.075 (31), 3.489 (28), 2.525 (25), 5.454 (24), 8.22 (16)

Chemistry:

	(1)	(2)		(1)	(2)
P_2O_5	[43.1]	43.75	CaO	1.59	4.94
Al_2O_3	0.01	0.13	Li_2O	0.04	0.01
Fe_2O_3	28.15	22.43	Na_2O	6.90	6.52
FeO	9.12	13.93	K_2O	0.00	
MnO	7.25	5.04	H_2O^+	0.64	
ZnO	0.06		insol.	1.19	
MgO	1.98	3.25	Total	[100.0]	[100.00]

(1) Pleasant Valley pegmatite, South Dakota, USA; P_2O_5 by difference; corresponds to $Na_{0.24}(Na_{0.83}Ca_{0.13}Mn^{2+}_{0.04})_{\Sigma=1.00}(Fe^{2+}_{0.54}Mn^{2+}_{0.46})_{\Sigma=1.00}(Fe^{3+}_{1.69}Mg_{0.24}Fe^{2+}_{0.06}Li_{0.01})_{\Sigma=2.00}(PO_4)_3$.
(2) Angarf-Sud pegmatite, Morocco; recalculated after deduction of barbosalite 10%; corresponds to $Na_{0.52}(Na_{0.51}Ca_{0.43}Mn^{2+}_{0.06})_{\Sigma=1.00}(Fe^{2+}_{0.72}Mn^{2+}_{0.28})_{\Sigma=1.00}(Fe^{3+}_{1.37}Mg_{0.39}Fe^{2+}_{0.23}Al_{0.01})_{\Sigma=2.00}(PO_4)_3$.

Polymorphism & Series: Forms a series with alluaudite.

Mineral Group: Alluaudite group.

Occurrence: From zoned granite pegmatites; in phosphatic nodules.

Association: Triphylite, barbosalite, ferrisicklerite, apatite.

Distribution: From the Pleasant Valley pegmatite and the Helen Beryl mine, near Custer, Custer Co., South Dakota, USA. At Rapid Creek, Yukon Territory, Canada. In the Angarf-Sud pegmatite, Tazenakht Plain, Anti-Atlas Mountains, Morocco. From the Norrö pegmatite, on Rånö Island, Sweden. At Kiluli, Rwanda.

Name: For its dominant content of *ferrous* iron and relation to *alluaudite*.

Type Material: National Museum of Natural History, Washington, D.C., USA, 162558.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 669–670 [varulite, part]. (2) Moore, P.B. and J. Ito (1979) Alluaudites, wyllieites, arrojadites: crystal chemistry and nomenclature. Mineral. Mag., 43, 227–235.
(3) Fransolet, A.-M., K. Abraham, and J.-M. Speetjens (1985) Evolution génétique et signification des associations de phosphates de la pegmatite d'Angarf-Sud, plaine de Tazenakht, Anti-Atlas, Maroc. Bull. Minéral., 108, 551–574 (in French with English abs.).