Natrodufrénite $Na(Fe^{3+},Fe^{2+})(Fe^{3+},Al)_5(PO_4)_4(OH)_6 \cdot 2H_2O$

Crystal Data: Monoclinic. *Point Group:* $[2/m]$ (by analogy to dufrénite). As radially fibrous spherulites, to 5 mm, may be in warty nodules.

Physical Properties: *Tenacity:* Brittle. Hardness = n.d. D(meas.) = 3.20(5) D(calc.) = 3.23

Optical Properties: Translucent. *Color:* Greenish brown. *Streak:* Green. *Optical Class:* Biaxial (+). *Pleochroism:* X = pale yellow; Z = dark green. *Orientation:* Positive elongation. $\alpha = 1.765(5)$ (α') β = n.d. $\gamma = 1.775(5)$ (γ') 2V(meas.) = n.d.

Cell Data: *Space Group:* $[C2/c]$ (by analogy to dufrénite). $a = 25.83(2)$ $b = 5.150(3)$ $c = 13.772(9)$ $\beta = 111°32'$ Z = 4

X-ray Powder Pattern: Rochefort-en-Terre, France; close to dufrénite. 3.152 (100), 12.04 (80), 3.400 (80), 3.204 (80), 5.040 (60), 4.124 (50), 2.989 (50)

Chemistry:

	(1)
P_2O_5	32.67
Al_2O_3	5.51
Fe_2O_3	46.21
FeO	0.42
CaO	0.14
Na_2O	2.36
H_2O^+	13.04
Total	100.35

(1) Rochefort-en-Terre, France; Na, Al, Ca by AA, P, Fe by colorimetry, H_2O by the Penfield method; thought to correspond to $[Na_{0.63}(H_2O)_{0.35}Ca_{0.02}]_{\Sigma=1.00}(Fe^{3+}_{0.67}Fe^{2+}_{0.05})_{\Sigma=0.72}(Fe^{3+}_{4.11}Al_{0.89})_{\Sigma=5.00}[(PO_4)_{3.80}(H_4O_4)_{0.20}]_{\Sigma=4.00}[(OH)_{5.56}(H_2O)_{0.44}]_{\Sigma=6.00} \cdot 2H_2O$.

Occurrence: A low-temperature secondary mineral.

Association: Cyrilovite, goethite.

Distribution: From Rochefort-en-Terre, Morbihan, France. At the Pinilla de Fermoselle pegmatite, Zamora, Spain. In Australia, at the Mt. Oxide mine, Mt. Isa district, Queensland; in the Lake Boga granite quarry, near Swan Hill, Victoria; and at Broken Hill, New South Wales. From the Lone Star copper deposit, Safford district, Graham Co., Arizona, USA.

Name: For essential sodium, *natrium*, and its relation to *dufrénite*.

Type Material: Natural History Museum, Paris, 106384, 106385; National School of Mines, Paris, France, 18329.

References: (1) Fontan, F., F. Pillard, and F. Permingeat (1982) La natrodufrénite (Na, □) $(Fe^{+++},Fe^{++})(Fe^{+++},Al)_5(PO_4)_4(OH)_6 \cdot 2H_2O$, une nouvelle espèce minérale du groupe de la dufrénite. Bull. Minéral., 105, 321–326 (in French with English abs.). (2) (1983) Amer. Mineral., 68, 1039 (abs. ref. 1).