Natrophosphate $Na_7(PO_4)_2(F,Cl)\cdot 19H_2O$

Crystal Data: Cubic. *Point Group:* $4/m\ \overline{3}\ 2/m$. Rare as octahedra, dodecahedra, or tetrahedra, to 1 cm, typically rounded; in monomineralic aggregates and veinlets.

Physical Properties: *Cleavage:* On {111}, imperfect, in slightly altered specimens. *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = 1–2.5 D(meas.) = 1.71–1.72 D(calc.) = n.d. Fluoresces pale orange under UV, with a stronger orange cathodoluminescence; partially decomposes to a white powder on exposure to air, dissolves in H_2O.

Optical Properties: Transparent to translucent. *Color:* Colorless to white. *Luster:* Vitreous to greasy, waxy to frosty on exposure.
Optical Class: Isotropic. n = 1.450–1.462

Cell Data: *Space Group: Fd3c.* a = 27.79–27.93 Z = 56

X-ray Powder Pattern: Mt. Yukspor, Kola Peninsula, Russia.
2.67 (10), 2.42 (9), 8.18 (7), 3.05 (6), 4.93 (5), 4.06 (5), 2.90 (5)

Chemistry:

	(1)	(2)		(1)	(2)
SO_3		0.97	F	3.20	3.30
P_2O_5	21.51	18.00	Cl		1.86
CO_2	2.60		H_2O	41.30	47.04
Na_2O	32.60	29.53	$-O = (F,Cl)$	1.34	1.81
			Total	99.87	98.89

(1) Mt. Karnasurt, Kola Peninsula, Russia; with a separate DTA determination of H_2O 47.0%, and after deduction of CO_2 attributed to atmospheric contamination, then corresponds to $Na_{6.94}(PO_4)_2F_{1.11}\cdot 18.2H_2O$. (2) Aris quarry, Namibia; Na by AA, P, S, F, Cl by ion chromatograph, H_2O by Karl-Fischer titration; corresponds to $Na_{7.04}[(PO_4)_{1.87}(SO_4)_{0.09}]_{\Sigma=1.96}(F_{1.28}Cl_{0.39})_{\Sigma=1.67}\cdot 19.29H_2O$.

Occurrence: A rare mineral in ijolite-urtite pegmatite in a differentiated alkaline massif (Kola Peninsula, Russia); in sodalite xenoliths in an intrusive alkalic gabbro-syenite complex (Mont Saint-Hilaire, Canada); in miarolitic cavities in phonolite (Aris quarry, Namibia).

Association: Villiaumite, aegirine, delhayelite, strontian apatite, natrolite, pectolite, albite (Mt. Yukspor, Kola Peninsula, Russia); villiaumite, nahpoite, dorfmanite, kogarkoite, sidorenkite, thermonatrite, analcime, aegirine (Mts. Alluaiv and Karnasurt, Kola Peninsula, Russia); villiaumite, ussingite, vuonnemite, lovozerite, eudialyte, steenstrupine, chkalovite, lueshite, serandite, griceite, kogarkoite (Mont Saint-Hilaire, Canada); villiaumite, aegirine, albite, eudialyte (Aris quarry, Namibia).

Distribution: On Mts. Yukspor and Koashva, Khibiny massif, and Mts. Karnasurt and Alluaiv, Lovozero massif, Kola Peninsula, Russia. From Mont Saint-Hilaire, Quebec, Canada. In the Aris quarry, about 25 km south of Windhoek, Namibia.

Name: For sodium, *natrium*, and *phosphate* in the composition.

Type Material: Vernadsky Geological Museum, Moscow, 51117; A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, 74383.

References: (1) Kapustin, Y.L., A.V. Bykova, and V.I. Bukin (1972) Natrophosphate – a new mineral. Zap. Vses. Mineral. Obshch., 101, 80–86 (in Russian). (2) (1973) Amer. Mineral., 58, 139 (abs. ref. 1). (3) Horváth, L. and R.A. Gault (1990) The mineralogy of Mont Saint-Hilaire, Quebec. Mineral. Record, 21, 284–359, esp. 325. (4) Genkina, E.A. and A.P. Khomyakov (1992) Refinement of the crystal structure of natural natrophosphate. Kristallografiya (Sov. Phys. Crystal.), 37, 1559–1560. (5) Khomyakov, A.P. (1995) Mineralogy of hyperagpaitic alkaline rocks, 162–164. (6) Petersen, O.V., T. Fockenberg, P.C. Toft, and M. Rattay (1997) Natrophosphate from the Aris phonolites, Windhoek, Namibia. Neues Jahrb. Mineral., Monatsh., 511–517.