Vuonnemite $Na_5Nb_3Ti(Si_2O_7)_3O_2F_2 \cdot 2Na_3PO_4$

Crystal Data: Triclinic. *Point Group:* 1 or $\overline{1}$. In aggregates of platy to scaly and bladed crystals, to over 10 cm.

Physical Properties: *Cleavage:* Perfect on {001}, and two others. *Tenacity:* Brittle. Hardness = 2–3 D(meas.) = 3.13–3.15 D(calc.) = 3.17 May be light to intense green or pale yellow under SW UV, yellow under LW UV, faint bluish green phosphorescence.

Optical Properties: Transparent to translucent. *Color:* Light yellow, white, may have a brownish hue. *Streak:* White. *Luster:* Vitreous to greasy.
Optical Class: Biaxial (+). α = 1.636–1.639 β = 1.651–1.654 γ = 1.678–1.681
2V(meas.) = 53°–86° 2V(calc.) = 86(2)°

Cell Data: *Space Group:* $P1$ or $P\overline{1}$. a = 5.38–5.50 b = 7.02–7.16 c = 14.15–14.44
$\alpha = 87.65°-92.63°$ $\beta = 89.50°-95.33°$ $\gamma = 90.57°-93.67°$ Z = 1

X-ray Powder Pattern: Mt. Karnasurt, Russia.
2.869 (10), 7.14 (6), 3.582 (6), 1.790 (6), 5.16 (5), 4.77 (5), 4.24 (5)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
SiO_2	22.31	22.57	26.83	CaO	0.25	0.33	
TiO_2	8.07	7.50	5.94	Na_2O	30.23	32.03	25.36
Al_2O_3	0.46	0.26		K_2O	0.07		
Nb_2O_5	23.16	23.99	29.67	F			2.83
FeO		0.26		P_2O_5	13.50	13.13	10.56
MnO	0.53	0.08		LOI	0.96		
MgO	0.14			$-O = F_2$			1.19
				Total	99.68	100.15	100.00

(1) Khibiny massif, Russia; spectrographic traces of Ba, Sr, and RE. (2) Ilímaussaq intrusion, Greenland; by electron microprobe, traces of Mg, K, Zr, Ce; F ~1.5%–2.5%. (3) $Na_5Nb_3Ti(Si_2O_7)_3O_2F_2 \cdot 2Na_3PO_4$.

Occurrence: In albitized alkalic rocks in differentiated alkalic massifs (Kola Peninsula, Russia); in a transition zone between two nepheline syenites (Ilímaussaq intrusion, Greenland); in sodalite xenoliths in an intrusive alkalic gabbro-syenite complex (Mont Saint-Hilaire, Canada).

Association: Albite, microcline, nepheline, aegirine, lorenzenite, cancrinite, sérandite, villiaumite (Kola Peninsula, Russia); microcline, natrolite, epistolite, sodalite, villiaumite (Ilímaussaq intrusion, Greenland).

Distribution: From Mt. Eveslogchorr, Khibiny massif, and the Jubilee pegmatite and elsewhere on Mt. Karnasurt, Lovozero massif, Kola Peninsula, Russia. In the Ilímaussaq intrusion, southern Greenland. From near Gunnison, Gunnison Co., Colorado, USA. At Mont Saint-Hilaire and near Saint-Amable, Quebec, Canada.

Name: For the occurrence near the Vuonnemiok River, Khibiny massif, Kola Peninsula, Russia.

Type Material: Geology Museum, Kola Branch, Academy of Sciences, Apatity, 3255; Mining Institute, St. Petersburg, Russia, 1058/2; National School of Mines, Paris, France.

References: (1) Bussen, I.V., A.P. Denisov, N.I. Zabavnikova, L.V. Kozyreva, Y.P. Men'shikov, and E.A. Lipatova (1973) Vuonnemite, a new mineral. Zap. Vses. Mineral. Obshch., 102, 423–426 (in Russian). (2) (1974) Amer. Mineral., 59, 875 (abs. ref. 1). (3) Rønsbo, J.G., E.S. Leonardsen, O.V. Petersen, and O. Johnsen (1983) Second occurrence of vuonnemite: the Ilímaussaq alkaline intrusion, South West Greenland. Neues Jahrb. Mineral., Monatsh., 451–460. (4) Horváth, L. and R.A. Gault (1990) The mineralogy of Mont Saint-Hilaire, Quebec. Mineral. Record, 21, 283–359, esp. 346.