Epistolite $Na_4Nb_2Ti(Si_2O_7)_2O_2(OH)_2(H_2O)_4$

Crystal Data: Triclinic. *Point Group*: $\bar{1}$. As crystals, rectangular and tabular on (001), to 5 cm. Also as irregular plates and curved lamellar masses.

Physical Properties: *Cleavage:* Perfect on {001}, distinct on {110}. *Tenacity*: Very brittle to friable. Hardness = 1.5-3 D(meas.) = 2.65-2.89 D(calc.) = 2.987

Optical Properties: Opaque to translucent, transparent in thin sheets. *Color*: White, gray, yellow-gray, tan, light brown; in thin section, colorless. *Luster*: Pearly to silky. *Optical Class*: Biaxial (-). *Orientation:* Z ^ c = 70°. *Dispersion*: r > v; inclined. α = 1.610 β = 1.650-1.720 γ = 1.682-1.770 2V(meas.) = 60-80°

Cell Data: *Space Group*: $P\bar{1}$. a = 5.460(1) b = 7.170(1) c = 12.041(2) α = 103.63(3)° β = 96.01(3)° γ = 89.98(3)° Z = 1

X-ray Powder Pattern: Ilímaussaq alkaline complex intrusion, Greenland.
4.322 (10), 2.99 (9), 2.869 (9), 12.00 (8), 5.902 (7), 1.790 (7), 2.155 (6)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
SiO_2	27.59	25.60	29.59	CaO	0.77	0.00	1.89
TiO_2	7.22	14.55	10.24	Na_2O	17.59	4.97	14.45
ZrO_2		0.00		K_2O	trace	0.70	0.27
Al_2O_3		2.05		F	1.98	0.00	1.32
Nb_2O_5	33.56	31.40	31.43	H_2O^+	9.26	7.35	
Ta_2O_5		0.90	0.28	H_2O^-	1.75	8.20	
Fe_2O_3			0.35	$H_2O_{(calc)}$			10.46
FeO	0.20	0.90		P_2O_5		2.10	0.36
MnO	0.30	1.20	0.34	$-O = F_2$	0.83		
MgO	0.13	0.00		Total	99.52	99.92	100.43

(1) Julianehåb district, Greenland; material partly altered. (2) Lovozero massif, Russia. (3) Ilímaussaq alkaline complex, South Greenland; electron microprobe analysis, H_2O calculated from structure analysis; K and P considered contaminants; corresponding to $(Na_{3.79}Ca_{0.27}Mn_{0.04})_{\Sigma=4.06}(Nb_{1.92}Ti_{1.04}Fe^{3+}_{0.04})_{\Sigma=3.00}(Si_2O_7)_2O_2(OH_{1.44}F_{0.56})(H_2O)_4$.

Occurrence: A low temperature mineral in alkalic pegmatites, albitites, sodalite xenoliths, and hydrothermal veins.

Association: Aegirine, albite, murmanite, sphalerite, manganoan pectolite, neptunite, steenstrupine, sodalite, eudialyte, nenadkevichite.

Distribution: At a number of localities in the Ilímaussaq alkaline complex intrusion, southern Greenland. From the Lovozero massif, Kola Peninsula, Russia. At Mont Saint-Hilaire and near Saint-Amable, Quebec, Canada.

Name: From the Greek for *letter*, in allusion to the flat rectangular crystal habit and white color.

Type Material: University of Copenhagen, Copenhagen, Denmark, 319, 320.

References: (1) Dana, E.S. and W.E. Ford (1909) Dana's system of mineralogy, (6th edition), app. II, 39. (2) Vlasov, K.A., Ed. (1966) Mineralogy of rare elements, v. II, 562-564. (3) Khalilov, A.P., Y.S. Makarov, K.S. Mamedov, and L.A. P'yanzina (1965) Crystal structure of minerals of the murmanite-lomonosovite group. Doklady Acad. Nauk SSSR, 162, 179-182 (in Russian). (4) Karup-Møller, S. (1986) Epistolite from the Ilímaussaq alkaline complex in South Greenland. Neues Jahrb. Mineral., Abh., 155, 289-304. (5) Mandarino, J.A. and V. Anderson (1989) Monteregian Treasures. Cambridge Univ. Press, 76. (6) Sokolova, E., and F.C. Hawthorne (2004) The crystal chemistry of epistolite. Can. Mineral., 42, 797-806.