Calciomurmanite $(Na,\square)_2Ca(Ti,Mg,Nb)_4[Si_2O_7]_2O_2(OH,O)_2(H_2O)_4$

Crystal Data: Triclinic. *Point Group*: $\bar{1}$. As lamellae, to 0.6 cm, sometimes in fan-shaped aggregates to 3.5 cm.

Physical Properties: *Cleavage:* Perfect on {001}, distinct on two other directions nearly ⊥ to one another and (001). *Fracture*: Stepped. Hardness = 2.5-3 D(meas.) = 2.70(3) D(calc.) = 2.85

Optical Properties: Translucent. *Color*: Pale brown, purple; colorless in transmitted light. *Streak*: White. *Luster*: Pearly on cleavage; greasy on fracture surfaces.
Optical Class: Biaxial (–). α =1.680(4) β = 1.728(4) γ = 1.743(4) 2V(meas.) = 58(5)° 2V(calc.) = 57° *Orientation*: *Y* and *Z* are in the *ab* plane.

Cell Data: *Space Group*: $P\bar{1}$. a = 5.3470(6) b = 7.0774(7) c = 12.1456(13) α = 91.827(4)° β = 107.527(4)° γ = 90.155(4)° Z = 1

X-ray Powder Pattern: Lovozero and Khibiny complexes, Kola peninsula, Russia.
11.69 (100), 2.940 (100), 4.251 (89), 2.900 (79), 5.87 (68), 2.940 (47), 3.825 (44)

Chemistry:

	(1)	(2)		(1)	(2)
Na_2O	5.39	4.18	Al_2O_3	0.85	
K_2O	0.30		SiO_2	30.27	32.43
CaO	7.61	7.83	TiO_2	29.69	32.33
MgO	2.54	2.72	Nb_2O_5	6.14	8.96
MnO	2.65		P_2O_5	0.27	
FeO	1.93		H_2O	11.59	11.55
			Total	99.23	100.00

(1) Lovozero and Khibiny complexes, Kola peninsula, Russia; average of 7 electron microprobe analyses supplemented by FTIR spectroscopy, H_2O by the Alimarin method; corresponds to $Na_{1.34}Ca_{1.04}K_{0.05}Mg_{0.49}Mn_{0.29}Fe_{0.21}Nb_{0.36}Ti_{2.85}(Si_{3.87}Al_{0.13})_{\Sigma=4}O_{16.40}(OH)_{1.60}(PO_4)_{0.03}(H_2O)_{4.94}$.
(2) $NaCa(Ti_3Mg_{0.5}Nb_{0.5})[Si_2O_7]_2O_{2.5}(OH)_{1.5}(H_2O)_4$.

Mineral Group: Murmanite group of the seidozerite supergroup.

Polymorphism & Series: Forms a continuous series with murmanite.

Occurrence: Formed by late-stage, low-temperature hydrothermal alteration (hydration and natural cation exchange) of a high-temperature, anhydrous phosphate-bearing titanosilicate, most likely lomonosovite and/or betalomonosovite, in peralkaline (hyperagpaitic) rocks.

Association: Microcline, aegirine, lorenzenite, fluorapatite (Mt Flora); microcline, aegirine, lamprophyllite, tsepinite-Ca, tsepinite-K (Mt. Eveslogchorr); betalomonosovite, aegirine, microcline, lamprophyllite, pectolite (Mt. Koashva).

Distribution: From Mt. Flora, Lovozero complex and Mt. Eveslogchorr and the Koashva open pit, Vostochnyi apatite mine, Khibiny complex, Kola Peninsula, Russia.

Name: As an analogue of *murmanite* with essential calcium and sodium.

Type Material: V.I. Spepanov collection, A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (ST4994, Mt Flora); Bel'kov Museum of Geology and Mineralogy, Geological Institute of Kola Science Center, Russian Academy of Sciences, Apatity, Russia (3667, Mt. Eveslogchorr).

References: (1) Lykova, I.S., I.V. Pekov, N.V. Chukanov, D.I. Belakovskiy, V.O. Yapaskurt, N.V. Zubkova, S.N. Britvin, and G. Giester (2016) Calciomurmanite, $(Na,\square)_2Ca(Ti,Mg,Nb)_4[Si_2O_7]_2O_2(OH,O)_2(H_2O)_4$, a new mineral from the Lovozero and Khibiny alkaline complexes, Kola Peninsula, Russia. Eur. J. Mineral., 28, 835-845. (2) (2017) Amer. Mineral., 102, 1565 (abs. ref. 1).