Natrotitanite $(Na_{0.5}Y_{0.5})Ti(SiO_4)O$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As chemically and optically distinct thin rims on prismatic crystals of (Na,Y,REE)-bearing titanite.

Physical Properties: *Cleavage*: None. *Fracture*: n.d. *Tenacity*: Brittle. Hardness = n.d. D(meas.) = n.d. D(calc.) = 3.833

Optical Properties: Transparent to translucent. *Color*: Milky white to yellowish grey. *Streak*: White. *Luster*: Vitreous.
Optical Class: Biaxial (n.d.). α = 1.904(2) β = n.d. γ = 2.030(2) 2V = n.d.

Cell Data: *Space Group*: *C*2/*m*. *a* = 6.5691(2) *b* = 8.6869(3) *c* = 7.0924(2) β = 114.1269(4)° Z = 4

X-ray Powder Pattern: Verkhnee Espe REE deposit, Kazakhstan.
2.597 (100), 3.248 (80), 2.994 (60), 3.253 (40), 1.641 (40), 4.941 (30), 1.498 (30)

Chemistry:

	(1)		(2)
Nb_2O_5	1.28	Ho_2O_3	0.16
SiO_2	27.83	Er_2O_3	2.24
TiO_2	35.00	Tm_2O_3	0.50
SnO_2	0.57	Yb_2O_3	2.53
V_2O_3	0.36	Nd_2O_3	0.35
Fe_2O_3	0.23	Lu_2O_3	0.28
Y_2O_3	7.87	MnO	0.33
Ce_2O_3	0.83	CaO	8.16
Sm_2O_3	0.26	Na_2O	5.55
Gd_2O_3	0.46	F	1.52
Tb_2O_3	0.17	-O=F	0.64
Dy_2O_3	2.45	Total	98.71

(1) Verkhnee Espe REE deposit, Kazakhstan; average electron microprobe analysis; corresponds to $(Na_{0.39}Ca_{0.32}Y_{0.15}Dy_{0.03}Yb_{0.03}\ Er_{0.03}Ce_{0.01}Ho_{0.01}Tm_{0.01}Gd_{0.01}Nd_{0.01})_{\Sigma=1.00}\ (Ti_{0.95}Nb_{0.02}Sn_{0.01}Fe^{3+}{}_{0.01}\ Mn_{0.01}V_{0.01})_{\Sigma=1.01}\ Si_{1.01}O_{4.00}(O_{0.83}F_{0.17})$.

Occurrence: In the wall rock zone of an alkaline granite associated with a granitic massif.

Association: Yttrium-bearing fluorite, microcline, albite, quartz, riebeckite, aegirine, biotite, astrophyllite, rutile, zircon, elpidite.

Distribution: From the Verkhnee Espe REE deposit, northern margin of the Akjailyautuas granite massif, Kazakhstan.

Name: For a *titanite* structure with Na(Y,REE)-dominant in the *Ca* site.

Type Material: Geological Scientific Museum, K.I. Satpaev Institute of Geological Sciences, Almaty, Kazakstan (3010).

References: (1) Stepanov, A.V., G.K. Bekenova, V.L. Levin, and F.C. Hawthorne (2012) Natrotitanite, ideally $(Na_{0.5}Y_{0.5})Ti(SiO_4)O$, a new mineral from the Verkhnee Espe deposit, Akjailyautas mountains, Eastern Kazakhstan district, Kazakhstan: description and crystal structure. Mineral. Mag., 76, 37-44. (2) (2012) Amer. Mineral., 97, 1529 (abs. ref. 1).