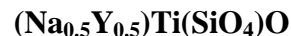


**Natrotitanite**

**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.).  $\alpha = 1.904(2)$   $\beta =$  n.d.  $\gamma = 2.030(2)$  2V = n.d.

**Cell Data:** *Space Group:* C2/m.  $a = 6.5691(2)$   $b = 8.6869(3)$   $c = 7.0924(2)$   $\beta = 114.1269(4)^\circ$  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)

<b>Chemistry:</b>	(1)		(2)
Nb <sub>2</sub> O <sub>5</sub>	1.28	Ho <sub>2</sub> O <sub>3</sub>	0.16
SiO <sub>2</sub>	27.83	Er <sub>2</sub> O <sub>3</sub>	2.24
TiO <sub>2</sub>	35.00	Tm <sub>2</sub> O <sub>3</sub>	0.50
SnO <sub>2</sub>	0.57	Yb <sub>2</sub> O <sub>3</sub>	2.53
V <sub>2</sub> O <sub>3</sub>	0.36	Nd <sub>2</sub> O <sub>3</sub>	0.35
Fe <sub>2</sub> O <sub>3</sub>	0.23	Lu <sub>2</sub> O <sub>3</sub>	0.28
Y <sub>2</sub> O <sub>3</sub>	7.87	MnO	0.33
Ce <sub>2</sub> O <sub>3</sub>	0.83	CaO	8.16
Sm <sub>2</sub> O <sub>3</sub>	0.26	Na <sub>2</sub> O	5.55
Gd <sub>2</sub> O <sub>3</sub>	0.46	F	1.52
Tb <sub>2</sub> O <sub>3</sub>	0.17	<u>-O=F</u>	<u>0.64</u>
Dy <sub>2</sub> O <sub>3</sub>	2.45	Total	98.71

(1) Verkhnee Espe REE deposit, Kazakhstan; average electron microprobe analysis; corresponds to (Na<sub>0.39</sub>Ca<sub>0.32</sub>Y<sub>0.15</sub>Dy<sub>0.03</sub>Yb<sub>0.03</sub>Er<sub>0.03</sub>Ce<sub>0.01</sub>Ho<sub>0.01</sub>Tm<sub>0.01</sub>Gd<sub>0.01</sub>Nd<sub>0.01</sub>) $\Sigma=1.00$  (Ti<sub>0.95</sub>Nb<sub>0.02</sub>Sn<sub>0.01</sub>Fe<sup>3+</sup><sub>0.01</sub>Mn<sub>0.01</sub>V<sub>0.01</sub>) $\Sigma=1.01$  Si<sub>1.01</sub>O<sub>4.00</sub>(O<sub>0.83</sub>F<sub>0.17</sub>).

**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 Akjailyautas 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<sub>0.5</sub>Y<sub>0.5</sub>)Ti(SiO<sub>4</sub>)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).