Bykovaite $BaNa\{(Na,Ti)_4[(Ti,Nb)_2(OH,O)_3Si_4O_{14}](OH,F)_2\}\cdot 3H_2O$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As acicular crystals elongated on [010] to 0.05 mm; as "chains" of spherulites.

Physical Properties: *Cleavage*: Perfect on {001}, imperfect on {100}. *Fracture*: Fibrous. *Tenacity*: Brittle. *Hardness* = 3 D(meas.) = 2.98(3) D(calc.) = 2.72

Optical Properties: Translucent. *Color*: Cream colored (sometimes with weak pinkish or yellowish tones), light gray to colorless in transmitted light. *Streak*: White. *Luster*: Silky. *Optical Class*: Biaxial (+). $\alpha = 1.668(2)$ $\beta = 1.679(2)$ $\gamma = 1.710(3)$ 2V(meas.) = 63(5)° 2V(calc.) = 63° Orientation: $a \approx Y$, $b \approx Z$, $c \approx X$. *Pleochroism*: None.

Cell Data: *Space Group*: *I*11*b*. $a = 5.552(1)$ $b = 7.179(1)$ $c = 50.94(1)$ $\beta = 91.10(1)°$ Z = 4
polytype 1*M*: *P*112/*m* $a = 5.552$ $b = 7.179$ $c = 25.47$ $\gamma = 91.1°$ $Z = 2$
polytype 2*M*: *I*112/*m* $a = 5.552$ $b = 7.179$ $c = 50.94$ $\gamma = 91.1°$ $Z = 4$

X-ray Powder Pattern: Shkatulka pegmatite, Mt. Alluaiv, Kola Peninsula, Russia.
25.5 (100), 3.17 (74), 8.48 (72), 2.763 (20), 12.74 (14), 3.44 (14), 2.110 (14)

Chemistry:

	(1)		(1)
Na_2O	13.34	SiO_2	29.05
K_2O	0.67	TiO_2	18.93
CaO	0.20	Nb_2O_5	10.75
SrO	0.66	F	1.40
BaO	13.22	-O = F	0.59
FeO	0.28	H_2O	10.00
MnO	2.22	Total	100.28
Al_2O_3	0.15		

(1) Shkatulka pegmatite vein at Mt. Alluaiv, Kola Peninsula, Russia; average of 5 electron microprobe analyses supplemented by IR spectroscopy; corresponds to $(Ba_{0.71}Na_{0.47}K_{0.12}Sr_{0.05})_{\Sigma=1.35}(Na_{3.07}Ti_{0.61}Mn_{0.26}Ca_{0.03}Fe_{0.03})_{\Sigma=4.00}(Ti_{1.34}Nb_{0.66})_{\Sigma=1.00}(Si_{3.98}Al_{0.02})O_{14}[(OH)_{3.13}F_{0.61}O_{0.58}]_{\Sigma=4.32}\cdot 3H_2O$.

Polymorphism & Series: 1*M* and 2*M* polytypes.

Occurrence: In the core of a zoned pegmatite in poikilitic nepheline-sodalite syenite of the central part of an alkaline igneous complex.

Association: Vuonnemite, ussingite, bornemanite.

Distribution: From the the Shkatulka pegmatite vein at Mt. Alluaiv, Lovozero alkaline massif, Kola Peninsula, Russia.

Name: Honors analytical chemist Alexandra Vasilyevna Bykova (1917-2001), who first discovered that bornemanite could be transformed to a synthetic form of bykovaite upon treatment with water.

Type Material: The Museum of the St. Petersburg Mining Institute, Russia (# 2869/2).

References: (1) Khomyakov, A.P., Yu.P. Menshikov, G. Ferraris, P. Nemet, and G.H. Nechelyustov (2005) Bykovaite, $BaNa\{(Na,Ti)_4[(Ti,Nb)_2(OH,O)_3Si_4O_{14}](OH,F)_2\}\cdot 3H_2O$, a new heterophyllosilicate from the Lovozero Alkaline Massif, Kola Peninsula, Russia. Zap. Ross. Mineral. Obshch., 134(5), 40-48 (in Russian, English abstract). (2) (2006) Amer. Mineral., 91, 1452 (abs. ref. 1). (3) Nèmeth , P., A.P. Khomyakov, G. Ferraris, and Y.P. Menshikov (2009) Nechelyustovite, a new heterophyllosilicate mineral, and new data on bykovaite: a comparative TEM study. Eur. J. Mineral., 21, 251-260.