Tuliokite $Na_6BaTh(CO_3)_6 \cdot 6H_2O$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}$. As prismatic to rhombohedral crystals, to 4 mm, dominated by $\{10\overline{1}0\}$ and $\{10\overline{1}1\}$.

Physical Properties: *Tenacity:* Brittle. Hardness = 3–4 D(meas.) = 3.15(1) D(calc.) = 3.25 Radioactive.

Optical Properties: Translucent. *Color:* Pale to dark gray, due to included organic matter; colorless in transmitted light. *Streak:* White. *Luster:* Vitreous.
Optical Class: Uniaxial (+). $\omega = 1.574(2)$ $\epsilon = 1.587(2)$

Cell Data: *Space Group:* $R\overline{3}$. $a = 14.175(7)$ $c = 8.605(4)$ Z = 3

X-ray Powder Pattern: Khibiny massif, Russia.
2.354 (100), 2.674 (90), 7.03 (85), 3.15 (80), 1.959 (65), 4.07 (60), 2.039 (60)

Chemistry:

	(1)	(2)
CO_2	[25.5]	27.07
ThO_2	24.3	27.07
Fe_2O_3	0.4	
CaO	0.1	
BaO	14.6	15.72
Na_2O	17.9	19.06
H_2O	14.0	11.08
Total	[96.8]	100.00

(1) Khibiny massif, Russia; by electron microprobe, total Fe as Fe_2O_3, CO_2 calculated from stoichiometry, H_2O by coulometry, crystal-structure analysis indicates $6H_2O$; presence of CO_2 and H_2O confirmed by IR; then corresponds to $Na_{5.99}(Ba_{0.99}Ca_{0.02})_{\Sigma=1.01}(Th_{0.95}Fe_{0.05})_{\Sigma=1.00}(CO_3)_{6.01} \cdot 8.06H_2O$. (2) $Na_6BaTh(CO_3)_6 \cdot 6H_2O$.

Occurrence: In hydrothermal veins in nepheline syenite pegmatite.

Association: Sidorenkite, vinogradovite, villiaumite, microcline (vein 1); pirssonite, shortite, trona, thermonatrite, natron, villiaumite, natrolite, aegirine, microcline (vein 2).

Distribution: From the Kirov apatite mine, Mt. Kukisvumchorr, Khibiny massif, Kola Peninsula, Russia.

Name: For the Tuliok River, Kola Peninsula, Russia, near where the mineral was first found.

Type Material: Geology Museum, Kola Branch, Academy of Sciences, Apatity, 5947; Mining Institute, St. Petersburg, 2024/1; A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, r430/2.

References: (1) Yakovenchuk, V.N., Y.A. Pakhomovskii, A.V. Voloshin, A.N. Bogdanova, N.A. Yamnova, and D.Y. Pushcharovskiy (1990) Tuliokite $Na_6BaTh(CO_3)_6 \cdot 6H_2O$ – a new hydrous carbonate of sodium, barium, and thorium from alkalic pegmatites of the Khibiny massif (Kola Peninsula). Mineral. Zhurnal, 12, 74–78 (in Russian with English abs.). (2) (1992) Amer. Mineral., 77, 209 (abs. ref. 1). (3) Yanova, N.A, D.Y. Pushcharovskiy, and A.V. Voloshin (1990) Crystal structure of tuliokite – a new sodium, barium, thorium carbonate. Doklady Acad. Nauk SSSR, 310, 99–102 (in Russian). (4) Pekov, I.V. (1998) Minerals first discovered on the territory of the former Soviet Union. Ocean Pictures, Moscow, 217.