Toturite $Ca_3Sn_2(SiFe^{3+}_2)O_{12}$

Crystal Data: Cubic. *Point Group*: $4/m\ \bar{3}\ 2/m$. Forms thin regular growth zones, to 5 μm, and irregular spots in an Fe^{3+}-dominant analog of kimzeyite. Also, as pseudomorphs after zircon.

Physical Properties: *Cleavage*: n.d. *Tenacity*: n.d. *Fracture*: n.d. Hardness = n.d.
D(meas.) = n.d. D(calc.) = 4.49

Optical Properties: *Color*: Light-brown or yellow. *Streak*: White with a cream tint. *Luster*: n.d. *Optical Class*: Isotropic.

Cell Data: *Space Group*: $Ia\bar{3}\ d$. $a \approx 12.55$

X-ray Powder Pattern: Calculated pattern.
2.562 (100), 1.677 (91), 3.138 (74), 4.437 (67), 1.146 (31), 1.046 (25), 1.984 (23)

Chemistry:

	(1)	(2)		(1)	(2)
UO_3	n.d.	1.83	Cr_2O_3	0.01	n.d.
V_2O_5	0.02	n.d.	Sc_2O_3	n.d.	0.46
Nb_2O_5	0.03	0.18	Fe_2O_3	19.27	15.96
Sb_2O_5	7.77	n.d.	FeO	0.53	0.07
SiO_2	4.90	4.95	MnO	n.d.	0.04
TiO_2	4.24	5.95	CaO	24.78	24.98
ZrO_2	0.24	1.51	MgO	0.02	n.d.
SnO_2	32.58	38.51	SrO	<0.1	n.d.
HfO_2	0.01	0.08	Y_2O_3	<0.1	n.d.
Al_2O_3	4.59	4.85	Total	98.99	99.37

(1) Upper Chegem caldera, Northern Caucasus, Kabardino-Balkaria, Russia; average of 21 electron microprobe analyses supplemented by Raman spectroscopy; corresponding to $(Ca_{2.989}Fe^{2+}_{0.011})_{\Sigma=3}(Sn_{1.463}Sb^{5+}_{0.325}Ti^{4+}_{0.193}Zr_{0.013}Mg_{0.003}Nb_{0.002}Cr_{0.001})_{\Sigma=2}(Fe^{3+}_{1.633}Al_{0.609}Si_{0.552}Ti^{4+}_{0.166}Fe^{2+}_{0.039}V^{5+}_{0.001})_{\Sigma=3}O_{12}$. (2) Do.; electron microprobe analysis supplemented by Raman spectroscopy; corresponds to $(Ca_{3.016}Mn^{2+}_{0.004})_{\Sigma=3.02}(Sn_{1.731}Zr_{0.083}Ti^{4+}_{0.066}Sc_{0.045}U^{6+}_{0.043}Nb_{0.009}Hf_{0.003})_{\Sigma=1.980}(Fe^{3+}_{1.353}Al_{0.644}Si_{0.558}Ti^{4+}_{0.438}Fe^{2+}_{0.007})_{\Sigma=3}O_{12}$.

Polymorphism & Series: Endmember of a complex continuous solid solution of Ca-garnet $Ca_3(Sn,Zr,Ti^{4+},Sb^{5+},U^{6+}...)_2(Fe^{3+},Al,Si,Fe^{2+},Ti^{4+}...)_3O_{12}$.

Mineral Group: Garnet supergroup, schorlomite group.

Occurrence: An accessory mineral in high-temperature skarn at the contact between altered carbonate-silicate xenoliths and ignimbrite.

Association: Larnite, rondorfite, wadalite, magnesioferrite, lakargiite, cuspidine, ellestadite-OH, Fe^{3+}-dominant analog of kimzeyite, andradite.

Distribution: From near Lakargi Mountain, Upper Chegem caldera, Northern Caucasus, Kabardino-Balkaria, Russia.

Name: For the *Totur* River situated in Eltyubyu village (the starting point for the climb to Lakargi Mountain where the mineral is found), also Totur is the name of a Balkarian god, and an ancient warrior.

Type Material: A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (3839/1).

References: (1) Galuskina, I.O., E.V. Galuskin, P. Dzierżanowski, V.M. Gazeev, K. Prusik, N.N. Pertsev, A. Winiarski, A.E. Zadov, and R. Wrzalik (2010) Toturite $Ca_3Sn_2Fe_2SiO_{12}$ - A new mineral species of the garnet group. Amer. Mineral., 95, 1305-1311.