

## **Toturite $\text{Ca}_3\text{Sn}_2\text{Fe}_2\text{SiO}_{12}$ —A new mineral species of the garnet group**

**IRINA O. GALUSKINA,<sup>1,\*</sup> EVGENY V. GALUSKIN,<sup>1</sup> PIOTR DZIERŻANOWSKI,<sup>2</sup>  
VIKTOR M. GAZEEV,<sup>3</sup> KRYSZTIAN PRUSIK,<sup>4</sup> NIKOLAI N. PERTSEV,<sup>3</sup> ANTONI WINIARSKI,<sup>5</sup>  
ALEKSANDR E. ZADOV,<sup>6</sup> AND ROMAN WRZALIK<sup>5</sup>**

<sup>1</sup>Faculty of Earth Sciences, Department of Geochemistry, Mineralogy and Petrography, University of Silesia, Będzińska 60, 41-200 Sosnowiec, Poland

<sup>2</sup>Institute of Geochemistry, Mineralogy and Petrology, Warsaw University, al. Żwirki i Wigury 93, 02-089 Warszawa, Poland

<sup>3</sup>Institute of Geology of Ore Deposits, Petrography, Mineralogy and Geochemistry (IGEM), Russian Academy of Sciences, Staromonetny 35, 119017 Moscow, Russia

<sup>4</sup>Faculty of Materials Science, University of Silesia, Bankowa 9, 40-007 Katowice, Poland

<sup>5</sup>August Chelkowski Institute of Physics, University of Silesia, Uniwersytecka 4, 40-007 Katowice, Poland

<sup>6</sup>OOO Science-Research Center NEOCHEM, Dmitrovskoye Highway 100/2, 127238 Moscow, Russia

### **ABSTRACT**

A new Sn-rich garnet, toturite  $\text{Ca}_3\text{Sn}_2\text{Fe}_2\text{SiO}_{12}$ , occurs as an accessory mineral in high-temperature altered carbonate-silicate xenoliths in ignimbrite of the Upper Chegem structure in the Northern Caucasus, Kabardino-Balkaria, Russia. The empirical formula of toturite from the holotype sample is  $(\text{Ca}_{2.989}\text{Fe}_{0.011})_{\Sigma 3}(\text{Sn}_{1.463}\text{Sb}_{0.325}\text{Ti}_{0.193}\text{Zr}_{0.013}\text{Mg}_{0.003}\text{Nb}_{0.002}\text{Cr}_{0.001})_{\Sigma 2}(\text{Fe}_{1.633}\text{Al}_{0.609}\text{Si}_{0.552}\text{Ti}_{0.166}\text{Fe}_{0.039}\text{V}_{0.001})_{\Sigma 3}\text{O}_{12}$ . The mineral forms thin regular growth zones and irregular spots in the  $\text{Fe}^{3+}$ -dominant analog of kimzeyite. Toturite is cubic,  $Ia\bar{3}d$ ,  $a \approx 12.55 \text{ \AA}$ , as is confirmed by electron backscatter diffraction (EBSD) data. The strongest lines of the calculated powder diffraction pattern are [ $d$ ,  $\text{Å}$  ( $hkl$ )  $I$ ]: 2.562 (422) 100, 1.677 (642) 91, 3.138 (400) 74, 4.437 (220) 67, 1.146 (10.4.2) 31, 1.046 (884) 25, 1.984 (620) 23. Raman spectra of toturite are analogous to those of kimzeyite and shows the following diagnostic bands ( $\text{cm}^{-1}$ ): 244, 301, 494, 497, 575, 734. The association of toturite with larnite, rondonfite, wadalite, magnesioferrite, lakargiite, and cuspidine indicates a high temperature ( $>800 \text{ }^\circ\text{C}$ ) of formation. The mineral name is given after the Totur River situated in Eltybyyu village, also Totur is the name of a Balkarian god.

**Keywords:** Garnet, toturite,  $\text{Fe}^{3+}$ -dominant analog of kimzeyite, Sn, Sb, Raman spectroscopy, EBSD, Lakargi Mountain, Russia