Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29606

Unraveling the tin isotope composition of granitic ore deposits

KATHARINA EBERT[1], FRANÇOIS HOLTZ[1], DR. JULIE ANNE-SOPHIE MICHAUD[1], DINO LEOPARDI[2], PHILIP WIEGEL[1], INGO HORN[1] AND STEFAN WEYER[3]

[1]Leibniz University Hannover
[2]Helmholtz-Zentrum Dresden-Rossendorf
[3]Leibniz University Hannover, Germany

Tin is an element of significant economic importance. Understanding the formation of tin deposits where cassiterite (SnO_2) is the predominant ore mineral, is crucial for efficient mining and ensuring sustainable tin utilization. Since, the crystallization of cassiterite is accompanied by redox change from mainly Sn^{2+} in silicate melts (or fluids) to Sn^{4+} in SnO_2 [1] [2] and heavier tin isotopes are preferentially bonded to Sn^{4+} [1], studying tin isotope compositions may help track the relative effect of melt and/or fluid on tin enrichment and cassiterite crystallization.

This study aims at improving our understanding of the tin isotopic behavior in granitic systems and greisen ore deposits in order to constrain the crystallization conditions of cassiterites. As a case study, we compare the isotopic evolution of cassiterites from the rare metal granite system of Argemela (Portugal), where tin transport and concentration are mainly melt-driven, with the greisen system of Sadisdorf (eastern Erzgebirge, Germany) resulting mainly from fluid-driven processes.

Tin isotope analyses were conducted *in situ* using femtosecond laser ablation multi-collector inductively coupled plasma mass spectrometry (fs-LA-MC-ICP-MS) enabling to measure the tin isotope composition of individual zones corresponding to different crystallization stages of the cassiterite grains. This method provides information on the transport medium involved and the conditions during the evolution of the ore-forming processes.

Preliminary results show that cassiterite crystals of Sadisdorf show relatively heavier isotopic ratios ($\delta^{124/117}Sn$ = +0.17 to +1.43 ±0.06‰) as compared to those from Argemela with a more magmatic signature (most $\delta^{124/117}Sn$ ratios between -0.34 ±0.08‰ and +0.57 ±0.11‰), in agreement with tin transport by oxidizing fluids. Differences in crystallization environments are also supported by differences in cassiterite compositions, which are Nb-Ta-bearing in Argemela and W-Ti-bearing in Sadisdorf.

[1] Yao et al. (2018), *American Mineralogist* 103, 1597-1598.

[2] Linnen et al. (1996), *Geochim. Cosmochim. Acta* 60, 4965-4976.