Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28553

Reading cassiterite geochemistry: a multi-scale, multi-analytical approach to ore-forming systems and mineral exploration in the Góis-Panasqueira-Argemela-Segura Sn-W Belt (Portugal)

MIGUEL GASPAR[1], PATRÍCIA MOITA[2], ZHAOSHAN CHANG[3], RUTE SALGUEIRO[4], NUNO GRÁCIO[5], SHIQIANG HUANG[3], ANDRÉ SANTOS[6], MAFALDA COSTA[2], MASSIMO BELTRAME[2], PEDRO BARRULAS[2], ANTÓNIO MATEUS[1], MARIE-CHRISTINE BOIRON[7] AND MICHEL CATHELINEAU[8]

[1]FCUL-IDL
[2]Universidade de Évora
[3]Colorado School of Mines
[4]Laboratório Nacional de Energia e Geologia, Unidade de Recursos Minerais e Geofísica
[5]Faculdade de Ciências e Tecnologia da Universidade de Coimbra
[6]Instituto Dom Luiz
[7]Université de Lorraine - CNRS - CREGU - GeoRessources Laboratory
[8]CNRS, University of Lorraine

Cathodoluminescent (CL) imaging, micro-X-ray fluorescence (μ-XRF) mapping, and chemical analyses by EPMA and LA-ICP-MS were used to characterize cassiterite from W-, Sn-, and Li-dominant magmatic-hydrothermal and hydrothermal deposits within the Góis-Panasqueira-Argemela-Segura tin-tungsten metallogenetic belt (central Portugal).

In situ cassiterite U-Pb dating yielded ages between 310-290 Ma (oldest from Li-dominant deposits), matching the age of regional highly differentiated leucogranites. CL and μ-XRF images revealed primary and secondary growth textures, including oscillatory zoning, sector zoning, and dissolution-reprecipitation features. Minor (>1000 ppm) to trace (<1000 ppm) enrichments in Ti, Nb, Ta, Fe, Mn, W, Zr, Hf, Al, Ga, and Sc are common. Variations among deposits, within individual deposits, and even at the grain scale reflect multi-phase and complex mineralizing systems.

Cassiterite from rare metal granites and aplite-pegmatites typically contains high Nb (up to 30,000 ppm), Ta (up to 50,000 ppm), Fe (up to 7,000 ppm), Mn (up to 12,000 ppm), Al and Zr (up to 2,800 ppm), and Hf (up to 700 ppm), with low Ti (<500 ppm) and V (<1 ppm). In contrast, cassiterite from hydrothermal quartz lodes is generally enriched in Ti (>3,000 ppm, up to 10,000 ppm) and V (30-500 ppm). In hydrothermal W>Sn systems, such as Panasqueira, W contents reach up to 4,000 ppm, with even higher values (up to 1.5% W) in Segura Li-aplite-pegmatites.

Other cassiterite compositions reflect local chemical signals acquired by mineralizing fluids. For example, in Panasqueira, cassiterite from the sulfide stage shifts from its typical Ti-rich signature to an exclusively Fe-rich composition. In some deposits cassiterite shows a composition intermediate between hydrothermal and magmatic signatures. In others, cassiterite starts with a typical hydrothermal signature, later recrystallized by fluids with a magmatic-dominant component.

Element ratios –Fe/Mn, Nb/Ta, Zr/Hf, Al/Ga, Ti/Al, Hf/Ga, Ti/Zr, and Ti-(Fe+Mn)-(Nb+Ta)– are sensitive to magmatic-hydrothermal ore forming processes, helping distinguish deposit types, mineralizing styles, end-member fluid compositions and characteristic mixing trends. Their application to alluvial cassiterite in Segura highlights their effectiveness as an exploration tool for Sn-W ore deposits.

This research is supported by the Portuguese Fundação para a Ciência e Tecnologia (FCT, I.P./MCTES) through national funds (PIDDAC): UID/50019/2025 and LA/P/0068/2020 (https://doi.org/10.54499/LA/P/0068/2020).