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Turning advances in high-precision cassiterite U-Pb geochronology into improved mineral system models

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Radio-isotopic geochronology plays an important role in the analysis of both deposit-scale and wider mineral system models for the critical and essential raw materials needed to undertake decarbonisation of our society. Tin (Sn) has ubiquitous application in electrical solders and is often found in geological association with other strategic metals such as tungsten, tantalum, and lithium in granite-hosted magmatic-hydrothermal systems. The next generation of Sn deposit models requires understanding of their 4-D evolution, and there is a necessity to better constrain the temporal evolution of Sn deposits, either at broader regional scales through *in-situ* geochronology, or high-precision geochronology of individual deposits.

Conventional hydrothermal mineral-based geochronometers, such as molybdenite ^{187}Re-^{187}Os, are notoriously challenging when applied to Sn-deposit types. Whilst other U-Pb mineral geochronometers (e.g., hydrothermal monazite) can yield precise dates for ore-formation [1], they do not occur abundantly in all deposits, or may not record the hydrothermal stages important to Sn mineralization. Cassiterite (SnO_2), the principal tin ore mineral provides a highly versatile and accessible route to constrain the timing and timescales of magmatic-hydrothermal systems linked to tin deposit formation. However, achieving precise and accurate U-Pb geochronology of cassiterite presented significant challenges until the development of a low-blank methodology for leaching, decomposition, and isotope dilution geochronology [2].

Here, we examine the state-of-the-art in high-precision isotope dilution thermal ionisation cassiterite U-Pb geochronology. We demonstrate how analytical strategies and integrated workflows can be optimised for application to: 1) develop and characterise cassiterite U-Pb reference materials for improving precision and accuracy of *in-situ* measurement techniques, and 2) unravel long-standing questions surrounding the complex granite-related mineral system of the world-class Cornubian ore-field, SW England.

References:

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