Utilising In-situ Lu-Hf Dating to Constrain Timing of Mineralisation in the Mount Isa Inlier: A Case Study from Maronan.

Helena Hordern[1], David Murphy[1], John Caulfield[1], Elena Belousova[2]
[1]Queensland University of Technology, Brisbane, Australia, [2]Geological Survey of Queensland, Brisbane, Australia

The Mount Isa Inlier in northwest Queensland hosts a diverse range of mineral deposit types including Pb-Zn Broken Hill-type deposits (e.g. Maronan), Iron Oxide-Copper-Gold (IOCG) deposits (e.g. Mount Dore and Mount Colin), and sediment-hosted copper deposits (e.g. Mount Oxide). Conventional geochronological techniques such as Re-Os on molybdenite, U-Pb on apatite and Ar-Ar on mica are commonly used and well-established. However, these systems can be reset by later thermal overprinting events, complicating interpretations of the timing of mineralisation.

This project seeks to further develop the Lu-Hf dating techniques as a key method of dating apatite and garnet associated with mineralisation across the Mount Isa region. Crucially, the Lu-Hf system is less susceptible to thermal resetting. Using this method, we aim to refine age constraints of ore-forming processes, including in overprinted terranes.

The initial phase of the project focuses on the Maronan deposit, a Broken Hill-type deposit in the Inlier. Core samples sourced from the Geological Survey of Queensland were used to produce thin sections for detailed petrographic imaging and geochemical analysis. Techniques including optical microscopy, Raman spectroscopy, EPMA, cold-CL, TIMA phase, BSE and CL imaging and trace element analysis through LA-ICP-MS are employed to characterise apatite and garnet and assess their relationship to mineralisation. Samples showing the strongest textural and geochemical association with mineralisation events will be selected for Lu-Hf geochronology.

Future work will apply this workflow to remaining deposits. Our aim is to assess the Lu-Hf method as a versatile tool for dating mineralisation across a range of deposit types. Ultimately, this research will enhance our understanding of mineralisation processes in the Mount Isa Inlier, with the potential to contribute to global exploration. If garnet and apatite show to possess unique geochemical fingerprints related to ore formation, they may serve as valuable mineralisation vectors in the search for critical minerals.