Assessing Proximity to Cu and Au Deposits Using Resistate Mineral Chemistry

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This presentation shows outcomes from a coordinated research effort within MinEx CRC investigating resistate mineral chemistry for assessing proximity to Cu and Au deposits. Resistate minerals are capable of withstanding weathering, erosion, and transport processes, and often survive in young, barren cover sediments that obscure older, prospective basement terranes. This is particularly relevant in Australia, where ~80% of basement rocks lie beneath younger cover, thereby obscuring economically significant mineral systems.

Our research has used iron oxide-copper-gold (IOCG) and iron sulfide-copper-gold (ISCG) systems in the Gawler Craton (South Australia) and Cloncurry District (Queensland) as well as orogenic Au systems in the central Victorian goldfields, southeastern Australia. We demonstrate that LREE, Y, and Th concentrations in monazite can indicate proximity to LREE-rich IOCG deposits, while Ca, S, and Th content are more relevant for ISCG systems (Tiddy et al., 2021: Minerals; Batch et al., 2024: J. Geochem. Expl.). Zircon from IOCG settings shows distinct heavy REE (HREE) fractionation and europium (Eu) anomalies (Brotodewo et al., 2021: Minerals). In orogenic Au systems, apatite displays distinct concave REE + Y profiles, along with characteristic Mn, Fe, Sr contents, Y/Ho ratios, and Eu anomalies (e.g., Tylkowski et al., in review: Gond. Res.).

These geochemical insights provide a basis for targeted mineral exploration sampling in covered terrains. Monazite and zircon retain their indicative chemistry into transported sediments, while apatite, although susceptible to acid weathering, preserves its original chemistry when intact. Sampling strategies that incorporate paleolandscape and paleoenvironment understanding can effectively use these resistate minerals to assess proximity to buried Cu-Au mineralisation. Future research includes using apatite for IOCG systems (for example) to add to the toolkit of mineral chemistry across multiple mineralising systems, effectively enhancing the ability to detect buried ore systems by expanding their geochemical footprint.