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## Assessing Proximity to ISCG and IOCG Mineralisation Using REE-Bearing Phosphate Chemistry

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Copper is a critical metal required for the green transition, and can be sourced from iron sulfide-copper-gold (ISCG) and iron oxide-copper-gold (IOCG) deposits. However, finding copper deposits is becoming increasingly difficult, especially in areas where sedimentary cover dominates the landscape. Geochemical tools that use the chemistry of resistate minerals to assess proximity to mineralisation can aid exploration in covered terrains.
This study presents geochemical discrimination schemes for ISCG and IOCG deposits based on the chemistry of REE-bearing phosphates (monazite and rhabdophane) from mineralised and barren rocks. ISCG and IOCG deposits in the Cloncurry District of the Mount Isa Inlier, north-west Queensland, Australia, are used as case studies.
The ISCG discrimination scheme uses samples from Jericho and Kulthor ISCG deposits, which preserve REE-bearing phosphates with higher S/Th and Ca/Th molar ratios compared to their unmineralised counterparts and consistent total REE concentrations across deposits. Jericho is the only deposit in which rhabdophane is identified. The discrimination scheme for IOCG deposits shows that samples from mineralised and barren areas within the Osborne and E1 IOCGs can be distinguished based on their light REE (La, Ce, Nd) and Th content, which supports previous investigations in using monazite chemistry as an indication of IOCG mineralisation (Tiddy et al., 2021). Phosphates from mineralised and barren samples from the SWAN IOCG deposit can be discriminated using both schemes.
These results indicate elevated S and Ca, and depleted Th concentrations characterise REE-bearing phosphate chemistry from ISCG mineralisation, while elevated La + Ce and depleted Nd and Th are typical of REE-bearing phosphate chemistry associated with IOCG mineralisation. These criteria offer the advantage of using the resistate mineral phase, monazite, which can be integrated into cover sequence materials, thereby enhancing the geochemical signal of buried mineralisation. It is noted that the weathering potential of rhabdophane is not yet realised.