Geochemical Signatures of Apatite in IOCG Systems in the Cloncurry District, Queensland

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As the world transitions towards a sustainable, green energy future, an increase in deposit discovery is necessary to meet growing global metal demands. To aid in mineral exploration, techniques are being developed to increase the footprint of a system and therefore the size of the exploration target. This can be done through looking at mineral chemistry (e.g. apatite, monazite) to understand proximity to the system and gain insight into how the system formed. Apatite is a common accessory mineral that is being recognised as a valuable indicator mineral as its rare earth element (REE) patterns and trace element ratios have been shown to preserve unique signatures that can be related to different mineralising events (Mao et al., 2016: Econ-Geol). Previous studies have demonstrated this for porphyry Cu-Au (Bouzari et al., 2016: Econ-Geol) and orogenic gold (Zheng et al., 2022: Mineralogy and Petrology) systems however minimal work has been done across iron oxide-copper-gold (IOCG) and iron sulfide-copper-gold (ISCG) deposits (Krneta et al., 2017: Minerals).

In this study, chemistry of apatite from IOCG and ISCG systems in Australia are compared. Kulthor ISCG and Osborne IOCG deposits from Cloncurry District, Queensland are used as case study areas. Scanning electron microscopy (SEM), Electron Probe Micro-Analyzer (EPMA) and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) are used to quantify apatite chemistry and textural features in both background and mineralised samples. This facilitates understanding of physical and chemical changes that have occurred within mineralisation-associated apatite and identification of multiple generations of apatite within the system. Results are compared to apatite geochemical data from other systems in the Cloncurry district and Olympic Province in South Australia. Comparative analysis will be undertaken to identify similarities and differences across the study areas to generate a broad apatite exploration criterion for IOCG and ISCG systems in eastern Australia.