Characterisation of Ore Deposits: Overcoming Cross- and Multi-Scale Challenges

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Economic geology research commonly focuses on individual mineral deposits, emphasising their genesis and deposit type classification. However, distal alteration footprints of individual deposits and their connections to regional mineral systems remain poorly understood and under-represented in publicly accessible geological sample and data collections. The Geological Survey of Queensland (GSQ) have achieved significant success in closing this gap in Queensland. GSQ built up an extensive reference collection of drill cores and ore and alteration samples from 110 mineral deposits representing most important mineral systems across the state and employed multiple advanced analytical methods for characterisation of deposits and their alteration footprints at various scales.

The most extensive data acquisition has been completed for mineral systems in the Mount Isa Province (IOCG, sediment-hosted Cu and Zn-Pb-Ag deposits) and intrusion-related mineral systems in NE Queensland, with multiple deposits investigated for each distinct mineral system. Each target deposit is characterised based on 3 to 6 representative drill cores. Continuous hyperspectral scanning is used first for fast mineralogical logging and identification of common rock-forming and alteration minerals, followed by other non-destructive core scanning, including continuous XRF and petrophysical data acquisition. Representative samples are then selected for comprehensive whole-rock geochemistry and detailed mineralogy and geochemistry using micro-XRF, LIBS and TIMA instruments. Selected well-characterised samples from each deposit are then further investigated to document mineral chemistry of key ore and alteration minerals, including isotope geochemistry.

Integrating results of these multiple complementary methods applied across an individual mineral deposit allows comprehensive characterisation of its mineralisation signature and alteration footprints. When systematically applied to characterise multiple genetically related deposits across a mineral district, and integrated into a regional geological context, this approach generates an invaluable dataset to successfully identify, map and navigate alteration footprints of a mineral system from deposit to district scale, ultimately assisting and facilitating mineral exploration.