Intrusion-Related and Epithermal Gold Systems in North-East Queensland, Australia: Multiple Metallogenic Districts and Epochs, Diverse Geochemical and Mineralogical Signatures

Vladimir Lisitsin[1], Courteney Dhnaram[1], Al-Tamini Tapu[1], Malcolm Stallman[1], Friedrich von Gnielinski[1], Benjamin Hines[1]
[1]Geological Survey of Queensland, Brisbane, Australia

North-East Queensland hosts over 150 diverse gold deposits of multiple types, with highly variable mineralisation styles and geochemical and mineralogical signatures. They were formed by several genetically distinct regional-scale mineral systems which were intermittently active from middle Carboniferous to Early Permian, producing multiple partially overlapping metallogenic districts and camps. Most major gold deposits in the region have genetic links to felsic to intermediate porphyry to sub-volcanic intrusive complexes, thereby representing Intrusion-Related Gold Systems (IRGS). The remainder are orogenic and epithermal gold deposits.

Over the past decade, the Geological Survey of Queensland (GSQ), in collaboration with multiple research and industry partners, have undertaken a large-scale data acquisition and research program of multi-scale characterisation of gold mineral systems in the region. The program involved systematic comprehensive characterisation of numerous deposits and camps for each mineral system, focusing on the mineralogical and geochemical signatures of mineralisation and alteration (>1,000 samples) and geochronology of metallogenically significant geological events (tens of new U-Pb, Re-Os and Ar-Ar dates). The deposits and camps investigated in this study include Ravenswood, Kidston, Mt Leyshon, Mt Wright, Red Dome, Mungana, Mt Carlton, Agate Creek, Alice River and multiple smaller deposits.

Intrusion-related gold deposits (IRGD) exhibit the greatest variability of mineralisation styles and geochemical signatures, reflecting a complex interplay of factors including the composition, fractionation and emplacement depth of and proximity to causative intrusions, and chemical composition of host rocks. Most IRGD formed at the porphyry level and occur as breccias, veins, stockworks and rare skarns, with geochemical signatures characterised by enriched Au-Ag-Te-Bi-Cu-Zn-Pb-As-Sb(±Mo-W-Sn) and distinct zonation within deposits and camps. In contrast, epithermal vein gold deposits have predominant Au-Ag-As-Sb-Te geochemistry – similar to distal epizonal IRGD.

IRGD formed at ~335 Ma, 325-315 Ma and 290-305 Ma (synchronous with most Sn and W-Mo deposits), while most epithermal deposits – at 285-275 Ma.