Deformation zone architecture, reactivation and mineralisation processes in the Eastern Succession of the Mount Isa Inlier

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Introduction

This project aims to integrate each separate stage of regional scale faulting in the Eastern Succession of the Mt Isa Inlier, in order to form a complete history of localised deformation, and to regard the role of the deformation zones in fluid flow and mineralization in IOCG deposits.

IOCG deposits are currently considered to be closely related to the intrusion of a suite of syn- to late-tectonic granitoids. However, this association has been challenged by new age data, and a preliminary analysis of the spatial distribution of these deposits shows a stronger relationship between deposits and moderate to large S to SE trending faults than to granites. Every large, discovered ore deposit in the Eastern Succession possesses evidence that clearly indicates formation was influenced or dominated by fluid flow along deformation zones.

The research will focus on key areas of dilation and irregularity along major faults (which may control the sites of important deposits e.g. Ernest Henry Cu-Au deposit) and fault junctions and intersections of major fault systems of the same and of different ages. This method will allow the use of a large body of pre-existing fault data, recorded during the exploration of now well established orebodies. The distinction in geometry, kinematics and fluid conduit properties of the major faulting events will be investigated.

Questions

This research addresses three of the five fundamental questions posed by the pmd*CRC in the context of IOCG deposits in the Eastern Succession, and applies this evaluation to realistic deformation architecture problems specific to the Eastern Succession.

- What is the architecture of the system?
- What are the fluid flow drivers and pathways?
- What are the metal transport and depositional processes?

These questions will be addressed through the investigation of the major regional deformation zones, which will allow them to be applied directly to circumstances specific to the Eastern Succession. This in turn will generate site and region specific solutions to fault history problems. This project will also investigate the individual geometries of the faults, fault jogs and bends, and fault intersections which make up this architecture, and the fluid systems in place pre- during and post-mineralisation, which utilise these structural scale fluid conduits and fluid traps.

Study Areas

The first study area targeted by this project is the Cloncurry Fault. This is a major regional fault system and long lived fluid conduit. The Cloncurry Fault has been recognised as having a long and complex history of movement, involving multiple reactivation episodes, potentially spanning...
entirely separate deformation events. It is this long, recorded history of activity which makes the Cloncurry Fault a valuable asset to the field research campaign.

The input of structural information from currently mined orebodies affected by multiple phases of deformation, such as Ernest Henry, Eloise, Osborne, Cannington and Selwyn, will be achieved by mine site work including data collaboration and mine site observation.

The second major target area for field research is the major structural junction created between the Fountain Range Fault and the Pilgrim Fault/Ballara-Corella River Fault Zone. Crosscutting smaller late- to post-tectonic faults complete a picture of a substantial period of faulting in this locality. The field investigation of this “series” of faults should create a relatively comprehensive faulting history for the area, which will in turn lend itself to correlation over the entire inlier.

**Mechanical Modelling**

The long and complex history of faulting of the Eastern Succession was created by structural activity during multiple, style-distinct deformation events. This has produced a regional architecture which shows a massive variation in fault geometry over time. Far field stresses applied to geometrically distinct brittle structures and brittle structural regimes, show a wide variation in effects with regard to resultant fault geometry and reactivated fault geometry, crustal composition and fluid migration pathways. This project will apply mechanical models to regional architecture within the Eastern Succession in order to simulate mechanical processes over time and document and evaluate the geological results of these processes.

**Conclusion**

This project will involve some exciting mechanical modeling, fluid flow modeling and, in turn, ore-formation locality prediction. The evaluation of the stratigraphic perturbation caused by faulting over the history of mineralised rocks in the Eastern Succession should provide a fundamental building block for the formation of the overall evaluation of the geology of the Eastern Succession.