The Role of Structural Inheritance in Gold Mineralisation Along the Gondwana Supercontinent Margin: Insights from Ravenswood, Queensland

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Supercontinent margins undergo repeated convergence-extension dynamics and global plate kinematic reorganisation resulting in structural inheritance and reactivation. Globally, the (re-)activity of major structures and their intersections is thought to control the spatial distribution of major gold deposits. Furthermore, successive structural events may modify and displace economic gold deposits. To improve predictive exploration targeting, it is crucial to decipher the kinematics and relative timing of first- and lower-order structural architectures relative to gold mineralisation. Here, we focus on the structural evolution of the Jessop Creek Fault (JCF) as a major structure that may have influenced the formation of the Ravenswood Gold deposit – the largest gold mining operation in Queensland, Australia. The region lies within the Paleozoic history of the northeastern Thomson Orogen, part of the Gondwana margin. The deposit occurs at an intersection of major EW, NW-SE, and N-S structures, with gold hosted in NW-striking conjugate quartz-sulphide veins, which record polyphase activation. The latest stage of movement along the N-trending JCF truncates pre-existing structures, mineralisation, and hydrothermal alteration. However, integration of structural, geophysical, and regional deformation data suggests a more complex and multiphase evolution of the JCF, with important implications for fluid flow and gold deposition. We propose that the JCF originated during NE-SW compression, contemporaneous with emplacement of the 420 Ma Jessop Creek Tonalite Complex. The early structural architecture comprised E-W, N-S, and NW-SE faults. Subsequent NW-SE-directed shortening during Devonian-Carboniferous reconfiguration resulted in sinistral transpressional movement along N-trending structures, offsetting pre-existing E-W faults. NW-trending faults likely developed as sinistral strike-slip zones. Late Carboniferous E-W extension reactivated the structural architecture and enabled fluid flow and gold mineralisation. In summary, reactivation of early structures controlled high-permeability pathways for gold precipitation during hydrothermal activity. Our study improves understanding of Gondwana margin-related lithospheric architecture development, critical for ongoing and future exploration strategies.