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Structural Controls on Carlin-Type Mineralization at the Fourmile and Goldrush Deposits, Nevada, USA

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Brittle fault zones are critical controls on crustal fluid flow and influence orebody geometry, continuity, and grade in Carlin-type gold deposits (CTGDs). In particular, the damage zone vein and fracture networks of pre- and syn-mineralization faults have been identified as high-permeability conduits for hydrothermal fluids as they migrate from distal sources to geochemically reactive host rocks. Published structural analyses of CTGDs have largely focused on the Carlin Trend, while more recent discoveries in the Cortez District are less studied.

The Fourmile¹ and Goldrush ore bodies are world-class CTGD's in the Cortez District, Nevada, USA, , oriented along a ~7km trend of mineralization. Dense drilling and underground development allow for the characterization of ore-controlling structures across these deposits. Mineralization transitions from high-grade associated with a complex east-verging thrust fault in metamorphosed and metasomatized lithological units at Fourmile in the north to lower-grade, stratabound breccias at Goldrush in the south.

Detailed logging of fault zones, UV-fluorescent calcite veins, and hydrothermal alteration are coupled with downhole image log analysis and multi-element geochemical data to address the following questions:

1. What are the relationships between structures and mineralization at different orebodies at Fourmile and Goldrush?
2. How do the characteristics of individual structures vary spatially at the deposit scale?
3. Can we use structural data to classify and model fluid flow properties on structures in CTGD's and identify zones of upflow?

This study indicates that compositional and mechanical heterogeneity in host strata influenced the style and intensity of later deformation and brittle faulting and ultimately defined the fluid-flow properties of key structures at Fourmile and Goldrush. Hydrothermal fluids were initially focused along damage zone fracture networks and breccias with dissolution-driven volume loss further enhancing permeability and facilitating lateral flow during deposit formation.