

Constraining the Structural Evolution of the Bingham Canyon Copper Porphyry District Using 2-D and 3-D Kinematic Modeling

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Understanding the regional to district-scale structural-geologic evolution of the Bingham Canyon porphyry copper system is essential for economic resource assessments. We use regional tectonic context integrated with 2-D and 3-D kinematic forward modeling and restoration to characterize the first-order structural evolution of key elements of the Bingham District, including the Mesozoic Cordilleran Midas Thrust System and its hanging wall, the Apex–Rood anticline–syncline fold pair, and the Eocene intrusive sill, dike, and stock complex. We investigate components of polyphase deformation, including translations, rotations, and strains required to accommodate the emplacement of several cubic kilometers of granitic rocks within a collapsing (extensional) orogenic hinterland during the waning phases of the Sevier Orogeny. Our analyses build upon previous efforts, but with the addition of new insights gained over the past decade based upon kilometers of both geologic pit-mapping and drill-core.

The results of the structural analyses indicate that, in addition to the surface trace of the Midas Thrust, the system likely includes deeper, blind thrusts required to generate the tight folding observed both at the surface and within the footwall of the Midas Thrust. The inclusion of deeper thrusts is further supported by subsurface observations. Additional implications of the structural analyses, particularly those constrained by line-length and volume conservation, include local contraction (imbrication) and forced folding within an overall extensional regime; stratal delamination driven by successive sill inflation, coupled with structural dissection (syn-intrusive faulting and diking) that produced kilometer-scale rafts of sedimentary host rocks translated up to ~1 kilometer and rotated (uplifted) to accommodate voluminous igneous emplacement.

Collectively, these results provide a structural framework for understanding porphyritic igneous emplacement and improve confidence in static 3-D geologic models used for resource estimation and geotechnical pit-slope stability analyses.