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Advancing the Carlin Mineral System: Examples From the Prolific NE Nevada Trends

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Carlin-type gold systems remain enigmatic with respect to metal source, transport, and trapping mechanisms. A magmatic–hydrothermal origin has been widely proposed (e.g., Muntean et al., 2011), although models invoking significant meteoric fluid involvement (Ilchik and Barton, 1997) and precursor gold accumulation within basin sediments (Emsbo et al., 2003) have also been suggested. This study evaluates these hypotheses through observations from several giant deposits in northeastern Nevada, including Goldrush–Fourmile, Cortez Hills, and Turquoise Ridge.

The tectonic evolution of northeastern Nevada exerts fundamental controls on Carlin-type mineralization. Basin development from the Cambrian to Permian terminated during the Carboniferous during the Antler Orogeny thrusting deeper marine siliciclastic strata over carbonate platform sequences that later served as favorable reactive host rocks.

Subduction of the Farallon Plate initiated ~180 m.y. of contractional deformation. Intrusions at ~140 Ma and ~90 Ma exploited transcrustal structural corridors that later served as conduits for Eocene magmatism and hydrothermal mineralization.

Paragenetically early mineralization is characterized by an As-saturated, relatively low-sulfur magmatic–hydrothermal fluid. These assemblages occur proximal to early Eocene quartz–feldspar porphyry intrusions and metasomatized margins that locally host high-grade free gold mineralization. This stage likely developed during transient stress associated with early Eocene flattening of the Farallon slab, causing partial melting of the sub-continental lithospheric mantle.

Slab roll-back promoted asthenospheric upwelling and crustal anatexis during a period of extension within a reducing sedimentary basin, influencing the chemistry of fertile Eocene intrusions. Increased uplift and exhumation enabled deep meteoric circulation, potentially leaching gold from carbonaceous sediments and overprinting earlier mineralization with lower-temperature Carlin-type sensu-stricto systems.

The resulting mineral system is interpreted as zoned, with an early high-temperature magmatic–hydrothermal stage of arsenopyrite + quartz + native gold ± Cu-Pb-Zn-Mo sulfides, bismuthinite, and tellurides, evolving to a lower-temperature assemblage dominated by nano- to micro-scale gold inclusions and lattice-bound gold in arsenian pyrite.