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Dike-Hosted Ores of the Beast Deposit and the Importance of Eocene Magmatism in Gold Mineralization of the Carlin Trend, Nevada

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Abstract

The Beast, low-grade (7.3 Mt @ 0.7 g/t), disseminated Au deposit in the Carlin trend, Nevada, is unique among Carlin-type Au deposits in having as much as 50 percent of the ore hosted by a 37.3 Ma porphyritic rhyolite dike. Nonetheless, the deposit has the characteristics of Carlin-type deposits, including (1) an ore mineral assemblage consisting mostly of fine-grained pyrite, arsenian pyrite, and arsenopyrite; (2) association of Au with As, Sb, Hg, and Tl, and high Au/Ag ratios; (3) a paragenesis that includes early Fe-As sulfides and kaolinite, intermediate stibnite, and late barite; and (4) moderate to strong silicification and/or kaolinitization of rocks in ore zones and decarbonatization of silty carbonate rocks peripheral to faults. The Beast deposit is less than1 km from the Genesis deposit and 3 km from the huge Betze-Post deposit, and these and many other important deposits are located along the Post-Genesis fault system.

The rhyolite dike at Beast not only provides an important age constraint on Carlin-type mineralization in the Carlin trend but also gives information on the nature of mineralized rock largely free from earlier diagenetic, thermal, or hydrothermal alteration experienced by Paleozoic and Mesozoic rocks. Strong leaching and silicification of the rhyolite produced rock composed mostly of quartz and kaolinite. Gold is most concentrated in matrix- and clast-supported siliceous breccia developed in and near the faulted footwall of the rhyolite dike adjacent to Silurian-Devonian laminated silty carbonate rocks but also occurs in massive quartz-kaolinite in both rhyolite and limestone. Secondary oxidation of the bulk of the ores produced abundant hematite, jarosite, scorodite, and alunite. Supergene alunite yielded an $^{40}Ar/^{39}Ar$ age of 18.6 Ma that is within the range of ages on supergene alunite (30–8 Ma) from deposits in the Carlin trend.

Eocene intrusive rocks dated between 40.1 and 37.3 Ma are common in the northern Carlin trend. The rocks are high K calc-alkaline, and most range in composition from dacite to rhyolite. In addition to the Beast deposit, mineralized Eocene dikes are recognized in the Betze-Post, Deep Star, Genesis, and Meikle-Griffin deposits and indicate that major gold mineralization in the Carlin trend occurred after ~40 Ma, probably as a consequence of multiple Eocene intrusive events. Textures in dikes that are locally altered and mineralized as well as steep attitudes of dikes and gentle tilts of nearby nearby Eocene volcanic rocks are consistent with shallow emplacement and only modest extension since 40 Ma. This suggests that mineralization on the Carlin trend occurred at equally shallow depths without major extension.

Eocene dikes of the northern Carlin trend underlie or are immediately adjacent to a large (700-km_2) positive aeromagnetic anomaly. The anomaly also corresponds closely with exposures of contemporaneous volcanic and intrusive rocks of the nearby 200-km2 Emigrant Pass volcanic field and smaller Welches Canyon center. It is likely that the anomaly represents a buried, mainly Eocene, plutonic complex. Growing evidence for a spatial and temporal association between Carlin-type Au mineralization and Eocene magmatism strongly suggests

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a genetic relationship. Eocene magmatism is considered the major process that drove hydrothermal circulation, which formed Carlin-type deposits of the Carlin trend. This relationship allows the possibility that magmas may also have contributed metals and other components. If Carlin-type deposits are pluton related, as suggested here, then their relation to other pluton-related Au deposits, including distal-disseminated Au-Ag and Au skarn, requires reevaluation.