

## Pre-eruptive characteristics of “suspect” silicic magmas in Carlin-type Au-forming systems

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### ABSTRACT

World-class Carlin-type Au deposits hosted in sedimentary rock were formed when profuse Eocene silicic magmatism swept across northern Nevada in response to arc migration. Carlin-type Au deposits formed along with porphyry/skarn Cu-Mo-W-Au deposits, epithermal Ag-Au deposits, and distal disseminated Ag-Au deposits. But unlike these other Au-bearing deposits that have clear associations with igneous intrusions, Carlin-type ore deposits appear to have formed distant from concealed plutons, and their origin remains controversial. Despite decades of abundant geophysical, geochronological, and geochemical studies suggesting the involvement of magmas, concrete evidence for magmatic involvement is still lacking. Consequently, the involvement of contemporaneous igneous systems remains inferred based on age, proximity, and variable isotopic, geochemical, and geophysical clues. A recent synthesis of deposit models postulates that Carlin-type Au deposits are intrusion-related, but that the causative magmas reside deeper (~6–12 km) than in typical porphyry and peripheral systems (~3–5 km), meaning that Carlin-type deposits are perhaps more distal expressions of igneous intrusions. We investigate a collection of “suspect” magmatic systems over a ~7 m.y. timespan (~41–34 Ma) that are contemporaneous with and near known Carlin-type ore deposits. We report results of a multifaceted array of in situ geochemical analyses (FTIR, EMP, SHRIMP-RG, LA-ICP-MS) of quartz-hosted melt inclusions, biotite, and quartz to better characterize the pre-eruptive characteristics of these magmas. We also report results of thermobarometry and thermodynamic phase equilibria modeling to help place constraints on magmatic reservoir depths and processes. Rather than a single “flavor” of silicic magma, we observe a surprisingly broad compositional spectrum of rhyolites, with one end of the spectrum exhibiting more arc-like (I-type) characteristics and the other end displaying more post-subduction, thick-crust extensional (A-type) characteristics. This broad compositional spectrum suggests a more complex picture of silicic crustal magmatism operating over a narrow span of time during slab rollback. Despite this spectrum, magmatic systems in this study are consistently ferroan and generally peraluminous, which we interpret as an expression of the relatively elevated geotherm at the time and incorporation of variable amounts of highly peraluminous metasedimentary crustal components. The silicic magma spectrum encompasses a range of mineralization associations, including subduction-related Cu-Mo-W-Au-Ag and post-subduction, thick-crust extensional rare-metal Mo-Sn-W-F-Be-Ag-Au, consistent with the prolific and diverse array of ore deposits that formed during this time. Carlin-type Au deposition appears to be associated with nearly the entire magmatic spectrum. This apparent indifference to silicic magma “flavor” would seem to imply that if magmas are involved in Carlin-type Au deposit genesis, they perhaps do not need to be compositionally specialized and/or possibly are only relevant as heat sources driving circulation to remobilize and redistribute metals.

**Keywords:** Carlin-type Au, rhyolite, melt inclusions, magma reservoirs, slab rollback, ignimbrite flare-up, ore deposits, Nevada