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Miocene and Early Pliocene Epithermal Gold-Silver Deposits in the Northern Great Basin, Western United States: Characteristics, Distribution, and Relationship to Magmatism

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Abstract

Numerous important Miocene and early Pliocene epithermal Au-Ag deposits are present in the northern Great Basin. Most deposits are spatially and temporally related to two magmatic assemblages: bimodal basalt-rhyolite and western andesite. These magmatic assemblages are petrogenetic suites that reflect variations in tectonic environment of magma generation. The bimodal assemblage is a K-rich tholeiitic series formed during continental rifting. Rocks in the bimodal assemblage consist mostly of basalt to andesite and rhyolite compositions that generally contain anhydrous and reduced mineral assemblages (e.g., quartz + fayalite rhyolites). Eruptive forms include mafic lava flows, dikes, cinder and/or spatter cones, shield volcanoes, silicic flows, domes, and ash-flow calderas. Fe-Ti oxide barometry indicates oxygen fugacities between the magnetite-wustite and fayalite-magnetite-quartz oxygen buffers for this magmatic assemblage. The western andesite assemblage is a high K calc-alkaline series that formed a continental-margin arc related to subduction of oceanic crust beneath the western coast of North America. In the northern Great Basin, most of the western andesite assemblage was erupted in the Walker Lane belt, a zone of transtension and strike-slip faulting. The western andesite assemblage consists of stratovolcanoes, dome fields, and subvolcanic plutons, mostly of andesite and dacite composition. Biotite and hornblende phenocrysts are abundant in these rocks. Oxygen fugacities of the western andesite assemblage magmas were between the nickel-nickel oxide and hematite-magnetite buffers, about two to four orders of magnitude greater than magmas of the bimodal assemblage.

Numerous low-sulfidation Au-Ag deposits in the bimodal assemblage include deposits in the Midas (Ken Snyder), Sleeper, DeLamar, Mule Canyon, Buckhorn, National, Hog Ranch, Ivanhoe, and Jarbidge districts; high-sulfidation gold and porphyry copper-gold deposits are absent. Both high- and low-sulfidation gold-silver and porphyry copper-gold deposits are affiliated with the western andesite assemblage and include the Comstock Lode, Tonopah, Goldfield, Aurora, Bodie, Paradise Peak, and Rawhide deposits.

Low-sulfidation Au-Ag deposits in the bimodal assemblage formed under relatively low oxygen and sulfur fugacities and have generally low total base metal (Cu + Pb + Zn) contents, low Ag/Au ratios, and notably high selenide mineral contents compared to temporally equivalent low-sulfidation deposits in the western andesite assemblage. Petrologic studies suggest that these differences may reflect variations in the magmatic-tectonic settings of the associated magmatic assemblages—deposits in the western andesite assemblage formed from oxidized, water-rich, subduction-related calc-alkaline magmas, whereas deposits in the bimodal assemblage were associated with reduced, water-poor tholeiitic magmas derived from the lithospheric mantle during continental extension. The contrasting types and characteristics of epithermal deposits and their affinities with associated igneous rocks suggest that a genetic relationship is present between these Au-Ag deposits and their temporally associated magmatism, although available data do not prove this relationship for most low-sulfidation deposits.