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The Relationship of Alteration and Trace-Element Patterns in Epithermal Precious-Metal-Bearing, Fossil Geothermal Systems in the Great Basin

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ABSTRACT

In the Great Basin, epithermal precious-metal deposits occur principally in carbonate and volcanic host-rock environments. Detailed study of these fossil geothermal systems indicates that similar ore mineral deposition processes and trace-element associations occur in both environments. The principal differences are in alteration processes and consequent mineralogies.

Carbonate-hosted deposits characteristically show early decarbonation and multiple episodes of silica deposition including the formation of a silica cap (jasperiod). Argillaceous and feldspathic material is altered to illite. During these alteration episodes, gold, silver, arsenic, and sulfur are the most significant minor elements deposited, along with lesser amounts of tungsten, molybdenum, mercury, thallium, antimony, and tellurium. Carbonaceous material is mobilized and enriched along fault zones and as rinds around intensely silicified zones. Superimposed on this early alteration and metallization are abundant arsenic, mercury, antimony, thallium, and fluorine in association with calcite and kaolinite. A late-stage hypogene argillization is common with the deposition of barite, kaolinite, montmorillonite, jarosite, and alunite.

High-level volcanic-hosted deposits display variable intensities of propylitization in the more mafic host rocks and weak propylitization in silicic host rocks. Phyllic alteration is generally restricted to vein selvages, and feldspar is primarily within the veïns. A silicified or capping zone occurs in the upper parts of vein systems. Hypogene argillic alteration, when present, commonly occurs as an apron collapsing downward across the other alteration types adjacent to and beneath the silica cap. The precious and base metals occur in trace amounts in the silica cap, and are primarily restricted to quartz veins beneath the cap. Arsenic, antimony, mercury, and thallium are highest in the main fluid conduit areas as well as being strongly enriched in the hypogene argillic alteration. When base metals are present, cadmium is also high. Fluorine, bismuth, tellurium, selenium, and tungsten are highly variable from deposit to deposit.