The Geochemistry of Carlin-Type Gold Deposits, Nevada, USA

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Ore and alteration minerals from the Getchell gold deposit, Nevada, provide important information about the physical-chemical conditions during Au deposition in Carlin-type systems. Au occurs in trace-element rich pyrite grains that were overgrown by jasperoid quartz, followed by late-stage realgar and calcite. Fluid inclusion studies show that ore fluids contained < 4 mole % CO_2, trace H_2S, ~4-6 wt.% NaCl equivalent, and were about 180° - 220°C. Ore was deposited at >~ 1.2 km depth.

Elemental gains and losses from wall rocks were determined from samples collected along single beds from ore to waste rocks. Au is hosted non-preferentially by calcareous siltstones and carbonaceous limestones that contain elevated Ag, As, Au, Cu, Hg, Sb, Se, Si, Te, Tl, and W and are depleted in Ca, Mn, Sc, and Sr. Cu and W may be related to the local presence of skarn deposits. K-feldspar is present in unaltered waste rock, but was not observed in ore assemblages. Illite was identified only in ore; its abundance correlates positively with gold (R^2=0.782), and illite likely formed from K-feldspar during Au deposition.

Seven types of pyrite identified by morphology and trace element composition include 2 pre-ore, 4 ore-stage, and 1 post-ore populations. Pre-ore pyrites formed during diagenesis and following igneous intrusion; both types have near stoichiometric compositions. Three fine-grained, ore-stage pyrites have signficantly reduced S and Fe, and elevated Au, As, Cu, Hg, Sb, and Tl (ore elements). High grade pyrite contains 3400 ppm Au and 16.5 wt.% As. The 4th ore-stage pyrite and post-ore marcasite contain nil to low ore elements and ~1 wt.% As.

Au-bearing pyrite precipitated rapidly under non-equilibrium conditions as trace element-rich, acidic fluids reacted with carbonate rock. Fluid-rock reaction caused limestone dissolution, K-feldspar alteration to illite, and sulfidation and Au deposition as reactive Fe in hostrocks was exposed.