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The Oil-Bearing, Carlin-Type Gold Deposits of Yankee Basin, Alligator Ridge District, Nevada

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Abstract

The Carlin-type gold orebodies of Yankee basin, in the Alligator Ridge district of northeastern Nevada, are unique for this deposit type in that they contain abundant oil. This liquid hydrocarbon occurs as (1) primary and secondary fluid inclusions in calcite ± realgar vein networks encircling the orebodies in variously fresh-appearing to strongly decalcified, silicified, and collapse-brecciated Mississippian to Devonian Pilot Shale; and (2) vug- and fracture-filling free oil proximal to the orebodies in scattered, residual pods and lenses of unoxidized, basal Pilot limestone. The fluid-inclusion and free oils are geochemically equivalent and have similar thermal maturities (early to peak oil-generation stage). Timing of entrapment of the fluid-inclusion oils is paragenetically constrained as dominantly premineral and synmineral. Associated free oil could have arrived at any time prior to, during, or after mineralization but before late, oil-barren, spelean calcite vein-mineralization and subsequent supergene oxidation. Biomarker fingerprints and carbon isotope signatures indicate that the oils were self-sourced from the Pilot Shale; their concentration in the organically lean basal limestone suggests derivation from carbonaceous siltstones higher in the formation, but in structurally lower configurations.

The Yankee fluid-inclusion oils were clearly involved in the gold-mineralizing hydrothermal system but were not thermally degraded to pyrobitumen, the analogous solid hydrocarbon characteristic of Carlin-type gold deposits. This relationship suggests that the Yankee system was cooler than the 175° to 250°C widely cited as typical for such mineralization, a contention supported by independent geothermometers. The oil-bearing fluid inclusions all have homogenization temperatures lower than 150°C, with most less than 120°C. Temperature-sensitive biomarker transformation ratios of the oils, expressed as equivalent vitrinite reflectance (R_o; 0.75–0.95%) suggest peak paleotemperatures no higher than about 145°C. These implied low system temperatures are consistent with the lack of evidence for a contemporaneous igneous heat source.

The fossil Yankee basin hydrothermal system is similar in many ways, such as paleotemperature, host rocks, hydrocarbons, hydrothermal alteration, and geochemistry, to nearby, active, moderate-temperature (120º– 130°C) but gold-poor systems which encompass producing oil reservoirs. Numerous such warm systems have likely existed in the past in this region. We suggest that many of them formed small Carlin-type gold deposits and/or oil reservoirs that still await discovery.