

# Evaluation of Radioisotope Dating of Carlin-Type Deposits in the Great Basin, Western North America, and Implications for Deposit Genesis

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## Abstract

A variety of techniques have been used in attempts to date the mineralization in Carlin-type deposits in the Great Basin, with highly variable results. These techniques and results are reviewed in this paper, along with presentation of two new dates, for the Rodeo deposit on the Carlin trend and for the Barneys Canyon deposit in Utah. Complete resetting of sericite by hydrothermal fluids of the temperature and duration of hydrothermal activity that form Carlin-type deposits is considered highly unlikely. Therefore, dates from sericite are generally of questionable value unless that sericite can be shown to have formed during the same hydrothermal event during which Au was deposited. For the deposits that have been investigated to date, sericite dates rarely, if ever, record the age of Au mineralization. However, sericite ages do appear to record pre-Au events in some districts. Such events may have contributed to ground preparation and, to a much lesser extent, to the tenor of the ore. Fission-track and U/Th-He techniques provide important age constraints on mineralization in some districts but also suffer from a less than clear association with Au. Rb-Sr dating of galkhaite, an Hg sulfosalt, provides the only direct age of mineralization, but galkhaite has been recognized in only a few locations (and dated in only two deposits). In a similar manner, adularia is contemporaneous with Au at Twin Creeks, but Twin Creeks is the only Carlin-type deposit where adularia has been reported. Several other techniques (U-Pb, Re-Os, Sm-Nd) have been used in attempts to date the deposits but with limited success.

The best available ages are those from preore and postore igneous events and those from galkhaite. Galkhaite from Getchell indicates a mineralization age of ~39 Ma and that from Rodeo (Carlin trend) indicates a mineralization age of 40 Ma. A new U/Th-He age (34 Ma) for apatite at Barneys Canyon suggests contemporaneity with the nearby Bingham porphyry Cu system. The most reliable data from several deposits and districts in the Great Basin indicate that Carlin-type mineralization occurred in a relatively narrow time interval, between 33 and 42 Ma. This interval coincides with the transition from a compressional to an extensional tectonic environment in the region. Although similar tectonic environments have existed at different times and places in western North America, no other Carlin-type mineralization is known to exist in the region. Therefore, although the age and tectonic environment of these deposits is now reasonably well constrained, it is clear that tectonic environment alone is insufficient to explain the genesis of Carlin-type deposits. Additional, perhaps unique, factors such as host rock geochemistry must have contributed to the development of these exceptional deposits.

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