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DISTINGUISHING HYDROTHERMAL EVENTS USING APATITE FISSION-TRACK THERMOCHRONOLOGY; IMPLICATIONS FOR AU-MINERALISATION IN THE CARLIN – JERRITT CANYON REGION, NORTHERN NEVADA

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Recent dating suggests that the Carlin-type Au-deposits in the Carlin-Jerritt Canyon region of Nevada formed between ~42 and 37Ma. One hundred and five apatite fission-track (AFT) analyses from pre-Cenozoic rocks in this region yield two main age clusters. An older, ~120-70Ma, cluster cooled from >100°C to <60°C during the Sevier orogeny at >60Ma, and preserve the background cooling history. The younger cluster at ~60-20Ma reflect the partial to complete annealing of apatite fission-tracks by heterogeneous pulses in thermal energy from ~40-15Ma. The thermal resetting is concentrated in the Jerritt Canyon-Wheeler Mt area, the northern Carlin trend, and on the NE margin of a large subsurface, ~38Ma, intrusion complex at Welches Canyon adjacent to the Carlin trend.

Samples from the Carlin trend-Welches Canyon area record evidence for a rapid episode of cooling from >100°C at ~40Ma. Subsequent episodes of annealing continued in the Oligocene and Miocene, some samples cooling from >100°C as late as ~20Ma. In the Jerritt Canyon region, at least one sample underwent its last major cooling episode from >100°C at ~ 40Ma. Most of the others underwent their last major cooling event after the end of the Eocene; several in the period between 20 and 15Ma.

At ~40Ma, apatite in the Welches Canyon region and adjacent Carlin trend, underwent an initial period of complete annealing in response to conductive and convective heating associated with emplacement of the ~38Ma igneous complex. The greatest volume of Au in the Carlin trend occurs on the margin of the zone of apatite annealing, where Eocene to Miocene AFT ages are interspersed with older Cretaceous ages. AFT annealing and mineralization in this part of the Carlin trend were the product of fracture controlled hydrothermal flow and advective heat transfer on the periphery of the intrusive complex at ~42-37Ma. The area remained a zone of enhanced permeability that enabled punctuated egress of localised hot fluids to near surface depths until the Miocene. The pattern of Eocene-Miocene AFT annealing in the Jerritt Canyon area reflects a similar pattern of advective heat transfer. Au-mineralization occurs on the margin of a zone of persistent crustal fracture that enabled hydrothermal fluids to reset apatite fission-tracks at several different times after Au-deposition in the middle Eocene.

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