A history of fluid flow at the Marigold gold deposit as determined by apatite and Fe-oxide minerals

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Despite the impressive production history from Carlin-type gold deposits (CTGDs), researchers continue to debate the source of the mineralizing fluid. The Marigold deposit within the Battle Mountain-Eureka mining district has recently been reclassified as a CTGD. Gold mineralization at Marigold is concentrated along fault planes and within the altered margins of Cretaceous dikes. The primary objective of this study is to determine the age of the hydrothermal fluid associated with gold mineralization in the altered margins using (U-Th)/He thermochronology on apatite aliquots from two dikes. The apatites from both dikes yielded Eocene ages (39.9 ± 0.3 Ma and 41.9 ± 0.3 Ma). Although Eocene magmatism has not been previously recognized at the Marigold site, five intrusions at the Lone Tree mine (8 km north of the Marigold deposit) yielded Eocene CA-TIMS U/Pb ages of 40.937 ± 0.030 Ma and 40.947 ± 0.030 Ma. Local Eocene magmatism can, therefore, be interpreted as the source of the hydrothermal fluids responsible for gold mineralization at the Marigold site. A secondary focus of this study is an investigation of the potential for Fe-oxide (U-Th)/He thermochronology to be used as an exploration tool for targeting CTGDs. Iron-oxide minerals, such as jasperoids, are frequently (though not always) spatially associated with Au mineralization in CTGDs, which makes them unreliable indicators for exploration. However, if the emplacement of jasperoids were better understood and could be linked to Au mineralization associated specifically with Eocene fluids, then they could become a useful tool when targeting Eocene-age deposits. There are complications with this method because Fe-oxides can form as secondary minerals due to supergene oxidation, however, (U-Th)/He thermochronology of Fe-oxides can still provide insight on the timing of fluid circulation and potential meteoric inputs to the system, which helps to better understand local genesis. Petrographic/geochemical characterizations of Fe-oxides are presented here.