

Two discrete gold mineralization events recorded by hydrothermal xenotime and monazite, Xiaoqinling gold district, central China

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ABSTRACT

We present in situ LA-ICP-MS U-Pb dating of xenotime and monazite in assemblages with native gold and Au (Ag) tellurides from the Xiaoqinling lode gold district in central China. Composite xenotime and monazite grains formed through coupled dissolution-reprecipitation reactions reveal two discrete gold mineralization events. The first gold mineralization event, recorded by monazite (158.6 ± 3.3 Ma, Tera-Wasserburg lower intercept age) and xenotime cores (157.11 ± 0.83 Ma, weighted mean $^{206}\text{Pb}/^{238}\text{U}$ age), is characterized by the mineral assemblage of lingbaoite (AgTe_3)-sylvanite ($[\text{Au}, \text{Ag}]_2\text{Te}_4$)-stützite ($\text{Ag}_{5-x}\text{Te}_3$)/native tellurium-sylvanite-stützite. The second gold mineralization event, recorded in the rims of xenotime (135.46 ± 0.93 Ma, weighted mean $^{206}\text{Pb}/^{238}\text{U}$ age), is characterized by the mineral assemblage of native gold-calaverite (AuTe_2)-petzite (AuAg_3Te_2)-tellurobismuthite (Bi_2Te_3). Our study implies that the large-scale Jurassic mineralization event in eastern China, related to flat subduction of the paleo-Pacific plate beneath the eastern China continent, also caused widespread gold mineralization in the Qinling-Dabie Orogen, in addition to production of its world-class porphyry Mo deposits. The fact that only a few Jurassic gold mineralization ages have been reported before, may be due to the lack of suitable geochronometers to record the earlier Jurassic hydrothermal processes, which have been overprinted by the better-recognized Early Cretaceous gold mineralization event. This study also presents a rare example of xenotime compositional alterations and resetting of U-Pb ages induced by low to moderate salinity carbonic-aqueous fluids at low temperatures. The textural relationships between gold minerals in contact with such composite xenotime crystals demonstrate that they could have precipitated before, coeval with, or after the dated domains. Since low to moderate salinity carbonic-aqueous fluids are commonly involved in the formation of lode gold deposits, it is crucial to examine xenotime textures and recognize potential alteration textures before carrying out isotopic dating of xenotime collected from these deposits. Without prior compositional and textural characterization, attempts to date such composite crystals could yield mixed dates and meaningless ages.

Keywords: Xenotime, monazite, gold deposit, LA-ICP-MS U-Pb dating, Xiaoqinling, central China