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

Wei Jian[1,*], Jingwen Mao[1], Bernd Lehmann[2], Shitou Wu[3], Lei Chen[1], Shiwei Song[1,†], Jiandong Xu[1,4], Peng Wang[5], and Junchen Liu[1,‡]

[1]MNR Key Laboratory for Exploration Theory & Technology of Critical Mineral Resources, School of Earth Sciences and Resources, China University of Geosciences (Beijing), Xueyuan Road 29, Beijing, 100083, China
[2]Mineral Resources, Technische Universität Clausthal, Adolph-Roemer-Strasse 2A, Clausthal-Zellerfeld 38678, Germany
[3]State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beitucheng Road 19, Beijing, 100029, China
[4]State Key Laboratory of Plateau Ecology and Agriculture, Qinghai University, Ningda Road 251, Xining, 810016, China
[5]School of Earth Sciences and Spatial Information Engineering, Hunan University of Science and Technology, Xiangtan 411201, China

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 $^{206}Pb/^{238}U$ age), is characterized by the mineral assemblage of lingbaoite ($AgTe_3$)-sylvanite ($[Au,Ag]_2Te_4$)-stützite ($Ag_{5-x}Te_3$)/native tellurium-sylvanite-stützite. The second gold mineralization event, recorded in the rims of xenotime (135.46 ± 0.93 Ma, weighted mean $^{206}Pb/^{238}U$ 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 carbono-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 carbono-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