

Nano- to Micron-Scale Particulate Gold Hosted by Magnetite: A Product of Gold Scavenging by Bismuth Melts

Xiaoming Sun,* Haoyang Zhou, Nigel J. Cook, Hai Lin, Yu Fu, Richen Zhong, and Joël Brugger

School of Earth Science and Engineering, Sun Yat-sen University, Guangzhou, China, *e-mail, eessxm@mail.sysu.edu.cn

In hydrothermal ores, gold is commonly hosted by sulfide minerals due to its affinity for reduced sulfur. In contrast, the occurrence of gold in oxide minerals remains poorly documented and incompletely understood. In this study, we demonstrate that magnetite can be a significant host mineral for gold. Skarn ores from the giant Cenozoic Beiya Au deposit (323 t Au @ 2.47 g/t), southwest China, contain abundant nano- to micron-sized gold hosted by magnetite. A range of bismuth minerals (e.g., native bismuth, maldonite, and bismuthinite) occur within the same assemblage. Textural and mineralogical studies as well as thermodynamic modeling indicate that Bi melts scavenged Au from hydrothermal fluids during magnetite growth. Fluctuating $fO_2(g)$ at the surfaces of crystallizing magnetite led to the precipitation of Bi-Au melt, ongoing gold refinement, and entrapment of gold and bismuth minerals within magnetite. Sulfidation of Bi, triggered by increased sulfur content and/or decreased temperature, further promoted gold precipitation. Bismuth melts are interpreted to have played a crucial role in Au enrichment from gold-undersaturated fluids at Beiya. The results imply that magnetite-rich systems are also potential targets for Au exploration and extraction, particularly in cases where coexisting Bi-minerals are observed in abundance.