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Bismuth mineral inclusions in gold-bearing magnetite from the giant Beiya gold deposit, SW China: insights into mineralization process

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Bismuth minerals are commonly found in a wide range of gold deposits and could offer valuable information on the process of gold mineralization. This is because Bi minerals always show immediate association with gold and are sensitive to chemical-physical variations (Afifi et al., 1988). Specifically, native bismuth has a melting point of 271°C and could melt at lower temperatures when gold is added (Okamoto et al,, 1983). It has been verified that Bi melt could efficiently scavenge gold from hydrothermal fluids (Tooth et al., 2008, 2011). The Beiya deposit, situated in the Sanjiang Tethyan tectonic domain in the southwestern China, is one of the largest gold deposits in China (10.4 Moz Au @ 2.47g/t). Located along the contacts between a ∼36 Ma quartz syenite porphyry and the Triassic limestones, the deposit contains abundant massive Au-bearing magnetite ores, which are considered as a product of skarn mineralization. However, the pivotal processes accounting for the huge accumulation of gold resource at Beiya area are poorly constrained. In the massive magnetite ores, abundant native gold was observed to be present as submicron-scale inclusions hosted by magnetite (Zhou et al., 2017). We also noted that abundant Bi minerals occur within these ores (Zhou et al., 2016), which provide critical clues to reveal the processes of gold mineralization. An assemblage of Bi minerals, composed of native bismuth, maldonite and bismuthinite, is present as tiny inclusions in these Au-bearing magnetite grains. Mineralogical study illustrates the encapsulation of native bismuth and maldonite as melts during magnetite growth, which is also supported by the ore-forming temperatures over 300°C derived from previous fluid inclusions study (He et al., 2016). Our thermodynamic modeling demonstrates that Bi melts scavenged gold from hydrothermal fluids. Subsequently, sulfidation of Bi melts resulted in precipitation of gold, which was captured by growing magnetite. We thus propose that Bi melt scavenging gold is responsible for significant volumes of gold inclusions enclosed by magnetite at Beiya.

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