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Contribution of Te-Bi melts in gold enrichment at the giant Jiaodong gold province, North China Craton: Insights from the Taishang deposit

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Abstract

Te-Bi melts have been recognized as crucial agents for scavenging gold in gold deposits related to magmatism, often characterized by a notable Au-Te-Bi association. This association is also recognized in the gold deposits of the Jiaodong district, although the specific roles of Te and Bi in gold enrichment in this region have not been thoroughly evaluated. In this study, we investigate the mineralogy and geochemistry of Au-Ag-Te-Bi mineral assemblages and pyrite at the Taishang gold deposit to better understand the influence of Te-Bi melts on gold enrichment and refine the ore genesis models for the Jiaodong district.

The gold mineralization at Taishang comprises three stages: phyllic alteration (Stage I), pyrite-quartz veins (Stage II), and polymetallic sulfide veins (Stage III). In Stage I, gold mainly occurs as inclusions of native gold and electrum within pyrite, alongside hessite, petzite, and minor tetradymite. Stage II features multiphase Au-Ag-Te-Bi-(S)-(Pb) assemblages, including native gold, electrum, hessite, petzite, tetradymite, tsumoite, joséite-B, and sub-micrometer Te-Bi-(Pb)-(Au)-(Ag)-rich phases as inclusions and fracture-fillings in pyrite. In Stage III, gold mineralization is less intense, marked by sparse native gold and electrum grains intergrown with pyrite, galena, and chalcopyrite. The mineralogical patterns reveal a strong relationship between Au, Ag, Te, and Bi, corroborated by trace element compositions of pyrite, which exhibit strong positive correlations among these elements. Furthermore, the texture of Au-Ag-Te-Bi assemblages in Stage I and II (i.e., unsharp and curvilinear boundaries) suggests crystallization from melts. Supported by relevant experimental evidence, the low temperature of Au-Ag-Te-Bi systems enables Te-Bi melts to effectively scavenge gold from fluids at the temperature conditions of Taishang (246–336 °C). The presence of Au-Ag-Te-Bi association in both Taishang and other Jiaodong gold deposits underscores the importance of Te-Bi melts in enhancing gold enrichment. This finding introduces vital insights into the established model of gold mineralization in the Jiaodong district.

Keywords: Tellurium-bismuth melts, gold enrichment, Taishang, Jiaodong