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The contribution of bismuth melts to gold mineralization: a case study from the Baolun gold ore deposit in Hainan Province of South China

D.R. Xu[1] ,Q. Shan[1], C.J. Wu[1], X.Y. Yu[1], Z.L. Wang[2], M.Z. Hou[1,3], Q.Q. Jiao[1,3], H. Zhang[1]

[1] CAS Key Laboratory of Mineralogy and Metallogeny, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences, Guangzhou 510640, China. E-mail: xuderu@gig.ac.cn
[2] School of Geosciences and Info-Physics, Central South University, Changsha 410083, China
[3] University of Chinese Academy of Sciences, Beijing 100049, China

The Baolun gold (Au) ore deposit in Hainan Province of South China is a large-scale (proven metal Au reserve of more than 80 t), high-grade (average Au grade of 10.3 g/t), native Au-dominated mesothermal (orogenic-type) deposit[1]. With the auriferous altered fractured rocks as minor ores, the auriferous quartz veins (i.e. lode Au) are the main ore modes. They are generally present along a swarm of NNW-trending fracture zones within the Lower Silurian clastic sedimentary rocks of greenschist facies metamorphism[2]. Both thin-section observation and EPMA analysis show that the quartz vein-type ores contain an abundance of Au- and Bi-bearing minerals (e.g., native Au, maldonite, buckhornite, native Bi, bismuthinite, galenobismuthite, cosalite, radhakrishnaite, ingodite), although quartz is the predominant gangue mineral, with minor mica and calcite. This suggests that the Baolun deposit might originate from Au-Bi-S-rich but Te-poor ore fluids.

Four stages of Au mineralization have been identified in the Baolun deposit. The first stage, which occurred at a relatively high temperature from 351°C to 390°C, yielded coarse-grained native Au and associated arsenopyrite, chalcopyrite, pyrrhotite and pyrite. This suggests that ore fluids during this stage was saturated in Au and had low sulfur and oxygen fugacities. The second stage of mineralization with a temperature from 247°C to 325°C is characteristic of Au-Bi metallogenesis, which mainly produced maldonite (Au_2Bi) and associated pyrrhotite and pyrite. These two stages have been considered to deposit the majority of Au. As a result, the ore fluids for the third stage had a dramatic reduction in Au concentration and an obvious elevation in Bi/Au ratio. This is consistent with that Au and Bi occurred as auriferous Bi-melt blebs or droplets with the Au contents lower than 10 wt.%. The presence of auriferous Bi-melt blebs and droplets indicates that Bi was in form of melts coexistent with Au-unsaturated ore fluids when the ore-forming temperatures were over the melting point of Bi (271°C). In this case, the Bi-melts scavenged Au from the auriferous but Bi-rich ore fluids after the first- and second stages of mineralization to form maldonite and auriferous Bi-melt blebs and droplets when the ore-forming temperatures decreased to below 247°C. With the continuous decreasing temperatures up to below 116 °C for the ore fluids, the maldonite became unstable and was decomposed into native Bi and native Au with a pronounced symplectite texture. Moreover, the native Au disseminated in the native Bi-melt blebs by exsolution shows vermiform texture. Finally, the fourth stage of mineralization was characteristic of a metasomatism by the residual Bi-Te-S-rich fluids after the third stage of mineralization, resulting in minerals bismuthinite, jonassonite, joseite, radhakrishnaite, and buckhornite. The present study further confirmed that Au-scavenging by Bi melt has played an important role on the formation of the Baolun Au deposit.

References:

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