

Ore-controlling Structural Model of the Jiaojia Gold Belt, Shandong Province, China

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China has been the world's top gold producer over the last 10 years, and Jiaodong is the most important gold producing area in China, particularly the Jiaojia gold belt, which is one of the three dominant districts in the northwestern part of Jiaodong. Based on the regional geologic background and tectonic evolution of the area, we focus on the key gold deposits of the Jiaojia gold belt, mapping the detailed features of the structural-alteration-mineralization networks and analyzing the architecture of the Jiaojia fault zone and its deformation characteristics in different stages. According to regional- and outcrop-scale deformation features, combined with microstructures and element geochemistry of the ore minerals related to the visible gold, we have established an ore-controlling model and conducted finite element simulation. The results and highlights of this work are as follows. (1) The detailed mapping of typical cross sections in the Xincheng, Jiaojia, and Sizhuang gold deposits in the Jiaojia gold belt shows that the architecture of the Jiaojia fault zone is distinctly zoned by the deformation feature of tectonite from the main fault plane to the footwall rock. The Jiaojia fault can be divided into fault core, cataclastic zone, weak deformation zone, and undeformed wall rock. (2) Five deformation stages can be recognized according to the deformation characteristics of rock in the Jiaojia fault zone. D1 is pre-mineralization ductile deformation during compression. D2 is ductile to brittle deformation also in a pre-mineralization event during the transfer to a transtension regime. D3 is ductile to brittle deformation at the time of early gold mineralization during regional NW transtension. D4 is brittle deformation at the time of late gold mineralization, which is observed as brittle secondary order faults or fractures filled with sulfide veins and calcite veins. D5 is brittle deformation at a post-mineralization time, which occurs as a cataclastic zone filled with fault gouge and breccia caused by NW compression. (3) Pyrite is one of the most important gold-bearing minerals in the Jiaojia gold belt. Four types of pyrite been recognized (Py1, Py2, Py3, Py4), which were often associated with visible gold. Most of the gold occurs in the micro-fractures of the pyrite and a few as inclusions, and there is even some nanoparticle gold among dislocations in pyrite that are probably formed by the remobilization of lattice-gold during the deformation. (4) The complicated kinematic and dynamic features of the Jiaojia fault show that it could be a reverse fault with a possible strike-slip component during pre-mineralization transpression and a normal fault associated with gold mineralization during transtension. Based on analyzing the general structural deformation, the ore-controlling model is mainly transtensional with some dextral slip at the time of mineralization. We have rebuilt the stress field of the Jiaojia gold belt in different deformation stages. Then 3-D finite element simulation of the Jiaojia gold belt in a pre-mineralization setting shows the areas of high main stress or shear stress that are the potential positions for the concentration and precipitation of gold as a result of the release of strain energy and removing the earlier structures.