LI Ruihong, YANG Liqiang, LI Hailin and LIU Yu, 2014. Mineral Assemblages and Deformation of An Ore-Controlling Fault: A Case Study from the Xincheng Gold Deposit, Jiaodong, China. *Acta Geologica Sinica* (English Edition), 88(supp. 2): 1462-1463.

Mineral Assemblages and Deformation of An Ore-Controlling Fault: A Case Study from the Xincheng Gold Deposit, Jiaodong, China

LI Ruihong, YANG Liqiang*, LI Hailin and LIU Yu

State Key laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Beijing, 100083, PRC

The Jiaojia-Xincheng fault zone is one of the most important regional gold-producing belt in the Jiaodong Peninsula, China (Deng et al., 2010; Wang et al., 2014). The Xincheng gold deposit is situated north of the fault, within a typical "Jiaojia" type alteration rock type located within a cataclastic zone (Yang et al., 2004). The shape and scale of orebodies display strong structural control. This is thus an ideal region in which to research the role of deformation in control of ore, and the coupling of structures and fluids within a complex metallogenic system (Yang et al., 2006a, b; 2007; 2009; 2014a, b). The mineral assemblages in the Xincheng gold deposit are not only responses to deformation within the cataclastic fault zone (Deng et al., 2006), but also are supporters for the behavior of ore-controlling structure deformations (Yang et al., 1999).

This paper is based on a detailed structural analysis of representative outcrops. We have collected oriented samples in the cataclastic zone in Xincheng gold deposit, and conducted microstructural and EBSD fabric analysis (Liu et al., 2008; Hu et al., 2009). Ore minerals include pyrite, chalcopyrite, galena, sphalerite and minor pyrrhotite, electrum, native gold, tellurides, and bismuth minerals. Gangue minerals are quartz, sericite, calcite and porphyroclastic feldspar. Microstructural features of the mineral assemblages from the Xincheng gold deposit can be divided into ductile and brittle deformation regimes. Ductile deformation features include undulatory extinction, banded extinction, quartz subgrain development, quartz subgrain rotation recrystallization, boundary migration recrystallization, ribbon structures, σ- and δ-type porphyroclast development, kink bands, deformation and stress-induced lamellae, myrmekite textures, mica fish, and mechanical twinning. Brittle deformation features include domino porphyroclastic structrue, tension cracks, compressional and shear fractures. Many of the ductile deformation features mentioned above are consistent with deformation at high temperatures and took place prior to precipitation of gold mineralization. Our observations of undulatory extinction, subgrain development and rotation recrystallization in quartz, mechanical twinning in calcite and tension cracks in feldspar, show that both ductile deformation and brittle deformation occurred simultaneously with gold mineralization. The compressional and shear fractures without fill represent brittle deformation at low temperature which took place after gold mineralization.

In combination with EBSD fabric analysis, the ore-controlling structure deformation conditions of the Xincheng gold deposit can be divided into three stages. Firstly, the ductile-brittle sinistral shear deformation occurring before gold mineralization resulted from NW-SE compression, at temperatures of 600-700 °C, differential stress of 61-111 MPa, and strain measurement a/c 2.3-4.0, The fractal dimension value of the quartz boundary of dynamic recrystallization is 1.47-1.60, indicating conditions of high temperature, high pressure, high strain zone and strain rate occurred before gold mineralization. Secondly, the NW-SE compressional regime changes to a NEE-SWW direction at the time of gold mineralization. The NE-SW brittle compression-shear deformation is promoted, with temperatures of 200-500 °C, differential stress of 66-136 MPa, and strain measurements of a/c 1.4-2.2. The fractal dimension value of the quartz boundary of dynamic recrystallization is 1.32-1.38, suggesting that conditions at the time of gold mineralization were characterized by low temperatures, high pressures, low strain zones and low strain rate. Lastly, NWW-SEE compression results in post-mineralization compressed-shear deformation at 150-300 °C (low temperature, low pressure brittle deformation conditions).

* Corresponding author. E-mail: lqyang@cugb.edu.cn

Acknowledgments

We are very grateful to Professor Nigel Cook, who reviewed our manuscript with very constructive comments that greatly improved it. This work was financially supported by the National Natural Science Foundation of China (Grant Nos. 41230311), the National Science and Technology Support Program (Grant No. 2011BAB04B09), 111 Project (Grant No. B07011) and Open Research Fund Project of State Key laboratory of Geological Processes and Mineral Resources (Grant No. GPMR201307).

References

Deng Jun, Yang Liqiang, Ge Liangsheng, Wang Qinfei, Zhang Jing Gao Bangfei, Zhou Yinhua and Jiang Shaoqing. 2006. Research Advances in the Mesozoic Tectonic Regimes during the Formation of Jiaodong Ore Cluster Area. Progress in Nature Sciences, 16(8): 777-784.

Deng Jun, Chen Yuming, Liu Qin and Yang Liqiang. 2010. The gold metallogenic system and mineral resources exploration of Sanshandao fault zone, Shandong province. Geological Publishing House, Beijing, 1-371 (in Chinese).

Hu Lin, Liu Junlai, Ji Mo, Cao Shuyun, Zhang Hongyuan and Zhao Zhongyan. 2009. Deformation microstructure Identification Manual. Geological Publishing House, Beijing, 1-92 (in Chinese with English abstract).

Liu Junlai, Cao Shuyun, Zou Yunxin and Song Zhijie. 2008. EBSD analysis of rock fabrics and its application. Geological Bulletin of China, 27(10): 1638-1645 (in Chinese with English abstract).

Wang Zhongliang, Yang Liqiang, Deng Jun, Santosh M., Zhang Huafeng, Liu Yue, Li Ruihong, Huang Tao, Zheng Xiaoli, and Zhao Hai. 2014. Petrogenesis and tectonic setting of gold-hosting high Ba-Sr granitoids in the Xincheng gold deposit, northwest Jiaodong Peninsula, East China: Mineralogy, geochemistry, zircon U-Pb and Lu-Hf isotopes. Journal of Asian Earth Sciences, Doi: http://dx.doi.org/10.1016/j.jseaes.2014.03.001.

Yang Liqiang, Deng Jun, Fang Yun, Chen Congxi, Han Shuqin, Liang Dechao and Meng Qinfen. 1999. Numerical sumilation of structures-fluids coupled ore-forming effects. Buletin of the Chinese Academy of Geological Sciences, 20, 433-437 (in Chinese with English abstract).

Yang Liqiang, Deng Jun, Wang Jianguo, Wei Yanguang, Wang Jianping, Wang Qinfei and Lu Ping. 2004. Control of deep tectonics on the superlarge deposits in China. Acta Geologica Sinica, 78 (2): 358-367

Yang Liqiang, Deng J, Wang Qinfei and Zhou Yinhua. 2006a. Coupling Effects on Gold Mineralization of Deep and Shallow Structures in the Northwestern Jiaodong Peninsula, Eastern China. Acta Geologica Sinica, 80(3): 400-411.

Yang Liqiang, Deng Jun, Ge Liangsheng, Wang Qinfei, Zhang Jing, Gao Bangfei, Jiang Shaoqing and Xu Hao. 2006b. Metallogenic Age and Genesis of Gold Ore Deposits in Jiaodong Peninsula, Eastern China: A Regional Review. Progress in Nature Sciences, 17(2), 138-143 (in Chinese with English abstract).

Yang Liqiang, Deng Jun, Zhang Jing, Wang Qinfei, Gao Bangfei, Zhou Yinghua，Guo Chunying and Jiang Shaoqing. 2007. Preliminary studies of fluid inclusions in Damoqnjia gold deposit along Zhaoping fault zone, Shandong province, China. Acta Petrologica Sinica, 23(1), 153-160

Yang Liqiang, Deng Jun, Guo Chunying, Zhang Jing, Jiang Shaoqing, Gao Bangfei, Gong Qingjie and Wang Qingfei. 2009. Ore-forming fluid characteristics of the Dayingezhuang gold deposit, Jiaodong gold province, China. Resource Geology, 59(2): 182-195.

Yang Liqiang, Deng Jun, Richard J. Goldfarb, Zhang Jing, Gao Bangfei and Wang Zhongliang. 2014a. $^{40}Ar/^{39}Ar$ geochronological constraints on the formation of the Dayingezhuang gold deposit: new implications for timing and duration of hydrothermal activity in the Jiaodong gold province, China. Gonwana Research, 25(4): 1469-1483.

Yang Liqiang, Deng Jun and Wang Zhongliang. 2014b. Ore-controlling structural pattern of Jiaodong gold deposits: geological-geophysical comprehensive constraints. Beijing: Science Press (in Chinese with English abstract).