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A Preliminary Study on the Occurrence State and Precipitation Mechanism of Gold in Pyrite of Zhengguang Au Deposit

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1 Research Background

The Zhengguang Au deposit is located at the Duobaoshan ore-concentrated area, northeastern of Great Xing'an Range. The genesis of this deposit remains controversial. Pyrites are the mainly Au-hosting mineral, which are well developed throughout the following metallogenic phases: (1) Quartz-Pyrite phase (Qtz-Py) produced euhedral medium to coarse-grained pyrite, a few chalcopyrite occurs in the fractures of pyrite and along grain boundaries; (2) Quartz-Calcite-Sulfide phase (Qtz-Cal-Sul) led to the precipitation of euhedral medium to fine-grained pyrite, together with chalcopyrite, galena and sphalerite; (3) Calcite-Pyrite phase (Cal-Py) major as euhedral to subhedral medium to coarse-grained pyrite with few other sulfides. In this paper, trace elements in pyrite from different phases were analyzed by electron microprobe to find out the occurrence state and precipitated mechanism of Au.

2 Analytical Methods

Electron microprobe analysis was performed at the MRL Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences. All pyrite grains were examined by reflected light microscopy to avoid discrete native gold grains or other sulfide minerals within the pyrite prior to analysis.

3 Discussions

Previous studies showed that As was incorporated into pyrite lattice by the replacement of AsS^{2-} or $[\text{AsS}]^{3-}$ (Cook and Chrysosoulis, 1990; Simon et al., 1999a; Simon et al.,

1999b). The negative correlation between As and S indicates that As substitutes for S within pyrite (Fig.1).

Many researchers believe that the contents of Au in pyrite are closely related to As. The positive correlation between Au and As suggests that Au may occurs in the lattice of pyrite (Fig.2). Lattice-gold could be present in two forms: (1) Au^{3+} substitutes for Fe^{2+} to compensate charge disequilibrium, due to the substitution of Au^{3+} by $[\text{AsS}]^{3-}$ (Cook and Chrysosoulis, 1990). (2) Au^+ occurs in a

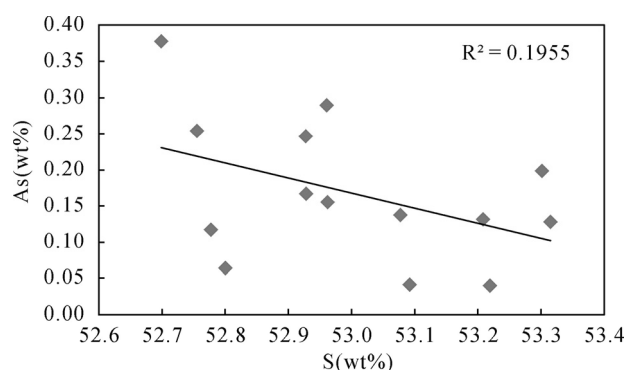


Fig. 1. As-S correlation diagram of pyrites in the Zhengguang Au deposit.

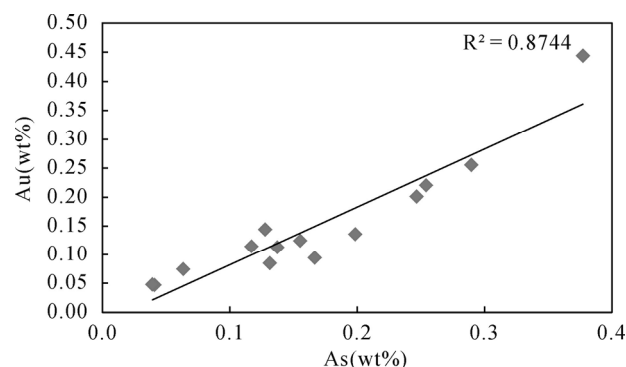


Fig. 2. Au-As correlation diagram of pyrites in the Zhengguang Au deposit.

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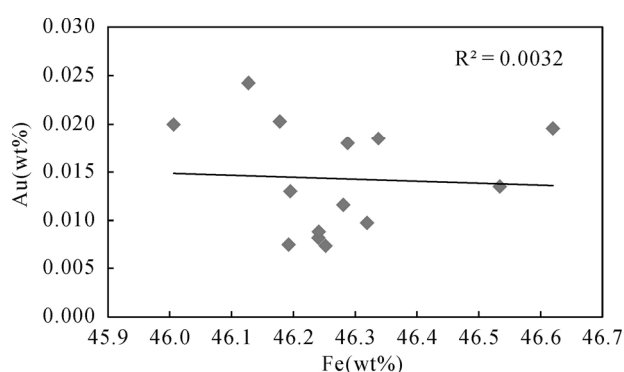


Fig. 3. Au-Fe correlation diagram of pyrites in the Zhengguang Au deposit.

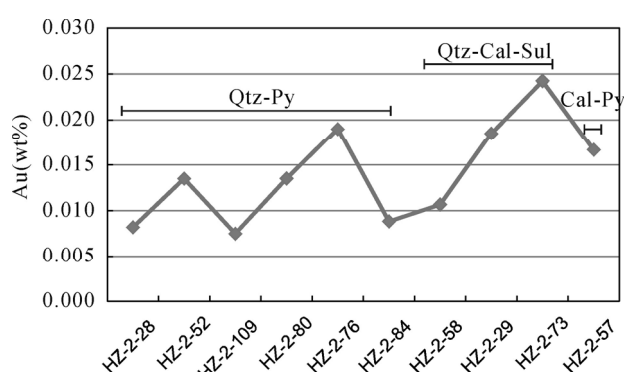


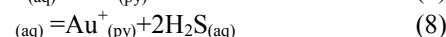
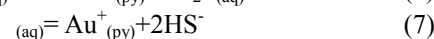
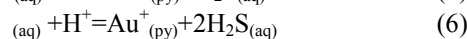
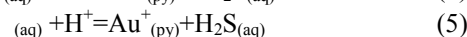
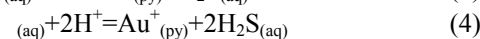
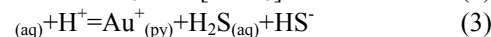
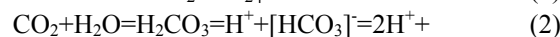
Fig. 4. Contents of Au in pyrites of Zhengguang Au deposit.

cationic vacancy position that was deformed by substitution of S by As, or alternatively formed an unknown Au-As-S compound (Simon et al., 1999a).

When Au^{3+} substitutes for Fe^{2+} , Au is negative correlated with Fe, which contradicted the result (Fig.3). Au may have positive correlation with As, when Au is present as Au^+ .

The crystallization of calcite and sulfides may be helpful in Au precipitation, because of contents of gold in pyrite increased with the evolution of mineralization and reached the highest at Qtz-Cal-Sul phase (Fig.4). Previous study on fluid inclusion showed that the ore-forming fluid enrich , K^+ , CO_2 and H_2S , lack of F^- and Cl^- . Therefore, Au migrated mainly via , and . Moreover, calcite cements surrounding rock breccias have been found in ore district. From the above, gold may precipitate as following process: Reaction (1) to the left and reaction (2) to the right caused by temperature decreasing (Zhai et al., 2011), resulted in concentrations of H_2S , H^+ and in ore-forming fluid increased. Increase in concentration of H_2S lead to abundant sulfides crystallization and concentrations of H^+ further increased; concentrations of increased, leading to calcite precipitation and cements the surrounding rock

breccias; H^+ increased resulting in reaction (3)(4)(5)(6) (Simon et al.,1999b) to the right and Au^+ incorporation into pyrite lattice. In addition, the reduction of pressure caused by tectonic activities may result in the decomposition of gold compound and Au^+ incorporation into pyrite lattice as reaction (7)(8) (Simon et al.,1999b).



4 Conclusions

Au within pyrite of Zhengguang Au deposit may occupy cationic vacancy positions or form Au-As-S compounds. And the crystallization of calcite and sulfides may facilitate Au precipitation. Further studies are needed to confirm the inference.

Acknowledgments

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