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Incorporation mechanism of structurally bound gold in pyrite: Insights from an integrated chemical and atomic-scale microstructural study

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Abstract

Pyrite is one of the most important carriers for Au in hydrothermal deposits, but the incorporation mechanism of structurally bound Au has long been a matter of debate. This is due to a poor understanding of the chemical state and coordination environments of Au in the pyrite structure. Arsenian pyrite is the dominant Au-hosting mineral from the Shanggong Au deposit (130 t Au) in the southern margin of the North China Craton. Our EPMA and LA-ICP-MS results show that the arsenian pyrite has remarkably high Au (0.05–0.78 wt%) and As (0.39–4.60 wt%) contents. Au is negatively correlated with Fe but positively correlated with As. Z-contrast HAADF-STEM imaging reveals that Au atoms sit at the Fe atom sites in the arsenian pyrite structure. Our μ-XANES results and previously reported data suggest that Au and As in arsenian pyrite are predominant of chemically bound Au^+ and As^-, respectively. We thus propose that Au^+ and As^- are both structurally bound and sit at the Fe and S atom sites of pyrite, respectively. As may not be necessary but favorable for the incorporation of structurally bound Au in pyrite. These results have significant implications for understanding the enrichment mechanism of Au from ore-forming fluids with low-Au and low-As concentrations into arsenian pyrite and for revealing the role of As in Au mineralization of hydrothermal deposits.

Keywords: Arsenian pyrite, μ-XANES spectroscopy, Z-contrast HAADF-STEM image, Au incorporation mechanism