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Effects of arsenic on the distribution and mode of occurrence of gold during fluid-pyrite interaction: A case study of pyrite from the Qiucun gold deposit, China

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Abstract

This paper presents the results of an investigation of the incorporation of Au within pyritic ore from the Qiucun epithermal Au deposit, China. The new data provide insights into the mode of occurrence of Au during fluid-rock interactions within epithermal systems. The distribution and mode of occurrence of Au within arsenian pyrite were investigated using a chemical and structural characterization-based approach combining laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) trace element analysis, megapixel synchrotron X-ray fluorescence analysis (MSXRF), and atom probe tomography (APT). The resulting data indicate that invisible Au is present at elevated concentrations in the form of a homogeneous solid solution within As-rich pyrite domains, which yields Au concentrations that positively correlate with As. Arsenic-induced lattice defects, such as stacking faults and the expansion of the pyrite unit cell, provide evidence of the effect of As on the incorporation of Au into pyrite. The nucleation and crystallization of electrum preferentially occurred at the fluid-pyrite reaction interface or along fractures and grain boundaries within the pre-existing pyrite. This study indicates that changes in physicochemical conditions (e.g., temperature, pH, and sulfur fugacity) during fluid-pyrite interactions are key controls on the development of nanometer- or micrometer-scale clusters of gold. The systematic compositional and textural observations documented in this study provide new insights into the mechanisms responsible for the different modes of occurrence of Au (ionic vs. particulate) and enable us to further understand the processes involved in the formation of Au mineralization.

Keywords: Gold, arsenian pyrite, fluid-rock interaction, epithermal gold deposit