# Arsenic influence on the distribution and modes of occurrence of gold during the fluid-pyrite interaction: a case study of pyrite from the Qiucun gold deposit, China

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Different modes of gold are common in arsenian pyrite from epithermal gold deposits, but little is known about the effect of arsenic on distribution and modes of occurrence of Au in pyrite during fluid/rock interactions in epithermal systems. Here we present a detailed study using a novel combination of scanning electron microscopy, electron probe micro-analyser, laser ablation-inductively coupled plasma-mass spectrometry, X-ray diffraction, laser Raman spectroscopy, electron backscatter diffraction, transmission electron microscopy, megapixel synchrotron X-ray fluorescence and atom probe tomography to identify distribution and modes of occurrence of Au in arsenian pyrite, characterize the structure of host pyrite and interpret Au behaviours during the hydrothermal replacement of pyrite by As-rich ore-forming fluids. Results show that invisible Au was enriched as homogeneous solid solution in the As-rich domains of pyrite. As-induced lattice defects by substitutions of As for both Fe and S provide space for occupation of invisible Au in pyrite. In contrast, visible Au was hosted in either grain boundaries or fissures in As-deficient interiors of pyrite. This study shows that extensive hydrothermal alteration at the fluid-pyrite interface promoted Au ions to take part in the build-up of As-rich products as homogeneous solid solutions with As-assisted incorporation, but Au ions also diffused along grain boundaries and fissures into the interiors of early pyrite where slower hydrothermal replacement would promote Au ions to preferentially crystallize as a secondary phase.