

Pyrite geochemistry and its implications on Au-Cu skarn metallogeny: An example from the Jiguanzui deposit, Eastern China

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ABSTRACT

Trace element geochemistry of pyrite is widely used to monitor ore-forming processes of various types of deposits, but its application to skarn mineral systems is not well constrained due to the multi-stage nature and complex associated mineral assemblages for skarn-type pyrite. The Jiguanzui skarn Au-Cu deposit in the Middle-Lower Yangtze River Valley Metallogenic Belt (Eastern China) is characterized by abundant pyrite that formed in the main-ore (Py1), late-ore (Py2), and post-ore (Py3) stages, which makes it ideal for unraveling skarn ore-fluid evolution. Specifically, Py1 is composed of quartz–pyrite (Py1a), quartz–calcite–pyrite (Py1b), quartz–sericite–pyrite (Py1c), quartz–chlorite±epidote–pyrite (Py1d), and quartz–K-feldspar–pyrite (Py1e), among which Py1a is the most widespread. Py2 comprises calcite–pyrite (Py2a) and calcite–K-feldspar–pyrite (Py2b), and Py3 comprise bird’s-eye pyrite (Py3a) and fingerprint-like pyrite (Py3b).

The varying Co/Ni ratios (mostly >2) and coexistence with hydrothermal minerals (quartz, calcite, K-feldspar, chlorite, and epidote) reveal the hydrothermal origin of Py1 and Py2. The Co/Ni (0.97–7.30), Cu/Ni (8.94–186), and As/Ni (0.80–11.7) ratios, and the high trace-element contents indicate that Py3a may have been genetically linked to the waning magmatic-hydrothermal system and increasing meteoric fluid influx. Py1 generally has higher Co-Ni-Se but lower Zn-As-Mo contents than Py2. Py1 in the orebodies also has higher Cu-Au contents than Py2, consistent with the formation of Py1 during the main Au-Cu ore stage. During the ore-fluid evolution, meteoric water input and abundant galena formation in the late-ore calcite-sulfide stage may have controlled the decreasing Se-Co-Ni contents from Py1 to Py2, while the fluid cooling and pH rise (caused by acidic fluid-carbonate rock reactions) may have increased the As-Zn-Mo contents from Py1 to Py2.

Py1a in the orebodies has higher As-Ag-Te, but lower Co-Ni-Se contents than Py1a in the wallrocks. The decompression and phase separation (fluid boiling) by extensive hydraulic fracturing may have caused the higher temperature, pH, and f_{O_2} for the Py1a-forming fluids in the orebodies (than those in the wallrocks). Such fluid physicochemical differences may have been the main controlling factor on trace element spatial variations of Py1a. More importantly, the spatial variation of these trace elements in Py1a provides insights for using pyrite trace element geochemistry in skarn mineral exploration.

Keywords: Pyrite geochemistry, skarn Au-Cu system, Jiguanzui deposit, Middle-Lower Yangtze River Valley Metallogenic Belt, Eastern China