Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28002

Cobalt Occurrence and Genesis of Cu-Co Deposit in the Zhongtiao Mountains, Trans-North China Orogen

BINGBING PEI AND SHAO-YONG JIANG

China University of Geosciences (Wuhan)

Sediment-hosted Cu-Co deposits constitute the world's most critical source of cobalt. However, their genesis—whether formed during syn-sedimentary-diagenetic processes or through later hydrothermal activity during orogenesis—remains contentious. Furthermore, the mechanisms driving cobalt enrichment are poorly constrained. To address these uncertainties, this study investigates the Hujiayu Cu-Co deposit in the Zhongtiao Mountains (southern Trans-North China Orogen), integrating in situ U-Pb geochronology of monazite, major element compositions of discrete cobalt minerals, and trace element analyses of sulfides.

Hydrothermal monazite associated with primary sulfide veins yields a U-Pb age of **1860.6 ± 4.8 Ma**, constraining the timing of mineralization. Cobalt manifests in two distinct modes: (1) as rare, localized independent minerals (linnaeite and cobaltite) and (2) via isomorphic substitution within pyrite and chalcopyrite. Petrographic and SEM observations delineate two paragenetic stages: 1. **Syn-sedimentary-diagenetic Cu-Co stage**: Characterized by fine- to medium-grained euhedral pyrite (Py I); 2. **Syn-orogenic Cu-Co stage**: Marked by coarse-grained pyrite (Py II, Py III) and chalcopyrite (Ccp III) in quartz-sulfide veins. Notably, nonporous Py III forms sulfide rims around porous Py II. Trace element data reveal a correlation between pyrite cobalt content and host lithology (marble, graphitic schist, siliceous albite rocks). Key findings include: Py I exhibits elevated Co and As but low Cu and Ni; Py II shows significantly higher Se, Sn, and In than Py I, reflecting high-temperature fluid-rock interaction; During syn-orogenic mineralization, Co and As progressively decline from Py**II** to Py**III**, signaling elemental depletion in evolving fluids.

These geochemical trends establish a robust link between mineralization stages. The results indicate that syn-orogenic mineralization resulted from the remobilization and upgrading of pre-existing syn-sedimentary-diagenetic mineralization. This study advances the understanding of sediment-hosted Cu-Co systems, emphasizing the role of orogenic hydrothermal processes in cobalt enrichment.