

Metallogenesis of Jinchang Co-rich porphyry gold deposit, NE China: evidence from ore-forming mineralogy

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As a critical and strategic metal, cobalt has seen an increase in demand in recent years due to its widespread use in new energy batteries. This has led to the need to search for new sources of cobalt. Some cobalt-rich skarn deposits are considered to be porphyry-skarn composite deposits, suggesting its potential to be rich in cobalt in porphyry deposits. However, there is a paucity of research on the occurrence, enrichment mechanisms, and metallogenic potential of cobalt in porphyry deposits. The Palaeo-Pacific slab subduction related Jinchang Au deposit (~80 t @ 8 g/t Au) is recently recognized as a Co-rich porphyry Au deposit located in the Heilongjiang province, NE China.

The deposit is characterized by breccia, and fracture-controlled and veinlet disseminated ore with clear Co enrichment in the breccia (Co content ~0.1 wt.%). The MapsMin automated mineralogy analysis on two bulk samples from the J0 breccia orebody further revealed cobalt contents of 0.27% and 0.07%, respectively. Accordingly, the Co mineralization in Jinchang deposit testifies to the huge potential for cobalt mineralization and enrichment in this porphyry Au deposit.

Electron microprobe analysis showed that cobalt is mainly enriched in pyrite in the form of isomorphism, and to a lesser extent in two cobalt minerals, siegenite (CoNi₂S₄) and cobaltite (CoAsS). Three types of pyrites are divided according to their occurrences. Type I pyrites are large-grained euhedral formed in the early stage, coexists with magnetite, and contain high cobalt contents. Type II pyrites are small-grained euhedral-subhedral formed at a later stage, mostly surrounded by chalcopyrite, quartz and carbonate minerals, and have moderate cobalt contents. Type III pyrites are large-grained euhedral-subhedral pyrites occurred in late quartz-pyrite veins, have relatively low cobalt contents. The crystal size distribution data shows that siegenite revealed by MapsMin was formed in two different stages. The decrease of temperature and f_{O_2} or the increase of the As/S ratio leads to the precipitation of cobaltite. Based on the isotopic studies, it is considered that the cobalt in Jinchang deposit is likely to originate from deep mantle-derived magma. Therefore, the Co-rich porphyry deposit is a little-known but special type of cobalt mineralization.

