Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29456

Multi-stage epigenetic mineralization in the Vähäjoki Fe-Cu-Co-Au deposit, Peräpohja belt, northern Finland

DR. MIKAEL VASILOPOULOS, PHD, TERO NIIRANEN, IRMELI HUOVINEN AND JUHA KÖYKKÄ

Geological Survey of Finland

The Vähäjoki Fe-Cu-Co-Au deposit is situated in the Paleoproterozoic Peräpohja belt in northern Finland. It was discovered in the late 1930s, and its genetic classification has remained controversial to this day. Due to the rapidly growing interest in critical raw materials, there is a renewed interest in better understanding the formation history of various polymetallic deposits in northern Finland, including Vähäjoki. In this work we present results of in situ U-Pb dating of monazite and xenotime grains, and trace element analyses from sulfides and magnetite from Vähäjoki performed with the use of single-collector LA-ICP-MS. We also present key mineralogical and lithogeochemical characteristics of the mineralized zones.

Geological and mineralogical characteristics support an epigenetic mineralization at Vähäjoki, with a magnetite- and locally chlorite- and biotite-rich matrix brecciating the predominantly dolomitic host rocks. A later sulfide-rich stage dominated by the presence of pyrite and chalcopyrite is associated with growth of amphibole. Concentrations of Co, Cu and Au reach up to 0.85 wt%, 3.4 wt% and 2.2 ppm, respectively. Cobalt enrichment is related to the presence of accessory cobaltite, but pyrite is also a significant host, having Co concentrations up to 7.3 wt%. The trace element geochemistry of pyrite and magnetite from Vähäjoki is comparable to that found typically in IOCG deposits, giving support for an IOCG classification. Xenotime and monazite grains record several episodes of ore formation between 1.93-1.78 Ga, corresponding to different stages of the Svecofennian orogeny. Sulfide deposition took place during late stages of the orogeny, similarly to several sulfide-rich gold deposits in northern Finland [1, 2, 3]. Metasedimentary rocks belonging to the evaporitic Petäjäskoski formation were identified on the footwall of the deposit. This observation has implications for the involvement of high-salinity evaporitic fluids in the formation of the polymetallic mineralization at Vähäjoki.

[1] Molnár et al. (2018) *Ore Geology Reviews 101*, 936–959

[2] Niiranen et al. (2007) *Ore Geology Reviews 30*, 75–105

[3] Vasilopoulos et al. (2024) *Journal of Geochemical Exploration 258*, 107419