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Brittle fault evolution and fluid composition of hydrothermal Cu-Zn mineralization in the West Troms Basement Complex, Northern Norway

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In this study, we combine structural analysis of fault architecture with a multi-technique approach including fluid inclusion studies, mineral geochemistry analyses, and stable isotope analyses to decipher the fluid evolution, fluid source, and depositional mechanisms for hydrothermal quartz-carbonate-chalcopyrite-sphalerite mineralization. The mineralization is hosted by the brittle Vannareid-Burøysund fault (VBF) in the Neoarchaean to Palaeoproterozoic West Troms Basement Complex, northern Norway (Bergh et al. 2007). Existing K–Ar illite dating of this fault yielded a late Carboniferous through early Permian age (Davids et al. 2013); concurrent with incipient continental rifting that resulted in the opening of the North Atlantic Ocean.

The structural analysis shows that the evolution and architecture of the VBF has strongly controlled the spatial distribution of mineralization, and from cross cutting hydrothermal vein relationships we can discern two main phases of mineralization. Early quartz-sphalerite veins are injected into the cataclastic fault core zone where initial movement along the fault created a fluid conduit that allowed for fluid flow and sphalerite deposition. With subsequent movement and widening of the fault zone, a later and spatially more extensive generation of quartz-chalcopyrite veins formed in both the fault core and damage zones.

Fluid inclusion microthermometry of inclusions hosted by quartz, sphalerite and calcite revealed that the ore-forming fluids were highly saline (27-30 wt. % NaCl equiv.) and composed of $NaCl+CaCl_2+H_2O$. The combination of homogenization temperatures and salinity measurements indicates that the paragenetically early sphalerite was deposited in veins by fluid mixing, while later chalcopyrite were deposited by a combination of cooling and wall-rock interactions. In addition, the early quartz-sphalerite veins contained a higher Na/Ca ratio than the later quartz-chalcopyrite veins, possibly indicating a change in fluid source. The propylitic alteration assemblage indicates a near neutral fluid, with a temperature of 280-300˚C obtained from alteration chlorite geothermometry. The isotopic composition of hydrothermal carbonates ($\delta^{13}C_{VPDB}$ = -4.4 to -6.1 ‰ $\delta^{18}O_{SMOW}$ = 9.3 to 11.0 ‰) indicates a magmatic source of CO_2.

The obtained results indicate that the Cu-Zn mineralization in VBF was epigenetic and strongly structurally controlled, where sulphide minerals (predominantly sphalerite and chalcopyrite) were deposited successively from an evolving saline, near-neutral hydrothermal fluid of a magmatic origin.

References:

Bergh SG, Kullerud K, Corfu F, Armitage PEB, Davidsen B. Johansen HW, Pettersen T, Knudsen S (2007) Low-grade sedimentary rocks on Vanna, North Norway: a new occurrence of a Palaeoproterozoic (2.4-2.2 Ga) cover succession in northern Fennoscandia. Norwegian Journal of Geology 87, p 301-318

Davids C, Wemmer K, Zwingmann H, Kohlmann F, Hjacobs J, Bergh SG (2013) K-Ar illite and apatite fission track constraints on brittle faulting and the evolution of the northern Norwegian passive margin. Tectonophysics 608, p 196-211