ARCHITECTURE OF BRITTLE FAULT STRUCTURES AND SIGNIFICANCE FOR HOSTED ZN-CU MINERALIZATION IN THE WEST TROMS BASEMENT COMPLEX, NORTHERN NORWAY

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Fracture systems in crystalline rocks are high-permeability zones that significantly control fluid flows in the upper crust and may affect transport and deposition of metals under hydrothermal conditions (Gabrielsen and Braathen, 2014). Minerals deposited by the hydrothermal fluids can seal the permeability of the fault. This causes a fluid pressure build up and can cause a subsequent fracturing of the rock adjacent to the fault, creating a seal-crack pump mechanism (Sibson et al., 1975). In this study, we analyze cohesive brittle fault rocks (cataclasites), pre-existing microstructures, and hydrothermal textures to understand the relationship of the fault architecture and the associated Cu-Zn-quartz-calcite hydrothermal mineralization in the brittle Vannareid-Burøysund fault (VBF) on the island of Vanna, located in the Neoarchean to Palaeoproterozoic West Troms Basement Complex (WTBC), northern Norway (Bergh et al., 2007; Bergh et al., 2010).

The VBF is ENE-WSW striking oblique-normal fault system that down-dropped hanging wall strata to the south (Ojala et al., 2013). Five structural and lithological domains exist in section across the VBF and these are characterized as follows: 1) The hanging wall that consists of non-mineralized mylonitized quartz-mica schist. 2) A smaller fault core zone (<7 m wide) comprises at least two generations of protocataclasitic tonalite, hydrothermally cemented with quartz and chalcopyrite. These cemented cataclasites are crosscut by open space Cu-bearing quartz breccias, multiple generations of Cu-bearing quartz veins, and syn-kinematic cracks filled by fine-grained, cohesive cataclasite. 3) A fault damage zone consists of minor cataclasite and relic fragments of the host tonalitic gneiss. An early formed muscovite-rich foliation in the gneisses is overprinted by chloritic shear bands. Multiple generations of Cu-bearing hydrothermal massive veins to feathery quartz stock works crosscut the pre-existing structures. 4) A core zone with minimum two generations of hydrothermal mineralization; early quartz sphalerite overprinted by quartz-calcite-chalcopyrite. The first hydrothermal event cements a fine grained cataclasite 5) Fracture zone in meta-gabbro host rock with cross cutting chalcopyrite bearing massive quartz veins.

The VBF architecture and pre-defined anisotropies of the different host rocks, including core and fracture zones, seem to have strongly controlled fluid flow and hydrothermal mineralization. Early hydrothermal quartz-sphalerite mineralization is linked to core zone (4), suggesting that the core zone was an early fluid pathway. Progressive sealing of this core zone by hydrothermal minerals while cracks still were opening in the fracture zones forced fluids to flow into the surrounding fracture zones (3&4) depositing later quartz+carbonate±chalcopyrite. Highly strained (mylonitic) quartz-mica schists in zone (1) have a lower vertical permeability and thus could have acted as a cap preventing hydrothermal fluids to flow further upward.

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