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Structurally controlled copper mineralizations in the Paleoproterozoic Repparfjord Tectonic Window, Northern Norway

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As part of an ongoing multi-disciplinary study of the Paleoproterozoic Repparfjord Tectonic Window (RTW) in Northern Norway, the possible structural control on the formation of a number of copper mineralizations is being investigated. By combining detailed structural field work, new geochemical and geochronological constraints, high-resolution airborne geophysics and newly acquired seismics, this study aims to develop a conceptual model for the formation of these, still poorly understood, copper occurrences.

The RTW is a culmination of lower greenschist facies metasupracrustal rocks within the Caledonian Nappe System. The known copper mineralizations of the RTW differ in type and size. These include the stratabound carbonate-shale-hosted Nussir deposit (26.7 Mt @ 1.13 % Cu) and the sandstone-conglomerate-hosted Ulveryggen deposit (7.7 Mt @ 0.81 % Cu), in part already exploited. In here we focus, however, on small-scale deposits associated with hydrothermal calcite (+/-quartz) veins, mainly emplaced in metabasalts and metatuffs. These deposits are relatively copper-rich (<10 % Cu) and occasionally enriched in gold (1-4 ppm Au), but are usually thin (1-5 m) and have limited lateral extent (<100 m). Field investigations have revealed significant structural control on their emplacement, and have enabled us to better understand how their metallogenesis fits into the overall regional geological evolution.

The Porsa copper deposit was exploited in the early 20th century and is one of the largest known calcite vein-type copper occurrences in the RTW. It consists primarily of two sub-vertical E-W striking veins arranged in an en echelon pattern. The wall-rock greenstones are influenced by chloritization, albitization and carbonatization alteration reactions, and greenstone clasts are abundant within the veins. Chalcopyrite, pyrite and magnetite are the main ore minerals, while calcite, albite, quartz, actinolite and chlorite make up the gangue mineral assemblage. The contacts of the veins to the wall-rock are relatively undeformed, but their central core is characterised by a strong mylonitic foliation with a sub-horizontal mineral lineation. Kinematic indicators invariably indicate dextral strike-slip kinematics, which is also observed at the regional scale within the RTW. The available evidence suggests that fracturing, fluid circulation, vein formation and metallogenesis were roughly coeval with dextral shearing of the host greenstones, and that the veins formed in an overall NW-SE-oriented shortening field, as part of a regional dextral transpressional setting.

The Bratthammer deposit is a <1 m calcite-quartz vein dipping 50° to the SE. Like the Porsa deposit it has a strongly developed mylonitic foliation, although here a phyllonitic fault gouge is also developed along the contacts of the vein to the side-walls. A well-defined mineral lineation, together with small-scale duplexes and sigma-clasts indicate dip-slip top-to-the NW thrusting. Despite the different orientation and kinematics, it can be related structurally to the same NW-SE directed transpressional stress regime of the Porsa deposit. Preliminary K-Ar geochronology of clay-size mica/illite from the fault gouge constrains a Cambrian maximum age for the faulting and most likely also the vein emplacement.

Based on the preliminary results we suggest that calcite vein-deposits in the RTW are structurally controlled and formed in an overall NW-SE transpressional setting that might be as young as Silurian in age. Re-Os geochronological studies on the sulphides from these deposits are in progress as a first test of the model.