Effect of deformation and metamorphism on metal redistribution at the Sulitjelma volcanogenic massive sulfide deposits

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The Sulitjelma historical mining district in northern Norway shows classic examples of Cu-(Zn) volcanogenic massive sulfide (VMS) deposits, containing more than 20 known ore bodies. The Cu-(Zn) mineralization formed in a marginal back-arc basin setting during Ordovician westward subduction at the Laurentia margin. The basin experienced closure, with ophiolite obduction, as a result of the Scandian phase of the Caledonian Orogeny at 430-420 Ma (Roberts & Sturt 1980). The observed greenschist to amphibolite facies metamorphism is related mostly to Scandian phase deformation and subsequent exhumation.

Deformation and metamorphism can play a significant role in modification of primary deposits and (re)mobilization of metals and elements in sulfide minerals, however the role of crystal plastic deformation in mobilization is not often investigated and therefore poorly understood. Dubosq et al. (2018) showed that several trace elements are introduced or remobilized into deformation-induced substructures within pyrite during deformation. Metamorphic reactions are commonly accompanied by generation of fluids of various compositions which can influence the nature and extent of deformation mechanisms and element remobilization. Our work investigates the interplay between deformation, element remobilization and fluids during greenschist- to amphibolite-facies metamorphism on the VMS deposits at Sulitjelma using both geochemical and microstructural mapping methods to characterize multiphase mobilization of sulfides.

Samples were collected from the Ny-Sulitjelma, Hankabakken, Giken, Jakobsbakken and Sagmo ore deposits and were studied by optical light microscopy, SEM, EBSD, Raman spectroscopy, trace element mapping by LA-ICP-MS, and fluid inclusion microthermometry. We will present preliminary results combining EBSD and trace element data on pyrite grains, showing a complex history of the ores in the area. Numerous fluid inclusion assemblages (FIA) were found with variable compositions (salinity ranging from 0.9±0.3 wt% $NaCl_{equiv}$ to 44.3±1 wt% $NaCl_{equiv}$; presence of different volatiles including CO_2, N_2 and CH_4) and homogenization temperatures (between 138±7°C and 363±5°C) reflecting the evolution of metamorphic fluids that contributed to remobilization of metals during the metamorphic phase of the Sulitjelma deposits.

References

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