GEOCHEMICAL CHARACTERISTICS OF THE SULITJELMA Cu-Zn VMS DEPOSITS, NORTHERN NORWAY

Strmic Palinkas, S. and Birkeland A.
UiT The Arctic University of Norway, Dramsveien 201, 9037 Tromsø, Norway.

The Sulitjelma ore deposits, Nordland County, hosts more than 20 Cu-(Zn) ore bodies with a total tonnage exceeding 35 Mt at 1.8 % Cu and 0.4 % Zn. The mineralization is spatially associated with the Ordovician Sulitjelma ophiolite complex that belongs to the Køli Nappe of the Upper Caledonian Allochthon (e.g., Boyle, 1989; Pedersen et al., 1991; Cook et al., 1993). Both, ore bodies and their host rocks, were exposed to deformation processes and recrystallization during the cycle of metamorphism and tectonic transport caused by the Caledonian Orogeny (Cook, 1996).

The mineralization at the Sulitjelma deposits is characterized by predomination of pyrite over other sulfide minerals. The major ore-bearing phases are chalcopyrite and sphalerite. Galena occurs as a major mineral only in the Jakobsbakken ore body. Pyrrhotite predominates in the Sagmo ore body. Ag-sulfides, Fe-oxides and Ti-oxides are common accessory minerals. Sphalerite contains significant amounts of Fe and Cu, and traces of Mn. The CuS content of sphalerite that occurs in equilibrium with chalcopyrite was used as independent geothermometer after Hutchison & Scott (1981). The CuS-sphalerite geothermometer yielded temperature of 590^{o}C ± 20^{o}C, suggesting the equilibration of sphalerite and chalcopyrite under high temperature metamorphic conditions. In contrast, a low Ag content in galena and close spatial association of galena and Ag-sulfides/sulfosalts suggest retrograde decomposition of primary Ag-rich galena into two immiscible Pb-S and Ag-S phases. Lithogeochemical analyses of bulk ore samples reflect a positive correlation of Ti, Sc and V with Al, indicating alumosilicate mineral phases, probably micas and/or biotite, as a major carrier of these elements.

Although the Sulitjelma deposits were metamorphosed up to amphibolite grade and recrystallisation evidently took place under dynamic conditions near the peak of the metamorphic cycle, rare primary fluid inclusions hosted by syn-ore quartz have been preserved. These fluid inclusions reflect pre-metamorphic ore-forming conditions, including temperature and pressure of ore deposition. The fluid inclusion assemblages that consist of coexisting L-rich and V—rich inclusions suggest entrapment from a boiling fluid. Their homogenization temperatures in an interval from 355 to 370^{o}C reflect entrapment pressure of 20-24 MPa or 2000 – 2400 m depth, assuming a bulk salinity of 7.5 wt.% NaCl and a hydrostatic regime. However, primary fluid inclusion assemblages have been overprinted with later, metamorphogenic, fluids. The metamorphogenic fluids show variations in their salinities, homogenization temperature and volatile content. Secondary fluid inclusions found in Ny Sulitjelma samples are indicative for prograde metamorphic conditions (salinity = 1.4 to 2.1 wt. % NaCl equ, T_h = 125 to 145 °C, no CO_2), whereas secondary inclusions from Giken and Jakobsbakken rather represented retrograde fluids (salinity = 0.9 to 1.9 wt. % NaCl equ., T_h = 260 to 360 °C, variable amount of CO_2).

References

Boyle, A.P. (1989) The geochemistry of the Sulitjelma ophiolite and associated basic volcanics: tectonic implications. The Caledonide Geology of Scandinavia. Graham and Trottman, London: 153-163.

Cook, N.J., Halls, C., and Boyle, A.P. (1993) Deformation and metamorphism of massive sulphides at Sulitjelma, Norway. Mineralogical Magazine 57: 67-67.

Cook, N.J. (1996) Mineralogy of the sulphide deposits at Sulitjelma, northern Norway. Ore Geology Reviews 11: 303-308.

Hutchison, M.N., and Scott, S.D. (1981) Sphalerite geobarometry in the Cu-Fe-Zn-S system. Economic Geology 76: 143-153.

Pedersen, R. B., Furnes, H., and Dunning, G. (1991) A U/Pb age for the Sulitjelma Gabbro, north Norway: further evidence for the development of a Caledonian marginal basin in Ashgill–Llandovery time. Geological Magazine 128: 141-153.