

Cu, Zn and Fe isotope systematics of low-T hydrothermal Fe-Si deposits

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The formation of Si-rich ferric oxyhydroxide deposits is observed distal to the white smoker-type Jan Mayen hydrothermal vent fields at the Mohns Ridge, North Atlantic, in an area of diffuse low-temperature venting. Individual stratified laminated layers within these deposits are largely composed of branching, twisted filaments resembling encrusted stalks of Fe-oxidising bacteria, indicating biologically influenced precipitation of ferric iron.

In this study, we used stable isotope systematics of transition metals from different layers of the Fe-Si deposits in order to trace the evolution of hydrothermal fluids within the oceanic crust, from which these deposits ultimately formed. Isotope measurements show fractionation of the redox-sensitive elements Fe and Cu, whereas Zn with its singular oxidation state behaves more conservatively. Isotopically light Fe ($\delta^{56}\text{Fe} = -2.09$ to -0.66%) points to abiogenic partial, subsurface Fe oxidation [1] and/or dissimilatory iron reduction in combination with re-oxidation by Fe-oxidising bacteria. The reactive surface of the ferric oxyhydroxides of the Fe-Si deposits may absorb Cu and Zn from the venting fluid, thereby preferentially incorporating the heavy isotopes of these elements [2]. However, measured Zn isotope data do not show a significant enrichment relative to hydrothermal fluids [3] and Cu is isotopically lighter than primary hydrothermal Cu sulphides [4]. We hypothesize that precipitation and/or adsorption processes below the seafloor lead to the depletion of heavy isotopes in the evolved hydrothermal fluids from which the Fe-Si deposits formed.

[1] Rouxel *et al.* (2003) *Chem. Geol.* **202**, 155–182.

[2] Balistrieri *et al.* (2009) *GCA* **72**, 311–328. [3] John *et al.* (2008) *EPSL* **269**, 17–28. [4] Rouxel *et al.* (2004) *Econ. Geol.* **99**, 585–600.

Geochemistry of Cheshmeh Sefid manganese deposit, Sabzevar, Khorasan province, Iran

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Cheshmeh Sefid manganese deposit is located in 60 km south of Sabzevar, a major city in Khorasan province, northeast of Iran. The study area is situated in central Iran structural zone. Manganese mineralization is occurred in a volcano-sedimentary succession consisted of grey limestone, submarine volcanic, Neogene sediments and flysch-like deposits. Manganese mineralization is mainly hosted by green colored rhyolitic tuffs of Eocene age. Manganese rich stratiform bodies are enclosed in jasper and overlain by grey colored dacite and rhyodacite. They are often syngenetic, based upon the stratigraphic persistence of the manganese horizon and the observed interstratification of manganese ore and hosting volcanics. Manganese deposits occur as lenses and stratiform bodies of different sizes. Upper and lower contacts of the ore bodies are characteristically sharp. Ore mineralogy and XRD examinations were indicated that pyrolusite, psilomelane and cryptomelane were major manganese ore minerals in the studied deposit.

Geochemically, iron and manganese were characteristically fractionated, producing low Fe/Mn ratios. Si-Mn-Fe and Al-Si discrimination diagrams were also used to recognize between hydrothermal and hydrogenous manganese deposits. The collected geochemical data from the study area plot in the characteristic field of hydrothermal deposits. The manganese ores were indicated relatively low concentrations of Ni, Co, and Cu compared with those concentrations in hydrogenous manganese deposits. Diagnostic plot to Mn-Fe-10 (Ni+Co+Cu) discrimination diagram was indicated a characteristic depletion in Ni, Co, and Cu, suggesting a hydrothermal origin for the studied manganese deposit. Geochemical composition of manganese deposits of the studied area and their host rocks indicates that manganese oxides of the study area are the result of rapid deposition from Mn-rich fluids. These fluids have a hydrothermal exhalative nature and were probably associated with volcanic activities in Eocene period.