Geochemistry of hyperalkaline spring water at the Oman ophiolite

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Hyperalkaline spring water, surrounding surface water, travertines and fissure fillings in peridotite were corrected from Oman ophiolite and investigated the geochemistry and mineralogy to elucidate the formation processes of the hyperalkaline spring water. All water samples ware filtered using 0.2 micron PTFE filter at site and served for the chemical analyses by ICP-MS, ion chromatograph and alkalinity titration. The mineralogy of travertine and fissure fillings were characterized by XRD, FT-IR, SEM-EDX and EPMA. Moreover, the geochemical reaction modelings of water-peridotite interaction were performed by using geochemical code React in the Geochemists Workbench (Bethke, 1996) based on the field observation and analytical results.

The hyperalkaline spring waters were the Na-Cl/Ca-OH type. These are characterized to high pH (11.0-11.7), low Eh, rich in Ca, and poor in Mg, Si, and CO3. On the contrary, surface waters are the Mg-HCO3 type, characterized by moderate alkalinity (8.14-8.73), rich in Mg and HCO3. Fissure fillings are composed of chrysotile, chlorite, sepiolite, brucite, dolomite, calcite, aragonite and magnetite. Two types of chrysotile were recognized in the fissure filling materials from SEM and EPMA analyses. One was the well crystalline chrysotile, and the other was micro-crystal with high Al content. The latter chrysotile was considered to form from the hyperalkaline spring water at low-temperature condition, because the chrysotile was unexceptionally accompanied with sepiolite which should be formed at very low temperature. The mineralogy of the travertine are aragonite, calcite, brucite, hydrotalcite (silica type), and hydromagnesite. The occurrence of hydrotalcite with silica is firstly reported in nature, although the hydrotalcite is an inorganic material which attracts attention worldwide.

Geochemical reaction modeling of water-peridotite interaction indicated that the hyperalkaline spring water was formed by serpentinization and sepiolitization of the peridotite in low temperature condition. High Ca content and high pH would be yielded from the dissolution of Ca-bearing minerals (ex. diopside) at system closed to CO2. Low Eh which can form methane and hydrogen gas is attained by the dissolution of Fe(II)-bearing minerals and formation of magnetite.