

Geochemistry of hyperalkaline spring water and low temperature serpentinization at the Oman ophiolite

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Hyperalkaline spring water (pH 11-12) has been known to issue from the partly serpentinized peridotite (Barnes et al., 1978). If serpentinization is a present-day near-surface phenomenon, formation and evolution of the hyperalkaline water are important for understanding of interaction between groundwater and peridotite/serpentine. Since serpentinized peridotite is one of the major components of the ocean crust (Cannat et al., 1995), the alteration of peridotite may play a much larger role than previously thought in determining the solute chemistry of seawater. In this context, hyperalkaline spring water, surface water, and precipitates around the springs in the northern Oman ophiolite were investigated to model the formation and evolution of hyperalkaline spring water and related precipitates.

The spring water is characteristically hyperalkaline, reducing, low-Mg, Si and HCO₃⁻, and high Ca, while the surface water is moderately alkaline, oxidizing, high Mg and HCO₃⁻. The calculated results from the reaction between the surface water and minerals found in dunite and harzburgite imply that the dissolution of Ca-bearing pyroxene, serpentinization and isolation from carbonate ions are necessary for the production of hyperalkaline spring water with the above characteristics.

White veins composed of carbonate minerals fill the fracture in ultramafic rocks. Some of these veins extend to the surface making the past vent pathway to the surface. Al-bearing serpentine and sepiolite are found at the contact between the vein and ultramafic rock. These also occur as the crusts of sediments surrounding the inactive vents. Hydrotalcite with silica intercalations (Si-HT) were found only around the most actively upwelling spring vent. The paragenetic relationship of these minerals was investigated through laboratory synthesis experiments. Si-HT was synthesized in short duration experiments from a solution containing Mg:Si:Al ratio of 5:3:2 under N₂ environment, and at pH 9.5. The Al concentration was also varied to assess its influence in the formation of Si-HT. Results show Si-HT appears to be a precursory phase to the formation of serpentine and sepiolite. The location of the Si-HT precipitates and its absence in the white veins also suggests its status as a precursory phase.