Geochemical study on Green Tuff related hot springs in Hokuriku district, central Japan

Michiko Ohwada[1]; Hiroshi Satake[2]; Keisuke Nagao[3]

[1] Res. Center for Deep Geol. Environ., GSJ, AIST; [2] Environ. Chem.,Toyama Univ.; [3] Lab. Earthquake Chem., Univ. Tokyo

The Green Tuff is widely distributed along the Japan arc which consists of Neogene sediment of volcaniclastics (hyaloclastite), which erupted by a submarine volcanic activity of subduction zone. Many non-volcanic hot springs are fed in the Green Tuff area. Chemical features of hot springs in the Green Tuff are, 1) quality of water is Na-Ca-SO4-Cl-type, so-called Green Tuff-type hot springs (GT-type), 2) oxygen and hydrogen isotopes in hot spring waters indicate the meteoric origin, suggesting that the water in Green Tuff is replaced from Neogene seawater to the meteoric water. Although these hot springs are non-volcanic, the helium isotope ratios are relatively higher (R/Ra~5) indicating the high contribution of the mantle helium. In this study, we consider the chemical and isotopic features of GT-type hot spring waters, and discuss about the origin and the generation processes of these hot springs.

The Saturation Index for calcite (CaCO3), gypsum (CaSO4.2H2O) and anhydrite (CaSO4) is calculated from the observed chemical compositions. The GT-type hot springs are slightly undersaturated in gypsum and anhydrite, and saturated or oversaturated in calcite. There is a strong correlation between the total dissolved carbon concentration and Na/Ca ratio, whereas almost no relation between SO42- and Na/Ca ratio. The chemical process suggested from chemical features mentioned above is summarized as follows: (1) Elution of gypsum and anhydrite occurred, and the hot spring waters became enriched in Ca2+ and SO42-. (2) Enrichment in Ca2+ causes the precipitation of calcite. (3) Decrease in Ca2+ and HCO3- concentrations due to the precipitation of calcite causes the elution of gypsum and anhydrite. The repetition of these reaction processes creates the water as Ca2+, SO42--rich and HCO3--poor. The d13C value of total dissolved carbon shows wide variation from -25 to -5 permil. The low d13C values of total carbon are found in waters with low HCO3- concentrations. This is consistent with the above mentioned calcite deposition process, because precipitation of calcite removes heavier carbon isotope from water leading d13C value of total carbon lower. On the origin and supply processes of helium to the GT-type hot springs, we consider about the following two possibilities, 1) the fossil mantle helium derived from the gases trapped in Green Tuff layer during its formation in Neogene, and 2) the mantle helium derived from the continental mantle flows into the present GT-type water.