Interaction experiments between eucritic glass and 0.1 M NaCl aqueous solution at 300-500℃ and 1.5 kbar: Suggestions on water-rock interactions at the bottom of Europa’s subsurface ocean

*Makoto Nagasawa[1,2], Yutaro Takaya[1]

1. Department of Resources and Environmental Engineering, School of Creative Science and Engineering, Waseda University, 2. Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo

Europa, the second satellite of Jupiter, probably has subsurface ocean under its icy crust. The yellow-brown color of its leading anti-Jovian hemisphere could be explained by endogenous substances such as sodium chloride, which suggests the presence of hydrothermal activity (water-rock interaction) [Hand and Carlson, 2015]. In this study, we conducted water-rock interaction experiments to determine the mineral assemblage of altered rock on Europa’s mantle surface and to constrain the amount of available energy for sustaining the putative chemoautotroph-based ecosystems.

In our experiments, eucritic synthesis glass and 0.1 M NaCl aqueous solution were reacted at 300-500℃ and 1.5 kbar for 8, 16 and 32 days, using cold-seal type pressure vessels. The water/rock mass ratio was fixed at 1/1 in all the experiments (50 mg of powdered glass to 50 μL of NaCl solution). Solid products were analyzed by X-ray diffractometer and SEM equipped with EDS. Water chemistry of the reacted solution were determined by ICP-MS.

The mineral assemblages observed in our experiments were as follows.
・Fe-rich smectite (saponite), epistilbite and xonotlite at 300℃ and 1.5 kbar
・Fe-rich smectite (saponite), ferroactinolite, Ca-rich plagioclase and minor amount of magnetite at 400℃ and 1.5 kbar
・Mg-rich smectite, ferroactinolite, Ca-rich plagioclase, magnetite and hydroxyapatite at 500℃ and 1.5 kbar

The formation of magnetite at 400-500℃ suggests that these high-temperature water-rock interactions may generate hydrogen and sustain chemoautotroph-based ecosystems. As a future work, we would like to evaluate the hydrogen generation potential quantitatively.

Keywords: Europa, Water-rock interaction

