Japan Geoscience Union Meeting 2010
(May 23-28 2010 at Makuhari, Chiba, Japan)

U004-P04 会場:コンベンションホール 時間: 5月24日17:15-18:45

飽和蒸気圧下における蛇紋岩化作用に関するの水熱反応実験

Hydrothermal experiments on serpentinization along liquid-vapor saturation curve

小笠原 由一[1*], 岡本 敦[1], 土屋 範芳[1]

Yuichi Ogasawara[1*], Atsushi Okamoto[1], Noriyoshi Tsuchiya[1]

[1]東北大学大学院環境科学研究科

[1]Tohoku University

Hydration of ultramafic rocks (sperpentinization) commonly occurs in mid-ocean ridges and mantle wedges within the subduction zones. Serpentinization plays an important role on the global circulation of water, generation of earthquakes and volcanism. Although there has been several experimental studies (e.g., Martin and Fyfe, 1970; Seyfried et al., 2003), however, fundamental knowledge on the kinetics of serpentnization is still unclear. In this study, we conducted hydrothermal experiments on the interaction between ultramafic rocks and pure water to understand the effects of the evolution of solution chemistry and water/rock ratio on the progress of hydration reaction.
The staring materials were powders of olivine (Fo90, Fa10) or orthopyroxene (En65, Fs35) with size of 0.125-0.25 mm and <0.125mm. The powders and the distilled water were set in the batch type vessel made of the stainless steel with water/rock ratio of 1.0. The temperatures were 200, 2 50 and 300 degreeC along the liquid-vapor saturation curve. The duration was 96 h, 168 h, 336 h and 504 hours for each series of the experiments. After the experiments, the solid samples were dried at 90 C for one day, and then were analyzed by X-ray diffractometry (XRD). The progress of serpentnization was also measured as loss of ignition by Thermogravimetry (TG). The concentrations of Si, Mg and Fe in the solutions were analyzed by Inductively Coupled Plasma-Mass Spectrometry. In this study, Fe concentration was less than detection limit in all experiments. The pH values of the solution after the experiments were 8-9.
For the experiments with using opx, we could not detect any signatures of the formation of hydrous minerals by XRD spectrum and weight loss even after 504 hours. The Si concentration increased with time toward 107 ppm, whereas the concentration of Mg was below 3 ppm.
In the experiments with olivine, a clear peak of serpentine was found at 12 degree (2theta) at 250 and 300 degreeC after 504 hours. For the experiments with fine olivine powders (<0.125mm) , the H2O content in the products was 3.5 wt.% at 300 degreeC and 0.4 wt % at 250 degreeC, indicating that 23.3% and 2.7% of forstelite was serpentinized, respectively. In the experiments with coarse powders (0.125-0.250 mm), 4 % of olivine was translated to serpentine. The concentrations of Si and Mg increased toward 25.35ppm and 43.8ppm, and then decreased drastically toward 0.6ppm at 504 hour.
According to activity diagram in Mg-Si-O-H system, the serpentine is stable in high Mg and Si regions. Our results suggest that (1) serpentinazation of olivine occurs faster than that of orthopyroxene, and (2) the evolution of Mg and Si is essential to the progress of serpentinization. Now, we carry out the experiments to investigate the evolution of solution chemistries and water/rock ratio more in detail, and discuss the implication to the natural systems of seprntinization

especially focusing on the difference in the open and closed systems.

References

Janecky D.R. and Seyfried W.E., (1986) Geochim Cosmochim Act, 50,1357-1378
Martin B. and Fyfe W.S., (1970) Chemical Geol 6, 185-202
Allen D.E.and Seyfried, Jr. W.E., (2002) Geochim Cosmochim Act, 67, 1531-1542

キーワード:蛇紋岩化,水熱反応実験,吸水反応,超塩基性岩
Keywords: serpentinization, hydrothermal experiment, hydoration, ultramafic rocks