Mechanism of water chemistry in volcanic areas: experimental study of water-rock interaction

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Introduction

Surface water, such as river or lake water, is affected by various factors such as rock weathering, airborne sea-salt, volcanic activities or anthropogenic influence. Among those factors, it is well known that the behavior of major cations and silica of surface water in volcanic areas is mainly controlled by rock weathering. In order to understand the chemical processes in natural surface waters, it is indispensable to clarify the influence of water-rock interaction in detail. In this research, rock dissolution experiments were performed using andesite and granite, which are typical igneous rocks in Japan. In addition, Shirasu ignimbrite, which covers all over southern Kyushu Island, was also applied. The chemical variation in time series of the experimental water was analyzed to clarify the mechanism of water chemistry in volcanic areas.

Experimental Methods

The dissolution experiments were performed in batch system for over 3 months. The polyethylene reactor was filled with 2L of water solution, of which pH was adjusted with sulfuric acid between 1 to 6. The 100 gram of powdered rocks of less than 150 micrometer in diameter was then added to the reactor. At the fixed time intervals, the 50 mL of water samples were taken to determine the concentration of Na+, K+, Mg2+, Ca2+, Si, in addition to pH and temperature.

Results and Discussion

In each solution, high influence of pH on the chemical concentration was observed. In the experiments of Shirasu ignimbrite, Na+ concentration increased markedly, which accounted for over 70% of the total cation for all terms of the experiment, whereas K+ for about 10%, Mg2+ and Ca2+ for about 5% respectively. At lower pH, Na+ ratio decreased to 50-30%, while the other cations ratio increased, specifically, Ca2+ increased up to 20-40%. The chemical variation in time series was classified into three stages. The experimental solution on the boundary between the first stage and the second stage was plotted around the boundary between gibbsite and kaolinite in the stability diagrams. A similarity of chemical variation was observed between the experimental solutions and the water samples of Kotsuki River, which is a typical river passing through Shirasu ignimbrite area.

We will present the experimental results of the other type of rocks. We will also compare the chemical behaviors between the experimental solution and the real surface water to quantify the influence of water-rock interaction to the water chemistry in volcanic areas.