

Hydrothermal experiments between basalt and H₂O at 130°C and 230°C*Kyoka Ikeda¹, Tomoharu Miyamoto²

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Water-rock interaction occurs during weathering on ground surface, hydrothermal alteration around hot spring on continental crust, and reaction in oceanic crust. Many hydrothermal experiments have been conducted to examine the rock alteration and/or chemical composition of solution under various reaction temperature conditions, but most of them were focused on compositional variation after reactions between seawater and rock samples. In this study, as a primary, pure water was reacted as solvent with basalts samples under 130°C and 230°C conditions to understand the temporal evolution of composition of the basalts and solution under simple reaction in different temperature conditions.

In the experiments at 230°C, many kind of elements were dissolved in the solvent from basalts after reactions. Especially, concentrations of SiO₂ and Na₂O decreased by their dissolutions, on the other hand, Fe₂O₃ and MgO increased by their insolubility, relatively. The run products at 230°C experiments changed their compositions from starting materials more greatly than those at 130°C. In such run products, coarse grains(>200µm) were more outstanding at 230°C experiments, on the other hand, fine grains(<200µm) were kept leaving after long-term experiments at 130°C. It is suggested that groundmass as glass components and fine crystals dissolved precedingly at 230°C during reactions.

Solubility in the solvent showed different temporal variations every element. However, they can be classified into three major patterns. First, concentration of element increased primary and then decreased (pattern I). Secondly, concentration increased primary, decreased secondly, and then increased again (pattern II). Thirdly, concentrations repeated increasing and then decreasing twice (pattern III). Decreasing of elemental concentrations shows its precipitation by saturation after dissolution of starting material. Concentration increasing after decreasing suggests that the precipitated materials dissolved again under unsaturated situation by over precipitation. In the experiments at 130°C, behavior of Fe, Mg and Al, which are classified into pattern I, suggest immediate precipitation unless redissolution after reactions. In contrast, behavior of Si, Na, K, Ca, and Nb, pattern II, suggest that such elements redissolve it easily by the situation of the solution changing even if they were precipitated by oversaturation. Such elemental behaviors in solution are consistent with temporal variations of compositions of solid materials modified after basalt samples: increasing Fe and Mg, decreasing SiO₂, progressively. On the other hand, experiments at 230°C showed immediate precipitations of Fe, Na, K and Nb (pattern I) and re-precipitations of Si, Mg, Ca, and Al after redissolution(pattern III). It is expected that the degree of dissolution and variation of elements in the solution depend on temperature. And then, such factors changed basalt compositions variously detailed in different run products, caused by difference of elemental precipitation or dissolution during reactions.

Keywords: Hydrothermal experiments, Basalt , Alteration