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Reaction and transport during weathering of rhyolite

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Reaction and transport during weathering of rhyolites in Kozushima, Japan, were studied. By comparing the rhyolites having different durations of weathering, a dissolution rate in the field was obtained to be about 6E-19 mol Si $cm^{-2}s^{-1}$. To experimentally analyze the mechanisms and rates of reaction and transport, water was flowed through a core of the rhyolite and the dissolution rate under low Si concentration was measured at room temperature. The dissolution rate decreased with time, and the rates of 1E-17 to 2E-16 mol Si $cm^{-2}s^{-1}$were obtained. The difference of the rates between the field and laboratory appears to stem from the differences of the surface condition and solution composition. The decrease of dissolution rate during the experiment is inferred to be due to the effect of the development of surface alteration layer. To evaluate the effect of solution composition, a diffusion test and a permeability test were conducted on the rhyolite. Although similar diffusion coefficients in bulk water have been reported for K, Cl and Si, the effective diffusion coefficient of Si in pore water was smaller than those of K and Cl. An analysis using a reaction transport equation was applied to the field condition and the concentration profile of Si in rock pores was evaluated. It was revealed that below a depth of several meters the solute concentrations become saturated, which results in slow dissolution rate. Thus, both the effects of surface alteration layer and solution composition largely contribute to the difference of dissolution rates between the field and laboratory.

Keywords: weathering, dissolution, diffusion, permeation, rhyolite