

Ion distribution profile in rock pore water as characterized by centrifugation

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Chemical weathering is the process that primary minerals are transformed to secondary minerals which are metastable or stable near the earth's surface. During the process, ions are dissolved from the primary minerals and some ions are precipitated as secondary products while the other ions are transported to main flow path and are eventually flushed off. In stagnant pore water, dissolved ions are mainly transported by diffusion and concentration gradient from main flow path toward rock interior is formed. Concentration gradient is also formed near a water-mineral interface due to the effect of the electric double layer. Characterization of these concentration gradients is essential for quantitative modeling of water-rock interaction. In order to evaluate ion concentrations in rock pore water, a water-saturated rock core was immersed in deionized water for a week and the pore waters were centrifugally extracted with increasing centrifugal force in incremental steps. A porous rhyolite from Kozushima, porosity 30% and pore radius ranging from 8 nm to 100 μm , was used in the experiment. As increasing centrifugal force, water is considered to come out in the order of larger pores to smaller pores. The analyses of the extracted pore water revealed that the concentrations of Na^+ , Ca^{2+} , K^+ , Cl^- and Si were roughly constant in pores of 100 to 2 μm radius. With decreasing pore size (increasing centrifugal force), the concentrations of ions having relatively high solubility (Na^+ , Ca^{2+} , K^+ , Cl^-) increased by 3 to ~ 100 fold while that of Si somewhat decreased. These concentration gradients appear to correspond to the diffusion profile from bulk water to water-mineral interface. The decrease of Si concentration could be partly attributed to the effect of the decrease of Si solubility in small pore.