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# Relationship between water saturation and reactive surface area of sandstone

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Dissolution and precipitation of minerals and adsorption of dissolved matters onto minerals occur at the contact surface between minerals and water. Estimation of the contact surface area (reactive surface area) is important for quantitative treatment of the reaction and material transport in rocks. Many studies on water-rock interaction have measured the dissolution rate and reactive surface area by inpouring a liquid into a saturated rock. However, in the earth surface the rock pores are not filled only with water but also with air, and the water saturation often changes owing to intermittent supply of water. In such unsaturated condition, only subsets of minerals contact with water. This indicates that the reactive surface area measured by the laboratory experiments using a saturated rock may differ from the values of natural conditions. To our knowledge, few studies have evaluated how the water saturation of a rock affects the reactive surface area.

In the present study, we conducted dissolution experiment under various water saturations and evaluated the effect of water saturation on reactive surface area. Fontainebleau sandstone (porosity: 7.4%, pore radii: 1-10 micro meter, mineral composition: 100% quartz) was used as a sample. Water saturation of the rock sample was first adjusted to 0%, 50%, 100%. Then, for each water saturation, water was inpoured into the sample under a constant water head and dissolved Si in the water passed through the rock was measured by Molybdate blue method. By dividing these values by a value for completely saturated condition, relative reactive surface areas, the ratio of reactive surface area for each water saturations to that in completely saturated condition, were calculated for each water saturations. The relative reactive surface area decreased with decreasing water saturation. At a water saturation of 39%, a minimum relative reactive surface area of 50% was obtained.

Although the extent at which water saturation affects reactive surface area may depend of mineral composition and pore structure, the result in the present study indicates that estimation of the effect of water saturation is important in quantitative treatment of water-rock interaction in the earth surface.

Keywords: reactive surface area, water-rock interaction, water flow, water saturation, sandstone