Effect of difference in mineral wettability on water-mineral reaction in rock pores

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When water infiltrates rock pores, dissolution occurs at the contact site of water and mineral. In many cases rock pores near the ground surface are not fully saturated with water and a portion of pores is filled with air. In order to study how the presence of air in pores affects the reactivity of each rock-forming mineral, the amounts of elements leached out from the rock were compared for water-saturated condition and unsaturated condition by using a core of Berea sandstone. The sandstone consists mainly of quartz with several percentages of feldspar, carbonates, and clays. In the case of the saturated condition, initially pores were saturated with water by vacuum treatment, then water was passed through the core at a constant water head difference. In the case of the unsaturated condition, water was passed through a dry core. After the onset of the experiment under the unsaturated condition, water saturation (the fraction at which pore volume is saturated with water) became ~60% almost immediately (air 40%), and gradually increased and reached ~100% after 9 days passed. Dissolution rates of Si and Ca (amount of dissolution per unit time per whole rock) were determined by measuring the concentrations of dissolved Ca and Si in leachates. The difference in dissolution rate between unsaturated condition and saturated condition was generally greater in the case of Ca than that of Si. This appears to be due to the difference of wettability of silicates and carbonate. Probably silicates were more easily wet and many silicate surfaces dissolved even under the presence of air, while dissolution of carbonate was diminished due to the absence of water contact or the insufficient flushing of Ca in the wetting film of the carbonate surface.

