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Abstract:

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Spontaneous Imbibition Measurements to Demonstrate Wettability Change During Carbon Geosequestration In Saline Aquifers

The threat of global warming due to anthropogenic carbon dioxide in the atmosphere makes the capture and geologic storage of this greenhouse gas an option for environmental remediation. It is anticipated that geologic storage of CO_2 can meet global emission reduction targets aimed at limiting atmospheric temperature increase to 2^oC by the year 2050. Nevertheless, geologic storage appears to be a major concern among the environmental community. The geologic constraint is linked to the two-phase flow hydraulic parameters of the carbon dioxide-water-aquifer rock system. These hydraulic parameters are fluid phase relative permeability and capillary pressure, which are strongly governed by the wettability state of the system. The wettability of such a geologic storage system evolves due to the carbon dioxide-water-rock reaction phenomenon. Previous research has addressed the wettability change phenomenon, but these studies have predominantly used minerals of representative saline aquifer and sealing rocks. In all cases contact angle measurements were made on the surfaces of the minerals after interacting them with carbon dioxide.

In this study two mineralogically distinct siliciclastic potential saline aquifer rock core samples have been used in a two-phase flow experiment governed by capillary pressure gradient to determine the effect of pH on wettability. Spontaneous imbibition measurements under laboratory conditions using water and brine at varying pH have been used to simulate in situ geologic conditions during carbon dioxide injection into saline aquifers. Core samples saturated with air were subjected to spontaneous imbibition from a beaker of water and the height rise of the imbibition front was measured *vs.* time. Contact angles were calculated in accordance with the theory of spontaneous imbibition dynamics using this data and the petrophysical properties of core samples.

The results give evidence of pH induced wettability evolution similar to those encountered using representative minerals. On the basis of the results of contact angle computations, silica or quartz rich saline aquifers without pH buffering minerals have been recommended for efficient geologic storage of anthropogenic carbon dioxide.