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Wettability from Capillarity of CO_2-Brine-Rock Systems at Reservoir Conditions

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The wettability of CO_2-brine-rock systems will have a major impact on the management of carbon sequestration in subsurface geological formations. Recent contact angle measurement studies have reported sensitivity in wetting behaviour of this system to pressure, temperature and brine salinity. We report results of an investigation into the impact of reservoir conditions on wetting through direct observations of their impact on the capillary strength of the system. Eight capillary pressure characteristic curves were measured using CO_2 and brine in a single fired Berea sandstone at pressures (5 to 20 MPa), temperatures (25 to 50 °C) and ionic strengths (0 to 5 M kg-1 NaCl) representative of subsurface reservoirs. A ninth measurement using an N2-water system provided a benchmark for capillarity with a strongly water wet system. The semi-dynamic capillary pressure core flooding technique was used with in situ saturation monitoring. In all cases, the capillarity of the system, scaled by the interfacial tension, were equivalent to the N2-water system within measurement uncertainty. Thus reservoir conditions did not have a significant impact on the capillary strength of the CO_2-brine system through a variation in wetting. Two steady-state relative permeability measurements with CO_2 and brine and one with N2 and brine similarly show little variation between conditions, consistent with the observation that the CO_2-brine-sandstone system is strongly water wetting and invariant across a wide range of reservoir conditions.