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Laboratory Measurement of Streaming Potential Coupling Coefficient for Sandstones Saturated with High Salinity Brine

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Measurements of streaming potential can be used to monitor subsurface flow using electrodes installed at the surface or along boreholes. However, to interpret the measurements requires an understanding of the streaming potential coupling coefficient, which dictates the magnitude of the streaming potential for a given fluid potential. Previous laboratory measurements of the coupling coefficient in earth materials focussed on crushed and intact rock samples saturated with NaCl and KCl brine of relatively low salinity: salt concentrations were typically lower than average seawater. However, many subsurface brines are of significantly higher salinity.

We have measured the streaming potential coupling coefficient in intact sandstone samples saturated with NaCl brine at concentrations up to 5.5 mol/L. The values we record at low salinity are consistent with those reported previously. As brine salinity increases, the coupling coefficient decreases in magnitude, falling to a value of c. 0.145 mV/MPa at 5.5 mol/L, and remains negative over the entire salinity range. We obtain consistent results from several sandstone samples, and using two different sets of experimental apparatus.

The magnitude of the coupling coefficient, and corresponding zeta potential, that we observe at high salinity, is larger than predicted by extrapolating measurements at lower salinity into the high salinity domain. This suggests that streaming potential measurements may be used to monitor flow in a wider range of subsurface environments than previously thought.