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Salinity and saturation dependence of the streaming potential coupling coefficient of porous carbonate rocks

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The seismoelectric and self-potential methods are showing promises to characterize both the vadose zone of the Earth, hydrocarbon reservoirs and CO2 sequestration. That said, the dependence of a key parameter, the streaming potential coupling coefficient, with the saturation remains highly debated. We explore here the relationship between the streaming potential coupling coefficient, the water-gas saturation and the salinity in saturated and partially saturated carbonate rocks characterized by distinct textures. All the samples are saturated with NaCl brines, from 2.10-3 Mol L-1 to 2 Mol L-1. The magnitude of the coupling coefficient increases when the brine salinity decreases. Moreover, the streaming potential coupling coefficient seems independent of the nature of the rock in the range 2 –600 mD. The core samples are characterized in terms of their porosity and intrinsic formation factor. A new core flooding system is used to measure simultaneously both the relative permeability, the resistivity index and the streaming potential coupling coefficient in steady-state two-phase flow conditions as a function of the saturation with CO2 or N2. The results are compared with a recently developed theoretical model, which can accommodate either the Brooks and Corey model. This model is predicting a set of relationships between the streaming potential coupling coefficient, the relative permeability and the second Archie's exponent. We found a good agreement between the model based on the Brooks and Corey approach and experimental data.

References

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