Impact of wettability on two phase flow at the pore scale

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Flow behaviour during immiscible displacement in porous rock is significantly influenced by the wetting properties of the chemically heterogeneous rock surface. This impacts various multiphase problems, for instance oil recovery. Lowering the salinity of injected water was found to change the wettability and to cause an increase in production [1]. Although this Low Salinity method was proven [1, 2], the processes leading to the increase in production at the Darcy scale are still not fully coupled to pore scale understanding. In this study we directly observe the effect during water floods in 3D and real time, for crude-oil saturated sandstone and carbonate rocks by employing synchrotron beamline-based fast X-ray computed tomography. The obtained 3D fluid configurations provide insights into when and where in the pore space low salinity influences the flow behavior. An initial analysis of the whole range of samples over varying flow conditions from 200 g/l to 27 g/l KI-brine at a flowrate of 30 µl/min clearly show a movement of the crude from pore throats to pore bodies at the transition from high salinity to low salinity brine.

[1] Webb et al. (2003) SPE 81460 [2] Mahani et al. (2015) Energy & Fuels 29.3, 1352-1367.