Supplementary Material (ESI) for Lab on Chip
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Supporting Information

Functionalization of Micromodels with Kaolinite for Investigation of Low Salinity Oil-Recovery Processes

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In the following sections, we provide information to supplement the article content. This document shows the images in Fig.9 in more detail, and the velocity field for single phase, incompressible flow through the micromodel as determined by pore-scale flow simulation.

Pore-scale flow simulation

Pore-scale simulation of single phase, incompressible flow through a system with the same geometry as the micromodel used in this study shows the locations of the preferential flow paths and high velocity (red) vs. low velocity regions (blue). The simulation results are obtained from full Navier-Stokes solutions for this given setup. The simulations were performed by Cyprien Soulaine.[1,2] Importantly, the flow paths here follow the pressure gradient applied and narrow pore throats in preferential flow paths are seen to constrict the flow and drastically increase the local fluid velocity. These correlate well to locations where pore-bridging clay structures were initially deposited.

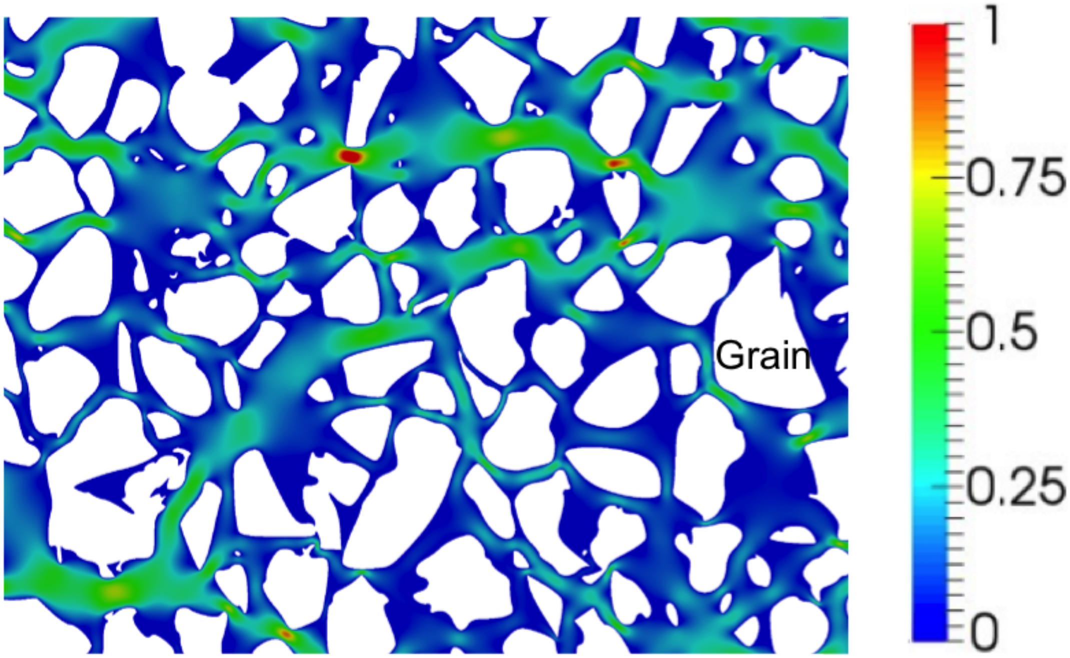

Fig. S1. Pore-scale simulation of single phase, incompressible flow through the micromodel; flow is from left to right in accordance to the pressure gradient applied. Velocities have been normalized to lie between 0 and 1. Preferential high velocity flow paths, indicated by the green regions, are seen. Constrictions due to narrow pore throats in these flow paths clearly indicate a drastic increase in flow velocity and correlate well to locations where initial pore-bridging structures were found. Significant clay particle deposition was found in the low velocity regions (indicated by blue) that are in close proximity to the high velocity regions.

High resolution images of Fig. 9.

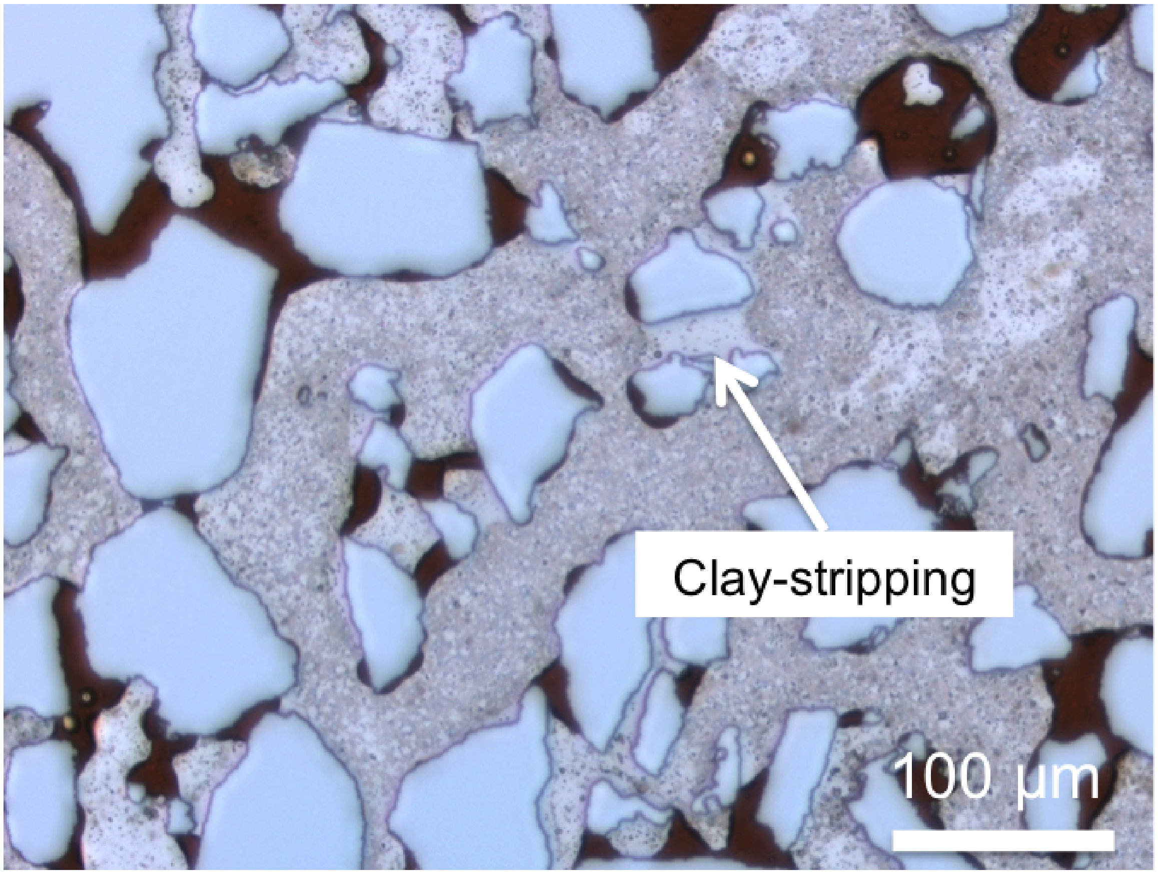

Fig. 9(a) Clay stripping from the pore surface due to low salinity brine injection.

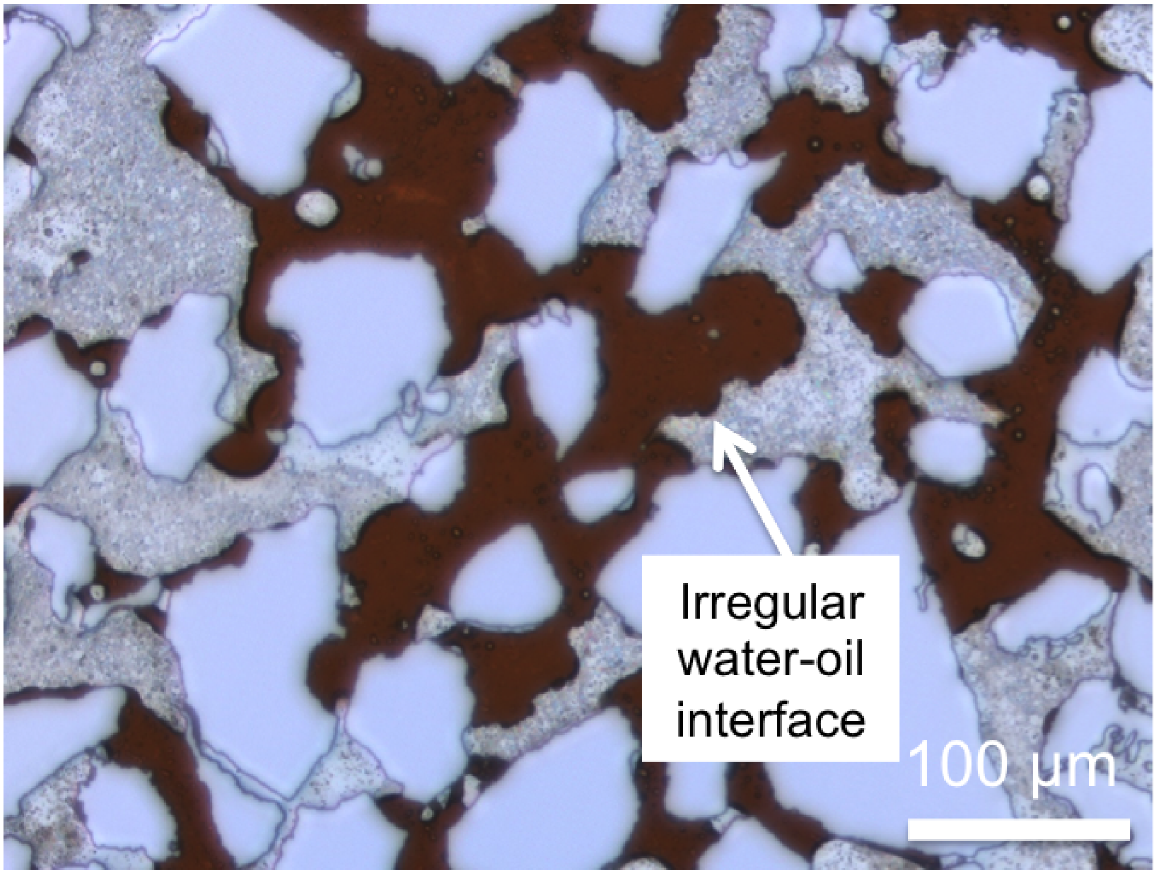

Fig. 9(b) Irregularly shaped water-oil interfaces due to surface interactions between oil components and clay.

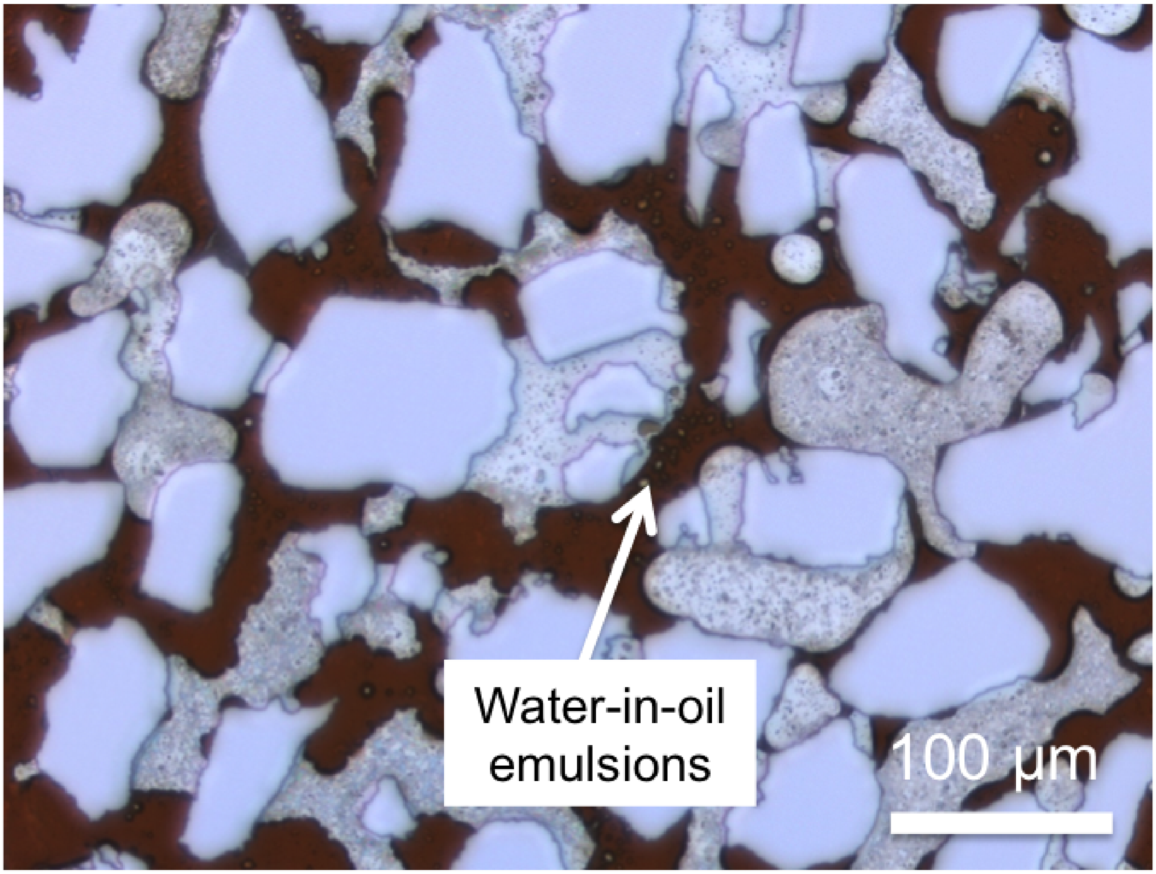

Fig. 9(c) Water-in-oil emulsions were found throughout the oil phase following the low salinity flood.

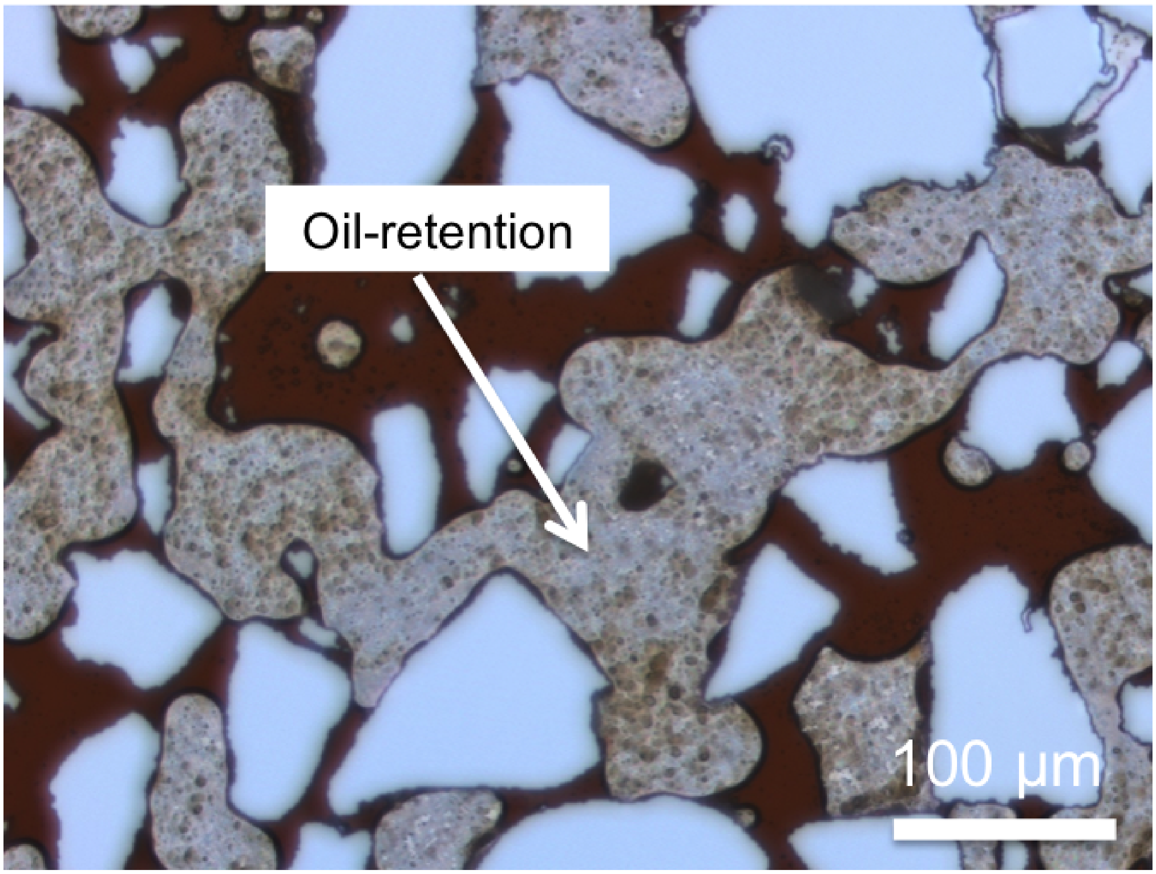

Fig. 9(d) Retention of oil on the clay surface after low salinity waterflooding indicate oil-wettabililty of clay particles.

1. C. Soulaine, personal communication.
2. S. Roman, C. Soulaine, M. Abu AlSaud, A.R. Kovscek, H. Tchelepi, "Particle Velocimetry Analysis of Immiscible Two-Phase Flow in Micromodels," *Advances in Water Resources*, submitted Apr 2015.