Pore scale release and transport of oil by low salinity water
An iCASE Studentship with BP at Sunbury – 4 years funding with internship
Supervisor: Dr Sam Krevor

The use of low salinity injection water can boost oil production in reservoirs, but there is still uncertainty around the underlying physical mechanisms. We propose the use of recent advances in X-ray imaging of fluid displacement processes in the pores of rocks to uncover the key processes leading to enhanced oil production. The entrapment, release, and flow of oil is controlled by interfacial forces between the fluid and solid phases. Recently contact angles between fluid and solid phases have been characterized *in situ* leading to a mechanistic understanding of macroscopic wetting states, e.g., mixed and water wet *[Al-Menhali et al., 2017]*. There is a wide distribution of contact angles in mixed and oil-wet rocks, and this is possibly controlled by local variations in mineral chemistry and morphological texture *[Lai et al., 2015]*. The multiphase flow of fluids at low capillary numbers characteristic of reservoir systems has also been shown to be far more dynamic than previously assumed. There is a constant reorganization of connectivity during steady state flow *[Reynolds et al., 2017].* In this project we propose to build on this understanding to evaluate the changing interfacial force balance during low salinity flooding, and its impact on pore scale fluid dynamics. The project will make use of the advanced petrophysical optical and X-ray light imaging and experimental facilities at Imperial College London, with the possibility for observations at the Diamond Light Source Synchrotron.

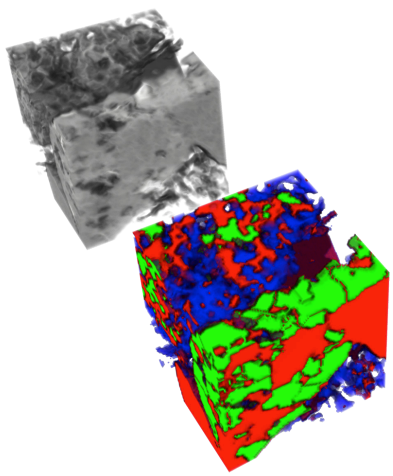

Figure 1. 1mm^3 X-ray CT image of a sandstone (upper) segmented into mineral groups - Quartz, clay, K-feldspar. From *Lai et al., 2015*

Project aims
The aims of this work are to deepen our understanding of the mechanisms of the effects of low salinity flooding on multiphase flow in the pore spaces of rocks. This project aims to use the most advanced experimental and modeling tools available in characterizing flow phenomena, potentially opening the door to the development of fully predictive models of multiphase hydrogeologic processes.

Student profile and Imperial Research Environment
The project will combine both components of laboratory research, image processing, and the use of in-house numerical models to analyse and simulate flow properties. The students may have primarily background in experimental or computational work, but should be willing to adopt an approach where various tools will be combined. The digital rock experimental and analytical facilities within the research group are world leading, with in house capabilities for 3D X-ray

imaging of fluid displacement at scales ranging from the micrometer size of individual pores up to meters where continuum models of multiphase flow are typically applied.

This studentship is offered as an Industrial CASE, or iCASE, studentship in collaboration with leading researchers at BP in Sunbury. The student will receive 4 years of full funding plus extra support from BP. Additionally, the student will spend a minimum of 3 months with BP at Sunbury. This provies an excellent opportunity to collaborate with leading industrial researchers in the fields of digital rocks and low salinity flooding. The links with industry also provide important opportunities for career development. See more information about the iCASE program at the following:
https://www.epsrc.ac.uk/skills/students/coll/icase/intro/

Please do not hesitate to contact me for further information and informal enquiries:
s.krevor@imperial.ac.uk
http://www.imperial.ac.uk/people/s.krevor
http://www.krevorlab.com

References:

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