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

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: