Geophysical Research Abstracts
Vol. 20, EGU2018-10643, 2018
EGU General Assembly 2018

Fast-scan X-Ray Tomography of Imbibition and Drainage in Carbonates

Michael Lacey (1,2), Cathy Hollis (1), Nima Shokri (2), Nathaly Archilha-Lopez (3), Thomas Seers (4), Matthew Andrew (5), Hannah Menke (6), and Peter Lee (7)

(1) School of Earth and Environmental Science, University of Manchester, Manchester, United Kingdom, (2) School of Chemical Engineering and Analytical Sceince, University of Manchester, Manchester, United Kingdom , (3) Brazilian Synchrotron Light Laboratory, Campinas, Sao Paolo, Brazil, (4) Department of Petroleum Engineering, Texas A&M University, Doha, Qatar, (5) Zeiss United Kingdom, Cambridge, UK, (6) Department of Earth Science and Engineering, Imperial College London, London, UK, (7) Diamond Light Source, Oxford, UK

Carbonate systems exhibit heterogeneity from the basinal to the micro scale, with often unique combinations of pore types forming by specific depositional and diagenetic processes within different formations. This leads to great complexity in predicting permeability from one location to another whether metres or kilometres apart. There are a number of methods to try and constrain this uncertainty in carbonate permeability heterogeneity across multiple scales such as facies characterisation and sequence stratigraphy at the macro-scale, core and thin section analysis and fabric classification at the meso-scale and conventional lab techniques such as porosity, permeability and MICP relating to the micro-scale. However, single phase permeability can rarely predicted from porosity alone. Pore topology has an important control on single phase permeability, and this is now being investigated for two phase flow as well.

This work focuses on characterising the topology of the pore network and investigating the effect this has on the distribution of the two invading fluids. In order to investigate the effect of pore topology on permeability in carbonates, a real-time drainage and imbibition experiment has been conducted. The experiment consisted of two stages; initially the brine saturated carbonate sample was injected with a 50/50% dodecane and iododecane solution to simulate oil emplacement, followed by brine injection to simulate waterflooding. Throughout the experiment high resolution 3D images were captured at regular timesteps, 40 seconds apart.

Preliminary results indicate a relationship between a pores geometry and the timestep at which the given pore is filled. The pore shape parameters used to characterise the pore topology are: pore size, aspect ratio, sphericity, and specific surface area (SSA). In results to date, each of these parameters show that the more geometrically simple pores (lower aspect ratio, higher sphericity or lower SSA) are invaded in earlier timesteps relative to more complex pores.