An experimental and digital investigation into the impact of diagenesis above and below the oil-water contact

Francis Mujica*, Lesley A.* James*, Carl F.* Berg and *Derek H. C* Wilton

Abstract. We have investigated core samples from the Ben Nevis Formation in the Hebron field, offshore Newfoundland, Canada. This field has a short transition zone, and a clearly identified oil-water contact (OWC). Through analysis of Scanning Electron Microscope (SEM) and Cathodoluminescence (CL) images of thin sections from samples close to the OWC, we have identified different diagenesis above and below the OWC. In particular, we have observed more quartz cementation in the water zone. This observation is in agreement with the "oil retard diagenesis" theory widely discussed in the literature.

The purpose of this project was to investigate how the observed differences in diagenesis affect the pore structure and transport properties in the Ben Nevis Formation. We have evaluated the core samples' pore structure through mercury injection capillary pressure (MICP) experiments and micro-CT imaging of the core samples. Further, we have conducted digital rock simulations to evaluate the transport properties. We have simulated mercury injection by a quasi-static morphological method, electrical conductivity by solving the Laplace equation, and single-phase flow by solving the Stokes equation. Both, experimental and digital analysis were performed to eleven core samples distributed from the oil and water zones.

Our results show that despite the differences in quartz overgrowth above and below the OWC, the pore structure remains surprisingly consistent. This indicates that the diagenetic differences undergone by the rock as a result of the different pore fluids do not substantially affect the flow properties. We will discuss the experimental and digital methods and why the diagenetic differences apparently have small influence on pore structure and transport.