

## Imaging of Micro-Scale Wettability and Fluid Distribution in Unconventional Light Oil Reservoirs

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### Summary

Rock composition and pore structure in unconventional light oil (ULO) reservoirs is known to vary at the micro-scale, yet fluid-rock interaction is typically only characterized at the macro-scale. While micro-scale variations in wettability and fluid distribution are expected to have an impact on fluid flow controls such as capillary pressure and relative permeability, techniques for quantifying this variability have remained elusive.

In this study<sup>1</sup> (Deglint et al. 2016), micro-scale variability in wettability and fluid distribution in a tight oil reservoir (Middle Bakken, Viewfield Saskatchewan) is investigated using an FEI Quanta FEG 250 environmental field emission scanning electron microscope (E-FESEM). Three approaches were identified:

1. Condensation of water through careful control of sample temperature and water vapor pressure in the sample chamber of the microscope. An innovative approach for assessing water droplet contact angle at the micro-scale is then applied to evaluate wettability variation. This technique is only applicable to the evaluation of distilled water wettability.
2. Cryogenically freezing the samples, then imaging of static rock-fluid relationships in preserved core samples, or in samples that have been subjected to prior fluid injection experiments. This technique has shown promise for assessment of preserved core fluid distribution or for providing “snapshots” of fluid distribution during displacement experiments.
3. Selective injection of native or non-native fluids through a micro-injection system, followed by imaging of rock-fluid interactions. This technique offers the greatest potential for selective fluid wettability experiments, including those involving hydraulic fracturing fluids for compatibility evaluation.

This study demonstrates that wettability heterogeneity in tight rock at the micro-scale can be significant, but may be quantified for use in pore-scale modeling of fluid flow using the E-FESEM.

### References

Deglint et al. 2016. Understanding Wettability Heterogeneity at the Micro and Nano Scale in Unconventional Light Oil Reservoirs. Paper URTEC 2461328 presented at the Unconventional Resources Technology Conference held in San Antonio, Texas, USA, 1-3 August.

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<sup>1</sup> An early version of this work was provided in the Deglint et al. (2016) URTEC paper