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Characterization of Tight Carbonate Reservoirs from a Static and Dynamic Perspective

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ABSTRACT

The work presented in this paper discusses the link between static and dynamic rock properties on a tight Middle Eastern carbonate reservoir, with wettability variations along the oil column. The paper also addresses the fluid flow behaviour in this type of reservoirs and the implications on the ultimate recovery.

Core samples were characterized from a static perspective using petrography, Dual Energy Scanning, Digital Rock Physics, conventional core analysis and also from a dynamic perspective, using time-lapse Nuclear Magnetic Resonance (NMR) coupled with ultra-centrifuge for the joint determination of NMR T2 cut-offs and capillary pressure behaviour. Reservoir conditions drainage and imbibition electrical properties were also measured to refine the water saturation model by determining the mismatch between open-hole log Sw and SCAL Sw.
Both rock and fluid properties, accounting for variations in rock fabric and wettability, were input into a mechanistic flow model to study the physics of the process and the implications on the sweep efficiency. The hysteresis effect across the transition zone is also addressed in the paper.

The authors emphasize on the need to have a good characterization of tight carbonates to understand the original facies (depositional environments), the subsequent diagenetic processes which made the rock tight, and the rock-fluid interaction properties (using SCAL). With all this data we are able to unravel the relationships between lithofacies, petrophysical groups, and rock types (addressing wettability), which are a pre-requisite for a representative rock-fluid input for flow simulation purposes.

A workflow for tight carbonate characterization and modelling is discussed and presented in this paper.