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Revolutionizing Reservoir Characterization: High-Resolution Rock Typing Modeling of the Wara Sands in Magwa Field, South and East Kuwait

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Abstract

The complexity of contemporary Clastics formations demand advanced methodologies to accurately assess reservoir parameters. The evaluation of the Wara Sands in South and East Kuwait has revealed significant heterogeneity and spatial variability. Current resolution of the basic logging tools fails to capture the intricate nature of the Wara Clastics, leading to uncertainty in the calculated formation porosity. Additionally, the permeability of the sands exhibits challenging variability that requires a lot higher resolutions measurements to understand the reservoir flow behaviour. A new workflow has been developed that integrates lab cutting measurements at low resolution with a comprehensive rock typing model for the Wara Clastics, establishing a robust foundation for high-resolution parameterization with exceptional accuracy.

A conventional suite of well logs has been integrated with the Routine Core Analysis (RCA) to structure a calibrated petrophysical interpretation for the Wara Formation in the Magwa Field. The RCA dataset was leveraged to create a robust core-based reservoir rock typing model utilizing the Hydraulic Flow Units (HFU) Concept. Five different rock types have been classified forming the electrofacies model, describing the extreme variations from the high permeable sands that exceed 1.5 darcy to the ultra-tight rocks that have permeabilities of 0.001 mD or lower. The calculated permeability has been validated through the core permeability measurements and achieved excellent match, reflecting the reservoir heterogeneity at high resolution. Furthermore, low resolution lab measurements on cuttings for the grain size distribution and rock hardness have been integrated into the workflow and upscaled throughout the entire interested section on high resolution. The results have yielded very interesting insights through various petrophysical 5D-crossplots, mapping a clear view on reservoir rock quality, shale content, volume of the heterolithic sands and grain size variations.

The workflow offers very effective approach to upscale different parameters measured at the log resolution or lower to generate high resolution outputs. The reservoir rock typing model has significantly reduced the uncertainty in permeability calculations in the Wara Formation reservoir sands. The workflow, upon establishment, can be utilized on real time basis allowing rapid evaluation for very challenging petrophysical parameters. The high resolution parameters can help detailed, accurate and robust 3D reservoir modeling.