Beyond Gas Bubbles in a Norwegian Oil Fields: An Integrated Technique to Understand Reservoir Fluid Distribution

Paper Ref: SPWLA-2025-0100

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Abstract:

The understanding of fluid phases in reservoirs poses significant challenges, particularly when dealing with depletion, moving contacts, gas injection, or any physical phenomenon. Such conditions can complicate conventional petrophysical evaluations and neutron-density separation and borehole resistivity responses can lead to ambiguous interpretation. To address these complexities and make informed reservoir development decisions, results from various techniques and sources, such as advanced mud gas analysis, fluid sampling, and petrophysical data, are integrated to gain additional insights while drilling.

In the example of a depleted Norwegian oil field, three zones of interest were identified based on the analysis of mud gas and conventional logs. However, the presence of both oil and gas phases in the transition zone made it difficult to get and accurate fluid interpretation. Consequently, a sampling tool was deployed to confirm the flowing phase, and new cut-offs for the mud gas measurement in this depleted reservoir were established, allowing calibration of subsequent wells in the same field. Post-well PVT analysis showed consistent fluid properties with the real-time measurements taken by the sampling tool.

In another field, we were able to identify oil flowing zones with unclear log responses, using these techniques. This raises important questions: Is the industry ready to adopt this technology as a routine approach? Can we trust these measurements to build a robust interpretation, and how can we quantify the added value from this technology selection process? Moreover, this paper presents additional cross-comparison statistics to reinforce confidence in technology adoption and its added value.

This integrated workflow compiling petrophysical logs, advanced mud gas, and Formation Sampling While-Drilling fluid samples has provided critical insights and aided decision-making for complex reservoir development projects. By utilizing this approach, a greater understanding is achieved in identifying efficient and productive hydrocarbon reservoirs and improving hydrocarbon recovery processes. The information gathered from these various techniques leads to conclusions validating fluid contacts, residual oil and gas saturations, and hydrocarbon distribution in the reservoir. With the industry increasingly focusing on mature field development, the significant potential business value of this innovative method becomes apparent.

Bios:

Maria Cecilia Bravo is a principal reservoir engineer at Equinor. She holds a Bachelor's degree in Chemical Engineering from Universidad Simón Bolívar in Venezuela and a Master's degree in Petroleum Engineering from Heriot-Watt University in Edinburgh. Prior to joining Equinor in 2022 as a specialist in PVT and fluid properties predictions, she worked at SLB Drilling and Well Construction, where she focused on logging measurements and fluid sampling while drilling, formation pressure, and mud gas operations. At Equinor, her work involves developing and implementing the reservoir fluid identification project.

Silvia Roblero Nunez is a principal petrophysicist at Equinor with a university background in petroleum engineering and innovation management. She has held several technical roles in the oil and gas industry for the past eighteen years, where she has specialized in petrophysics, well logs analysis, data integration and innovation management. She joined Equinor in 2023 as petrophysicist specialist contributing to well services and area subsurface development. Her work involves well planning and execution and petrophysical input for subsurface development.