Obtaining Remaining Oil Saturation For The Johan Sverdrup Field From a Variety of Logging Data

Paper Ref : **SPWLA-2024-0102**

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Abstract:

Johan Sverdrup, situated on the Norwegian continental shelf, stands as the third largest oil field with a recoverable volume spanning approximately between 2.2 to 3.2 billion barrels of oil equivalent (BOE). The field came on production in October 2019. Given the reservoir's proximity to hydrostatic pressure, maintaining a consistent production pressure hinges on the concept of voidage replacement. The drainage strategy is seawater and produced water re-injection and, in a subsequent phase, water alternating gas (WAG) injection. The reservoir has excellent reservoir properties and multi-Darcy permeability. The ambition is to recover 70% of hydrocarbon in place; therefore, a comprehensive data acquisition strategy is in place to unravel and optimize reservoir drainage.

Dedicated to waterflooding observation, Well 16/2-D-22 plays a crucial role in this strategy. Drilling the well at the right time, a full suite of openhole logs has been acquired to fully characterize formation and fluids. The well has been completed with an unperforated cemented liner. Pulsed-neutron logging is conducted every 3 months to monitor waterfront evolution and evaluate in-situ water saturation (Sw).

Logging results allow us to evaluate the waterfront evolution pace while also confirming that waterflooding primarily occurs laterally along the most permeable layer. These observations are used in the reservoir and petro-elastic models and validate their overall accuracy.

Notably, the pulsed-neutron-derived water saturation within the flooded zone currently deviates from the estimated residual oil saturation obtained from openhole saturation evaluation and core experiments. To address this discrepancy, a comprehensive investigation has been undertaken, utilizing a multitude of data sources, including advanced nuclear magnetic resonance (NMR) techniques, verified by laboratory measurement. This investigation reveals that the residual of drilling oil-based mud, relatively deep into the borehole wall, may still influence pulsed neutron several years after drilling. It is believed that future well-log acquisitions will contribute significantly to our understanding of this phenomenon.

Bio:

Brice Fortier is the discipline leader for petrophysics for Equinor's operated Johan Sverdrup and Martin Linge fields, based in Stavanger, Norway. He graduated in 2005 from Ecole de Geologie de Nancy with a master's degree in geology engineering and in 2006 from IFP-School in Paris as a petroleum geologist. Prior to joining Equinor, he worked with Schlumberger in Luanda, Angola as a wireline field engineer then with Data and Consulting Services as a borehole geologist in Aberdeen, Scotland and Stavanger, Norway. He joined Statoil in 2011 as an asset petrophysicist for the Fram and Vega fields. He has been working with Equinor's Johan Sverdrup field since 2014. Brice also leads the image-log competence group for Equinor and has been contributing in creating customized internal web based applications to optimize petrophysics workflows.