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A Novel Approach to Petrophysics in the Canadian Oil Sands

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Summary

The Canadian Oil Sands hold vast reserves and development will continue for many years to come, however evaluation of the reservoir and its fluids is not without challenges. The fluvial estuarine Cretaceous McMurray formation can change rapidly laterally and vertically both in facies and fluids. Formation water variations within the McMurray can also be frustratingly complex with salinity varying spatially and vertically by orders of magnitude. SAGD technology is used to produce these wells, which relies on steam chamber growth and dynamic changes within the reservoir, creating an additional dimension of variability in the fluid and rock properties.

Nexen CNOOC's Long Lake property is a challenging reservoir and this case study will highlight some of these challenges. These include Bottom water, Top water, Top gas, Low resistivity gas (fizzy water), Lean zones, Facies variation, and Changing Rw.

The McMurray reservoir has been cored extensively to help characterize the deposit, but this can be very costly when drilling hundreds of wells to find the sweet spot. Along with this, Dean Stark analysis of the core is often found to be unreliable due to various factors that will be discussed. After drilling thousands of wells with about 14000m of McMurray core, we have a huge dataset that has contributed to understanding the reservoir and developing our petrophysical models. Operators must look for new methods to evaluate the reservoir and reduce development costs, while reducing uncertainties to make oil sands projects more competitive.

Logging programs and integrated analysis were used to overcome some of these challenges of reservoir characterization while eliminating costs of coring, core analysis and core handling. We will show examples of why we designed logging programs to include micro-resistivity imaging and nuclear magnetic resonance. We will also show examples of using Pulsed Neutron Logging to monitor steam chamber growth and reservoir sweep efficiency.

We have had considerable success logging micro-resistivity imaging tools to get a high resolution characterization of the reservoir along with facies identification. Nuclear Magnetic Resonance has been proven to be a robust tool for saturation prediction that is independent of formation water salinity. An annual pulsed neutron logging campaign has also been implemented to make steam injection more efficient and maximize oil production.

Understanding the true benefits and weaknesses of acquiring core and core analysis can save you a lot of money in a SAGD delineation program. Our workflow shows how you can save money and still reduce reservoir uncertainty with the correct evaluation program and petrophysical routine.