An Integrated Approach to Identify Heavy oil Contacts

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Abstract

The identification of heavy oil contacts is key to successful resource assessment and development, but is a difficult task. Conventional techniques used to determine fluid contacts are less effective in the presence of a heavy oil transition zone, as they have no sensitivity to viscosity. The limitations of conventional logs make it a challenge to identify heavy oil contacts and can lead to uncertainty in estimating oil volumes.

In this study, the challenge was overcome by applying an integrated approach. Nuclear magnetic resonance (NMR) viscosity logs were used in conjunction with fluid sample and pressure data, test results, PLT injection test, conventional well logs, and core descriptions to determine hydrocarbon fluid typing and identify the heavy oil contact in both vertical and horizontal wells with high confidence. This data was then used to map the contact across the study area.

The approach utilizes NMR viscosity log for every well to define consistent criteria for the contact and validate against all heavy oil indicators from other tools. The NMR viscosity log showed a well-defined viscosity gradient from lower to high viscosity. The heavy oil contact depth is determined by NMR viscosity logs right above 1000cp. The PLT injection test profiles confirmed non-injectivity in the heavy oil zone, where NMR viscosity was greater than 1000cp. Additionally, a change in the pressure profile with depth, usually observed as scattered or supercharged pressure points combined with low mobility (<1 md/cp) data suggest the interval was potentially heavy oil bearing. Several oil samples successfully were collected in the light oil zone and confirmed the fluid typing. Also, the pyrolytic oil productivity index, or POPI method showed a lower index in the heavy oil zone, further confirming the NMR-based interpretation.

This work demonstrates the necessity of an integrated approach, using NMR viscosity logs and other tools, to determine fluid contacts accurately in wells where conventional methods result in data gaps and uncertainty due their limitations in heavy oil transition zones. The heavy oil contact workflow presented here provides an effective method for identifying contacts, which can be applied to reduce uncertainty in volumetric calculations.