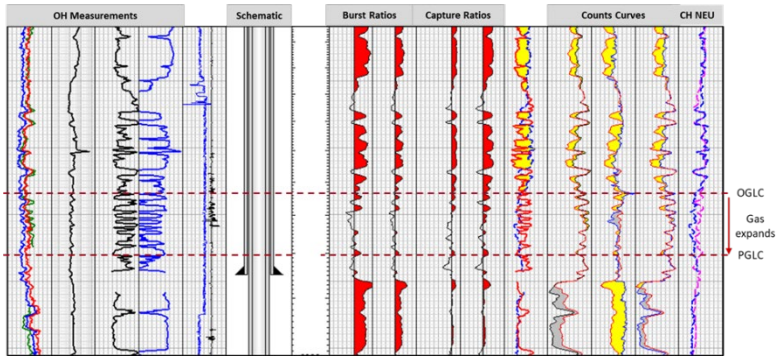
Raptor® 2.0 Cased-Hole Evaluation System

With Tractor Accurately Located Gas Contact, Quantified Saturations in Highly Deviated Well



The composite logs show the major gas identification measurements from the N-Vision logging as deployed by the Raptor 2.0 system. Gas contact is evident to move down from the original gas-liquid contact due to secondary gas cap expansion.

Objectives

- Validate current fluid gas contact and saturation in support of development strategy. Most of the primary reservoirs were undergoing comingled production and the customer needed to identify which reservoirs were depleted to evaluate if the gas-liquid contact is moving down.
- Deploy wireline conveyance in horizontal well via tractor.

Our Approach

- A customer contacted Weatherford for sigma and carbon/oxygen (C/O) pulsed neutron logging to identify the current fluid contact and saturation in the target reservoirs.
- Weatherford experts recommended the proprietary N-Vision™ technique as deployed by the Raptor 2.0 cased-hole evaluation system rather than the traditional sigma for gas-liquid saturation measurements in freshwater reservoirs due to its highest sensitivity to gas via burst ratio. For gas reservoirs, the N-Vision technique quantifies gas-liquid saturation across nearly the entire spectrum in porosity ranges as low as 5%.
- Based on the intervention modeling simulation and due to high deviation in the subject well, the job would need wireline conveyance with a tractor to reach the bottom logging depth.
- In pre-job collaboration with the customer and field personnel, Weatherford experts ensured the compatibility of the Raptor 2.0 system with the tractor, a first deployment in this field.
- Monte Carlo N-Particle characterization models were requested to better quantify the current saturation and to understand the effect of depletion on the studied reservoir.

LOCATION
Malaysia

WELL TYPE
Development wells
(single horizontal producer)

FORMATION
Clastic

HOLE SIZE AND ANGLE
8-1/2 to 12-1/4 in., deviation up to 82°

CASING SIZE
Dual 9-5/8 in., 6 5/8-in. casing

MEASURED DEPTH BELOW DRILL FLOOR
9,070 ft (2,764 m)

TOTAL LOGGING INTERVAL
1,080 ft (329 m)

PRODUCTS/SERVICES
- Raptor 2.0 cased-hole evaluation system
- Interpretation and Evaluation Services

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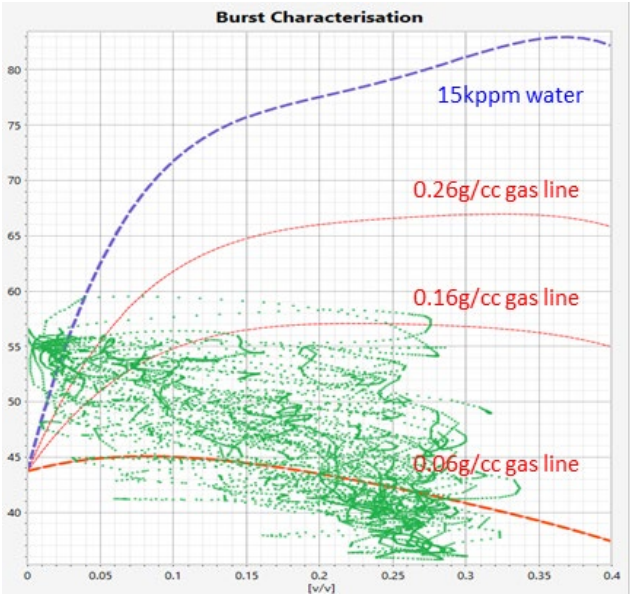
Our Approach (continued)

- Drawing on their understanding of the production history and past pulsed neutron logging results in a nearby well, Weatherford experts performed data validation to evaluate the current field-wide gas contacts.
- Weatherford's own proprietary emulated neutron porosity and burst and capture ratio curves from the N-Vision mode confirmed the expansion of gas into deeper reservoirs.
- The local Weatherford team presented the saturation results, and gas contact was confirmed to move down due to the secondary gas cap expansion, matching the customer's expectation. Zones that most probably experienced depletion were also pinpointed based on the understanding of the raw N-Vision data with the characterization model.

Value to Customer

- The interpretation provided by the local Interpretation and Evaluation Services team helped the customer accurately pinpoint the current gas contact and saturation. These results enabled the customer to better pre-plan the development strategy.
- Based on the result in the subject well, consistency was demonstrated in line with production history and pulsed neutron results in nearby wells.



This illustration shows the benefits of the integrated response characterization model in identifying depleted reservoir using Weatherford's propriety N-Vision workflow. The unnormalized raw data are evident to fall below the predicted formation gas density 100% 0.06g/cc gas line, indicating this zone of interest is most likely undergoing depletion.

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