

PDO Evaluates Pure Formation Water Acquired from Submillidarcy Carbonate Transition Zone

Ora wireline platform applies focused fluid sampling in extremely low mobility reservoir with little salinity contrast for high-confidence measurements downhole

Deploying the new Ora* intelligent wireline formation testing platform enabled Petroleum Development Oman (PDO) to verify the cleanup of water-based mud (WBM) filtrate from similar-salinity formation fluid in an extremely low mobility reservoir transition zone for conducting accurate downhole fluid analysis. The ability to differentiate formation water from WBM filtrate with low resistivity contrast in the presence of oil made it possible to confidently place the station depth in the transition zone and accurately interpret contacts, saturation, and ultimately hydrocarbon in place.

Ultralow-mobility, low-salinity-contrast challenges

Establishing formation fluid flow in submillidarcy rock is difficult, much less establishing and maintaining sufficient flow for applying focused sampling. This meant that evaluating the cleanup of WBM filtrate from formation water with little salinity contrast in the presence of formation oil had been virtually impossible. An additional concern is that the long pumping times required increase the risk of the tool becoming stuck.

What was tried first

In a previous well, an attempt to collect a water sample from the formation with unfocused extraction technology yielded inconclusive measurements because the contamination level could not be assessed in real time.

What Schlumberger recommended

The Ora platform integrates large-area focused sampling via dual flowlines and a focused radial probe with new calibrated, induction-based resistivity sensors to provide complete in situ fluid acquisition and analysis. This configuration establishes flow, conducts focused sampling, and evaluates the cleanup in real time to acquire pure reservoir fluid for analysis, even in challenging low-mobility and multiphase flow scenarios.

What PDO achieved

Ora platform’s resistivity measurements established consistent WBM filtrate salinity values for both the guard and sample flowlines. The sample line measurement was then transitioned to a stable baseline of formation water salinity in the presence of formation oil. To confirm sensor-to-sensor accuracy between the two lines, the guard line fluid was temporarily routed to the sample line for measurement.

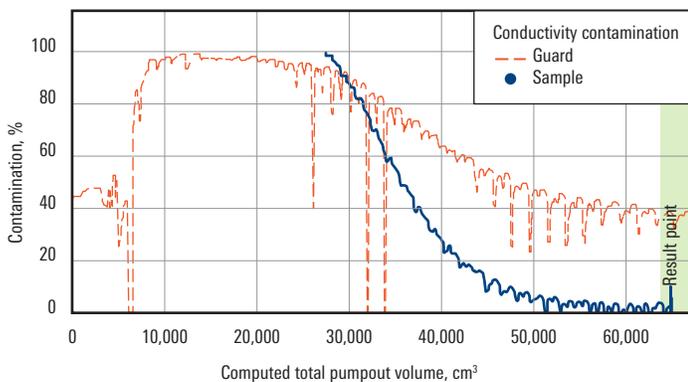
The Ora platform provided the measurements as a contextual answer product for direct use in PDO’s petrophysical analysis. The early insight provided by the real-time downhole measurements was subsequently confirmed through onsite sample analysis.

“The Ora platform allowed us to confidently characterize our formation fluids in real time in an environment previously almost prohibitive for wireline formation testing. In addition, it allowed us to keep station times short, minimizing the risk to the wellbore. The high degree of confidence can also mean that expensive and time-consuming surface analysis can be reduced or omitted.”

Daniela Frese

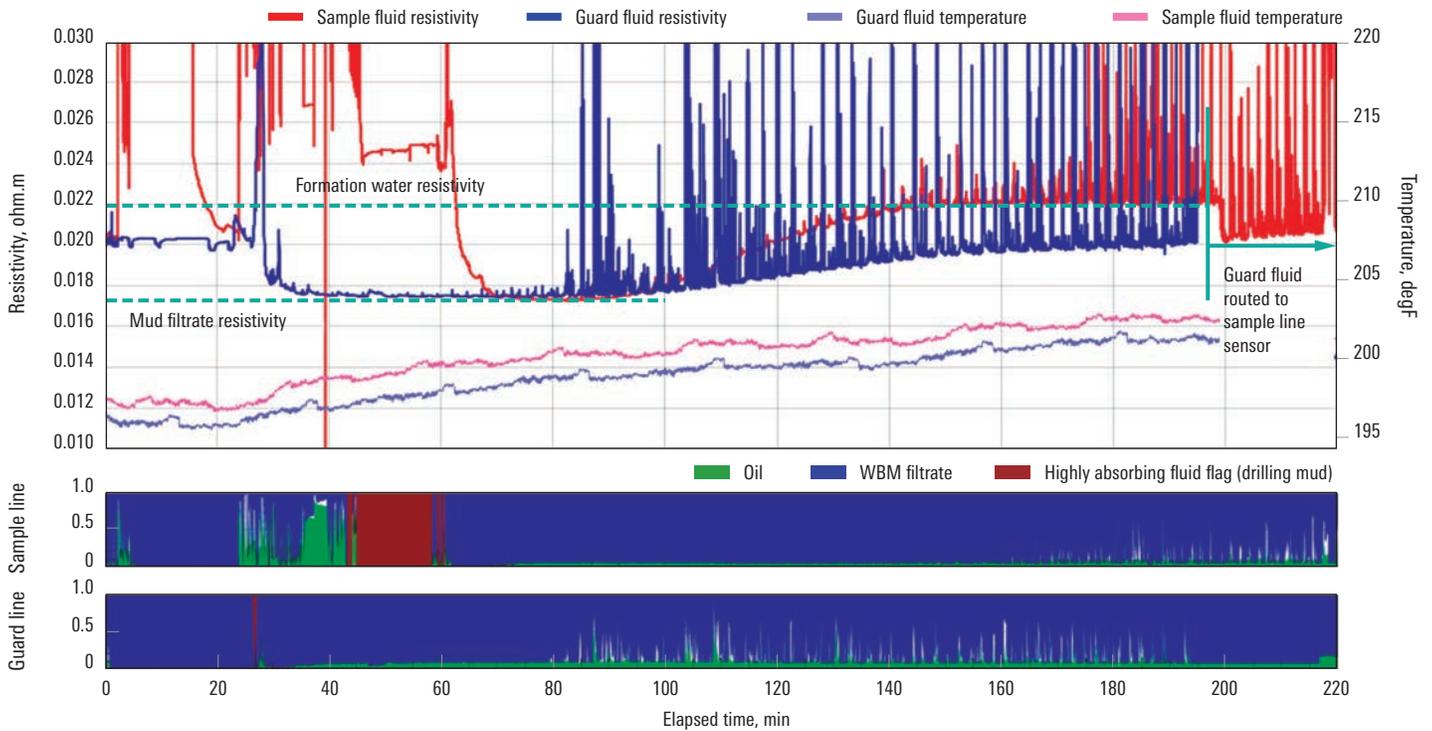
Petrophysics Discipline Lead GGP SME Open Hole Data Acquisition

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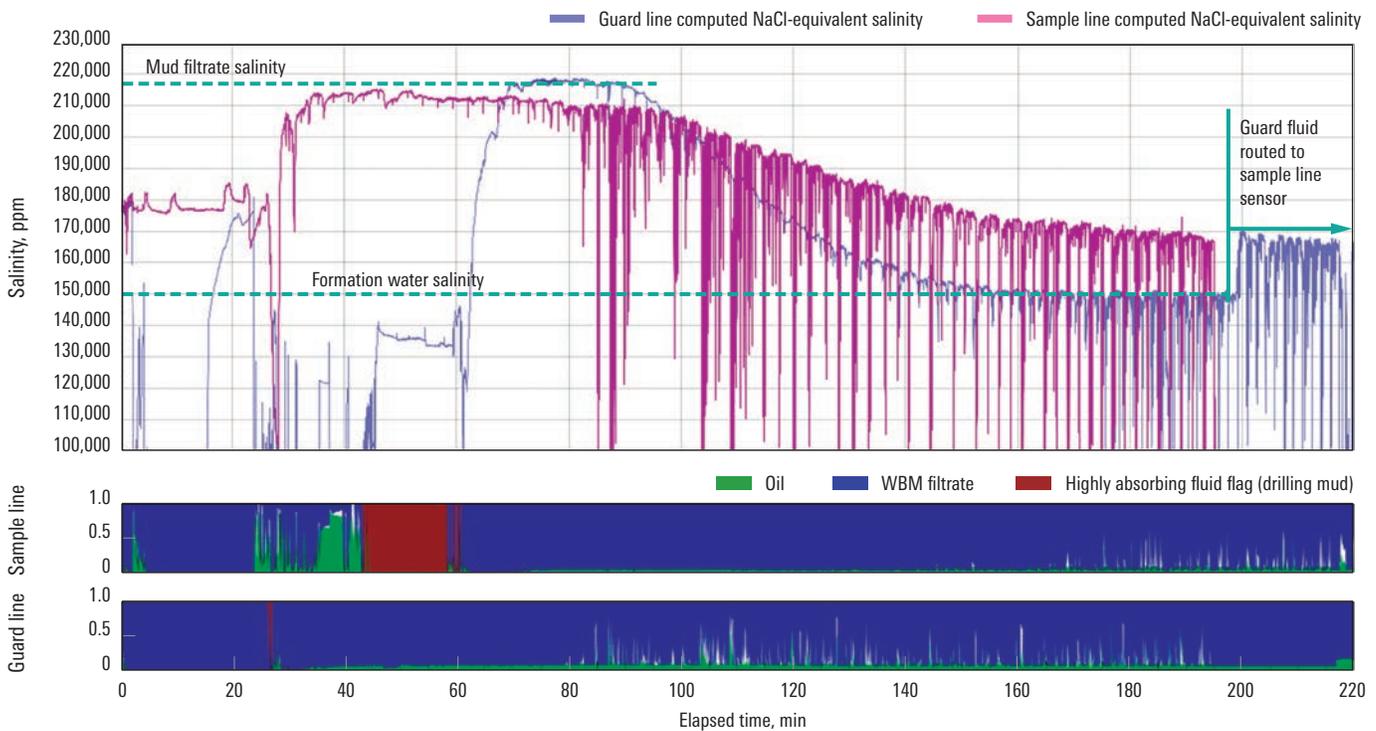


Differentiating WBM filtrate and formation water in this difficult environment characterizes the transition zone and enables accurate interpretation of contacts, saturation, and ultimately hydrocarbon in place. The Ora platform’s calibrated resistivity cell made this possible by quantifying contamination from the measured conductivity in both the guard and sample lines to definitively differentiate WBM filtrate from formation fluid and determine when cleanup was achieved for conducting accurate analysis.

Case study: PDO uses the Ora platform to evaluate pure formation water, Oman



Routing the guard line fluid through the sample line's induction-based calibrated resistivity sensor confirmed sensor-to-sensor accuracy, providing confidence in the measurements distinguishing WBM filtrate from formation water in the presence of formation hydrocarbon. Despite the multiphase flow scenario, the measurement was free of fouling.



The resistivity and temperature data are combined to compute the NaCl-equivalent salinity of the guard and sample line fluid contents.

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