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Saturn Probe Enables Diagnosis of Water Influx During Drilling of Slim, High-Temperature Well

Downhole fluid analysis disproves dry well concerns by identifying reserves and establishing crossflow as the water source, offshore Mexico

CHALLENGE

Measure pressure and collect samples from deep, tight, dual-porosity carbonate reservoir to resolve drilling issues and identify hydrocarbon content and potential compartmentalization.

SOLUTION

Deploy the 5-in version of the Saturn* 3D radial probe and the dual-packer configuration of the MDT Forte-HT* rugged high-temperature modular formation dynamics tester to address the challenging combination of matrix and open fractures.

RESULTS

Successfully identified near-critical gas, liquid hydrocarbons, and compartments to validate reservoir potential while enabling diagnosis of the water influx during drilling as crossflow for guiding adjustment of the completion plan.

Formation testing challenges in a high-temperature 6.5-in exploration well

After drilling a high-temperature exploration well offshore Mexico into a tight, deep carbonate reservoir, the operator needed high-quality formation pressure measurements and sample collection for downhole fluid analysis (DFA). This information was of critical importance for understanding the reservoir fluid composition and identifying potential compartments.

The main concern was the large water influx that had occurred during the drilling phase and required control through managed pressure drilling. Was the water indicative of problems in well construction or was the well dry?

Representative pressures and sampling with zero sump fluid acquisition

To efficiently resolve these questions, Schlumberger deployed the MDT Forte-HT formation tester with a dual-packer module and the 5-in Saturn 3D radial probe. This combination provided operational reliability at high temperatures and the flexibility to effectively isolate the test intervals for addressing the challenging co-occurrence of low-permeability matrix and open fractures that were revealed by openhole logging images.

The Saturn probe acquires formation fluid with four self-sealing elliptical probes that have the industry's largest inlet flow area in this hole size, totaling more than 59 in^2. Even in tight and challenging formations, flow is quickly established and maintained from the entire circumference of the wellbore instead of funneling fluid from the reservoir to a single-probe access point, thereby optimizing DFA, sampling, and transient testing applications. This design also eliminates any sump volume, minimizing storage volume effects and accelerating fluid cleanup.

The InSitu Fluid Analyzer* real-time downhole fluid analysis system was included in the formation testing toolstring to conduct DFA, ensure sample quality, and definitively characterize the fluids at reservoir conditions.

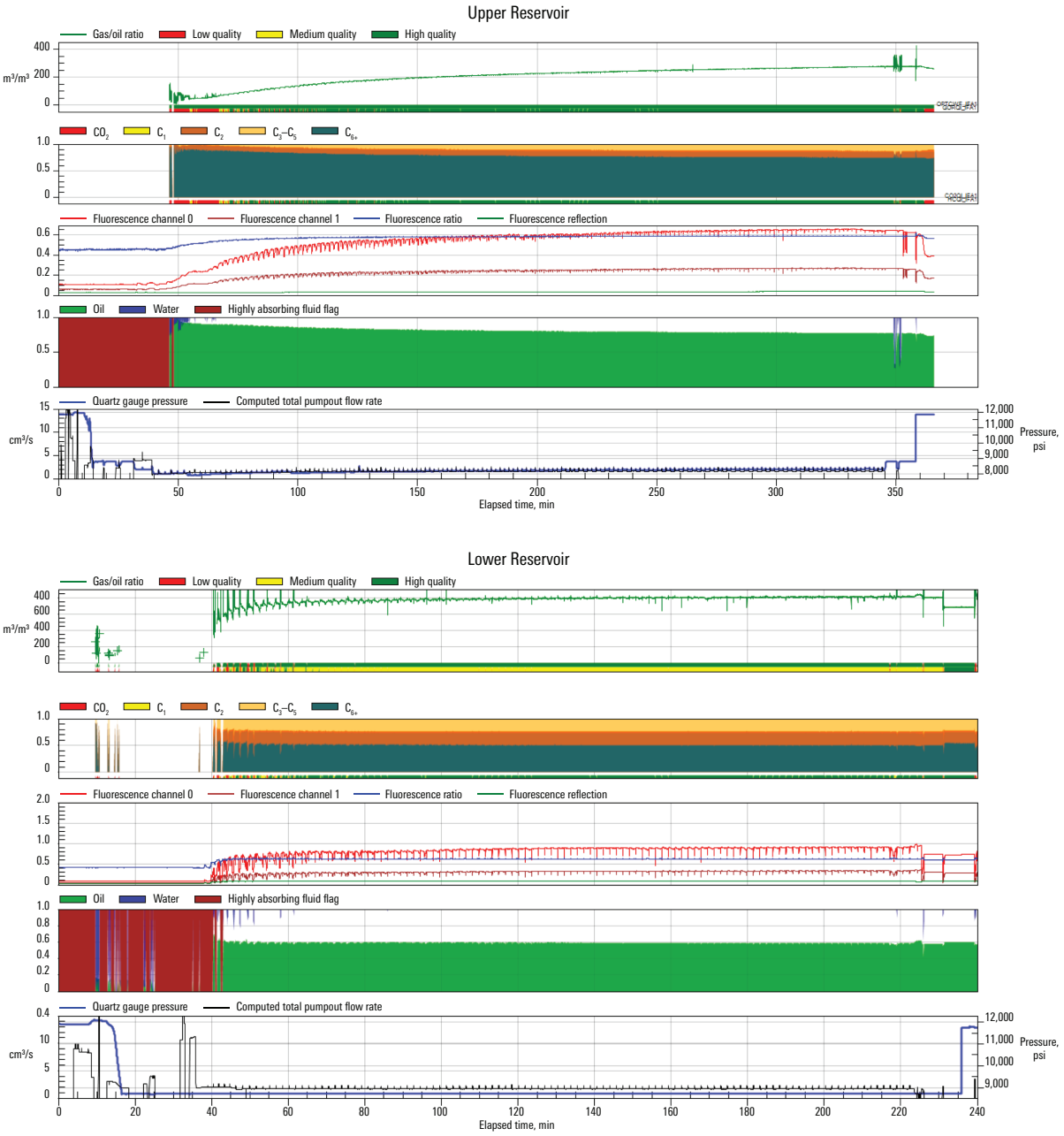
Identification of reserves and completion guidance

The water influx during the drilling phase was causing the operator to consider abandoning the well as water filled. Despite this poor prognosis, the formation testing program proceeded, with the MDT Forte-HT tester, 5-in Saturn 3D radial probe, and InSitu Fluid Analyzer system efficiently returning representative pressure and fluid composition data as the basis for a new perspective on the reservoir potential. Formation fluid samples were also obtained.

The 5-in version of the Saturn 3D radial probe brings efficient flow performance to a wide permeability range while its self-sealing technology provides circumferential support in the case of unconsolidated reservoirs.

The identification of water at the top of the reservoir section suggested possible crossflow from another zone. The sample collected by the Saturn probe in this zone confirmed that the salinity corresponded to water from the overlying Cretaceous formation, suggesting poor cement isolation in the previous section instead of a dry well.

Furthermore, both oil and near-critical light hydrocarbons were identified in the main reservoir by using multiple DFA stations. With this promising insight, the well was proved to be hydrocarbon bearing, and the operator was able to adjust the completion plan accordingly.



Real-time DFA conducted with the MDT Forte-HT tester and 5-in Saturn probe at stations in the upper and lower sections of the reservoir document the difference in composition within the hydrocarbon column.

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