CASE STUDY

GAS BREAKTHROUGH IDENTIFICATION BY CAPACITANCE & HIGH-RESOLUTION TEMPERATURE ARRAY TOOL AND PRODUCTION PROFILE EVALUATION BY **STREAM**™ ALLOWS TO OPTIMISE THE WELL PERFORMANCE

Location: Middle East

Well type: horizontal oil producer

Average production rate: 751 bpd

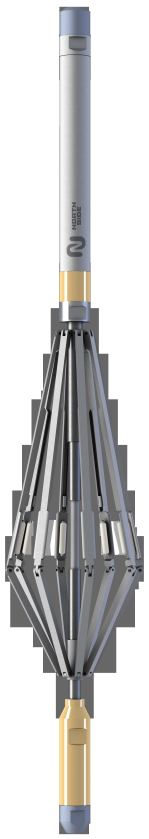
Challenge: new well drilled in the fractured limestone formation. The well is characterized by intermittent self-flow regime with a high GOR and water cut.

Objectives: evaluate the detailed production profile across the open hole section of the newly drilled oil producer, addressing the segregation of reservoir fluid across the lateral; locate the gas/water source.

Solution: due to the nature of horizontal oil producers and the challenge of precise evaluation of the flow across the lateral because of the segregation of the fluid phases, the Capacitance and High-Resolution Temperature Array Tool was proposed for the circumferential evaluation of the fluid phases and construction of a detailed production profile based on the T-FLOW technology. The FIND technology was also included in the tool string to confirm and differentiate various types of wellbore and reservoir flow, fractures contribution to the flow, if any.

CAPACITANCE AND HIGH-RESOLUTION TEMPERATURE ARRAY TOOL

Capacitance and High-Resolution Temperature Array Tool consists of 6 miniature probes mounted on 6 self-centralized rigid arms facing fluid flow at 45° to the fluid flow covering the entire cross-section of the wellbore. Each sensor includes capacitance and high-resolution temperature probes (2 in 1). The tool allows a 3D fluid phase evaluation in horizontal oil producers with segregated flow regimes



STREAM™ (**S**PINNERLESS **T**ECHNOLOGIES for **R**ELIABLE **E**VALUATION, **A**NALYSIS, and **M**ODELING of well-reservoir flow)

T-FLOW (Temperature Modeling)

The math solver allows predicting the heat exchange between the wellbore and the reservoir based on hydro/thermo-dynamic theory and high-resolution temperature data acquired by the High-Resolution Temperature Array Tool. The method provides a detailed reservoir production/injection profile for open/cased hole wells with vertical, deviated, or horizontal trajectories.

FIND (Flow Identifying Noise Detector)

A new-generation spectral noise logging tool records data by four channels with different frequency ranges and amplification to signal. It allows to provide detailed full-spectrum acoustic profile without distortion, including wellbore/reservoir flow intervals detailing, fractures localization, leak detection, and flow behind the casing determination.

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Results

The High-Resolution Temperature Array Tool sensors indicated a local temperature decrease below the 7” liner shoe. According to T-FLOW production profile, the main production zone corresponds to the interval below the 7” liner shoe and the rest of the logging interval is practically not involved in the production.
The Capacitance Array Tool sensors localized the oil presence below the 7” liner shoe matching with T-FLOW production profile anomaly as well as trapped oil at the bottom of the logging interval.
The FIND indicates low-frequency noise anomaly by the Channel 3 across the interval of major production related to wellbore flow and high-frequency noise anomaly by Channel 4 across the same interval corresponded to reservoir flow.
It was concluded that the nature of the well self-flow is a pressure differential created by gas influx from below the 7" liner shoe. However, it is not sufficient to involve the bottom part of the open hole in the production.

Major outcomes

- localization of gas influx source below the 7” liner
- determination of the main production zone around the 7” liner shoe related to the gas influx
- 2/3 of the open hole is practically not involved to the production