CASE STUDY

WATER SOURCE LOCALIZATION IN HIGHLY DEVIATED OIL PRODUCER BY **STREAM**™ AND **FLOWJET TECHNOLOGY** ENABLED THE OPERATOR TO REDUCE THE WATER PRODUTION

Location: North Africa.

Well type: offshore highly deviated (63°) oil producer.

Average production rate (by FlowJet Pump):
934 bpd

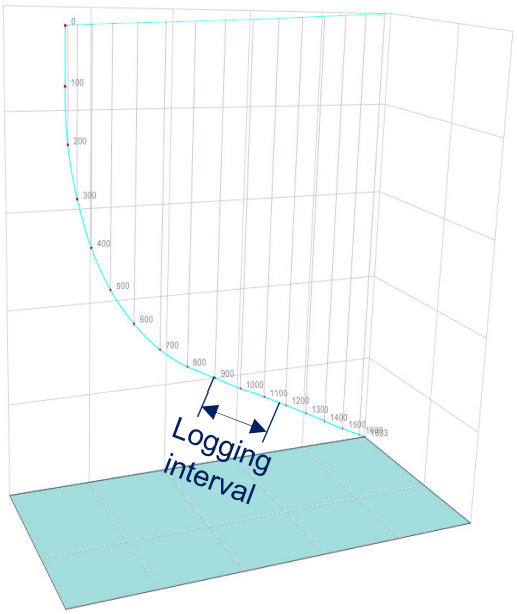
Challenge: high water cut well with multiple perforation zones and open hole section previously isolated by a cement plug.

Objectives: identify the water inflow zones and evaluate the contribution of each perforation zone to construct well-reservoir related production profile for further well optimization.

Solution: since the Y-tool or dual string were not available on the platform to conduct the MPLT in the flowing regime, the FlowJet Technology has been proposed to be done during the planned ESP replacement workover. Due to the challenge of precise evaluation of the flow across perforation zones and behind the casing (from the reservoir) the STREAM™ was proposed, including the TFT for wellbore flow evaluation and T-FLOW for reservoir flow profile calculation.

FLOWJET TECHNOLOGY

The technology allows the creation of an artificial lift during the MPLT for reservoir performance evaluation. The FlowJet Pump (FJP) is run on the tubing pipes to the required depth during the workover. Next, water is pumped inside the tubing to activate the FJP. Then pumped water and wellbore fluid are lifted through the A-annulus to the surface.



Well trajectory

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

Thermal Flow Tool (TFT)

The TFT works on the principle of a thermal anemometer: the TFT sensor is heated-up by the battery current to a temperature higher than the temperature of the surrounding fluid. The fluid flow cools the sensor and thereby changes its active resistance, which is inversely proportional to the average linear flow rate, which allows to calculate the flow rate and build a production or injection profile.

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 Tool. The method provides a detailed reservoir production/injection profile for open/cased hole wells with vertical, deviated, or horizontal trajectories.

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Results

Based on the TFT production profile the major production corresponds to the second half of the logging interval (perforation zones 2 & 3). The veracity of the TFT-based production profile was confirmed by the in-line spinner. Reservoir-related T-FLOW production profile also align with wellbore profiles results.

The warmback color map created based on transients and static HRT curves indicates a longer temperature relaxation across the major production zone. The fluctuation of transient HRT curves across the interval 1023.0-1065.0 m confirms a residual fluid flow from perforation zone 2 during the relaxation period (after the production was stopped).

Considering the temperature gradient (black dashed line on the figure below), the positive temperature anomaly started at the bottom of perforation zone 2 down to the bottom of the logging interval indicates the presence of upward fluid flow behind the casing which is released through the perforation zone 2. A possible reason for such phenomena could be a water encroachment related to a downhole water source previously isolated by the cement plug.

Major outcomes

- water inflow zones were provided
- flow behind the casing was confirmed
- downhole water encroachment phenomena were identified
- operator has isolated zones 2 and 3 based on the log results and the WC was reduced from 90% to 10%