CASE STUDY

WELL-RESERVOIR PERFORMANCE EVALUATION BY **STREAM**™ IN HORIZONTAL HIGH WATER CUT OIL PRODUCER ALLOWED TO LOCALIZE THE WATER SOURCE

Location: Middle East

Well type: horizontal open-hole oil producer

Average production rate: 1400 bpd

Challenge: 10 years old well with a drastic increase in WC within the last two years. Logging in tough wellbore conditions: horizontal open-hole section in fractured carbonate formation.

Objectives: evaluate the detailed production profile across the open hole section of the well and localize the water source.

Solution:
Given the harsh well logging conditions, conventional spinner-base methods cannot be applied due to the high possibility of tool damage and stuck.
TFT has been proposed as a spinner alternative for the wellbore fluid flow measurement and the creation of a relevant production profile.
T-FLOW technology was performed to determine reservoir-oriented production profile through HRT data acquisition and subsequent numerical temperature modeling.
Flow Identifying Noise Detector (FIND) was conducted to record the noise response for precise localization of the wellbore/reservoir flow intervals.

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

A powerful suite of tools and technologies that provide high-resolution and accurate logging capabilities. STREAM is an integration of FIND, TFT, and T-FLOW technologies, working in perfect harmony to unlock unparalleled insights into the processes occurring inside and beyond the wellbore.

T-FLOW (Temperature Modeling)
The numerical temperature modeling is a math solver that allows the calculation of low-compressible fluid flow dynamics and prediction of the heat exchange between the reservoir and the surrounding rocks based on hydro/thermo-dynamic theory and logging data acquired by the HRT tool.

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 the precise localization between the wellbore and reservoir flow intervals as well as the classification of reservoir flow types (formation fractures, matrix flow, etc).

TFT (Thermal Flow Technology)
Measurement of the wellbore flow based on the thermal anemometry principle and creation of a wellbore-oriented production profile.

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Results

The T-FLOW production profile revealed a localized zone of reservoir flow across the interval of 7700-8500 ft. The high-frequency Channel 3 of the FIND tool revealed an extended vertical noise anomaly at a frequency range of 1.0-5.0 kHz related to formation matrix flow across the production interval detected by temperature modeling (fig. 6). The stabilization color map indicates the zone of major reservoir flow across the interval of highest flow rates on temperature modeling production profile. In addition, high-frequency Channel 4 of the FIND tool presents two horizontal noise anomalies at a frequency range of 9.0-60.0 kHz across the depths of 7721 ft and 7867 ft corresponding to formation fracture flow.

The production profile determined by TFT uncovered a slightly different flow rate distribution. The interval of the reservoir fluid entering the wellbore was localized across the depths of 7700-8050 ft. The low-frequency Channel 1 of the FIND tool confirms the active wellbore flow across the same interval by vertical noise anomaly at a frequency range of 0.01-0.5 kHz. Thus, the interval of production from 8050 ft to 8500 ft provided by the temperature modeling production profile is related to reservoir flow only.

Major outcomes

- Interval of wellbore flow was localized for further precise WSO
- Interval of reservoir flow (real water source) was captured;
- Second half of the OH section with trapped oil is not involved into the production