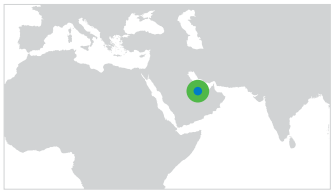
TGT

Case study Total Flow

Advanced acoustic analysis reveals complex fluid movement in the wellbore and close by reservoir



Location: Abu Dhabi, UAE
Well type: Oil producer
Reference: SPE 161712

Case benefits
- Determined and quantified both flowing (including low-rate) and bypassed reservoir zones not involved in production
- Located the water source
- Detected inter-reservoir communication behind casing (through channel in cement)
- Defined fluid entry points

Challenge

As part of a wider programme to enhance oil recovery, an operator of an offshore Abu Dhabi field wanted to obtain a more detailed understanding of fluid movement in and around their producer wells and identify the source of unwanted water. The diagnostic results would provide insights to support future decisions about reservoir management, remedial work and optimum workovers, and would shape the plans for drilling new wells.

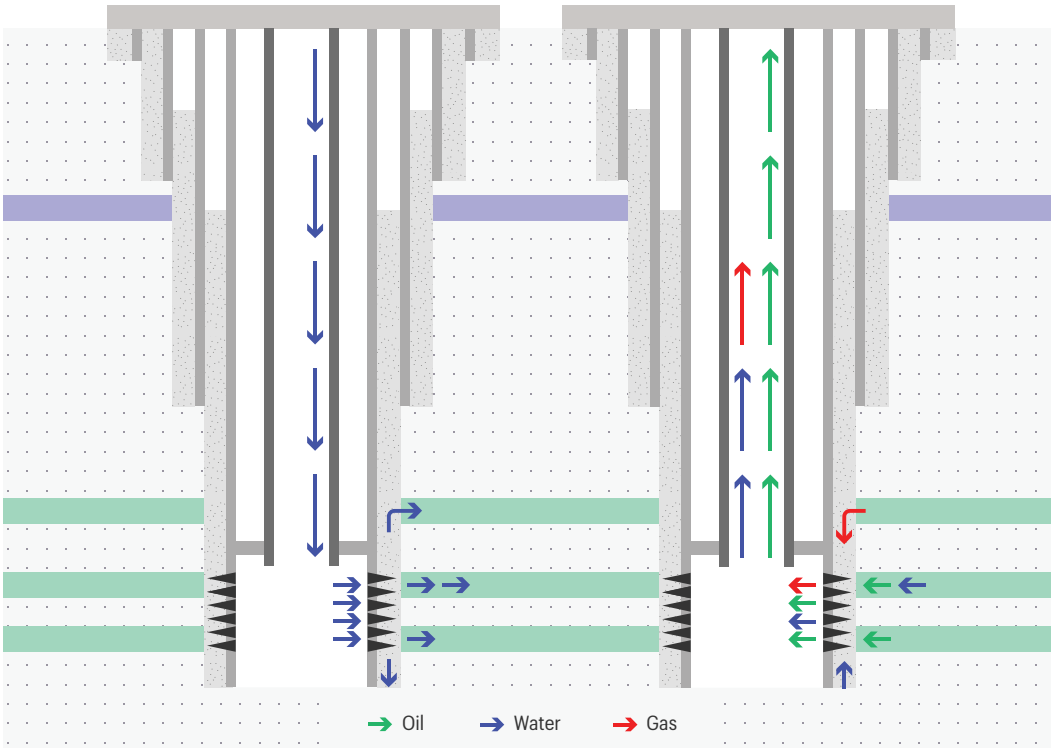
Solution

The Total Flow product was selected by the client to understand wellbore and reservoir flows, and to manage the performance of the well system more effectively. Total Flow is delivered by TGT's True Flow system which uses the Chorus acoustic platform and the Cascade thermal platform.

Result

Spinner data showed that fluid (oil and water) inflow to the wellbore occurred only from the middle-perforated interval P2 across the A2 unit and that no fluid was being produced from either the upper or the lower perforation intervals.

High-amplitude and low-frequency (0.1 kHz) acoustic signal recorded in the middle perforated interval P2 indicated flow through the perforations. No low-frequency signals were recorded in the upper perforated intervals P1 and P3.



Total Flow example well sketch.

Total Flow locates and quantifies wellbore and reservoir flow, and reveals the relationship between the two.

Delivered by our True Flow system with Chorus and Cascade technology, Total Flow provides the clarity and insight needed to manage well system performance more effectively.

Total Flow is commonly used to diagnose unexpected or undesirable well system behavior, but it can also be used proactively to ensure the well system is working properly.

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A high-amplitude acoustic signal at the top of A1 unit correlated with the lithology model, this suggested that fluid was moving through the reservoir matrix and that the top of the unit was producing (Figure 1). Reservoir flow profile indicates this zone to be the main contributing interval in the target reservoir. Minor activity is captured across bottom part of A1 producing through the perforation interval P2.

A low-frequency signal extending down to the oil-water contact suggested a crossflow from the aquifer zone into the perforated interval P2.

Combining the data, the scenario assumes that the water was entering the wellbore, not from the target reservoir, but from the aquifer via a channel in cement. The scale deposition captured by the Gamma Ray tool across the entire interval where the low-frequency acoustic signal was observed supports this scenario. Additionally, the aquifer yield estimated by the Cascade platform correlated well with the water cut of this producer.

To increase oil production from this well it was recommended to 1) shut-off water from the aquifer, 2) re-perforate the upper perforation interval and 3) stimulate the lower one.

The channelling was detected by combining spinner, Chorus and Cascade results. The display on the CHORUS SPECTRUM shows the 'spectral signature' of amplitude (volume) and frequency (pitch) of the acoustic energy detected at various depths in the well; red regions represent high amplitude. Flow through the perforations creates low-frequency acoustic signal; the markedly higher-frequency energy is attributed to flow within the reservoir rock. The production profile built from spinner and multiphase sensor data is presented in the left two columns. The reservoir-related reservoir flow profile based on Chorus and Cascade Platforms data is shown in the right two columns.