DEEP WATER

CASE STUDY

Top of Cement Identification in Ultra-Deepwater Well Saves Operator USD 700,000

XBAT™ SERVICE PROVIDES ACCURATE TOP OF CEMENT EVALUATION DURING CEMENTING OF LINER

GULF OF MEXICO

CHALLENGES

- Operator was unable to establish returns during cementing of 7⅝-inch liner
- Based on cement lift pressure, operator expected cement column to be less than planned

SOLUTION

- XBAT™ azimuthal sonic and ultrasonic LWD service to identify TOC during cleanout run and confirm with wireline CBL
- Optimize LWD acoustic firing using two monopole high-frequency modes in memory mode with fast sample rate

RESULTS

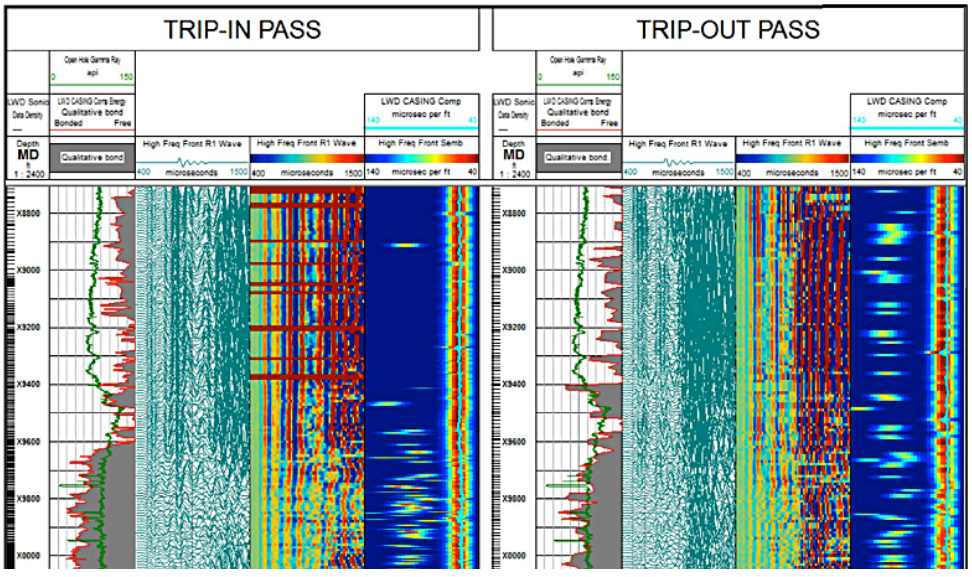
- TOC and micro annulus identified from LWD acoustic data while wireline CBL provided inconclusive results
- Successfully identified TOC and micro-annulus from LWD acoustic data, while wireline CBL provided inconclusive results

OVERVIEW

Acoustic logging-while-drilling (LWD) tools can be used to provide an assessment of top of cement (TOC), offering an alternative to a conventional wireline cement bond log (CBL). During the cementing of a 7⅝-inch liner in an ultra-deepwater Gulf of Mexico well, the operator could not establish cement returns during pumping operations. The final differential pressure of 150 psi during cementing was less than the planned 180 psi, and, based upon the cement lift pressure, the operator anticipated the cement column to be less than planned by approximately 150 feet (46 meters). Foreseeing cement integrity issues, the operator planned to perform a cement squeeze job following a cleanout run, and also planned to use a wireline CBL, run on a tractor, to confirm the TOC.

XBAT™ SERVICE HELPS REDUCE WELL TIME THROUGH EARLY TOC DETECTION

During the cleanout run to drill the cement inside the liner, a complete fluid displacement was performed. The XBAT azimuthal sonic and ultrasonic LWD service was included in the drill-out assembly, and was used to log inside the casing during both the trip-in pass and trip-out pass while the liner was pressurized differentially. A wireline CBL was run following the displacement, but, since it was not possible to perform a pressurized logging pass, the presence of the microannulus could not be confirmed.



TOC analysis performed inside 7⅝-inch casing during the trip-in pass of a cement cleanout run (left) compared to the trip-out pass (right). The trip-out pass occurred with lighter mud than the trip-in pass, following displacement of the drilling fluid.

WAVEFORMS AND CASING ARRIVAL ANALYSIS CONFIRM TOC

The XBAT service acquired acoustic waveforms during the cleanout run inside the liner to assist with the identification and confirmation of TOC acquired by the wireline CBL. The tool was programmed to fire two high-frequency monopole modes and to acquire data in memory at a fast sample rate to ensure sufficient data density without the need to slow down the tripping operations. TOC was identified at around X9,650 feet, based on based upon four different datasets acquired from the two different firing modes and from both trip-in and trip-out logging runs. The waveform analysis and casing arrival analysis complemented each other in confirming the TOC depth, and helped to identify a micro-annulus, in contrast to the wireline CBL data, which was inconclusive.

As a direct result of the LWD analysis, the operator resumed normal drilling operations in the next hole section without the need for the cement squeeze, and confirmed the suitability of the XBAT service for future TOC evaluation applications.

CLIENT TESTIMONY

"The primary cement job of the 7⅝-inch liner had total losses. Because we were at 77° inclination, we did not have any lift pressure indication to help us identify TOC depth. We did not know where the losses occurred. The LWD sonic sensor was added to the cleanout BHA to obtain early indication of cement bond, as well as to test the effectiveness inside 7⅝-inch (47.1lb/ft). We ran in, displaced on bottom from 10.0 ppg to 8.3 ppg fluid, POOH [pulled out of hole] and retrieved the LWD sonic memory data, then ran a segmented bond tool (SBT) on wireline while the LWD data was being interpreted. The SBT said we had no cement. We had a C-flex port collar in our 7⅝-inch string, so we were planning on going in to squeeze. When we reviewed the LWD sonic data, we saw that we had good bond on the trip-in data. The trip-out data did not show as high quality a bond, but it was still present. Given this revelation that we had cement behind pipe, we canceled the C-flex squeeze job because we did not believe we would be able to obtain injection through the micro-annulus. We opted to drill out, perform a FIT [fracture injection test], and perform a shoe squeeze if necessary. Fortunately, the FIT was successful, showing that the micro-annulus was at least liquid tight. We then continued drilling ahead. Savings were approximately 1.5 days/USD 700,000."

This case study includes data from a technical paper prepared for presentation at the SPE/IADC Drilling Conference and Exhibition held in The Hague, The Netherlands, March 14–16, 2017.

HALLIBURTON