MATURE FIELDS

CASE STUDY

Superior Look-Ahead Detection of Reservoir Boundaries on First Use

BRIGHTSTAR® LOOK-AHEAD RESISTIVITY SERVICE REVEALS RESERVOIR BOUNDARY WELL, GAINING OPERATOR CONFIDENCE

NORWAY

CHALLENGE

- Prevent penetration of the reservoir boundary to meet coring requirements
- Perform geostopping at an optimal distance above the top reservoir
- Existing casing shoe is positioned very close to target reservoir
- Implement new LWD EM sensor technology and ensure safe operations

SOLUTION

BrightStar look-ahead resistivity service used for:

- Inversion depth up to 30 m ahead (dependent on spacing and resistivity environment)
- Correlation with established LWD logs and at-bit resistivity to qualify new technology

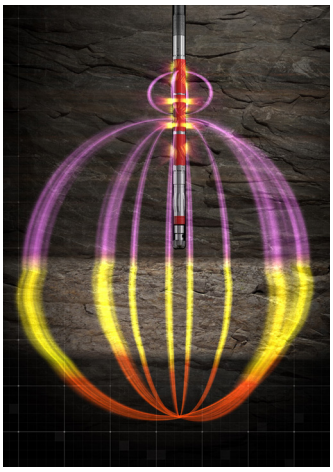
RESULT

- Successfully picked the reservoir top 12 m TVD below, prior to the coring run
- Qualified the BrightStar predictions with a wipe log across the boundary to confirm the results
- Identified additional low contrast boundaries ahead of the transmitter

OVERVIEW

A Norwegian oil exploration and development company was planning to drill a nearly vertical, 11-degree inclination well to assess a reservoir in the Norwegian Continental Shelf. Coring across the reservoir boundary was required, necessitating a geostopping operation on the drilling run prior to commencement of core sampling. The previous section was cased off at an estimated 58 m MD above the top reservoir.

Halliburton Sperry Drilling recommended the implementation of our newest logging-while-drilling (LWD) electromagnetic (EM) sensor technology, BrightStar look-ahead resistivity service, to illuminate the reservoir boundary.



BrightStar look-ahead resistivity and antenna placement

CHALLENGE

When deploying new technology, establishing the confidence in delivering the expected results is vital. The BrightStar EM antenna-type sensors were run alongside existing LWD services with the ultra-deep transmitter being placed 9 m behind the bit rather than the optimal 3-m placement, requiring "very early" detection of the top of the reservoir.

The close proximity of the casing shoe above, a cause of concern for interference with the EM signals, further limited the open hole section in which to establish the background resistivity and then identify the reservoir below.

SOLUTION

The operator agreed to run the BrightStar service with the transmitter-to-receiver spacing optimized for early reservoir boundary detection, while limiting interference from the existing casing. To ensure an early warning of the reservoir top, pre-well modeling was performed to confirm the tool's ability to detect the top of the reservoir up to 24 m below the transmitter. Assessment of offset data also indicated the look-ahead inversion could be supported by correlation against gamma ray and near-bit resistivty logs. This provided confidence in geostopping before penetrating the reservoir.

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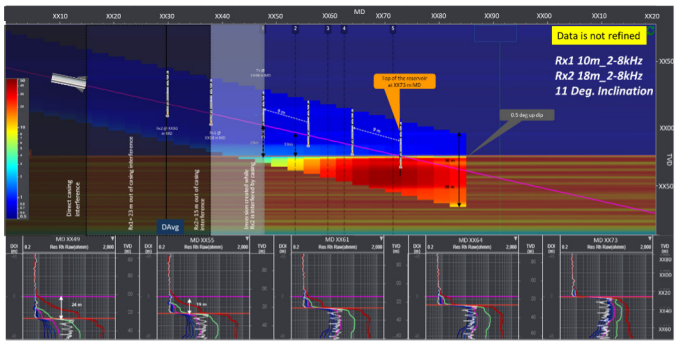
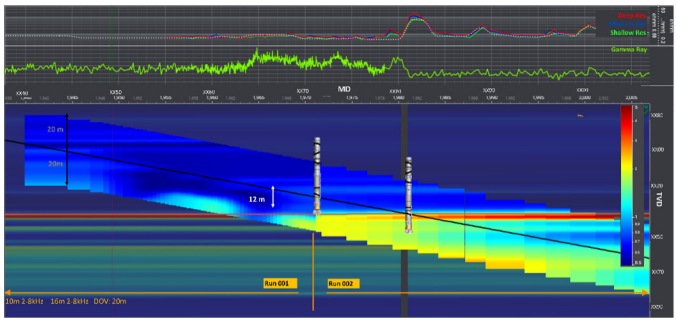
TECHNICAL DETAILS

This project deployed the first LWD EM sensor equipped with a fully triaxial, co-located, tilted antenna structure for real-time anistrophy and dip angle determination. The tool, along with a unique processing scheme, enables the determination of horizontal and vertical resistivity, as well as the dip angle and the azimuth of the formation, while drilling in real time. The co-located sensor design is capable of acquiring multi-component signals that are sensitive to formation anisotropy and structural dip in wells at any orientation.



BrightStar pre-well modeling data.



BrightStar LWD data shows geostopping section and wipe section across the reservoir boundary to confirm its position.

RESULT

Pre-well modeling indicated that with the expected thickness and resistivity of the reservoir, boundaries could potentially be detected up to 24 m below. The reservoir resistivity and thickness were much less than anticipated. However, the boundary was still detetcted prior to being penetrated by the bit with confidence 12 m below the transmitter and ahead of the bit. After a successful coring run, the reservoir top was confirmed at the depth predicted by the BrightStar LWD data.

SUMMARY

This project demonstrates the reliability of the BrightStar look-ahead resistivity service to accurately detect the top of a reservoir before it is penetrated. Coring was successfully conducted, and casing was set at an optimal distance above or within the target formation. Despite the promixity to casing that limited the transmitter-to-reciever spacing and a lower resistivity contrast than anticipated, the results were outstanding - poviding high confidence in the deployment of the BrightStar service for use in other operations.

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