Baker Hughes

Case study: Colombia

StarTrak ML service efficiently logs high-resistivity formation to reach TD without a wireline run

An operator drilling exploratory wells in Colombia required high-density logging-while-drilling (LWD) data to effectively geosteer through a complex formation characterized by high resistivity, multiple fractures, stick-slip vibrations, and a risk of washouts in some mudstone layers.

The operation required high-quality, real-time resistivity data to improve geostopping decisions and avoid dropping angle in some intervals. Simultaneously, the operator wanted to avoid the rig time of separate wireline runs to collect the resistivity data in the highly deviated wells (with inclinations from 35° to 45°).

As an alternative to wireline, the operator considered placing a resistivity sensor in the bottomhole assembly (BHA).

The resistivity tools of other service providers required lower rates of penetration (ROPs) to minimize vibrational effects and collect LWD data at the required density and depth of investigation (DOI), which added time and cost to the drilling operation.

The operator asked Baker Hughes for a reservoir characterization solution that provided high-density resistivity data without sacrificing ROP. Baker Hughes proposed its StarTrak™ ML imaging service, which operates reliably in high-vibration drilling environments to generate multi-laterolog resistivity and high-resolution images at the required DOI.

This project marked the first deployment of the StarTrak ML service in a high-resistivity, geologically complex formation in the Western Hemisphere. The operator agreed to deploy this solution based on Baker Hughes's vast field experience and proven record of acquiring high-quality resistivity data with advanced LWD technologies.

Collaborating on the optimal execution plan

Various Baker Hughes product lines—including Drill Bits, Wireline, Fluids, and Reservoir Technical Services—worked together to develop the optimal StarTrak ML service deployment plan.

Specific parts of the plan included:

- Placing the resistivity sub far enough from the bit to mitigate vibrations and dysfunctions but close enough to capture data for geostopping and geosteering with required DOI
- Performing geomechanical analysis on each well to support risk mitigation strategies developed by the RiskGuard™ analysis and risk management solutions
- Developing geomechanical models of the wells, which the operator lacked
- Increasing the drilling mud's rheological properties to maintain the target yield point between 24 and 26 lbf/100 ft^2
- Reducing the length of the adjustable kick-off sub in the motor to mitigate bending
- Avoiding washouts by reviewing hole cleaning requirements and controlling parameters such as flow rate, weight on bit, and revolutions per minute

Challenges

- High-resistivity formation and complex reservoir environment challenged LWD logging
- Hostile geological environment included multiple fractures, washouts in mudstone formations, and tendency for high stick-slip vibrations
- Highly deviated wells with inclinations from 35° to 45° created deployment challenges for wireline
- Third-party LWD tools required a drop in ROP to capture data at required density

Results

- Collected high-quality resistivity measurements in complex reservoir environment to make real-time geostopping decisions
- Successfully reached target depth in multiple wells, drilling a total of 7,638 ft in 212 hours with no ROP reduction
- Reduced operational time while eliminating additional wireline logging runs
- Mitigated operating risks and ensured flawless execution through close cross-discipline collaboration

With the plan approved by the operator, Baker Hughes deployed the StarTrak ML service in 8 ½-in. hole sections of multiple exploration wells.

Executing efficiently to target depth

The StarTrak ML service deployed efficiently and performed flawlessly to deliver high-density resistivity logs and real-time reservoir characterization in each exploration well.

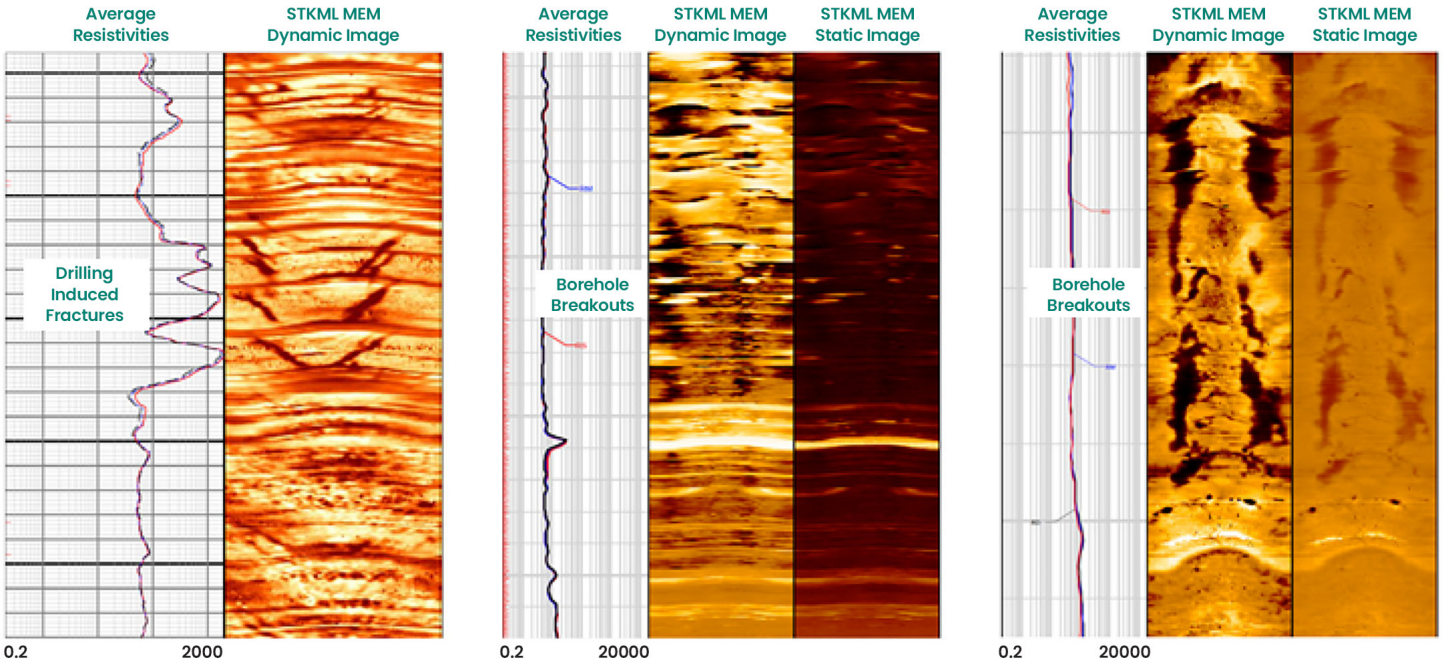
Optimal placement of the resistivity sensor close to the bit ensured that the StarTrak ML service reliably captured data at the desired DOI, without reducing the ROP and extending drilling time. The high-quality resistivity data also helped the operator avoid the time and expense of conducting separate wireline runs.

The drilling team used the real-time data to navigate efficiently through the high-resistivity formation to the planned geological targets and make real-time geostopping decisions with minimal drill bit sliding for course corrections.

The operator used the StarTrak ML service's detailed reservoir characterization to confirm the exploration block's production potential and add it to Colombia's hydrocarbon reserves. The formation data identified the block's reserves as light crude oil, making the reservoir an attractive commercial find compared to neighboring blocks predominated by heavy crude oil.

The operator considered this first drilling campaign with the StarTrak ML service a success, thanks in large part to the extensive pre-planning among the Baker Hughes product teams. This planning, coupled with the vast experience of the company's field crews and their ability to incorporate lessons learned from well-to-well, helped minimize drilling dysfunction risks and vibration-induced tool damage on the way to target depth.

Following this initial success, Baker Hughes deployed the StarTrak ML service in several wells for other clients in Colombia to successfully drill a total of 7,638 ft (2,328 m) in just 212 hours. With each successive drilling operation, the StarTrak ML service adds to its reputation as the preferred resistivity logging service in fields with high-resistivity formations.



The StarTrak ML service provides high-quality resistivity data and imaging that identifies geomechanical features like drilling-induced fractures and borehole breakouts with greater sharpness and clarity than other tools.

Baker Hughes