

Case study: Colombia

DELTAFLOW increases wellbore integrity in highly faulted formations, saves 7 days of drill time

The customer's drilling operation in a highly faulted formation in the Colombian foothills presented significant wellbore integrity challenges and high fluid losses.

The customer asked the Baker Hughes team to develop a fluid solution that maintained well integrity and maximized a return permeability in the formation of interest.

After a careful review of the formation information, Baker Hughes recommended its DELTAFLOW™ low-impact drill-in fluid (DIF) system. Through the optimal selection of bridging and sealing materials, the DELTAFLOW system produces a high-quality filter cake that improves wellbore stability and minimizes fluid losses.

Designing fit-to-purpose fluid system

This operation marked the first application of the DELTAFLOW system in Colombia. The DCF team conducted a series of laboratory tests to optimize the system's performance.

The DELTAFLOW system delivered a return permeability of 95.6%, a significant increase from the 91.0% return from the previous fluid system.

The return permeability tests also showed a tendency for minimizing formation damage. The DELTAFLOW system minimized formation damage from 9% to only 4.4%.

The DELTAFLOW system exhibited superior rheological and hole cleaning properties in the lab. The yield stress (YS) was improved, which is the

minimum stress at which the formation undergoes permanent deformation while maintaining flat gels with a low yield point (YP) and plastic viscosity (PV). These results imply that the DELTAFLOW system ensures proper wellbore cleanup without increasing circulating pressures or equivalent circulating density (ECD).

The DELTAFLOW system demonstrated improved electrical stability compared to the legacy fluid, which indicates a low tendency to form emulsions and oil-wet the formation. The addition of Baker Hughes DELTA-TROL™ LA helped to minimize mixing times and maintained excellent high temperature/high pressure (HTHP) filtration control. In filtration testing, the product consistently kept the HTHP filtrate below 4 mL/30 min.

Efficiently drilling while maintaining well integrity

The superior laboratory performance of the DELTAFLOW system convinced the customer to trial the system in the field. The customer drilled an 8½-in. interval with the DELTAFLOW system and achieved several performance improvements over wells drilled with the legacy fluid:

- Formulation facilitated easier preparation in the field and avoided mixing problems like fisheyes that could block the pump or plug bottomhole tools
- Provision of superior filter cake quality, which subsequently increased wellbore integrity and formation stability through each formation

Challenges

- Drill wells through highly faulted formations while maintaining integrity and minimizing fluid losses
- Reduce tripping, reaming, and back-reaming times
- Avoid risks of stuck pipe and plugged bottomhole tools associated with tight holes
- Perform efficient hole cleaning without compromising equivalent circulating density and risking pack off

Results

- Minimized the risks of formation instability to improve hole cleaning, ECD, and circulating pressures
- Successfully drilled 3,556 ft (1,084 m) interval, exceeding planned depth by 714 ft
- Delivered interval 7 days early, reducing CO₂ emissions at the rig site
- Saved \$36,000 USD on fluid by avoiding losses to the formation
- Increased return permeability from 91.0% to 95.6% compared to the previous fluid system

- Precise hourly addition of sealing and bridging agents to avoid formation losses due to ongoing measurement of particle size distribution in the fluid and the DCF team's bridging and sealing design
- Yield strength held to maintain adequate wellbore cleaning while eliminating the risk of stuck pipe, pack-offs, caving, and wellbore restrictions
- Increased wellbore stability saved 168 hours in tripping time, 13 hours in reaming time, and 13.5 hours in back-reaming time

Ultimately, the DELTAFLOW system allowed the customer to drill a 3,556 ft (1,084 m) reservoir section—714 ft (218 m) longer than planned depth—through eight separate formations and faults in the highly fractured foothills region. The interval was delivered 7 days early, reducing CO₂ emissions at the rig site. The customer also saved an estimated \$36,000 USD in fluid costs by avoiding losses to the formation.

Baker Hughes' expertise and technologies helped the customer meet its drilling objectives, with

improved performance, profitability, and reduced carbon emissions. With this successful operation as proof of the DELTAFLOW system's ability to deliver stable wellbores in less time and lower cost, the customer is working with Baker Hughes to explore other applications of the system in future wells.

