New Geomechanics Approach Solves Wellbore Instability Issues in Unconventional Play

Combining geomechanics and drilling engineering techniques results in successful horizontal well

**CHALLENGE**
Drill a viable horizontal well in a challenging unconventional play despite wellbore instability problems and no clear safe mud-weight window.

**SOLUTION**
Determine a safer mud weight by developing a mechanical earth model (MEM) with a depth-of-damage approach; foster collaboration between geomechanical and drilling engineers to predict and manage dynamic changes in mud density.

**RESULTS**
Effectively drilled a successful horizontal well suitable for long-term production while avoiding the risk of borehole collapse and other severe losses.

Planning a drilling operation where two previous attempts failed
An operator in Texas planned to drill a horizontal well in an unconventional formation in which two previous attempts to do so had failed. The region was known to be particularly challenging to drill; past campaigns resulted in wellbore instability issues and hole collapse due to weak rocks and insufficient mud weight. The success of this horizontal campaign hinged on making better-informed decisions that would mitigate instability, drilling risks, and geohazards while ensuring long-term production.

Combining geomechanics and drilling techniques for unique approach
To gain a better understanding of wellbore stability, find the safest mud-weight window, and ensure a viable operation, the operator requested a geomechanical evaluation for its planned trajectory in the shale play. Collaborating with the operator, Schlumberger petrotechnical experts combined geomechanics data, an MEM, and wellbore-stability analysis with a depth-of-damage approach. Schlumberger petrotechnical specialists also offered recommendations on lateral landing targets to increase the chance of drilling a successful horizontal wellbore.

The petrotechnical specialists analyzed a previously drilled pilot well by creating an MEM that consisted of a suite of log-derived rock mechanical properties. The MEM helped the team determine the in situ stress in the subsurface and the mechanical stability of the wellbore in the context of that stress state. Wellbore-stability analysis data helped calibrate the MEM by matching instability predictions with log-derived observations. The data was also used in determining the safest mud weight for optimal wellbore stability. The analysis also helped

- define the minimum acceptable mud weight
- determine the equivalent circulating density limits
- evaluate the significance of wellbore azimuth and deviation for stability
- evaluate the current drilling design for long-term field-development goals.

The wellbore-stability window detected potential risks in the formation, including mud-loss, tunnel-failure, failure-management, and hole-collapse events.
Drilling successful horizontal well with less risk
Two integral components of wellbore-stability analysis were introduced to this customer. The first, depth-of-damage analysis, predicted the severity of wellbore instability to give drillers a sense of the wellbore’s likely conditions and behavior. These results were directly used in the second component—drilling engineering techniques that considered how drilling and tripping practices affected the stability of the wellbore.

Through a collaborative effort using geomechanics techniques and drilling engineering, the operator successfully drilled its third well where its two earlier attempts to do so had failed under the same conditions. Data that was obtained helped locate the mud weight needed to safely drill and avoid the risk of borehole collapse and severe losses. Schlumberger also provided the recommended lateral landing target to successfully drill with the best wellbore stability. Schlumberger considered reservoir, completion, and drilling quality when recommending the landing target that was most suitable for long-term development decisions.

Reservoir-, completion-, and drilling-quality measurements were balanced to find the safe mud-weight window in the unconventional reservoir.