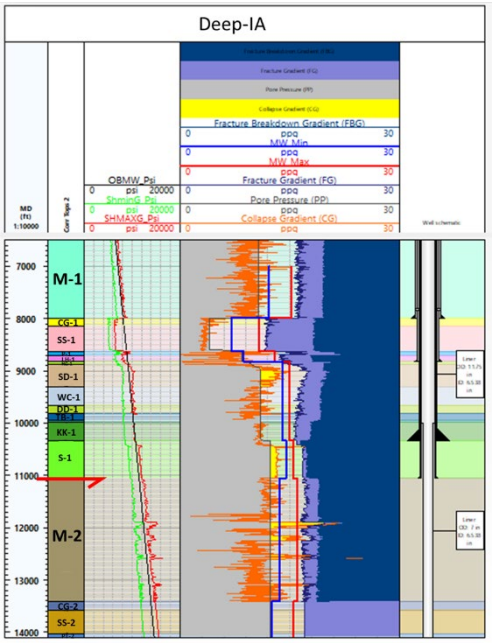
1D Geomechanics, Wellbore Stability Analysis

Enabled Operator to Drill Salt Formation in One Run After Three Failed Sidetrack Attempts in Offset Wells



Pre-drill wellbore stability model of the target well.

Objectives

- Develop a pre-drill 1D Geomechanical Earth Model (GEM) for wellbore stability (WBS).
- Prepare a realistic data set by using data from offset wells and generate missing data to create a reliable WBS model.
- Estimate the pore pressure by using seismic velocities and correlation with actual reservoir pressure where available.
- Analyze rock mechanical properties and stress fields for the target well.
- Determine the possible causes of drilling risks related to wellbore instability.
- Establish recommendations for preventing/mitigating/avoiding drilling risks on the target well.
- Enable the customer to drill through a salt formation to maintain the mud weight window and avoid hole collapse and stuck pipe issues.

Our Approach

- Weatherford geomechanical experts conducted the study across two phases.

LOCATION
Pakistan

WELL TYPE
Horizontal

FORMATION
Carbonate

HOLE SIZE AND ANGLE
22 in. (vertical)
12.45 in. (vertical)
8.5 in. (vertical)

MEASURED DEPTH
14,000 ft (4,267 m)

PRODUCTS/SERVICES
- 1D Geomechanics modeling (1D GEM)
- Wellbore Stability Analysis (WBS)

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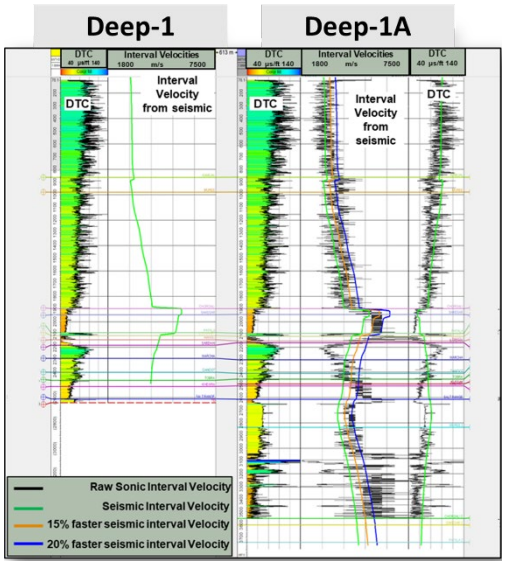

Pore pressure from seismic.

Our Approach (continued)

- Stage I included data gathering, performing QA/QC, and loading the data into the system. The experts analyzed drilling data for three offset wells, propagating the data and filling in the gaps by using 3D well prediction and 3D neural network techniques in both the near/far offset wells and the target well.
- These analyses defined the lithology (mechanical stratigraphy) and calculated the overburden stress, the horizontal stresses (Sh min and SH mix), magnitude, and direction.
- Pore pressure was calculated by using sonic and seismic velocity data, and the experts studied the geomechanical elastic and plastic properties as well as examined the post-drill WEB models of the offset wells.
- Stage II centered on the pre-drill wellbore stability analysis of the target well.
- A 1D geomechanical and wellbore stability model was built by using very limited offset data, especially for a salt formation which is the most difficult formation to drill due to the salt creeping behavior.

Value to Customer

- While the well was initially modeled to drill about 725 ft (220 m) of the salt formation, the thickness of the salt formation increased more than 1,000 ft (304 m). The well was drilled up to an 800-ft (243-m) thickness of salt without having any problem to maintain the modeled mud weight window. Due to increased thickness of salt and depth, however, the customer had to increase the mud weight up to just below the maximum mud weight window limit.
- In previously drilled offset wells, the customer was not able to complete the well even after 3 sidetracks due to the salt formation in the oil field targeting the Paleocene reservoir.
- Weatherford experts were able to deliver an optimistic mud weight window and casing shoe depth after the operation encountered a challenging area of two stratigraphic sheets. The upper sheet was depleted and bounded by high pressure shales while the lower sheet had same high-pressure shales with salt formations. The Weatherford solution enabled the customer to complete the well successfully.

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