AGOCO Optimizes Exploration Decisions with Expert Formation Microimaging Data Interpretation

Advanced petrotechnical interpretation fills in knowledge gaps in openhole logging for more comprehensive reservoir characterization, Libya

**CHALLENGE**
Construct a reliable facies model of two Ghadames basin reservoirs with high vertical and lateral disconnect.

**SOLUTION**
Obtain and interpret high-resolution FMI* fullbore formation microimager measurements to use with other detailed logging data to build a geological modeling for advanced petrotechnical evaluation.

**RESULTS**
Optimized decisions based on better understanding of clastic facies distribution, deepened knowledge of basinal geology, and reduced uncertainty of vertical and lateral facies continuity.

“We express our gratitude and appreciation to Schlumberger, which provided invaluable assistance that helped our technical departments construct the depositional facies scheme.”
Aiyad Alhassi
Geology Department Manager
Arabian Gulf Oil Company

**Enhance exploration in high-uncertainty formations**
The Arabian Gulf Oil Company (AGOCO) had exploration wells accessing the Memouniat and Acacus sandstone formations in the Libyan portion of the Ghadames basin. The geometry of these sandstone units is not fully demonstrated, and there are numerous uncertainties involving the reservoirs’ lateral uniformity and continuity—even within a few kilometers’ distance. Without accurate data for characterization and formation evaluation of the facies, determining their distribution and correlation was challenging.

In these formations, identifying facies based on traditional openhole logs is unreliable and cannot be used to construct a definitive facies model. Limited core data, from which sedimentological and directional information can be obtained, was recognized as a source of potential difficulty in creating a robust geological model. Previous-generation, conventional openhole logging techniques showed good agreement in log response between adjacent wells, but AGOCO wanted to know whether better-informed decisions based on higher accuracy petrotechnical data were possible.

**Improve geological modeling with accurate data**
The basic openhole logs indicated that the sandstone units of the Acacus and Memouniat reservoirs had no marked facies variations and therefore could be assumed to share similar depositional conditions. This conclusion could have led to suboptimal field development decisions. Advanced petrotechnical interpretation using recently acquired data proved that the sandstones had very different facies characteristics than previously thought.

Schlumberger petrotechnical experts collaborated with AGOCO to design a measurement-acquisition plan that included deploying the FMI fullbore formation microimager as a standard log in its exploration wells in the basin. FMI microimager details can be discerned down to 50 um and can help describe intervals where no coring and sampling data was obtained. After the petrotechnical team processed the microimages, they performed a detailed dip interpretation and integrated elemental analysis and elemental capture spectroscopy results. Finally, the team created a high-resolution microfacies log to construct and interpret a decisive 3D facies model of the wells in the Ghadames basin.

Microfacies interpretation is useful for describing the subsurface stratigraphy of clastic facies in basins with high vertical and lateral sedimentological complexity. Additionally, microfacies analysis describes sandstone reservoir properties that exhibit extreme petrophysical behavior and aid in determining different well-correlation methods for the Ghadames basin wells. The petrotechnical interpretation helped determine the specific positions in stratigraphic cycles in which sandstone facies with good-quality reservoir properties were more likely to occur.
CASE STUDY: Advanced petrotechnical interpretation fills in knowledge gaps in openhole logging, Libya

Better understand subsurface variations with expert analysis

The AGOCO and Schlumberger team demonstrated the importance of applying detailed interpretation techniques to multiwell facies analyses for better-informed subsurface characterization and exploration decisions. This petrotechnical interpretation helped identify high-quality intervals for fracturing, testing, and perforation in the stratigraphically and sedimentologically complex basin. Optimizing the selection of these intervals saves money and time as well as increases production from the zones or facies. On the basis of the results of the in-depth petrotechnical evaluation, AGOCO decided to run the FMI microimager as part of its standard logging tools in exploration wells.

Interpretation summary log showing measured depth from the kelly bushing, borehole drift, and FMI microimager dual calipers (Track 1); static FMI microimager results (Track 2); arrow-plot display showing dip and azimuth of the interpreted FMI microimager features (Track 3); ECS* elemental capture spectroscopy sonde mineralogical percentages display (Track 4); dip azimuth rosettes for the interpreted bedding and crossbedding (Tracks 5 and 6); iCore* lithofacies from elemental capture spectroscopy and microresistivity imager column (Track 7); manually interpreted FMI microimager lithofacies log (Track 8); cyclicity from log profiling and FMI microimager (Track 9), and formation tops (Track 10). According to the data obtained using the ECS sonde and FMI microimager, the X1 formation interval within the well shows a fining-upward sandstone pattern. A sharp unconformity is interpreted between the X1 and the X2 formation that overlays it.
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Interpretation summary log showing measured depth from kelly bushing, borehole drift, and FMI microimager dual calipers (Track 1); static FMI microimager results (Track 2); arrow-plot display showing dip and azimuth of the interpreted FMI microimager features (Track 3); ECS sonde mineralogical percentages display (Track 4); neutron density and photoelectric factor (Track 5); ELANPlus* advanced multimineral log analysis volume (Track 6); gamma ray profile (Track 7); array laterolog resistivity (Track 8); bedding and crossbedding azimuth rosettes (Track 9); manually interpreted FMI microimager lithofacies log (Track 10); iCore lithofacies (Track 11); cyclicity from log profiling and FMI microimaging (Track 12); and formation tops (Track 13). Geological observations within the X3 formation show tidal flats and channels (fining-upward cycles) over the bottom parts overlaid by tide-dominated deltas (coarsening-upward cycles), and the pattern repeats once more. Some contacts between the X3 and X4 formations look gradationally conformable.

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