Geomechanics Pinpoint Cause of Sand Production

Case Study: DCS integrated techniques help AGOCO better understand thin-bed reservoirs

Challenge
Sanding in Arabian Gulf Oil Company’s (AGOCO) Sarir field in Libya has become progressively worse in an increasing number of wells. Geomechanics studies have been conducted, but each on its own was unable to detect the definitive cause of sand production.

Solution
Petrophysical log enhancement was used in the evaluation of thin-bed formations. Schlumberger Data & Consulting Services (DCS) findings led to a better understanding of performance issues and what to expect in the future.

Results
The DCS approach proved that integrated geomechanics and petrophysics studies could help leverage log data, allowing for planning and intervention before a crisis occurs.

Sand management challenge
Since 1984, sanding in Arabian Gulf Oil Company’s (AGOCO) Sarir field in Libya has become progressively worse in an increasing number of wells. Geomechanics studies have been conducted, but each on its own was unable to detect the definitive cause of sand production.

Generating mechanical earth models (MEMs) to analyze reservoirs can become a challenge in beds with thin-bed sequences, especially those made up of weak and strong sand layers less than 1 ft thick. The bed’s heterogeneity and variation between adjacent layers often go undetected by logging tools because the bed is thinner than the tools’ resolution. The tools can provide only an averaged report on the reservoir’s mechanical properties without acknowledging the existence of strong and weak sequences. The result is an incomplete picture of the reservoir’s sanding potential.

AGOCO called on the interpretive skills of Schlumberger Data & Consulting Services (DCS), which initiated a geomechanics and sanding study in 2004. It was thought that skilled interpretation of the results would provide the information needed to select the right sand management solution, guide development decisions, allow appropriate completions planning, and optimize future reservoir management.

![Graphs showing initial log-derived rock strengths indicating no sanding problems and FMI images and laboratory test data revealing thin weak beds.](Data & Consulting Services)
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Geomechanics analysis
The DCS team first conducted a data audit of existing geomechanics information to characterize previous sanding problems and help diagnose the causes. One study, based on wireline sonic data, indicated no tendency for sanding across a thick reservoir interval at the drawdown pressures required for economic oil production. These sonic logs were unable to detect thin weak zones in the Sarir field with thicknesses below the vertical resolution—about 42 in—of the wireline sonic tool. The log-derived unconfined compressive strength (UCS) curve indicated that the entire reservoir was above the critical sand-free UCS, contradicting the field’s history of solids production with depletion.

DCS had also commissioned a laboratory testing program on core samples to obtain measurements of the rock mechanics parameters relevant to stress modeling and sanding prediction. The laboratory data showed a big spread in UCS, including rock strengths that would present a significant sanding risk. Integrating the laboratory results with other geomechanics information available from log, field, and drilling measurements provided the initial MEM, which contained most of the information necessary for subsequent evaluations.

But the DCS team took it a step further by introducing FMI* Fullbore Formation MicroImager data from the same thin-bed intervals. Alpha processing and other petrophysical log enhancement techniques generated a 0.2-in high resolution porosity log. The downscaling techniques were combined with empirical UCS-porosity relationship data from the laboratory. The downscaled UCS log results exhibited the wide range of strength values known to exist across the thin-bed sequence.

The sanding predictions based on the new high-resolution UCS log closely matched the observations of sanding in the field, unlike the results from other analyses that had used only the DSI* Dipole Shear Sonic Imager log. The UCS data from this process, which showed the same strength heterogeneities as the core data, improved the description of rock strength in the MEM that was needed for subsequent sanding analyses of the thin-bed sequences. Petrophysical log enhancement, which provided a high-resolution rock strength profile of the Sarir wells, is believed to be a “first” in generating downscaled mechanical properties for geomechanics and sanding evaluation of thin-bed formations.

Conclusions
Schlumberger DCS delivered to AGOCO a detailed evaluation of the field. The findings led to a better understanding of performance issues and what to expect in the future, allowing for planning and intervention before a crisis occurs. The DCS approach proved that integrated geomechanics and petrophysics studies could help leverage log data. Combining different log data and adding interpretive expertise contribute value to the evaluation process, confirming that the whole is more than just the sum of the parts.

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References