Performing a 4D Geomechanical Modeling Study to Protect EOR Production Facilities Investment

Case study: Middle East operator uses VISAGE coupled modeling to mitigate surface movement risk

Challenge
Understand and mitigate risk of surface movements during EOR operations.

Solution
Perform 4D geomechanical modeling to calculate the preproduction effective stress state using VISAGE reservoir geomechanics modeling software.

Results
Developed optimal injection and production schedules based on modeling findings, thereby helping to protect surface facilities investment.

Understand EOR-induced surface movements
Because of the considerable facilities costs for steam-injecting and producing a well, an operator needed to understand and mitigate the risk of potential future uplift caused by the steam injection. An uplift event in this Middle Eastern heavy oil well could necessitate expensive remedial works to one or several facilities.

Predict stress trends with 4D geomechanics modeling
To fully comprehend the surface movement risk, the operator chose to perform a fieldwide geomechanics analysis. The company opted to work with Schlumberger Data & Consulting Services (DCS) because of previous successes with 2D geomechanical studies using the VISAGE stress simulator and its ability to include complex geological structures and perform 4D coupled modeling.

With the expertise of the Reservoir Geomechanics Center of Excellence in Bracknell, UK, the DCS team conducted a one-way coupled modeling workflow using the VISAGE software.
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This process included

- preparing fluid flow data
- building a 3D mechanical earth model (MEM)
- computing the preproduction stress state
- history-matching of production, microseismic, and movement events and modeling future production.

By matching the 1D preproduction stress state and the historical surface movement data, as well as forecasting microseismic events, the Bracknell team predicted a range of field behaviors accurately. The team also predicted EOR-induced movements over the next 25 years, which showed differential-induced deformations directly beneath the field’s main facilities.

Adjust schedule to minimize risk

The 4D geomechanical modeling of the preproduction state provided the operator with a better understanding of the induced surface movements and the potential for fault reactivation. Armed with this information, the company was able to optimize the reservoir surveillance and management systems to minimize the risk to the facilities.

The 4D geomechanical modeling performed by the DCS team provided the operator with a better understanding of surface movements and fault reactivation, thereby protecting a USD 1.6 billion investment.


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