13.02: 3D Mad Dog Pressure and Stress Prediction using the FES Method in Horizon (Elfen)

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ABSTRACT

We couple seismic velocities and a 3D geomechanical model (FES workflow) to predict stress and pressure at the Mad Dog field. We model both sand and mudrocks as poro-elastoplastic materials. Sands have a higher friction angle and lower uniaxial stress ratio than the mudrocks. We focus our study on the anticline below the Mad Dog salt at the original platform area. We find that the elastoplastic analysis predicts higher pressure, lower least principal stress, and a narrower drilling window (Fig. 1) compared to the poro-elastic analysis (Talk 12.02). We show that shear-induced pressures are the major component of the higher overpressures. We also find that the stress ratio in the mudrocks decreases to ~55% of its uniaxial value (Fig. 2). In contrast, when the pressure regression in the sands is modeled, the stress ratio in the sands remains comparable to its uniaxial value (Fig. 2). The 3D geomechanical model is built in Horizon (Elfen). Modified Cam Clay is used to describe the form of iso-porosity contours. Initial pore pressures are initialized using the VES pressure estimate. The workflow converges in 5 iterations.

CLICK ON IMAGE FOR LARGER VIEW

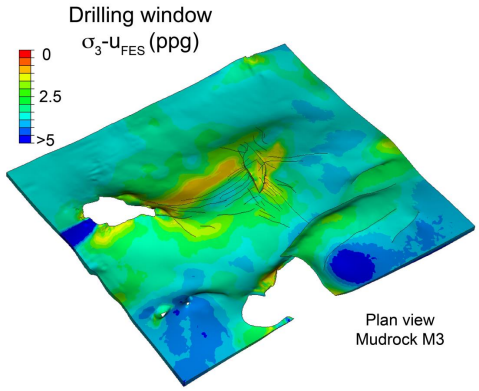


Figure 1: Plan section of 3D geomechanical model with contours illustrating the difference between least principal stress and pore pressure gradients. Warmer colors indicate smaller window.

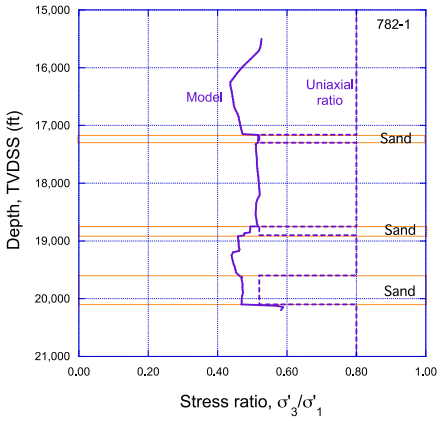
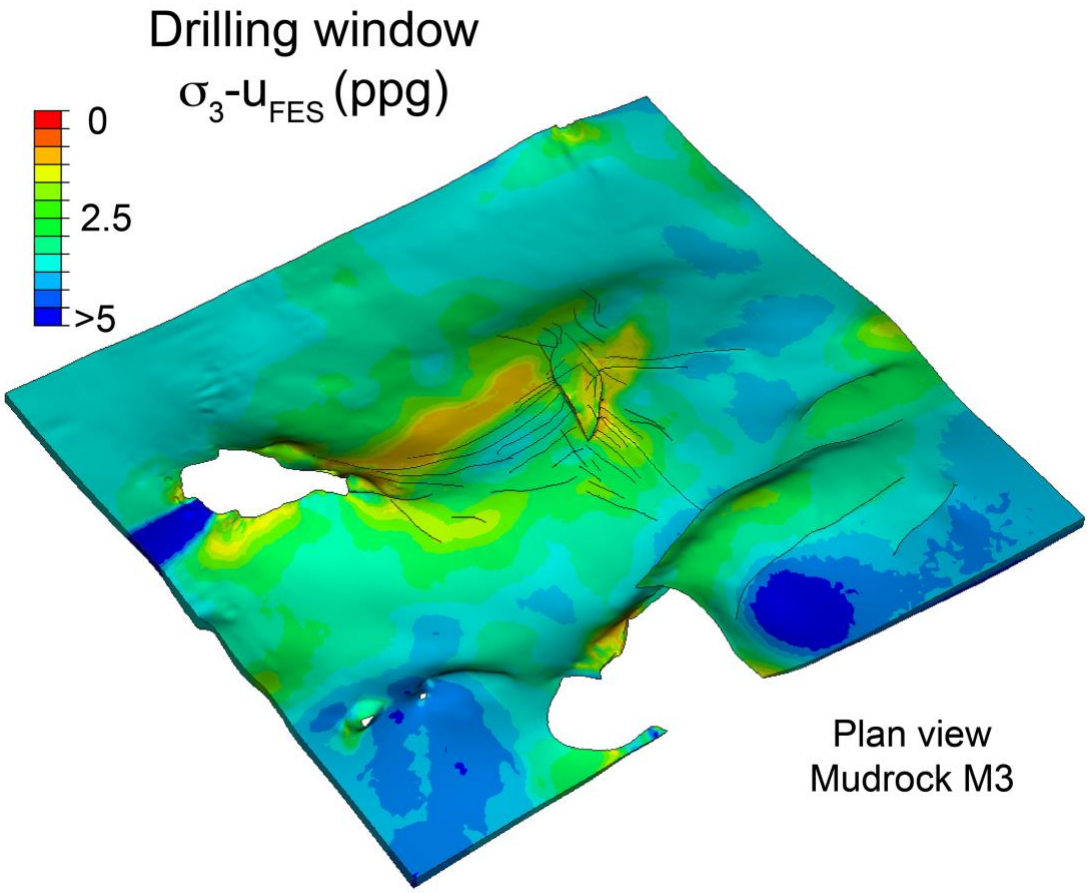


Figure 2: Stress ratio predicted by the poro-elastoplastic geomechanical model with FES workflow (solid line) compared to uniaxial ratio for mudrocks and sands (dashed line). Constant measured overpressure is applied in sands.



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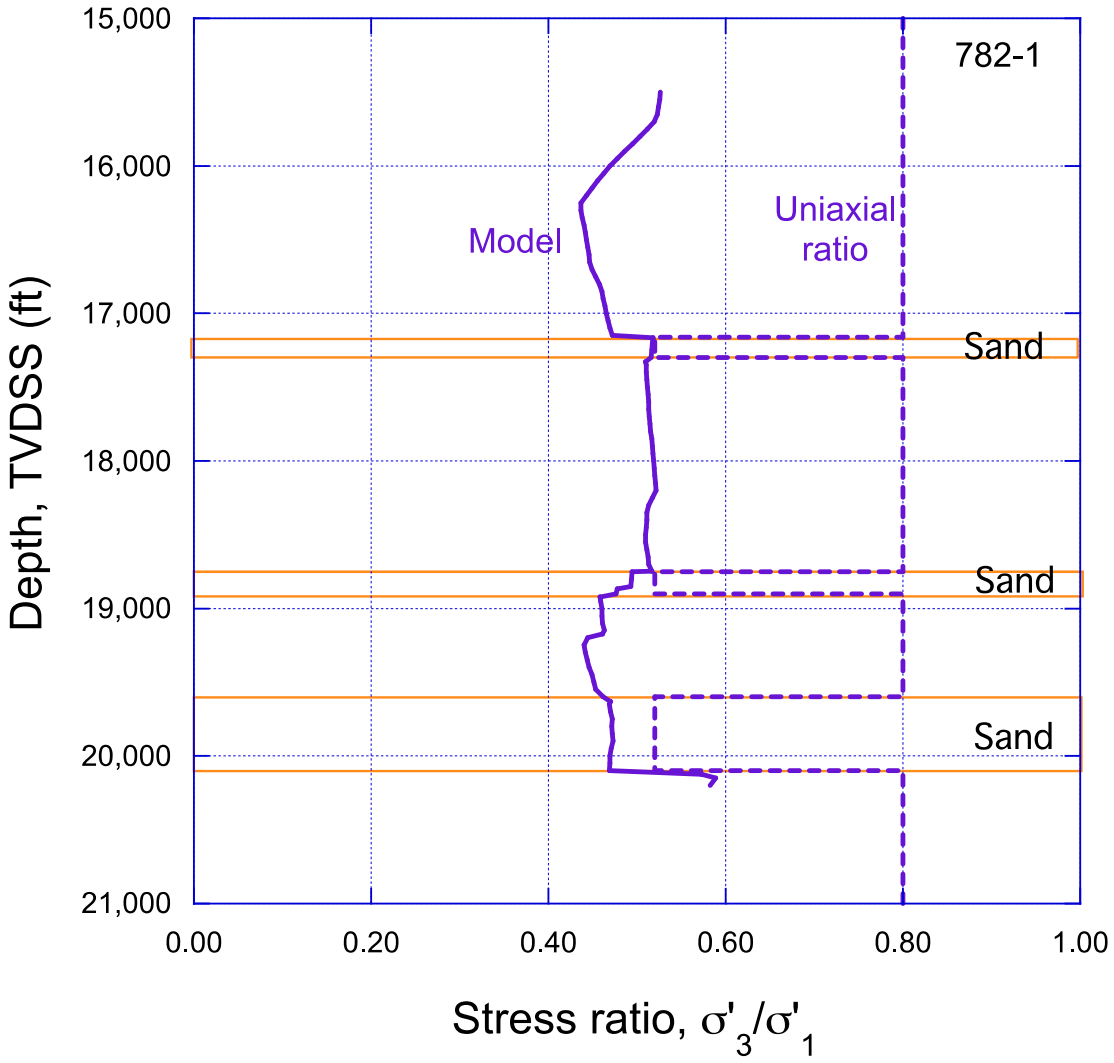
Back



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Back