

08.10: Coupling geomechanical modeling with seismic pore pressure prediction

Mahdi Heidari

ABSTRACT

We enhance the effective stress method for seismic pore pressure prediction to take into account the complexity of stress and deformation state in geologic formations where these states are different from those in purely vertical, uniaxial deformation. In these formations, pore pressure is a function of mean and shear stress. Pore pressure is calculated as the difference between total and effective mean stresses. Total mean stress is estimated from geomechanical modeling. The effective mean stress is estimated from velocity using a relation that takes into account the contribution of shear stress to sediment compaction and velocity. To consider the effect of pore pressure on total stresses, we use the predicted pore pressure field in the geomechanical model, leading to iterative pressure prediction. We use our method to predict pore pressure and stress field around a salt body beneath Sigsbee escarpment in Mad Dog field, Gulf of Mexico. Our method predicts significant perturbation of stress field caused by the salt body and the significant change in the basin bathymetry (Fig. 1). Pore pressure is higher than predicted by the vertical method where total mean and shear stress are higher than those along the calibration well. Our method also improves the predicted minimum stress field and hence safe mud weight gaps for drilling (Fig. 2). The improvements offered by our method for prediction of pore pressure and stress fields help better understanding of hydrocarbon migration and trapping across the formation, estimation of formation sealing capacity and hydrocarbon columns, and design of wellbores in complex geologic environments.

**CLICK ON IMAGE FOR
LARGER VIEW**



Fig. 1: Orientation of maximum principal stress predicted by geomechanical model in a salt basin, Mad Dog field, Gulf of Mexico. Stresses are strongly perturbed particularly in front of salt due to large lateral thrust from salt and updip sediments.

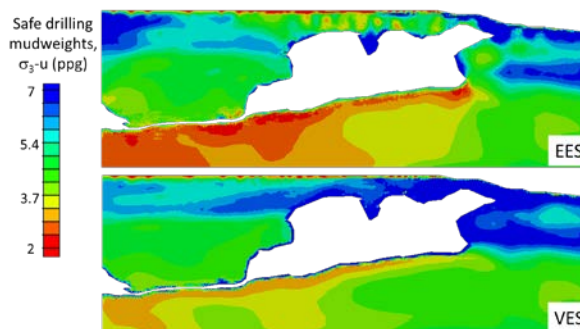


Fig. 2: Safe mudweight gap for drilling predicted by our method (top) and by vertical method (bottom). Our method predicts narrower gap subsalt and in front of salt.

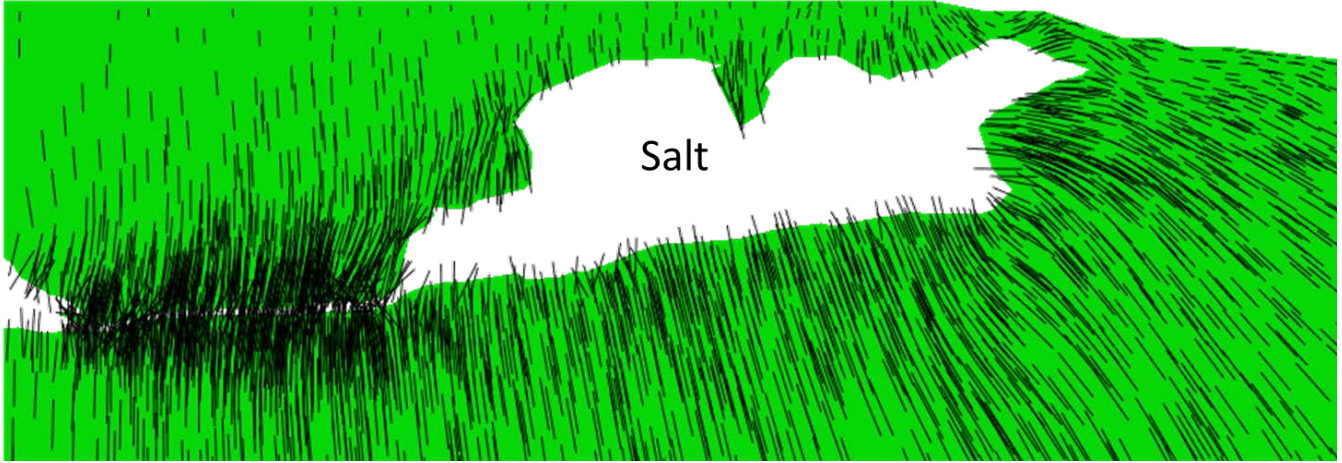


Figure 1: Orientation of maximum principal stress predicted by geomechanical model in a salt basin, Mad Dog field, Gulf of Mexico. Stresses are strongly perturbed particularly in front of salt due to large lateral thrust from salt and updip sediments.

[Back](#)

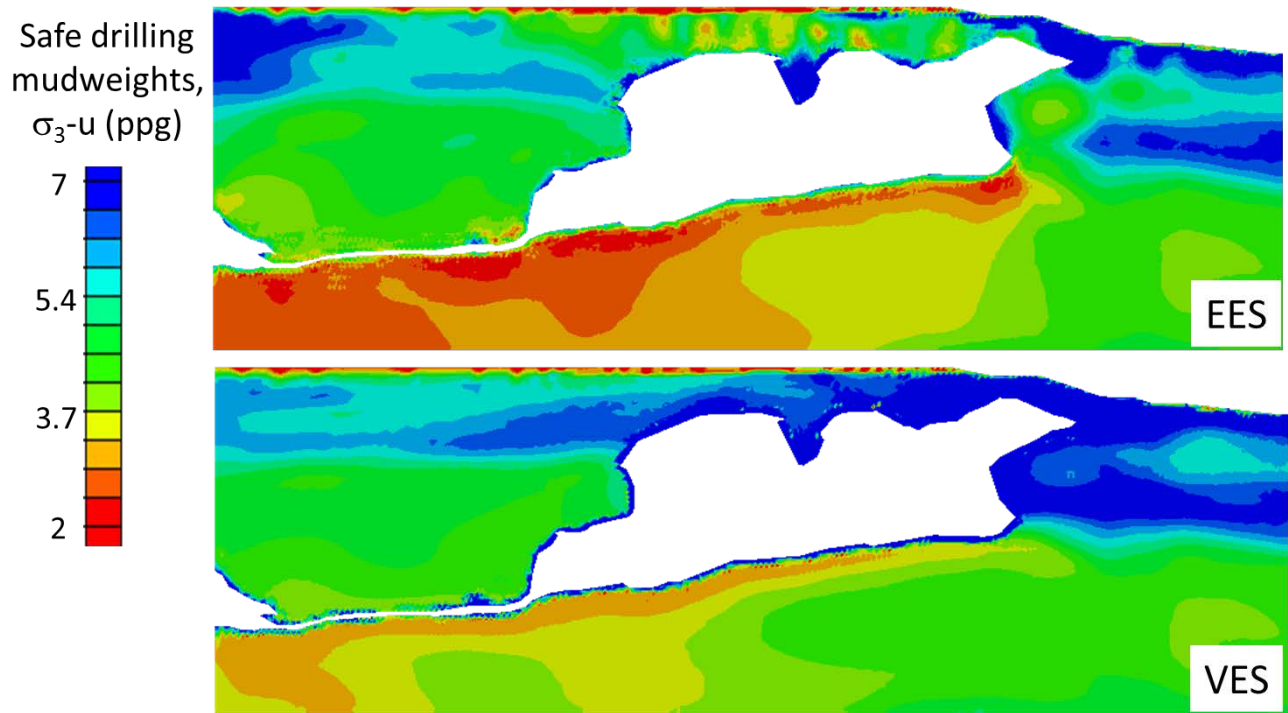


Figure 2: Safe mudweight gap for drilling predicted by our method (top) and by vertical method (bottom). Our method predicts narrower gap subsalt and in front of salt.

[Back](#)