Near Salt Stresses, wellbore stability, and seismic velocities: A finite element study and its applications

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ABSTRACT

Stress perturbations around salt bodies result in wellbore stability problems, and perturbations of seismic wave velocities. Here, we applied a finite element model with viscoelastic salt and elastic overburden, to simulate stress fields around a salt sphere and an irregular salt sheet, and to explore wellbore stability and changes in seismic wave velocities around these salt bodies. We found that 1) stress fields including shear stresses and minimum principal stresses are largely perturbed around these salt bodies; 2) wellbore instability tends to occur around the salt bodies due to low minimum principal stresses and high shear stresses ; 3) perturbations of seismic wave velocities and seismic anisotropy are significant around the salt bodies.

CLICK ON IMAGE FOR LARGER VIEW

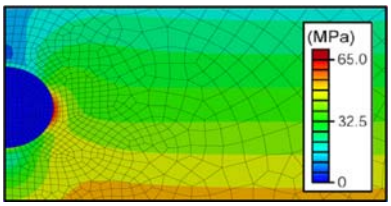

Fig. 1: Model predicted shear stress (von Mises stress).

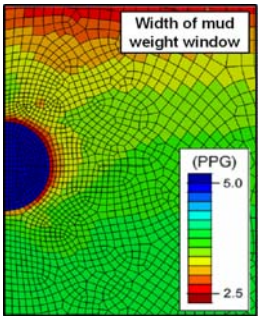

Fig. 2: Our calculated width of safe mud weight window.

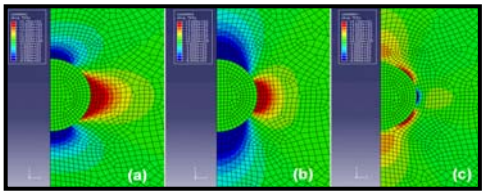

Fig. 3: Our calculated changes of P-wave velocity: (a) changes of horizontally propagating Vp; (b) changes of vertically propagating Vp; (c) P-wave seismic anisotropy: the differences between horizontally and vertically propagating Vp.

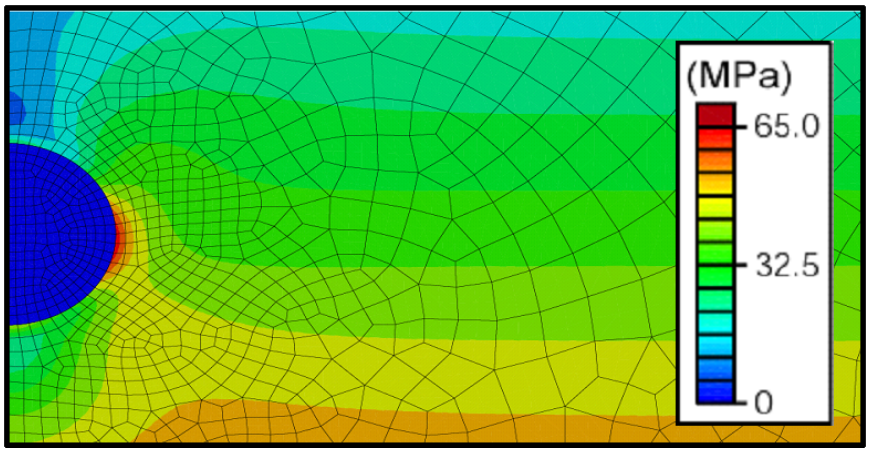

Fig. 1: Model predicted shear stress (von Mises stress) is concentrated at the edge of the salt sphere.

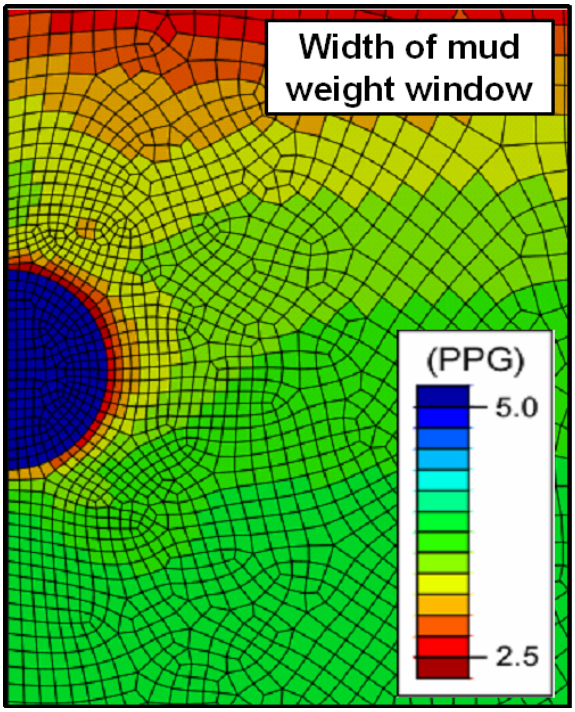

Fig. 2: Our calculated width of safe mud weight window. The safe window is narrow just around the salt sphere. This is consistent with low minimum principal stresses and high shear stresses calculated close to the salt.

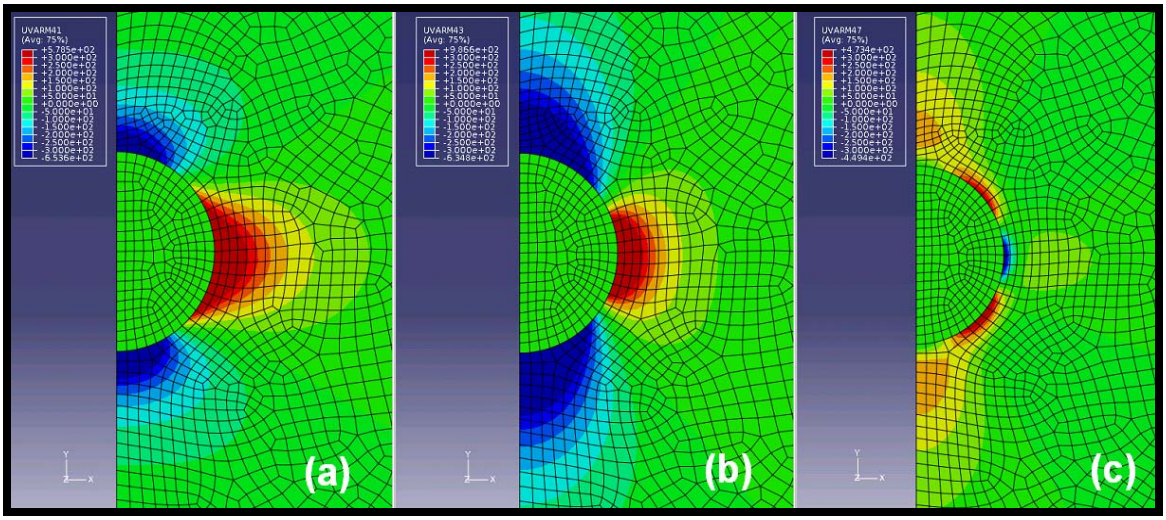

Fig. 3: Our calculated changes of P-wave velocity: (a) changes of horizontally propagating P-wave velocity caused by the salt sphere; (b) changes of vertically propagating P-wave velocity caused by the salt sphere; (c) P-wave seismic anisotropy: the differences between horizontally and vertically propagating P-wave velocities. Red color: fast; blue color: slow.