

Geomechanical modeling of the Mad Dog structure

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ABSTRACT

This study shows that large salt bodies push laterally and elevate the horizontal stresses in front of the salt and in mini-basins. We build in Abaqus 2-dimensional finite-element models of the Mad Dog field, GoM. We use PreStack Depth Migrated Seismic data and Wide Azimuth data provided by BP & Partners to realistically represent the salt geometry and the bathymetry. We model the salt as viscoelastic and the sediments as elastic materials and we calculate how the stresses change due to the salt relaxation. We show that when the salt extends laterally much more than its height, the stresses within the salt converge to the overburden value. Consequently, the horizontal stresses increase significantly and the salt subjects the sediments along its inclined faces to thrust loading. We predict high effective stress ratios (values close to 1) in front of the salt and in mini-basins, and ratios close to the initial value below the flat base of salt. Our results compare well with LOT and FIT measurements and illustrate that contrary to traditional basin models, geomechanical analyses can explain horizontal stresses close to the overburden value.

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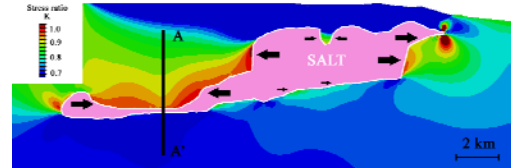


Figure 1: Finite element model of a cross section of the Mad Dog salt body. Stresses within the salt converge to the overburden, leading to a lateral push. The contours plot the values of the effective stress ratio within the sediments and show that horizontal stresses are high in mini-basins and in front of the salt.

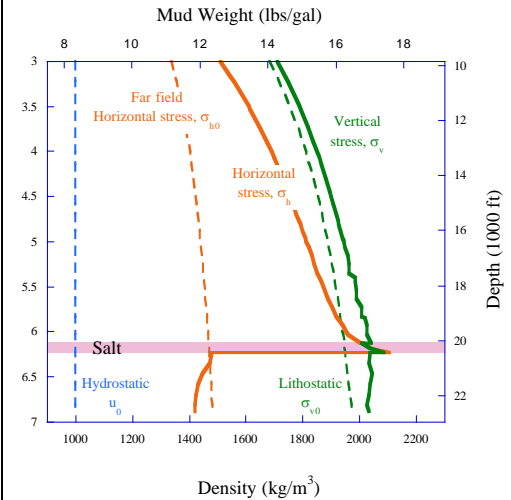


Figure 2: Stress profiles along section AA' in Figure 1, showing that the horizontal stresses are significantly elevated within the mini-basin and mud-weights are close to the overburden value.

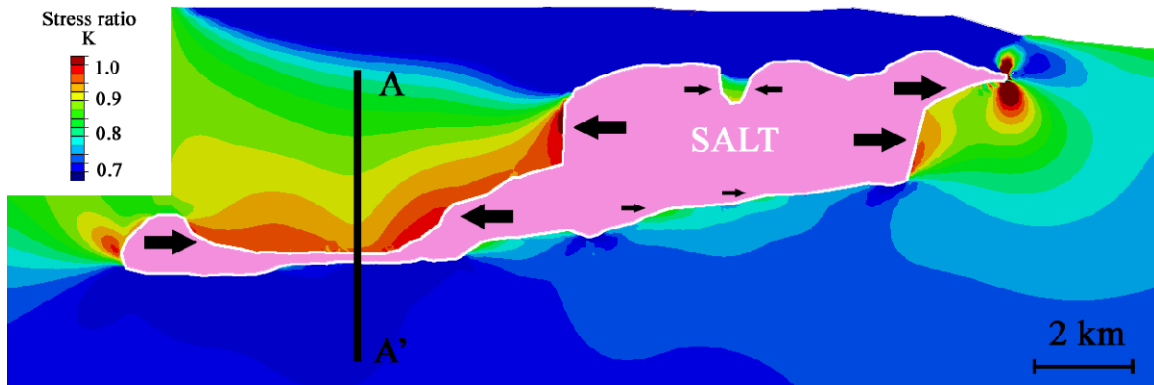


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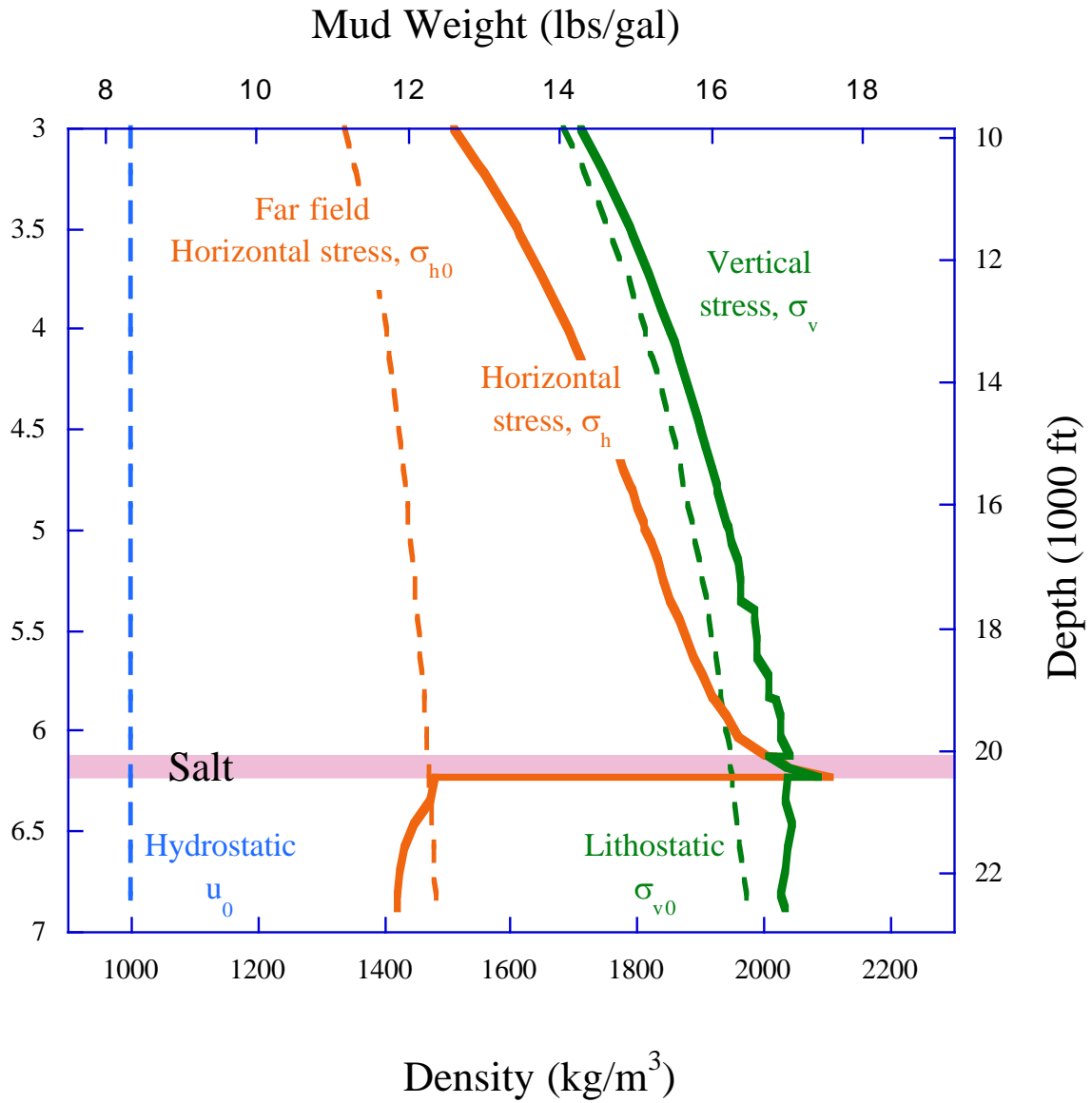


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