Pressure Prediction in the Miocene beneath Salt: Lessons from Mad Dog, GOM

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ABSTRACT

Sandstone pressures follow the hydrostatic gradient in Miocene strata of the Mad Dog field, deepwater Gulf of Mexico, while pore pressures in the adjacent mudstones track a trend from well-to-well that can be approximated by the total vertical stress gradient. The sandstone pressures within these strata are everywhere less than the bounding mudstone pore pressures and the difference between them is proportional to the total vertical stress. The mudstone pressure is predicted from its porosity with an exponential porosity vs. vertical effective stress relationship where porosity is interpreted from wireline velocity. Sonic velocities in mudstones bounding the regional sandstones fall within a narrow range throughout the field from which we interpret their vertical effective stresses can be approximated as constant. We show how to predict sandstone and mudstone pore pressure in any offset well at Mad Dog given knowledge of the local total vertical stress. At Mad Dog, the approach is complicated by the extraordinary lateral changes in total vertical stress that are caused by changing bathymetry and the presence/absence

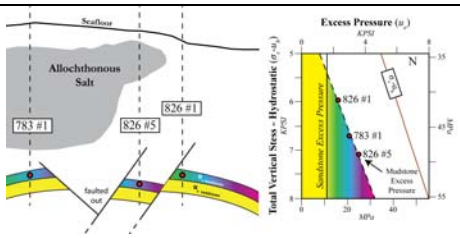

Fig. 1: A conceptual model of how the mudstone pressures near the bounding sandstone reservoir co-vary with the total vertical stress across the Mad Dog Field.

of salt. A similar approach can be used in other sub-salt fields. We suggest that pore pressures within mudstones can be systematically different from that of the nearby sandstones and that this difference can be predicted. Well programs must ensure that the borehole pressure is not too low, which results in borehole closure in the mudstone intervals, and not too high, which can result in lost circulation to the reservoir horizons. **CLICK ON IMAGE FOR LARGER VIEW**	

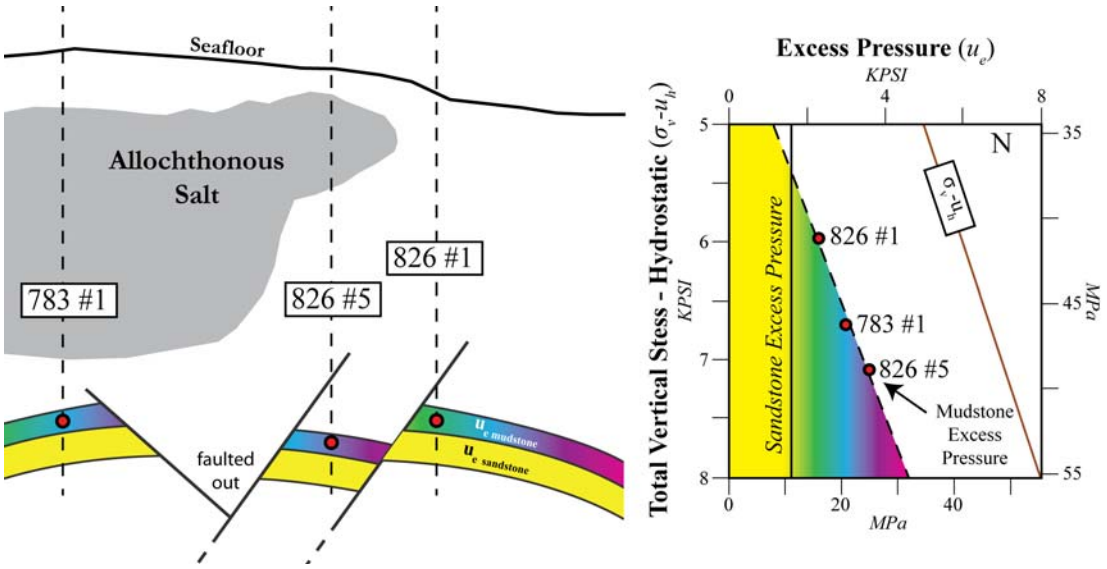

Fig. 1: A schematic diagram showing 3 different well penetrations with varying degree of salt penetrations from the Mad Dog Field. A conceptual model of how the mudstone pressures near the bounding sandstone reservoir co-vary with the total vertical stress (σ_v) across the Mad Dog Field. The sandstone excess pressure (u*) appears as a vertical line and remains constant across the field (yellow). The 826 #1 well drilled outboard of salt has the lowest total vertical stress, thus the excess pressure in the mudstone will be lower compared to wells 826 #5 and 783 #1 inboard of salt that exhibits a higher total vertical stress and higher mudstone excess pressure. Note: The mudstone excess pressures (red circles) nearly parallel the total vertical stress less the hydrostatic pressure ($\sigma_v - u_h$) (brown line).

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