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Constraining Pore Pressure from Wellbore Failure Observations: examples from Venezuela

Pore Pressures in shales are difficult to predict in parts of northern Venezuela. Traditional methods that assume undercompaction in subsiding basins do not work well. This is because the region is presently under a high horizontal stress load and sediments have often been uplifted. There is also some evidence of thermally generated pressures in the shales plus large differences between shale pressures and those measured in adjacent sand bodies. Typically, drilling mud weights are chosen to prevent the shales from 'collapsing'.

Drillers have long recognized hole collapse or 'pressure cavings' and, attributing the cause to inadvertently drilling underbalanced, typically responded by increasing the mud weight. In fact these symptoms are caused by to compressive shear failure at the borehole wall and are not only dependent on pore pressure but also the stress magnitudes, stress directions, pore pressure, rock strength, and well trajectory.

Borehole observations of this failure, which includes both breakouts and drilling induced tensile cracks, can be observed in image logs in many Venezuelan wells. This, along with measurements of minimum horizontal stress from leak-off tests, estimates of the vertical stress from density data, and estimates of rock strength from sonic logs enables stress magnitudes and rock properties to be measured and constrained. Typically in Venezuela, the largest uncertainty in this wellbore stability analysis is the pore pressure. Thus with observations of wellbore failure and knowledge of the other stresses and rock properties, pore pressure in shales can be constrained more accurately than using traditional pore pressure prediction techniques.