Pore Pressure Prediction Based on High Resolution Velocity Inversion in Carbonate Rocks, Offshore Sirte Basin - Libya

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ResidualTM velocity analysis was employed to refine the input gathers and velocity field for pressure prediction in Cretaceous Carbonates and further processed to produce an inverted velocity cube. From the acoustic inversion a shale velocity trend was generated and used for pressure calibration with the control wells to predict pressures in 3D. Attributes were generated for pore pressure (PP), pore pressure gradient (PPG), overburden pressure (OB), overburden gradient (OBG), fracture pressure (FP), fracture pressure gradient (FPG) and effective stress (ES).

Two reservoir-specific PP models with different saturating fluids were generated to account for buoyancy effects; Z Reservoir = FG at structural crest. From down dip pressures P-Max is calculated to a maximum extent of the possible fluid column to predict for pore fill columns using the local closure and spill points and pressure prediction at the penetration point for the reservoir assuming the existence of a centroid pressure point in a monoclinal structure. Fluid gradients used were; for brine 0.465 psi/ft, for light oil 0.3 psi/ft, and for gas 0.1 psi/ft.

PPP results indicate a benign shallow section and then increases steadily below 11,500 ft to a maximum of 15.5 PPG at 15,100 ft and temperatures exceeding 300 deg F at TD.

Comparison of pre-drill prediction, based on seismic velocities, with LWD guided pressure monitoring, intermediate and final VSP data and final WL results show a high affinity with the prognosis. Space and resolution dependent PP Models can be generated from actual well data and seismic displaying the inherent velocity heterogeneity of seismic data versus high resolution of WL data.

Integration of regional knowledge, sound understanding of the basin specific structural setting and offset well data, PSTM and PSDM data, with real-time drilling parameter monitoring and a technology limited by the carbonate setting, provides valuable data for kick management and casing design in a HPHT environment.