New Approach to Pore Pressure Predictions: Generation, Expulsion and Retention Trio, Case Histories from GOM

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ABSTRACT

A comprehensive framework and fresh perspective to pore pressure prediction methods and algorithms based on the established geological building blocks is presented. Applying the suggested four subsurface zones is the backbone of this pore pressure prediction approach. Determining the boundary of the four subsurface zones utilizing petrophysical data is crucial for selecting the appropriate method and algorithms for pressure prediction.

This approach divides the previously so-called normally pressured upper section into two zones: namely hydrostatic and hydrodynamic. Consequently, data in the hydrodynamic section is used to establish the compaction trend and not the entire section above the top of geopressure. The section below the top of geopressure is divided into transition and geo-pressured zones. This method is to mathematically calculate the compaction trend, rather than graphically displaying it for calibration purposes. Moreover, it eliminates the confusion of extrapolating the effective stress predictive values above the top of geopressure. Algorithm supported by empirical data is introduced to calculate the sand beds vs. formation and mud pressures to evade the deep water's shallow water flow (SWF) and sinking wells' head (SWH).

Entrapment represents the main cause of overpressure buildup. Fluid pressure inflation due to stress, aqua-thermal and dewatering processes is the genesis and not the outcome. Therefore, the effective seal is the main cause of creating excess pressure. Investigating possible breach due to subsurface structural failure is a key objective for pore pressure prediction.

The subsurface hydro-geological zoning greatly impacts the velocity, resistivity and density profiles. Seismic velocity to pore pressure transformation modeling foresees the trio process from generation to expulsion to entrapment before drilling the prospect. The newly introduced subsurface partitions, trio concept, algorithms and predictive modeling incorporated with the geological setting are supported by case histories from the Gulf of Mexico.