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PORE PRESSURE PREDICTION AS A PROSPECTING TOOL, INPUT TO RISK, VOLUMES AND FIELD DEVELOPMENT

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Traditionally, pore pressure predictions calculated from offset wells and interval velocity data have been used almost exclusively to design well casings and drilling mud weight programs. However, a pore pressure prediction also contains valuable information on how oil, gas and water is behaving in the subsurface and importantly how fluid pressures will effect top seals, fault seals and column heights in hydrocarbon prospects.

PETRONAS Carigali have begun to use pore pressure as a critical input to pre-drill prospect evaluation by combining fault and horizon information, derived from geological maps, with an understanding of how fluid migration and pore pressures, derived from pore pressure predictions, can affect trap risk and volumes.

The use of pore pressure predictions as an primary exploration tool has the advantage that it does not require any additional computational work since a pore pressure prediction must be produced in order to design a well. The key change is a modification to the existing exploration workflow so that pore pressures are calculated during the initial exploration stage which allows them to be combined with mapped horizon and fault data to produce integrated geo-pressure / geometric trap scenarios.

The advantages of the new pore pressure workflow will be illustrated using three exploration / development case studies.

The first, from Sabah offshore Block SB301 illustrates how the centroid concept (Dickinson, 1953 & England et al. 1987) or dynamic capacity model (Finkbeiner et al. 2001) can be used to identify a state of catastrophic seal failure where up dip pore pressure transfer from adjacent synclines has pushed water pressure at the crest of the trap to leak off. This example further highlights how the integration of all available pressure data is vital to produce a geologically valid trap scenario.

The second example, from Sabah offshore Block SB-1 illustrates how pore pressure predictions combining wire line logs and interval velocity data can be used to predict mechanical top seal risk which in turn is used to predict column heights and volumes in an un-drilled down dip fault trap. This type of analysis directly addressed a critical pre-drill risk and was successful in quantifying the risk as well as reducing uncertainty.

The third example is from Central Asia and illustrates the power of combining pore pressure/fluid migration data with structural fault seal and top seal analysis. The approach was used to define a new trap scenario based on "pressure balance" and provided a geological model which tied together several disparate pieces of data. The outcome of the analysis revealed a potentially danger for the position of development wells and the potential for early water break through.

References

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Finkbeiner, T., Zoback, M., Flemings, P. & Stump, B. 2001. Stress, pore pressure and dynamically constrained hydrocarbon columns in the South Eugene Island 330 field, northern Gulf of Mexico. *AAPG Bulletin*, V.85, No. 6, pp 1007-1031

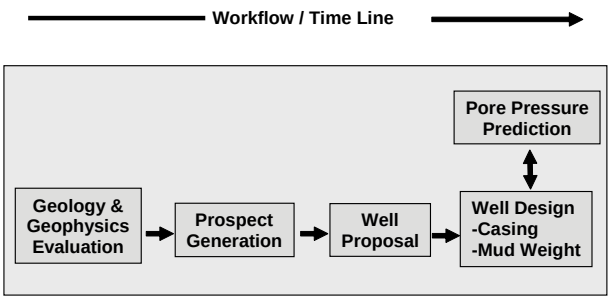

Figure 1: Standard Pore Pressure Workflow.

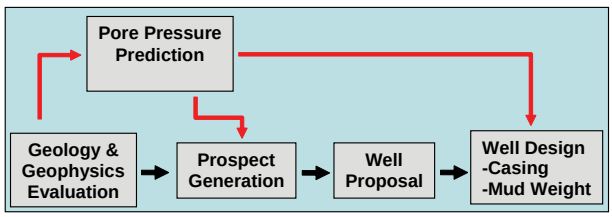

Figure 2: PETRONAS Carigali Pore Pressure Workflow.