Planning and Preparation of a Viable Pore Pressure Prediction in a Wildcat High Pressure, High Temperature (HPHT) Exploration Well in Offshore Sarawak, Malaysia

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ABSTRACT

Efficient and efficacious well planning is the key to lowering the cost of drilling, and pore-pressure prediction is an important part of this planning process. Precise and accurate pore-pressure prediction is necessary for assessing the seal integrity through to delivering the pressure profiles to the drilling engineer. This paper focuses on different aspects of pore-pressure analysis that were considered to deliver a prediction with high precision and accuracy, leading to the successful drilling of a wild cat HPHT exploration well in Central Luconia Province, offshore Sarawak, Malaysia. Firstly, the uncertainties in prediction models arise from the quality and relevance of offset well control. In the study area, two offset wells penetrated thick carbonate sequence and one offset well encountered a thick sand-shale sequence with carbonate stringers. The variation in lithologies has to be considered while selecting the relevant offset well. Secondly, understanding the drilling challenges in offset wells related to pore pressure is key to design the planned well. All the offset wells drilled encountered significant challenges in terms of pore pressure. Similar drilling challenges were expected at the proposed location. However, the offset wells didn't penetrate the deeper cycles and as such there is no calibration in deeper undrilled sections at the proposed location. The third aspect is the complexity of the geological and structural conditions around the well. The proposed well was planned to be drilled in a structure which was formed on the footwall block for the shallow targets and crossing the fault to hanging wall block to hit the main target in deeper cycles. The fourth aspect, deals with the overpressure generation mechanism and prediction methodologies. A conventional workflow to plan a wild cat exploration well makes an accurate and precise prediction almost impossible until the overpressure generation mechanism is well understood in the study area. Such analysis were carried out in offset wells to carry a fit for purpose prediction at the proposed location. The fifth aspect considers the seismic velocities in terms of quality and calibration. Very coarse 2D seismic velocities were available with very poor quality seismic reflections along the proposed well path. The errors that are inherently present in such velocities from different sources has to be considered for determining the quality of the seismic based pore-pressure calibration. By considering all the above aspects and their associated uncertainties, a fit for purpose pore-pressure model was developed to develop high predictive accuracy with precision. The paper outlines how all the aspects were addressed to reduce uncertainty to increase precision. Three scenarios for pore pressure was proposed which helped to make decisions on well design in real-time. A postdrill analysis shows the actual pore pressure was within the uncertainty model which validated our pore-pressure prediction approach.