THE IMPACT OF OVERBALANCED DRILLING FROM EXPLORATION/APPRAISAL WELLS TO FIELD DEVELOPMENT PLAN

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Abstract:

During well planning, drillers and petrophysicists have different principle objectives. The petrophysicist's aim is to acquire critical well data, but this can lead to increased operational risk. The driller is focused on optimizing the well design, which can result in compromised data quality. In extreme cases, the impact of well design on petrophysical data can lead to erroneous post-well results that impact the entire value-chain assessment and decision making toward field development.

In this paper, we present a case study from a syn-rift, Upper Jurassic reservoir in the Norwegian Sea where well design significantly impacted reservoir characterization. Three wells (exploration, appraisal, and geopilot) are compared in order to demonstrate the impact of overbalanced drilling on well data from both logs and core. Implications for reservoir quality assessment, volume estimates, and the errors introduced into both a static geomodel and dynamic reservoir simulation are discussed. This case study highlights the importance of optimizing well design for petrophysical data collection and demonstrates the potential for value creation.

Extensive data collection was initially carried out in both exploration and appraisal wells, including full sets of logging while drilling (LWD), wireline logging, fluid sampling, and extensive coring. Both wells were drilled with considerable overbalanced mud weights due to the risk of overpressured reservoirs in the region. The log data was subsequently corrected for significant mudfiltration invasion, with calibration to core measurements guiding the interpretation. Geological and reservoir models were built based on results from the two wells, and development wells were planned accordingly.

A thorough investigation of core material raised suspicion that there could also be a significant adverse effect of core properties resulting from overbalanced drilling. The implications were so significant for the reservoir volume that a strategic decision was made to drill a geopilot well close to the initial exploration well, prior to field development drilling. The well was drilled six years after the initial exploration phase with considerably lower overbalance. Extensive well data, including one core, were acquired. The recovered core was crucial in order to compare the reservoir properties for comparable facies between all three wells. The results from the core demonstrate distinctly different rock quality characteristics, especially at the high end of the reservoir quality spectrum. Results of the core study confirmed the initial hypothesis that overbalanced drilling had significantly impacted the properties of the core as well as the well logs. The study concluded that the updated reservoir model properties would significantly increase the in-place volumes compared to the pre-geopilot estimate.

This study shows how well design adversely affected petrophysical measurements and how errors in these data compromised geological and reservoir models, leading to a suboptimal field development plan that eroded significant value. This example provides a case study that can be used to improve the well design so that petrophysicists and drillers can both be part of the same value creation result. Future work will include further laboratory investigations on the effects of high overbalanced drilling on core and possible "root causes" for compromised core integrity.

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Bio:

Matthew Guy Reppert is a Lead Petrophysicist with Neptune Energy Norway. He has over 35 years in the petroleum industry, having worked extensively in the North Sea for both American and French companies. Matt studied geology at Texas A&M university and has been active in SPWLA, serving many years on the technical committee.