Production Optimization in Mature Carbonate Field with Seismic Reprocessing and Quantitative Interpretation

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Abstract

Objectives/Scope: There are increasing challenges with over time the mature field X from pressure reduction to aquifer encroachment. These mentioned challenges induce error in the initial field life productivity prediction, leading to declining in field daily productivity. 3D seismic reprocessing and Quantitative Interpretation (QI) can yield better insight and understanding of these uncertainties with enhanced seismic quality. With improved reservoir and fluid characterization, this can levitate the daily production rate and longevity of the field life.

Methods, Procedures, Process: Field X Gas Initial In Place (GIIP) was significantly underestimated by initial static model based on latest P/Z plots from daily production data. The main uncertainty is time-depth conversion of the structural interpretation due to an over-pressure shale overlaying the carbonate field, inducing low velocity interval. To address and reduce this uncertainty, the 3D PreSTM undergoes reprocessing to QPreSDM with application of Full Waveform Inversion (FWI). Improved QI studies based on reprocessed 3D seismic will address other uncertainties such as porosity and permeability. A new static model recalibrated with daily production profile to be built for better volumetric assessment.

Results, Observations, Conclusions: An inaccurate PreSTM velocity model for time-depth conversion severely underestimates the field X GIIP, resulted from smaller structure. Thus, the field productivity was not optimized, with less production well and lower production rate. Though the PreSTM seismic has higher frequency, but it also has lower S/N ratio (signal/noise). Through broadband reprocessing, 3D QPreSDM seismic exhibits significant improvement in quality. A more accurate velocity model was achieved by incorporating Full Waveform Inversion (FWI), undulated reflectivity especially within the carbonate has been corrected and better fits with carbonate depositional setting. New Quantitative Interpretation (QI) studies showed much improved results with better reservoir properties distributed in each strata within the carbonate. The updated static model with accurate modelled time-depth structure and QI models aligns better with the dynamic model, a better P/Z curve fitting. Consequently, future development wells can be optimized and higher productivity rates can be achieved.

Novel/Additive Information: This case study shows that field optimization can be achieved by improved seismic quality and QI studies with integration of reservoir simulation. Future development wells can be optimized with a higher productivity rate over the number of required wells. Subsequently, the sustainability of field life.