

# **Impact of Depth Conversion and Seismic Inversion on Dynamic Simulation Across Two Giant Oil Fields with 2000 Wells**

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## **Abstract**

The Sabriyah and Raudhatain onshore oil fields of North Kuwait were discovered in 1955. Close to 2000 wells have since been drilled and are producing from both clastic and carbonate stacked reservoirs. In an on-going drive to maximize production, the Integrated Reservoir Modeling (IRM) team has been dedicated to re-building and updating Static and Dynamic Models for all the North Kuwait reservoirs. Traditionally, Geophysics would have limited impact on brownfields of this magnitude. However, Geophysics has to the contrary proven to be a game-changer on all questions related to Reservoir distribution, Volume calculation, Aquifer support and finally the planning of new wells. This has clicked in place via a close, integrated workflow between Geophysics, Geology, Petrophysics and Reservoir Engineering.

A key enabler in the successful integration of seismic in all current reservoir studies, is the comprehensive (complex and time-consuming) data management and improvement process. As part of the integrated approach, the geophysical workflow started with a new and revised Depth Conversion, built from scratch using more than 350 wells. Achieving world-class result of 0.4% depth error at 8000-9000 ft, measured from almost 1200 "blind wells", high confidence could be put on the new depth seismic and the 20 re-interpreted regional depth surfaces. A new fault interpretation was merged with the horizon interpretation and was used to generate detailed structural models. This resulted in a high confidence structural model, with more realistic fault geometries also capturing relay zones, serving together with the depth seismic and surfaces as key inputs to the Static Model.

A comprehensive Inversion study was kicked off at Zubair and Burgan levels (clastics) with data from more almost 150 wells included. A key success factor for the project was the attention to details on all data points used for the Inversion. The inversion results are able to address sand/shale distribution, including thinner layers, and DHI effects. Based on the seismic inversion, a set of well calibrated reservoir distribution maps within the Zubair and Burgan formations were delivered and used directly in the new Static Model. The accuracy of the inversion data was confirmed by later well penetrations, blind tests and dynamic simulation work.

For reference, two more reservoir distribution models were made - one grided without seismic constraints, and one using conceptual geological trends for sand distribution. It proved that despite of having large number of wells, seismically unconstrained models had significant uncertainty in predicting sand distribution in these fields.

The final phases were Dynamic Model build and History Match, which confirmed the model using reservoir distribution maps from the Seismic Inversion were most correct. Ultimately this model led to revised volumes - thereby giving a measurable and significant business impact from this integrated Geophysical workflow.