Rejuvenating Egypt's Gulf Of Suez Using Ocean Bottom Node Acquisition And Imaging

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Abstract

Objectives/Scope: Egypt's Gulf of Suez (GoS) is a complex rift zone with rotated faults blocks that are challenging for seismic imaging due to the strong acoustic impedance contrasts between lithological boundaries such as top of the layered evaporite sequence, various intervals within the heterogeneous clastic and salt bodies. With the objective of overcoming the imaging challenge we investigate the designing of an ocean-bottom node (OBN) survey. The design study includes using synthetic data to simulate seismic data acquisition as well as the use of contemporary industry technologies for seismic processing.

Methods, Procedures, Process: To understand the root causes of the poor seismic images we performed different survey design simulations. Simulation of the existing legacy narrow-azimuth limited-offset towed-streamer configuration yielded poor images, whereas the design using longer offset and full azimuth OBN data produced much better results. Following this study, OBN acquisition was designed and acquired using receiver nodes laid out on a 200 m x 200 m grid and simultaneous source shots on a 37.5 m x 50 m grid. Contemporary seismic data processing technologies were applied to overcome interference from simultaneous shooting, shear noise effects and different multiple types. Additionally full-waveform inversion was the key step in the earth model building process.

Results, Observations, Conclusions: The seismic images from this GoS OBN acquisition showed significant uplift compared to the legacy seismic data that were suffering from poor pre-rift illumination. Data showed consistent matching with the well data dip meter logs, and we were able to observe new structures and potential hydrocarbon prospects that were less clear or absent on the legacy data. Hence, this can be the gate for potentially increasing the hydrocarbon reserves, especially in the areas with little or no well data. This was achieved by utilizing contemporary seismic data signal processing and earth model building workflows including full gather full waveform inversion and calibration with well data to overcome the challenges raised from strong elastic components, simultaneous seismic acquisition, and the presence of surface and interbed multiples.

Novel/Additive Information: In addition to the synthetic finite difference simulation studies, we will describe the innovative approaches we used in the seismic data processing such as 1- Injecting synthetic direct arrival to enhance the quality of Up/Down Deconvolution (UDD) in very shallow water areas reaching as shallow as 16 meters in depth where it was not possible to record real direct arrivals in the seismic data. 2- Utilization of the horizontal geophone components to model and subtract shear noise in the curvelet domain. 3- Integrating acquired short streamer with OBN in both 3D SRME, interbed multiple prediction also in earth model building.