Full-waveform inversion on Nile Delta deep-water survey offshore Egypt – a Case Study

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The Nile Delta basin was formed during a series of Early Mesozoic rift events. The geology of this region is complex comprising of large faults driven by compressional events. Messinian salt of varying thickness is present throughout the basin and varies from being locally absent to having thicknesses in excess of a hundred meters. Further, the salt composition varies from being a massive homogeneous evaporite to mixed lithology. The heterogeneity in salt thickness and composition significantly challenges seismic imaging in the basin.

In this study, we observe that the application of FWI helps (to some extent due to the data limitation) to resolve the velocity of the Messinian dirty salt and intra salt sediment inclusions, which in turn, improves imaging of the subsalt Oligocene events.

Full-waveform inversion (FWI) aims to estimate a high-resolution velocity model by minimizing the difference between observed and modelled seismic waveforms. We discuss the application of FWI to a deep-water marine data set from the Nile Delta (Mediterranean Sea), offshore Egypt. The acquired survey is in an area, where the water depth reaches down to 2 km. The target depth is at 4 km. The offset is relatively short, at about 8 km. The FWI used refraction and reflection data. In addition to FWI, the new marine processing technique of Ghost Wavefield Elimination (GWE) has been applied. The technique boosts the low-frequency signal that plays an important role in successful FWI applications. The lowest usable frequency was 5 Hz.

The combination of both technologies has improved the velocity model and the structural image of the post Messinian which resulted in improving the pre-Messinian section