Imaging and Inversion Challenges for Deep Targets and Low Porosity Plays: A Case Study from Illizi Basin, Algeria

Glenn Nyein[3], Luca De Vincenzi[1], Stefano Trezzi[3], Anubrati Mukherjee[3], Karim Elsadany[3], Tahar Chelbi[2], Omar Aly[3], and Anna Glushchenko[4]

[1]Dragon Oil, Dubai, United Arab Emirates.
[2]Sonatrach, Boumerdes, Algeria.
[3]WesternGeco, Abu Dhabi, United Arab Emirates.
[4]Schlumberger, Abu Dhabi, United Arab Emirates.

ABSTRACT

This case study summarizes the data reprocessing effort applied to improve the image quality of seismic data located in a structurally complex reservoir with low porosity & permeability and subsequent inversion to rock properties. The results show significant enhancements in structural definition, whilst the inversion to rock properties has enabled lithology and porosity characterization with increased confidence. The Tinrhert Nord Perimeter lies within the South Berkhine-North Illizi basin in Eastern Algeria. This is a highly productive petroleum province with a 60-year exploration history (Dixon, 2010). Target reservoirs are classed into two petroleum systems. System I is sourced from Frasnian age shales with good quality reservoirs of Devonian and Silurian age sandstones. System II is sourced from Silurian age shales with reservoirs of Ordovician and Cambrian age sandstones. The latter reservoirs quality is considered poor, with less than 6% porosity and 15mD permeability. The prospect is covered by three separate legacy seismic data volumes. The final seismic data image quality in each case was of generally low resolution & limited bandwidth, and not considered conducive to obtain a proper reservoir characterization in the typically thin, low porosity reservoirs. The Tinrhert Nord legacy seismic volumes were therefore re-processed concurrently with a workflow designed to improve lateral event continuity, preserve sharper terminations at discontinuities such as faults and channels, decrease the amount of multiple contamination, and increase the temporal resolution through a wider signal bandwidth. The final pre-stack merged seismic volume shows a significant upgrade in image quality over pre-existing legacy data, indicating that the applied processing sequence was appropriate. Rock physics analysis and pre-stack simultaneous AVO inversion was then performed to estimate P-impedance and S-impedance from the conditioned seismic data. Well log and petrophysical analysis were carried out to establish the relationship between seismic attributes and rock properties. Results showed good sensitivity of the acoustic and elastic properties AI and SI to PHIT, VCL and SW. Pre-stack inversion attributes were used to characterize target reservoirs using the reprocessed seismic data. Consistent wavelet extraction at well locations indicated the high quality of the input seismic data, which was also observed form the excellent match between logged and inverted traces.