Hydrocarbon Saturation Prediction from Full-Stack Seismic Data Using Probabilistic Neural Network

Islam Ali Mohamed[1]

[1]RASHPETCO

Abstract

In complex geological settings with great degree of heterogeneity in reservoir properties such as submarine channel complexes, as in Nile Delta province, we face the challenge of characterizing the reservoir based on seismic different attributes. Direct Hydrocarbon Indicator (DHI) and Amplitude Variation with Offset (AVO) analysis techniques proved very impressive results delineating the gas bearing reservoirs, especially in the clastic systems. However, low quality facies or low saturation reservoirs give the same seismic amplitude response. The pre-stack seismic inversion products such as P-impedance, V_p/V_s and Lambda-Mu-Rho (LMR) can provide more realistic quantitative reservoir characterization. Absence of control wells and/or pre-stack seismic data makes it impossible to use the pre-stack inversion approach. In addition, quantitative prediction of hydrocarbon saturation from seismic is ambiguous because of their independent nonlinear relationship with conventional seismic attributes and inversion products.

Hydrocarbon saturation prediction away from the well is essential to characterize reservoir effectively. Therefore, a special approach has been adopted which is Probabilistic Neural Network (PNN) analysis to predict hydrocarbon saturation 3D volume using full-stack seismic data and Hydrocarbon saturation logs. In this case study, we applied the proposed neural network workflow over one of the late Pliocene gas sandstone reservoirs in West Delta Deep Marine (WDDM) concession, offshore Nile Delta, Egypt. The resulting volume was then tested using a blind well that hasn't been used in the analysis. The predicted volume contains fine details that will help for better delineation of hydrocarbon-saturated reservoir in 3D space.