Application of Probabilistic Neural Network and Rock Physics Analysis for Carbonate Reservoir Characterization: A Case Study from Onshore Supergiant Oil Field

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Identification and modeling of the carbonate tidal channels is key for finding sweet spots or areas at higher risk to water breakthroughs which have a significant impact on the development and monitoring of reservoir dynamic performance. However, such these channels cannot be easily characterize by conventional seismic attributes. It is important to decipher the complexity of carbonate tidal channel architecture with integrated multisource data and different approaches.

A step wise approach has been taken in this work. First, rock physics model was carried out to ensure that elastic properties can be applied for reservoir characterization from the seismic data. Then, post-stack seismic inversion was carried out on the high resolution of 3D seismic dataset. The seismically derived porosity estimation is undertaken using geostatistical method and multiattributes combination was used. Probabilistic neural network training technique was then performed to improve the results for thick reservoir and the result has been used for seismic conditioning of geological models. Finally, the spatial distribution of porosity volume was cautiously assessed through the comparison between input and blind wells, also validated by core data.

The analysis of rock physics displayed a high correlation between elastic properties and the porosity distribution of the Mishrif channel, three facies were observed. The final interpretation of seismically derived characterization in Mishrif channel, observed a different lateral distribution of inverted elastic properties. These features of Mishrif carbonate tidal channels could be classified into these regions: north, southwest, and east. Related a high porosity with low acoustic impedance appeared mostly in these channels which reflect a good reservoir quality grainstone channels or sholas bodies. While, outside these channels is heavily mud filled by peritidal carbonates and characterized a high acoustic impedance anomaly with low quality of porosity distribution.

The results provided a new insight into the distribution of the petrophysical properties and reservoir architecture of facies with quantification of their influence on dynamic reservoir behavior in the Mishrif channelized systems and also for similar heterogeneous carbonate reservoirs.