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Multi-Attribute Porosity Estimation from 3D-Seismic Data

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ABSTRACT

The objective of this study is to develop a prediction model for the determination of porosity volume from 3D-seismic data and hence, assist in detailed reservoir characterization of one of the carbonate fields located in Saudi Arabia. Porosity log from 23 wells, model based acoustic impedance as an external attribute and 3D-seismic data volume were collected. A series of other commonly used seismic attributes were also computed. These attributes were correlated to the porosity log. A correlation ranking was hence assigned to each attribute. The acoustic impedance was found to have the best correlation. Subsequently, a step-wise regression approach was undertaken to correlate the porosity data with a combination of attributes, where, in each step of regression one additional attribute was added to the combination of attributes, while maintaining the others obtained in the previous step. The 9-point convolution operator was found to be optimized in the course of this study. The hence obtained correlation for each combination of attributes formed the basis of the predictive model for porosity. It was then validated by determining the average errors for each considered combination of attributes. The average error was based on the error in prediction for each well, while using the model based on data from the remainder of the wells. The validation error when plotted against the number of seismic attributes taken into consideration gradually decreased with increasing number of attributes, reaching minima, and then increased consistently with additional attributes. The lowest error was recorded for the combination of four seismic attributes – acoustic impedance, filter, derivative, and amplitude weighted phase, with 9 point convolution transformation operator. In this case, the predicted porosity in the reservoir zone was shown to have an accuracy of over 80% when compared to the actual porosity log.