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Facies Classification and Prediction in the Upper Jurassic Carbonate Formation Using Heterogeneous Rock Analysis Technique: As Sayd and Rimthan fields in Saudi Arabia.

Harianto Soepriatna[1], Stanley Wharton[1], Yajun Zhang[1], Abdullah Alzahrani[1]

[1]Saudi Aramco, Dhahran, SAUDI ARABIA

ABSTRACT

It is essential to delineate the reservoir quality rocks and their thicknesses in As Sayd and Rimthan fields to understand the extension of the reservoirs there. In a study using 17 wells, a facies classification technique was introduced to better understand the reservoir variability of the Arab reservoirs. The technique used to predict and classify the reservoir quality rock facies is termed Heterogeneous Rock Analysis (HRA). The result of this HRA technique is facies classifications used in the seismic inversion for calibrating seismic facies volumes. The calibrated seismic facies volumes are representations of the subsurface distribution of the reservoir quality facies, in this case within the adjacent As Sayd and Rimthan fields.

This technique's challenges include:

- The predicted facies must show separation in the log and elastic domains.
- The predicted facies must be correlatable with the geological facies.
- The predicted facies must be related to the rock texture and composition.
- The predicted facies must be consistent for all the wells used.

These challenges must be successfully addressed by the HRA technique.

The HRA method is a clustering workflow to define rock classes based on multivariate input data. It defines the rock classes based on their fundamental attributes of texture and composition as discriminated by the data input.

The first step of HRA is to conduct a principal component analysis (PCA) of the data being used. The purpose of this analysis is to transform the input data onto independent axes that front-load the data variance, thus ensuring that the data used in the clustering are functionally independent.

The second step is to run K-means clustering. The K-means clustering algorithm is used to define an optimal number of classes based on minimizing the distribution of the input per class, as well as to maximize the uniqueness of the classes.

The third and last step is the output of the HRA facies classification and prediction technique described above. From the results of the HRA facies classification in this study, we can demonstrate that all the challenges were addressed successfully.

The results from this technique are 5 HRA facies that are separable in the log and elastic domains. Separation of the HRA facies in the elastic domain is essential and must be performed before it can be used in the seismic facies calibration.