Estimation of effective porosity in the space between wells using classification of seismic attributes by Adaboost algorithm

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Keywords	Extended Abstract
Effective Porosity **Seismic Attributes** **Petrophysical Properties** **Adaboost Algorithm**	**Summary**

In this paper, by combination of seismic data and well log data, the effective porosity in the space between wells is estimated. One of the important petroleum reservoir features is effective porosity that engineers are always looking to find an appropriate model for distribution of this parameter in the reservoir. The petrophysical properties of petroleum reservoirs are very complex. In the last few decades, the effective porosity estimation procedures have become one of the hot topics in the industry to evaluate these procedures or methods. In the current research, by integration of petrophysical, seismic data and seismic attributes classification using Adaboost algorithm, it is tried to estimate the effective porosity in a two-dimensional seismic cross section of the block F3 Dutch sector of the North Sea. In the first step, seismic attributes of two-dimensional seismic section has been extracted. Based on the feature selection methods, six seismic attributes have positive impact on the process of the classification. The six attributes of seismic data and effective porosity have been classified and labeled in the positions of wells. Adaboost algorithm has been used for training, and training has been led to the accuracy of 76.6 percent. The next step is the accuracy of Adaboost algorithm or validation, which has been led to accuracy of 71.7 percent. Adaboost algorithm can also be used for classification of effective porosity in other parts of the reservoir where data are not available. The algorithm outputs have shown a good effective porosity in the lower layers, where there may be an economic horizon for the oil production.

Introduction

This paper is aimed to find the best seismic attributes that show the highest correlation with the changes of effective porosity and to classify the seismic attributes by Adaboost algorithm. The lateral variations of reservoir characteristics are among the most important investigations in hydrocarbore reservoir evaluation. In connection to these variations, petrophysical data has some limitations. Seismic data compared to petrophysical data have a better lateral development. Therefore, the combination of these two sources of data may make the best conditions to have more information from between boreholes.

Effective porosity, permeability and water saturation are among the most important reservoir characteristics. These characteristics of the reservoir have shown high variations in the entire reservoir. One of the best way to have an accurate evaluation of effective porosity is to classify reservoir parameters based on their distribution in the reservoir. Adaboost algorithm is one of non-liner classification method and a training machine procedure, which has been recommend by Shaper (1995). This algorithm has been used for evaluation of heterogenetic parameters in the block F3 Dutch sector of the North Sea.

Methodology and Approaches

In this research, seismic attributes and effective porosity data were estimated in between boreholes of the block F3 Dutch sector of the North Sea by applying Adaboost classification algorithm. The effective porosity was classified into four classes based on oil industry standards. 100 iterations was considered for the used Adaboost algorithm to estimate the effective porosity values in the boreholes. In this case, the algorithm reached to minimum error after 68 iterations. In the next step, this algorithm was used for the estimation of effective porosity values in the boreholes without data. For this reason, 30 seismic attributes were extracted, and then, some of the effective attributes were related to the target by feature selection method.

Results and Conclusions

The Adaboost algorithm was first validated, and then, seismic data was classified by this algorithm. The third class included most of the spatial variations of effective porosity that were between 15% to 25%. Moreover, the lowest layers had good effective porosity and the variations of effective porosity in the first and forth classes were slight.

To validate the procedure, the seismic data close to F2-1 borehole as observation borehole, was deleted from total matrix after the classification of whole seismic data. The classification was carried out based on seismic data from three boreholes. The results of this investigation in the F2-1 borehole was compared with seismic data close to this borehole. In this research, feature selection was made, and Adaboost algorithm was used for classification of seismic attributes with fewer errors. Finally, the potential of Chalky groups reservoir formations from economical point of view was determined as good.