Enhancement of 3-D Fault Interpretation from Seismic Data Using a Post-Stack Seismic Data Conditioning and Artificial Neural Network Approach in Cai36 3-D Prospect of the Junggar Basin, China

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Abstract

In order to improve the quality of fault image, in this study, we adopted post-stack seismic data conditioning and a combination of seismic multi-attribute for generating a new hybrid attribute through a supervised multilayer perceptron neural network in the Cai36 3D prospect located in the eastern part of the Junggar Basin. We first conditioned original seismic data by using the dip-steering cube extracted from the original seismic data. Secondly, we extracted seismic attributes such as similarity, polar dip, curvature, laplacian and RMS from the conditioned data that can effectively enhance the image of fault signatures. Thirdly, we selected a set of “picks” (known as the training data sets) at a 4500 ms time-slice within the seismic data volume which represents the presence or absence of faults. Fourthly, we adopted the supervised multilayer perceptron neural network to train over the selected seismic attributes extracted at the fault and non-fault positions. The neural network contains 11, 5, and 2 nodes in the input layer, hidden layer and output layers, respectively. Finally, we obtained a new fault probability cube containing data values ranging from 0 to 1, where 0 and 1 stand for the lowest and highest probability of the presence of the fault. The strong acquisition footprints were effectively removed from the original seismic data at the phase of the data conditioning. Moreover we observed that

similarity long window provided the highest contribution followed by most positive curvature, similarity mid window and RMS short. The normalized root-mean-square error values for both test and train data produce a minimum value between 0.52 and 0.60. A minimum misclassification percentage of 9.59-11.5% is obtained between the train and test data sets. This study provides an effective way of fault imaging from seismic data. Thus, the efficacy of fault imaging via combination of seismic multi-attribute is more accuracy than the single seismic attribute and is more acceptable by interpreters.

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