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A Comparison between 3D Waveforms Classification and RMS to Identify Stratigraphic Features in Seismic Volumes

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Abstract

Traditionally seismic data is interpreted based on the refection of subsurface layers. The seismic reflection varies based on the shape and character of the seismic waveform which also contains information about the phase, frequency and amplitude. Hence seismic waveform is often used to characterize reservoir quality, where the conventional seismic attributes fail This approach can be performed based entirely on the characteristics of the seismic response, without using of any well information, or automatic identification of the facies where well information is available. In this paper, we present a comparison between the traditional RMS attribute and Seismic waveform classification in defining the facies over a region of interest.

Introduction

Among the various geophysical techniques available for characterizing stratigraphic features, 3D seismic attributes are particularly useful for identifying these features and zones that fall below seismic resolution. Attributes like RMS help us to identify the channel sands present in the system as it provides a direct measure of the acoustic impedance contrast of the stratigraphic body compared to its surroundings. However, Seismic waveform shape and character can define facies and reservoir parameters with far more detail than traditional time and amplitude mapping (Anderson and Boyd, 2004). Hence they are often used to characterize reservoir quality where conventional seismic attributes like RMS may fail to characterize the reservoir.

The seismic facies variation at any target level can be gridded by recognizing the patterns present in the seismic waveform parameters and then compare it with RMS horizon attribute. This approach can be performed based entirely on the characteristics of the seismic response, guided by well information, or automatic identification of the facies where well information is available.

RMS seismic attribute:

Root mean square attribute helps to measure the reflectivity in order to map direct hydrocarbon indicators in a zone of interest. It emphasizes the variations in acoustic impedance over a selected sample interval. It reflects the acoustic impedance of a body in contrast to its surrounding bodies. For example, channel sands show relatively high RMS value due to the acoustic impedance contrast with their surroundings. Thus RMS amplitude attribute helps us to identify some of the channel related facies,

But sometimes we can get same values of RMS at other places also which makes it difficult to delineate any stratigraphy bodies like channels from the attribute map. Like the RMS amplitude in the area of interest shows high reflectivity areas suggesting facies classification but it is difficult to delineate the stratigraphic features present. In the example shown below high RMS values are present in two areas and it is difficult to identify the actual channel (figure.1).

Seismic waveform classification:

Seismic waveform classification uses 3D waveforms to classify the given area of interest into different facies/classes. Waveform classification technique is based on the Self Organized Mapping [SOM] algorithm to classify the facies and identify the stratigraphic features in the depth of interest.

The classification starts with defining the 3D typical waveforms for each of the class. Objects are classified based on the amount of similarity between the waveforms of the two objects. The measure of amount of similarity results in the probability maps.

There are two main types of Self organized mapping algorithms available, one is supervised by using well control points and the other is an unsupervised classification. Due to the lack of well control information in the area, we have used an unsupervised classification of facies to compare seismic waveforms and group them into different classes using Waveform classification process.

This method provides users to perform seismic waveform classification to define the facies in a layer. It can be observed that waveform classification gives better results when compared to the conventional seismic attributes. The channel can be readily observed running from north-west to south-east (figure. 2). Due to the lack of much well information in other parts of the area of interest we can observe that these areas are not better classified. Hence it can be concluded that though seismic waveform classification is a better method of facies classification, sufficient well control information is required to ensure accuracy of the classification. In a unique approach, we have used the net classification maps created to identify the stratigraphic features present in the area. The output of waveform classification was a facies map and probability map showing the chances of getting similar facies in the entire zone. This facies map can later be used as trend for modeling the facies.

Conclusion

Seismic waveform classification method shows better results in identifying subtle stratigraphic features where the conventional seismic attribute mapping techniques like RMS have failed. The classification method shows a more precise and clear understanding of the facies distribution in the given interval of interest. Also if more well information is available supervised method can also be used which gives a more accurate facies classification and unsupervised facies classification can also be quality checked. The distribution and probability maps generated can be readily used in further petrophysical modeling as trend surfaces.

References

1. S. Chopra and K. Marfurt, “Seismic Attributes for Stratigraphic Feature Characterization”, Geoconvention 2008, Alberta, May 12-15.

2. E. Andersen and J. Boyd, “Seismic Waveform Classification: Techniques and Benefits”, CSEG Recorder, 26-29, 2004.

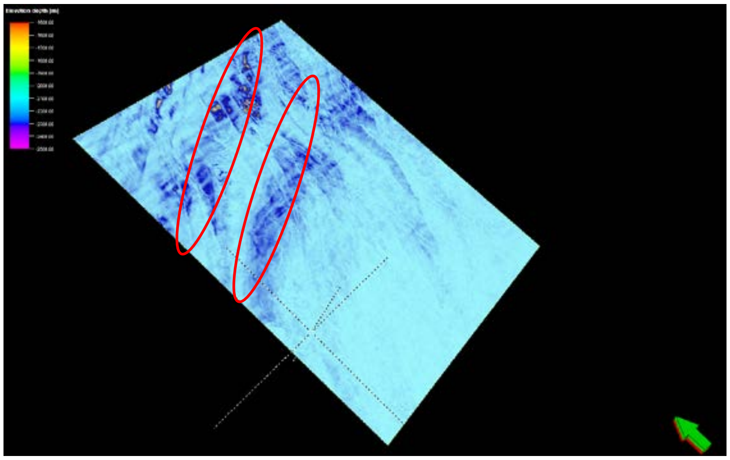

Figure 1: RMS attribute for the zone of interest

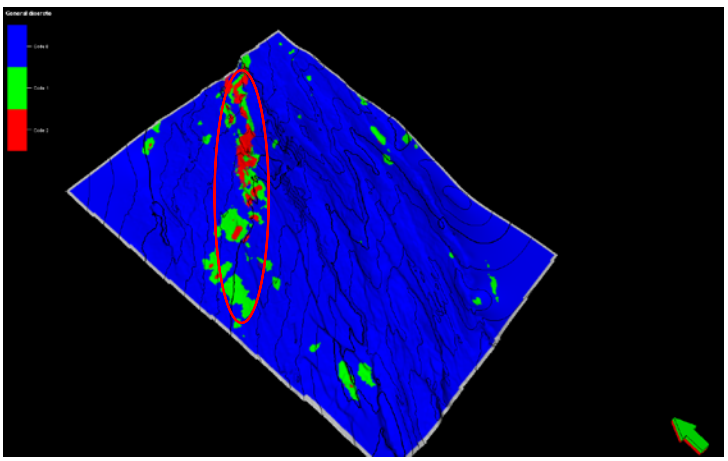

Figure 2: facies map created using waveform classification