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APPLICATION OF SIGNAL ENVELOPE AND ITS DERIVATIVES TO ENHANCE RESERVOIR CHARACTERIZATION OF "X" FIELD IN THE NIGER DELTA BASIN

When analyzing traditional seismic data, seismic attributes could be a helpful tool for identifying hidden structures and features [1, 2, 3, 4, 9]. Our study focused on using the signal envelope and its derivatives to uncover and illuminate hidden features and structures in a post-stack depth migrated seismic volume in order to support the reservoir characterization objectives of the Niger Delta Basin's "X" field. The work's objective was to investigate how the envelope attributes and its derivatives can improve or illuminate seismic data as proposed by the works of [5, 6, 7, 8, 10], for the purpose of identifying bright spots, gas accumulations, sequence boundaries, significant lithologic changes, and porous media as this will foster and increase the field's overall goals for reservoir characterization. Well logs, 3D post-stack depth migrated seismic data, and time-depth relationship surveys obtained from the field were among the data requirements employed in the study's execution. The data was processed and visualized using the Schlumberger Petrel and Opendtech tools. The resistivity logs were utilized to identify the presence of hydrocarbons, while the gamma ray log helped to determine the lithology. The well logs were given a time function using the time-depth relationship function, allowing events found in the logs to be displayed on the seismic data. In order to create time-slices, the envelope attribute and its derivatives were created from the initial seismic volume and conditioned into time gates. Following the application of the signal envelope and its derivatives, the rock and fluid properties on the seismically enhanced volume were then interpreted. It was found that the envelope attribute was useful in identifying bright spots, gas accumulations, sequence boundaries, significant lithologic changes, and porosity. The first derivative of the envelope did not work as well as the envelope. While they performed rather well in spotting bright spots on inlines, they were unable to distinguish them along the time slices. They performed poorly when it came to identifying porous material, significant lithologic changes, and sequence boundaries. When it came to highlighting bright spots, gas accumulations, sequence boundaries, significant lithologic changes, and porous medium, the second derivative of the envelope performed just as poorly. This study has therefore successfully shown the effectiveness of the envelope attributes for the detection of bright spots, gas accumulations, sequence boundaries, major lithologic changes and has also shown its robustness in identifying porous media within the X field. The inherent limitations of the envelope derivatives have also been established. In conclusion, we have successfully demonstrated and shown that the envelope attribute works better than its derivatives (the first and second derivatives) when deployed for illuminating bright spots and associated structures and can be successfully utilized as an important tool at an early stage for a reservoir characterization project.

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