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High Resolution Diffraction Imaging for Reliable Interpretation of Fracture Systems

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Summary

Natural fractures in shale formations can provide a pathway for higher permeability; therefore, they need to be characterized. The characterization of small-scale features is a challenge when dealing with conventional seismic methods. Seismic resolution has limitations for understanding sub-seismic scale structural patterns, stratigraphic variations and reservoir heterogeneities.
Minor fault trends, stratigraphic edges and fractures represent scattering sources for seismic wave propagation. The wavefield generated by those source points is identified as diffraction energy. This energy is always registered during seismic acquisition, but suppressed by standard processing sequences and imaging algorithms. The method explained in this paper is based on an imaging algorithm that maps the recorded surface information into the local angle domain (LAD). The differentiator of this method is its ability to preserve the wavefield through decomposition into reflection and diffraction energy. This paper shows the benefits of LAD technology when applied to the Eagle Ford play in South Texas, where seismic data can be of moderate quality, leading to accurate, high-resolution, and high-certainty seismic interpretation for risk management in field development.

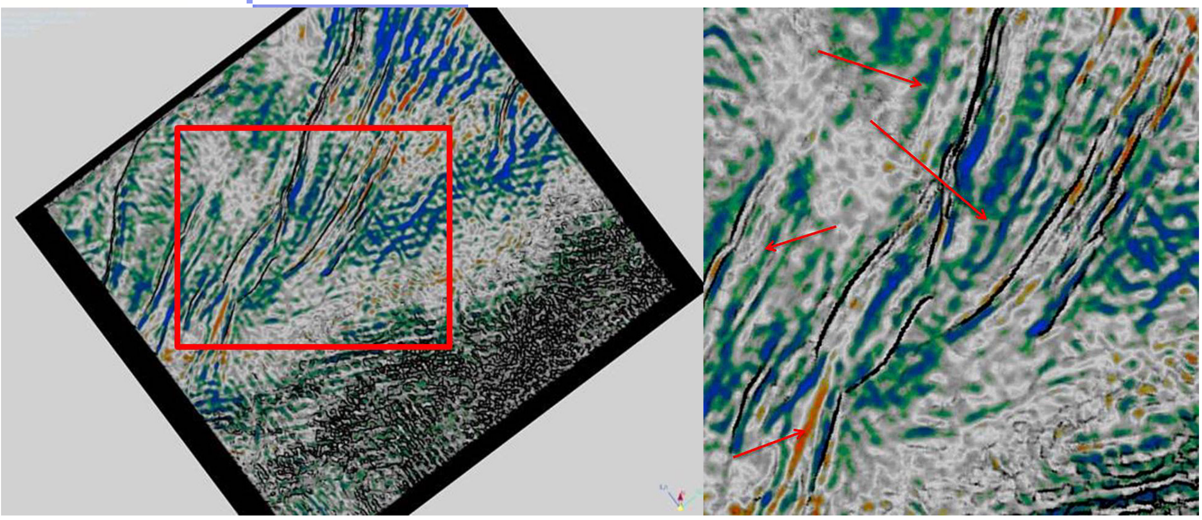

Figure 2 *Depth slice, merge of extracted diffraction and coherence volumes. Enlarged area corresponds to red square. Red arrows indicate improvements in fault definition (continuity, extension and potential) - Data courtesy of Seitel.*

Conclusions

In this paper, we demonstrate the use of diffraction energy to generate a seismic image, for more confident interpretation. When comparing conventional coherence and/or curvature to diffracted images, it is shown that the resolution obtained from depth migrated diffraction stacks is superior to that obtained using a conventional approach. Diffraction stacks provide high-resolution seismic information to supplement conventional interpretation workflows.

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