The Case for Depth Imaging All 3D Data: Complex Thrust Belts to Low Relief Resource Plays

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Introduction

Prestack time migration has been accepted by the industry as a standard 3D seismic processing practice. This has lead to improved imaging in many areas and the ability to use 3D seismic data for AVO, prestack inversion, and other advanced prospecting methods. Refinements, such as including diving rays and the incorporation of anisotropic parameters, have provided further improvements in time imaging. Despite these innovations, time migration is inherently incapable of properly handling even subtle lateral velocity variations, limiting its effectiveness for accurate imaging. In certain cases, only prestack depth migration can yield the level of accuracy needed to extract the valuable information contained within the seismic data.

Prestack depth migration has been used extensively to resolve imaging problems in areas where strong lateral-velocity contrasts are caused by salt bodies or complex structural geology. However, the method has been under-utilized in areas of lower structural relief, and "simple" velocity regimes where the limitations of time imaging can be less obvious. The combination of high-resolution gridded tomography and prestack depth migration can resolve the local velocity contrasts that distort subtle structural responses and compromise seismic attributes. We illustrate the uplift provided by depth imaging using synthetic and field data.

Conclusions

Structural complexity in time-imaged seismic data is often due, not to geology, but to lateralvelocity variations that have not been properly addressed. Synthetic and field data examples have shown the improved imaging and phase stability that depth migration provides when compared with time migration. Gridded cell tomography is the enabling technology that allows the development of geologically consistent velocity models suitable for use with prestack depth migration. The incorporation of VTI or TTI parameterization in the imaging process can also provide benefits, especially if well calibration is invoked, since this will improve the structural response and form "true-depth" 3-D cubes. Improving the integrity of seismic data through depth imaging has the potential to reduce the exploration cycle time, allow for improved horizontal well-planning; and reduce the uncertainty involved when fault avoidance is critical.

References:

Hess VTI model synthetic data example courtesy of Hess.
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