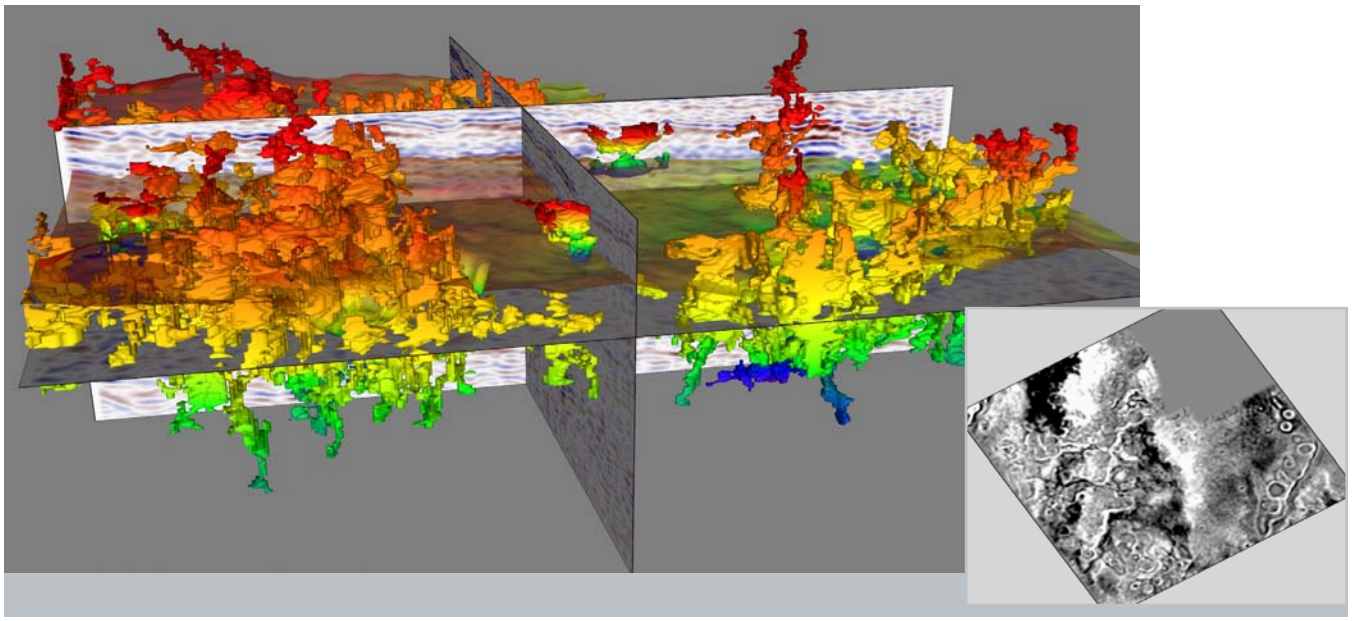
# EarthStudy 360 Diffraction Imaging


15th Annual World Oil AWARDS 2016 WINNER Best Exploration Technology Award

## An Innovative Approach to High-resolution Seismic Imaging and Interpretation of Diffraction Energy

Up to 50% of the subsurface information obtained from seismic data is believed to be either underutilized or lost using standard seismic imaging procedures. These imaging procedures remain biased towards high energy events defined by continuous reflectors or major discontinuities such as large faults. This energy is referred to as "specular" energy, and typically dominates the seismic data volumes used by seismic interpreters. While image processing techniques like coherency and volumetric curvature can help recover or enhance discontinuities in the seismic data, they cannot recover the high-resolution and lower energy details that have already been masked by standard processing and imaging procedures.

A significant amount of energy associated with high-resolution features such as small faults, stratigraphic edges and reservoir heterogeneities is recorded in the form of "diffraction" energy. The information encoded in diffraction energy can help explain reservoir compartmentalization, permeability and performance. It is this information that is masked by the dominant specular energy and irretrievably lost through the integration and stacking processes that are employed in standard seismic processing and imaging procedures. While these standard procedures improve signal-to-noise ratios, they do not recover the detail that can resolve subsurface complexities, influence prospectivity decisions, or control reservoir behavior.



▲ Complex geobodies (karst features) detected from volumetric curvature attribute generated from diffracted energy partial dip stacking, shown in the depth slice inset on the right. Jointly visualized with structural interpretation of the Top of Ellenburger formation.

EMERSON™

# Diffraction Imaging

The key advantage of the innovative Paradigm EarthStudy 360™ system is its ability to both recover and separate specular and diffraction energy from recorded seismic data. The process decomposes the fully recorded seismic wavefield in situ and in depth, without the need for integration or an early stacking stage, so that the lower energy associated with subsurface diffractions can be isolated and subsequently enhanced. Two types of images are then constructed: Specular weighted stacks for emphasizing subsurface structural continuity, and diffraction weighted stacks, which emphasize discontinuities in small-scale objects such as faults, channels and fracture systems.

The recovery of diffraction energy from seismic data is enabled by a rich multi-dimensional decomposition technology defined by full-azimuth directivity and reflectivity. Once diffraction energy is isolated, it can be followed by enhancement of the interpretation image to create high-resolution images of subsurface stratigraphic and structural features.

This procedure is applicable to all exploration and field development projects, including deep water, shale plays, fractured carbonate reservoirs and mature fields. When used properly, it can lead to accurate, high-certainty seismic interpretation for risk-managed field development.

### Features

- A unique ability to decompose the wavefield into reflection and diffraction energy directly at the image locations.
- Creates new seismic data deliverables that interpreters can use to further their understanding of the subsurface.
- Two methods for creating diffraction weighted stacks - energy separation and structural dip separation – with interactive analysis to select the most suitable option for the data.

### The Paradigm Advantage

- Avoid loss of useful information from early stacking stage.
- Complement the traditional poststack interpretation method by using the full wavefield of depth migrated data.
- Specular reflection energy provides insight into major continuous events and discontinuities.
- Diffraction energy provides high-resolution information about small scale discontinuities and subsurface geological features.

### Interoperability

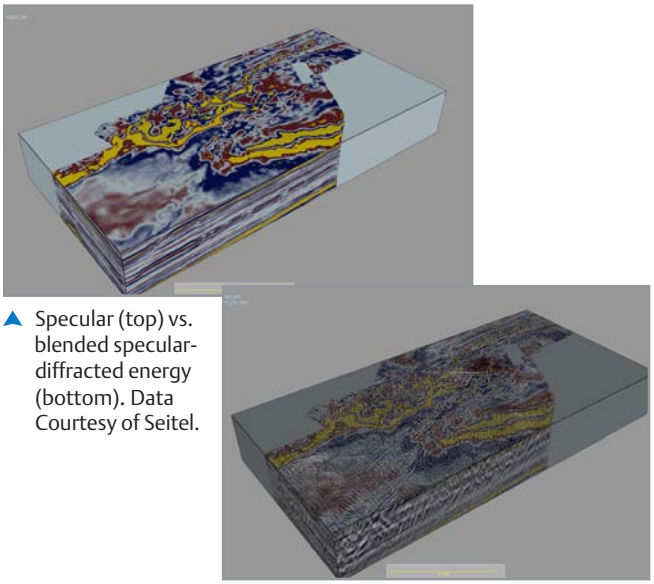
All Epos-based applications enable interoperability with third-party data stores, including:

- RESQML 2.0.1
- OpenWorks® R5000.10
- GeoFrame® 2012
- Petrel* 2017 & 2016
- Recall™ 5.4.2

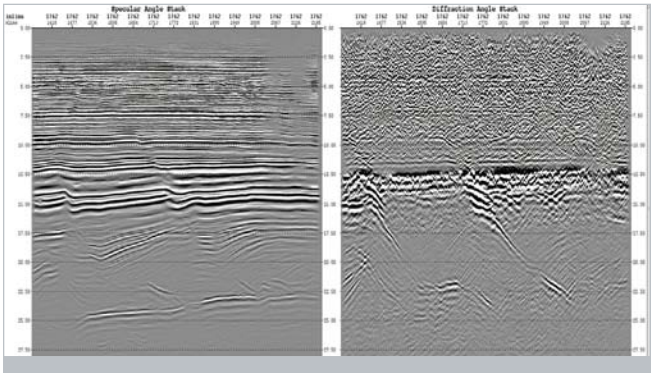
*(* a mark of Schlumberger)*

### System Specifications

- 64-bit Red Hat® Enterprise Linux® 6.8 and subsequent minor releases and 7.1 and subsequent minor releases
- Windows for analysis of 3D gathers (from Paradigm 17)



▲ Specular (top) vs. blended specular-diffracted energy (bottom). Data Courtesy of Seitel.



▲ Specular reflection stack (left) and diffraction stack (right). Data Courtesy of Seitel.

EMERSON

**www.emerson.com/paradigm**