VisualVoxAt™

TECHNICAL BULLETIN

SPECTRAL DECOMPOSITION

OVERVIEW

Thin bed pay can remain largely undetected using conventional seismic interpretation techniques. Spectral decomposition enables the detection of thin beds and geological features beyond the limits of traditional seismic analysis by breaking down the seismic signal into its frequency components. VisualVoxAt's spectral decomposition tool generates amplitude and phase maps tuned to specific frequencies. The resulting spectral amplitude maps can aid in estimating bed thicknesses while phase maps help to define lateral stratigraphic discontinuities.

By viewing amplitude and phase interference in the frequency domain, the user can quickly identify structural bodies and stratigraphic edges that would otherwise be overlooked in full bandwidth displays. By mapping areas where anomalous frequency signals are attenuated, the user can detect the presence of hydrocarbon fluids. Comparison of spectral decomposition results to well data can greatly improve the prediction of bed thicknesses and hydrocarbon-bearing zones away from wells.

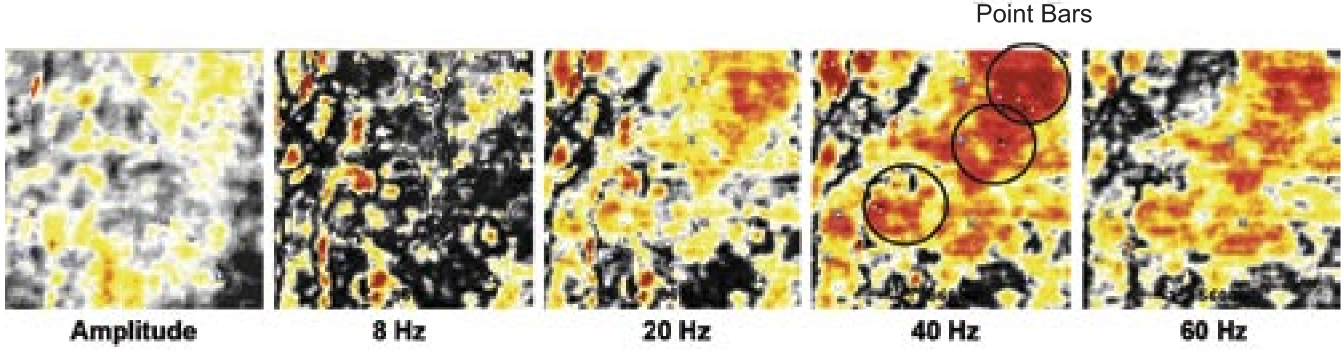


Figure 1: Spectral decomposition is applied to an interval derived from post-stack amplitude to generate a tuning cube consisting of frequency slices. Scrolling through the frequency domain reveals point bars at 40 Hz.

DETECT SUBTLE STRATIGRAPHIC AND STRUCTURAL FEATURES OVER A RANGE OF FREQUENCIES

- Generate tuning cubes from horizon interpretations to view multiple frequency slices (amplitude and phase maps tuned to a given frequency).
- Use frequency slider bar to scroll through frequency slices while maintaining time, or maintain one frequency while sliding through time, line or trace.
- Analyze the spectral response at multiple tuning frequencies to locate subtle faults, hydrocarbon traps and thin bed interference patterns.
- Estimate bed thickness by extracting the tuning frequency (first peak amplitude of the tuning cube) and interpreting the corresponding event.

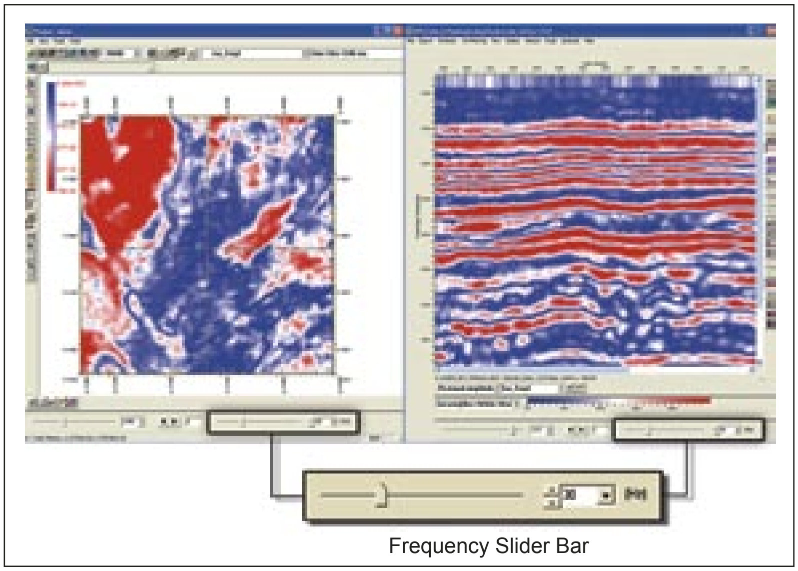


Figure 2: The frequency slider bar allows the user to slice through the spectral range while maintaining time or maintain one frequency while sliding through time, line or trace.

IDENTIFY HYDROCARBON TRAPS AND THIN BEDS BELOW SEISMIC TUNING THICKNESS

- Transform seismic data into the frequency domain with Continuous Wavelet Transform (CWT) and Discrete Fourier Transform (DFT) methods.
- Map temporal windows around seismic data with DFT to identify areas of thin bed interference.
- Enhance subtle reflection events in seismic volumes with CWT. The method eliminates undesirable windowing effects associated with traditional Fourier analysis, allowing for finer sampling of wavelets and increased resolution.

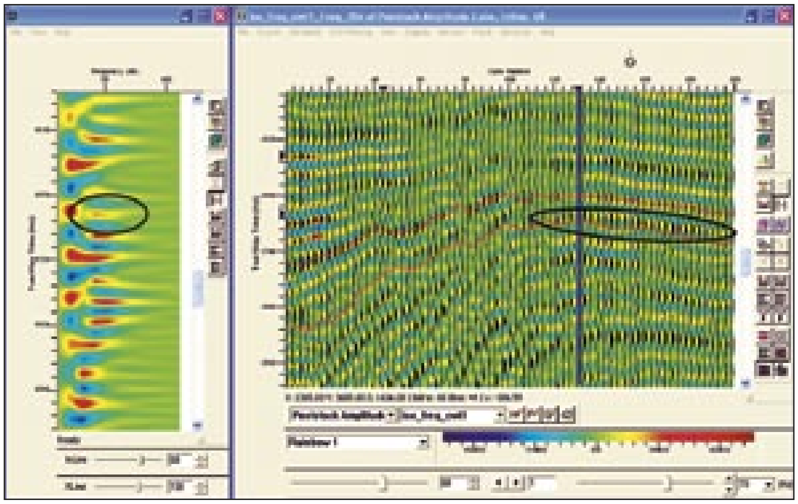
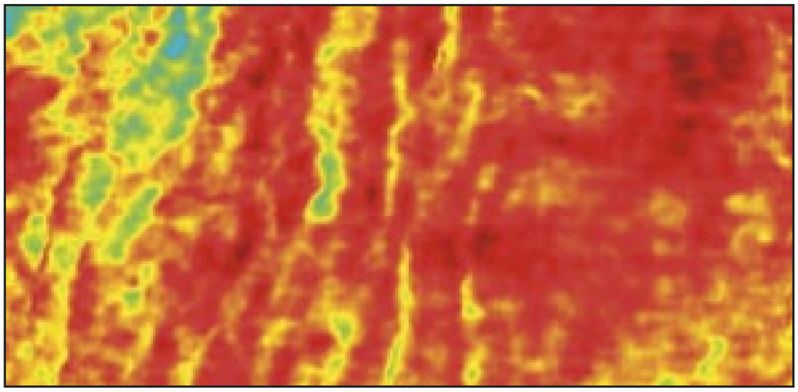


Figure 3: Continuous Wavelet Transform is applied to a post-stack amplitude cube, revealing a thin bed between two horizons (circled). Right screen shows amplitude section at a frequency of 70 Hz. Left screen shows the frequency gather of amplitude versus frequency for a selected common depth point (delineated by blue line).

REDUCE CYCLE TIMES

- Increase interpretation efficiency with rapid and interactive displays between frequency slices, sections and 3D views.
- Select the best well placements based on enhanced spectral analysis and high-resolution 2D and 3D imaging.

A



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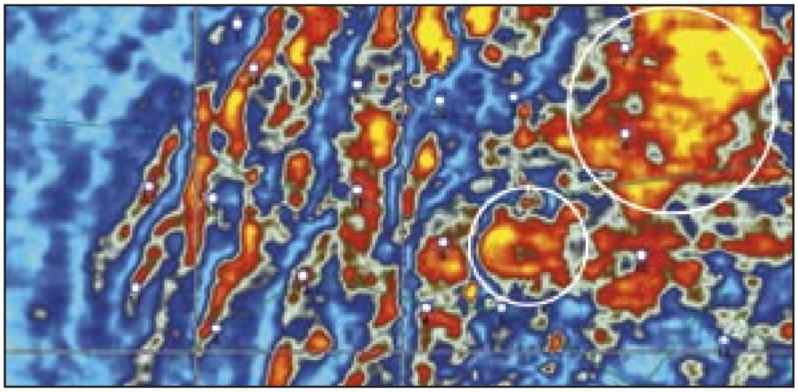

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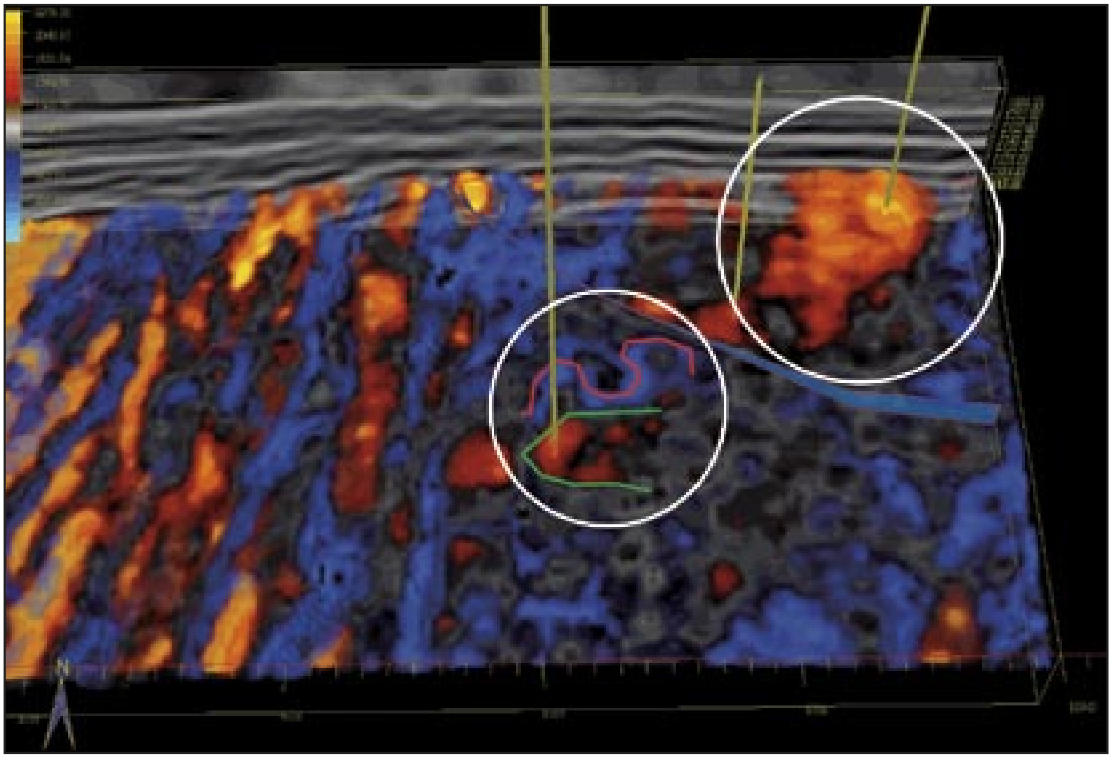
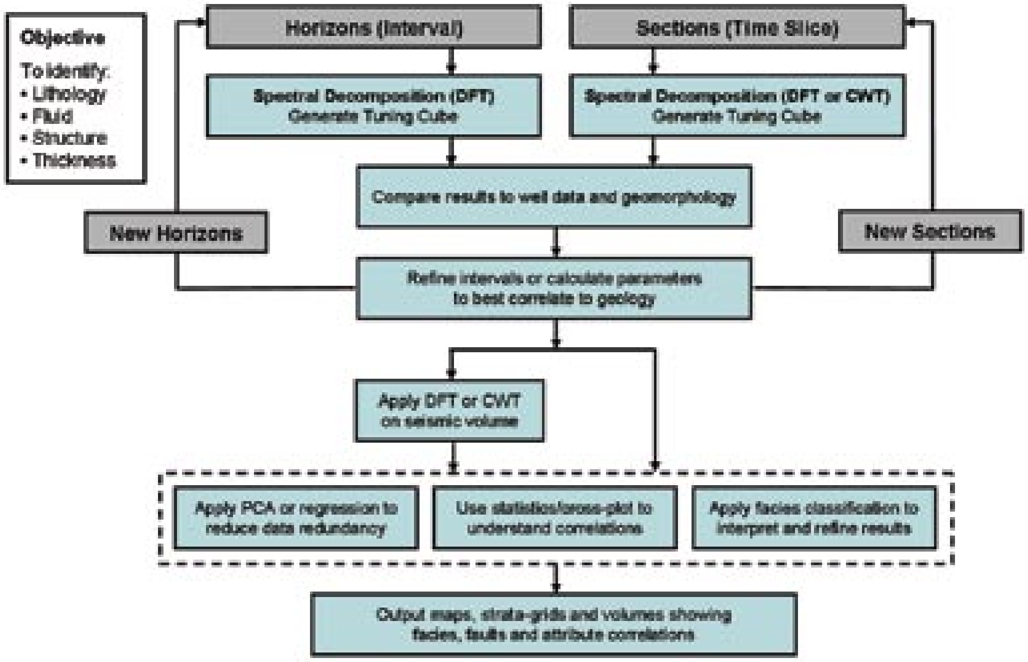


Figure 4: Poststack amplitude map showing poor resolution of a channel system (A). Spectral decomposition extracts amplitude of maximum frequency (B) to reveal meandering channels and multiple point bars (circled). Strata-grid spectrum of max frequency is shown in 3D with an inline and three wells in (C) - green line delineates an oxbow and red line above it outlines a meandering channel.

SPECTRAL DECOMPOSITION WORKFLOW



VisualVoxAt is an integrated, Windows-based toolkit for seismic attribute generation, visualization, calibration, classification and interpretation. The software combines fast rendering technology with easy-to-use analysis tools to reduce cycle times for faster decisions. As a plug-in to reservoir interpretation workflows, VisualVoxAt is a cost-effective solution for optimizing reservoir assets and increasing well accuracy.