Seismic Resolution and Thin Bed Reflectivity Inversion

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Abstract

When it comes to thin bed resolution, conventional wisdom usually follows the conclusions enunciated by Widess (1973). According to the Widess model (which consists of an isolated thin bed) the peak frequency of the seismic response is higher than that of the wavelet; below 1/8th of a wavelength the seismic response becomes the derivative of the wavelet and does not change shape with changing thickness. Our experience with spectral decomposition has led to the surprising conclusion that the Widess model of thin bed response is a very special case that is very different from most combinations of reflection coefficients. When the reflection coefficients at the top and base of a thin bed are not exactly equal and opposite, a more general behavior is observed where the peak frequency decreases as thickness decreases below the tuning frequency. This tells us that the seismic response is more sensitive to thin beds than thought previously. In fact, we find that encoded in the spectral decomposition of a seismic trace is information that exceeds the bandwidth of the actual seismic signal and allows us to make inferences about thin beds that are far thinner than classical limits of seismic resolution. Such knowledge can be used to remove the seismic wavelet without magnifying noise and can thus be used to produce high resolution reflectivity sections that are far superior to conventional seismic sections in resolution and interpretability (Chopra et al 2006).

Real data examples will illustrate how high resolution reflectivity inversion yields an enormous amount of detail not only in terms of extra reflection cycles, but also the fault detail. Correlation with log curves provides the final confirmation that interpreters usually look for.

References

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