Broadband Marine Seismic - Breaking the Limits

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The importance of recording the full range of frequencies (low as well as high) is widely accepted for high resolution imaging. High-fidelity, low-frequency data provides deeper penetration for the clear imaging of deep targets, as well as providing greater stability in seismic inversion. Broader bandwidths produce sharper wavelets and both low and high frequencies are required for high-resolution imaging of important features such as thin beds and stratigraphic traps.

The industry has been facing many issues that have limited the performance of marine seismic surveys with respect to bandwidth. Among them, we find mechanical and acoustic noise, source and receiver ghosts and attenuation with depth. Until recently, conventional de-ghosting was found to be sub-optimal. Thanks to recent advances in technology and also in operational capabilities, we have seen several improvements, in particular with the use of solid streamers, deep towing and notch diversity.

In this presentation, we describe a different technique to achieve broadband marine streamer data. The proposed solution is a new combination of streamer equipment, novel streamer towing techniques, and a new de-ghosting and imaging technology. It uses receiver notch diversity to yield a broadband spectrum and takes full advantage of the low noise and low-frequency response of the new generation of solid streamers. As a result, the method creates an exceptionally sharp and clean wavelet for interpretation. It can be tuned for different water depths, target depths and desired output spectra.

The de-ghosting method contains no 2D assumption and works equally well in 3D and wide-azimuth. It is true amplitude, being able to extract the true de-ghosted reflectivity, which is the reflectivity that would have been obtained should the water surface be non-reflecting.

A dataset was acquired with the new technique offshore NW Australia and processed with the new de-ghosting algorithm, revealing an exceptionally wide bandwidth with low frequencies down to 2.5 Hz and high frequencies up to 110 Hz. The data was migrated in depth just after source de-signature. The de-ghosted output shows the broadband nature of the final image both in low and high frequencies together with its intrinsic noise free performance.