EAGE

M08

Dual-sensor Streamer Increases Data Bandwidth Leading to Improved Penetration and Higher Resolution

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SUMMARY

The use of a dual-sensor streamer allows the exact removal of the receiver ghost. The bandwidth of the seismic data is consequently increased, providing better penetration and greater resolution. In addition, seismic velocities and earth attenuation are estimated more accurately. These results are illustrated with case studies from basins worldwide.

The quest for the remaining oil and gas fields is getting harder. Reservoirs are deeper, covered with complex overburden and within increasingly complex stratigraphic traps. To meet these challenges, seismic exploration needs extended bandwidth: More low frequencies for deeper penetration (subsalt and sub-basalt) and more high frequencies for increased resolution.

Unfortunately, the bandwidth in marine seismic is constrained by ghosting. The frequency content of the recorded data therefore depends on sensor depth. A shallow streamer is favorable to high frequencies and detrimental to low frequencies. Conversely, a deeper streamer favors low frequencies at the expense of high frequencies. Marine seismic acquisition therefore involves a trade-off between high and low frequencies, which inherently limits data bandwidth.

A dual-sensor streamer, with both pressure and velocity sensors, can resolve this conundrum. The two sensors are combined to split up- and down-going waves, thereby eliminating the effects of ghosting and restoring the full data bandwidth. This in turn benefits both penetration and resolution of seismic reflections, providing a clearer image of the subsurface especially in challenging environments.

The technology has been applied in the North Sea, the Gulf of Mexico, Australia North West Shelf and the Mediterranean (Cyprus and Egypt). For all these cases, legacy seismic data lacked resolution and/or penetration. The dual-sensor streamer provided an efficient and effective solution. Figure 1 shows an example from offshore Australia. The presence of a thick and complex carbonate layer masks the underlying reflectors. A deep towed (15m) dual-sensor streamer delivers an improved image of the deep reflectors while enhancing shallow resolution. Similar results have been achieved in all other basins.

The increased bandwidth also helps data processing in many respects. Not only are velocity spectra more focused, which improves picking, but earth attenuation can be readily estimated from surface seismic data alone (Figure 2). The use of down-going waves in addition to the deghosted up-going waves promises further benefits for multiple attenuation and pre-stack imaging.

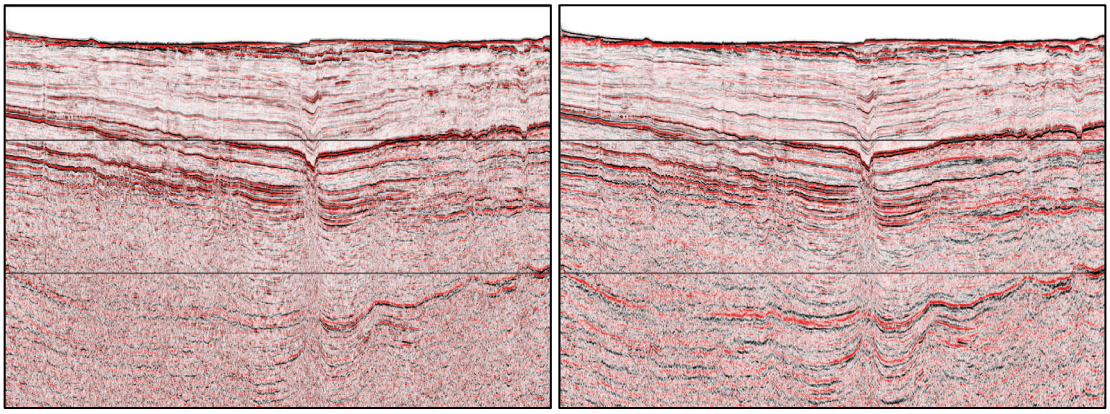

Figure 1: Seismic sections from Australia North West Shelf. The conventional data (left) does not properly image below the carbonate layer. The dual-sensor derived up-going wave (right) offers better penetration and improved resolution.

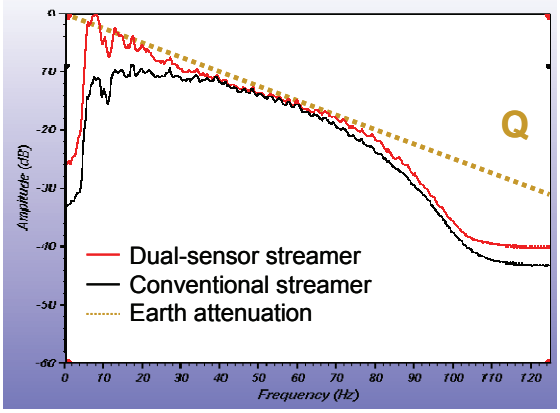

Figure 2: Spectral comparison between a conventional streamer (black) and the dual-sensor streamer (red). The improved low frequency content enables an accurate estimation of earth attenuation Q.