The Value of Broadband Seismic from Dual-sensor Streamer for the Interpreter and Reservoir Geophysics

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The seismic industry is constantly seeking ways of improving the contribution of seismic data to the upstream E&P workflow from seismic acquisition to reservoir modeling. We review recent developments in broadband seismic and illustrate how these add value for seismic interpreters and geoscientists involved in reservoir characterization or quantitative interpretation projects. In 2007 a dual-sensor streamer acquisition system was developed with the objective of providing broader seismic frequency bandwidth without any compromise in pre-stack data quality or acquisition efficiency. The increase in bandwidth is achieved by removing the sea-surface ghost at the receiver end via the principle of wavefield separation. Results over the last five years have demonstrated the benefits of this system in processing, seismic interpretation and reservoir geophysics. Case studies from different geological settings illustrate the benefits to end-user practitioners in seismic interpretation and seismic reservoir characterization across a range of E&P asset development phases from exploration to appraisal and field development and optimization.

The dual-sensor approach for de-ghosting (as part of the acquisition process via wavefield separation) retains the amplitude and phase integrity of the pre-stack data. This is an important feature of the system as it ensures that all subsequent pre-stack analysis (such as AVO, inversion, and QI studies) is robust.

The simultaneous extension of both low and high frequencies has a major positive impact on seismic interpretation and quantitative seismic interpretation or reservoir properties derivation: the low side of the spectrum contributes in particular to the improved derivation of the absolute elastic properties such as acoustic and shear impedance, whereas the high side of the spectrum improves the seismic resolution and hence the detection of thin reservoir layers. A modeling exercise using a synthetic wedge model is used to demonstrate the effect of bandwidth on resolution and on the ability to accutrately invert seismic data. The broadening of the seismic bandwidth also has benefits for seismic imaging and especially for the full waveform inversion algorithms as more low wavenumber are available. Moreover, extended seismic bandwidth on both the low and high side reduces significantly the dependency on strong a-priori information (low frequency model) by retaining and further improving resolution and increases noticeably the ability to predict with confdence elastic properties away from well control making it a key element in the prospect derisking process.