1216621 Variable-Depth Streamer Acquisition: Broadband Data for Imaging, Inversion and Interpretation

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Variable-depth streamer acquisition is a solution for broadband marine seismic where the depth profile of the streamer is optimized in order to create receiver ghost diversity, which in turn enables deconvolution of the residual ghost at the imaging stage, either pre-stack or post-stack. This technique benefits from towing streamers at depths of up to 50 meters, which, combined with the use of solid streamers, ensures the raw data has an exceptionally good signal-to-noise ratio, especially at low frequencies.

This broadband marine towed streamer solution has now been used in production in a variety of locations around the world, in different water depths and over different geologies. In addition to the early 2D results, 3D, AVO and inversion data have now been obtained, all of which show significant improvements over conventional data, achieving bandwidths of up to 6 octaves (2.5Hz -160 Hz). This broad bandwidth translates into improved results for seismic inversion. The lack of low frequencies in conventional seismic data means that a low frequency model must be incorporated in the inversion process, usually obtained by interpolating low-passed filtered impedance logs between well locations. With variable-depth streamer data, high-resolution NMO-derived seismic velocities are used to define the low frequency model in the 0-5Hz range, while the reflectivity provides information from 2.5Hz. Pre-stack elastic inversion has also been performed, providing both impedance and Vp/Vs sections, so proving the feasibility of pre-stack deghosting of variable-depth streamer data.

Interpretation of this broadband data is aided by the reduced noise and additional low-frequency energy, which helps to delineate deep structures, improves sedimentary package differentiation and delineation and shows clear local impedance contrasts and heterogeneities. This is due to the lack of side lobes to the wavelet and the excellent phase control of the low frequencies, which also provide texture and continuity to the data. The broad bandwidth provides stratigraphic detail, allowing direct discrimination of rock or fluid properties. It also improves correlation from trace to trace, enabling horizons to be picked automatically, even through discontinuities, so that auto-tracking can work optimally with greatly reduced intervention. All of these factors enhance interpretation.

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