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How High Can We Go? Pushing Limits of Lateral and Vertical Resolution in Deepwater Seismic

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Summary

We acquired low-cost high-resolution 3D (HR3D) streamer seismic surveys using the P-Cable system with a small air-gun source array (300 in3) over deepwater fields with water depths ranging from 900m to 3000 m. The P-Cable HR3D streamer system employs multiple short streamers (100 m) connected to a cross-cable. In our surveys we deployed 18 streamer cables with each of the 100 m streamer cables having 16 hydrophone groups spaced at 6.25 m intervals. With shot intervals spaced every 12.5 m, the nominal bin size of this configuration is 6.25 m x 3.125 m and the fold is four. In the Shallow sections, we achieved migrated images with frequencies up to 200 Hz. The lateral resolution of the images is found to be superior to that from high-resolution processing of conventional data (streamer and OBN). In the deeper section, the frequencies dropped to much lower values indicating that the earth has more control on the high frequency end than the geophysicist.

We also acquired Near Field Hydrophone (NFH) data in overlapping regions of the same field using a dual source of 2950 cu in with NFHs recording active and inactive sources up to 10s record length. NFH data provide decent quality near-offset stacks in the shallow section the signal-to-noise ratio (S/N) degrades with depth due to the noisy environment at the hydrophone locations on the source array. We compared the NFH dataset with the P-Cable data and find the latter is superior in delineating intricate sub-surface features and in delivering better S/N, especially in deeper sections of the formation that house reservoir horizons of interest. Overall, it is promising to be able observe first order subsurface features in the shallow sections using NFH data that comes at little cost with nearly all marine seismic surveys and that has so far been used for primarily for QC purposes. For more detailed work such as monitoring shallow geohazards and time-lapse seismic, the NFH data in its current state is sub-optimal and could be improved by towing one or more short hydrophone cables behind or in front (to reduce bubble noise) of the source arrays. Given the small cost of the actual hardware and the high quality of data delivered, it is worth looking into the possibility of optimizing marine source surveys to routinely tow short hydrophone streamers or P-Cable-style streamers in the future.