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3D OBC sesimc data processing to overcome sampling sparseness and irregularity

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ABSTRACT

An OBC technique generally provides several technical advantages over a conventional towed streamer survey. However, due mainly to commercial and operational constraints, some compromises on survey parameters are required though dense and symmetric sampling is ideal. As a result, seismic data is often sparsely and irregularly sampled, leading to several challenges in processing of OBC seismic data offshore Abu Dhabi. Conventional linear noise attenuations are not effective with Scholte waves as they are usually aliased with typical source and receiver sampling intervals in 3D OBC seismic data, and sometimes scattered because of near-surface heterogeneity offshore Abu Dhabi. To address this, we apply model-based surface wave attenuation, Surface Wave Analysis Modeling and Inversion (SWAMI), which enables an estimate of local near-surface properties and create noise model by analyzing dispersion curves. The method does not involve multi-channel filtering to the input data so both direct and scattered Scholte waves are effectively attenuated without suffering a lack of spatial sampling. Matching Pursuit Fourier Interpolation (MPFI) is then implemented to enhance spatial sampling caused by acquisition geometry. MPFI is a frequency domain interpolation and regularization technique. Iterative process along with its anti-aliasing capability enables optimum data reconstruction for each frequency range at desired locations. In addition to regularization aspect, MPFI is targeted to densify receiver line interval and extend source lines with 5D implementation (4 spatial coordinates and time). This consequently enhances fold, offset and azimuth distributions of the data.

SWAMI deals with complex properties of Scholte waves and attenuates both direct and scattered ones without any processing artefacts. MPFI with 5D implementation dramatically improves spatial sampling. The several aspects of values of interpolation are recognized such as improvement of signal to noise ratio and stack response. The results enhance the value of sparsely and irregularly sampled OBC seismic data, and indicate a possibility that seismic data with insufficient spatial sampling could achieve an equivalent data quality to dense and full azimuth survey. Unlike a land case, these two techniques had not previously been applied to OBC data. This study, therefore, proved their applicability, reliability and benefits to 3D OBC data.