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Reverberation Attenuation Strategy for an Arabian Gulf 3-D OBC Survey

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SUMMARY

Water-column related reverberations are well pronounced in a 3D OBC data from Arabian Gulf. Effective removal of the reverberations is critical for obtaining a reliable seismic image. The reverberation mitigation is complicated by substantial noise in the data. The data processing strategy includes a deterministic source-side de-reverberation filter and post-stack 2C OBC combination. Effectiveness of the reverberation attenuation strategy is demonstrated.

Reverberations are a significant problem in shallow-water, hard water-bottom areas, such as the Arabian Gulf, where a 3-D, 2-C OBC survey has been acquired.

Using 1-D modeling, we demonstrate that the dominant frequency of the data is largely controlled by the reverberation phenomenon and that water depth in the area is strongly correlated with the data frequency content, creating a substantial data quality issue. Spectral analysis of the data helps identify contributions from both source- and receiver-side reverberations. The high level of noise in the data, of which Figure 1 is typical, complicates the de-reverberation process. To reduce the effect of noise on the combination of the two components, we employ a poststack approach (Reilly et al., 2008). We estimate the water-bottom reflection coefficient, R_{wb} , from CMP stacked OBC hydrophone and geophone volumes using Duren's (2003) method. The estimated lateral trends in R_{wb} are strongly correlated with water depth in the area and with the velocity of surface-waves, which we estimate using the method of Lee and Ross (2008). We attenuate source-side reverberations in the data using deterministic Backus (1959) filtering.

We demonstrate the efficacy of the filter application on both OBC hydrophone and geophone data, as well as on the 2-C combined data. The receiver-side reverberations are mitigated using a 2-C OBC combination (Duren, 2003), and we use spectral analysis to show effectiveness of that approach. Lateral variation in the data's dominant frequency has been substantially reduced as a result of our de-reverberation processes. We have also verified the success of the de-reverberation strategy through seismic synthetic well ties.

Figure 1. Raw shot gathers: reverberations dominate both (A) hydrophone and (B) geophone records.

References

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