WS08_08

Multi-Parameter Waveform Inversion Using Broadband Data from the North West Shelf of Western Australia

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Summary

We present a multi-disciplinary approach to determine overburden anisotropy on the North West Shelf of Australia. Beginning with a synthetic dataset we demonstrate the significance of incorrect overburden anisotropy in seismic imaging and develop a workflow for solving the problem. This is followed by application of our workflow to a field case study involving the use of geological inference, log-based rock property relationships, and surface seismic data. Comparisons are made between applying the workflow using conventional and broadband streamer datasets acquired over the same area.

Abstract

Multi-parameter full waveform inversion (MFWI) is an appropriate technology to use in an integrated model building workflow to improve seismic imaging and reduce overburden rock property uncertainty. Of particular interest in seismic imaging are the Thomsen parameters associated with weak anisotropy (Thomsen, 1986). Cumulative anisotropic errors in the overburden and subsequent leakage into velocity can have potentially serious problems for imaging at the reservoir – inducing both structural and amplitude errors. This is of particular importance on the North-West Shelf of Australia where amplitude plays are prominent.

We have developed a multi-disciplinary model building capability that allows us to recover velocity and anisotropy (epsilon) from surface seismic broadband data using MFWI. Our model building approach and quality control procedure combines several different forms of inference, including: geologic knowledge from interpreters; conventional log data analysis; recently developed rock physics and log data driven anisotropy predictions; and multi-parameter waveform inversion. We have applied this model building capability to relatively long offset 2D broadband data from the NW Shelf Australia and made comparisons with models derived from a co-located conventional towed streamer used in a similar workflow. Of specific interest were areas where previously built anisotropy models may not have been geologically plausible, particularly in the overburden. We are now testing this approach on other suitable surface seismic datasets from the same region. In addition, we are also investigating the use of walk-away VSP data to assist in constraining the inversion.

Acknowledgements

The authors would like to thank the Australian Business Unit for their approval in publishing this work and for provision of data and useful discussions to assist this work.