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Land Seismic Acquisition Repeatability for Time-Lapse Monitoring of CO2 Sequestration

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Abstract

Time-lapse surface and borehole seismic surveys are planned for monitoring the injection of CO2 in the CO2CRC Otway Basin Pilot Project in Victoria. Critical to the success of this is to ensure optimum repeatability of acquisition parameters and ground conditions. In order to assess the relative influences of source types and environmental conditions, a series of repeated test surveys have been undertaken.

The study utilised repeated high-resolution seismic surveys along the same 2D line. The first test line was acquired with mini-vibroseis (6000 lb) in wet conditions when the top soil and the weathered layers were fully saturated. The line was subsequently re-recorded in dry conditions where we utilised the same mini-vibrator, but in addition repeated the line using a free-fall weight drop. Both sources have similar total energy output but a vibrator is a controlled frequency source while a weight drop is not.

Despite differences in the frequency content and phase of the signal generated by these two sources, and positioning differences for source and receiver locations of up to 1m, almost identical stacked sections were obtained after phase matching and scaling of the two datasets. Far greater differences in total energy, frequency content and phase of the signal were observed between the two vibroseis lines recorded at different times of the year (wet and dry periods).

Our results clearly demonstrate that near surface conditions has a first order effect on repeatability of land seismic surveys. A common belief that deployment of the same seismic source and positioning errors are crucial for successful time-lapse seismic needs to be reexamined in light of our results, which show that these factors are of secondary importance when it comes to land seismic surveys.

Technical Area: Time-lapse/CO2 sequestration, Seismic acquisition