High-resolution 3D marine seismic acquisition in the overburden at the Tomakomai CO_2 storage project, offshore Hokkaido, Japan

GCCC Publication Series #2019-29

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Keywords: monitoring, above-zone, seismic 3d

Cited as:
Meckel, T.A., Y.E. Feng, R.H. Trevino, D. Sava, 2019, High-resolution 3D marine seismic acquisition in the overburden at the Tomakomai CO_2 storage project, offshore Hokkaido, Japan, GCCC Publication Series #2019-29, originally published in *International Journal of Greenhouse Gas Control,* 88, 124-133.

Abstract

Monitoring injected CO_2 is an important part of assuring permanence of long term storage to mitigate atmospheric emissions. Three-dimensional (3D) seismic has been shown to be an effective technology for visualizing and quantifying subsurface geology and fluids. In this study, we demonstrate the successful acquisition, processing, and initial interpretation of a first-of-its-kind high-resolution 3D (HR3D) marine seismic survey above an active CO_2 injection site offshore Tomakomai, Japan. An initial sensitivity study indicated generally favorable subsurface conditions for imaging subsurface pore fluid changes. A unique processing workflow incorporating multiple data processing software packages has been tailored to the short-offset and low-fold HR3D acquisition. The final 3D volume shows generally flat and laterally-continuous stratigraphy in the overburden above the injection zone without identifiable faults, indicating coherent overburden above the CO_2 injection site and low associated risk of vertical CO_2 migration. The successful deployment of this novel marine seismic monitoring technology in the overburden at a small-scale (100kt/yr) demonstration project suggests HR3D will also be a useful characterization and monitoring tool for larger demonstration and commercial-scale (˜10MT) offshore Carbon Capture and Storage (CCS) sites.