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Monitoring Of CO2 Leakage Using High-Resolution 3D Seismic Data – Examples From Snøhvit, Vestnesa Ridge And The Western Barents Sea

B. Bellwald[1]*, M. Waage[2], S. Planke[1,3,4], N. Lebedeva-Ivanova[1], S. Polteau[1], A. Tasianas[2], S. Bünz[2], A.A. Plaza-Faverola[2], C. Berndt[5], H.H. Stokke[6], J. Millett[1], R. Myklebust[7]
[1]Volcanic Basin Petroleum Research (VBPR) AS, [2]Centre for Arctic Gas Hydrate, Environment, and Climate (CAGE), The Arctic University of Norway, [3]Centre for Earth Evolution and Dynamics (CEED), University of Oslo, [4]Research Centre for Arctic Petroleum Exploration (ARCEx), The Arctic University of Norway, [5]GEOMAR, Helmholtz Centre for Ocean Research Kiel, [6]P-Cable 3D Seismic AS, [7]TGS

Summary

Injection of CO2 in subsurface reservoirs may cause overburden deformation and CO2 leakage. The aim of this study is to apply technologies for detection and monitoring of CO2 leakage and deformation above the injection reservoirs. The examples of this study include data from the Vestnesa Ridge natural seep site, the Snøhvit gas field and CO2 storage site region, and the Gemini North gas reservoir. Reprocessing of existing 3D high-resolution seismic data allows resolving features with a vertical and lateral resolution down to c. 1 m and c. 5 m respectively. The current acquisition systems could be modified to image structures down to one meter in both the vertical and horizontal directions. We suggest a monitoring workflow that includes baseline and time-lapse acquisition of high-resolution 3D seismic data, integrated with geochemical, geophysical, and geotechnical seabed core and water-column measurements. The outcome of such a workflow can deliver reliable quantitative property volumes of the subsurface and will be able to image meter-sized anomalies of fluid leakage and deformation in the overburden.

Figure 4 *Integrated approach for the monitoring of CO_2 leakage. The use of high-resolution 3D seismic data allows to image structures and fluid anomalies in the shallow subsurface with a meter-size resolution. The seismic data were collected in 2014, and the exploration well 7325/4-1 was drilled in 2017. MSGL: Mega-scale glacial lineations.*

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The integration of time-lapse high-resolution 3D seismic data with in-situ measurements of geological properties and seep anomalies is our proposed strategy for monitoring overburden deformation and potential CO_2 leakage above CO_2 storage sites. Our integrated approach allows an effective response for the detection and monitoring of CO_2 leakage. 4D seismic data analysis is a powerful tool to detect changes caused by fluid injection in particular when data are interpreted at detection level rather than resolution level. As fluid injection (or extraction) is capable of deforming the overburden several meters, 4D seismic data have the potential to monitor reservoir pressure variations on much larger scales than borehole measurements.

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