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Time-lapse analysis of sparse 3D seismic data from the CO_2 storage pilot site at Ketzin, Germany

M. Ivandic (1), C. Yang (1), S. Lüth (2), C. Cosma (3), and C. Juhlin (1)

(1) Department of Earth Sciences, Uppsala University, Uppsala 75236, Sweden, (2) Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum (GFZ), Telegrafenberg, 14473, Potsdam, Germany, (3) Vibrometric Oy, Taipaleentie 127, 01860 Perttula, Finland

Capture and geological storage of CO_2 is considered to be a feasible method for reducing carbon emissions. In April 2004, a research pilot project in the German town of Ketzin started as the first onshore CO_2 storage project in Europe. Injection started in June 2008 and until the latest repeat survey in February 2011 around 45 kilotons of CO_2 had been injected into a saline aquifer at approximately 630-650 m depth. Different seismic methods, such as time-lapse Vertical Seismic Profiling (VSP), Crosswell, Moving Source Profiling (MSP) and surface seismics have been employed to detect and monitor changes in the reservoir. We present here time-lapse results from sparse 3D seismic surveying with a "star" geometry, i.e. with a radial distribution of acquisition profiles directed towards the approximate location of the injection well, which were acquired to link downhole surveys with full 3D surface seismic surveys. The main objectives of the sparse 3D surveys were (1) to identify changes in the seismic response related to the injection of CO_2 between the repeat surveys and baseline survey and (2) to compare these results with those from the repeat 3D seismic survey. The results are consistent with the 3D seismic time-lapse studies over the injection site and show that the sparse 3D geometry can be used to qualitatively map the migration of the CO_2 plume within the saline reservoir, as well as potential migration out of the reservoir rock at a significantly lower effort than the full 3D surveying. The latest repeat survey indicates preferential migration of the CO_2 to the west. Both sparse 3D repeat surveys show that the CO_2 is being confined within the aquifer, implying that there is no leakage into the caprock at the time of the repeat surveys. The same observation was obtained from the 3D dataset.