Geophysical Research Abstracts
Vol. 14, EGU2012-10758, 2012
EGU General Assembly 2012
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Passive and Active Seismic Monitoring of CO_2-Storage at Ketzin

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Since July 2008, CO_2 is injected into a saline aquifer near the town of Ketzin in Germany. The reservoir used for this purpose is located at a depth of about 650 m. For monitoring the CO_2-migration in the reservoir close to the injection well, TNO installed and exploits, since August 2009, a 2D seismic array, with 3-component geophones at the surface, 4-component receivers at 50 meters depth and a central vertical array of 4-component receivers. This specific acquisition set-up was and is being used both for the recording of high-quality active time-lapse seismic data as well as for continuous passive seismic data recording.

Two active 2D surveys that were acquired using shot lines in a close vicinity of the two monitoring wells have meanwhile been processed. A first analysis of these data already shows that the use of an array of buried receivers results in time-lapse data that offer a high S/N ratio, thereby suppressing both ambient noise and surface-related coherent noise. Therefore, this setup is expected to lead to an increased data repeatability as compared to conventional seismic acquisition with sensors mounted at the surface only.

The passive seismic data that were recorded continuously with the same array since September 2009 are exploited following two, largely different, approaches:

1)Spectral-ratio data pre-processing and back-projection of identified seismic events. This approach is data-driven and allows handling of variations in data quality caused by temporal and spatial changes in environmental site conditions. The first results are presented here whereby two months of data were investigated. The large majority of the identified events appears to originate from a single location at the surface. A few weak events originating from the subsurface have also been observed.
2)Testing of a new technique called ambient noise seismic interferometry: continuous passive noise registrations are correlated with each other to produce P-wave reflections as if these had been generated by active sources at the surface. Prior to performing the actual real-data correlations, a modeling study is currently carried out that is aimed at the assessment of the feasibility of using this technique for the monitoring of CO_2-migration paths in the Ketzin-subsurface. We present here the first results from this modeling study.