



Ketzin pilot site, Germany (photos: courtesy of GFZ).

At the Ketzin pilot site field measurements have been carried out by GFZ and CO₂ReMoVe project partners. The Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS, and the Bureau de Recherches Géologiques et Minières – BRGM, have been testing the performance of their instruments for geophysical surface and downhole investigations of CO₂ plume detection in the target reservoir zone of the Ketzin saline aquifer.

A pilot site in urban area

The storage site near the town of Ketzin is located close to the cities Berlin and Potsdam in Germany, in a populated environment. The location includes industrial and agricultural land, and its infrastructure makes it suitable as a testing site for underground injection of CO₂ into a deep saline aquifer. A field laboratory is developed with one injection well and two observation wells (50 m and 100 m distance), drilled to a depth of 750 m to 800 m. The focus of the Ketzin pilot site is on monitoring the fate of the injected CO₂ using a broad range of geophysical, geochemical and microbiological techniques. A major objective of this storage project is to provide operational field experience to aid in the development of harmonized regulatory frameworks and standards for CO₂ geological storage in Europe.

Challenging tasks

The CO₂ReMoVe geophysical field campaigns have been involved in the Ketzin monitoring concept, and carried out in combination with the surveillance program of the CO₂SINK/CO₂MAN projects. Joint activities helped to share personnel and technical resources e.g. the deployment of the heavy-weight lubricator technique which is highly recommended for downhole measurements in the pressurized observation wells.



Observation well Ktzi200 during preparation of the lubricator system for the downhole seismic measurements (photo: courtesy of GFZ).

Passive seismic measurements and Controlled Source Electromagnetics (CSEM)

In May 2008, the first measurements for passive seismic monitoring commenced, carried out by a team from OGS, before CO₂ injection started. This was to assess the noise level in the two observation wells and to test the borehole instrumentation. Repeats were carried out in autumn 2009, and also in February 2011 under pressurized conditions, with the help of the above mentioned lubricator, and with modified instrumentation. A 3-component highly sensitive downhole receiver was deployed for approximately 12 hours every night, while no active seismic or other site activities were taking place. To get an optimum data recording the passive survey was acquiring across a pressure change - i.e. injection stop and go regime of the CO₂ facility.

In addition, a team from BRGM installed an array of buried seismic broadband stations at four significant places around the site which have been continuously recording from summer to autumn 2009. A joint data evaluation from all these measurements could contribute to a deeper understanding about of the role of seismic passive monitoring to gain information on the state and dynamics of a reservoir in CCS monitoring projects.



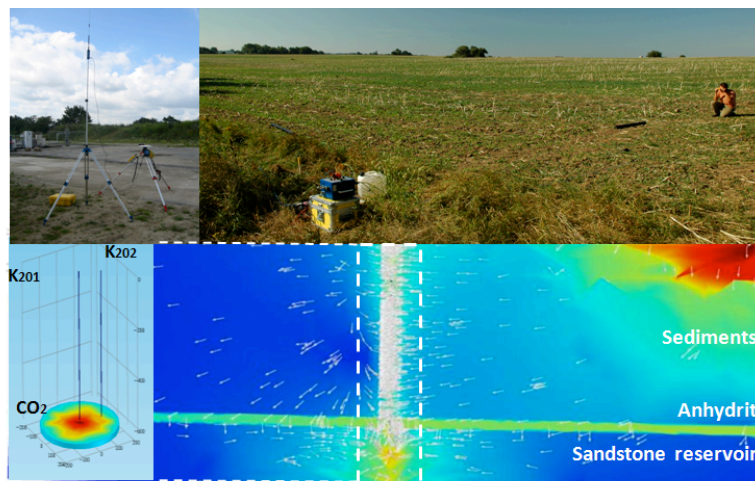
OGS transporter as mobile measurement cabin for the passive seismic recording via 3C-downhole receiver in observation well Ktzi202 (photo: courtesy of GFZ).



Buried broadband seismometer and isolation installation (photo: courtesy of BRGM).

Another geophysical approach was given by the **Controlled Source Electromagnetic (CSEM)** surveys, carried out by BRGM Orléans. The basic idea is to investigate the CO₂ plume by a grounded injection of electrical current through the three available metal-cased Ketzin wells which act as long electrodes, and to measure the resulting electric field at the surface. This concept has been designated as Long Electrode Mise-à-la-Masse (LEMAM).

A baseline measurement was carried out in summer 2008, followed by repeats in 2009 and 2010, and the data evaluation was performed in time-lapse mode. This field work contributes to the question addressed whether geoelectrical/Electromagnetic (EM) measurements can reliably track the CO₂ plume propagation. A joint data evaluation with other Ketzin Electrical Resistivity Tomography (ERT) measurements is still ongoing.



Receiver stations spread around the injection site are relocated by D-GPS (top-left) to measure the electric and magnetic field (top-right) generated at the ground surface by a hole-to-surface current injection (bottom) disturbed by the CO₂ injection (photo: courtesy of BRGM).

The above reported work was carried out under the EU-projects CO₂ReMoVe, CO₂GeoNet, and CO₂SINK.