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Seismic monitoring at the CO2SINK project site, Ketzin, Germany: Past, present and future.

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Storage of CO2 in saline aquifers is, perhaps, the most promising and relevant sequestration option for Europe. Saline aquifers are ubiquitous and their storage capacity exceeds that of depleted oil and gas fields. The CO2SINK project, officially started in April 2004, is aimed at developing an "in-situ laboratory" for CO2 storage to fill the gap between numerous conceptual engineering and scientific studies on geological storage and a full-fledged on-shore sequestration demonstration. Major objectives of the project are to (1) advance the understanding of the science and practical processes involved in underground storage of CO2 to reduce emissions of greenhouse gases to the atmosphere, (2) build confidence towards future European CO2 geological storage, and (3) provide operational field experience to aid in the development of harmonized regulatory frameworks and standards for CO2 geological storage. Three boreholes have now been drilled into the target Stuttgart formation on the southern flank of the Ketzin anticline, one injection well and two observation wells. Injection of CO2 at a rate of about 100 tons/day will begin in early 2008 at a depth of about 650 m and continue for about 2 years.

An important component of the project, and for geological storage of CO2, is monitoring the movement of injected CO2 using seismic methods. Seismic monitoring methods that will be applied include cross-well, vertical seismic profile (VSP), moving source profiling (MSP), 2D and 3D time lapse techniques. As a first step in the seismic program a 3D seismic survey with about 12 square km of sub-surface coverage was acquired in 2005 with the objectives of providing (1) if possible, an understand-

ing of the structural geometry for flow pathways within the reservoir, (2) a baseline for later evaluation of the time evolution of rock properties as CO2 is injected into the reservoir, and (3) detailed sub-surface images near the injection borehole for planning of the drilling operations. In addition to the 3D survey, seven 2D lines in a “star” configuration were acquired in 2005. During the autumn of 2007, baseline cross-well, VSP and MSP data will be acquired at the injection site. Cross-well seismics will be repeated several times in the early stages of the injection process to map the time evolution of the CO2 plume in the vicinity of the injection well. VSP and MSP acquisition will be repeated twice during the injection period to map migration of the CO2 away from the injection well. Repeat of the 2D “star” will be at the end of the injection period and will allow mapping of possible migration of the CO2 up towards the top of the anticline. Funding for a repeat 3D survey has been applied for and, if successful, will be acquired in 2010. Results from seismic modeling and dynamic modeling of the flow of the injected CO2 will be used when evaluating the time lapse seismics.