Geophysical Research Abstracts
Vol. 15, EGU2013-2852, 2013
EGU General Assembly 2013

3D hydro-mechanical scenario analysis to evaluate changes of the recent stress field as a result of geological CO_2 storage

Fabien Magri (1), Elena Tillner (1), Thomas Kempka (1), Wenqing Wang (2), Norihiro Watanabe (2), and Günter Zimmermann (1)

(1) Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences, Section 4.1, Reservoir Technologies, Potsdam, Germany (fabienma@gfz-potsdam.de, +49 331 288 28723), (2) Helmholtz Centre for Environmental Research UFZ Leipzig, Germany

CO_2 storage in deep saline aquifers is one of the strategies used to reduce greenhouse gas emissions into the atmosphere. However, pressure buildup due to the CO_2 injection process and subsequent pressure dissipation alter the recent stress field in and around the reservoir. These stress changes may lead to ground uplift, rock fracturing or fault reactivation. In order to study these phenomena by numerical simulations, flow and mechanical equations have to be solved together, requiring a hydro-mechanical coupling.

In the present study, a prospective CO_2 storage site located in the Northeast German Basin serves as 3D geological framework for a numerical evaluation of deformations and in situ stress changes induced by CO_2 injection into the Middle Bunter sandstone. For that purpose, two open-source simulators are coupled: TOUGH2 (Pruess et al., 1999) is applied to calculate reservoir pore pressures which are subsequently transferred into the hydro-geomechanical simulator OpenGeoSys (Wang et al., 2009) to solve the hydro-mechanical equations.

A scenario analysis was undertaken to evaluate the mechanical effects of CO_2 injection on the reservoir and caprock stability. The results show that under specific assumptions the vertical movement of the top reservoir is negligible. Furthermore, the changes in the recent stress field predicted by geomechanical modeling are limited to the surrounding of the injection well and not significant enough to endanger the mechanical stability of the reservoir and caprock considering the geological boundary conditions of the study area and the proposed injection scheme

The presented study demonstrates the hydro-mechanical effects of CO_2 storage in a well-constrained 3D geological regional-scale model based on the characterization of residual rocks, and can therefore be representative for CO_2 storage in the Northeast German Basin.

References

Pruess, K., C.M. Oldenburg, and G. Moridis, "TOUGH2 User's Guide, Version 2.0", Lawrence Berkeley National Laboratory, Berkeley, (1999), pp. 198.

Wang W, Kosakowski G, Kolditz O (2009) A parallel finite element scheme for thermo-hydro-mechanical (THM) coupled problems in porous media. Comput Geosci 35(8):1631–1641