Geophysical Research Abstracts
Vol. 19, EGU2017-16380, 2017
EGU General Assembly 2017


# Enhancing the revision of the static geological model of the Stuttgart Formation at the Ketzin pilot site by integration of reservoir simulations and 3D seismics

Thomas Kempka, Ben Norden, Alexandra Ivanova, and Stefan Lüth
GFZ German Research Centre for Geosciences, Potsdam, Germany (kempka@gfz-potsdam.de)

Pilot-scale carbon dioxide storage has been performed at the Ketzin pilot site in Germany from June 2007 to August 2013 with about 67 kt of $CO_2$ injected into the Upper Triassic Stuttgart Formation. In this context, the main aims focussed on verification of the technical feasibility of $CO_2$ storage in saline aquifers and development of efficient strategies for $CO_2$ behaviour monitoring and prediction.

A static geological model has been already developed at an early stage of this undertaking, and continuously revised with the availability of additional geological and operational data as well as by means of reservoir simulations, allowing for revisions in line with the efforts to achieve a solid history match in view of well bottomhole pressures and $CO_2$ arrival times at the observation wells. Three 3D seismic campaigns followed the 2005 3D seismic baseline in 2009, 2012 and 2015. Consequently, the interpreted seismic data on spatial $CO_2$ thickness distributions in the storage reservoir as well as seismic $CO_2$ detection limits from recent conformity studies enabled us to enhance the previous history-matching results by adding a spatial component to the previous observations, limited to points only.

For that purpose, we employed the latest version of the history-matched static geological reservoir model and revised the gridding scheme of the reservoir simulation model by coarsening and introducing local grid refinements at the areas of interest. Further measures to ensure computational efficiency included the application of the MUFITS reservoir simulator (BLACKOIL module) with PVT data derived from the MUFITS GASSTORE module. Observations considered in the inverse model calibration for a simulation time of about 5 years included well bottomhole pressures, $CO_2$ arrival times and seismically determined $CO_2$ thickness maps for 2009 and 2012. Pilot points were employed by means of the PEST++ inverse simulation framework to apply permeability multipliers, interpolated by kriging to the reservoir simulation model grid.

Our results exhibit an excellent well bottomhole pressure match, good agreement with the observed $CO_2$ arrival times at the observation wells, a reasonable agreement of the spatial $CO_2$ distribution with the $CO_2$ thickness maps derived from the 2009, 2012 and 2015 3D seismic campaigns as well as a good agreement with hydraulic tests conducted before $CO_2$ injection. Hence, the inversely determined permeability multipliers provide an excellent basis for further revision of the static geological model of the Stuttgart Formation.