Geophysical Research Abstracts, Vol. 9, 09345, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09345

Coupled hydromechanical modeling of the integrity and safety of geological storage of CO_2

M. Seyedi (1), N. Guy (1,2), J. Rohmer (1) and F. Hild (2)

(1) BRGM/ARN, Orléans, France, (2) LMT-Cachan, Cachan, France, (m.seyedi@brgm.fr / Fax: +33 2 38643689 / Phone: +33 2 38643408)

The storage of CO_2 in major geological formations such as oil and gas reservoirs, deep saline aquifers, unminable coal beds and deep oceans is a promising solution to decrease greenhouse effects from the emission of CO_2. However, it is not yet possible to predict with confidence storage volume, formation integrity and storage performance over long time periods.

The underground activities may modify the stress field and thus create negative consequences on the surface. The main goal of geomechanical modeling is to predict the (modified) stress and displacement state in the rock mass and to evaluate the potential induced damage at sealing unit level to the surface. The objective of the present work is to study the effects of CO_2 injection in deep geological formations on its mechanical response. Two different aspects are considered, namely, the potential damage induced in the caprock due to the stress field modification, and the global displacement of the formation especially at the surface level.

Large scale coupled hydromechanical finite element calculations were performed to evaluate the change in effective stresses due to gas injection for different initial in situ stresses. Results indicate that the most important process in hydromechanical behavior of the caprock is a general reduction of effective stresses, caused by the high-pressure injection of CO_2. A probabilistic damage model is used to study possible cracking of the caprock due the effective stress changes. The model takes into account the effects of material heterogeneity on the fracturing process. The effect of damage on the sealing properties of the caprock is discussed through different existing damage – permeability relationships. The effect of the induced non-linearity on the total displacement of the geological formation is also discussed through finite element calculations.