Geophysical Research Abstracts
Vol. 16, EGU2014-15984, 2014
EGU General Assembly 2014

Reactive transport modeling of leaking CO_2-enriched brine through fault zones taking into account the physical and geochemical interactions with calcite formation and the effects of porosity variations on the flow field

Nawaz Ahmad and Anders Worman

Civil and Architectural Engineering, KTH Rolal Institute of Technology, Stockholm, Sweden (nawaza@kth.se, +46-(0)8-790 6857)

One of the concerns related to CO_2 underground storage is the possibility of CO_2 leakage from the injection formation. Although CO_2 starts getting dissolved in brine after its injection in the reservoir there is risk of its leakage in dissolved form due to either increased reservoir pressure as a result of CO_2 injection or large-scale groundwater motion. The flow of brine through weaker zones like faults may cause the leakage of dissolved CO_2. The mobility and spreading of reactive solutes is however significantly affected by diffusion, sorption in the fault zone and the rock-matrix and geochemical reactions with the rock-forming minerals. This study presents the results of numerical modeling of leaking CO_2-enriched brine through a fault zone with physical and geochemical interactions with the neighboring limestone rock matrix over a period of 1000 years for 10m long fault zone with 2.5m wide rock matrix domain. Coupled geochemical reactive transport modeling is performed using COMSOL Multiphysics and MATLAB.

Calcite dissolution and precipitation are observed in the fault zone and the rock matrix, however, dissolution of calcite dominates the calcite precipitation in the rock matrix. Calcite dissolution/precipitation results in porosity variation in both the fault zone and the rock matrix mainly close to the bottom inlet boundary and along the fault zone. An intense dissolution of calcite is observed, in close vicinity of the fault inlet boundary, in the rock matrix which results in a cave like formation with porosity increasing to unity. A porosity decrease in the rock matrix is also observed due to calcite precipitation. In the fault zone, a cyclic porosity variation is observed due to a cyclic calcite dissolution and precipitation in the fault zone. Overall porosity increase is observed in the fault zone reaching to unity in some parts of the fault zone.

The variation in porosity is observed as posing strong effects on the flow field in the fault and the rock matrix. A decrease in vertical velocity in the fault zone is observed particularly at the inlet boundary due to calcite precipitation. Results are compared between diffusion dominated and advective, dispersive and diffusive flow regimes in the rock matrix. A complete sealing of the leakage pathway is expected to take place over longer period of time as a result of calcite precipitation due to leaking saturated brine from the storage reservoir.