Geophysical Research Abstracts
Vol. 13, EGU2011-11814, 2011
EGU General Assembly 2011

Modelling of novel tracers in a two-phase flow system for characterization of geologically stored CO2 in deep saline formations

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Geological storage of CO2 in deep saline formations is an attractive technology for the mitigation of greenhouse gas emissions to the atmosphere. Typically the storage formations are at depths of 800 to 3000 m below ground surface and access to these formations is limited to a small number of deep boreholes. Additionally, significant uncertainty in the geological properties and their spatial variation between the boreholes usually exists. Consequently, accurate monitoring of the spatial distribution of the injected CO2 and its migration and fate is highly challenging. At the same time, in-situ measurements of CO2 migration and trapping processes are crucial both in terms of improving our understanding of the fundamental phenomena as well as in commercial CO2 storage projects, in which monitoring of the injected CO2 is an important requirement.

As part of the EU FP7 MUSTANG project, a set of novel partitioning tracers is being developed and tested, specifically for the purpose of characterization of geologically stored CO2 and its phase partitioning and migration in deep saline formations. Due to reactive processes at the sc CO2 – brine phase interface, these tracers transfer from the sc CO2 phase to the aqueous phase and thereby carry with them information about the sc CO2 – brine active interfacial area, its development during the transport and the migration of the sc CO2 plume. Hence they constitute a potentially powerful tool for in-situ CO2 monitoring and research. However, for correct interpretation of the tracer signals, new simulation models which incorporate two-phase flow of sc CO2 and brine together with the phase partitioning, transport and reactions of the novel tracers are needed. This work presents the development and specifics of such a model, along with a demonstration on CO2 injection experiments to be carried out at the Heletz site, Israel.