Geophysical Research Abstracts
Vol. 13, EGU2011-12421-1, 2011
EGU General Assembly 2011

Reactive transport modeling of CO_2 injection into storage reservoirs: application to case-studies in The Netherlands

Tim Tambach (1), Mariene Gutierrez-Neri (2), Marielle Koenen (1), Frank Van Bergen (1), Henk Kooi (2), and Bert Van der Meer (1)

(1) TNO Geological Survey of The Netherlands, Sustainable Geo Energy, Utrecht, The Netherlands (tim.tambach@tno.nl), (2) VU University Amsterdam, Department of Hydrology and Geo-Environmental Sciences, Faculty of Earth & Life Sciences, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands

The Netherlands play a key role in Carbon Capture and Storage (CCS) implementation in northwestern Europe. Here, CO_2 sources and storage reservoirs are located at relatively short mutual distances and pipeline infrastructure is already in place for (cross-border) gas transport over large distances. Application of CCS within the next 5 years is promoted by the government, because of strong commitments to reach the emission reductions and maturing of the oil and gas production. It is expected that many fields will be abandoned in the coming two decades. After a field is abandoned, it will probably not be economically feasible to prepare it for CO_2 storage. The near-future application of CCS in the Netherlands requires standardized methodologies for the evaluation of the reservoir for HSE issues and accountability of the stored amount of CO_2, as for example requested by the European Directive on CCS and mandatory for government policy. The aim of this study is, by using real field examples, to bring the geochemical assessment of potential reservoirs from an academic approach to a methodology that can be used by policy-makers to grant licenses.

Due to the practical limitations involved in experimental observation of the *in situ* behavior of CO_2 in reservoirs, numerical models are frequently used for evaluating the short- and long-term effects. In this study reactive transport modeling (*TOUGHREACT*) is used for modeling the short- and long-term geochemical effects of CO_2 storage in potential reservoirs of The Netherlands that are selected for near-future storage. First, the composition of the formation water was defined by equilibrating the reservoir mineralogy with water and gas, not accounting for transport, at a given temperature and pressure. Then the geochemical composition was applied to a reservoir grid with cells that are in contact with each other. Small scale cells were constructed near the well-bore, to take a closer look at near-well effects.

During the short-term injection phase, dry-out of the near-well zone is observed and salt precipitation is computed. This occurs due to water uptake by the injected dry CO_2, which then flows into the reservoir. The impact of salt precipitation and the radius of the completely dried out zone around the well-bore depends on the water saturation, the amount of CO_2 that is injected, the salinity, and the total injection time. This radius is computed to be in the order of 10 to 100 m. In the dried out zone further dissolution and precipitation of mineral reactions stop taking place due to the absence of water. Salt precipitation can lead to serious injectivity problems.

The dissolution of CO_2 in the formation water, away from the dried out zone, leads to a relatively fast decrease in pH, from approximately 6.5 to 3.5. Subsequently, this decrease is slowly buffered by mineral dissolution throughout the reservoir, as well as mineral precipitation, porosity changes, and CO_2 trapping in several carbonate minerals (e.g. calcite, dolomite, dawsonite, siderite, and magnesite), thereby immobilizing the CO_2 and increasing storage security. Although quartz is predominantly present and relatively stable in most reservoirs, the initial composition of the other minerals in the reservoir is important for the specific mineral reactions that are taking place in the reservoir. The porosity and permeability changes away from the dried out zone are computed to be small up to hundreds of years. It is therefore not expected that any problems will occur with respect to the integrity of the reservoir within this time frame. Sufficient CPU time or smarter computational techniques are required for further predicting the long-term stability of CO_2 in potential storage reservoirs.