European Mineralogical Conference
Vol. 1, EMC2012-541, 2012
European Mineralogical Conference 2012

Geochemical and geomechanical effects on reservoir sandstones caused by the reaction of impure CO_2: an experimental approach to in-situ conditions in deep geological reservoirs

M. Schmidt, H. Marbler, K. Erickson, C. Lempp, and H. Poellmann

Martin-Luther-University Halle-Wittenberg, Institute for Geosciences, Halle, Germany (michael.schmidt@geo.uni-halle.de)

Within the German national project COORAL* the behaviour of reservoir sandstones from deep saline aquifers during the injection and geological storage of CO_2 with inherent impurities such as SOX, NOX and O_2 is studied in laboratory experiments. Samples are taken from outcrops of possible reservoir formations of Rotliegend and Bunter Sandstones from the North German Basin. A combination of geochemical/mineralogical autoclave experiments and geomechanical tests in a heatable triaxial cell was carried out on these rocks to study the potential effects of the impurities within the supercritical (sc)CO_2 pore fluid, compared to tne effects with pure scCO_2. Mineralogical alterations were observed within the sandstones after the exposure to scCO_2 with SOX/NOX/O_2 and brine, mainly of the carbonatic, but also of the silicatic cements, as well as of single minerals. Besides the partial solution effects, secondary mineral precipitations of carbonate and minor silicate minerals were observed on the surface and within the pore space of the treated sandstones. The evaluation of the chemical composition of the reaction fluid during the autoclave alteration experiments also indicate that dissolution and precipitation processes occur in the system fluid/rock/gas. The alterations affect the porosity and permeability of the treated sandstones and also weaken their grain-to-grain bonds. Results of geomechanical experiments on untreated samples indicate that the rock strength as well as the amount of injected scCO_2 is influenced by the chemical composition of the pore pressure fluid (scCO_2 + SOX/NOX/O_2). After long-term autoclave treatment with impure scCO_2, sandstone samples exhibit reduced strength parameters and modified deformation behaviour compared to untreated samples.

* The project “COORAL“ (“CO_2 Purity for Capture and Storage”; acronym derived from German project title) is supported by the German Federal Ministry of Economics and Technology on the basis of a decision by the German Bundestag. Third-party funding: Alstom, EnBW, E.ON, Vattenfall Europe, VNG.