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Geochemical and geomechanical behaviour of reservoir rocks during the injection of CO2 in deep geological formations: results of the project COORAL

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Within the COORAL* project we are investigating the impact of CO2 with inherent impurities such as SOX, NOX, O2 on the reservoir rocks during the injection and storage of CO2 in deep geological formations. To simulate in-situ conditions during CO2 storage, combined geochemical experiments in coupled autoclave systems and geomechanical tests in a heated triaxial pressure cell were carried out. Sample materials include outcrop sandstones of potential reservoir formations from the North German Basin. These sandstones were exposed to supercritical CO2 (scCO2) and brine in the autoclave system under defined P-T conditions. After the exposure to scCO2 and brine during long-term geochemical experiments alterations were observed within the matrix of the rock samples. Especially carbonatic, but also silicatic bound sandstones show dissolution effects of the cements as well as of single minerals. These effects may partly weaken the rock structure. Results of geomechanical experiments with alterated and unalterated sandstones clearly show a dependency of the maximum effective pressure of the rocks on confining pressure, pore fluid pressure and different degrees of rock saturation. The results also show that the rock strength behaviour changes with varying pore pressure media. Sandstone samples reveal reduced strength parameters after the treatment with scCO2 in the autoclave experiments as well as modified deformation behaviour compared to fresh samples. Furthermore a change in porosity was detected in these geochemically altered and triaxially loaded samples. During geochemical experiments secondary mineral precipitation reaction may also occur within the pore space. The experimental results indicate that already moderate increases of pore fluid pressure under constant confining pressure conditions may significantly lower the rock strength.

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