

Swelling of clays/shales to ensure underground storage

CO₂ Seal Integrity

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Due to their low permeability, shales trap hydrocarbons in the subsurface. They are expected to fulfil the same role when utilizing depleted reservoirs to store CO₂ underground. However, any pathway to surface must be sealed to control CO₂ leakage. The CO₂ Seal Integrity project investigates mechanisms to promote expansion of shales and seal their interface with plugs and/or along wells, e.g. by swelling of clay minerals. This limits the need for repair of the well cement sheath and/or eliminates the need for plugs. Samples from the Danish North Sea corresponding to the potential location of plugs are reconstituted to their in situ conditions (density, stress, pore-water chemistry) in large scale setups. Thereafter, a series of specimens are taken and subjected to changes in pore-water and stress conditions mimicking drilling operations. Finally, they undergo different treatments aimed at inducing expansion and/or swelling. Throughout the process expansion/contraction is measured at a macroscopic scale. Furthermore, microscopic characterization is performed by means of nuclear magnetic resonance spectroscopy and X-Rays diffraction analysis. The aim is to evaluate different sealing strategies and compare their efficiency in terms of performance and feasibility.