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CO_2 – Fluid – Rock interaction and its impact on petrophysical properties of reservoir rock samples

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Reservoirs are fine balanced systems, which might become sensitively perturbed by external influences. The injection of CO_2 into saline aquifers will result in a disturbance of both the hydrodynamic and chemical equilibrium of the reservoir and might – in the worst case – cause the damage of the formation, e.g. due to the migration of fines or scaling. The risk of fines migration is highest near the borehole, where the fluid velocity is highest. In greater distance from the well fines migration becomes more and more dominated by colloidal forces and depends increasingly on the water chemistry.
We have performed a long-term (5 months) experimental study on core percolation to evaluate the influence of CO_2 – fluid – rock interactions on the rock and fluid chemistry and on petrophysical properties. We have investigated reservoir rock samples from the Pakoslaw gas field (Poland) at in-situ conditions (Pconf = 390 bar, Ppore = 180 bar, T = 65°C). Our data show that a balanced system becomes disequilibrated due to the injection of CO_2 as the change of water chemistry stimulates the detachment of fines. Microprobe and XRD analyses, the determination of the permeability and measurements of the electrical formation resistivity factor point both to the dissolution of carbonate minerals and to a redistribution of clay particles from smaller capillaries into pore throats of larger voids.