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Interaction between non-wetting phase viscosity and rock heterogeneity in UK reservoirs

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The flow of supercritical CO_2 and brine in the subsurface is predicted to be strongly dependent on both the fluid properties and the heterogeneity of the pore space. However there are few laboratory studies that characterise the interaction between fluid properties and heterogeneity in real reservoir rocks.

We present the results of an experimental study measuring relative permeability of supercritical CO_2 and brine at reservoir conditions in sandstones. Measurements were performed on reservoir rocks or equivalent subsurface samples for current or planned CO_2 storage sites around the UK and Australia.

Samples from potential North Sea and East Irish Sea reservoirs are compared. The rock samples are all of high permeability (>500mD) and porosity (>12%), and are clean and homogeneous sandstones. Relative permeability is found to be highly sensitive to minor heterogeneities in pore structure at reservoir conditions that give rise to a low CO_2 viscosity, but is insensitive to brine salinity or interfacial tension. This suggests that the flow of CO_2 may be very different in similar reservoir lithologies as the impact of pore space heterogeneity on flow will vary with reservoir temperature and depth.

Experiments are performed at 8 – 20 MPa, 40 – 90°C and brine molalities of 0 – 5 mol/kg NaCl. Saturation is measured in situ, using a medical x-ray CT scanner, which allows the fluid arrangement to be observed at a resolution of 0.25x0.25x1mm.