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MODELLING AND DATA REQUIREMENTS FOR THE DESIGN OF CARBON DIOXIDE INJECTION

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Two different approaches for the rapid and effective entrapment of injected CO2 in aquifers and oilfields are proposed. The first is CO2 and brine injection followed by chase brine. The combined injection lowers the mobility contrast between the injected and displaced fluids, giving a better penetration (sweep) of the reservoir, while the chase brine rapidly traps the CO2 as a residual phase. The second approach is the use of CO2 injection in giant fractured aquifers. Here the CO2 rapidly channels through the fracture network, presenting a huge surface area to the matrix for dissolution mediated by molecular diffusion through the matrix. This process is governed by a characteristic timescale, typically of order a few days, beyond which dissolution becomes the dominant transport mechanism.

Both injection designs are discussed with the aid of analytical and numerical solutions using representative three-dimensional reservoir models. The limitations in terms of data requirements are discussed and work in progress to address these problems is presented. Specifically, the amount of trapped CO2 as a function of the initial CO2 saturation is very poorly predicted using current models implemented in simulators. Furthermore, the connectivity and extent of the fractures, coupled with the effective diffusion coefficient of CO2 in brine governs storage in fractured domains. An approach to this challenge using a combination of experimental and numerical approaches over several scales, from pore-scale analysis to field trials, is outlined.