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Caprock effects of geological sequestration of carbon dioxide

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Elevated concentrations of anthropogenically sourced greenhouse gases in the atmosphere since the industrial revolution, particularly CO2, have been strongly implicated as a cause of global warming. Options to reduce emissions include injection of industrially produced CO2 into geological reservoirs for long term storage. The subsurface storage of CO2 can only work if there is closure to structure intended to trap it, part of which requires a sealing caprock, commonly a low permeability mudstone.

Subsurface storage of CO2 is a recent and novel proposal. As such there is a lack of data pertaining to geochemical reactions and their effects caused by storage. Our geochemical modeling has shown that dissolution of CO2 in reservoir formation water will lead to pH as low as 3. Acidic conditions could cause various geochemical reactions with the caprock. In turn these could potentially change a caprocks physical properties, such as permeability and porosity and promote the leakage of CO2 from the structure. There is a particular paucity of information relating these reactions, however evidence from enhanced oil recovery, experimental studies, and field trials indicate possible reactions including carbonate mineral dissolution, and feldspar and clay alteration reactions. Although the majority of these studies concentrate on the host formation rather than the caprock, the reactions could be indicative of caprock reactions.

Little work has been conducted on the effects of CO2 storage on cap rock properties. We plan to address this problem experimentally. Caprock samples recovered from a CO2 injection pilot scheme will be placed under confining pressures of up to 100

MPa, simulating pressure conditions at depth. Water and acidic CO2 / water mixes will be fed through the sample over prolonged time periods (days to weeks) using servo-controlled pumps at either end of the sample. Continuous measurement of flow rate and pressure difference across the sample during the experiment will be used to monitor any temporal porosity and permeability changes with progression of the experiment and hence geochemical reaction. Analysis of samples, using techniques such as XRD, CL and SEM at various points in their dissolution history will quantify the types and rates of geochemical reactions and their effects on the physical properties of the rock.

This poster contribution describes the scope of the problem to be tackled, defines the key issues that motivate the current investigation and outlines our experimental approach, and initial mudstone characterisation and properties results.