**Carbon Storage**

**Integrating Experiments & Modelling to Quantify Trapping Capacity & Efficiency in the Subsurface**

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**MEASURING TRAPPING CAPACITY**

This is a fundamental study of trapping of non-wetting fluids in porous media. When injecting CO₂ into an aquifer for carbon storage, the non-wetting phase (CO₂) is trapped due to capillary forces.

**MOTIVATION**

Capillary trapping is one of the quickest and most secure means to render CO₂ immobile.

Water, the wetting phase, displaces CO₂ and leaves behind disconnected ganglia of CO₂ in pores:
- rock matrix: green
- water: grey
- CO₂: blue

How much CO₂ is trapped?
How does trapping vary with initial CO₂ saturation?

**EXPERIMENTS**

Horizontal and vertical core floods with analogue fluids.

Oil/water system - oil density similar to scCO₂ density.
Gas/water system - gas viscosity similar to scCO₂ viscosity.

![Micro-CT image of capillary trapping](image)

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**MODELLING TRAPPING EFFICIENCY**

Design an injection strategy to maximise CO₂ storage capacity and efficiency on the field scale - incorporating experimental and pore scale modelling results.
Streamline based simulator modified for this purpose.

![Streamline based simulator](image)

The ratio of the mobility of injected brine and CO₂ to the formation brine as a function of the injected CO₂ phase volume fraction, f_CO₂.

Once CO₂ injection ceases the reservoir is waterflooded. Due to the mobility contrast the waterflood front catches up with the CO₂. This process results in CO₂ being trapped on the pore scale as a residual phase.

**Experimental Results showing the oil/water and gas/water trapping curves**

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Two years after chase water injection
Trapping efficiency = 95%

In other words 95% of the injected CO₂ is rendered immobile through capillary trapping or dissolution.

Only 5% of injected CO₂ is reliant upon hydrodynamic trapping below an impermeable cap rock.

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**SPE 10 reservoir model, 1,200,000 grid cells (60 x 220 x 85), 7.8 Mt CO₂ injected.**

Our work on the design of an injection strategy implies that we can safely store carbon dioxide deep underground.

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