

[Objective of the research]

This research is carried out at the Laboratory of Soil Mechanics at the EPFL within the phase 24 of the CS-C project with the objective of better understanding the caprock material.

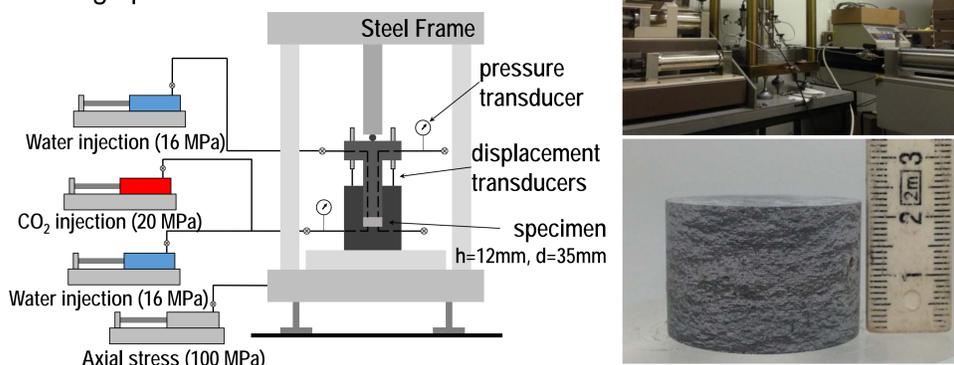
Opalinus Clay (OPA) is often used for studying the behaviour of caprocks as it demonstrates the traits of a proper caprock material for geological CO₂ storage. The OPA samples cored from Mont terri URL contained a thin section of highly concentrated carbonates. Clay-rich OPA was reported to be chemically inert to CO₂, however, since carbonate minerals are highly reactive to acid, the geomechanical response of carbonate-rich OPA (CAR-OPA) to CO₂ was investigated.

To observe the effect of CO₂ on the CAR-OPA, evolution of permeability with CO₂ exposure and spontaneous displacement during CO₂ injection was monitored.

[Experimental scheme]

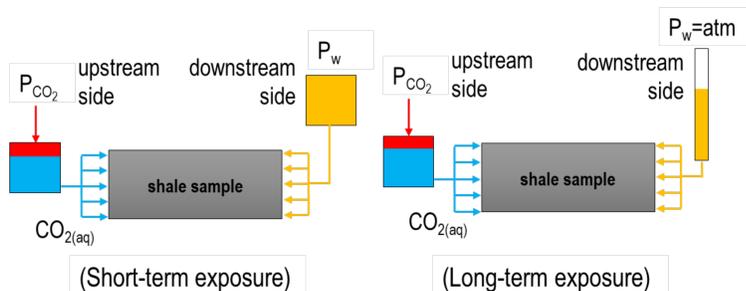
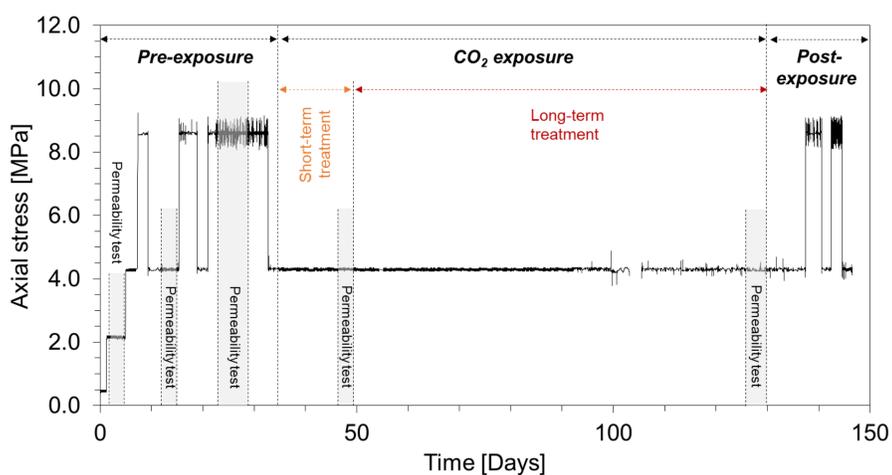
□ Apparatus:

High pressure Oedometer cell



□ Experimental procedure:

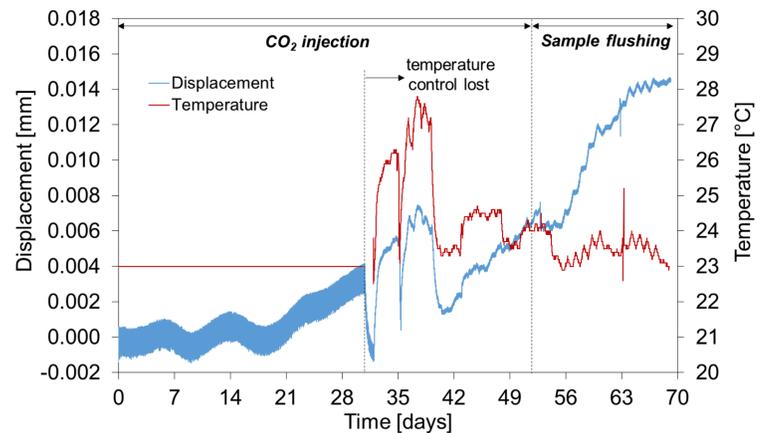
- Pre-exposure phase
 - 1) Saturation of the sample under constant stress state
 - 2) Loading to $\sigma_a = 2.1, 4.3, 8.6$ MPa of total axial stress with pore pressure of 1.0 MPa
 - 3) Constant head permeability test each stress state
- CO₂ exposure phase
 - 1) Short-term exposure followed by constant head permeability test
 - 2) Long-term exposure followed by constant head permeability test
 - 3) Injection of CO₂ under $\sigma_a = 4.3$ MPa
- Post-exposure phase
 - 1) Reloading-unloading cycles from 4.3 to 8.6 MPa



[Results]

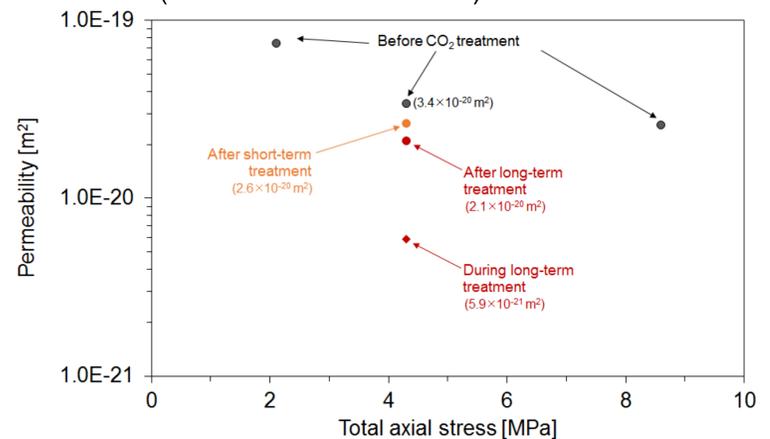
□ Displacement measured during long-term injection

- Compaction continued until the sample flushing stage
- Total compaction 14μm (irreversible)
- Recorded displacement responds sensitive to temperature



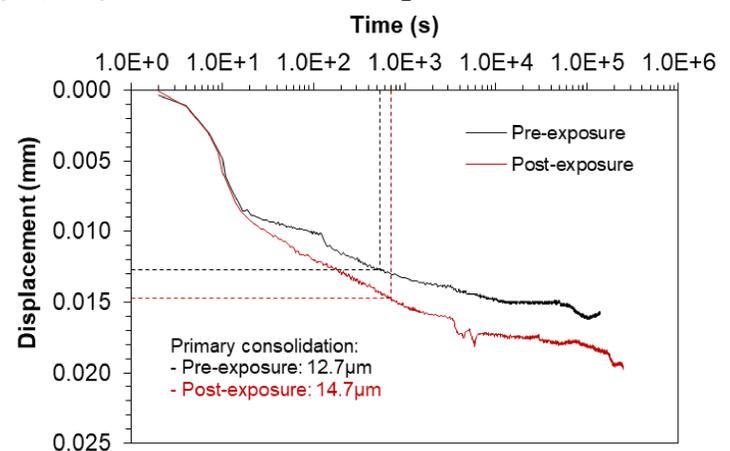
□ Permeability measurement

- Slight decrease in permeability measurements, using deaerated water, after each treatment
- Permeability measured during the long-term CO₂ injection stage is much lower (fluid is carbonated water)



□ Compression curve pre and post-exposure

- Slightly larger compaction after CO₂ exposure



[Discussion]

- Permeability measured during the long-term injection can be due to the difference in physical properties (density and viscosity) which the values were unable to measure during the experiment.
- The response to temperature may be the response of the sample itself or the system compliance

[Summary]

- Permeability was not significantly affected by the CO₂ injection
- Irreversible displacement was monitored
- Slightly larger compaction after CO₂ exposure
- The experiment reacts sensitive to the surrounding temperature

[Acknowledgements]

- The financial support of Swisstopo is acknowledged.