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## Using rock physics to monitor CO<sub>2</sub> content and stiffness of chalk during CO<sub>2</sub> injection and water flooding experiments in triaxial rock-mechanical setup

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Depleted chalk fields in the North Sea Basin are under consideration for CO<sub>2</sub> storage. The advantage being huge pore volume, distance to inhabited areas and already existing infrastructure. A disadvantage could be the solubility of carbonates in carbonic acid causing concern for frame softening and consequent potential for pore collapse or fracturing. In order to evaluate the feasibility, chalk samples were tested in a triaxial rock-mechanical setup fitted with ultrasonic wave transducers.

Supercritical CO<sub>2</sub> was injected into water-saturated chalk under fixed stress ratio ( $\sigma_R/\sigma_A$ ), SR, of 0.35, followed by waterflooding at constant stress below pore collapse stress, with creep phases in between. The procedure was done three times. Each sample was then brought to pore collapse at constant axial strain rate. Strain was monitored by LVDT and strain gauges. Velocity of ultrasonic waves were measured throughout. A corresponding sample was tested in a separate setup for clarifying geochemical effects.

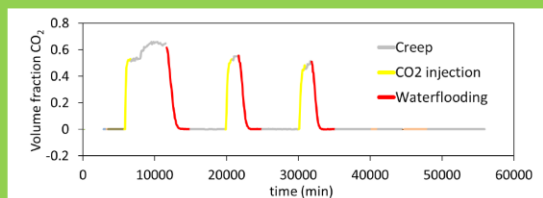
### We find:

Up to 65% of the pore space becomes saturated with CO<sub>2</sub> upon CO<sub>2</sub> injection.

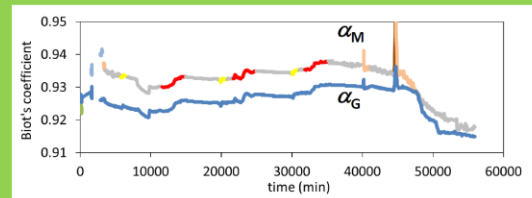
No indication of residual CO<sub>2</sub> after water flooding.

CO<sub>2</sub> injection followed by water flooding causes Biot's coefficient,  $\alpha$ , to increase, indicating softening of the chalk frame. The softening is partially reversed during creep phases, and the net-increase in  $\alpha$  is small.

The subsequent pore collapse and compaction of the chalk caused by increasing stress, causes Biot's coefficient to decrease to lower values than before CO<sub>2</sub> injection as an indication of work hardening.



CO<sub>2</sub> saturation



Biot's coefficient