

CO₂ storage research in the Czech Republic: Fundamentals for understanding of CO₂ migration and interaction processes

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Potential CO₂ storage host rock options in the Czech Republic: Deep saline aquifers, hydrocarbon fields, coal measures

Main potential: SALINE AQUIFERS

Central Bohemian Permian-Carboniferous basins



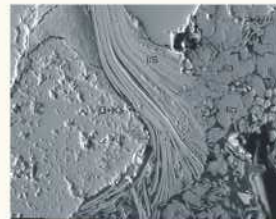
Neogene sedimentary complex of the Carpathians



Example of the potential storage rock:
Sandstone (Carboniferous, Central
Bohemian Basin, well Cvrčovice)



Example of the potential cap rock:
Claystone (Neogene, Carpathian
Foredeep)



Example of sample analyses: Siliceous
sandstone (well Brány, depth 1115 m,
Central Bohemian Basin): Kf – feldspar, Ka –
carbonates, Q – quartz, I/S – illite/smectite

Understanding of migration/interaction processes in the system of supercritical CO₂ - rock - groundwater

ROCK SAMPLES (archive + new shallow analogue borehole)

Rock characterisation, mineral
content determination:
XRD, HREM.

GROUNDWATER

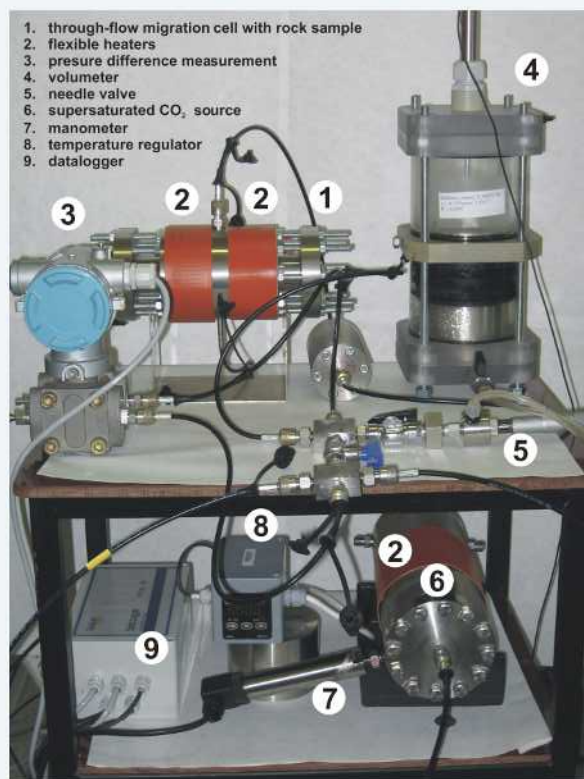
Representative saline water data
determination from depth higher
than 800 m (Permian-Carboniferous
basins) on the base of 10 GW
analyses.

Supercritical CO₂

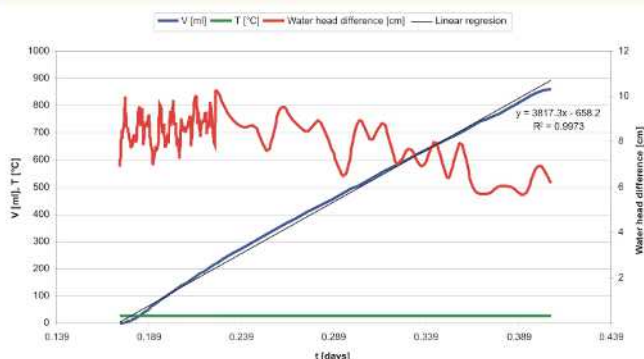
STATIC INTERACTION EXPERIMENTS WITH ROCK SAMPLES

(under $p(\text{CO}_2) > 75$ bar, $T = 31 - 35$ °C)
To study mineralogical changes due
to long term supercritical CO₂-rock
interaction. To be started in 2011.

Dynamic flow-through experiments with rock samples Laboratory high pressure apparatus constructed in Waste Disposal Dept., NRI Rez



PILOT TEST1: Influence of CO₂ exposure on rock permeability



Example of CO₂ flow-through experiment: CO₂ flow through the sample after permeability measurement. Experiment parameters: $p = 3$ bar, no heating, sample saturated with demi water. Rock sample: Tertiary sandstone from the Hrusky site; Q, dolomite, calcite, plagioclase, feldspar, chlorite, mica; $r = 40$ mm, $h = 50$

High pressure migration apparatus: constructed in 2010, tested in 2011. Based on migration chamber where sample is emplaced. Sealing is affected by applying a confining pressure, higher than pore liquid pressure. CO₂ is pressurised and heated in the gas exchanger and after reaching supercritical state is enabled to migrate through the sample. The pressure difference is measured between chamber entrance and exit.

Sample hydraulic conductivity for water was measured prior, ensuring full water saturation of the sample: $k_w = 1.6 \times 10^{-5}$ m/s. Pressurised CO₂ (3 bar) was pushed through the sandstone, saturated with water. No permeability was measured for the sample after CO₂ exposure – pores clogged with newly formed phases? Mineralogy analyses of newly formed phases is on the way.

FURTHER RESEARCH: PILOT TEST 2

Successful pressurisation of CO₂ up to supercritical state ($p = 80$ bar; $T = 33$ °C) was reached during second pilot tests. A series of experiments with rock samples and representative saline groundwater is under preparation.

References

Hladík V., Kolečka V., Lojka R., Fott P., Vácha D. (2008): CO₂ emissions and geological storage possibilities in the Czech Republic. Slovak Geological Magazine, pp 29-41.

Acknowledgement

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