MiReCOL: developing corrective measures for CO$_2$ storage

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Significant irregularities?
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Nagylengyel, Hungary, 1998
Currently available techniques

- Existing techniques
  - Pressure management
  - Back production of CO₂
  - Well remediation techniques
MiReCOL objective

➤ To develop a toolbox of techniques available to mitigate / remediate undesired migration or leakage of CO$_2$
  ➤ Support the definition of corrective measures plans
  ➤ Help building confidence in deep subsurface storage of CO$_2$
Project approach

1. Create an inventory of *existing* remediation techniques
   ➔ Study merit for number of real / realistic storage complexes, e.g.:
     ➔ Fluid migration control through pressure management
     ➔ Remediation techniques for leakage along well

2. Add *new* remediation techniques
   ➔ Study merit for number of real / realistic storage complexes, e.g.:
     ➔ Sealants
     ➔ Smart materials in wells

3. Focus is on mitigation and remediation techniques in **deep subsurface**
   ➔ Corrective measures in (near-) surface region: use literature overview and other projects
Project approach

Central concept is **risk level**

Merit of mitigation or remediation technique is obtained by establishing overall risk level *before* and *after* deployment of the technique

- **Unmitigated risk** (i.e., threat or leak has occurred, but no action is taken)

- **Mitigated risk** (i.e., residual risk of threat or leak after deployment of mitigation or remediation technique, plus the impact of the deployment of the technique on the risk level of the storage site)

A mitigating or remediating action should be taken only when the mitigated risk is lower than the unmitigated risk
Project approach

- **Site specificity vs general guidelines**
  - The details of threats to safe and secure storage, and of leakage events are strongly *site specific*, and so are the options to mitigate or remediate.
  - The project will study mitigation and remediation techniques on a range of real or realistic storage complexes, to derive a range of *site-specific results*, from which more general conclusions will be drawn.
Example: back production

Gas back production data at K12-B.
Data used to assess feasibility of back-producing injected CO₂ as corrective measure

Installations at Ketzin (Germany)
For back-production test.
Data to be used to assess feasibility
Of back producing stored CO₂.

Picture courtesy T. Kollersberger, GFZ
Example: flow diversion

- **Side view**
  - Horizontal well: $k = 5\text{mD}$
  - Hydraulic fracture
  - $CO_2$ injection: $k = 100\text{mD}$

- **Top view**
  - Fault plane
  - Horizontal well
  - Fracture
  - 100m
Example:
Flow diversion

Pressure developments both segments

- 9P Pressure leak seg., BASECASE
- 9P Pressure mon. seg., BASECASE
- 9P Pressure leak seg., CASE_J30_D5_K01
- 9P Pressure mon. seg., CASE_J30_D5_K01

Cum Gas leakage (M3)

- Cum leakage, BASECASE
- Cum Gas leakage, CASE_J30_D5_K01

Gas Rate leakage, BASECASE
- Gas Rate leakage, CASE_J30_D5_K01
Result of the project

- "Handbook" of remediation and mitigation options that can be applied in different parts of storage complex, against various leakage scenarios.
  - Handbook to inform operators, regulators, public
  - Results in handbook based on modelling for specific sites, to illustrate value of remediation & mitigation options

- The Handbook will also be implemented in a web-based tool that allows easy access to the project’s results
  - This tool will also support operators in setting up a corrective measures program
MiReCOL – results, handbook

Stakeholder input required

Project started March 2015, now in second year
Technical results available at and of year 2 (March 2016)

Year 3 of project:
- Formulate guidelines for mitigation / remediation measures
- Write / implement Handbook

MiReCOL & CCS projects, stakeholders
- Interaction needed to optimise Handbook
- ‘Event’ around March 2016
  - Presentation of results
  - Proposal for Handbook
  - Discussion with stakeholders

Please contact us!
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Mitigation and Remediation of CO$_2$ Leakage

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Mitigation and remediation of leakage from geological storage

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