ECCSEL Workshop
Underground laboratories for CO₂ geological storage research
5-6 June 2019, Nancy, France

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CO$_2$ Capture and Storage (CCS), a key climate change mitigation technology

Storing CO$_2$ underground:
- to reduce emissions from fossil-fuel power plants and carbon-heavy industries (steel and cement plants…)
- to achieve negative emissions, e.g. where CCS is applied to bio-energy plants, as the growing biomass removed CO$_2$ from the atmosphere

3 steps:
- Capture
- Transport
- Storage

= Returning the carbon back into the underground!
Mission Innovation report mentions the usefulness of using Underground Labs to address research priorities.

### Prioritized Research Directions (PRDs) for CO₂ Storage

<table>
<thead>
<tr>
<th>Priority</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S-1</td>
<td>Advancing multiphysics and multiscale fluid flow to achieve gigatonne/year capacity</td>
</tr>
<tr>
<td>S-2</td>
<td>Understanding dynamic pressure limits for gigatonne-scale CO₂ injection</td>
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<tr>
<td>S-3</td>
<td>Optimizing injection of CO₂ by control of the near-well environment</td>
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<tr>
<td>S-4</td>
<td>Developing smart convergence monitoring to demonstrate containment and enable storage site closure</td>
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<td>S-5</td>
<td>Realizing smart monitoring to assess anomalies and provide assurance</td>
</tr>
<tr>
<td>S-6</td>
<td>Improving characterization of fault and fracture systems</td>
</tr>
<tr>
<td>S-7</td>
<td>Achieving next-generation seismic risk forecasting</td>
</tr>
<tr>
<td>S-8</td>
<td>Locating, evaluating, and remediating existing and abandoned wells</td>
</tr>
<tr>
<td>S-9</td>
<td>Establishing, demonstrating, and forecasting well integrity</td>
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</tbody>
</table>
Some extracts from the Mission Innovation CCUS report

- Improve understanding of induced fractures (hydraulic and thermal) and other near-well treatments to enhance injectivity using combined laboratory, theoretical, and field research including the use of underground laboratories (e.g., the US Sanford Underground Research Facility or the Swiss Mont Terri and Grimsel laboratories).

- In situ experiments and underground laboratory experiments on fault properties and their evolution under stress may allow the development of new fault-displacement tools and new fault-property measurement tools. The collective advances in technology in this research field are needed to support gigatonne/year–scale CO₂ injection.
ECCSEL research facilities in Europe are available for access by worldwide scientists to address PRDs

ECCSEL ERIC
legal entity

- **5 countries**
  Norway, France, Italy, Netherlands, UK

- **15 owners**

- **54 research facilities**

- **1 of them is an underground lab**: [URL-Andra](http://www.eccsel.org)
The ECCSEL Workshop on Underground Laboratories

- **Objective:** Encourage researchers to use URL-Andra unique research facility to address PRDs

- **Programme:**
  - **Wednesday 5 June:** Visit to the URL-Andra Underground Research Lab in Bure
  - **Thursday 6 June:** Workshop in Nancy
    - Overview of current research at underground laboratories, either directly linked or that could inspire CO₂ storage research
    - Brainstorming/Break-out sessions: Ideas for experiments at URL-Andra

<table>
<thead>
<tr>
<th>Underground research laboratories</th>
<th>Country</th>
<th>Rock type</th>
<th>Depth (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>URL-Andra</td>
<td>France</td>
<td>clay</td>
<td>420-600</td>
</tr>
<tr>
<td>Tournemire</td>
<td>France</td>
<td>clay</td>
<td>200-250</td>
</tr>
<tr>
<td>Mol (HADES)</td>
<td>Belgium</td>
<td>clay</td>
<td>225</td>
</tr>
<tr>
<td>Mont Terri</td>
<td>Switzerland</td>
<td>clay</td>
<td>300</td>
</tr>
<tr>
<td>LSBB</td>
<td>France</td>
<td>carbonates</td>
<td>0-518</td>
</tr>
<tr>
<td>Grimsel</td>
<td>Switzerland</td>
<td>granite</td>
<td>450</td>
</tr>
<tr>
<td>Sanford Underground Research Facility</td>
<td>USA</td>
<td>schists</td>
<td>1500 max</td>
</tr>
</tbody>
</table>
Agenda – 6 June 2019

- **08:50 Welcome address** – Jacques Pironon, Head of GeoRessources laboratory (Université de Lorraine – CNRS) and scientific leader of the DEEPSURF project
- **09:00 Introduction to the Workshop** – Isabelle Czernichowski-Lauriol, ECCSEL French node Coordinator, BRGM, France
- **09:10 Presentation of ECCSEL** – Volker Röhling, ECCSEL ERIC Manager, Norway
- **09:30 Overview of existing underground facilities and current research** – Chair: Sébastien Dupraz, ECCSEL ERIC Operations Centre & BRGM, France
  - **09:30-10:00 Current research in LS-Andra Underground Lab and implications for CO₂ storage research** - Rémi de La Vaissière and Agnès Vinsot, Andra, France  (20 min + 10 min questions)
  - **10:00-10:30 Coffee break**
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- 10:30-10:50 **Well integrity** assessment by a 1:1 scale wellbore experiment in the Mont Terri Underground Rock Laboratory: temperature and pressure stresses, exposition to dissolved CO₂ and overcoring – *Pascal Audigane* (BRGM, France) et al.

- 10:50-11:10 **ELEGANCY CS-D** at Mont Terri in Switzerland: an in-situ experiment to monitor caprock and fault sealing integrity - *Alba Zappone* (ETHZ, Switzerland) et al.

- 11:10-11:30 **CO₂ Long-term Periodic Injection** Experiment at the Underground Rock Laboratory, Mont Terri - *Dorothee Rebscher* (BGR, Germany) et al.

- 11:30-11:50 **Water-rock processes** in deep geological storage of wastes and energy: experimental approaches and model predictions - *Jordi Bruno* et al. (Amphos 21 Consulting S.L., Spain)

- 11:50-12:00 **Discussion** – Chaired by Sébastien Dupraz, ECCSEL ERIC Operation Centre & BRGM
Agenda – 6 June 2019

- 13:00-15:00 Brainstorming session: “Underground Pub”
  *Ideas for experiments at LS-Andra for advancing CO₂ storage research*

- 15:00-15:30 Coffee break

- 15:30-16:10 Feedback from break-out sessions

- 16:10-16:30 Conclusions and closure
  
  Sébastien Dupraz, ECCSEL ERIC Operations Centre & BRGM
  Emilia Huret, Deputy Director of Research and Development, Andra
  Volker Röhling, ECCSEL ERIC Manager
Some figures

- 45 registered persons
  - Australia: 2
  - Egypt: 1
  - France: 26
  - Germany: 1
  - Italy: 5
  - Norway: 2
  - Poland: 1
  - Spain: 2
  - Switzerland: 3
  - UK: 2

- D-Day in Lorraine to brainstorm!

- …75 years after the D-Day in Normandy

- To fight climate change

- Have a fruitful and pleasant Day!