Embrace differences!
WELCOME ADDRESS: J. PIRONON

head of GeoRessources
Key numbers

INITIAL EDUCATION
>60,000 Students
16% international students

BUDGET
620 million €

HUMAN RESOURCES
3900 Faculty
3000 Technical & Admin Staff

FACILITIES
53 locations in Lorraine
900,000 m² for 262 buildings

FACILITIES
60 libraries

INITIAL EDUCATION
Founded in 1572
Merger of 4 former universities in 2012

RESEARCH
60 research centers
175 patent families
1860 PhD students
14% international joint PhDs
1/3 of scientific publications are co-written with foreign scientists

About 12,000 students involved in entrepreneurship programs

11/07/2019
10 Scientific areas & 60 research centers

- Agronomy, food, forest
- Geosciences
- Biology, medicine, health
- Chemistry and molecular physics
- Energy, mechanics, process, products
- Matter, materials, metallurgy, mechanics
- Computer science, automation, control, electronics, mathematics
- Knowledge, language, communication, societies
- Law and economy sciences, politics, management
- Time, spaces, literature, languages
<table>
<thead>
<tr>
<th>Topic</th>
<th>2018 France ranking</th>
<th>2018 World ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mining &amp; mineral engineering</td>
<td>1</td>
<td>24</td>
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<tr>
<td>Automation &amp; Control</td>
<td>2</td>
<td>39</td>
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<td>Metallurgical engineering</td>
<td>3</td>
<td>48</td>
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<td>Public health</td>
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<td>50</td>
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<tr>
<td>Chemical Engineering</td>
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<td>76-100</td>
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<tr>
<td>Mechanical Engineering</td>
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<td>76-100</td>
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<tr>
<td>Agricultural Sciences</td>
<td>5-6</td>
<td>76-100</td>
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<td>Earth Sciences</td>
<td>11-16</td>
<td>101-150</td>
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<td>Mathematics</td>
<td>17-21</td>
<td>101-150</td>
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<tr>
<td>Materials Science &amp; Eng.</td>
<td>7-12</td>
<td>151-200</td>
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<tr>
<td>Food Science &amp; Technology</td>
<td>5-9</td>
<td>151-200</td>
</tr>
<tr>
<td>Clinical Medicine</td>
<td>7-8</td>
<td>151-200</td>
</tr>
</tbody>
</table>
objectives:

• Develop new processes for separation
• Check different ways for enhanced recovery
• Develop efficient tools for quantitative CO$_2$ + annex gas analysis
• Propose solutions for on line and in situ long term analysis
• Compare surface and deep analysis of natural analogues
• Develop experiments in lab to simulate chemical and mechanical behaviors
• Integrate society perception, economic and legal contexts, history...
UL at the heart of the challenges of scientific research

Capture and transport of CO₂
- CO₂ injection
- Composition gradient (pH, redox)
- Fluid-rock interactions
- Pressure gradient
- Temperature gradient
- Geological storage
- Puits
- Cap rock
- Reservoir
- Sandstones, Limestones
- Geomodelling
- PVT, solubilities, corrosion
- Durability of well materials
- Cap-rock integrity
- Monitoring
- Environment
- Process
- PVT properties, separation, LCA

And the man in all of that
- Legislation, acceptability, economy, impact on territories
- Process
- Sandstones, Limestones
- Geomodelling
- Reservoir
- Puits
- Cap rock
- Environment
- Process
- PVT properties, separation, LCA

35 to 70°C
50 to 150°C
Carbon capture (CCUS) projects: Highlights

**Membrane gas separations**
- High performance membranes for CCS (FP7 Hipercap & M4CO2)
- Steel furnaces flue gases CCU (VALORCO Arcelor Mittal, H2020 C2FUEL)
- Process modelling (MEMSIC & MIND softwares) and optimal design tools

**Intensified absorption processes for post-combustion capture:**
- High flux dense skin composite fibers (ANR Cicadi)
- Pilot membrane contactor design and test (FP7 CESAR)
- MC for chilled ammonia CC and bicarbonate CCU (ANR Amélie and C2B)
- Pilot absorption unit for gas boiler plants (ANR Energicapt)
From the concept to the pilot

The « CO2 dissolved » project
how to couple CO₂ storage with geothermal energy?

Hyperthermal platform at GeoRessources

Wormholes » in limestone after injection of CO₂ brine (X-Ray tomography)
LORRAINE
Université d’Excellence
The objectives of the LUE initiative are to develop the international leadership of the Lorraine site, on engineering taken in a systemic sense around 6 major economic and societal challenges.
Towards a shared use of the soil and the subsoil in an energy goal

- gas
- intermittence of renewables
- nuclear
- biomass
- CCS
DEEPSURF

- technological solutions (biosensors, miniaturized geochemical and geophysical sensors, intelligent samplers)

- Database acquisitions on matter and heat transfer processes and definitions of laws of behavior to evaluate the consequences of the transfers

- Propose a generic method (i.e. adaptable to other regions of France) to help decision on energy
Thank you

Embrace differences!
Pilot for CCS in Lacq (France): capture and storage integrated project

Boilers with oxycombustion of Lacq

Injection well at Rousse