CO2 capture, transport and storage research facilities from the French node of ECCSEL available for access by the European scientific community

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ABSTRACT

ECCSEL, the European Research Infrastructure on Carbon Dioxide Capture and Storage, has been initiated in 2010 and is being transformed into a European Research Infrastructure Consortium (ERIC), a legal entity with statutory seat in Trondheim, Norway. The objective is to establish and operate world-class distributed research facilities and give the European CCS community (primarily), and non-European CCS communities access to these resources..

France, a founding member of the ECCSEL ERIC, is offering access to several outstanding research facilities: one CO_2 capture pilot, one CO_2 transport platform, one underground laboratory, one site for shallow CO_2 injection experiments, one bio-reactor at high temperatures and pressures, one mobile equipment for gas measurements on site, one laboratory for advanced gas analyses. In addition, a semi-industrial CO_2 transport loop is being designed.

EDF's CO_2 Capture Pilot, Le Havre

This pilot is a rare post-combustion CO_2 capture pilot in an operational 600 MW coal-fired power plant in Europe. The CO_2 contained in the flue gas is 12 vol% and the facility can capture 25 t CO_2/day (or less). The present equipment is a 'classical' solvent based process pilot. It can be adapted to host different post-combustion capture processes, with minor modifications for solvent-based processes, more important for other processes.

INERIS's CO_2 Transport Platform, Mont La Ville

This platform enables to manage gases under high pressures (between 100 and 200 bars) and to simulate gas leakages or breaches on pipes with diameters of 1 to 3 inches, to study:
- The flow upstream the breach and the various possible flow regimes,
- The characteristics of the jet formed after the breach (e.g. diameter, speed and concentration),
- The dispersion of the cloud in the atmospheric environment as well as the possible changes of state (liquid formation and, even, carbonic ice in the case of CO_2).

TOTAL's COOTRANS CO_2 Transport Loop, Lacq

TOTAL is studying the possibility to install in Lacq a facility to study the transport of CO_2 with impurities, issued from post-combustion and oxy-combustion processes, in dense phase. The size of the facility, a 800 m long and 4'' diameter loop, will allow to fill the gap between the scientific knowledge acquired in laboratory and the industrial scale. It will also contribute in gaining the required operational experience in order to properly design the future CO_2 pipelines networks for a reliable and safe operation.

Andra's Underground Research Laboratory, Bure
This is a unique facility accessible for in situ experiments in a deep clay formation at 500 m depth, with a hydraulic pressure of 46 bars and a vertical stress of 12 MPa, allowing performing different tests from small scale to large scale and in representative conditions of a caprock of a CO_2 storage site. The Callovo-Oxfordian clay layer lies between around 420 m to 600 m deep, and its thickness is at least 130 m. This layer has been well characterized as it could host a reversible deep geological disposal for radioactive waste.

INERIS' Shallow CO_2 Injection Site, Catenoy
This site enables to perform CO_2 injection in a shallow chalky aquifer in order to simulate a gas leakage, e.g. from a CO_2 storage site. Measurements can be performed in the saturated and non-saturated zones. The site is equipped with 9 piezometers of 25 m depth in the chalky aquifer, 4 ground gas monitoring wells of 11 m depth in the non-saturated zone, a technical shed, a weather station. Other sensors or measuring devices can be installed on the site for a given experiment.

IFPEN's Mobile ESCORT Station
This station, Equipment for Soil CO_2 ORigin Tracking, is dedicated to the monitoring of the natural gas exchange between the atmosphere and the soil vadose zone. It may be deployed on pilot or industrial sites for defining soil baseline conditions and leakage monitoring. It involves both an equipment and a data treatment software: a) continuously recording the soil CO_2 flux, the soil gas compositions (CO_2, CH_4 and O_2) at different depths together with relative soil temperatures, water saturations and weather conditions and b) statistically correlating the measured parameters to give a precise description of the controlling factors of CO_2 production and migration within the soil.

IFPEN's GasGeochem Laboratory, Rueil-Malmaison
This lab combines the instrumentation and expertise to analyse and interpret gas geochemistry data including:

- Major gas composition such as CO_2, N_2, O_2, He, CH_4, ethane, propane, butane, H_2, H_2S
- Stable isotopic composition of carbon in CO_2, methane, ethane, propane, butane
- Stable isotopic composition of H in H_2, methane, ethane, propane, butane
- Noble gas concentration of traces of He, Ne, Ar, Kr, Xe
- Isotopic composition of He ($^3He/^4He$ ratio) and Ar ($^{40}Ar/^{36}Ar$ ratio)

The uniqueness of this lab resides in the full integration of data production across different instruments on a single sample aliquot, and with great care to maximise data consistency from major gas composition to fine isotopic compositions of trace compounds.

BRGM's BIOREP reactor, Orléans
This facility enables to study fluid-rock interactions under a large range of pressure and temperature conditions, while continuously monitoring geochemical and bio-geochemical evolution. The facility is particularly adapted to monitor biological system evolution during the experiment. The facility can be used to do classical batch experiments, equilibration or transfer experiments between compartments through columns and also microfluidic percolations in highly pressurized micro-chips. The range of pressure and temperature allows simulating conditions that are typical for CO_2 storage or CO_2 leakage.