



16th International Conference on Greenhouse Gas Control Technologies **GHGT-16**

23-27th October 2022, Lyon, France

Data investigation in the process of selecting a CO₂ geological pilot site: example of the Paris Basin (France)

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Abstract

Sedimentary basins have been the receptacle of fossil resources that are in exploitation for over a century. The exploration methods that allow finding these resources have been in constant evolution, resulting from an increasingly complex set of technologies: from spotting surface manifestation to numerical modelling and artificial intelligence and from well geophysics to complex 3D geophysical acquisition and treatment. The result of all these investigations is a very large volume of data available for the development of new and more sustainable technologies (e.g. geothermal energy, CO₂ storage). We present here the data investigation carried out as part of the H2020 PilotSTRATEGY (<https://pilotstrategy.eu/>). Over the course of five years, working with end users and stakeholders, the project specialists will use relevant technologies to characterize the reservoirs at pilot scale. Study will focus on the ability of deep saline aquifers in five regions in Southern and Eastern Europe (Paris Basin included) to store CO₂. Calling on expertise from geoscience, engineering, and social sciences, PilotSTRATEGY will generate and curate information and data that enable the decision-making bodies in society to examine how a path towards CO₂ storage pilot could be pursued in these regions. The first step of this project is to identify the available data and to plan the research that will be required to support the identification of a secure site for a CO₂ storage pilot. We here focus on one of the five regions: the Paris Basin (France). It is an epicontinental basin that has a long history of oil and gas exploration, the first well was drilled in 1923. As a result, many data are available for the investigation of the subsurface: well logs, seismic lines, cores, petrophysical measurements, and geochemistry. For the purpose of our project, these data have been retrieved together with previous broad scale investigations (e.g. projects France Nord, PICOREF and other National funding projects as ANR SHPCO2). They have then been preliminary interpreted to try to locate and select what could be a pilot site for CCS. The knowledge of the evolution of the basin, its capacity to create suitable reservoirs, and the capacity to support its exploitation has also been considered either for the transferable knowledge from oil and gas and more recently from the renewable energy such as geothermal energy (that have been developed in the Paris Basin since the 1970s). The first result indicates an interesting area to the south-east of Paris, close to the PICOREF area, in the Dogger formation. The lithological assessment shows an interesting limestone formation made of oolitic development that commonly shows a good porosity and permeability, this is supported by the porosity and permeability measurements in the basin. The occurrence of operational geothermal wells in the Dogger aquifer allows defining the natural hydrogeological and geochemical setting expected into the prospected area of the saline aquifer. The reservoir is capped by a sealing formation (Callovian) that will require further investigation to assess its capacity to hold the increase of pressure that would occur in case of injection. Like for the reservoir, the caprock data available

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from the oil and gas industry remain to be completed for the purpose of clearly defining the full suitability and the following steps are ongoing for further data to be acquired to specifically assess a pilot site for CCS. Additional data (geomechanical properties) are representing a gap and will be acquired by core analysis and laboratory experiment during the lifetime of the project. It is planned to describe as precisely as possible the lithological variations based on cores, geophysical well logs and knowledge of the depositional environment. The geochemical impact of a CO₂ injection in the saline aquifer (local salinity around 25 g/l) will be assessed from laboratory experiments on the key carbonate facies composing the Dogger formation and on the caprock formation. Such experiments will reproduce the geochemical reactions to occur at the pressure and temperature would prevail in the aquifer following CO₂ injection. The expected partial dissolution processes of carbonates and precipitation of secondary minerals will be characterized and linked to the evolution of the mineral surface microtexture and the petrophysical characteristics (porosity, permeability, ...). Finally, 3D seismic will be acquired in a specific area to further understand the structures in the main anticipated reservoir.

Keywords: CO₂ storage; data; exploration; PilotSTRATEGY; pilote site; Paris Basin
