FLAGSHIP PROJECT

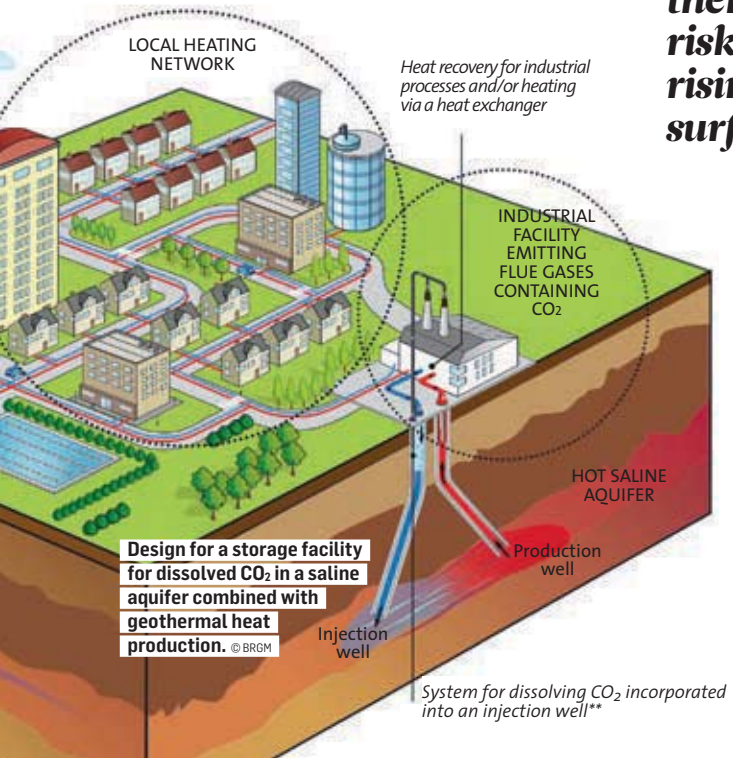
Successfully combining CO_2 storage and geothermal heat extraction

Christophe KERVEVAN
Project manager

Storing dissolved CO_2 in saline aquifers close to industrial emissions sources is the idea being investigated by the CO_2Dissolved project as a promising alternative to large scale storage.

While there is no doubt that geological storage of CO2 is necessary to cut atmospheric greenhouse gas emissions, the implementation, safety and monitoring conditions required raise scientific, technical, economic and social issues that are slowing its development in the short term. Storing CO2 on a small scale close to the emission sources would be an additional and possibly alternative solution. The 3-year ANR CO2Dissolved project explored this possibility.

"Storing dissolved CO_2 in an aquifer avoids the formation of a gas bubble and therefore the risks of gas rising to the surface"



Design for a storage facility for dissolved CO_2 in a saline aquifer combined with geothermal heat production. © BRGM

*System for dissolving CO_2 incorporated into an injection well***

With 7 partners* co-ordinated by the BRGM, the project demonstrated the feasibility of combining the storage of dissolved CO2 in an aquifer with the extraction of geothermal heat.

As project manager Christophe Kervévan explains, "*This solution has several advantages. The idea is to store the CO2 produced by an industrial facility on the same site by injecting it in dissolved form into an underlying deep saline aquifer. The water is pumped up and subsequently reinjected with the dissolved CO2 through one "injection" and one "production" well, similar to the geothermal doublets used to supply heating networks.*"

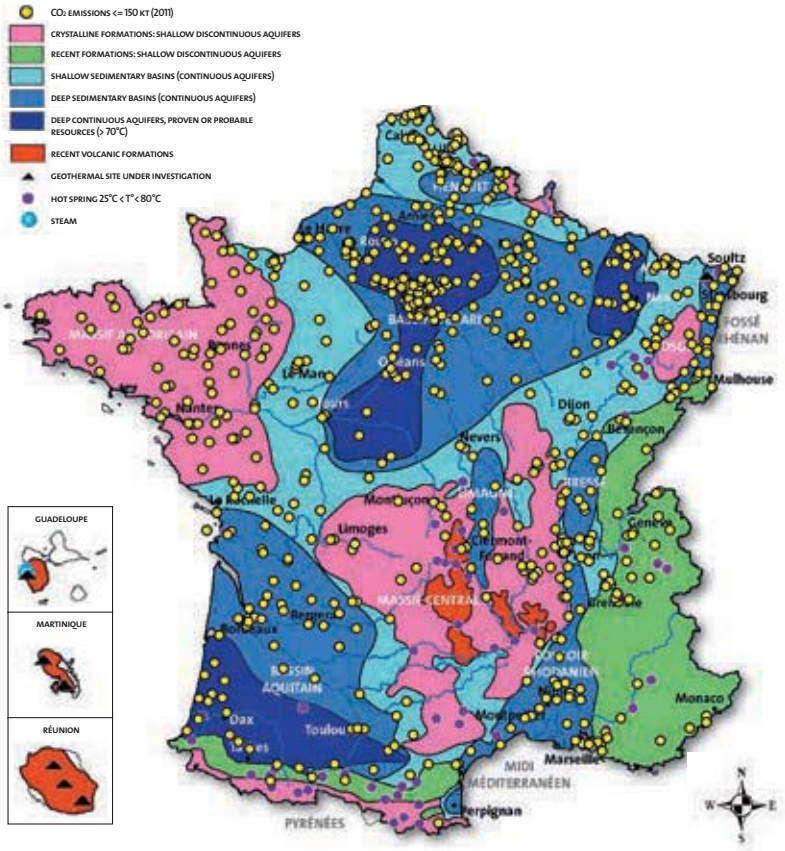
In situ CO2 storage would reduce both the costs and risks of transporting the gas, which, in addition to heat recovery, makes this an attractive solution, subject to the existence of suitable aquifers in the right location and proper control of the process.

Feasibility and risk control

Because CO2 is only is soluble in brine within certain limits, and because of the standard flow rates in geothermal doublets (250-350 m^3/h in the Paris Basin), this is a relevant solution for small-scale industrial emissions of CO2 (< 150 000 t/year). The storage sites targeted are deep aquifers (1 500 - 2 500 m) with temperatures in the region of 60 to 80°C. In France, 650 potentially compatible industrial sites (accounting for 25% of emissions in France) have been identified.

"*Our American partners have developed an innovative CO2 capturing process in which water is the only solvent*", says C. Kervévan. "*Possibilities for integrating this process into the CO2Dissolved system have been investigated, and depend on CO2 concentrations in flue gases and the possible need for separation prior to injection. Unlike large-scale sto-*

Map of France matching the locations of low emission industrial facilities - yellow dots - with geothermal resources in aquifers - deep sedimentary basins in blue. © BRGM



rage, where the CO2 is injected in supercritical form, in this case it is entirely dissolved in the brine of the aquifer. This removes the risks of a gas bubble forming underground, which could rise to the surface."

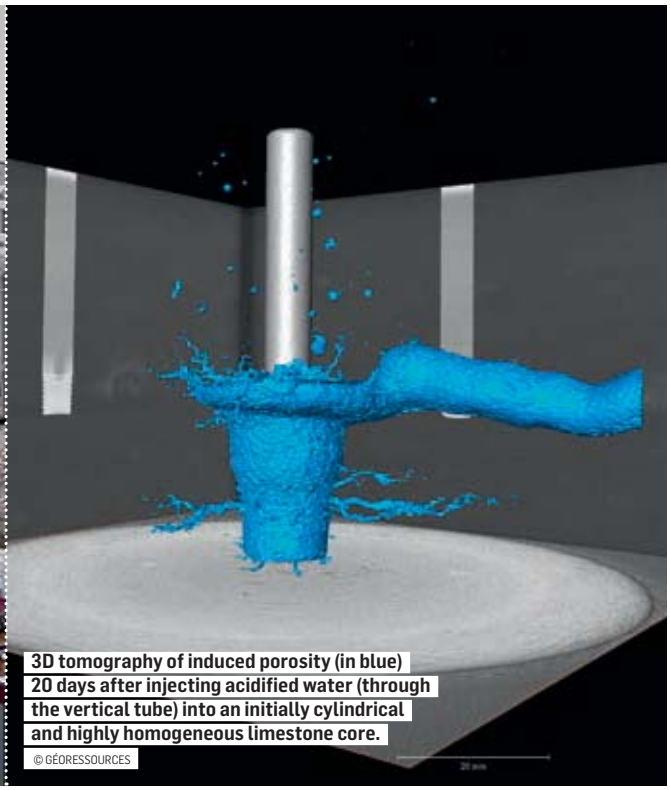
The impacts on the rock of injecting acid water and the resulting chemical reactions that depend on the hydrogeological characteristics of the environment have been digitally simulated and repeatedly tested at an experimental facility. The economic impact has also been investigated, in the case of a sugar mill and distillery in central France, and has demonstrated the viability of most of the scenarios simulated, thanks to the economic benefits of the heat recovered.

"The next stage", says C. Kervévan, *"will be to implement a demonstration pilot on an industrial site. The first steps are already under way with the new "Pilot CO2-Dissolved" project financed by the Géodénergies scientific interest group"*.

650

POTENTIALLY COMPATIBLE LOW-EMISSION INDUSTRIAL SITES IN FRANCE

The experimental MIRAGES-2 set-up for injecting a mixture of water and dissolved CO_2 into a core under pressure and temperature conditions typical of a deep aquifer. © GÉORESSOURCES



3D tomography of induced porosity (in blue) 20 days after injecting acidified water (through the vertical tube) into an initially cylindrical and highly homogeneous limestone core. © GÉORESSOURCES

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*** Technology patented by Partnering in innovation, Inc. (USA).*