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GEOLOGICAL LABS ON CHIP: INVESTIGATING DEEP UNDERGROUND PROCESSES UNDER PRESSURE AT MICROSCALE

Anaïs Cario, Abdou Khadre Diouf, Carole Lecoutre, Olivier Nguyen, Dominique Bernard, Yves Garrabos, Samuel Marre*

CNRS, Univ. Bordeaux, ICMCB, F-33600, Pessac Cedex, France
samuel.marre@icmcb.cnrs.fr

ABSTRACT

CO_2 geological storage in deep saline aquifers represents a mediation solution for reducing the anthropogenic CO_2 emissions. This kind of storage required adequate scientific knowledge and tools at the pore scale to evaluate injection scenarios or to estimate reservoir capacity. In this context, high pressure / high temperature microfluidic reactors (micromodel or geological labs on chip – GloCs) turn out to be excellent tools to investigate the different mechanisms associated with CO_2 geological storage in deep saline aquifers.

This talk will first highlight the latest results obtained at ICMCB concerning the application of the GLoCs to study the invasion processes of CO_2 in water and brine saturated GLoCs. In particular, direct optical visualization and image treatments allow following the evolution of the CO_2/brine phase distribution within the pores, including displacement mechanisms and pore saturation levels. We will then present some ongoing works aiming at integrating *in situ* spectroscopy techniques in HP microreactors to get information about the dissolution and mineralization trapping. We have developed an experimental set-up to recreate 3D reactive porous media within a microfluidic channel (fixed packed bed of calcium carbonate). Thanks to X-ray laminography carried out at the ESRF, we have observed on reconstructed 2D images, the dissolution phenomena occurring during the successive injection of constant volumes of non-equilibrium solution. This proof of concept has opened new possibilities for using this methodology to acquire kinetic data on 3D reactive front phenomena in porous media.

Eventually, we will introduce the use of GLoCs as a significant tool to mimic the *in situ* biogeological reservoirs conditions to investigate CO_2 bioconversion (in the frame of the ERC project “Big Mac”). These tools could also find wider applications in geological-related studies such as Enhanced Oil Recovery, shale gas recovery or geothermal energy.