Geological Labs On Chip (GLoCs): New tools for investigating key Aspects of CO_2 Geological Storage

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Underground CO_2 geological storage in deep saline aquifers represents a mediation solution for reducing the anthropogenic CO_2 emissions. Consequently, this kind of storage required adequate scientific knowledge to evaluate injection scenarios, estimate reservoir capacity and asses leakage risks. In this context, we have developed and used high pressure / high temperature microfluidic tools [1] to investigate the different mechanisms associated with CO_2 geological storage in deep saline aquifers (Figure 1). The silicon-Pyrex 2D porous networks can replicate the reservoir p,T conditions (25< T<50°C, 50<p < 10 MPa), geological and topological properties.

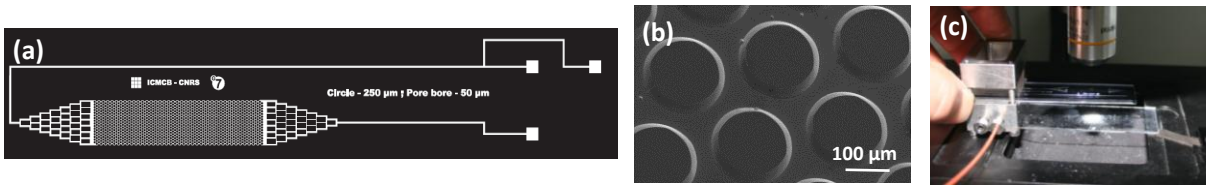

Figure 1: Illustration of a GLoC device (a) with additional enlargement (b) and overall set-up with fluidic connections (c).

This talk will first highlight the strategy to access to global characteristics of our porous media such as porosity and permeability, which are later compared to numerical modelling results. The presentation will then focus on the use of GLoCs to investigate each trapping mechanisms at pore scale [2]. The direct optical visualization and image treatments allow us to follow the evolution of the CO_2/brine phase distribution of the injected CO_2 within the reservoir, including displacement mechanisms and pore saturation levels. Finally, we will present some ongoing work aiming at coupling GLoCs to spectroscopy and optical characterization to get information about dissolution and mineralization trapping such as Raman spectroscopy [3] or the integration of optic fibers to our HP/HT microsystems [4]. Beyond CO_2 geological storage investigations, the GLoCs could also find wider applications in geological-related studies such as Enhanced Oil Recovery (EOR), shale gas recovery or geothermal energy.

[1] S. Marre *et al.*,Ind. Eng. Chem. Res., vol. 49, no. 22, pp. 11310–11320 (2010).
[2] S. Morais *et al.*, Imbibition and drainage in Geological Labs on Chip (GLoCs), to be submitted.
[3] N. Liu *et al.*,Chem. Phys. Lett., vol. 551, pp. 139–143 (2012).
[4] F. Starecki, S. Morais, *et al.*"In-situ CO_2 monitoring for microfluidic applications using IR emission of Dy3+ GaGeSbS fibers", submitted to Int. J. of Green House Gas Control.