MULTI-SCALE TRANSPARENT HIGH PRESSURE LABORATORY EXPERIMENTAL APPROACHES : APPLICATIONS IN DEEP ENVIRONMENTS STUDIES

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Abstract

Being able to investigate at lab scale the combined effects of thermodynamics, hydrodynamics, geo- and biochemical processes occurring in deep environment is still challenging. Over the last fifteen years, new types of HP transparent high-pressure micro- and millifluidics reactors (Figure 1) have been developed based on the idea of combining the advantages of small to medium scale process engineering (size reduction, fast screening, *in situ* analysis, reproducibility, control of hydrodynamics, improvement of thermal and material transfers, low consumption of reagents during optimization phases, etc.) with the properties of fluid systems used in high pressure and high temperature conditions (implementation of hydro- and solvothermal processes, studies of geofluid flows in model porous media, biology under extreme conditions, supercritical fluids, etc.). These tools allow to study more precisely the phenomena taking place at small scales and are complementary to the classical approaches using either macroscopic batch reactors or diamond anvil cells.

In this presentation, we will first detail the technologies available for the fabrication of high-pressure micro and millifluidics reactors, and then we will discuss their use in several applications related to the use of deep geological environments such as: (i) the geological storage of CO_2 (fluid flows, carbonation processes, solubility measurements, etc.), (ii) the production of hydrogen from iron and iron-bearing minerals in link with CO_2 capture and utilization topics and (iii) the effect of the deep biosphere on gas storage (CO_2, H_2) along with possible biochemical reactions (in particular methanogenesis).

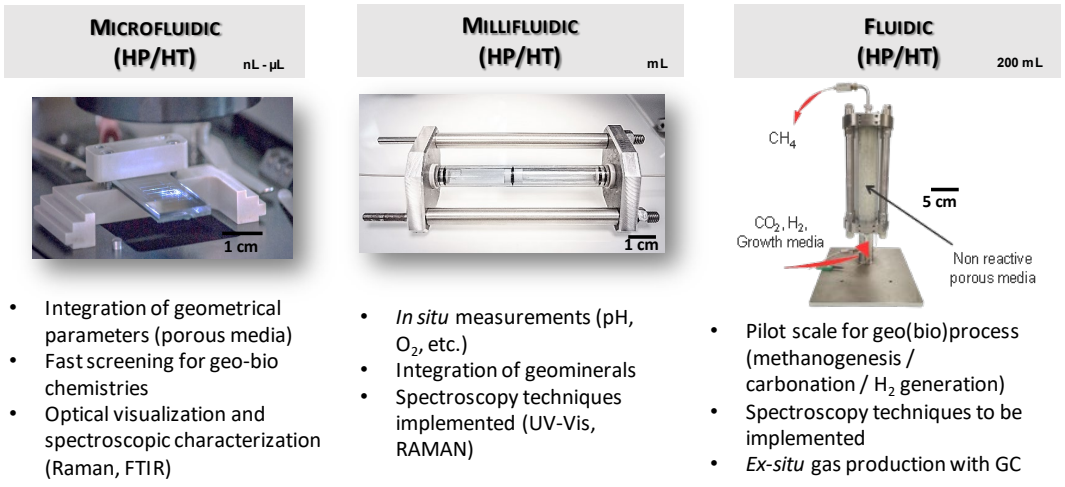

Figure 1: *Example of HP multiscale transparent reactors developed at ICMCB.*