

Can we get a better knowledge on dissolution processes in chalk by using microfluidic chips?

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This work has been initiated in the context of research on improving the oil recovery in chalk bedrocks. One of the methods to improve the oil recovery is to inject "smart water" (acidic water/brines). Experiments on core scale and field tests that have been carried out the last decade have clearly shown that water chemistry affects the final oil recovery. However, there is generally no consensus in the scientific community of why additional oil is released, and it is also still not understood what are the mineralogical and structural changes. Direct *in situ* observation of the structural changes that occur when chalk is flooded with brines could resolve many of the open questions that remain.

One of the highlights of this work is thus the development of an innovative methodology where fluid/rock interactions are observed *in-situ* by microscopy. To do so, we create several types of custom-made microfluidic systems that embeds reactive materials like chalk and calcite. The methodology we develop can be applied to other reactive materials.

We will present an experiment where a calcite window dissolves with a fluid, where we observe *in-situ* the topography features of the calcite window, as well as the dissolution rate [1]. The injected fluid circulates at controlled flowrates in a channel which is obtained by xurography: double sided tape is cut out with a cutter plotter and placed between the reactive window and a non-reactive support. While the calcite window reacts, its topography is measured *in situ* every 10 s using an interference microscope, with a pixel resolution of 4.9 μm and a vertical resolution of 50 nm. These experiments are also compared with reactive flow simulations done with Lattice Boltzmann methods.

Then, we will present a dissolution experiment done with a microfluidic system that embeds chalk. In this experiment, the main flow takes place at the chalk surface, in contact with fluid flowing in a channel above the chalk sample. Thus the reaction mostly occurs at the surface of the sample. The reacting chalk surface is observed *in situ* by stereomicroscopy and by interferometry. The dissolution velocities are highly heterogeneous. To identify the mineral change of the surface, *a posteriori* measurements using field emission scanning electron microscopy (FE-SEM), and energy dispersive X-ray spectroscopy (EDS).

[1] Neuville et al, 2016, Xurography for microfluidics on a reactive solid, *Lab on Chip*, DOI: 10.1039/c6lc01253a