Microfluidics for geosciences to unravel reactive transport processes in porous media

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Résumé

There is a strong interest in imaging and numerical modeling of reactive flow at the pore scale applied to reservoir engineering, subsurface hydrology, soil remediation, and CO2 sequestration. The dynamics at the pore-scale, however, remain relatively unknown but influence macroscale behaviors considerably. In particular, an in-depth understanding of dissolution and precipitation of minerals in porous media and the complex feedback on the transport of fluids and colloids is essential for various subsurface applications.
Using state-of-the-art microfluidic experiments, we explore pore-scale mechanisms and their consequences on the upscaling of rock and fluid properties. Such micromodels have the pore network pattern and pore sizes of a real rock or idealized medium. Importantly, these micromodels permit direct, high-magnification, time-lapse observations of fluid movement through pores, as well as visualization of the evolution of the pore space due to dissolution or precipitation. We combine microfluidic experiments, high-resolution imaging, chemical and geo-electrical characterization, and numerical simulations to understand the microdynamics of reactive flow in geological porous media.

In this work, we will describe and discuss the current possibilities and challenges associated with microfluidics for reactive transport processes in geosciences, as well as how these experimental datasets are used to provide data to verify and complete numerical models, to gain a better understanding of the mechanisms at the pore-scale, and to improve large scale models.

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