Reactive transport, mixing and filtration

• Pietro de Anna[1]

[1] *Institute of Earth Sciences, University of Lausanne, CH-1015, Lausanne, Switzerland*

Natural soils are host to a high density and diversity of substances, suspensions and microorganisms, and even deep-earth porous rocks provide a habitat for active microbial communities. In these environments, transport by disordered flows is relevant for a broad range of natural and engineered processes, from biochemical cycling to remineralization, bioremediation and filtration. A key property of most porous systems is the underlying heterogeneity that may occur due to non-uniformity in size or shape of the constitutive grains. Such physical heterogeneity controls transport and mixing of solutes driving geochemical reactivity kinetics and colloidal/bacterial deposition and filtration. The complexity that rises from the coupling of these microscopic processes, makes predictions based on rates measured under homogenized, well-mixed, conditions different by orders of magnitudes from field observations.
I present and discuss numerical methods and laboratory experiments (based on micro fluidics and time-lapse video-microscopy) to investigate the microscopic processes (as flow, transport, microbial growth) that take place within the confined space of the heterogeneously distributed pores and, at the same time, we monitor their macroscopic consequences (including deposition profiles, breakthrough curves, reaction kinetics and biomass growth). Based on such pore-scale observations, we build new theoretical models, that we feed with directly measured parameters, to unravel the link between the microscopic and the macroscopic scale.