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A lab on a chip concept for rationalizing hydro-geochemical processes at the pore scale

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Hydro-geochemical processes such as transport-induced mineralization are important processes governing the evolution of many subsurface systems. These processes can lead to an alteration of permeability, diffusivity and other physical characteristics of the rock matrix that can have significant effects on subsurface solute and gas transport. The understanding of these phenomena at the pore scale is a prerequisite for the development of predictive conceptual approaches for a “close to reality” description of the evolution of the subsurface. Our lab on a chip concept which combines microfluidic experiments and reactive transport modelling[1, 2] has proven to be a powerful tool for rationalizing these processes. In this work, we present an overview where we have successfully applied this methodology to i) evaluate the impact of hydraulical heterogeneity on nucleation mechanisms[3], (ii) decode oscillatory zoning exhibited by solid solutions crystallizing in porous media[4], (iii) evaluate the kinetic and thermodynamic controls on crystallization processes in confined porous media, and (iv) parameterize porosity-diffusivity relationships with respect to coupled mineral dissolution-precipitation reactions[5] as well as further opportunities of this approach.

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