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Evaluating the dynamics of fluid-mineral and fluid-rock interfaces

DR. CATHERINE NOIRIEL[1] AND CYPRIEN SOULAINE[2]

[1]Géosciences Environnement Toulouse

[2]Earth Sciences Institute of Orleans, Univ. Orleans, CNRS, BRGM

Presenting Author: catherine.noiriel@get.omp.eu

Fluid-mineral interfaces are a key parameter controlling the reactivity of rocks and fate of fluids as the changes of physical properties in rocks and aquifers. Interface dynamics results from complex processes involving a tight coupling between chemical reactions and transport of species as well as a strong dependence on the physical, chemical, mineralogical and structural properties of the reacting solid phases. Advances in pore-scale imaging and reactive flow modelling are improving our understanding of interface dynamics through space and time. We present results of dissolution experiments on several carbonate minerals or rock aggregates where time-lapse X-ray micro-tomography imaging is used to track the interface evolution and evaluate locally the mineral reactivity. The results evidence the areas at the surface where dissolution reaction preferentially occurs. Pore-scale reactive transport modelling then illustrates the dynamics of the interface for different transport regimes (i.e., diffusive- to advective-dominant) and interface geometry evolutions (i.e., sharp, non-reactive or smeared interface) along with the rock matrix properties.