Quantification of coupled fluid flow and reactive transport using a dissolved gas tracer test in a fractured media

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Identification of biogeochemical reactions in aquifers and determining kinetics is important for the prediction of contaminant transport in aquifers and groundwater management. Therefore, experiments accounting for both fluid flow and reactive transport are essential to quantify reactive transport properties at field scale.

This study presents the results of a groundwater tracer test using the combined injection of dissolved conservative and reactive gases (He, Xe, Ar, and O_2) and NO_3^- in order to evaluate the transport properties of a fractured media in Brittany, France.

Dissolved gas concentrations are continuously monitored in situ with a CF-MIMS (Continuous Flow - Membrane Inlet Mass Spectrometer) allowing a high frequency (1 gas every 1.5 seconds) multi-tracer analysis (N_2, O_2, CO_2, CH_4, N_2O, H_2, He, Ne, Ar, Kr, Xe) over a large resolution (6 orders of magnitude). Along with dissolved gases, groundwater biogeochemistry are monitored through the sampling of major anions and cations, trace elements and microbial diversity analysis.

The results show breakthrough curves allowing the combined quantification of conservative and reactive transport properties such as dispersivity, fracture aperture as well as reactions kinetic parameters. This ongoing work consisting in the field characterization of biogeochemical reactivity is to be implemented in other fracture networks in order to investigate the link between fluid flow properties and reaction kinetics.