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Effects of Iron-organic matter colloids on transport of Rare Earth Elements in saturated porous medium

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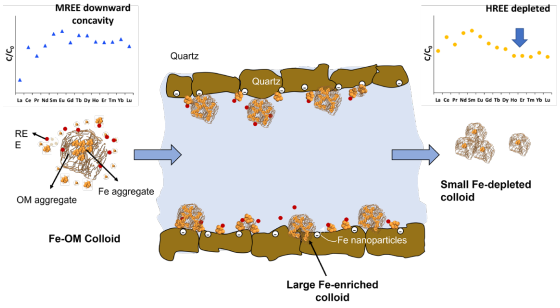

Colloidal particles are important carriers of contaminants, such as rare earth elements (REE), in the environment due to their strong adsorption properties and mobility. They are heterogeneous particles with variable size and composition which are significantly sensitive to changes in biogeochemical conditions. However, their transformation during transport and the effects on contaminants have been overlooked. By combining batch and column experiments, it was revealed that the mobility of REE can be strongly affected by the heterogeneity in colloid size and elemental composition under various conditions. Sand was used as immobile soil phase, whereas the mobile phase was composed of iron-organic matter nanoaggregates. Elemental fractionation, i.e., a discrepancy in the breakthrough curves (BTCs) with respect to the C/C_0 values of Fe and organic matter (OM), was observed which became more pronounced with the decrease in [Fe-OM], suggesting that Fe-OM composition may change with the REE loading due to the heterogeneous composition of mixed Fe-OM colloidal suspension. We used distinct REE patterns arising from subtle chemical differences within the 14-element series, as indicators of REE surface speciation, competitive binding and non-equilibrium conditions during colloidal transport through saturated sand columns. Overall, this study provides a comprehensive understanding of the behavior of nano particles during the migration of REE in water-saturated porous media.