Modelling of Sr reactive transport in a clayey sandstone at different scales

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To ensure the environmental monitoring of nuclear sites, reactive transport models enabling the prediction of contaminant migration such as ^{90}Sr in soils, sediments and aquifers need to be developed. Recently, a multi-site ion exchanger model has successfully been applied to the sorption of Zn in a natural soil under static conditions [1] and to the sorption of major constituents in dynamic conditions [2]. This model has the particularity of using a database that combines sorption properties of pure minerals that constitute the material. Knowing nature and proportions of reactive pure mineral phases, this approach can thus be applied to different environments without any adjustements of parameters on the studied material.

In this study, this sorption model is coupled to the advection-dispersion equation to describe Sr reactive transport in a clayey sandstone at two different scales. The two sets of reactive transport experiments has been made in two columns of 7 cm long and 1 cm diameter for the first and 35 cm long and 5 cm diameter for the second filled with homogeneous crushed material. Characterization of the sandstone revealed the presence of illite and smectite as reactive pure mineral phases. Therefore, a database of the Sr sorption properties on these minerals has been established using sorption data of litterature and new sorption experiments. The sorption model using this database has been then applied with success to the sorption of Sr on the clayey sandstone. Non-reactive experiments of the two columns have been performed to determine dispersivity and confirm the choice of the transport model.

In the end, results of reactive transport expriments of Sr in a clayey sandstone at two different scales are compared to their simulations by coupling the sorption model to the advection-dispersion equation.

[1] Tertre et al. (2009) Applied Geochem. 24, 1852–1861.
[2] Lu et al. (2014) Applied Geochem. 41, 151–162.