Predictive modelling of the adsorption of Cs and Sr onto French soils

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This work is part of the French project DEMETERRES (PIA), which aims at developing innovative methods and technologies in the field of decontamination and remediation of contaminated soils and effluents. After a nuclear incident, ^{137}Cs and ^{90}Sr, two major fission-products from ^{235}U, are known to strongly interact with clay minerals in soils. The decontamination of the soils requires the quantification of Cs and Sr interactions with the soils components, and the verification of the additivity of these interactions within the soils.

First, Cs^{+} and Sr^{2+} adsorption is investigated in representative clay minerals (smectite and illite), which were identified in French agricultural soils within the framework of DEMETERRES. From these investigations, a coherent thermodynamic adsorption database (TAD) is built in the framework of a model based on the multi-site ion exchange theory.

Second, adsorption experiments of Cs^{+} and Sr^{2+} onto French soils samples are done and the results are compared with simulations using the TAD. Simulations are done considering Ca-saturated soils (major exchangeable cation measured) and defined as illite/smectite mixtures in consistency with their CEC and DRX diffractograms. In most cases, simulations are in good agreement with the experiments. Some parameters such as the influence of natural organic matter or the competition with dissolved alumina are still under study to improve these simulations.