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Retention processes in clay-rocks

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Within the context of the clay barrier concept for underground nuclear waste storage, montmorillonite and bentonite have been widely used as reference materials for radionuclides (RN) retention studies. Associated modeling work aims at understanding and predicting the retention of RN in clay-rocks where clay minerals are assumed to be representative of the most reactive phases. This "bottom-up" approach relies on a good confidence in the mechanistic understanding of adsorption processes on clay mineral surfaces, and in the understanding of the reactivity of associated mineral (or organic) phases.

In the first part of the presentation, experimental and modeling works will be reviewed with a focus on divalent metals surface complexation on clay mineral surfaces, showing the limitations of current modeling approaches [1]. Missing information, which is necessary to model adsorption data in a mechanistic way, together with experimental features that cast doubt on the ability of surface complexation models to catch adequately the nature of divalent metal adsorption, will be highlighted.

In the second part of the presentation, "bottom-up" modeling approaches and related uncertainties will be detailed for the prediction of divalent metals retention in clay-rocks. The example of Ni^{2+} retention [2] will be used to show how the chemical reactivity of non-clay mineral phases can lower or enhance RN retention through time-dependant processes taking place in laboratory experiments as well as in storage conditions.

References:

[1] Tournassat, C.; Grangeon, S.; Leroy, P.; Giffaut, E. Am. J. Sci. 2013, 313, 395–451.

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