



Deliverable 5.6: FUTuRE – Final technical report on reversibility of sorption

Work Package 5

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Executive Summary

Within the EURAD WP5 FUTURE project, tasks 2.1 and 2.3 deal with the mobility of radionuclides in compacted clay and the reversibility of sorption, respectively.

The objectives of these tasks are to enhance the quantitative and mechanistic understanding of the impact on radionuclide mobility wrt. effects of solution composition and speciation, surface charge and microstructural properties of argillaceous porous media.

Radionuclide transport and retention are intrinsically coupled phenomena. Specifically for compacted system, the sorption and the sorption reversibility should bot be considered independently from transport phenomena. This is the one of the major recommendation and outcome of the conducted project.

To provide an consistent view of the transport and retention proceses and to avoid unnesessary repetitions of background information, the data on the sorption reversibility are entirely integrated into the joint report:

"Maes N., Glaus M., Rainer D., Churakov S.V. (eds). (2024): Final technical report on radionuclide mobility in compacted clay systems and reversibility of sorption. Final version as of 17.01.2024 of deliverable D5.4 of the HORIZON 2020 project EURAD. EC Grant agreement no: 847593.

The table of content for report D5.4 is provided below. The chapters addressing the sorption reversibility, initially planned to be included in this separated deliverable report D5.6 either exclusively or in connection with other processes are marked in bold and the page numbers are related to those in D5.4. The reviewers have appreciated the joining of the two reports into one as in has increased the readability and consistency of the reporting.

Executive Summary Erreur ! Signet non défini.

Introduction..... Erreur ! Signet non défini.

CHAPTER 1: MOBILITY OF WEAKLY/NON-SORBING (ANIONS)

RADIONUCLIDES IN CLAY Erreur ! Signet non défini.

1. Mobility of monovalent and divalent anions in clays: comparison of through-diffusion of iodine (I^-) and selenate (SeO_4^{2-}) in illite..... **Erreur ! Signet non défini.**
2. Adsorption and migration processes of selenium in clay minerals and clayrocks **Erreur ! Signet non défini.**
3. **Adsorption and diffusion of selenite on Boda Claystone Formation** Erreur ! Signet non défini.
4. **Achievements with respect to project objectives – Conclusions ...** Erreur ! Signet non défini.

CHAPTER 2: MOBILITY OF MODERATELY SORBING CATIONIC

RADIONUCLIDES IN CLAY Erreur ! Signet non défini.

1. Adsorption of ^{226}Ra and Ba on clay minerals..... **Erreur ! Signet non défini.**
2. Diffusion of ^{226}Ra through Opalinus Clay..... **Erreur ! Signet non défini.**
3. **Adsorption and diffusion of Ra, Ba, Sr on clay minerals and clayrocks ...** Erreur ! Signet non défini.
4. A process-based model describing transport induced co-precipitation and radionuclide retention **Erreur ! Signet non défini.**



5. Achievements with respect to project objectives – Conclusions.. **Erreurs ! Signet non défini.**

CHAPTER 3: MOBILITY OF MODERATELY SORBING TRANSITION

METALS IN CLAY **Erreurs ! Signet non défini.**

1. Sorption studies of transition metals (Cd, Co, Zn, Ni) on clay minerals (kaolinite, illite, FEBEX) **Erreurs ! Signet non défini.**
2. Competition effect of Ni on Zn diffusion in compacted illite **Erreurs ! Signet non défini.**
3. **Sorption studies of Ni(II) on Boda Claystone Formation: transferability, reversibility and competition with Co(II).....** Erreurs ! Signet non défini.
4. **Reversibility of Zn uptake by montmorillonite and illite** Erreurs ! Signet non défini.
5. Diffusion and retention of Co and Zn surface complexes in compacted illite preloaded with different cations **Erreurs ! Signet non défini.**
6. Diffusion of ^{57}Co tracer in compacted vermiculite, variation of grain size **Erreurs ! Signet non défini.**
7. Electrochemically controlled sorption experiments of Fe(II) with Montmorillonite **Erreurs ! Signet non défini.**
8. **Towards a mechanistic understanding of cation sorption by montmorillonite edges: experimental and modelling approaches.....** Erreurs ! Signet non défini.
9. **Achievements with respect to project objectives - Conclusions ...**Erreurs ! Signet non défini.

CHAPTER 4: MOBILITY OF STRONGLY SORBING (LA/AC)

RADIOMUCLIDES IN CLAY **Erreurs ! Signet non défini.**

1. **Uranyl speciation studies at the Illite - solution interface.....**Erreurs ! Signet non défini.
2. Europium Retention on intact Callovo-Oxfordian Clay Rock **Erreurs ! Signet non défini.**
3. Uranium retention in a Callovo-Oxfordian clay rock formation: From laboratory-based models to *in natura* conditions **Erreurs ! Signet non défini.**
4. Investigation of Pu diffusion in Opalinus Clay rock studied by time-of-flight secondary ion mass spectrometry **Erreurs ! Signet non défini.**
5. Diffusion study of UO_2^{2+} on Boda Claystone Formation.... **Erreurs ! Signet non défini.**
6. Investigation of the diffusion of U(VI) and Am(III) through Opalinus Clay down to ultra trace levels **Erreurs ! Signet non défini.**
7. Achievements with respect to project objectives - Conclusions... **Erreurs ! Signet non défini.**

CHAPTER 5: INFLUENCE OF GEOMETRY AND SATURATION

DEGREE ON RADIONUCLIDE MOBILITY IN CLAY **Erreurs ! Signet non défini.**

1. Influence of geometry and saturation degree on radionuclide mobility in clay. **Erreur ! Signet non défini.**
2. Achievements with respect to project objectives - Conclusions... **Erreur ! Signet non défini.**

CHAPTER 6: GENERAL CONCLUSIONSErreur ! Signet non défini.****

