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

Work Package 5

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Disclaimer

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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 not 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 (intended orginally to be published in Deliverable 5.6) are now combined and integrated into the EURAD Deliverable 5.4 - *"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 contents for D5.4 is as follows:

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

1. Mobility of monovalent and divalent anions in clays: comparison of through-diffusion of iodine (I-) and selenate (SeO42-) in illite
2. Adsorption and migration processes of selenium in clay minerals and clayrocks
3. Adsorption and diffusion of selenite on Boda Claystone Formation
4. Achievements with respect to project objectives – Conclusions

CHAPTER 2: MOBILITY OF MODERATELY SORBING CATIONIC RADIONUCLIDES IN CLAY

1. Adsorption of 226Ra and Ba on clay minerals
2. Diffusion of 226Ra through Opalinus Clay
3. Adsorption and diffusion of Ra, Ba, Sr on clay minerals and clayrocks
4. A process-based model describing transport induced co-precipitation and radionuclide retention

CHAPTER 3: MOBILITY OF MODERATELY SORBING TRANSITION METALS IN CLAY

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

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

1. Uranyl speciation studies at the Illite - solution interface
2. Europium Retention on intact Callovo-Oxfordian Clay Rock
3. Uranium retention in a Callovo-Oxfordian clay rock formation: From laboratory-based models to in natura conditions