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THE INFLUENCE OF BATCH SORPTION METHODOLOGIES ON CESIUM, NICKEL UPTAKE ONTO GRANITIC ROCK

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The batch sorption method of measuring radionuclide distribution between the crushed, sieved solid phase and liquid phase is commonly used for obtaining sorption coefficients R_d/K_d . These are often crucial input parameters used in reactive transport models for estimating a possible future radionuclide release from a radioactive waste repository [1]. Therefore, it is extremely important to standardize a robust methodology for the batch sorption experiments which can provide results (under simulated repository conditions) with non-systematic error margins, so the possible affecting parameters are under control and not allowed to influence the measured R_d values (or possibly K_d in case of the linear sorption isotherm).

Seven different methodological features of the batch sorption experiments were investigated using ^{134}Cs and ^{63}Ni as tracers. The solid phase was represented by migmatite gneiss from Bukov URF, using synthetic granitic water SGW2 as the liquid phase [2]. Investigated methodological features were following: contact time (7, 14, 28 days), non-radioactive carrier vs no-carrier experimental setup, continuous shaking vs occasionally shaking, pre-equilibrated vs non-equilibrated solid phase, different construction of linear sorption isotherm (variable concentration vs solid/liquid ratio), anaerobic vs aerobic environment.

Continual sample shaking during the batch experiment led to higher R_d values for both radionuclides compared to occasionally shaking. The reason for this difference could be that in the occasionally shaking method, diffusion can be the process controlling the sorption of radionuclides.

In the case of Cs, R_d values obtained for pre-equilibrated granite were higher than for non-equilibrated migmatite, probably due to different ionic strength of supernatant after pre-equilibration or by exchange with cations in the rock component biotite during pre-equilibration. However, lower R_d values for Ni on pre-equilibrated granite were observed, which points to a different sorption mechanism for Ni than for Cs.

Measured R_d values increased with sorption time for both radionuclides. This observation can be possibly explained by the formation of new sorption sites due to particles mechanical abrasion or rock surface changes. K_d values, obtained from a linear sorption isotherm for the Cs sorption with non-radioactive carrier were lower than for the system where the carrier was not present as a consequence of a lower number of available sorption sites in the case of Cs carrier presence.

In the case of linear sorption isotherm obtained using differing V/m or differing radionuclide concentration, both methods gave similar K_d values for both radionuclides. However variable concentration method suffers from the small number of experimental values. Moreover, using batch sorption experiment with variable concentration method produced a larger volume of radioactive waste.

Anaerobic conditions might have a significant impact not only on the chemistry of studied radionuclides in the case of Ni. Cs as a weak Lewis acid practically do not form complexes [3]. In this investigation, SGW2 was replaced by a calcium chloride solution with equivalent ionic strength, considering composition changes of SGW2 in anaerobic conditions. K_d values for Ni and Cs were higher under the anaerobic than in the ambient environment.

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