



Contribution ID: 395

Type: Poster

## Effect of high ionic strengths on U(VI) retention in montmorillonite

Tuesday, 13 May 2014 17:15 (1h 30m)

Argillaceous rock and clay minerals have properties that make them very suitable for nuclear waste storage. They are practically impermeable and have high sorption capacities. North German clay deposits feature pore waters of particularly high ionic strengths, ranging from 1.8 mol/l to 3.3 mol/l. in the depths relevant for nuclear waste repositories.[1] To enable an informed decision about the long term safety of nuclear waste disposal, the effect of high ionic strengths on radionuclide retention needs to be taken into account.

This work focuses on the uranium retention on montmorillonite (as model clay) in sodium and calcium chloride brines. These conditions are based on the Konrad mine that serves as reference site. There, montmorillonite is a major component. The ground water at a depth of about 480 m has sodium and calcium chloride as main components with an ionic strength of around 2.9 mol/l, and a pH between 5.75 and 6.85.[1]

The effect of ionic strength on uranium sorption on montmorillonite is very small. A true ionic strength effect, which is a decrease of sorption with ionic strength, can solely be observed below pH 6 and only up to an ionic strength of 2 mol/l sodium chloride. In calcium chloride, there are effects that show a positive correlation between sorption and ionic strength in the alkaline pH range but these can be explained with secondary phase formation rather than true ionic strength effects.

In the presence of carbon dioxide, U(VI) sorption decreases in the alkaline pH range regardless of electrolyte due to the formation of uranyl carbonate species. In the absence of carbon dioxide, U(VI) sorption at alkaline pH remains almost as high as the value at the sorption maximum. In general, the sorption maxima in both sodium and calcium chloride lie in the pH range of natural groundwaters in North German clay formations. Relative uranium uptake at the sorption maxima exceeds 99% for both electrolytes. Desorption experiments show that uranium sorption on montmorillonite in sodium chloride is largely reversible except for very high ionic strengths. In calcium chloride, on the other hand, reversibility depends less on ionic strength and more on pH.[2]

Further results that will be presented concern uranium sorption in a mixed electrolyte that is modelled on the naturally occurring ground waters of the Konrad site.

[1] Brewitz, W. (1982) Eignungsprüfung der Schachtanlage Konrad für die Endlagerung radioaktiver Abfälle. Gesellschaft für Strahlen- und Umweltforschung.

[2] Zehlike, L. (2013) Durchführung von Sorptions- und Desorptionsversuchen von Uran(VI) an Montmorillonit, Bachelor thesis, TU Dresden.

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**Session Classification:** Poster Session - Radionuclides in the Environment, Radioecology

**Track Classification:** Radionuclides in the Environment, Radioecology