Influence of background electrolyte on Th^{IV} sorption behavior

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Studying and understanding the behavior of radionuclides at the water-mineral interface on a molecular level is of high importance for making reliable statements for the safety assessment of nuclear waste disposals. Clay minerals are relevant for nuclear waste disposal sites, due to their retardation properties. Muscovite, a phyllosilicate material, is structurally similar to clay minerals but forms large single crystals with high quality surfaces, necessary for surface X-ray diffraction.

In a series of experiments we demonstrate that the background electrolyte has a significant influence on the sorption behavior of actinides, specifically thorium(IV). We study the sorption of Th(IV) ($c_{TH} = 10^{-4}$ mol/L), the softest of the tetravalent actinides, at the muscovite basal plane with several background electrolytes ($NaClO_4$, $KClO_4$, $LiClO_4$). Previous investigations [1], with sodium chloride (10^{-1} mol/L) as background electrolyte, act as reference for these experiments. We find that the sorption behavior of thorium is substantially affected by both, changes in the electrolyte cation (Li^+, K^+) and anion (Cl^-, ClO_4^-).

Briefly, compared to NaCl as background electrolyte, we observed increased sorption with $LiClO_4$ in the system (See table 1 below). On the other hand $NaClO_4$ almost completely supressed sorption at high ionic strength, while a lower ionic strength of $NaClO_4$, as well as $KClO_4$, decreases sorption [2].

	NaCl	hiNaClO$_4$	loNaClO$_4$	KClO$_4$	LiClO$_4$
c (mol/L)	10^{-1}	10^{-1}	10^{-2}	10^{-1}	10^{-1}
θ (Th/A$_{UC}$)	0.4	0	0.04	0.07	4.90

Table 1: Sample overview with background electrolyte concentration and occupancy of Th/unit cell ($A_{UC} = 46.72$ Å^2).

[1] Schmidt et al. (2012) *Geochim. Cosmochim. Acta* **88**, 66-76. [2] Schmidt et al. (2015) *Geochim. Cosmochim. Acta* (under review).