

## **The impact of salinity on the sorption of selenate onto aged $\gamma$ -Al<sub>2</sub>O<sub>3</sub> in the context of salt dome repositories**

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The radioactive isotope Selenium-79 is a long-lived fission product found in nuclear waste. Due to its long half life of  $3.27 \cdot 10^5$  years, it is expected to be one of the isotopes most contributing to the potential radiation dose according to safety assessments of nuclear waste underground repositories. A detailed knowledge of the mobility and bioavailability of selenium is therefore of great importance for a safe disposal of radioactive waste.

One major process controlling selenium mobility and bioavailability is the adsorption onto mineral surfaces of both the engineered and geological barrier. In this context, it is important to understand to what extent this sorption is influenced by different parameters, which are characteristic of deep underground storage of high level and long-lived radioactive waste. These parameters include inter alia the presence of different background salts, which are important with regard to salt domes as potential repositories.

The present study focuses on the impact of ionic strengths due to NaCl, MgCl<sub>2</sub> and CaCl<sub>2</sub> background electrolytes on the sorption of selenate (SeO<sub>4</sub><sup>2-</sup>) onto aged  $\gamma$ -Al<sub>2</sub>O<sub>3</sub>. Al<sub>2</sub>O<sub>3</sub> contributes to the formation of clays and other rock forming minerals. Thus and due to its well characterized properties it serves as a model oxide for process understanding.

A combination of macroscopic sorption experiments, electrophoretic mobility and *in-situ* ATR FT-IR spectroscopy measurements was used to study the interaction of selenate with aged  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> in the presence of NaCl, MgCl<sub>2</sub> and CaCl<sub>2</sub>.

From *In-situ* ATR FT-IR spectra, a change in the symmetry of the aqueous tetrahedral selenate anion can be derived, which is an evidence for the formation of a surface complex on  $\gamma$ -Al<sub>2</sub>O<sub>3</sub>. From batch experiments, we observe that the sorption of selenate is dependent on the ionic strengths and electrolyte composition. Additionally, the sorption decreases with increasing pH.

The isoelectric point (pH<sub>I<sub>EP</sub></sub>) of  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> is located at pH 9.6 for low NaCl background electrolyte concentration (I = 0.1 M). The increase of ionic strength (up to I = 1 M) results in a decrease of the zeta potential for both the acidic and alkaline pH range. However, in the alkaline range the decrease of the zeta potential is more pronounced. Additionally, we observe that the pH<sub>I<sub>EP</sub></sub> is shifted to more alkaline values and finally no charge reversal is found. To what extent these differences influence the sorption of selenate in the alkaline range has to be checked in detail.