Objectives

- Develop a better understanding of retardation processes of actinides under varying geochemical conditions in long-term safety assessments of radioactive waste repositories in e.g. Northern Germany
- Assessment of geochemical parameters (surface complexation parameters – SCP) via titration and batch experiments
- Column experiments and collection of transport data
- Application of the derived SCP in reactive transport models (PhreeqC)
- Validation of the chosen approach describing sorption characteristics of natural sediments by means of its constituting minerals
- Comparison of batch and column experiment data sets to investigate differences in resulting sorption data (SCP, K_d, R_f)

Approach

- State of the art mineral titration and batch experiments to assess SCP for Eu
  - pK-values (pK_1, pK_2)
  - Surface site density (SSD)
  - Specific surface area (SSA)
  - Surface complexation constants (log K_K)
- Development of a straight-forward, chemically-inert experimental set-up for column experiments to
  - Investigate sorption and retardation processes
  - Validate SCP
- Application of quartz, muscovite, orthoclase and natural sediment typical for Northern Germany

Results

Experimental results - red symbols (cf. Fig. 1, Fig. 2)

- Experimental set-up
  - Saturation of mineral-filled columns under vacuum with degassed 0.01 mol L^-1 NaClO_4
  - After column equilibration application of Eu-spiked solution (including Br^- as a tracer, 10^3 mol L^-1)
  - Varying geochemical parameters: pH 3.5 and 5.5
  - Column and tubing materials: PFA, PTFE
- Twofold experiments to assure reproducibility of experimental data

First model approaches (STANMOD^1) – blue line (cf. Fig. 1, Fig. 2)

Conclusions and Outlook

- Experimental set up of column experiments yield reproducible and plausible data
- STANMOD^1 fits indicate non-linear sorption characteristics (steeper front compared to tailing, Quartz pH 3.5 I and II, Fig. 2)
- So far, assessed SCP from titration curves match literature values well (Noseck, Brendler, Flügge et al. (2012)^2)
- Constant improvement of PhreeqC input files to model surface complexation reactions (surface complexation models)
- To follow
  - Column experiments with muscovite, orthoclase and natural sediment
  - Variation of ligand and competing cation concentrations, ionic strength, background electrolyte, application of transient conditions
  - Application of reactive transport models to validate derived SCP from batch experiments (PhreeqC)

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