- [x] **Acti**nide **S**cience (ANS)
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- [ ] **N**ano- and **M**icro-**T**echnologies (NMT)
- [ ] **C**ondensed **M**atter (CM)
- [ ] **Bio**logy and Bio Interfaces (BIO)
- [ ] **Cat**alysis (CAT)
- [ ] **S**ynchrotron **T**echnologies (ST)

Fate of Lu(III) during 2-line ferrihydrite transformation

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Iron (hydr)oxides are widespread in nature and can be considered as regulators of the concentration and distribution of pollutants. Commonly found are ferrihydrite and its transformation products goethite and hematite. In deep nuclear waste disposal sites, iron (hydr)oxides may form by the corrosion of drum steel and can serve as sink for radionuclides (RN). The way how RN are immobilized directly impacts the retention strength. The most effective retention may occur by structural entrapment as a result of direct precipitation or recrystallization/transformation in the presence of RN.

In the present work, two suspensions of ferrihydrite were aged (7 years for sample T5 and 11 years for sample T2) in the presence of Lu(III) that was used as surrogate for trivalent actinides. The solid phases were first separated from the supernatant by centrifugation. The solid phases and the supernatants were analysed with respect to their Lu content (ICP-MS) and their morphologies (SEM). The solid phases were further characterized by XRD to identify the structure(s). the Lu local environment was probed by EXAFS spectroscopy at the INE-Beamline at the Lu L_3-edge.

In both samples, ICP-MS data indicate that 30-40 % of Lu is associated with the solid phases. XRD patterns are consistent with one suspension containing only hematite (sample T5) and the second containing a mixture of hematite and goethite (sample T2). These results are corroborated by SEM micrographs: only rhombohedra are visible in the T5 micrographs whereas T2 contains rhombohedra and needles. The EXAFS data indicate marked differences in the Lu local environment. Lu is sixfold coordinated by O atoms at d(Lu-O) = 2.20 Å in T2 whereas two subshells compose the Lu first coordination sphere in T5. In T5, one subshell is located at a distance similar (2.33 Å) as the hydration water molecules for the free aqua ions (2.31 Å), and thus the subshell at d(Lu-O) = 2.19 Å can be interpreted as binding the mineral surface. Taking into account the samples compositions and the Lu binding environments, the transformation of ferrihydrite in the presence of Lu leads to an incorporation of the lanthanide in goethite and a surface retention on hematite.

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