

## Spatially-resolved characterization of Eu(III) interaction with granitic rock (Eibenstock, Germany)

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The mobility of (radio-)contaminants in the geosphere is controlled by their interaction with the surfaces of surrounding minerals. Typically these interactions are studied either with single mineral phases, or in field studies in natural rock formations consisting of multiple mineral phases. In the former case, the involved reactions can be characterized at the molecular level with appropriate spectroscopic tools, but the complexity of the natural rock is lost, while the latter case often only allows a quantitative approach due to the inherent complexity of the natural system.

Here we present a novel approach to bridge this gap in the understanding of sorption processes. Time-resolved laser-induced fluorescence spectroscopy (TRLFS) is a well established technique to characterize the speciation of luminescent metal ions, e.g. Eu(III)<sup>[1]</sup> or Cm(III).<sup>[2]</sup> We have adapted the technique to allow scanning a rock sample consisting of a variety of mineral grains, through a focused laser beam with a spatial resolution  $\sim 20 \mu\text{m}$  ( $\mu\text{TRLFS}$ ). This way we are able to obtain full emission spectra and lifetimes in each spot. Through this improvement, it is possible to not only map the distribution of a fluorescent probe on the rock, but also to determine its speciation in each location, with respect to its coordination strength and hydration state.

The interaction of Eu(III) with granitic rock thick sections from the former uranium mine Eibenstock, Germany, were investigated by  $\mu\text{TRLFS}$ . The investigation is complemented by mineral characterization using  $\mu\text{XRF}$ , EMPA, and thin section microscopy. The results clearly show the differing sorption capacity and sorption strength of the minerals contained in the granite, with the highest sorption capacity found for feldspars. In addition, grain boundaries often show a reactivity distinct from both bordering mineral grains, e.g. a quartz/biotite grain boundary showing higher adsorption than both, quartz and biotite.

In summary, the results highlight the necessity to complement studies of model systems with more realistic whole system investigations. The technical improvement to a well-established spectroscopic tool also offers opportunities for other fields of (bio)geochemistry.

(1) Binnemans, K., *Coord. Chem. Rev.* **2015**, 295, 1-45.

(2) Edelstein, N.M., *Coord. Chem. Rev.* **2006**, 250, 948-973.