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Exploring the Eu(III) translocation in hydroponically grown plants

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Lanthanides (Ln) have become critical metals in various industrial processes, scientific applications and everyday objects. Consequently, the intense exploitation of these metals cause a multitude of possible entry paths into the environment. Knowledge about the fate of these elements in the biosphere is crucial for reliable food safety assessments and conceptualizing phytoremediation strategies.

Our aim is to obtain a process understanding of the interaction between Ln and plants, from the initial exposure and the cellular uptake until the translocation into aboveground parts. Therefore, we use hydroponically grown *Medicago sativa*, a legume cultivated as forage crop in many countries, to investigate the uptake of Eu(III), as representative for Ln and as chemical analogue for the radioactive actinides Cm(III) and Am(III), and its distribution throughout the plant. After an incubation time of 96 h with 200, 20 and 2 µM Eu(III), that was spiked with its beta−emitting isotope Eu-152, time-resolved laser-induced fluorescence spectroscopy (TRLFS) was utilized to reveal the speciation change of the metal in the liquid nutrient medium during plant contact. Ashing of roots, shoots and leaves and subsequent acid digestion shows, that only about 1 % (≈66 $\mu g/g_{dry\ weight}$) of the bioassociated Eu(III) is found in the green plant parts, whereas the majority accumulates in the roots (≈5734 $\mu g/g_{dry\ weight}$). Autoradiography was further employed to unravel the macroscopic distribution of the metal in plant organs. Furthermore, chemical microscopy with Eu(III) as luminescence probe gave access to the microscopic distribution in various sections of the root (Fig.1). Data evaluation by the means of iterative factor analysis enabled the deconvolution of several Eu(III) species, which could be assigned to cellular binding motifs.

These studies contributed to a comprehensive understanding of the fate of trivalent Ln in the biosphere. Investigations regarding the uptake and distribution of Cm(III) by plants are currently under way.

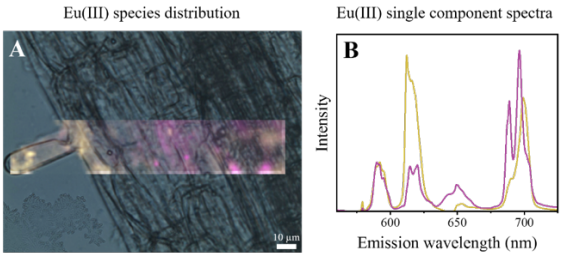

Fig. 1: Results of chemical microscopy: **A** Eu(III) species distribution in a root of *M. sativa*, **B** Eu(III) single component spectra, derived from non-negative iterative factor analysis.