Shells of *Corbicula fluminea* mussels and the bioavailability of anthropogenic Rare Earth Elements in river water

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Rare Earth Elements (REE) of anthropogenic origin can be found in river water and drinking water all around the world [1]. The Rhine River and the Weser River in Germany both carry an anthropogenic Gd anomaly that results from the use of Gd in MRI contrast agents that are introduced into the rivers with the effluents from waste water treatment plants [2,3]. In addition, the Rhine River also carries an anthropogenic La anomaly (and most recently an anthropogenic Sm anomaly [4]), downstream of the Town of Worms, where industry effluents with high concentrations of La (and Sm) are discharged into the river [3]. The shells of invasive freshwater mollusk *Corbicula fluminea* were collected from both rivers to investigate the bioavailability of these anthropogenic REE. As the aragonite shell of *Corbicula* grows from the epithallial fluid of the mussel, anthropogenic metals have to be taken up by the mussel organism in order to eventually be available for incorporation in the shell. *Corbicula* shells from the Weser River and from the upper Rhine River incorporate the geogenic REE from the river water, with slight preferential incorporation of LREE over HREE. Anthropogenic La is readily incorporated into the shells, reflecting La-REE relationships in ambient river water. In contrast, anthropogenic Gd could not be detected in any of the *Corbicula* shells. These results show that anthropogenic Gd is not bioavailable, probably due to the persistence of the highly stable Gd-DTPA complex that is used as MRI contrast agent. Potential effects of high doses of REE should be investigated, because fish are known to bioaccumulate REE [5] and anthropogenic REE have been found in tap water [2].

[1] Kulaksız & Bau (2011) *Appl Geochem* **26** 1877-1885 [2] Kulaksız & Bau (2007) *EPSL* **260** 361-371 [3] Kulaksız & Bau (2011) *Environ Intern* **37** 973-979 [4] Kulaksiz & Bau (2013) *EPSL* **362** 43-50 [5] Sun *et al*. (1996) Chemosphere 33 1475-1483

Time resolved monitoring of Uranium contamination of oak trees

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Monitoring organisms such as higher plants are used for qualitative and quantitative detection of contaminants in the environment because they take up nutrients and contaminants via air, water and soil. Since trees in temperate regions form annual rings, chronological records of environmental pollution for the near vicinity of the trees can be obtained by spatially resolved analysis of the tree rings.

In the current work a simple and minimal-destructive method for sampling and the spatially resolved (about 200 μm resolution) analysis of trees was developed. Concentration of nutrients and pollution of trees with U and other heavy metals was measured by laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) in annual rings of oak trees grown in a former uranium mining area in Thuringia. The area was contaminated with heap material during active mining and was elaborately remediated by Wismut GmbH in 2002 after termination of mining.

For quantification the standard reference material Virginia Tobacco Leaves CTA-VTL-2 was pressed and used for calibration while C was used as internal standard. Thus, it was possible to deduce a temporally resolved depiction of the element concentrations reflecting the history of uranium contamination for the last 50-60 years and also to indicate remediation success.

The U concentrations in the analyzed tree cores could be directly related to mobile U concentrations in the substrate thus verifying the applied method as a successful biomonitoring tool for U contamination in soils.

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