

CE-ICP-MS as speciation technique to analyze the complexation behavior of lanthanides with humic acid

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For the long-term disposal of radioactive waste, detailed information about geochemical behavior of radioactive and toxic metal ions under environmental conditions is necessary. Humic acid (HA) can play an important role in the immobilisation or mobilisation of metal ions due to complexation and colloid formation. Therefore, we investigate the complexation behavior of selected metal ions (europium and gadolinium as homologues of the actinides americium and curium) with HA.

To guarantee reliable results, two different analytical methods were used to determine stability constants by differentiating between uncomplexed metal ions and metal ions which are bound to HA (1). The evaluation of complex stability constants was performed by applying ultrafiltration, mechanically separating non HA complexed ions of Eu and Gd from the metal-humate complexes. Measurement of the separated ions from the filtrate was done by ICP-MS. As an alternative technique, capillary electrophoresis (CE) was hyphenated with inductively coupled plasma-mass spectrometry (ICP-MS). With this method both the uncomplexed metal ions and metal humate complexes can be simultaneous detected in one analysis step.

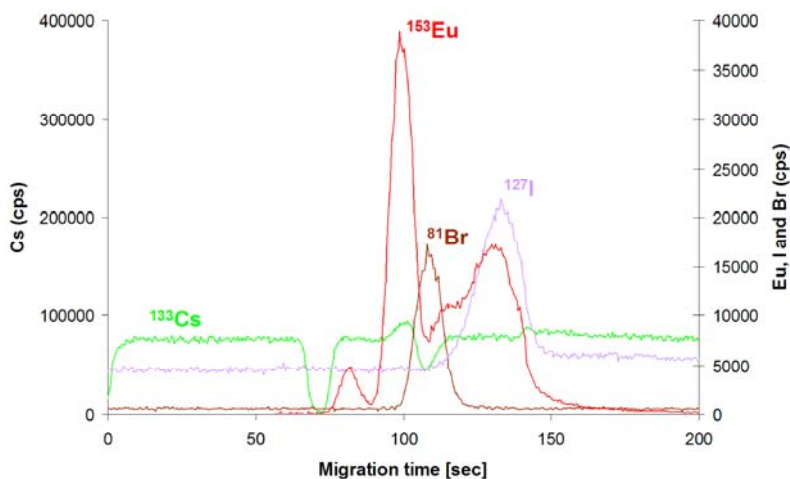


Fig. 1: CE-ICP-MS electropherogram showing Eu species (¹⁵³Eu) complexed or uncomplexed with iodinated HA (¹²⁷I), 1-bromopropane (⁸¹Br) as neutral marker and Cs (¹³³Cs) as CE electrolyte flow marker (1).

Generally, HA are not detectable by ICP-MS. To make the HA visible, we used a chemical procedure to halogenate the aromatic hydrocarbon-rings in the HA with iodine as "ICP-MS" marker. This results in an unambiguous differentiation of ICP-MS metal signals, assigned to HA complexed and uncomplexed metal species. The authors thank the BMWA for financial support of the project through grant no. 02 E 9683.

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