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## Optimization of a chemical separation strategy for trivalent actinides from rare-earth rich deep-sea archives

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The understanding of the formation of the elements has been an intriguing topic within the last decades. It is now approved that the heaviest naturally occurring elements on earth, the actinides, are produced in the astrophysical r-process. However, the exact site of this process is still disputed. Recently, the amount of interstellar  $^{244}\text{Pu}$  ( $T_{1/2} = 80.6$  Ma) in various geological archives like deep-sea ferromanganese crusts and sediments has been investigated by applying highly sensitive accelerator mass spectrometry measurements (AMS).<sup>[1,2]</sup> Correlation of the influx of supernova-produced  $^{60}\text{Fe}$  ( $T_{1/2} = 2.6$  Ma) and  $^{244}\text{Pu}$  could point to a possible origin of the r-process in the universe. To further prove this hypothesis, recent investigations focus on the determination of another long-lived radionuclide which is also produced in the r process,  $^{247}\text{Cm}$  ( $T_{1/2} = 15.6$  Ma), by AMS. However, the separation of the expected ultra-trace amounts of actinides (a few 100 atoms per gram) from huge amounts of matrix and interfering elements represents a major analytical challenge. Thus, this contribution aims to compare existing chemical separation strategies for trivalent actinides (Am, Cm) from deep-sea reservoirs, like ferromanganese crusts or nodules based on extraction chromatography. Our investigations show that procedures based on trivalent actinide separation by TRU<sup>TM</sup> resin<sup>[3]</sup> fail to extract trivalent actinides from matrices with high concentrations of rare-earth elements. Thus, an alternative separation method based on anion exchange (DOWEX 1x8 for Pu separation) and solvent extraction (DGA<sup>TM</sup> resin for An/Ln separation and TEVA<sup>TM</sup> resin for the separation of Am/Cm from rare-earths) has been adapted in our studies.<sup>[4]</sup>  $^{241}\text{Am}$  and  $^{244}\text{Cm}$  in kBq quantities were used as tracers to determine the yield of the full separation procedure by  $\gamma$ -counting and  $\alpha$  spectrometry. The effective separation of trivalent actinides from major matrix elements, like iron and manganese, as well as various rare-earth elements allow for processing multi-gram amounts of deep-sea ferromanganese crusts. This could finally lead to the detection of live  $^{247}\text{Cm}$  in geological archives. Furthermore, this adapted method can be used for the analysis of environmental samples regarding their content and isotopic ratio of anthropogenically produced Pu, Am and Cm which holds potential for nuclear safeguards and nuclear forensics studies.

### References

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