Contribution ID: **40** Contribution code: **PSA-64** Type: **Poster**

Development of a chemical separation strategy for r-process derived radionuclides from terrestrial and lunar geological archives

Monday, 21 October 2024 17:15 (20 minutes)

The understanding of the formation of the elements has been an intriguing topic within the last decades. It is now proven that the heaviest naturally occurring elements, the actinides, are produced in the astrophysical *r*-process. However, the exact site of this process is still under debate. Recently, the amount of interstellar ^{244}Pu ($T_{1/2}$ = 81.3 Myr) in various geological archives like deep-sea ferromanganese crusts and sediments has been investigated by applying highly sensitive accelerator mass spectrometry (AMS) measurements.[1,2] Correlation of the influx of ^{244}Pu with ^{60}Fe ($T_{1/2}$ = 2.6 Myr), which is produced by the *s*-process in massive stars and ejected into the interstellar medium by supernovae, could point to supernovae as the origin of the *r*-process in the universe. To further prove this hypothesis, recent investigations focus on the determination of other long-lived radionuclides which are also produced in the *r*-process, e.g. ^{247}Cm ($T_{1/2}$ = 15.6 Myr) and ^{182}Hf ($T_{1/2}$ = 8.9 Myr). However, the separation of the expected ultra-trace amounts of these nuclides (a few 100 atoms per gram) from huge amounts of matrix and interfering elements represents a major analytical challenge. Thus, this contribution aims to probe existing chemical treatment strategies for the determination of minute amounts of actinides and Hf from various geological archives. The separation method is based on anion exchange for Pu separation and extraction chromatography for Cm and Hf, respectively.[3,4] The yield of the different elements is monitored by a combination of AMS, γ-counting and ICP-MS measurements. The effective separation strategy of different actinides and Hf from major matrix elements allows for processing multi-gram amounts of different geological samples. This is a prerequisite for the detection of live interstellar ^{244}Pu, ^{247}Cm and ^{182}Hf in terrestrial and lunar geological archives. Furthermore, this method can be adapted for the analysis of other 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.

Acknowledgments
Ulf Linnemann from Senckenberg Museum Dresden is gratefully acknowledged for providing deep-sea nodules for chemistry tests. The Central Radionuclide Laboratory of TU Dresden is acknowledged for using their laboratories, gamma counters and ^{241}Am stock solution.

Student Submission

No

Primary author: FICHTER, Sebastian (Helmholtz-Zentrum Dresden-Rossendorf)

Co-authors: HOTCHKIS, Michael (ANSTO); Dr KOLL, Dominik (The Australian National University & TU Dresden & Helmholtz-Zentrum Dresden-Rossendorf); ZWICKEL, Sebastian (Helmholtz-Zentrum Dresden-Rossendorf); WALLNER, Anton (Helmholtz-Zentrum Dresden-Rossendorf)

Presenter: FICHTER, Sebastian (Helmholtz-Zentrum Dresden-Rossendorf)

Session Classification: Poster Session A

Track Classification: Sample Preparation Techniques