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Establishing matrix backgrounds and radionuclide concentrations for the metrology of new, SI-traceable isotope standards for the determination of key radioactive pollutants in the environment by (accelerator) mass spectrometry

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For its ultimate success, the zero-pollution ambition of the European Green Deal requires highly sensitive and state-of-the-art detection techniques to determine ultra-low amounts of pollutants in the environment. Mass spectrometry has become a key method for the determination of non-radioactive polluting elements, and is also of increasing importance for the detection of long-lived radionuclides. The MetroPOEM (Metrology for the Harmonisation of Measurements of Environmental Pollutants in Europe) project has been designed to bridge the gap between the radiometric techniques and mass spectrometry by comparing and linking both techniques, thus significantly improving measurement uncertainties and detection limits. As an important part of achieving this aim, this project will develop new reference materials, resulting in SI-traceable measurement procedures tracking the sources of pollution by commonly available mass spectrometers. The MetroPOEM Project Consortium has 22 Partners in 14 countries. The project is funded by the EU through the European Association of National Metrology Institutes (EURAMET).

The radioactive pollutants identified as the most significant for this project are ^{236}U, ^{237}Np, ^{239}Pu, ^{240}Pu, ^{241}Am, and ^{90}Sr. For these pollutants, project partners will create both single isotope activity standards available in 6 dilutions each, and multi-isotope solutions. Finally, these solutions will be used to create a solid and a liquid reference material mimicking typical environmental matrixes, enabling a full proficiency test based on a directly SI-traceable material. These materials will then be disseminated to participating laboratories for an inter-laboratory comparison.

In the area of radioactive pollutants accelerator mass spectrometry (AMS) is making an important and unique contribution. AMS offers the lowest isotopic abundance detection limits for the actinide isotopes, which has been demonstrated over many years by the pioneering actinide AMS system of the Vienna Environmental Research Accelerator (VERA). Recently, a new generation of small AMS systems, such as the Multi Isotope Low Energy AMS system MILEA designed by ETH Zurich and Ionplus AG, and operated at several labs worldwide including ETH Zurich, offer an efficient way for precise measurements at low levels for actinides. In a further advance in AMS, a new isobar separation system at the VERA facility for 90Sr, has shown that AMS is also the most sensitive method overall for the latter isotope. Meanwhile, at the Helmholtz-Zentrum Dresden-Rossendorf a new dedicated system –HAMSTER –advancing over the state-of-the-art for heavy isotopes and other isotopes is currently being implemented, however, only the actinide sample preparation laboratories are operational at this stage.

Here we present first results and details of our AMS determination of single and multi-isotope solutions and matrix backgrounds for the solid and the liquid reference material at both the facilities of ETHZ and University of Vienna, controlling for systematic effects of different systems and mass spectrometry methods. These measurements will represent an important step for the final deliverables of the MetroPOEM Project.

Student Submission

No

Primary authors: WALLNER, Anton (Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany); PÉREZ-TRIBOUILLIER, Habacuc (Laboratory of Ion Beam Physics, ETH Zurich, Zurich, Switzerland); HAIN, Karin (University of Vienna –Faculty of Physics, Isotope Physics, Vienna, Austria); Dr WINKLER, Stephan (Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany); KIRSCH, Klemens (Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany); Dr CHRISTL, Marcus (Laboratory of Ion Beam Physics, ETH Zurich, Zurich, Switzerland); MARTSCHINI, Martin (University of Vienna –Faculty of Physics, Isotope Physics, Vienna, Austria); STEIER, Peter (University of Vienna –Faculty of Physics, Isotope Physics, Vienna, Austria); FICHTER, Sebastian (Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany)

Presenter: Dr WINKLER, Stephan (Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany)

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