Physikalisch-Technische Bundesanstalt
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Progress and achievements of EURAMET project 21GRD09 MetroPOEM (Poster)

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Zitierform:

INTERNATIONAL METROLOGY CONGRESS
CIM2025

MetroPOEM

EURAMET

Progress and achievements of EURAMET project 21GRD09 MetroPOEM

Metrology for harmonization of measurements of environmental pollutants in Europe

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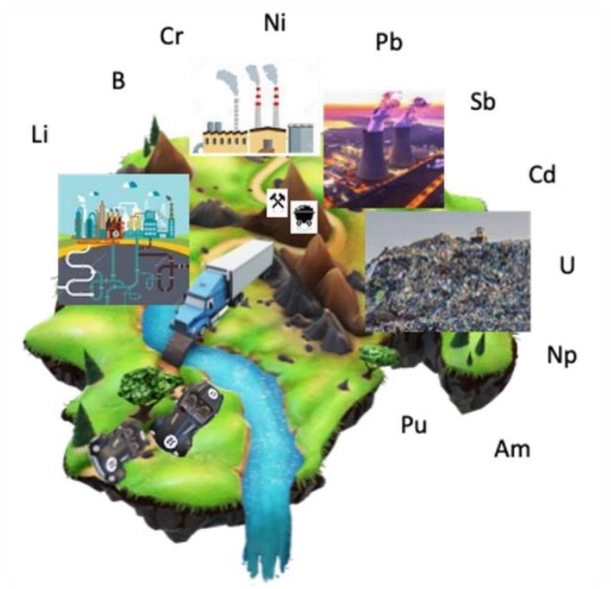
Overview

The European Green Deal's ambition for zero pollution requires the development of highly sensitive techniques to detect and trace ultra-low amounts of pollutants. Mass spectrometry is a key method for the determination of non-radioactive polluting elements, long-lived radionuclides, and increasingly radionuclides traditionally determined by activity measurements.

The MetroPOEM project bridges the traceability gap between activity and mass-based measurements – particularly the issue of estimation of mass bias.



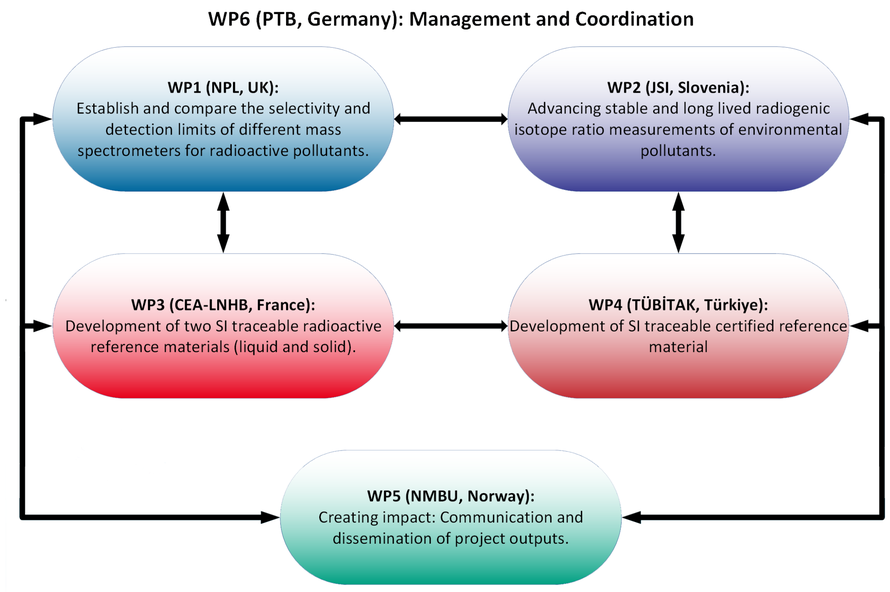
The Creation of Certified Reference Materials

A sample of 250 litres of sea water was taken from the German EEZ (North Sea), as a basis for the development of two different certified reference materials (CRMs). The raw material was subjected to further processing steps, including spiking with additional elements where necessary based on preliminary analysis and homogenisation.

Part of this candidate reference material was characterised for isotope ratios of Li, B, Cr, Cd, Ni, Sb, Pb, and U to generate a reference material with SI traceability for isotope ratios. Additionally, ČMI generated ~50×0,5L liquid RM aliquots of sea water spiked with natural U, ^{237}Np, ^{239,240}Pu and ^{241}Am.

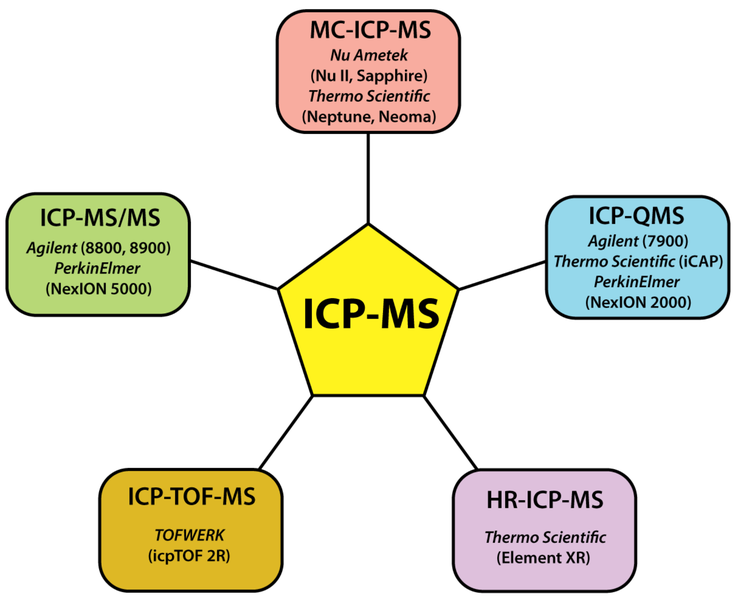
A third, solid silica-based reference material, produced by sol-gel synthesis at CEA spiked with ^{234,235,236,238}U, ^{237}Np, ^{239,240}Pu and ^{241}Am, as well as ~10 kg of an inactive material for testing dissolution

Objectives and Work Packages

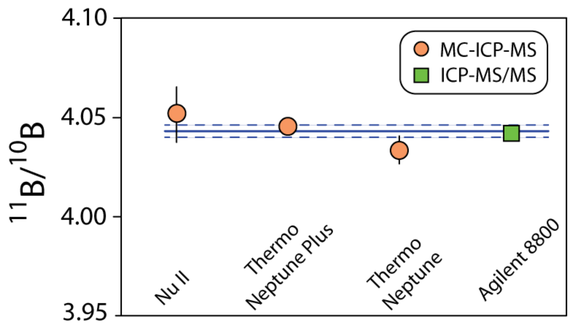


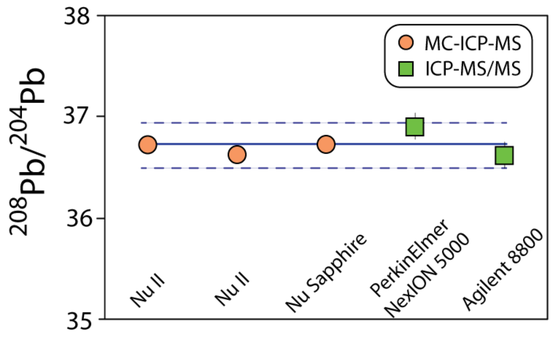
SI-traceable high-precision methods has been developed for isotope ratio determination of Li, B, Cr, Cd, Ni, Sb, Pb, and U in environmental matrices, focused on seawater as the model solution. Method development encompassed manual and automated methods for separating analytes from the matrix, evaluating different calibration approaches and instrumental isotope fractionation corrections, and estimating uncertainty budgets.

Single and multi-collector ICP-MS systems such as MC-ICP-MS, sector field ICP-MS, quadrupole ICP-MS and ICP-MS/MS techniques, as well as accelerator mass spectrometry (AMS), were used and their performances compared. Examples of boron and lead isotope comparisons are sown below.



Standard solutions with Radioactive tracers (^{90}Sr, ^{237}Np, ^{234,236}U, ^{239,240}Pu, ^{241}Am) were distributed to partner laboratories for measurement. The results and data analysis were compiled as a comparison report, leading to a peer-reviewed publication draft. The findings support the development of methods for radioactive isotope determination.



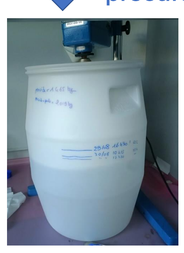


Solid – Radioactive

Individually characterized at NPL and CEA by MS and/or radiometric measurements

^{240}Pu/^{239}Pu < 0,1 Slightly enriched U

Mix with silica precursors



30 L

Wait for evaporation and solidification

9.5 kg

Milling and bottling; Shipment to 13 participants

82 samples of 100 g
Solid candidate RM

Dissolution, Measuremement

Liquid – Radioactive

^{240}Pu/^{239}Pu ~0,1 Natural U

Mix with raw seawater (filtrated, acidified, sterilized)

40 L

Bottling; Shipment to 14 participants

80 samples of 0.5 L
Liquid candidate RM

Measurement

^{235}U/^{238}U Isotopic ratio
^{239}Pu/^{240}Pu Isotopic ratio
Total U concentration
Total Pu concentration
Am concentration
Np concentration

Liquid – Stable

Mix with 120 L seawater (filtrated, acidified, spiked)

Homogenized, bottled and sterilized

470 samples of 0.25 L
Liquid candidate RM

Stability Testing, Measurement

Concentration & Isotopic ratios of:
Li, B, Cr, Ni,
Cd, Sb, Pb, U

Results & Outputs

Peer-reviewed papers describing scientific achievements, the instrument comparison, and presenting the results for the certified reference materials are in preparation.

To support end users interested in developing or upgrading their capabilities, two *Good Practice Guides* on (i) the measurement of radioactivity by mass spectrometric techniques, and (ii) sample treatment, uncertainties and mass bias quantification, are at the final draft stage.

Project outcomes also support standards and metrology organisations, including BIPM (particularly the CCRI/CCQM task group on mass spectrometry), ISO and CEN.

The MetroPOEM Project Website

Scan me!

Funding

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Partners

Collaborators