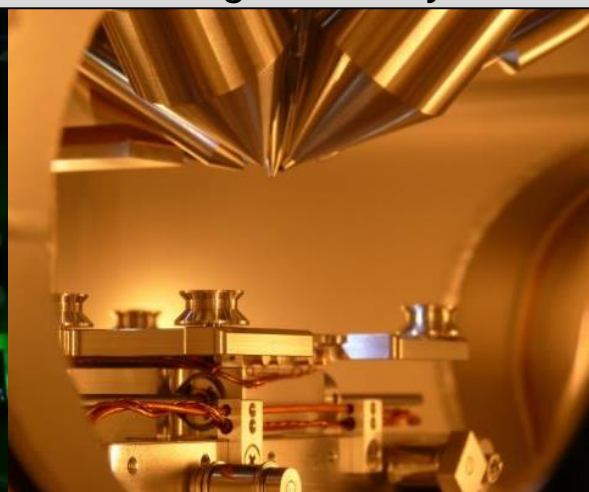


Ultra-trace characterization of natural and anthropogenic nanoparticles by SN MS

C. WALTHER(1), H. BOSCO(1), M. RAIWA(1), M. WEISS(1), K. WENDT (2)

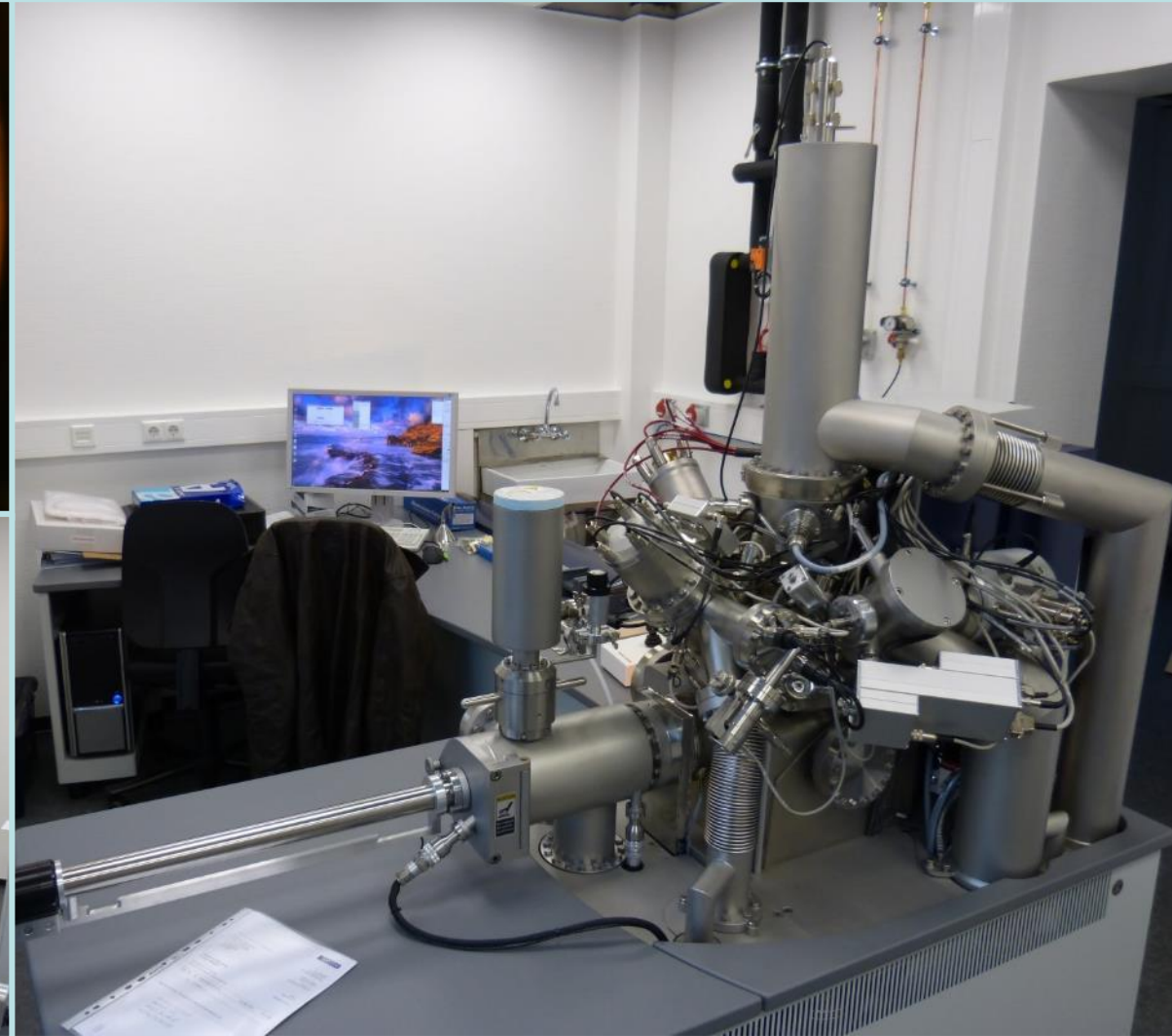
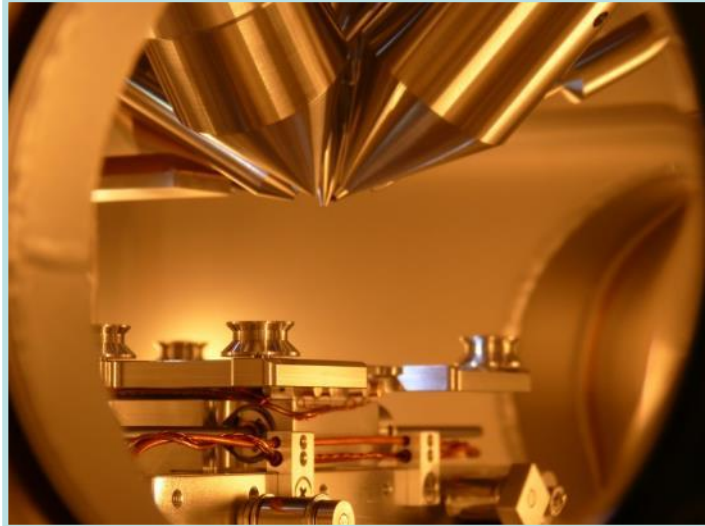
(1) Institute of Radioecology and Radiation Protection, Leibniz University Hannover

(2) Institute of Physics, Johannes Gutenberg-University Mainz



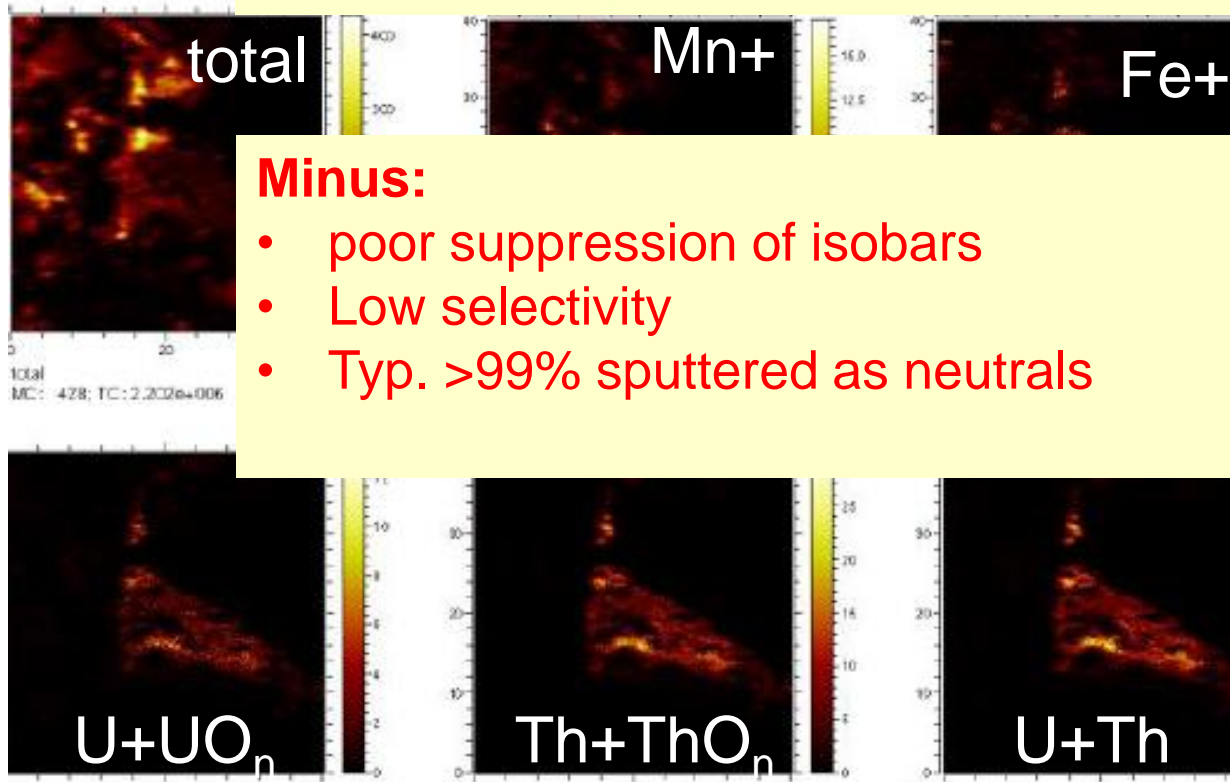
- Detection of hot particles, radioactive nanoparticles and colloids
- Distribution, migration and chemical behavior of RN (**or other pollutants**) in natural compartments and geotechnical barriers
- Development of a measurement system for:
 - **Imaging** of long- and medium-lived fission products and actinides at sub-ppb level
 - Inspection and localization of particles on the **submicron** level
 - Depth profiles of sorption layers
 - Isotope ratios
 - **Applicable to basically all metals**





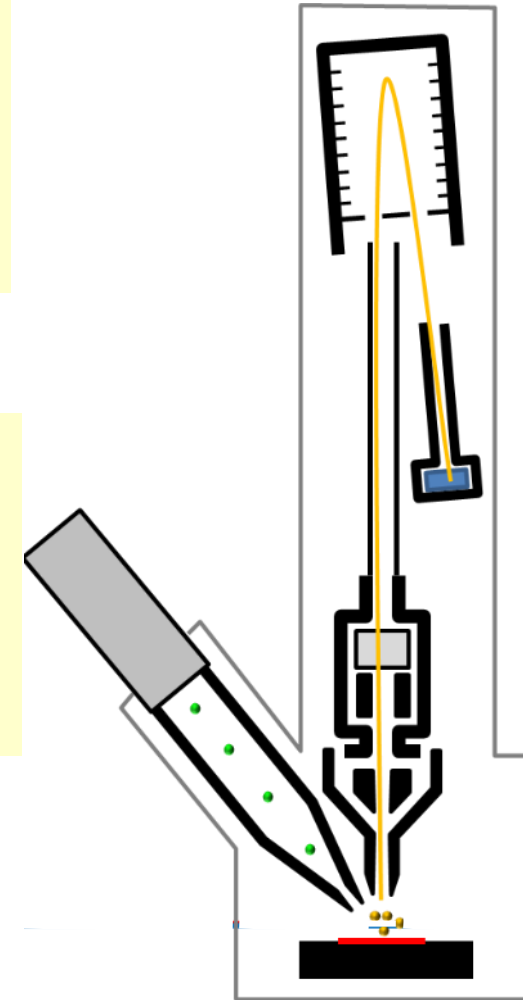
Plus:

- Low sample consumption
- Detection of (organic) molecules
- Insulating samples can be measured
- All „masses“ at a time in one spectrum
- Spatial transversal resolution 70 nm
- Vertical: single atomic layers



Minus:

- poor suppression of isobars
- Low selectivity
- Typ. >99% sputtered as neutrals



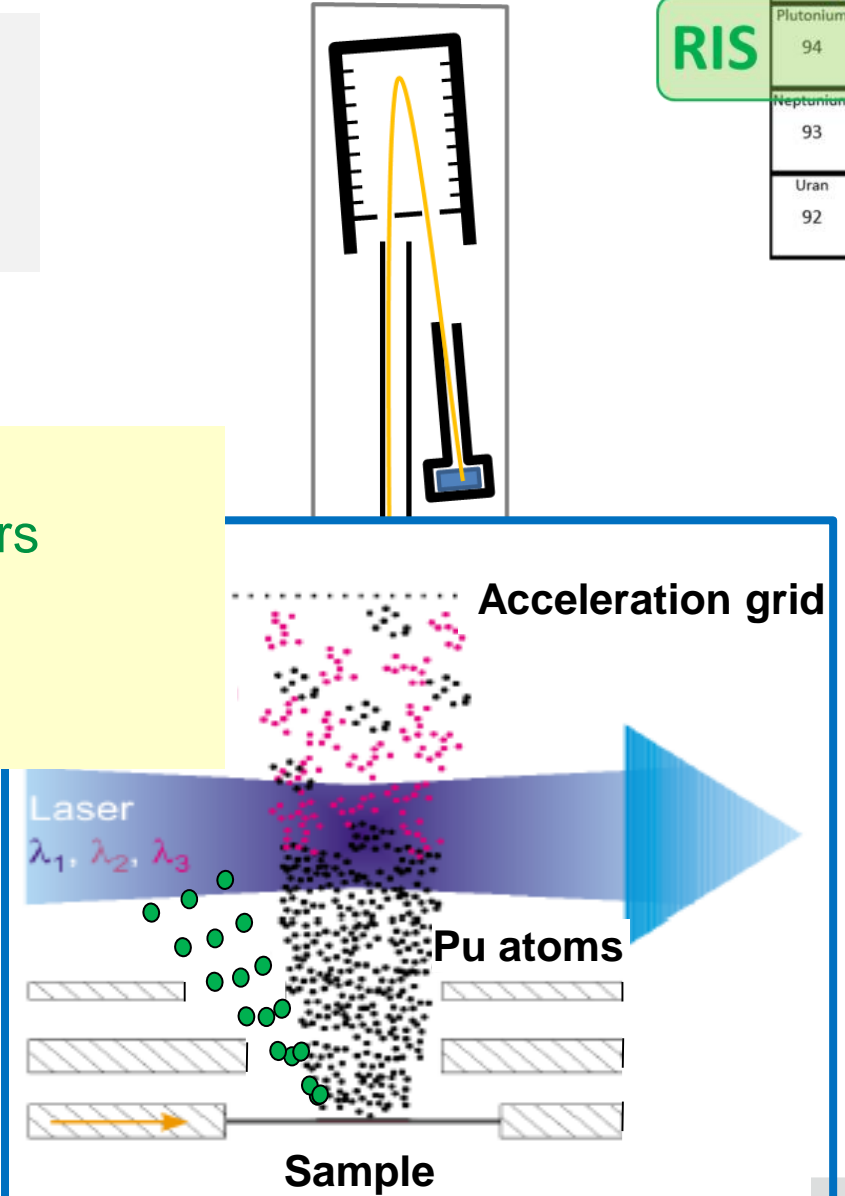
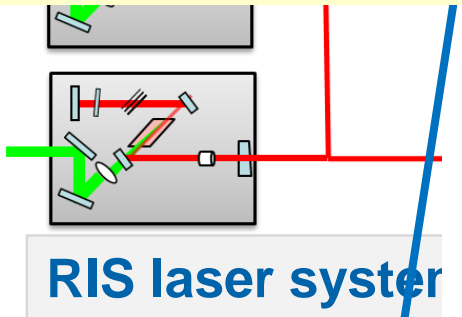
Secondary
Neutral
Mass
Spectrometry

RIS

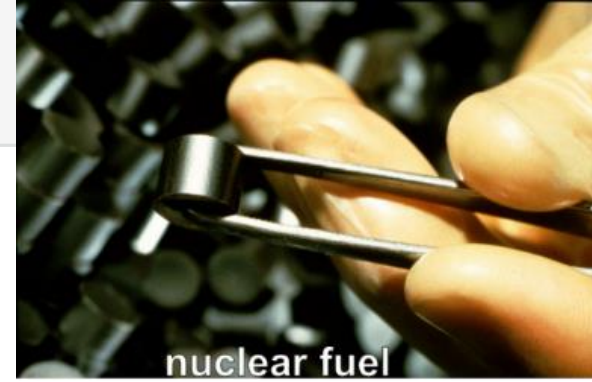
MS

Americium 96	Am238 1.63 h	Am239 11.90 h	Am240 2.12 d	Am241 432.80 y	Am242 16 ms	Am243 7.36e3 y
Plutonium 94	Pu237 180 h	Pu238 45.30 h	Pu239 87.70 y	Pu240 2.4114e4 y	Pu241 6.563e3 y	Pu242 14.33 y
Neptunium 93	Np236 22.50 h	Np237 1.52e5 y	Np237 2.14e6 y	Np238 2.12 d	Np239 2.36 d	Np240 7.40 m
Uran 92	U235 7.04e8 y	U236 0.7204	U236 2.37e7 y	U237 6.75 d	U238 99.2742	U238 4.468e9 y
					U239 23.47 m	U240 14.10 h

- Plus:**
- excellent suppression of isobars
 - high selectivity
 - Post ionization of neutrals



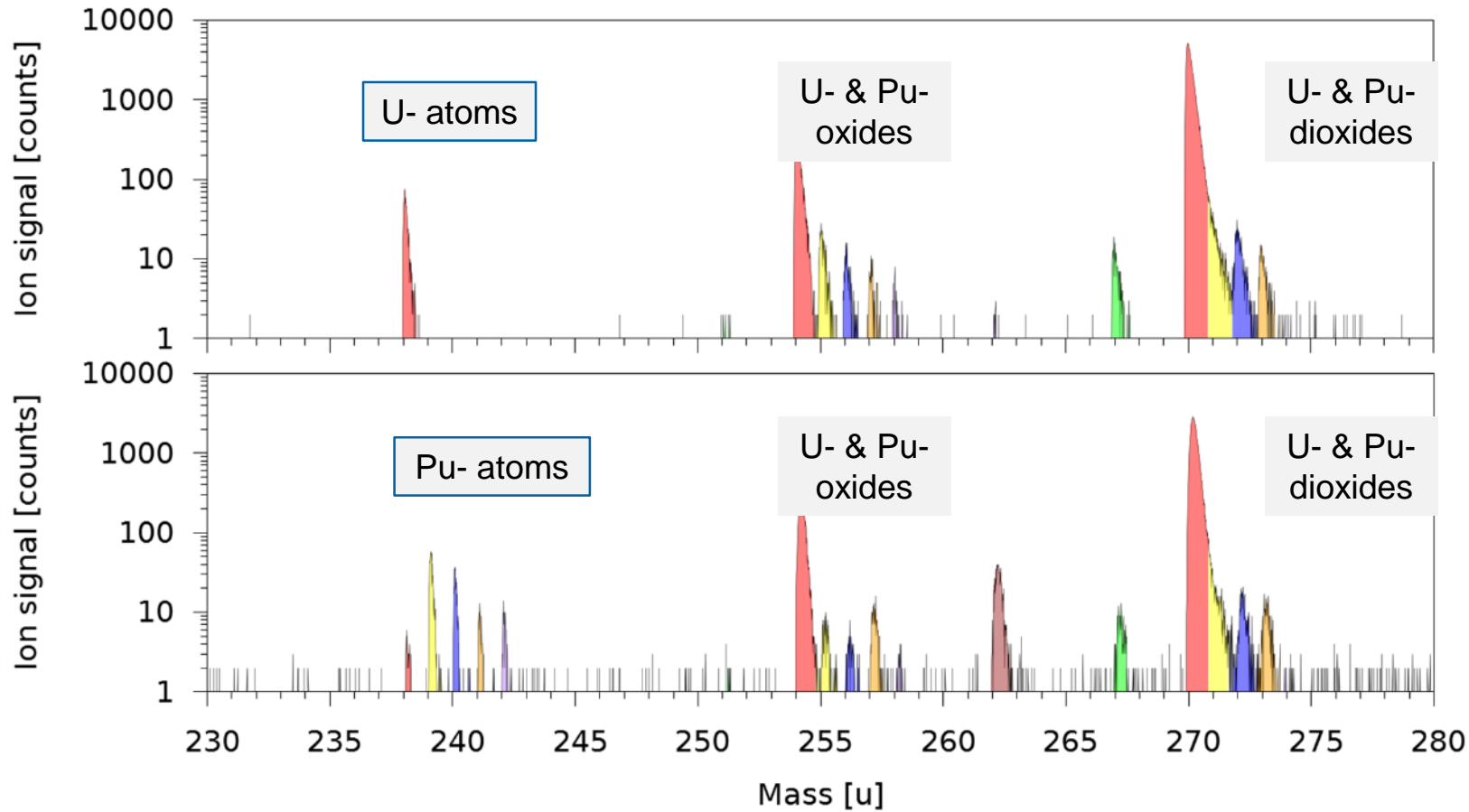
Mixed Oxide Fuel (MOX)



- Suppression of **isobaric** contamination

Laser on uranium

Laser on plutonium

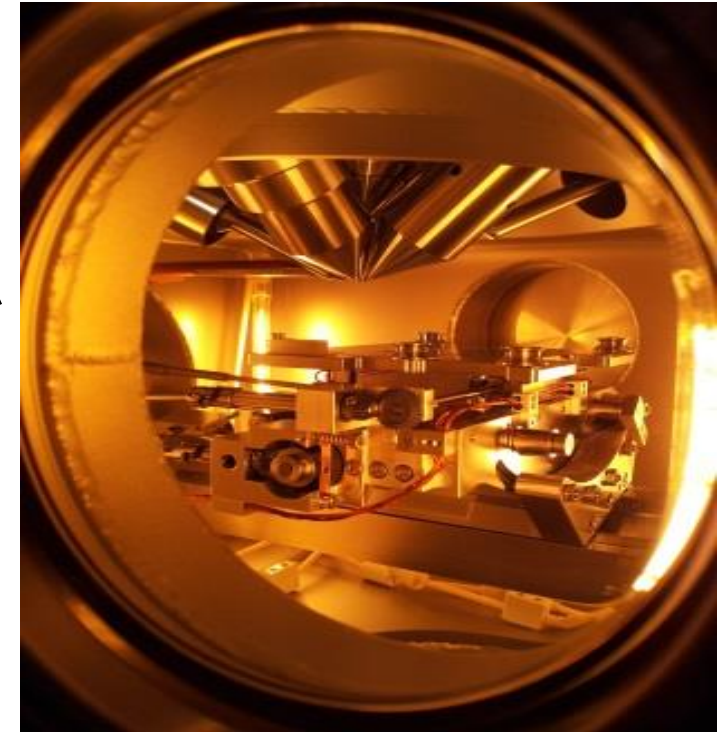
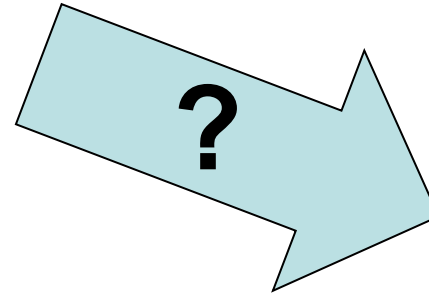
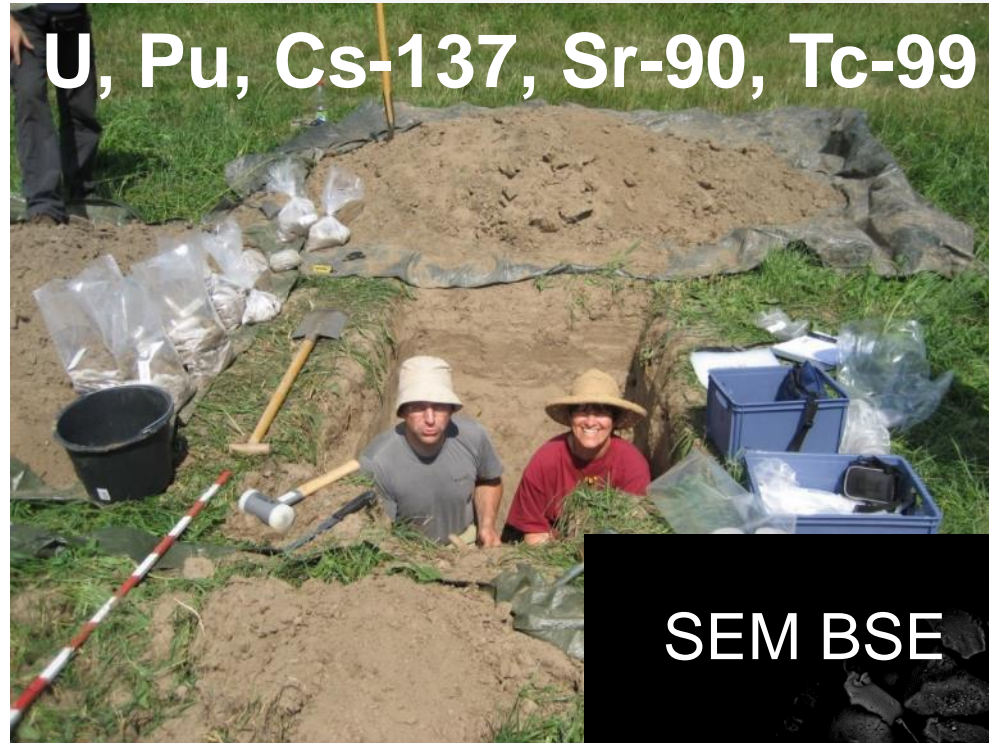


Plutonium ratio:

	²³⁸ Pu	²³⁹ Pu	²⁴⁰ Pu	²⁴¹ Pu	²⁴² Pu
Lit.	2,57%	56,2%	26,5%	7,1 %	7,7%
Measured	2,8(8)%	58(3)%	25(2)%	6,7(10)%	7,1(10)%

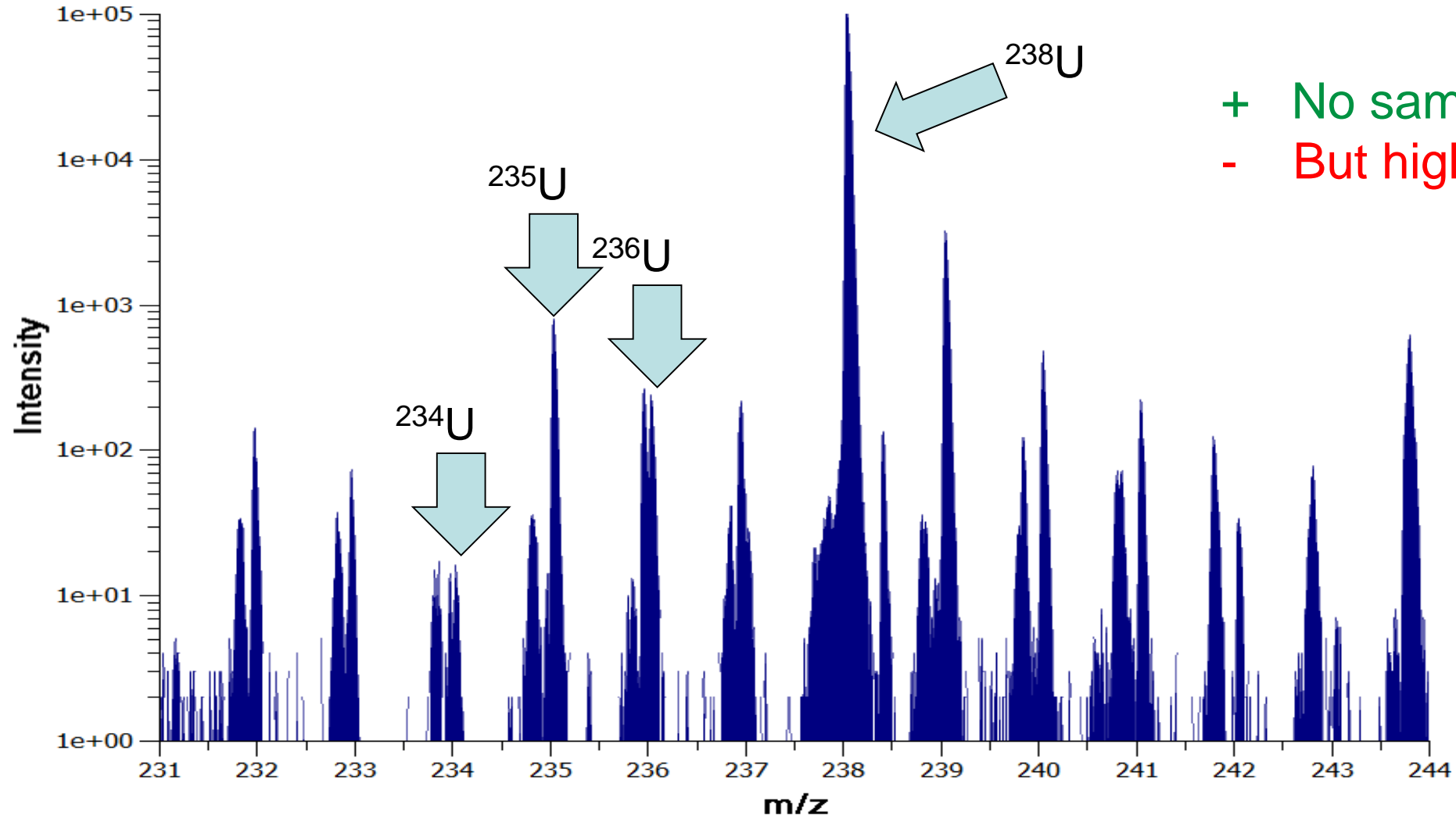
Uranium ratio:

	²³⁵ U	²³⁸ U
Lit.	0,25%	99,75%
Oxide	0,22(7)%	99,8(17)%
Dioxide	0,27(2)%	99,7(5)%

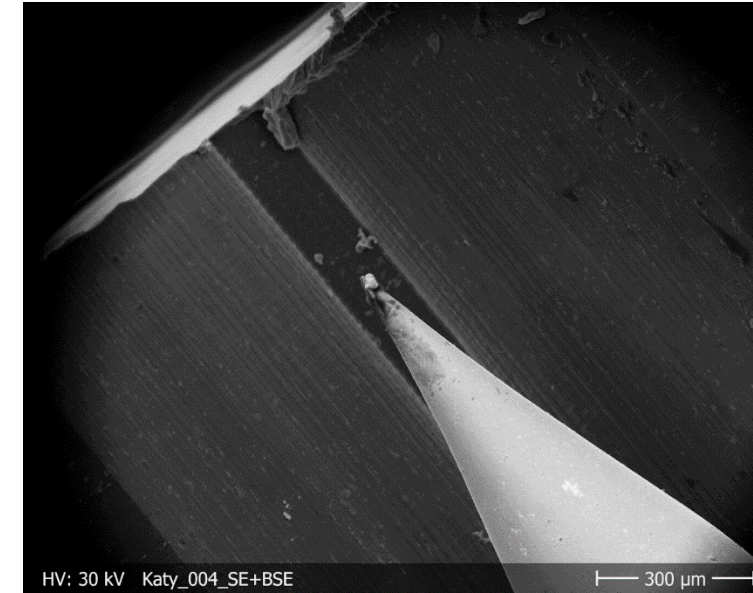
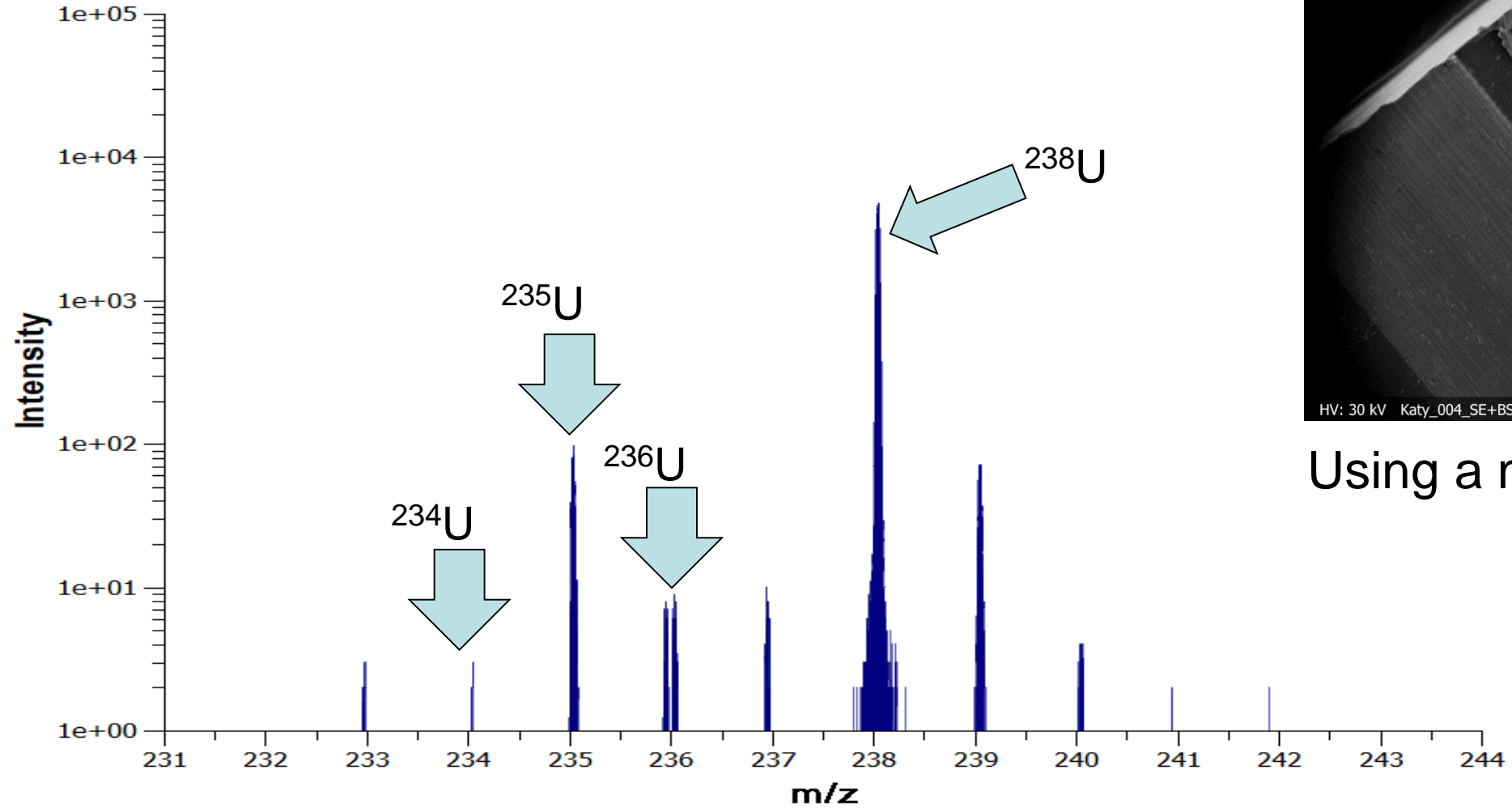




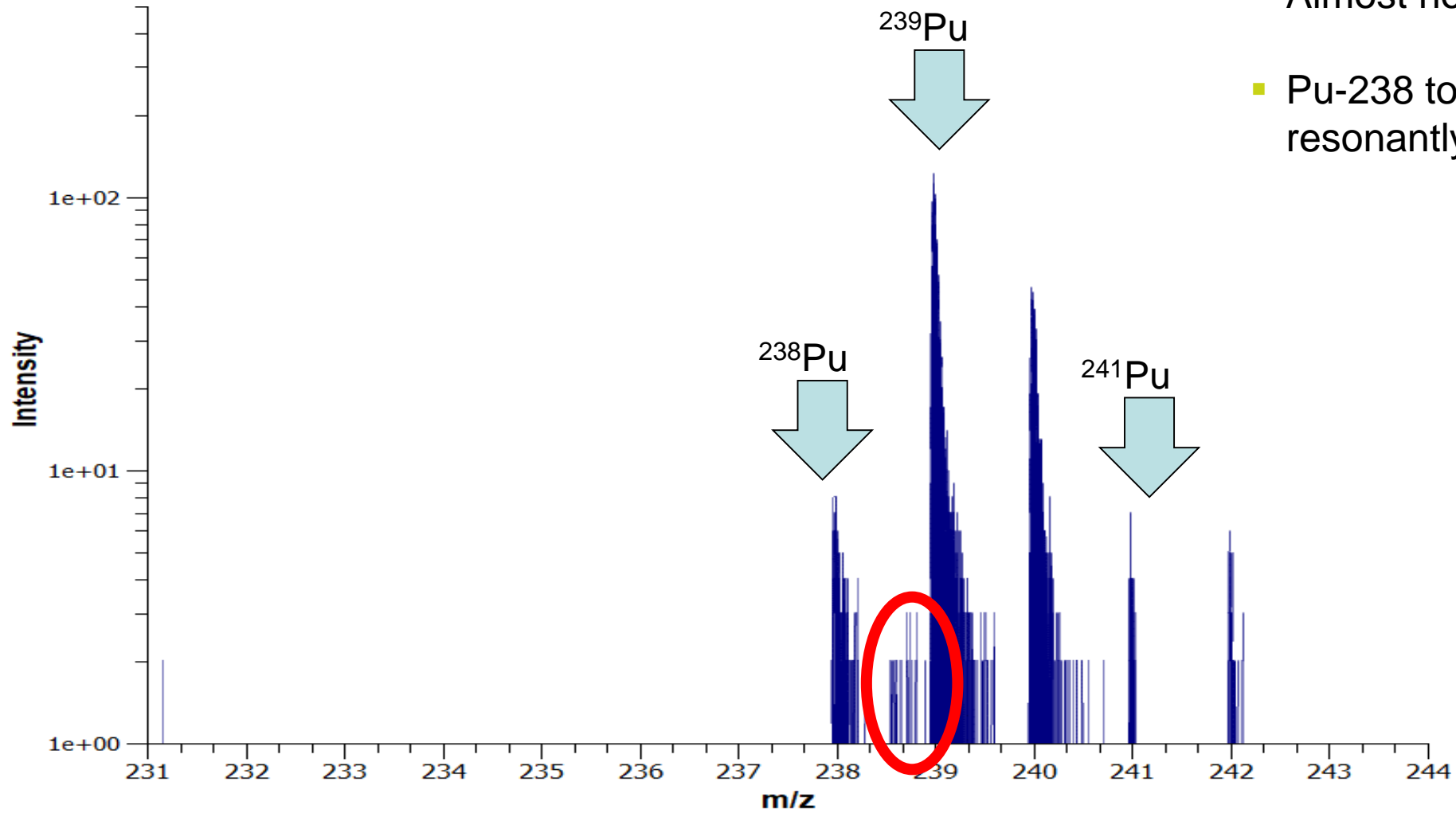
Ukraine excursion: 16. – 19.09.2014



+ No sample preparation
- But high background

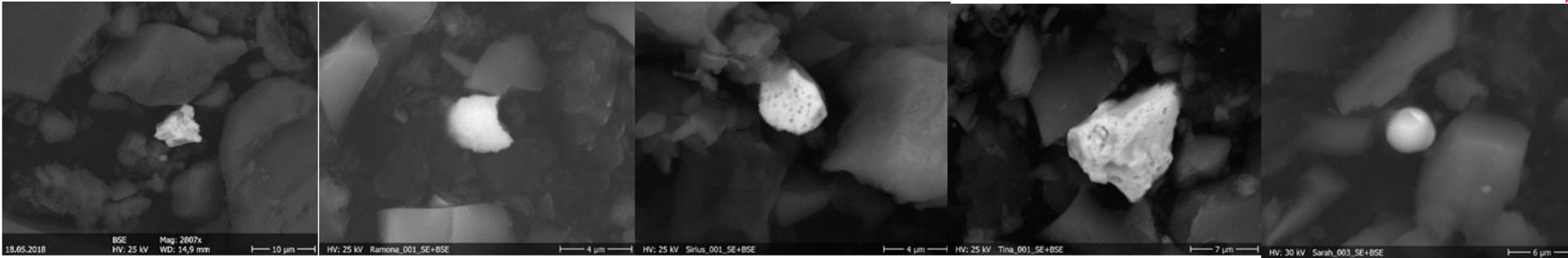


Using a micromanipulator



- Almost no background
- Pu-238 to Pu-242 resonantly ionized

Thanks to



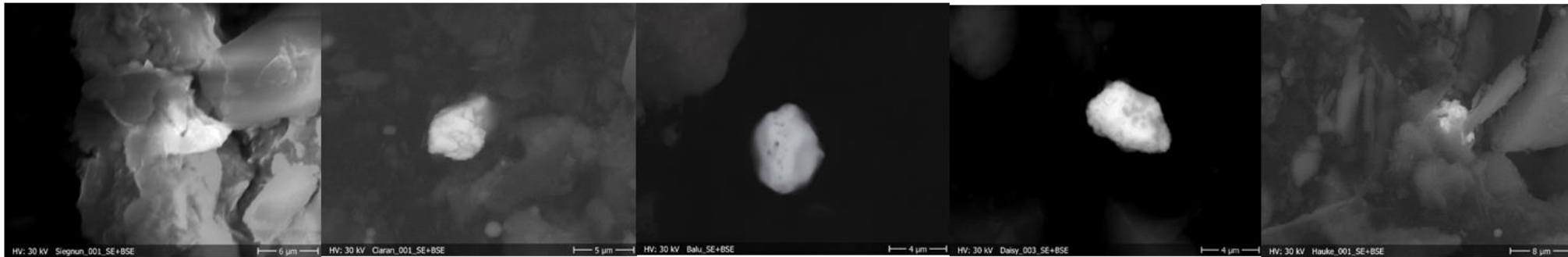
Quincy

Ramona

Sirius

Tina

Sarah



Siegnun

Ciaran

Balu

Daisy

Hauke

