



Contribution ID: 59

Type: oral presentation

Determination of the isotopic ratio U-236/U-238 in environmental samples

Monday 19 September 2011 16:35 (15 minutes)

Determination of the isotopic ratio $^{236}\text{U}/^{238}\text{U}$ in environmental samples

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^{236}U with a half-life of $2.3 \cdot 10^7$ years is produced via thermal neutron capture on ^{235}U . Natural production results from different neutron sources like from (α, n) reactions on lighter nuclides, spontaneous fission of ^{238}U , induced fission of ^{235}U and at the Earth surface from the cosmic rays. Only small amounts are produced naturally from uranium in ores, soils and rocks but a huge amount is produced in nuclear power plants. Naturally ^{236}U occurs in ultra trace concentration in the environment, therefore it is a big challenge to determine a natural isotopic ratio of $^{236}\text{U}/^{238}\text{U}$ in environmental samples which is expected to be in the order of 10^{-14} to 10^{-13} . For the analysis of this isotopic ratio, water samples from rivers and creeks were collected in the alpine region of Austria, from the Danube, the Black Sea and the Atlantic. From surrounding areas also soil samples were investigated.

After a pre-concentration and an anion exchange step the uranium fraction was co-precipitated with NdF_3 and thin sources were prepared for α -spectrometry to determine the activity ratio of $^{234}\text{U}/^{238}\text{U}$ and the chemical yield. Afterwards these filters were reprocessed for the analysis of the isotopic ratio $^{236}\text{U}/^{238}\text{U}$ by AMS (Accelerator Mass Spectrometry). The special aim was the characterization of the $^{236}\text{U}/^{238}\text{U}$ ratio in natural waters and soils, and to investigate the contribution from anthropogenic sources.

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Session Classification: Session 4

Track Classification: Nuclear Chemistry and Radiochemistry