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Can we use Pu-(239+240) isotopes as soil redistribution tracers in Austrian agro-environments? An initial investigation in Lower Austria

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A new artificial radioisotopic tracer, mostly originating from the past aerial nuclear weapon tests, has raised the attention of the scientific community: Plutonium (Pu). One of the main advantages of anthropogenic Pu isotopes over Cs-137 is their long half-life that ensures long-term availability to be used as tracers for agro-environmental purposes.

To date, soil redistribution researches in agroecosystems using Pu are still in their infancy. A couple of existing studies conducted in Australia, China, Germany, South Korea and Switzerland have demonstrated the potential of using Pu-(239+240).

As one of the contribution of the SWMCN Laboratory to the IAEA CRP D1.50.17 (i.e. Nuclear Techniques for a Better Understanding of the Impact of Climate Change on Soil Erosion in Upland Agro-ecosystems), an investigation to evaluate the potential in using Pu isotopes as soil tracers was carried out in Lower Austria at Grabenegg, at the experimental research station of the Austrian Agency for Health and Food Safety.

Upon selection of a suitable reference site (i.e. $\sim$100 m2 undisturbed flat pasture), one detailed soil profile for precise incremental radioisotopic determination and 12 bulk cores were collected. All soil samples were analysed for Cs-137 content using gamma spectrometry at the SWMCN Laboratory and for Pu-(239+240) content using alpha spectrometry at CNESTEN in Morocco.

Preliminary results showed that in terms of areal activity, 79% of the Cs-137 and 73% of the Pu-(239+240) are concentrated in the top 12 cm of the soil profile. As expected in a suitable reference site, the vertical distributions for both isotopes highlight an exponential decrease of their content with depth.

The initial Cs-137 and Pu-(239+240) fallout in 12 core samples collected at the reference site was evaluated to be 8179 $\pm$ 1794 Bq/m2 with a CV of 22% and at 56 $\pm$ 16 Bq/m2 with a CV of 28%, respectively.

Under our experimental conditions, the Cs-137 and the Pu-(239+240) baseline inventories were established with an allowable error of 12% and 14% at 90% confidence level, respectively.

Our finding at our reference site confirms the possibility to use Pu-(239+240) as soil tracer due to its similar behaviour to Cs-137 (specific vertical distribution and reduced spatial variability).

Further work involving a new sampling campaign to quantify soil redistribution through a multi-fallout radionuclides approach – including Cs-137 and Pu-(239+240) determination – will be scheduled along a typical transect of an adjacent agricultural field.