Isotopic signatures of artificial radionuclides: an important tool in today's world

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Radioactive fallout from past releases of radionuclides resulting from above-ground nuclear tests has contaminated the global environment with radioactive materials. Most of these radioisotopes: ^{137}Cs, uranium, plutonium isotopes (e.g. ^{235,236,238}U, ^{238,239,240}Pu), and ^{241}Am have been identified in various environmental compartments around the world. The half-lives of these radioisotopes are large enough to make radionuclides represent a persistent threat to humans and ecosystems. The concentrations of these radioisotopes and their isotopic compositions in different environmental matrices may reflect nuclear activities in the affected regions. Many countries around the world have recently initiated ambitious nuclear energy programs or declared their intention to generate electricity using nuclear power reactors in the near future. The assessment of the environmental impacts of these programs requires routine monitoring of radioactive fallout. Special attention should be paid to the applications of nuclear materials in space missions, where they provide an alternative to solar power generation. ^{238}Pu production was restarted in the US for NASA deep space missions and is continued by the Russian Federation. ^{241}Am has recently replaced ^{238}Pu due to its lower cost and longer half-life. Since 2009, the production of ^{241}Am has been under development in Europe as part of the European Space Agency's initiatives.

There is an increasing need to continue detailed analysis of ^{137}Cs, uranium, plutonium isotopes, and ^{241}Am in different matrices (e.g., sediments at the surface of glaciers and air filters) to identify sources and distinguish between resuspended or freshly released radioisotopes. In our 15 years of measurements in the Northern and Southern Hemispheres, we observed some isotope anomalies (^{238}Pu/$^{239+240}$Pu, ^{241}Am/$^{239+240}$Pu) that may be related to accidents such as the fall of the Mars-96 spacecraft in the south of the globe, production of radioisotopes as a power source in the north, or other unidentified events.

Funding: This study was funded by the National Science Centre, Poland (grant no. 2021/43/O/ST10/02428).