Use of Accelerator Mass Spectrometry (AMS) to study the migration and bioaccumulation of actinides in the environment

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The high sensitivity of AMS for actinides analysis can facilitate a range of studies aimed at improving understanding of how actinides behave in the environment. Former nuclear sites, which contain a range of levels of contamination with actinides, offer opportunities to study the migration and bioaccumulation of actinides. In addition to the evaluation of the radiological risk posed to potential human and non-human occupants of those specific sites, such studies can contribute fundamental data to the understanding of the behaviour of actinides in the environment.

The Little Forest Burial Ground, located on the edge of Sydney, was used by the Australian Atomic Energy Commission to dispose of low level radioactive waste in shallow trenches in the 1960s. The waste included small amounts of uranium and plutonium with various isotopic compositions. α-spectrometry is being used as the primary method of radio-analysis in current studies of this site [1]. In addition, AMS is being applied where higher sensitivity is required, and to measure isotopes not easily measureable by α-spectrometry. ^{239}Pu and ^{240}Pu cannot be resolved by α-spectrometry, and ^{233}U is poorly resolved from ^{234}U. In both cases we can apply AMS to define these isotopic signatures. In the case of plutonium, the ^{240}Pu/^{239}Pu ratio can be used to distinguish local contamination sources from global fallout. The high sensitivity of AMS has enabled the detection of Pu and ^{233}U in vegetation, providing data on uptake and bioaccumulation.

The former nuclear weapons test site at Maralinga in South Australia was used in the 1950s and 1960s for seven nuclear weapon detonations and also numerous 'safety trials' which dispersed plutonium and uranium in the environment. By analysing plutonium in wildlife and soil samples from around this site, we are able to evaluate the uptake of plutonium and its mobility, and compare present-day results with earlier studies of the site [2]. Further work is in progress examining the distribution of plutonium in the tissues of mammals and other species inhabiting the site. By exploiting the high sensitivity of AMS, non-lethal methods for investigating actinide uptake and its effects on wildlife are being developed for this work.

[1] T.E. Payne et al., *Environ. Sci. Technol.*, **47**, 13284 (2013).
[2] M.P. Johansen et al., *J. Environ. Radioact.*, **131**, 72 (2014).