**233U/236U – A new tracer for environmental processes?**

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Apart from the production of 236U by fast neutrons in thermonuclear weapons via the reaction 235U(n,3n)236U, 236U can be also produced in nuclear power plants and fission bombs via 235U(n,γ)236U using thermal neutrons. In contrast, the principle production path for 233U is via the reaction 235U(n,3n)233U, which requires fast neutrons with energies above 13 MeV (Gorbatchev et al., 1980). Therefore, an increased production can be expected in thermonuclear weapons using Oralloy (uranium enriched in 233U) as blanket or tamper. Consequently, in average, fallout from nuclear weapons testings should show a higher 233U/236U ratio than emissions from thermal nuclear power plants or reprocessing plants which allows source identification for contaminations present in the environment.

However, the cross section of the reaction 235U(n,3n)233U for 14 MeV neutrons is only about 0.1 barn, as shown in Figure 1. As there is only little experimental data available for the cross-section of this reaction and the utilization of Oralloy is not readily accessible for all nuclear devices which exploded during the period of atmospheric testing, the 233U fallout from thermonuclear weapons can be only roughly estimated to be around one to two orders of magnitude smaller than 236U fallout. Consequently, neglecting n capture on 232Th in rocks and local contaminations from the 232Th fuel cycle, the environmental concentrations of 233U can be expected to be extremely low, so that its detection is challenging also for the highly sensitive Accelerator Mass Spectrometry (AMS).

After an introduction to possible production paths of 233U and 236U, respectively, first results of the 233U/236U ratio detected in samples from the different environmental reservoirs named before will be presented in this talk and the interpretation of the data will be discussed.


EXFOR/ENDF database, 2016

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**Figure 1. Cross section in barn for the reaction 235U(n,3n)233U from model calculations (solid lines) and experimental data (blue squares) (EXFOR/ENDF, 2016)***

236U in environmental samples is already routinely analysed at the Vienna Environmental Research Laboratory (VERA) (e.g. Froehlich et al., 2016). VERA has recently increased its detection efficiency such that it is now capable to detect also 233U, which was demonstrated by analysing the concentration of this isotope in different types of environmental sampling material, including Irish Sea sediment, corals from the Pacific Ocean and peat bog samples from Germany. These samples were known to be affected by different contamination sources, i.e. nuclear weapons fallout and the reprocessing plant Sellafield, respectively. In average, the detected 233U/236U ratio in the environment is at a level of around 1%. However, the 233U/236U ratio in the Irish Sea sediments was around one order of magnitude lower than in the Pacific Ocean corals or the peat bog samples. These findings indicate that the 233U/236U can be indeed used for the discrimination between these two contamination sources.