

PUSHING LIMITS OF ICP-MS/MS FOR THE DETERMINATION OF ULTRALOW $^{236}\text{U}/^{238}\text{U}$ ISOTOPE RATIOS

Hugo Jaegler

hugo.jaegler@irsn.fr

IRSN, Fontenay-Aux-Roses, France

Hugo Jaegler, Alkiviadis Gourgiotis, Peter Steier, Robin Golser, Olivier Diez and Charlotte Cazala

In the context of radiological impact assessments, it is sometimes necessary to discriminate the different origins of the same element within a pollution. This is the case, for example, with uranium in the environment of former mining sites, which can come from the geochemical background, mining activities, uranium cycle facilities or former nuclear tests global fallout.

The highly contrasted $^{236}\text{U}/^{238}\text{U}$ isotope ratio between geochemical background ($10^{-14} - 10^{-12}$), uranium ore ($10^{-12} - 10^{-10}$) and global deposition ($10^{-9} - 10^{-7}$), could be used as a tracer of the uranium source . However, low values of such ratios make detection, by conventional mass spectrometry instruments, particularly difficult.

For the first time, we measured $^{236}\text{U}/^{238}\text{U}$ isotope ratios in the range of 10^{-10} with a triple quadrupole mass spectrometer (ICP-MS/MS). So far, such low ratios were only detectable with an acceleration mass spectrometer (AMS).

The precise determination of the U-236 signal is made possible by a good abundance sensitivity and the reduction in the formation of uranium hydrides ($^{235}\text{UH}^+$ ions), which constitute the majority interference to mass 236. For this purpose, an effective desolvating system was installed and nitrous oxide (N_2O) was used as a reaction gas in the ICP-MS/MS reaction/collision cell. This methodology has been successfully tested by measuring certified reference materials and environmental samples previously characterized by AMS, for ratios ranging from 10^{-6} to 10^{-10} . The ability to detect very low isotope ratios opens the way to a wide range of geochemical applications, particularly on the uranium marking of the environment by anthropogenic activities.