Determination of ultratrace radioiodine ^{129}I and halogen isotopes by ICP-MS/MS

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The long-lived radioiodine isotope ^{129}I (half-life: 1.57×10^{7} y) is one of the most important radionuclides released from nuclear fuel reprocessing plants and nuclear accidents into the environment. This nuclide has provided useful information on the behavior of radioiodine in the environment. In addition, ^{129}I has been used as a tool to reconstruct the distribution of ^{131}I (half-life: 8 days) at nuclear accidents.

The accident at the Fukushima Daiichi nuclear power plant (FDNPP) resulted in a substantial release of radioiodine, mainly ^{131}I, into the environment. An effective dose estimation of released ^{131}I is important but difficult due to lack of data on the deposition of ^{131}I. Therefore the determination of ^{129}I in soils in Fukushima is needed to reconstruct the early distribution of ^{131}I in the environment.

Advances in inductively coupled plasma quadrupole mass spectrometry (ICP-QMS) with a reaction cell have enabled us to determine ^{129}I in a number of environmental matrices. Although the measurement of ^{129}I by ICP-MS is very difficult due to a high background noise caused by $^{129}Xe^{+}$ which come from impurities in argon plasma gas, the $^{129}Xe^{+}$ signal can be reduced by using O_2 as a reaction gas to improve the precision and accuracy of the $^{129}I/^{127}I$ isotopic ratio measurements. However, the isobaric interference produced by ions such as $^{127}IH_2^{+}$ (where $^{127}IH_2^{+}/^{127}I^{+} = 3 \times 10^{-8}$) meant that the determination of ^{129}I in less contaminated soils could not be carried out. Recently, a triple quadrupole ICP-MS (ICP-MS/MS) can be available to measure $^{129}I/^{127}I$. This analytical approach has the potential to provide a more sensitive and robust technique for the quantitative analysis of ultratrace ^{129}I in the soil samples contaminated by the FDNPP accident.

In this study, we investigated how much the ICP-MS/MS could improve the signal/noise ratio ($^{127}I/^{129}Xe^{+}$) with the O_2 reaction gas flow rate and reduce the production ratios of polyatomic interferences, such as $^{127}IH_2^{+}$, $^{97}MoO_2^{+}$ and $^{113}CdO^{+}$. We also examined the applicability of the developed method to determine ^{129}I and other halogen isotopes in geochemical samples.