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Gas phase reaction of trace iodine-129 for determination by ICP–DRC–MS/MS

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Long-lived iodine-129 (^{129}I: $t_{1/2} = 1.57 \times 10^7$ years) provides important information as a tracer to estimate geochemical mobility of radioisotopes discharged from nuclear activities. An accelerator mass-spectrometry (AMS), typical analytical method of ^{129}I has been widely applied to understanding the environmental radioactivity. AMS is not suitable for screening of a large number of samples by limited availability machine work-time of its few facilities and the time-consuming purification process of ^{129}I. Inductively coupled plasma mass-spectrometry (ICP–MS) is capable of high-throughput data acquisition, whereas the application is limited to samples including relatively higher $^{129}I/^{127}I$ which was caused by primary interferences at *m/z* 129 ($^{129}Xe^+$ and $^{127}IH_2^+$). To remove the interferences, the dynamic reaction cell (DRC) which is gas phase reaction device in ICP–MS is used in this study. As far, $^{129}Xe^+$ can be removed by O_2 gas. In addition, ICP-tandem mass spectrometry (ICP–MS/MS) suppressed formation of polyatomic ions of $^{127}IH_2^+$. The $^{129}I/^{127}I$ ratio of $<10^{-9}$ level was achieved by previous study; however, lower level of $^{129}I/^{127}I$ ratio to further precisely discriminate interferences ($^{127}IH_2^+$ and $^{129}Xe^+$) is required to apply for various environmental samples.

In this study, we investigated gas phase reactions for the discriminate interferences ($^{129}Xe^+$ and $^{127}IH_2^+$) and $^{129}I^+$ in the DRC via ICP–MS/MS to achieve a further low ratio of $^{129}I/^{127}I$. Various mono-gases were individually introduced into the DRC; however, the background counts at m/z 129 in a test solution co-existing with an excess amount of ^{127}I could not be suppressed caused by remaining either $^{129}Xe^+$ or $^{127}IH_2^+$. Here, O_2–CO_2 gas mixture was introduced into the DRC, indicating the lowest counts at *m/z* 129 by removing the interferences simultaneously. We successfully determined spiked ^{129}I values in rainwater samples using this method, and the results were agreed with spiked amounts.