Speciation distribution of iodine isotopes (^{127}I and ^{129}I) in the Beaufort, Chukchi, and Bering Seas

The Univ. of Tokyo [1], Nihon Univ. [2], JAMSTEC [3], ○(P) Yuanzhi Qi[1], Qiuyu Yang[1], Takeyasu Yamagata[1], Hiroyuki Matsuzaki[1], Hisao Nagai[1,2], Yuichiro Kumamoto[3]
E-mail: yuanzhiqi@um.u-tokyo.ac.jp

Because of its special geographical location, the Arctic Ocean and its adjacent seas are very sensitive to climate change, and the material and energy cycles in them will in turn have an important impact on global climate change. Here, we present results on concentrations of different iodine isotopes (^{127}I and ^{129}I) of total iodine (TI), iodide (I^-), and iodate (IO_3^-) in seawater samples of two depth profiles collected in the Beaufort Sea and 15 additional surface seawater samples collected in the Beaufort, Chukchi, and Bering Seas from 12 August to 6 October 2022. T^{127}I and salinity showed a very good positive linear correlation, but there is no obvious correlation between T^{129}I and salinity, indicating that the distribution of T^{127}I is controlled by the dilution of fresh water, while T^{129}I had other sources. For T^{129}I, $^{129}I^-$, and $^{129}IO_3^-$, two depth profiles showed very similar vertical trends (Fig. 1), which are decreasing gradually from the surface with depth, increasing sharply between the depth of 200 and 300 m, maintaining a high concentration at the depth of 300 to 800 m, and then decreasing gradually with depth. According to the distribution of ^{127}I and ^{129}I, we identified different sources of seawater in our study area, including Pacific water, Atlantic water, freshwater, and aged Arctic water.

Large ^{129}I concentration differences between iodide (1–16 × 10^7 atoms/L) and iodate (1–28 × 10^7 atoms/L) were observed in the study area. In the surface layer, $^{129}I^-$ and $^{129}IO_3^-$ have similar concentrations, but as the depth goes down, there was a large difference between the two and $^{129}I^-$ concentrations were significantly lower than $^{129}IO_3^-$ concentrations. Even so, the $^{129}I^-/^{127}I^-$ atom ratios were higher than $^{129}IO_3^-/^{127}IO_3^-$ atom ratios at any depth. In the Arctic intermediate layer, where the seawater originates mainly from the Atlantic Ocean and has migrated in isolation for decades, the aforementioned differences were most pronounced, suggesting that the exchange between I^- and IO_3^- was extremely slow in the deep ocean. Our study shows that ^{129}I can provide essential and detailed information for tracing water masses and studying the iodine cycle.

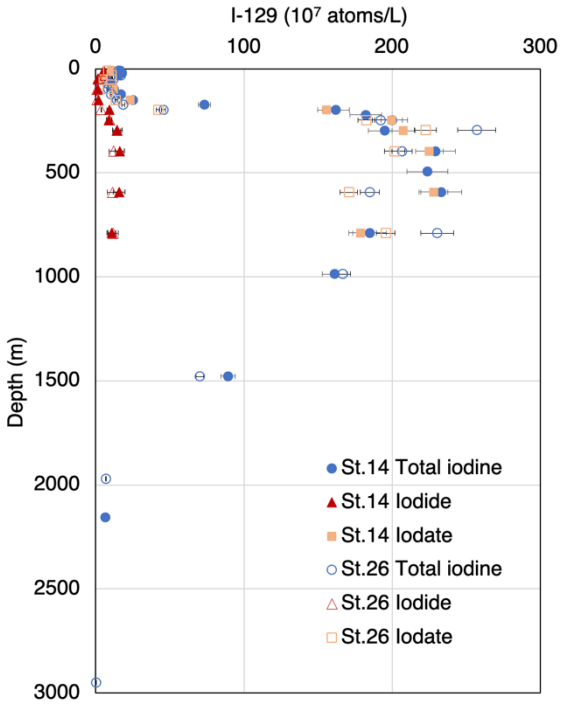

Fig.1. Distribution of different ^{129}I species.

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