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Seawater circulation in the Nordic Seas and Arctic traced by reprocessing derived 129I using AMS analysis

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Seawater circulation and interaction are important processes for pollutant dispersion and environmental and climate change. Salinity and temperature are the conventional parameters, which were widely used for the identification of water masses and circulation in the oceans. Generally, small differences in these two parameters are difficult to detect, which makes precise and accurate identification of water circulation problematic. This is particularly important for some locations where the water masses have very similar physiochemical features. Part of the problem can be resolved by using a marine water tracer more sensitive than salinity and temperature to the changes in water parcels and circulation. 129I has been proven to be well suited for such purposes, as the isotope is a long-lived radionuclide (T½=15.7 Ma) with a high solubility and conservativity in marine water. As a high-yield fission product from 235U and 239Pu, anthropogenic 129I is the dominant source in present-day environments. Among the major release sources of the isotope are the two spent nuclear fuel reprocessing plants at Sellafield and La Hague that have discharged a huge amount of 129I to the Irish Sea and the English Channel, accounting for more than 90% of the total human releases of 129I. This reprocessing derived 129I is therefore an ideal and unique tracer for the accurate identification of the dispersion of water-soluble pollutants and water circulation in marine environments, especially in the Nordic Seas and the Arctic. However, the analysis of 129I requires the use of accelerator mass spectrometry, which is amenable in some laboratories worldwide. Furthermore, the speciation of iodine in the environment is another feature that needs to be considered during the analysis of the isotope. In the past 25 years, we have analyzed a series of seawater and seaweed samples in the Nordic Seas and the Arctic for 129I and 127I, as well as their chemical species. This presentation aims to summarize all these investigations, highlight the major achievements, and show some perspectives. Göran Possnert has contributed to the data in all its aspects, and the authors are honored by his dedication and enthusiasm. He passed away in 2022, and for ethical reasons and scientific integrity, we put his name on the authorship list as we shall present data and conclusions that he has approved.

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