

Vertical distributions of ^{129}I and insight of current in the Southern Canada Basin

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Human activities, particularly nuclear fuel reprocessing and nuclear weapons testing, are the primary sources of ^{129}I in the marine environment. The Sellafield facility in the UK and the La Hague facility in France are the predominant contributors to ^{129}I discharges into the ocean. ^{129}I subsequently travels through the North Atlantic Ocean to the Arctic Ocean, eventually reaching the Canadian Basin. The current system in the Canadian Basin is intricate and intertwined with climate change. ^{129}I has been widely utilized in studies of ocean currents and water mass origins, providing significant insights into current systems.

This study is based on the most recent data collected by our laboratory in 2023. This study investigated two depth profiles at stations St.14 (72.4°N, 155.4°W) and St.32 (74.0°N, 162.0°W) in the region. Vertically, the $^{129}\text{I}/^{127}\text{I}$ ratio initially decreased from the surface layer to a minimum value of 2×10^{-10} , then increased to a maximum value of 138×10^{-10} (Figure 1). It remained relatively stable within a depth range to 1000 m, before gradually decreasing with further depth (Figure 1). Based on these ratio data, the water source composition is categorized into a freshwater mixed layer (0–20 m), Pacific-origin water (20–100 m), Atlantic-origin water (200–1000 m), and bottom aged water mass (near the seabed). Vertical mixing occurs between these water masses. Further analysis of the Atlantic-origin water layer revealed a distinct peak in the $^{129}\text{I}/^{127}\text{I}$ ratio at approximately 250 m (Figure 2). Previous studies have identified two primary currents from the Atlantic Ocean: the Fram Strait Branch Water (FSBW), with a core at around 400 m, and the Barents Sea Branch Water (BSBW), with a core at about 800 m. However, this observed peak at 250 m is not attributable to either FSBW or BSBW and exhibits a higher signal than both. This suggests the possibility of an unknown ^{129}I source in the Arctic or an unrecognized Atlantic Ocean current carrying a high ^{129}I signal.

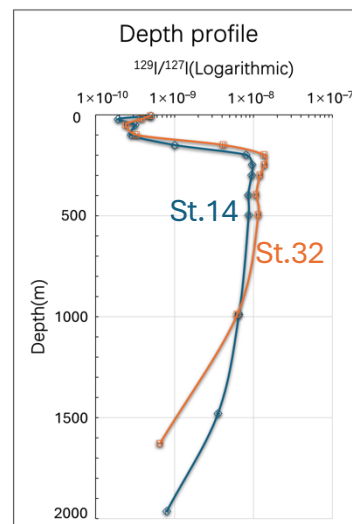


Figure 1. Depth profile of $^{129}\text{I}/^{127}\text{I}$ in logarithmic form

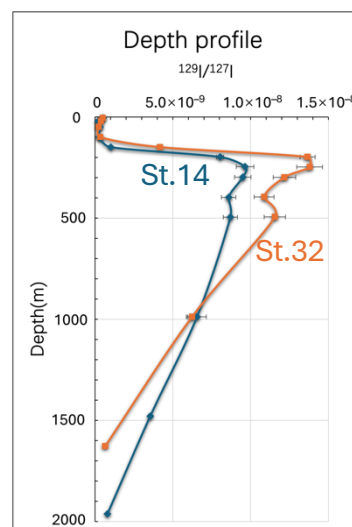


Figure 2. Depth profile of $^{129}\text{I}/^{127}\text{I}$ in linear form