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Investigating the North Equatorial Current bifurcation of nuclear bomb radionuclides from the Pacific Proving Grounds through iodine-129 in coral cores along the East Philippine coast

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In the Western Equatorial Pacific, a significant portion of ocean radioactivity is contributed by aboveground nuclear weapons tests (ANWTs) conducted in the Pacific Proving Grounds (PPG) during the 1950s. These radioactive materials can reach the Philippines through the North Equatorial Current (NEC), which splits into the Kuroshio (northward) and Mindanao (southward) currents upon hitting the country's eastern coast. Iodine-129, a long-lasting fission product ($t_{1/2} = 15.7$ Ma), is used as a tracer for ANWTs and other human nuclear activities (HNAs) due to its well-known behavior in the environment. While previous ^{129}I studies have focused on the northern Philippines, little is known about the southern regions affected by the NEC bifurcation. To investigate this, we present coral $^{129}\text{I}/^{127}\text{I}$ time series records from two sites in the eastern coast of the Philippines, one each from locations along the Kuroshio (i.e., referred to as Calaguas) and Mindanao (i.e., referred to as Cantilan) currents. ^{127}I and ^{129}I Measurements were done using inductively coupled plasma mass spectrometer (ICP-MS) and accelerator mass spectrometer (AMS), respectively. Results show that both sites exhibit low $^{129}\text{I}/^{127}\text{I}$ ratios before the year 1950 (i.e., natural ^{129}I), followed by distinct bomb peaks between the 1950s to 1960s from ANWTs, then a steady increase of about $(0.4 \text{ to } 0.5) \times 10^{-12}$ per year from 1960s onwards from nuclear fuel reprocessing (NFR) interspersed with distinct peaks from historical nuclear accidents such as the Chernobyl and Fukushima accidents. Mathematical simulations that were performed to determine the quantitative relationships between the ^{129}I signals in the coral samples from both sites and these HNAs show that ^{129}I from ANWTs were transported and divided almost equally and between the north and south bifurcations of the NEC. This study is instrumental for understanding better the past impacts of HNAs and the relevant complex oceanographic processes in the great Pacific Ocean.

Student Submission

Yes

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