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## **Pu-240/Pu-239 atom ratios in the northern North Pacific and equatorial Pacific water columns**

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Anthropogenic radionuclides such as Pu-239 (half-life: 24,110 years), Pu-240 (half-life: 6,564 years) and Pu-241 (half-life: 14.35 years) have been released into the environment as the result of atmospheric nuclear weapons testing, disposal of nuclear wastes and nuclear fuel-cycle reprocessing operations, etc. In the North Pacific Ocean, two distinct sources of Pu isotopes can be identified; i.e., the global stratospheric fallout and close-in tropospheric fallout from nuclear weapons testing at the Pacific Proving Grounds (PPG) in the Marshall Islands. The atom ratio of Pu-240/Pu-239 is a powerful fingerprint to identify the sources of Pu in the ocean. The objectives of this study are to measure the Pu-240/Pu-239 atom ratios in seawater from the northern North Pacific Ocean and the equatorial Pacific Ocean and to discuss the transport processes of Pu.

The Pu-240/Pu-239 atom ratios were measured with a double-focusing SF-ICP-MS, which was equipped with a guard electrode to eliminate secondary discharge in the plasma and to enhance overall sensitivity.

In the equatorial Pacific, Pu-240/Pu-239 atom ratios were 0.215 in the surface water and increased gradually with depth reaching 0.267 at the 3000 m depth after which they decreased with depth to 0.228 at the bottom layer. In the northern North Pacific, Pu-240/Pu-239 atom ratios showed no notable variation from subsurface water of 100 m depth to deep water of 2000 m depth, then increased with depth to 0.255 at the bottom layer. The atom ratios in water columns of the northern North Pacific and equatorial Pacific were significantly higher than the mean global fallout ratio of 0.18. High atom ratios of Pu-240/Pu-239 prove the presence of close-in tropospheric fallout from nuclear weapons testing at the Pacific Proving Grounds.

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