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Plutonium signature in the Northwest Pacific using modern coral archives

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Sources of Pu isotopes to the marine environment are well defined, both spatially and temporally, which makes Pu a potential tracer for oceanic processes. The main input of Pu to the Pacific Ocean is fallout from atmospheric nuclear weapons testing which consist of two main sources, global fallout and close-in fallout from the former US Pacific Proving Grounds (PPG) in the Marshall Islands. The Pu isotopic composition is dependent on the weapon type tested. The world-vide integrated global fallout is characterised by a ^{240}Pu/^{239}Pu atom ratio of 0.18 while debris from the PPG is characterised by ^{240}Pu/^{239}Pu atom ratios above 0.25. Remobilised Pu from the seabed around the Marshall Islands is continuously transported long distances along the westward North Equatorial Current (NEC) and the subsequent Kuroshio Current (KC). Corals are excellent tools for retrospective studies of the historical Pu signature in the marine environment as Pu is incorporated in the coral skeleton during growth, with a constant relationship between Pu concentrations in the coral and in the surrounding seawater. Depth profiles of ^{239}Pu and ^{240}Pu were determined in skeletons of dated modern corals from four sites (Chuuk, Guam, Ishigaki and Iki) in the Northwest Pacific to identify the historical Pu signature and estimate contributions from the two main sources, global and close-in fallout. The Northwest Pacific was dominated by PPG close-in fallout in the 1950s with an average ^{240}Pu/^{239}Pu atom ratio of 0.32, including a peak of 0.46 that can be attributed to fallout from the Ivy Mike thermonuclear detonation in 1952 at the Enewetak Atoll. The atom ratio decreased in the 1960s and 1970s due to an increase in the Pu contribution from global fallout. After the cessation of the atmospheric tests in 1980, Pu contamination in the Northwest Pacific was again dominated by Pu originating from the former PPG, with estimated PPG contributions in the range of 60–80 % depending on the location along the NEC and KC. The relationship between variations in the isotopic ratio and the strength of the prevailing ocean currents in the Northwest Pacific will be explored.