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Plutonium isotopes in the sediments of the marginal seas of the NW Pacific Ocean

J. ZHENG AND M. YAMADA

Nakaminato Laboratory for Marine Radioecology, National Institute of Radiological Sciences 3609 Isozakicho, Hitachnaka, Ibaraki 311-1202, Japan (jzheng@nirs.go.jp; m_yamada@nirs.go.jp)

Several studies on the Pu in Pacific sediments have reached a major conclusion that the Pacific marginal sediments underlying waters with high biological productivity and larger suspended sediment loads are major sinks for Pu removal and sequestration. In addition, general excess inventories of Pu over those anticipated from global fallout were observed, indicating that there is an additional Pu input. However, for a long time the source of the additional Pu input remained unknown because of the lack of a distinctive $^{240}Pu/^{239}Pu$ signature.

Information on Pu isotopic compositions in sediments is very useful in understanding the source of Pu present there since the $^{240}Pu/^{239}Pu$ ratio has proved to be a powerful fingerprint to identify the Pu contamination. Recently, we have developed a highly sensitive method for the determination of ^{240}Pu and ^{239}Pu in marine sediment samples by means of ICP-MS (inductively coupled plasma mass spectrometry) with a shield torch system. In the present study, we have applied this method in order to determine ^{240}Pu and ^{239}Pu and their ratios in sediment core samples collected in the marginal seas (Japan Sea and Okhotsk Sea) of the NW Pacific Ocean. Based on the $^{240}Pu/^{239}Pu$ ratio signature, we identified that the additional Pu input in Sagami Bay, Japan, was from the transported close-in fallout from Bikini and Enewetak nuclear weapon tests. We demonstrate that Pu activity and isotopic ratio profiles of marine sediment cores contain records of global fallout and close-in fallout Pu, which provide chronological information on the recent sedimentation. We propose that the transport route is through the oceanic currents, e.g. the North Equatorial Current and Kuroshio Current.

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Factors influencing the global distribution of iodine-129 in the environment: A look at the iodine cycle in surface reservoirs

G.T. SNYDER[1], U. FEHN[2], Y. MURAMATSU[3], M.S. SULTANA[4], J.E. MORAN[5] AND U. RAO[6]

[1] Rice University, USA (gsnyder@rice.edu)
[2] University of Rochester, USA (fehn@earth.rochester.edu)
[3] NIRS, Chiba, Japan (y_murama@nirs.go.jp)
[4] Jahanirnagar University, Bangladesh (mssultana@bdonline.com)
[5] Lawrence Livermore Nat. Lab., USA (moran10@llnl.gov)
[6] St. Josephs Univ., USA (urao@sju.edu)

Iodine-129 is a naturally occurring cosmogenic isotope, whose concentrations in surface reservoirs have increased strongly since the beginning of the nuclear age. Although most sources for anthropogenic I-129 are located in the northern hemisphere, increased levels of this isotope have been found all over the globe [1]. The surface nuclear bomb tests of the 1960's provided a significant input of this isotope into the environment, which can be utilized as a tracer of the migration of this element in the environment in the decades, which followed. In contrast to other anthropogenic radioisotopes, concentrations of I-129 have increased since the end of nuclear weapons testing, evidence for releases from ongoing nuclear activities, mainly from reprocessing of fuel rods and to a lesser extent from power-plant accidents. Although proximity to nuclear accidents and nuclear reprocessing facilities certainly plays a role in the current distribution of iodine-129 [2], we present a global data-set, which indicates significant atmospheric transport on a global scale. Broad regional trends in the stable iodine concentrations of river waters, when combined with the epidemiological distribution of iodine deficiency disorder (IDD) in humans, point to climate and climate-related trends in soil structure as important factors in the deposition and re-mobilization of this element. Comparison of iodine concentrations in both temperate and tropical environments suggests that soil type has a strong influence on the retentivity of iodine. Environmental factors such as soil type and redox conditions should therefore be taken into consideration when developing models to determine the dispersal of iodine isotopes into the environment in the event of nuclear accidents.

References

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