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Depth distributions of uranium-236 and cesium-137 in the Japan/East Sea; toward the potential use as a new oceanic circulation tracer

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^{137}Cs ($T_{1/2}$=30.2 y) has been spread all over the world as a fission product of atmospheric nuclear weapons tests in the 1960s. This nuclide has been used as a powerful tool for oceanography due to the well-defined origin and conservative behaviour in water . However, the number of atoms has decayed already to one thirds compared with its initial levels, and it will become more difficult to measure. In this situation, we focus on ^{236}U ($T_{1/2}=2.342\times10^{7}$ y) as a candidate for a new isotopic tracer for oceanography. The detection of ^{236}U in the environment has become possible only recently, by the development of measuring techniques with high sensitivity based on AMS. Our group showed that global fallout from bomb tests contains ^{236}U, which might be produced as nuclear reactions of ^{235}U(n,γ) and/or ^{238}U(n,3n). So ^{236}U has been therefore globally distributed in the surface environment. Thus, ^{236}U has a similar potential as a tracer for environmental dynamics as ^{137}Cs, especially for oceanography.

In this study, a comprehensive attempt was made to measure the concentration of ^{236}U in marine samples such as water, suspended solid and bottom sediments to clarify the environmental behaviour of this isotope. Furthermore, the discussion of the circulation of deep and bottom water in "Miniature Ocean", the Japan Sea, has been attempted.

Bottom sediments (4 sites) and seawater samples (7 sites) were collected from the Japan Sea. The sediment core was cut into 1 cm segments from the surface to 5 cm in depth within a few hours after the sampling. About 20 L of seawater samples were collected from some depths in each site, and immediately after the sampling, the water was filtered with 0.45 μm pore-size membrane-filters. After the appropriate pre-treatment for each sample, uranium isotope and ^{137}Cs were measured with AMS and Ge-detector, respectively.

^{236}U was successfully detected for all seawater samples, and ^{236}U/^{238}U atom ratios in seawater were in the range of $(0.19\text{-}1.75)\times10^{-9}$. The dissolved ^{236}U concentration showed a subsurface maximum and decreased steeply with depth. The minimum value was found at a depth of 2500 m and bottom (about 3000 m in depth) in the northern and the southern areas, respectively. These profiles are markedly different from that of natural ^{238}U which is nearly constant over the depth, suggesting that ^{236}U has not yet reached steady state. For the SS sample, ^{236}U could not be detected in significant levels. The total ^{236}U inventory of the water column was estimated at 10^{12}-10^{13} atom/m^2. This value is nearly the same as the global fallout level (17.8×10^{12} atom/m^2). ^{236}U was also found in the bottom sediments, and the inventory was about 1/40 compared with that in water column. All above characters are comparable with ^{137}Cs which is anthropogenic conservative nuclide in ocean. Actually, the diffusion coefficients for both nuclides show the nearly same value.

The detail discussion including the circulation of deep-water in the Japan Sea will be given in our presentation.