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Radioactive contamination of the Northwest Pacific Ocean in 1993 - 1996

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Results of ^{90}Sr, ^{137}Cs, and Pu isotopes contents in the water column, bottom sediment, and selected biota were determined to investigate in the Northwest Pacific Ocean from 1993 to 1996.

Peter the Great Bay off the Vladivostok houses one of the nuclear facilities of Russian Far East. $^{239,240}Pu$ activity varies from 0.2 to 1.5 Bq kg^{-1} in Peter the Great Bay. The activity ratios of $^{238}Pu/^{239,240}Pu$ are about 0.02. These values are similar to those of bottom sediments in Korea Strait. $^{239,240}Pu$ activity in mussels varied from 2.5 to 12.5 mBq kg^{-1} dry tissue weights in the region, and those values are comparable to the values observed in the other coastal marine areas.

In the East Sea Proper, ^{137}Cs and ^{90}Sr concentrations decrease with depth, and their concentrations in the surface waters are ca. 1.91 and 2.96 mBq kg^{-1} for ^{90}Sr and ^{137}Cs, respectively. $^{239,240}Pu$ concentration peaks at 750m depth below the surface. The maximum concentration of $^{239,240}Pu$ is 33.3 to 42.8 μBq kg^{-1}. The water column inventories of ^{137}Cs are 4004 Bq m^{-2} in the 3300m water depth (Japan Basin) and 2632 Bq m^{-2} in the 2200m water depth (Ulleung Basin). Water column inventories of 90Sr is 2095 Bq m^{-2} in the Ulleung Basin, and these values are 2 times higher than that of the Equatorial Pacific (2°N, 137°E). The sedimentary inventories of ^{137}Cs are 0.03 Bq m^{-2} (Japan Basin) and 115 Bq m^{-2} (Ulleung basin). The sedimentary inventory of ^{90}Sr is 86 Bq m^{-2} in Ulleung Basin. Most ^{137}Cs are in the water column in Japan Basin (99.999%) and in Ulleung Basin (97%). Most ^{90}Sr are in the water column in Ulleung Basin (96%). The sediment accumulate rate was determined (based on volcanic ash layer) and using ^{210}Pb-derived sediment accumulation rate is 11 and 22 mg $cm^{-2}yr^{-1}$ in Japan Basin and Ulleung Basin, respectively. The water column inventories of $^{239,240}Pu$ are 99 and 67 Bq m^{-2} in the Japan Basin and Ulleung Basin, respectively. These inventories are about 2.5 times higher than observed in the Equatorial Pacific (2°N, 137°E). Nagaya and Nakamura (1981) also observed earlier. $^{239,240}Pu$ contents in major zooplankton species are 0.01 to 0.08 Bq kg^{-1} dry weight. The sediment inventories of $^{239,240}Pu$ are 17 and 45 Bq m^{-2} in the Japan and Ulleung Basins, respectively. Sediment inventories of ^{137}Cs and $^{239,240}Pu$ are very well correlated with those of sediment accumulation rate in the sea. Most $^{239,240}Pu$ are still in the water column of Japan Basin (85%) and Ulleung Basin (73%), respectively. Fluxes of particulate $^{239,240}Pu$ are 387 and 243 mBq $m^{-2}yr^{-1}$ in the Japan and Ulleung Basins, respectively, based on the time series sediment trap (PARFLUX Mark 7G) deployed close to the sea floor. These values are similar to those of Panama Basin and a little higher than Equatorial North Pacific (Livingston and Anderson, 1983). Using water column inventories (dissolved plus particulate) and average deep sea particulate fluxes, the apparent residence times (inventory/flux) are 256 and 285 yr. Residence times of Pu in the East Sea is about half of those in the North Pacific.

In the Yellow Sea, ^{90}Sr and ^{137}Cs concentrations are 2.5 to 2.9 mBq kg^{-1} in the eastern coastal waters and 2.7 to 3.8 mBq kg^{-1} in the Yellow Sea Proper, respectively. Concentrations of ^{90}Sr and $^{239,240}Pu$ are high in the

central part and low in the Jinagsu coastal area. The maximum penetration depth of $^{239,240}Pu$ is consistent with its ^{210}Pb-derived sediment age. Sediment inventories of $^{239,240}Pu$ are low in the central part, distal bottomset deposits of the submerged Yellow River delta in low sedimentation area; however, they exceed the global fallout in the ancient deltaic deposit off Jiangsu coast. Sediment inventories of ^{90}Sr and $^{239,240}Pu$ are largely determined by the sediment accumulation rates in the Yellow Sea.

In the East China Sea, ^{90}Sr concentration monotonously decrease from the north (2.9 mBq kg^{-1} at 34o 30.8'N, mouth of the Yellow Sea) to the south (1.9 mBq kg^{-1} at 29°22.54'N). ^{137}Cs and ^{239}Pu concentration is generally 2.7 mBq kg^{-1} and ca. 5 μBq Kg^{-1},respectively. However, ^{137}Cs (3.0 mBq kg^{-1}) and $^{239,240}Pu$ (7 μBq kg^{-1}) concentration peaks at 32°N where is off the mouth of the Yangtz River. Mixed zooplankton samples contains 0.15 Bq kg^{-1} of $^{239,240}Pu$.

In the Western Pacific Ocean (2-25°N, 132-137°E), $^{239,240}Pu$ and ^{90}Sr concentration are 2.3 to 4.7 μBq kg^{-1} and 2.1 to 3.1 mBq kg^{-1}, respectively. At Equatorial region (2°N, 137°E), water column inventories of ^{90}Sr and $^{239,240}Pu$ was 1064 and 27 Bq m^{-2}, respectively.

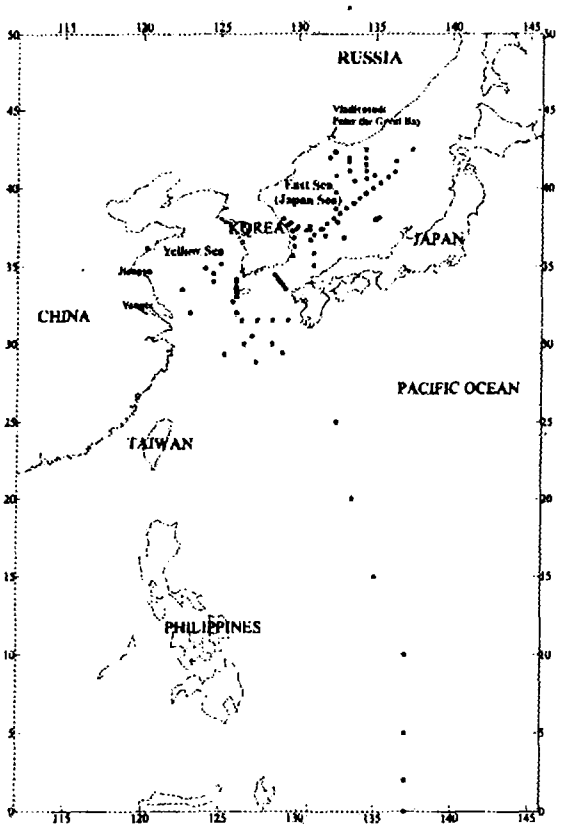

Figure. Sampling stations in 1993-1996.

References

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