150 YEARS OF CONTAMINATION HISTORY OF MERCURY IN RECIPIENT BAY OF HUMAN ACTIVITY IN OSAKA, JAPAN

HIDEO YAMAZAKI[1], KENJI DOI[1], KAZUTOSHI SAWADA[1], YUKO SAKAGUTI[1], AND SHUSAKU YOSHIKAWA[2]

[1]Department of Life Science, School of Science and Engineering, Kinki University, Higashiosaka 577-8502, Japan E-Mail: hideyam@msa.kindai.ac.jp

[2]Department of Biology and Geoscience, Graduate School of Science, Osaka City University, Osaka 558-8585, Japan

Osaka Bay, a large enclosed bay 58 km long by 25 km wide, is located in the eastern end of the Seto Inland Sea, Japan. Most of the basin water depth is shallower than 20 m. Streams of various sizes flow into the bay, but exchange with ocean water only occurs through the narrow Kii Channel at the southern end of the bay. The area surrounding the bay was developed since ancient times, though modernization of industry did not occur until after the Meiji restoration in the latter half of the 1800s. The cities of Osaka, Kobe and Sakai form a large metropolis surrounding the northeast shores of the bay. The aquatic environment in the bay has therefore been profoundly influenced by human activities. This paper presents the results of an investigation into the influence of modern Japanese industrial modernization on the environment. Mercury concentrations in sediment cores collected from Osaka Bay coast were investigated in detail to clarify the historical pollution record over the past 150 years.

The sediment cores were dated by the vertical profiles of ^{210}Pb and ^{137}Cs. The radioactivity in the sediment was measured by gamma-ray spectrometry using an HPGe detector (ORTEC LO-AX/30p) connected to a 4096-channel pulse-height analyzer. Mercury was determined by CV-AAS method, after it was extracted from the sediment using nitric acid. A time-dependent eddy diffusion model described the redistribution of sediment by the mixing of benthos and bottom current in sediment surface.

The sediment samples from northern-half area in the bay were analyzed to assess the historical load of mercury from the Osaka urban region. The mercury concentrations of the surface sediments were 0.13 from 1.15 ppm, and the average was 0.54 ± 0.28 ppm (n=36). The mercury was remarkably contaminated in river mouth and inshore, and the concentration rapidly decreased for offshore. The mercury concentration in the center of bay was nearly similar to the non-contaminated soil in the Osaka district. It is means that the anthropogenic mercury rapidly precipitates in sea water. Time trend of the mercury flux into the sediment was estimated retrospectively for a period corresponding to more than 150 years. Mass fluxes of sedimentary material in Osaka Bay were about 2.0 kg/m^2yr in the period from the 1850s to the 1960s, and then the flux increases 3.0 kg/m^2yr except the mid-1980s. Flux of the anthropogenic mercury increased from the 1860s. The maximum appeared in the mid-1960s, reaching level of 5.0 mg/m^2yr, which is also when mercury production peaked during the rapid post-war economic growth in Japan. In addition, mercuric pesticides were in common use in rice cultivation during this period. Used of mercury decreased rapidly after 1960. Mercury flux in the Osaka Bay sediment correspondingly fell after 1965, reaching around 1.5 mg/m^2yr in 2000. However, a large pulse of the flux may have occurred in the mid-1980s by reclamation construction of the Kansai airport. Historical trend of mercury flux in Osaka Bay from the 1850s to the present were determined by analysis of the vertical distribution of mercury concentration in the core sediment.