Ⅳ．英文Abstract

Investigation of mercury bioaccumulation in marine biota using a global model

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Global mercury (Hg) monitoring of air, biota, and human is a key aspect to evaluate effectiveness of the Minamata Convention. It assesses the reducing amount of anthropogenic Hg emission to the air and Hg transformation from the inorganic Hg to highly toxic methylated Hg (MeHg) in the aquatic environment. Human generally exposes to the MeHg through consumption of seafood. Details of the Hg transformation must be therefore obtained, and a global mathematical model for Hg biogeochemical cycling to predict future environmental Hg levels must be developed. Distribution of Hg species in the western North Pacific seawater and coexisting plankton, their reaction rates of Hg transformation, their partitioning between seawater and phytoplankton, and the future global atmospheric, oceanic and biota Hg levels were investigated in this study according to the analytical development and model refinement. The determined distribution of the seawater Hg species indicates that inorganic and MeHg concentrations are generally increased with increasing depth. The inorganic Hg concentrations were approximately 0.66 ± 0.2 pM, whereas the MeHg concentrations were approximately 0.16 ± 0.09 pM. The MeHg concentrations in plankton were increased with their increasing size and the higher latitude. The stable Hg isotope reverse dilution technique detected a deep-sea demethylation to produce the gaseous elementary Hg in the study area. These results provided the insights into the Hg distribution and transformation for the model refinement and the future prediction of the environmental Hg levels. The simulated model results indicated that impacts of 4 different climate scenarios on the air and seawater Hg levels were minimum until 2050, and future reduction of the anthropogenic Hg emissions would decrease those Hg levels to some extent. The global Hg emission to the air is predominated by re-emission and re-mobilization through the biogeochemical cycles so that the results suggested that timing of the environmental Hg reduction would be expected later than that of the reducing anthropogenic Hg emission. The future fish Hg levels would be more insusceptible to the reducing anthropogenic Hg emission because those levels are affected by biological and ecological impacts besides the environmental Hg levels. The model results indicated that there is a geographic variation in the reducing potential for Hg levels in the environments. The greatest effectiveness of the convention may be observed in those area, and the monitoring plans must be accordingly established.