Distribution and Residue Patterns of Polychlorinated Dibenzo-*p*-dioxins and Dibenzofurans in Coastal, River and Pond Water and Sediments from Matsuyama, Japan

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INTRODUCTION

Polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans (PCDD/Fs) are well known as a toxic environmental contaminants. Some PCDD/Fs that are included as impurities in organochlorine products, such as PCBs[1], PCP and CNP[2], are directly entered into the aquatic environment. Other PCDD/Fs could be formed by combustion processes, such as municipal and medical incinerators, are transported to atmospheric and aquatic environment over long distance and widely distributed in many environmental components. PCDD/Fs could be accumulated in coastal, river, pond and lake sediments, eventually those may be a secondary source of PCDD/Fs in the environment as well as human. Therefore, the investigation on sediments could also be evaluated PCDD/F exposure for a long term.

The Matsuyama City, Japan was chosen for the present study on PCDD/F contamination. The city is faced to the sea and the agricultural and industrial areas as well as two municipal incinerators are located. So far, we have been reported PCDD/Fs in atmosphere[3,4] from Matsuyama. However, data on aquatic environment are limited.

On the present study, the distribution and patterns of PCDD/Fs in water and sediments from the city are discussed.

EXPERIMENTAL

Samples

Water samples were collected from coastal area(n=3), river (n=22) and pond (n=3) from Oct. 1995 to Sep. 1997. Sediment Samples were taken in coastal area(n=7), river (n=7) and pond (n=3) from Apr. 1995 to Dec. 1997. Sampling locations of water and sediments are shown on Fig. 1 and Fig. 3, respectively.

Analysis

The analytical procedure for water samples was described earlier[5]. Sediment samples

(approximately 50g) were washed with 2N-HCl. Then, it was filtrated to solid and liquid phases. The solid phase was Soxhlet extracted with toluene (500mL) for 16 hours. The extract was concentrated to 1mL. The liquid phase was extracted with hexane by shaking. These extracts were combined. Clean up and determination methods were described previously[3]. The suspended particulate matter (SPM) in each water samples was measured. The SPM in water (20mL) was filtrated with a grass fiber filter (GFF, 1 μ m) and dried, and then weighted.

RESULTS and DISCUSSION

Water Samples

Fig. 1 shows the distribution of PCDD/Fs in water samples from Matsuyama, Japan. The concentrations of PCDD/Fs were ranged from 15 to 170 (ave. 51) pg/L in coastal water, from N.D. to 1500 (ave.180) pg/L in river water and from 44 to 530 (ave. 260) pg/L in pond water. PCDD/F concentrations of in coastal water were relatively lower than the other water samples. It might be thought that PCDD/Fs in coastal water were diluted with seawater and(or) deposited to the coastal sediment.

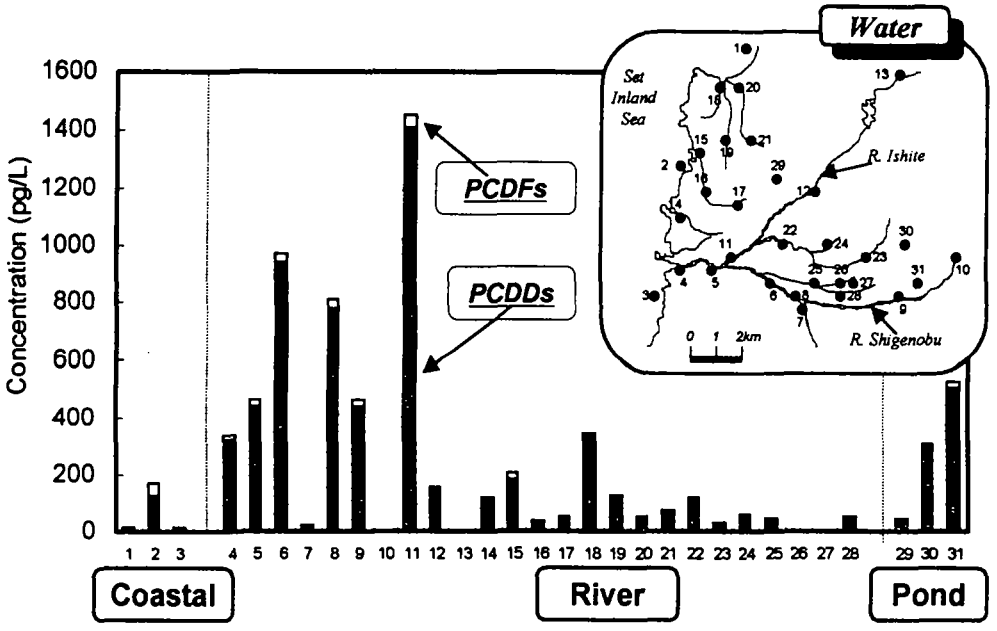

Fig.1 Distribution of PCDD/Fs in Water from Matsuyama, Japan

SPM concentrations were ranged from 0.2 To 57mg/L in river water (SPM in coastal and pond water was not analyzed). The SPM concentrations were related to PCDD/F concentrations (Fig. 2) . Rappe et al. have reported that 99.8% of PCDD/Fs in water from the River Elbe was particle-bound PCDD/Fs[6]. It could be suggested that most of PCDD/Fs in water was bound to particles and transported to the sediment of coastal area through the river water.

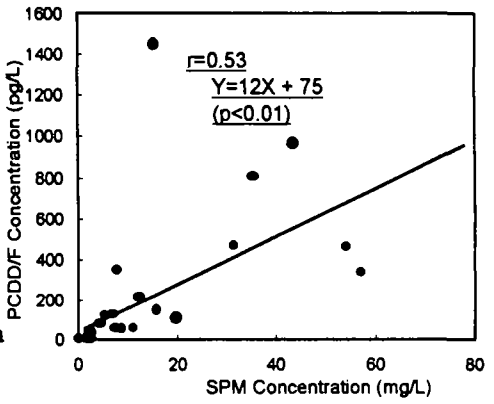

Fig.2 Relationships between SPM Concentrations and PCDD/F Concentrations in Water from Matsuyama, Japan

Sediment Samples

Fig. 3 shows the distribution of PCDD/Fs in sediment samples. The concentrations of PCDD/Fs were ranged from 2.0 to 16 (ave. 8.1) ng/g d.w. in coastal sediments, from 0.95 to 4.3 (ave.2.0) ng/g d.w. in river sediments and from 0.77 to 3.1 (ave.2.3) ng/g d.w. in pond sediments. PCDD/F concentrations in coastal sediments were relatively higher than those of sediments. 1,3,6,8-, 1,3,7,9-TeCDD and OCDD were mainly contributed to total PCDD/F concentrations in all the sediments. It is known that these congeners were the impurities of CNP and PCP which had been heavily used in paddy field in Japan. It is thought that these congeners which might be adsorbed on paddy soil particles were flowed into the aquatic environment and finally deposited on the coastal sediment.

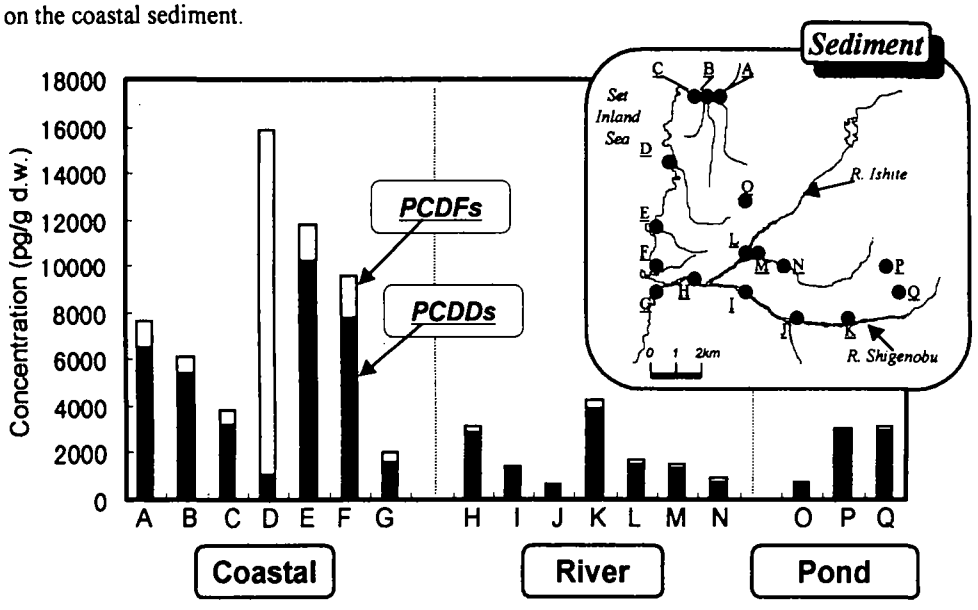

Fig.3 Distribution of PCDD/Fs in Sediments from Matsuyama, Japan

Fig. 3 also shows that the characteristic accumulation tendency of PCDDs to PCDFs in sediments. The ratio of PCDFs to total PCDD/Fs in the coastal sediments was higher than the other sediments. Fig. 4 shows homolog compositions of PCDDs and PCDFs in the all of sediment samples. As shown in Fig.4, TeCDDs and OCDD are detected as the predominant components of PCDDs. However, PCDF homolog compositions are varied among the samples in each sampling location. It suggests that CNP and PCP are mainly contributed to sources of PCDDs. In the case of PCDFs, sources of them are varied in the locations. For examples, sampling location D was contaminated by PCDFs from local sources, such as PCBs.

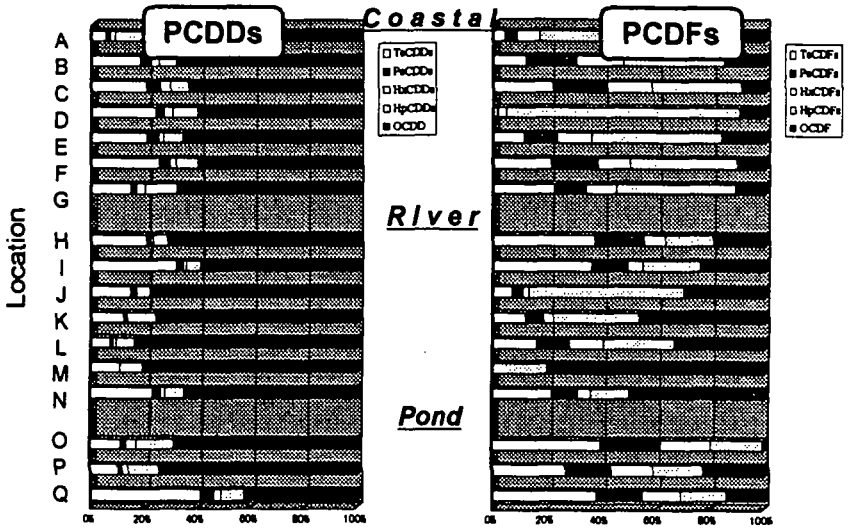

Fig.4 Homolog Compositions of PCDDs/DFs in Sediments from Matsuyama, Japan

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