Vertical distribution of polychlorinated biphenyls in a sediment core collected in Cheongpyeong lake, Korea

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Abstract

Polychlorinated biphenyls concentrations were investigated at 2 cm intervals in a sediment core collected from Cheongpyeong lake, to estimate the vertical pollution distribution in Korea. The PCBs and TEQ concentration range from 17.11 to 213.59 pg/g-dry and from 0.00 to 0.38 pg WHO-TEQ/g-dry, respectively. As a result of comparison between congener profiles of sediment core and these of potential sources, the sediment core might have been influenced by PCB commercial product than combustion process.

Introduction

In Korea, the concern of persistence organic pollutants (POPs) is increasing with the effectuation and ratification of Stockholm convention in May 2004 and Feb. 2007, respectively. The major sources of PCBs to the air are from volatilization from commercial PCB formulation and emission from combustion processes.[1] PCBs had never been produced in Korea and have only ever been imported from 1975 to 1984. Environmental stable compounds such as PCBs, that are relatively insoluble in water, tend to accumulate in sediments.[2]

The fundamental POPs monitoring data has been accumulated from 1999 in various environmental media such as ambient air, water, soil and biota in Korea. However the POPs monitoring research in sediment core are few.

The vertical distribution of PCBs in a sediment core in Cheongpyeong lake where located in the upper Han River was investigated to elucidate historical trends of PCBs.

Materials and Methods

Sampling

The Cheongpyeong lake, where located in the upstream part of the Han River, was made with construction of a Cheongpyeong dam in 1943. The lake has an area of 12.4 km^2 and a catchment volume of 180 million ton. This area is the previous agricultural farms which was flooded after the reservoir operation.

The sediment core samples were collected at 3 points (inflow, middle, outflow point) in Cheongpyeong lake in Dec. 2005 (D2 and D3) and April 2006 (D1) (see figure 1). About 40cm sediment cores were collected, which were sectioned to slices with thickness of 2 cm. Samples were freeze-dried and then made uniformed by 2mm sieve. In addition, the water content, ignition loss and TOC (total organic carbon) was analyzed for the core samples.

Analytical procedure

The dioxin-like PCBs (DL-PCBs) analysis was conducted as EPA method 1668A.[3] The samples were extracted using Soxhlet Dean Extractor with distilled toluene for more than 20hr, and then the 13C-labelled standard (Cambridge Isotope Lab. EC-4977) was spiked as internal quantification standards. The cleanup procedure was as follow; treatment of the concentrated sulfuric acid, multi-layer silica gel column and alumina column. The DL-PCBs was separated on a DB-5MS capillary column (60m× 0.32mm×0.25um). The DL-PCBs congeners were analyzed with HRGC HP6890N)/HTMS (Thermo Finnigan MAT-5XP).

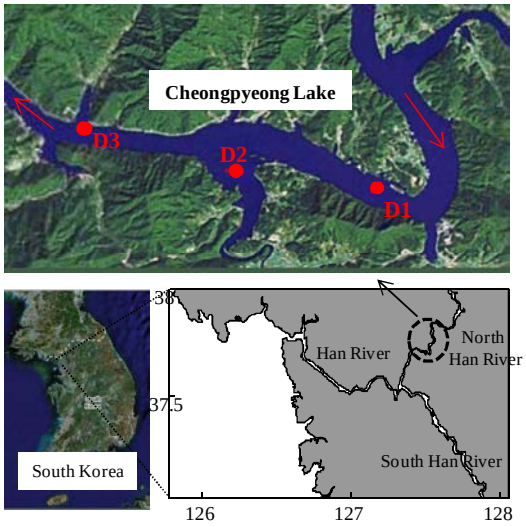

Figure 1. Sampling location

The mass spectrometer was operated with a resolution greater than 10,000 under positive EI conditions and SIM mode.

Results and Discussion

Concentration of DL-PCBs

Considering the length of short paper, the ^{210}Pb concentrations in sediment cores taken from Cheongpyeong Lake are not given. The sedimentary rate in Cheongpyeong Lake was estimated 1.75 (D2 point) and 2.64 cm/yr (D1 point), but the sedimentary rate was not estimated in D3 point.

The concentration of DL-PCBs was shown in Table 1 and Figure 1. The concentrations of DL-PCBs were generally lower than many previous studies. [3-5] The historical trend of DL-PCBs concentration was not shown except D1 point. The high concentration was detected in about depth 30cm at D2 and D3 point. Also the relationship between DL-PCBs concentration and TOC content was not significant.

Table 1 The concentration of DL-PCBs in sediment core in Cheongpyeong Lake

Compounds \ Sampling site		D1 (n=22)	D2 (n=20)	D3 (n=20)
DL-PCBs (pg/g-dry)	Min	44.69	30.23	17.11
	Max	169.41	149.88	213.59
	Mean	104.84	73.95	91.34
	SD	32.30	54.19	38.54
DL-PCBs (pg WHO-TEQ/g-dry)	Min	0.01	0.00	0.00
	Max	0.18	0.38	0.15
	Mean	0.06	0.12	0.03
	SD	0.07	0.14	0.05

SD means standard deviation

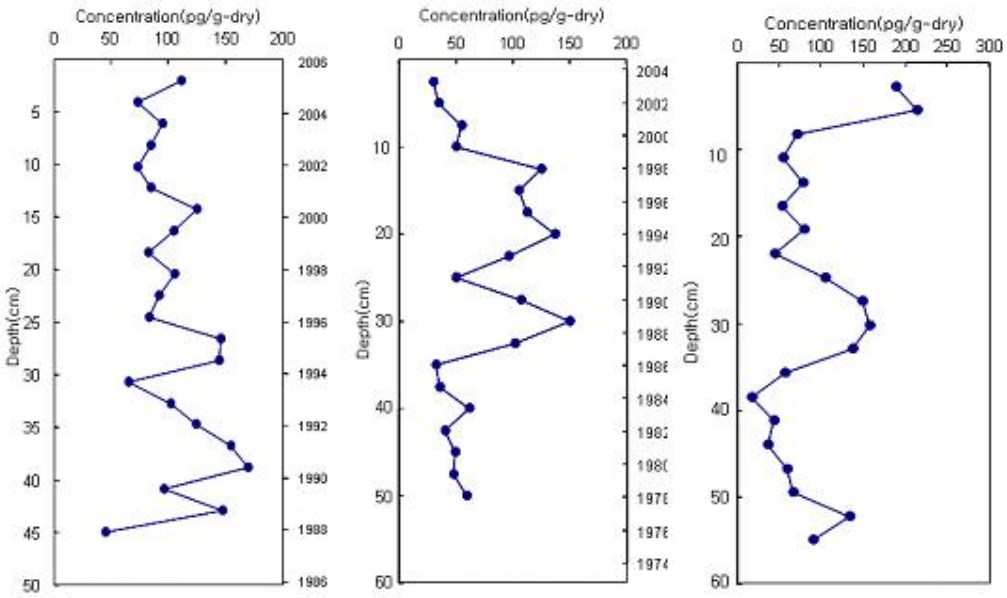

Figure 1. The concentration of DL-PCBs as core depth in Cheongpyeong Lake

Congener profiles of DL-PCBs

The distribution of DL-PCBs in sediment core as well as potential source of PCBs such as Aroclor, Flue gas was shown Figure 2. As shown Figure 2, the PCB-81, 77, 126 and 169 congeners was predominant in flue gas

samples, while the PCB-118, 105 and 156 congeners was dominant in sediment core and commercial PCB product. The congener patterns in sediment core were similar to those of Aroclor and Insulation oil samples. This result indicates that the sediment core might have been influenced by PCB commercial product than combustion process.

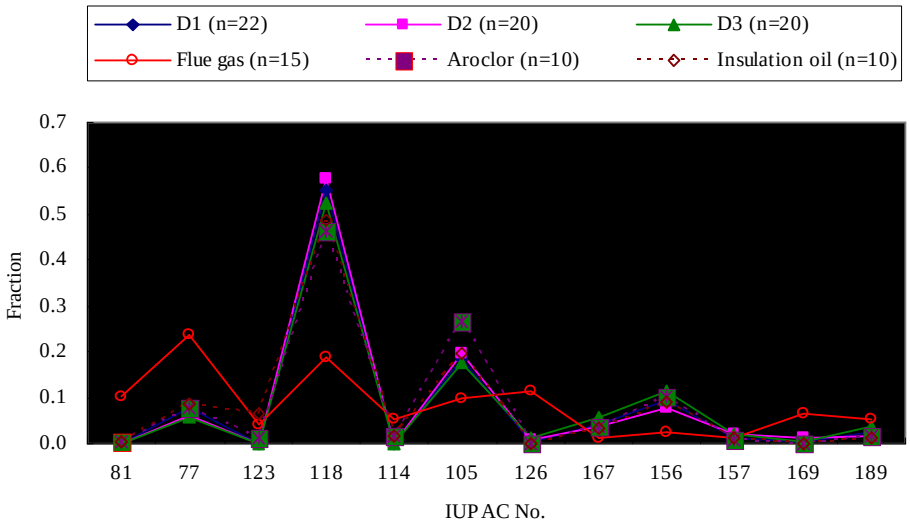

Figure 2. The congener pattern of DL-PCBs in sediment core and various potential sources

Acknowledgements

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