

# ENVIRONMENTAL LEVELS - POSTERS

## DISTRIBUTION CHARACTERISTICS OF PCBs IN THE MARINE SEDIMENTS FROM THE SEA NEAR PUSAN, KOREA

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### Introduction

Pusan city is located at east-south edge of South Korea. The west and east section of Pusan city is situated at the mouth of the Nakdong River and Kori nuclear power plant, respectively. Marine sediments have been considered as major environmental sinks for PCBs.<sup>1</sup> In the previous investigations for polychlorinated biphenyls (PCBs) in the marine sediments of Masan and Ulsan bay, Korea, we observed significant levels of PCBs in the sediments.<sup>2,3</sup> We extended PCBs study to the sea near Pusan, especially two locations. One site is situated at an estuary of the Nakdong River where large amounts of organic pollutants have been discharged from a factory district. The other site is situated near Kijang where Kori nuclear power plant has been operated since 1978, however, no large factory is located near this location. This study presents homolog and congener levels from the marine sediments from the two areas mentioned above.

### Materials and Methods

Sediment Sampling: The marine sediments were collected in March 1999 from 3 sites (site K1~K3; 129° 15' E, 35° 18' N) in the sea near Kijang and in May from 6 sites (site N1~N6; 128° 58' E, 35° 06' N) around an estuary of the Nakdong River with a grab sampler.

Standard Materials: Standard reference sediments (SRM 1939a) were obtained from NIST (U.S.A.) to evaluate and to validate the procedure and recovery rates. Total 43 congeners were investigated in this study including 16 co-planar PCB congeners, 18 congeners recommended by U.S. NOAA and EPA as congeners for the estimation of total PCB levels, and other abundant 9 congeners.

Congener Specific Analysis: Air-dried sediments and SRM samples were Soxhlet extracted in 1:1 mixture of n-hexane/acetone for 16 h. The cleanup procedure consisted of sulfuric acid treatment, copper treatment, and elution by passing a silica gel column. Identification for PCB congeners was performed by HP6890 gas chromatograph equipped with an electron capture detector (<sup>63</sup>Ni) using a HP-5 column (60 m length, 0.32 mm i.d. and 0.25 μm film thickness).

### Results and Discussion

In this process, the presence of sulfur lifted up the chromatogram base significantly. Therefore, copper treatment process was found to be essential to eliminate elemental sulfur from the marine sediment. The recovery of PCBs from SRM and sediments was dependent upon the congeners. The mean recovery rates with triplicate analyses were nearly quantitative at levels of 65~132% standard deviations ranged from 2 to 14%.

### ORGANOHALOGEN COMPOUNDS

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The 43 PCB congener levels in the sediments from the K and N area are listed in Table 1. Total PCBs levels from each site, and homolog patterns and distribution patterns of 43 congeners from K and N areas are illustrated in Fig. 1, 2, and 3 respectively. The mean total PCB levels in the K area is  $5.3 \pm 0.5$  ng/g, which implies PCBs are evenly distributed at very low level, so there seems to be no point source of PCBs around this area. In the N area, 92% of total PCB is located at site N2 and N3, which implies a point source of PCBs is located near these two sites. These two sites are positioned at very narrow area near the drainage of Shinpyung-Janglim factory district where many factories discharge various organic pollutants. Therefore, discharged pollutants are hard to be transported to open sea and likely to be easily accumulated around these sites. The other 4 sites of N1, N4, N5, and N6 showed much lower levels than the sites N2 and N3. This illustrates Shinpyung-Janglim factory district is the major source of PCBs to an estuary of the Nakdong River and the accumulated PCBs have not been well transported to open sea since the Nakdong estuary dike constructed in 1987 blocks the normal water flowing down the river.

In the K area, penta-CBs is a major homolog which accounts for 52% of total PCBs. Di-, tetra-, and hexa-CBs contribute only about 10% each, and the other homologs show sub-ppb levels. In the N area, tri-, tetra-, and penta-CBs are major homolog, each of which accounts for about 20~30% of total PCBs.

In congener specific analysis, 14 congeners (IUPAC No. 4, 18, 28/31, 44, 66, 77/110, 87, 101, 118, 123/149, and 138) show about 10 ng/g or more and contribute 2/3 of total congener levels in the N area. In the K area, only 3 congeners (IUPAC No. 8, 87, and 126) show just above 1 ng/g and all the other congeners show sub-ng/g.

The marine sediment concentrations of PCBs show most part of Kijang area is seen to be clean. At an estuary of the Nakdong River, however, there is potential contamination source of PCBs.

## Acknowledgments

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## References

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2. Jeong J.H., Joo Y. J., Kwak D.H., and Jeong G.H. (1999) Organohalogen Compounds, 43, 347.
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Table 1. The 43 PCB congener levels in the sediments from the K and N area, ng/g dry weight

IUPAC No.	K1	K2	K3	N1	N2	N3	N4	N5	N6
4	0.19	0.30	0.21	0.57	22	0.39	0.029	0.0099	0.042
8	0.34	0.41	0.27	0.14	1.4	2.4	0.033	0.037	0.012
18	0.16	0.27	0.19	0.34	5.9	13	0.011	0.011	ND
28/31 <sup>*</sup>	0.054	0.094	0.070	0.86	12	27	0.15	0.11	0.012
44	0.046	0.17	0.093	0.18	2.8	5.7	0.029	0.066	0.0066
49	0.14	0.14	0.14	0.13	2.6	3.4	0.032	0.023	0.0092
52	0.10	0.11	0.065	0.28	3.8	2.2	0.16	0.24	0.16
66	0.036	0.031	0.030	0.34	2.8	9.8	0.058	0.052	0.015
70	0.071	0.066	0.067	0.24	2.2	4.4	0.032	0.029	ND
74	0.091	0.22	0.091	0.14	1.8	0.85	0.018	0.014	ND
77/110 <sup>*</sup>	0.31	0.37	0.21	0.71	3.5	14	0.52	0.17	0.093
87	0.72	0.42	0.48	2.5	6.8	9.4	0.87	0.65	0.17
91	0.27	0.33	0.23	0.091	0.49	0.89	0.0051	0.011	ND
99	0.66	1.0	0.84	0.15	1.4	2.7	0.0052	0.030	0.043
101	0.049	0.090	0.056	0.30	2.7	5.2	0.30	0.0097	0.053
105	0.056	0.063	0.042	0.11	0.53	2.7	0.14	0.033	0.070
114	ND	ND	ND	0.024	0.15	0.22	0.019	0.13	0.0093
118	0.024	0.075	0.033	0.41	3.3	9.0	0.45	0.097	0.014
123 <sup>*</sup> /149	ND	ND	ND	0.55	15	4.7	0.31	0.059	0.0096
126	0.83	0.68	0.91	0.18	0.69	0.99	0.14	0.092	0.026
128/167 <sup>*</sup>	0.072	0.081	0.079	0.11	0.48	1.3	0.12	0.079	0.045
138	0.15	0.57	0.12	0.58	4.9	7.3	0.56	0.21	0.066
151	0.011	0.016	0.0045	0.11	0.62	0.11	0.12	0.048	0.039
153	0.038	0.052	0.026	0.42	2.8	4.3	0.40	0.15	0.029
156 <sup>*</sup> /171	0.11	0.093	0.081	0.41	0.52	1.5	0.23	0.16	0.12
157	ND	ND	ND	0.012	0.12	0.24	0.019	0.033	ND
158	ND	ND	ND	0.064	0.35	1.2	0.063	ND	0.0067
166	ND	ND	ND	0.14	0.19	0.11	0.038	0.074	0.021
169	ND	ND	ND	0.032	0.16	ND	0.027	0.027	0.056
170	0.036	0.052	0.039	0.10	0.99	0.060	0.12	0.071	0.029
180	0.049	0.057	0.055	0.03	1.8	2.6	0.19	0.070	0.0082
183	0.050	0.063	0.048	0.055	0.63	0.74	0.086	0.018	ND
185	0.077	0.067	0.082	0.090	0.085	0.18	0.020	ND	0.012
187	0.052	0.058	0.084	0.010	1.7	2.0	0.19	0.057	0.0064
189	ND	ND	ND	0.037	0.0074	0.070	ND	ND	ND
194	ND	ND	ND	0.17	1.1	ND	0.15	0.072	0.0076
206	0.14	0.15	0.15	0.073	ND	0.34	0.079	ND	0.050
209	ND	ND	ND	0.033	0.17	0.023	0.18	0.043	ND
<b>∑7Congeners</b>	<b>4.9</b>	<b>6.1</b>	<b>4.8</b>	<b>10.7</b>	<b>108</b>	<b>141</b>	<b>5.9</b>	<b>3.0</b>	<b>1.2</b>

<sup>\*</sup> Unresolved peaks are regarded '\*' marked congeners.

<sup>a)</sup> ND: not detected

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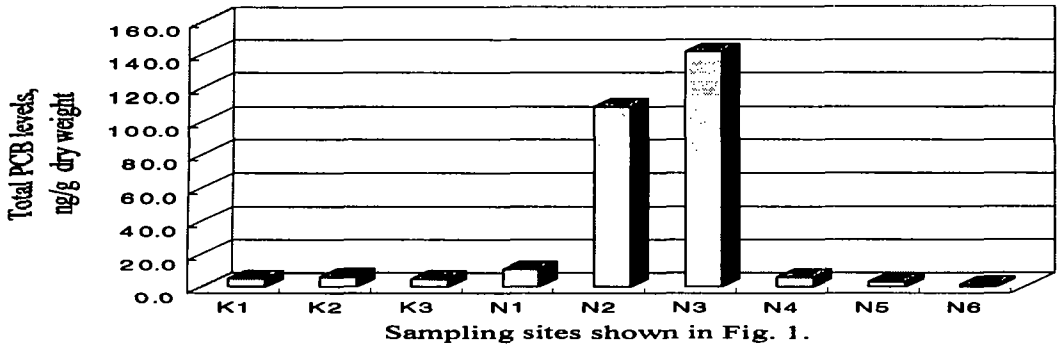


Fig. 1. Total PCB levels in the marine sediments of the sea near Pusan, K and N area.

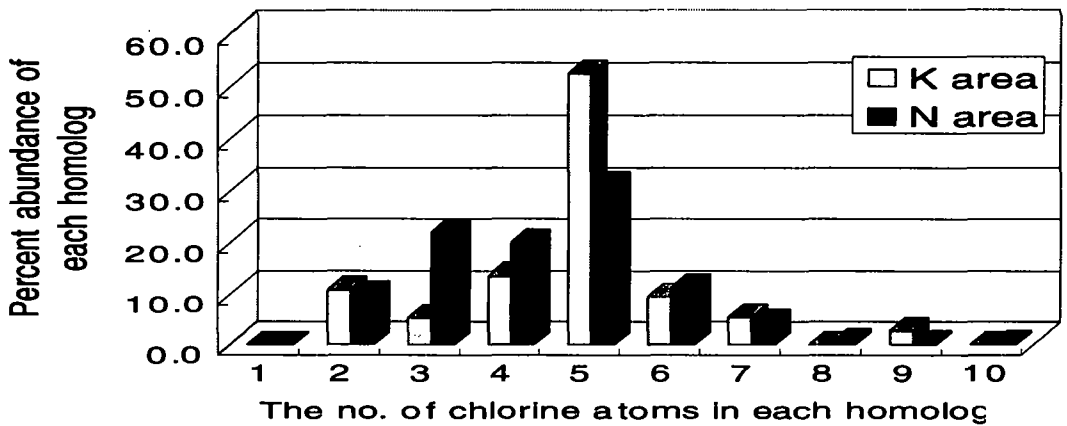


Fig. 2. PCBs homolog pattern observed from the sediments of K and N area

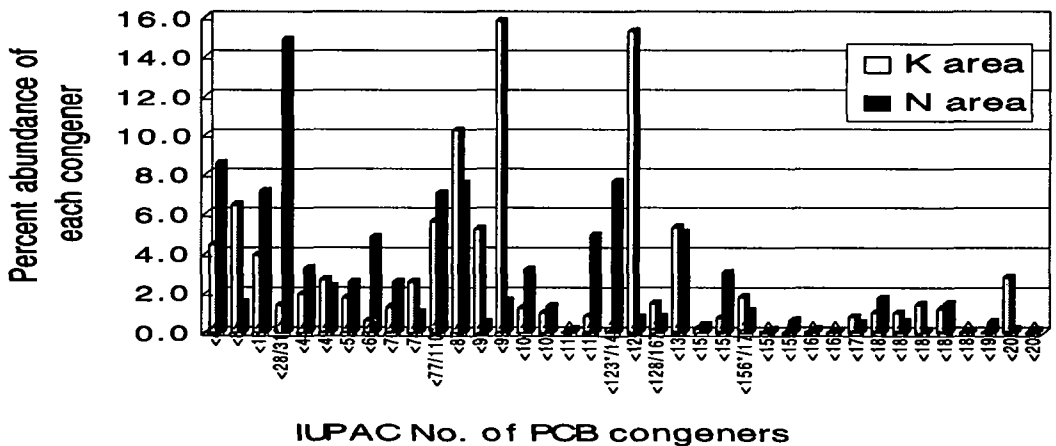


Fig. 3. Distribution pattern of the 43 PCB congeners observed from the sediments of K and N area