PCDD/Fs, Dioxin-like PCBs, and PBDEs in Sediment of Lake Huron and Its Tributaries

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Introduction

Sediment surveys were conducted in Lake Huron Basin by the Environment Canada (EC) and the Ontario Ministry of the Environment (MOE) to determine the occurrence and spatial distribution of a variety of persistent organic pollutants (POPs) and to identify potential sources of POPs to the lake. Surficial sediments samples were collected from open-lake areas including Georgian Bay and near-shore monitoring stations (Index Stations) which are located in areas representive of background conditions and in areas where there is a natural integration of the stressors fron a large area. Surficial sediment samples were also collected from selected Lake Huron tributaries to investigate river inputs of the POPs to the Lake. This poster presents data on concentrations of 2,3,7,8-substituted polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs), dioxin-like polychlorinated biphenyls (DLPCBs), and polybrominated diphenyl ethers (PBDEs) in the surficial sediment samples collected from all areas of Lake Huron Basin. This study is the first to report the levels and spatial trends of PBDEs, PCDDs/PCDFs and DLPCBs in Lake Huron sediments on a lake-wide basis.

Sampling Sites

Surficial sediment samples were collected from 30 sites in 2002 (EC, open-lake), 17 index stations in 2002 (MOE, near-shore), and 13 tributaries in 2004 (EC).

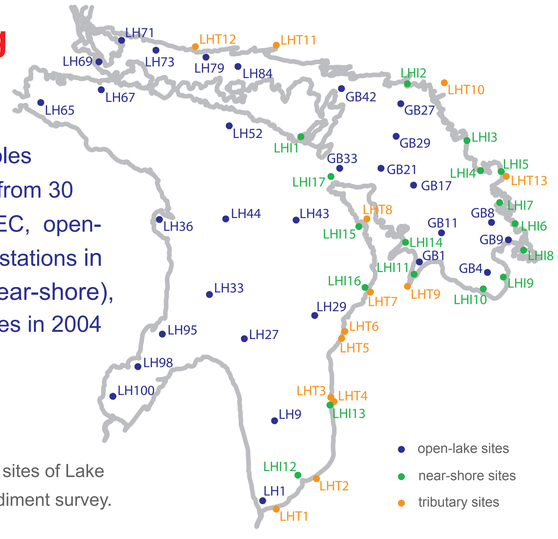

Figure 1. Sampling sites of Lake Huron sediment survey.

PCDD/Fs and DLPCBs in Sediment

PCDD/Fs and DLPCBs were detected in most sediment samples collected from the studied area. The WHO-TEQ concentrations of PCDD/Fs were in the range of 0.33 pg/g dry wt to 86 pg/g dry wt. Four stations (LH43, LH84, LH100, and LHT11 were found to have the concentrations higher than the Canadian PEL of 21.5 pg/g TEQs for PCDD/Fs[1]; none exhibited TEQ levels that were higher than the Canadian PEL of 277 ng/g for DLPCBs.

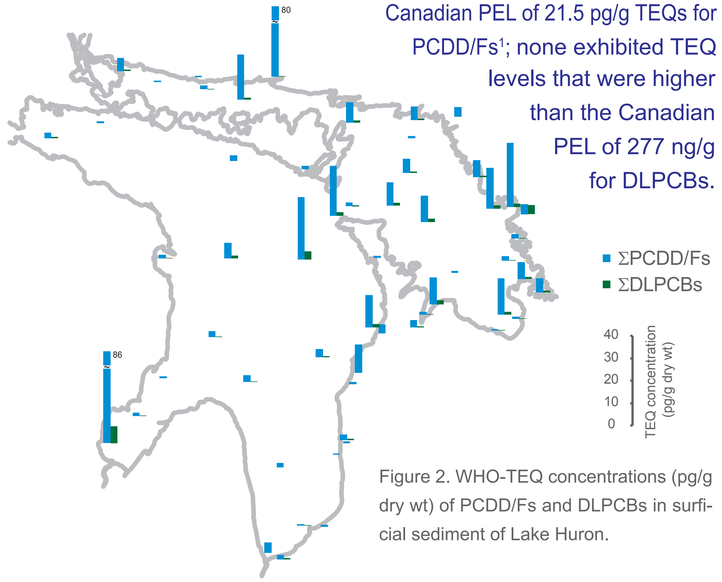

Figure 2. WHO-TEQ concentrations (pg/g dry wt) of PCDD/Fs and DLPCBs in surficial sediment of Lake Huron.

- Homologue profiles at most locations (e.g., LH43) are similar to those presented in the particle phase of air samples collected in remote and suburban regions[2,3].
- LH84, LH100 and LHT11 showed different patterns, although HpCDD and OCDD were still dominant in the samples.
- The homolog composition of LH84 and LHT 11 has a higher proportion of TCDD; while LH100 has a high proportion of HpCDF and OCDF (Figure 3).
- Areas of Saginaw Bay, near Spanish Harbour (LH84), and in the Spanish River (LHT11) have historically exhibited relarively high concentrations of PCDD/Fs as a results of industrial activities.

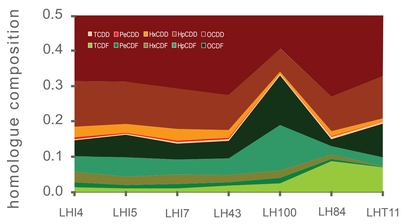

Figure 3. Homologue profiles at the sampling sites whose TEQ values are higher than Canadian PELs of 21.5 pg/g for PCDD/Fs.

LHI4 Parry Sound Bay
LHI5 Parry Sound Belle Bay
LHI7 Moon Island
LHT11 Spanish River

PBDEs in Sediment

PBDEs were measured only in open lake samples. Total concentrations (sum of 17 individual congeners BDE-17, -28, -47, -49, -66,-71, -77, -85, -99, -100-119, -126, -138, -153, -154, -183, and -209) were in the range of 0.67 to 13 ng/g dry wt with a lake-wideaverage of 4.1 ng/g dry wt. Highest concentrations in the lake were found at sites LH43 and LH100, which had levels of 13 ng/g dry wt and 8.5 ng/g dry wt, respectively.

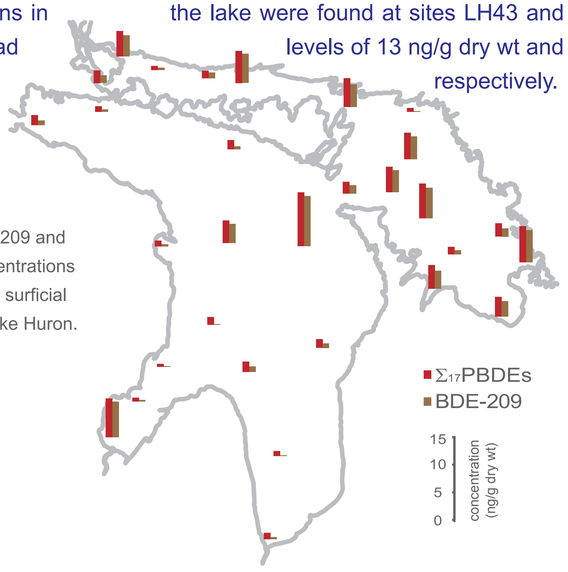

Figure 3. BDE-209 and Σ_{17}PBDE concentrations (ng/g dry wt) in surficial sediment of Lake Huron.

- BDE-209 was the dominant congener in most samples, which is consistent with that previously reported for Lake Huron sediment[4].
- Of the other tri- to hepta-BDE congeners, BDE-47, -99, -100, -153, -154, and -183 were mostly detected.
- Noticeable differences in congener patterns were observed among the samples collected at different sites of Lake Huron.

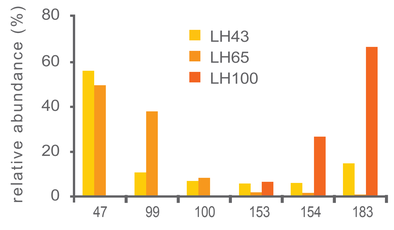

Figure 4. Typical PBDE congener patterns in Lake Huron sediment. Relative abundances are calculated by normalizing congener concentrations to the total concentration of BDE-47, -99, -100, -153, -154, and -183 for that sample.

LH65 is remote, where BDE-47 and -99 are apparently more abundant than the others; **LH43** is located in a depositional area. BDE-47 has a higher relative abundance at LH43, followed by BDE-183 and -99; **LH100** is close to Sagina Bay, where BDE-183 is the second most dominant congener in the sample, followed by BDE-154 and -153.

Conclusions

- Concentrations of PCDD/Fs, DLPCBs, and PBDEs in Lake Huron sediments were generally low.
- Highest concentrations were observed in open-lake depositional areas (LH43), and in areas influenced by industrialized/urbanized land use (LHT100, LH84, and LHT11). These areas were also characterized by shifts in homologue/congener patterns, compared to sites more characteristic of ambient concentrations.

Acknowledgements

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