



Polybrominated Diphenyl Ethers in Sediments of Tributaries and Open-Water Areas of the Great Lakes

This fact sheet describes the occurrence and distribution of polybrominated diphenyl ethers (PBDEs) in sediments across the Great Lakes basin. The spatial distribution of PBDEs reflects the effects of urbanization in the Great Lakes basin



CCGS Limnos, Environment Canada's primary Great Lakes research platform

Polybrominated Diphenyl Ethers in Sediments of Tributaries and Open-Water Areas of the Great Lakes

ISBN 978-1-100-17552-2

Cat. no.: En84-70/2009E-PDF

Information contained in this publication or product may be reproduced, in part or in whole, and by any means, for personal or public non-commercial purposes, without charge or further permission, unless otherwise specified.

You are asked to:

- Exercise due diligence in ensuring the accuracy of the materials reproduced;
- Indicate both the complete title of the materials reproduced, as well as the author organization; and
- Indicate that the reproduction is a copy of an official work that is published by the Government of Canada and that the reproduction has not been produced in affiliation with or with the endorsement of the Government of Canada.

Commercial reproduction and distribution is prohibited except with written permission from the Government of Canada's copyright administrator,

Public Works and Government Services of Canada (PWGSC). For more information, please contact PWGSC at 613-996-6886 or at droitdauteur.copyright@tpsgc-pwgsc.gc.ca.

Photos: © Environment Canada

© Her Majesty the Queen in Right of Canada, represented by the Minister of the Environment, 2010

Aussi disponible en français

Introduction

Chemical substances are everywhere around us—in the environment, our food, clothes, and even our bodies. Many of these chemical substances are used to improve the quality of our lives, and most are not harmful to the environment or human health. However, some of these chemicals have the potential to cause harm in certain doses, and should only be used when the risks are appropriately managed. The presence of some new persistent toxics represents a potential threat to the health of the Great Lakes ecosystem as these chemicals may adversely impact Great Lakes wildlife, biodiversity and ecosystem function.

Environment Canada conducts sediment research and monitoring programs to fulfill commitments under the Great Lakes Water Quality Agreement that include investigating the presence of new persistent toxic chemicals, evaluating trends and identifying emerging issues. Recent sediment surveys have been

carried out to measure the occurrence and spatial distribution of toxic substances, and have been expanded to include newer compounds used in our modern society such as the polybrominated diphenyl ethers. Results of these investigations further our understanding of the role human activities play in discharging chemicals to the environment, and provide important information for developing effective strategies to mitigate potentially deleterious ecosystem impacts.

Locations of sediment sampling sites reflect shore-based activities and inflows from tributaries. Tributary sampling is done to investigate sources of pollutants within watersheds as many contaminants are highly insoluble in water, and typically bind to sediment. These sediments also give time-integrated measures of the quality of particulate material being transported within tributaries.



Detroit River

Polybrominated Diphenyl Ethers

Polybrominated diphenyl ethers (PBDEs) are heavily-produced flame retardants used in thermoplastics, polyurethane foams and textiles. The PBDEs are classified according to three major formulations based on relative degree of bromine substitution; penta-, octa- and deca-BDE. The penta- and octa-BDEs have been designated as persistent, bioaccumulative and toxic chemicals by both the Canadian and American governments; production of these chemicals in North America was voluntarily discontinued several years ago. Prior to their banning and/or phasing out, North American demand represented the bulk of global production. A recent Canadian Government

State of the Science report concluded that decaBDE may contribute to the formation of bioaccumulative transformation products such as lower brominated BDEs, and is available for uptake in organisms and may accumulate to high and potentially problematic levels in certain species. As a result, all three major classes of PBDEs are routinely monitored in the environment. These compounds are amenable to long range transport, and are commonly detected in samples from remote areas. Due to its physical properties, deca-BDE typically comprises greater than 80% of the total PBDE burden in sediments.



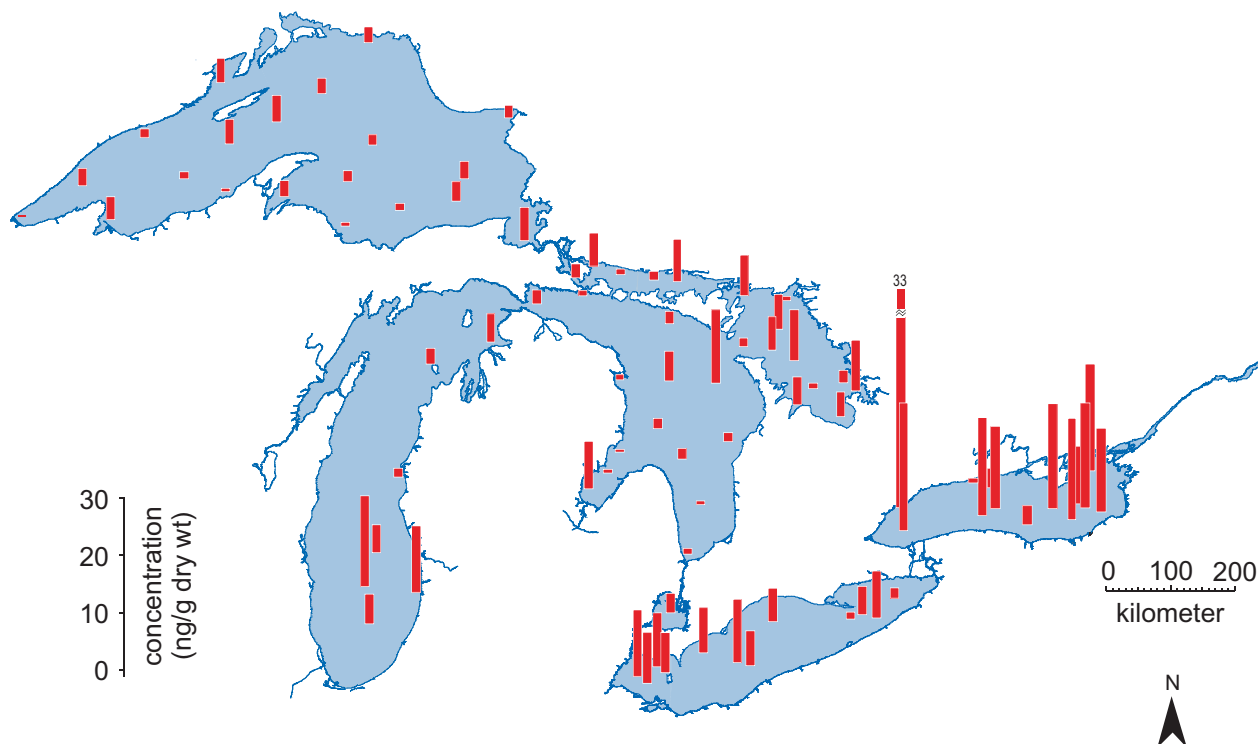
Tributary sediment sampling



Occurrence of Polybrominated Diphenyl Ethers in Sediments of Open-Water Areas of the Great Lakes

The main vector for PBDEs to enter the environment is through the atmosphere. PBDEs volatilize from consumer products into the atmosphere and condense onto particulates. Particulates then enter the waterways during storm events washing into tributaries and storm sewers. An assessment of spatial distributions and occurrences of PBDEs demonstrates a contrast in sediment contamination between

urban and non-urban areas throughout the Great Lakes. Relative to the sediment concentrations entering the Great Lakes via tributaries, the open-lake surficial sediment concentrations are generally lower. There is a general contamination gradient across the Great Lakes basin, which is due to a generally greater degree of urbanization/industrialization in Lakes Michigan, Erie and Ontario.

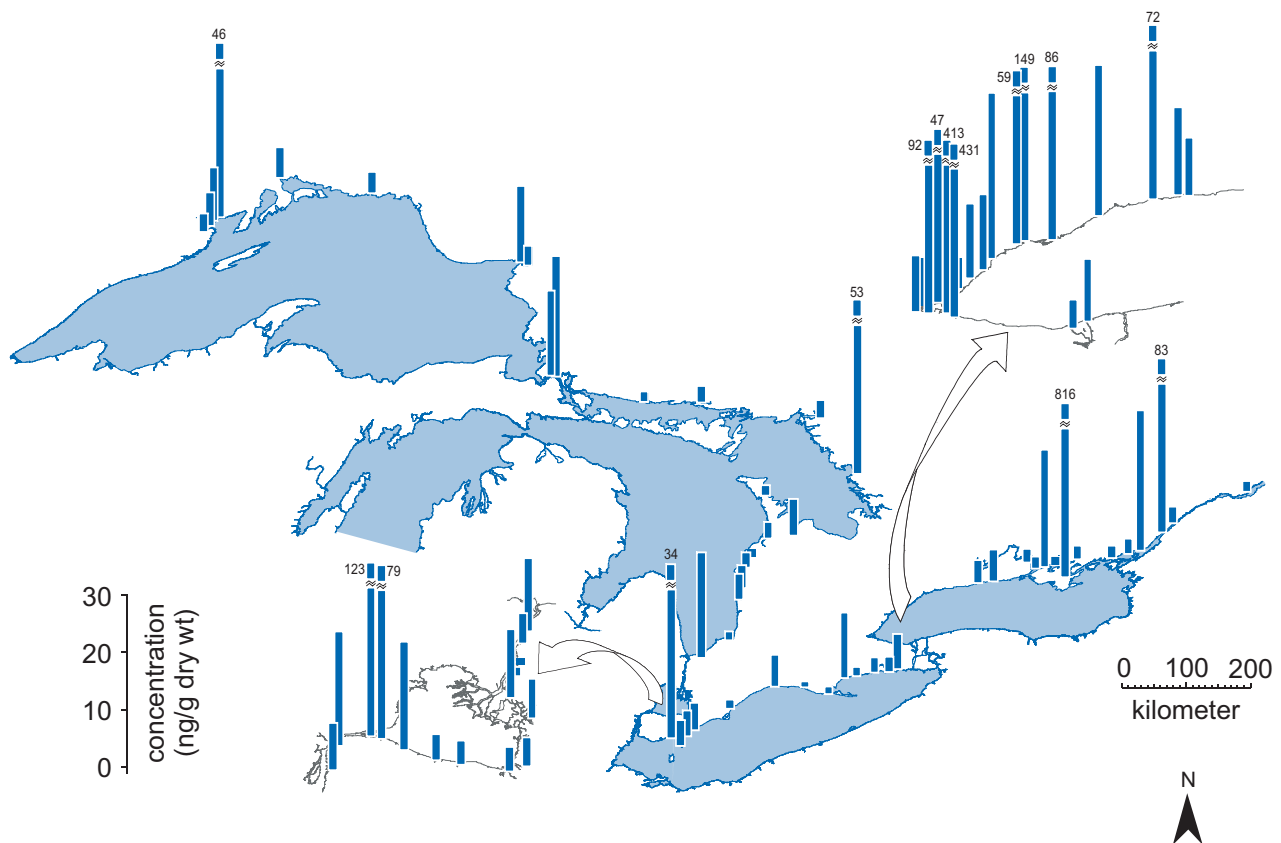


PBDE concentrations in surficial sediment in open water areas of the Great Lakes. Source: Environment Canada and the Ontario Ministry of the Environment.

Occurrence of Polybrominated Diphenyl Ethers in Sediments of Great Lakes Tributaries

Similar to our observations in open-water areas of the Great Lakes, concentrations of PBDEs in sediments of tributaries are generally higher in or near urban centers. Concentrations of PBDEs in tributaries of large cities such as Toronto, Detroit and Hamilton ranged from 50 to 430 nanograms per gram of sediment. One

nanogram per gram is equivalent to a part per billion. Although these urban-influenced concentrations are generally higher than in areas removed from cities, they are considerably lower than the historical highs of contaminants such as PCBs observed in the 1970s and 1980s.



PBDE concentrations in surficial sediment in the tributary waters to the Great Lakes. Source: Environment Canada and the Ontario Ministry of the Environment.

Findings

The results of both the open lake and tributary PBDE assessments corroborate the findings of other Environment Canada programs, and those of partnering agencies. The distributions of PBDEs in sediments in the Great Lakes appear heavily influenced by shoreline-based contemporary urban and industrial activities, which in some cases stands in contrast to contaminants such as PCBs that are generally associated with areas of historical industrial activity. The widespread occurrence, but

relatively lower concentrations of PBDEs, suggests that large urban areas can act as diffuse sources of PBDEs used in modern industrial and consumer products. These observations reinforce the importance of long-term research and monitoring programs in the Great Lakes which contributes to the development of sound science-based recommendations for management of chemicals Canadians may be exposed to as part of their everyday lives.

Management of Toxics in the Great Lakes

To address concerns about the management of persistent, bioaccumulative and toxic substances in Canada, Environment Canada developed the Toxic Substances Management Policy in 1995. The policy promotes a precautionary approach to substance management in all federal initiatives. Federal powers to support Canadian actions are derived from various pieces of federal legislation with the Canadian Environmental Protection Act (CEPA) as the primary pillar, as it provides for assessment and management of substances that may be released into the Canadian environment. The legislation was enacted in 1988 and was reviewed and updated in 1999. CEPA 1999 was strengthened by making pollution prevention the cornerstone of national efforts to reduce toxic substances in the environment, and shifted

the focus from cleaning up environmental problems to preventing them. Several new mandates were introduced to establish more efficient processes of identifying, categorizing, screening, and managing substances that are either persistent or bioaccumulative, and inherently toxic.

Canada's new Chemicals Management Plan, announced in December 2006, improves the management and regulation of hazardous chemicals. It includes a number of new, proactive measures to make sure that chemical substances are managed properly. Taking action now will significantly reduce future costs associated with water treatment, clean-up of contaminated sites, and treating illnesses related to chemical exposure. It will improve Canadians' quality of life, and better protect our



environment, including that of the Great Lakes ecosystem. This plan will also improve the conditions for business in Canada by ensuring a level playing field and a predictable, science-based regulatory regime. This new plan will build on Canada's position as a global leader in the safe management of chemical substances and products, and will marshal new and better science to improve the assessment and mitigation of risks.

As a result of the Chemicals Management Plan, assessment of the occurrence and fate of new chemicals has recently been incorporated into

Environment Canada's surface water, sediment, and biota monitoring programs. Priority chemicals are being targeted for determination of their occurrence, distribution and fate across the breadth of the Great Lakes ecosystem. Information from these programs will be a critical factor in development of sound science-based assessments of the threats posed by new chemicals, and subsequently the best polices for management and mitigation of potential health effects. These programs will also determine the environmental response to management actions on chemicals, and will support modeling and exposure/effects studies.



Toronto Harbour

Bibliography

<http://www.chemicalsubstanceschimiques.gc.ca/en/index.html>

See the Ontario Green Lane at www.on.ec.gc.ca for more information on the Great Lakes.

For more information on Great Lakes water and sediment quality monitoring programs, please contact:

Water Science and Technology Directorate
Environment Canada
Burlington, Ontario
L7R 4A6

Tel.: (905) 336-4641
Fax: (905) 336-4609

Email: Chris.Marvin@ec.gc.ca or Debbie.Burniston@ec.gc.ca