Analysis of PCB contamination in the Torch Lake Area of Concern

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Background
Torch Lake, Houghton County, is contaminated with pollutants from the copper mining and reclamation operations in the area. Copper mining and associated activities (such as smelting) started in the 1840s and ceased in 1968. In addition to the stamp sands, a source of polychlorinated biphenyl (PCB) contamination exists in the lake, which likely originates from disposal of electrical equipment or fluids used in stamp mills or the local power generation and distribution system. PCB presence in Torch Lake is cause for the stricter fishing consumption based use limitation (BUI) in Torch Lake Area of Concern (AOC). While this impairment exists, Torch Lake cannot be delisted as an AOC.

Elevated/Dispersed PCBs in Torch Lake Water as Compared to Nearby Lakes

• Semi-Permeable Membrane Devices (SPMDs) were used to measure water column PCB concentrations at 5 locations within Torch Lake and 5 locations in Lake Linden, Dollar Bay, the Keweenaw Waterway and Huron Bay. SPMDs are tubes with transport cavities whose interior surface is coated with a protein that absorbs hydrophobic organic compounds (such as PCBs) (Huckins et al., 1993).

• PCB concentrations in Torch Lake are higher than in nearby water bodies and have a higher contribution from heavy congeners.

• The range of total PCB concentration over the Torch Lake sample sites (Sites 1, 3, 5, and 6, Fig. 2) is 24 ppb to 151 ppb. The range of total PCB concentrations in other sample sites is 22 ppb to 26 ppb. According to Figure 2, heavier congeners have a more prominent presence in Torch Lake, while they are barely present in the non-Torch Lake sample sites.

Elevated PCBs in Fish Caught in Torch Lake as Compared to Fish Caught in Nearby Lakes

• Comparison of total PCB concentration in Medium-Sized Walleye from Torch Lake, Portage Lake and Huron Bay shows that Total PCB concentrations in Torch Lake fish are higher than total PCB concentrations in nearby water bodies (Fig. 3).

• Congener distribution patterns are fairly similar between the three lakes, but the concentrations are significantly higher in Torch Lake Walleye than in Walleye from Portage Lake or Huron Bay (Fig. 3).

Elevated Torch Lake Sediment, Groundwater, and Soil PCB Concentrations

• Sediments of Torch Lake and soils and groundwater along the Torch Lake shoreline were sampled and measured by the MDEQ and the EPA for PCB concentrations.

• Groundwater PCB concentrations range from 0.078 ppb water to 1.2 ppb water (Fig. 4). The EPA’s MCL for PCBs in drinking water is 0.5 ppb water (EPA, 2012). The MDEQ’s cleanup criteria at the groundwater surface water interface is 0.2 ppb (MDEQ, 2012).

• Sediment PCB concentrations range from 26 ppb sediment to 113 ppb sediment (there is one sample point whose PCB concentration is 12,400 ppb sediment) (Fig. 4). Currently an action level for Torch Lake sediments does not exist. Detected concentrations have been located mostly along the formerly industrialized western shoreline.

• Upland soil PCB concentrations range from 24 ppb to 1120 ppb (Fig. 4). The EPA’s action level for remediation of soil contaminated by PCBs is 1000 ppb (EPA, 2009).

Potential In-lake and Upland PCB Sources

• The PCBs are likely the result of buried electrical equipment and fluids associated with mining processes. This idea is based on the fact that to date, most detected PCB concentrations are located near the western shoreline of Torch Lake, where many of the buildings associated with mining and the electrical distribution system once stood (Fig. 4).

• In particular, PCBs are found in close proximity to the site of a former Calumet & Hecla electrical powerhouse. PCBs are also found near a former Calumet & Hecla smelter complex site in Hubbell (Fig. 4).

• The locations of elevated levels of PCBs in sediments coincide with the history of PCB development and usage. When PCBs were in use, one of their uses was to serve as dielectric fluids in electrical equipment such as transformers and capacitors (deVoogt and Brinkman, 1989). This equipment is commonly found in electrical substations.

Conclusions

• SPMD results show that PCB concentrations are elevated in Torch Lake compared to nearby lakes.

• The potential sources of PCBs in Torch Lake appear to affect the PCB concentrations in fish that are caught in Torch Lake as compared to nearby lakes.

• Likely sources of PCBs are located along the western shore of Torch Lake. PCBs from contaminated soils located there may leach into the groundwater and be transported into the lake from the groundwater.

• Localized elevated PCB concentrations in lake sediments, likely resulting from disposal of industrial waste, may also diffuse into the overlying lake water; this represents another potential source of contamination to the fish.

PCB concentrations in Torch Lake are higher than safe levels according to the EPA. Removal of the PCB contaminated sediments should reduce the PCB concentrations in Torch Lake so that they are less harmful to human and ecosystem health. Further research will be to determine by modeling what levels PCB input from upland soils and contaminated sediments will ameliorate the restriction on fish consumption BUI.

References

1.(2010). Analytical results of Water Samples - PCBs - June 2010 Chlor Power Plant Site Lake Linden, Houghton County, Michigan.


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