

Deposition of polychlorinated biphenyls to ice cores at opposite polar sites: Holtedahlfonna, Svalbard and Site M, Antarctica.

Mark Hermanson, Elisabeth Isaksson, Richard Hann, Camilla Teixeira, Derek Muir

Abstract

Between 2001 and 2005 we collected ice cores from glaciers and ice sheets that are nearly polar opposites, Holtedahlfonna, on Svalbard (Lat 79.13 N, Long 13.27 E), and Site M, near the coast in East Antarctica (Lat 75.00 S, Long 15.00 E). Both sites are remote and at high elevations (Holtedahlfonna, 1150 m.a.s.l., Site M, 3470 m.a.s.l.) and likely receive contaminant inputs only from long-range atmospheric transport (LRAT) which may be different in these hemispheres. All samples were analyzed for 87 PCB congeners in 80 peaks. The core from the Holtedahlfonna site has a historic record from 1953 – 2005, and Site M, as one sample, from 1958 – 2000. The qualitative results of PCB congeners from the two sites show some similarities and differences. Most congeners at both sites are in TriCB, TetraCB and PentaCB homologues and at Holtedahlfonna these three comprise 82.5%, and at Site M, 89.2% of Σ PCB. Site M PCBs are dominated by PentaCB (47.6%), while Holtedahlfonna is dominated by TetraCB (44.9%). The dominant congeners in TriCB through HexaCB are the same at both sites (PCB-28+31, PCB-70, PCB-101, PCB-138). The total PCB flux at Site M was 51% of Holtedahlfonna which would only partly be explained by the additional 10-year record at Holtedahlfonna. We developed an LRAT frequency diagram showing that sites in South America are sources to Site M more than 2% of the time between 1958 and 2000, with coverage of all of New Zealand and parts of southern Australia at a frequency of greater than 0.1%. A similar diagram for Holtedahlfonna shows greater than 2% coverage of Northern Norway, Sweden, Finland and the western Kola Peninsula, as well as all of Novaya Zemlya and Franz Josef Land. The historical trend of PCBs at Holtedahlfonna shows the lowest flux from 1962-1971 during peak PCB production and use times in North America. The maximum flux occurred between 1980 – 1988 after PCBs were being globally restricted from further use. The earliest sample, 1953-1962 had only slightly lower Σ PCB flux than the surface sample from 1995 – 2005. There is no apparent trend to PCB deposition over time at Holtedahlfonna which has been observed elsewhere on Svalbard. These results suggest that PCB sources have continued to emit PCBs in the polar airsheds in both northern and southern hemispheres after the end of new uses in the 1980s.

References