

**DETERMINING POLLUTANTS' SOURCES AND FATES BY MASS SPECTROMETRY**

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Since the 1970's, mass spectrometry has been the one indispensable tool for studying the environmental fate of organic pollutants. This tool has allowed the environmental science community to identify spurious compounds (even if the structures had not been previously known) and to measure the concentrations of these compounds. In this way, sources and fates of pollutants have been elucidated. Work from several projects from our laboratory will illustrate this sort of work:

The global distribution of 22 potentially harmful organochlorine pesticides was investigated in over 200 tree bark samples from 90 sites worldwide. In addition to the high organochlorine contamination levels found in some developing countries, industrialized countries continue to be highly contaminated even though the use of many of these compounds is restricted. The distribution of relatively volatile organochlorine compounds (such as hexachlorobenzene) is dependent on latitude (the so-called global distillation effect), while that of less volatile organochlorine compounds (such as endosulfan) is dependent on the socioeconomic status of the region of use.

The largest environmental source of the polychlorinated dioxins is combustion, particularly the incineration of solid and chemical wastes. Dioxins from these sources are released directly into the atmosphere and travel long distances to environmental sinks. We have carried out a global mass balance of these compounds. Atmospheric deposition exceeds source emissions by about a factor of four. To resolve this difference, we are currently measuring dioxin concentrations in the remote atmosphere at Bermuda and Barbados. Using negative ionization electron capture mass spectrometry, we are measuring concentrations as low as about 40 fg/m<sup>3</sup> of air.

We have measured the concentrations of toxaphene, a complex mixture of hexa- to decachlorinated norbornanes, in Great Lakes' lake trout and smelt sampled in 1982 and 1992. Concentrations in both species declined between 1982 and 1992, with the exception of Lake Superior, where there was no significant difference. Except for the Lake Superior samples, these trends were expected because toxaphene was banned in the United States in 1982. The lack of a decrease in the Lake Superior samples suggests that there may be some lake-specific source that is continuing to load toxaphene into Lake Superior or that toxaphene is not being removed from Lake Superior as quickly as the other Great Lakes.

Polychlorinated biphenyls (PCBs) are transported through the environment primarily in the atmosphere during which time the PCBs may undergo chemical reactions with OH radicals. Rate constants for the gas-phase reaction of 14 PCB congeners with the OH radical over the temperature range of 323-363 K were measured with on-line mass spectrometry. The calculated temperature dependencies of the reactions were used to estimate OH-PCB reaction rate constants at 298 K. A simple model for the vertical concentration gradient of PCBs in the troposphere was developed and used to calculate the total global loss rate of 8,300 tonnes/yr of PCBs from the atmosphere due to removal by OH. This pathway is very large in comparison to other known permanent PCB loss processes from the environment, such as deep ocean sediment burial..