USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

Project Title: Differentiating local contributions of mercury from regional inputs

Focus categories: NPP, TS, WQL

Keywords: mercury, incinerators, chlor-alkali, paleolimnology, atmospheric emissions, atmospheric deposition, bog sediment

Duration: September 1, 1998 to August 31, 2000 (two years)

Federal funds requested: $ 53,580

Non-federal match: $ 105,177

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Congressional District: Second district, Maine

Regional and State Water Problems:

The significance of mercury. Mercury contamination of biota is an international issue. The increasing awareness of the problem has resulted in fish consumption advisories in 38 states, many of them imposed in the past few years. The source of increased Hg is generally accepted to be from the atmosphere, as a consequence of combustion of fossil fuels, waste incineration, and industrial chemical processes. These sources are an issue in eastern Maine and local deposition from them is the focus of this proposal. Emission sources for Hg may have a disproportionate local influence on water and biota. Because of the widespread occurrence of emitters, it is important to distinguish between regional and local pollution sources.

The need for this research. Although the existing data on Hg in fish and surface lake sediments suggest (Land and Water Resources, 1997) that the local sources are having an impact on fish and sediment chemistry, other factors may play a significant role. These possible factors include local sources of geologic Hg, differences in Hg bioaccumulation caused by specific fish species, or certain physical and chemical lake characteristics.

Analysis of ^{210}Pb-dated lake sediment and peat cores will clearly indicate if the local sources are the explanation because we will see the increase in Hg accumulation in the sediment record at the time the sources commenced emissions. The cores will allow us to determine the *historical* impacts of the *local* sources, to test if these sources are important. The bog cores will enable a more accurate measure of the atmospheric deposition rate for Hg, free of distortion from sediment focussing and the lag time associated with accumulation and transport of Hg from the watershed to the lake.

Statement of results and benefits:

National and State significance of this project. Mercury pollution in surface waters and sediments and related high concentrations of Hg in fish have been identified problems for the northern tier of states from Minnesota to Maine for a decade (Engstrom and Swain, 1997; DEP, 1996; Norton et al., 1997). Although sources of Hg emissions are generally identified and enumerated (smelting, incineration, fossil fuel burning, industrial activity), their influence on local atmospheric deposition rates is not clear. Engstrom and Swain (1997) were able to descriminate between rural and urban sites, based on accumulation rates of Hg in lake sediments. Deposition of Hg has been monitored on a very local (100s of meters; Calasans and Malm, 1997) to intermediate distance (Steinnes and Krog, 1977; Gonzalez, 1991) using biological monitors. These studies clearly indicate depositional gradients away from the point source of pollution. Industrial facilities similar to those we hypothesize as being linked to local pollution are scattered across the country. Consequently, our findings will have broad applicability in the assessment of urban environmental impact from local or point sources of Hg atmospheric emissions. The 1998 WRRI 'call for proposals' in Maine specifically asked for projects that contributed to the needs of two agency programs: the federal USGS NAWQA or the state SWAT (Surface Water Aquatic Toxics). Projects involving SWAT priorities could include sources, fate, transport, and/or persistence of Hg, dioxin, PCBs, and/or pesticides in the environment. This proposal builds on existing SWAT data to investigate issues beyond the scope of agency resources. In addition, this project will collect information that may directly impact regulatory action, and result in reduction of Hg in the environment when the air emission licenses for the chemical plants and incinerators are revised. For example, the emissions from HoltraChem in Orrington, Maine (ca., an estimated 200 pounds per year in 1997; Land and Water Resources Council Report, 1997) are sufficient to account for all the Hg deposited annually in Maine in wet deposition.