United States Environmental Protection Agency

EPA-HQ-OPPT-2005-0013

http://www.epa.gov/mercury/roadmap/htm

This document is one chapter from "EPA's Roadmap for Mercury" published in Juy 2006. The reference number is EPA-HQ-OPPT-2005-0013. You can find the entire document at http://www.epa.gov/mercury/roadmap.htm.

EPA's Roadmap for Mercury

Introduction

July 2006

EPA'S ROADMAP FOR MERCURY: Introduction

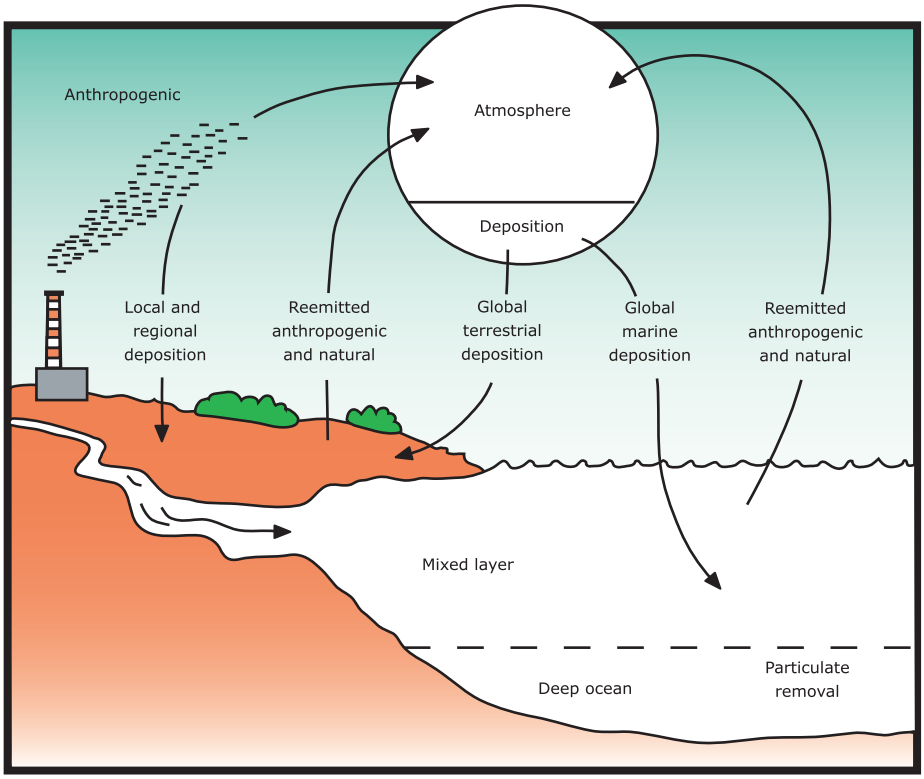
Mercury is a naturally occurring element. It enters the environment as a result of natural sources (such as volcanoes) and human activities (such as industrial combustion and mining). Mercury is widespread in the U.S. and global environment. Human activities have increased the amount of mercury that is available in the atmosphere; in soils and sediments; and in lakes, streams, and oceans.

While elemental mercury is toxic to humans when it is ingested or inhaled, EPA is most concerned about methylmercury, as it is a potent form of mercury and it is the form to which humans primarily are exposed. Methylmercury can be formed from other deposited mercury by microbial action in sediment and soils. Once formed, methylmercury can be taken up by aquatic organisms and bioaccumulates up the aquatic food web. While all forms of mercury can bioaccumulate, methylmercury generally accumulates to a greater extent than other forms of mercury.

Methylmercury accumulates in fish tissue, which may then be consumed by people and wildlife. Mercury concentrations in fish vary widely. Fish that are higher in the food chain—such as king mackerel, swordfish, tilefish, and shark—have much higher methylmercury concentrations than fish that are lower on the food chain. The majority of fish species consumed in the U.S. are ocean species and the methylmercury concentrations in these species are primarily influenced by the global mercury pool.

Local freshwater fish also contain methylmercury. States monitor their waters by sampling fish tissue for persistent pollutants that bioaccumulate. States issue their advisories and guidelines voluntarily and have flexibility in what criteria they use and how the data are collected. As a result, there are significant variations in the number of waters tested, the pollutants tested for, and the threshold for issuing advisories.Based on self-reporting, the national trend is for states to monitor different waters each year, generally without retesting waters monitored in

FIGURE 1. The Mercury Cycle[4]



previous years.[1] Forty-four states, one territory, and two Indian tribes have issued fish consumption advisories recommending that some people limit their consumption of fish from certain water bodies as a result of methylmercury found in fish.[2] Human-caused mercury emissions have dropped 45 percent in this country since 1990.[3] EPA has not monitored natural mercury emissions in this country, which may also have changed over the same period.

Mercury Sources

The primary sources of mercury releases to air, water, soils, and sediments can be grouped into four categories:

1. New releases from naturally-occurring sources (such as volcanic activity and weathering of rocks)
2. Re-releases of historic mercury previously deposited through natural and anthropogenic processes in soils, sediments, water bodies, landfills, and waste tailings/piles (also called "re-emitted sources")
3. New releases of mercury impurities from combustion of fossil fuels, and from smelting of metals such as gold and zinc
4. New releases resulting from uses of mercury in products and manufacturing processes such as chlor-alkali manufacturing

Human Health Effects

Mercury exposure effects can vary depending on the form of mercury to which a person is exposed and the level and length of exposure. The primary way humans are exposed to methylmercury is through

eating fish containing methylmercury. Research shows that most people's fish consumption does not cause a health concern. However, elevated methylmercury in the bloodstream of unborn babies and young children may harm the developing nervous system, impairing the child's ability to learn and process information. There is some evidence that exposures to methylmercury may result in genotoxic or immunotoxic effects. Other research suggests that reproductive, renal, cardiovascular, and hematologic impacts may be of concern. However, additional studies are needed to better characterize the effect of methylmercury on these endpoints.[5]

While the primary way humans are exposed to methylmercury is through eating fish containing methylmercury, individuals may also become exposed to harmful levels of elemental mercury vapor in homes and workplaces. When exposed to air, elemental mercury vaporizes and can be inhaled. Exposures from improper handling of mercury in schools, laboratories, and manufacturing plants; from accidental mercury spills; or in cultural and ritualistic uses can result in severe effects. Very small amounts of elemental mercury (even a few drops) can raise indoor air concentrations of mercury to harmful levels. The longer people breathe the contaminated air, the greater the risk to their health. At high exposures elemental mercury vapors can produce severe lung, gastrointestinal, and nervous system damage. The number of individuals exposed in this way in the U.S. is very small.

Ecological Effects

Birds and mammals that eat fish and their predators are at risk for greater exposure to methylmercury than other animals. Methylmercury has been found in eagles, otters, and endangered Florida panthers. The 1997 *Mercury Study Report to Congress* provides some data that suggest some highly-exposed wildlife species are affected by methylmercury.[6] Depending on the level of exposure, effects of methylmercury exposure on wildlife can include mortality, reduced fertility, slower growth and development, and abnormal behavior that affects survival.[7]

Reducing mercury releases to the air is important because airborne mercury can travel short and long distances; be deposited on land and water resources locally, nationally, regionally, and globally; and lead to elevated methylmercury levels in fish. EPA estimates that since the beginning of the industrialized period, total global atmospheric mercury burden has increased by a factor of between two and five.[8] Figure 1 illustrates the physical cycle of airborne mercury from natural and anthropogenic sources as it is deposited to land and water and re-released.

U.S. mercury deposition is from domestic man-made sources and from global sources, including natural, re-emitted, and international man-made sources. EPA has estimated that over three-quarters (83 percent) of the mercury deposited in the U.S. originates from international sources, with the remaining 17 percent coming from U.S. and Canadian sources.[9] These figures include mercury from natural and re-emitted sources. This estimate is based on an advanced, state-of-the-science modeling assessment of atmos-pheric fate, transport, and deposition of mercury. Air emissions of mercury from combustion and industrial processes are the largest contributor to U.S. emissions. EPA's air quality modeling indicates that a substantial variation in mercury deposition occurs

across the U.S., with domestic sources influencing mercury deposition much more in the eastern U.S. and global sources being a more significant contributor to mercury deposition in the west, where relatively few domestic sources exist. The scientific community's understanding of mercury atmospheric chemistry is evolving and there remain uncertainties regarding the simulation of mercury in atmospheric chemistry models. EPA continues to work to advance the state of the science on mercury chemistry and fate and transport modeling.[10]

Reducing Mercury Exposure

To further reduce risks associated with mercury, EPA's priority activities focus on six key areas:

1. Addressing mercury releases to the environment
2. Addressing mercury uses in products and processes
3. Managing commodity-grade mercury supplies
4. Communicating risks to the public
5. Addressing international mercury sources
6. Conducting mercury research and monitoring

EPA will continue to pursue regulatory and voluntary actions that will reduce risks associated with mercury. EPA's long-term goal is to reduce risks associated with mercury. EPA recognizes that to reduce the risks associated with mercury, the Agency must first understand what contributes to the risk and what the appropriate mechanisms of risk reduction might be. EPA will take action to identify exposed populations, minimize exposures through outreach efforts, and appropriately reduce anthropogenic releases. As part of its strategy, EPA will assess mercury sources of concern and will: focus on uses that would lead to risk, where cost-effective substitutes exist; promote reducing mercury in processes and products where benefits of such reductions would justify the cost, even where cost-effective substitutes do not exist; and work to identify and encourage development of alternatives to essential uses of mercury that lead to risk. EPA will also work with its federal partners to address risks associated with management and disposal of excess supplies of commodity-grade mercury in the U.S. In addition, EPA will support the efforts of other countries to take action to address risks associated with global mercury pollution by developing and implementing partnerships with international organizations, non-governmental organizations, and the private sector. As we work on these short and long-term plans, EPA will continue to work with federal partners to continue to educate the public about the risks of exposure from dietary and non-dietary sources.

State, Tribal, Local, and International Government Collaboration with EPA

In order to achieve reductions risks from mercury exposure, EPA will continue to collaborate with its state, tribal, and local government partners. As co-regulators with EPA, states have been actively engaged in a range of programs and partnerships to reduce mercury uses, releases, and exposure and to conduct mercury monitoring activities. In many cases, states and local governments have been leaders in mercury reduction efforts. EPA will build on these efforts and, where appropriate,

help state and local governments replicate successful efforts.

In May of 2001, a coalition of state government environmental association leaders formed the Quick-silver Caucus (QSC) in order to provide a forum for states to work together, and with EPA, to develop collaborative holistic approaches for reducing mercury in the environment. In addition, the Environmental Council of the States (ECOS), an association of state environmental agency leaders, has passed a number of resolutions over the past several years that address mercury issues, many of which are also addressed in the *Roadmap*. EPA and states are continuing to work together on mercury issues under a cooperative agreement with ECOS.

EPA is also working with tribes to develop new activities that will help the Agency make progress toward attainment of EPA's long-term goals of "fishable waters" and "edible fish." Tribal community members who follow traditional diets and lifestyles may face greater risk from locally-caught fish than do members of the general population due to the prevalence of locally-caught fish and shellfish in their diets. EPA will work with tribes to improve the quality of water and sediments in order to improve fish tissue concentrations in tribal waters.

EPA will also continue to collaborate with other federal agencies involved in domestic and international mercury issues, including the U.S. Food and Drug Administration; the Centers for Disease Control and Prevention; and the Departments of Energy, Defense, and State.

In addition, partnering with the international community is of great importance to furthering global mercury reductions. The majority of fish species consumed in the U.S. are ocean species and the methylmercury concentrations in these species are primarily influenced by global mercury contributions.[11] Also, even domestic freshwater and estuarine fish in many parts of the U.S. may contain methylmercury as a result of contributions from international sources in addition to domestic sources.