Identifying the movement of mercury emissions into nearby waterways

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Researchers from Monash University and Australian National University (ANU) have assessed the impact of high levels of mercury in the sediments of Lake Macquarie in New South Wales due to nearby coal-

fired power plants.

Many estuaries across Australia are at risk of increasing levels of metal contamination, particularly mercury (Hg) contamination from nearby coal-fired power plants and their associated ash dams.

Knowledge in this field will assist researchers in determining the appropriate Hg mitigation strategies and provide evidence for retrofitting power plants with emission control tools such as bag filters and wet scrubbers. As part of this particular research, findings revealed that coal-fired power plants did contribute to mercury contamination in sediments in Lake Macquarie.

Coal-fired power plants are often located near estuaries in Australia because they act as a water source for industrial processes in coal-fired power plants. Major coal deposits in Australia are often located near the coast with most of the population and industries in Australia located within 50 km of the coastline and close to population centers.

Despite the extensive use of coal-fired power in Australia—which generates 60 percent of the country's electricity—there is little understanding of how coal-fired power plants have contributed to Hg accumulation in aquatic sediments.

Lead researchers, Dr. Anna Lintern from the Department of Civil Engineering at Monash University and Dr. Larissa Schneider from ANU, believe it is critical to understand the Hg emissions from coal-fired power plants and the resulting fate of Hg ending up in nearby estuaries, so that appropriate management strategies can be implemented. These management strategies include, bag filters or wet flue gas desulfurisation which control atmospheric emissions, or recycling water from ash dams to prevent overflow into receiving waters.

"A key challenge in managing contamination of waterways is identifying the source of contaminants. In the context of Hg, it is important to identify whether Hg in aquatic systems is coming from atmospheric emissions, or from the ash dams associated with coal-fired power plants, so that targeted Hg management strategies can be designed and money isn't being wasted on strategies that don't address the biggest source of Hg," said Dr. Lintern.

Some previous studies have used Hg isotopes, which are types of Hg with different numbers of neutrons produced from different environmental and human-related processes, to identify sources of mercury and determine whether the key source of Hg deposited in aquatic sediments was from a coal-fired power plant or from soil erosion. However, with this method prone to alteration by natural processes, it is not always accurate.

Dr. Lintern and Dr. Schneider will be incorporating a new approach that can be used to support isotopic evidence to help determine where Hg is coming from in the coal-fired power plants.

The study assessed the level of deposition and distribution of Hg in the sediments of Lake Macquarie, which is part of the Hunter Region in New South Wales. The assessment was done using multiple lines of evidence, including stratigraphic records, statistical, hydrodynamic and atmospheric modeling.

"As part of this study, we reconstructed the historical deposition of Hg in sediments of the lake for the last 100 years to identify the impact of coal-fired power plants and atmospheric emission management strategies on Hg levels in aquatic sediments. We then used statistical, hydrodynamic, particle density and atmospheric modeling to identify whether Hg in the aquatic sediments were coming from ash dams or from atmospheric emissions from coal-fired power plants," explained Dr. Lintern.

These findings from Lake Macquarie can be used to better understand the impact of coal combustion on Hg accumulation in Australia, thereby filling the knowledge gap identified by the United Nations Environment Program (UNEP) (UNEP, 2019).

"Australia is currently at odds with many of its traditional international partners, such as Japan, the United States, Canada, United Kingdom, which have extensive information on Hg emissions and accumulation trends in aquatic sediments dating back to approximately the 1850s. The data indicate that in these countries, current Hg accumulation is 3.6 times greater than what it was prior to industrialisation. In Australia, more comprehensive studies are required on how Hg accumulation and deposition have changed water bodies from prior to the construction of power plants to the modern era," said Dr. Schneider.

The findings identified as part of this research have the capability to be applied across other aquatic systems globally to aid decision-making regarding monitoring and mitigating Hg pollution from coal-fired power plants.

More information: Larissa Schneider et al, Solving the puzzle of mercury fate and emissions by coal-fired power plants: The potential of hydrodynamic-atmospheric modelling, *Environmental Pollution* (2021). DOI: 10.1016/j.envpol.2021.117579

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