Particulate Bound Mercury: Understanding Sources, Transformation Mechanisms and Risk Assessments

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Abstract

Mercury (Hg) is a highly toxic, persistent and bioaccumulative heavy metal with a long-range global transportation. It is released into the atmosphere through human activities (such as industrial activities, mining, coal burning) and natural emissions (degassing of the earth, Hg re-emissions from oceans and forests). Being persistent, Hg cycles amongst the air, ocean, land and biosphere. Within the atmosphere, it has a large residence time; thus, travels great distances. Atmospheric Hg undergoes global circulation and enters terrestrial and aquatic ecosystems through wet and dry depositions. Atmospheric Hg exists as gaseous elemental Hg (GEM), gaseous oxidized Hg (GOM) and particulate bound Hg (PBM). GEM has a relatively large residence time of approximately a year whilst PBM and GOM typically remain in the atmosphere for several days to weeks. Due to its relatively short residence time, PBM plays a vital role in atmospheric deposition. PBM is a global environmental concern due to its sensitivity to physiochemical processes, thus resulting in large deposition velocities and scavenging coefficients, and later enters terrestrial and marine ecosystems. The deposition flux of PBM depends heavily on emission types. Usually PBM associates itself with particulate matter (PM) such as PM2.5 or PM10. These are released from sources such as wildfires, dust and industrial activities. Deposited Hg onto land and water bodies can be easily converted to methyl mercury (MHg), which is the most toxic form of Hg and easily bioaccumulates across the food chains. MHg is a neurotoxin and can impair neurological development in fetuses and young children, causing cognitive and developmental delays. Hence, PBM in the atmosphere is a significant environmental pollutant with far-reaching impacts on ecosystems and human health. Therefore, this presentation provides an overview on PBM and looks into the transformation mechanisms and health risk effects on humans as well as the environment.

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