

Mercury pollution: A looming global threat to human and environmental health

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Abstract

In present times, mercury pollution remains a critical environmental concern, posing substantial risks to both ecosystems and human health on a global scale. This article explores the sources, pathways, and consequences of mercury contamination, highlighting its persistent and accumulative characteristics in aquatic and terrestrial environments. Natural sources like volcanic eruption, geothermal activities as well as human activities such as mining, industrial processes, and the burning of coal are primary sources of mercury emissions into the atmosphere, where it eventually settles into water bodies and soil. Once absorbed by organisms, mercury bioaccumulates up the food chain, potentially causing neurological and developmental harm to both humans and wildlife. Addressing this issue effectively demands international collaboration, rigorous regulatory measures, and innovative technologies aimed at reducing emissions and mitigating the severe impacts of mercury pollution on our planet's vulnerable ecosystems and populations.

Keywords: Bioaccumulation, environment, human health and mercury

Introduction

Mercury, symbolized as Hg, derived from the Greek word *hydrargyrum* meaning liquid silver, is a natural element known for its unique properties. It is a silvery-white metal that remains liquid at standard temperature and pressure. It is present in the environment in various forms, including elemental mercury (Hg^0), inorganic like Mercurous (Hg^+) and Mercuric (Hg^{++}) salts, as well as organic compounds such as methyl-, ethyl-, and phenyl-mercury. Each form varies in toxicity and behaviour in the environment, influencing its ability to accumulate and pose risks to living organisms (Verma *et al.*, 2018) [13]. However, organic forms of mercury (mainly methyl mercury) are especially concerning due to their high bioaccumulation potential, presenting greater toxicity compared to inorganic species. mercury is one of the most toxic elements known to pose significant threats to wildlife, particularly through its ability to accumulate and magnify to hazardous levels within aquatic food chains (Munthe *et al.*, 2007) [9]. Mercury, an element neither created nor destroyed by humans, is mainly released into the environment by natural process like volcanic eruptions and naturally occurs in the earth's crust, primarily as mercury salts like mercury sulphide (HgS) and other mercury-containing minerals include corderoite ($Hg_3S_2Cl_2$) and livingstonite ($HgSb_4S_8$), both of which are rare on Earth. Mercury is found in uncontaminated soils at around 100 parts per billion (ppb) on average, while in naturally contaminated areas (near Hg-bearing deposits), its level can be as high as 3500 ppb. Since the industrial revolution, human activities such as intensified mining operations, extensive burning of fossil fuels, and widespread use of raw materials containing mercury have significantly contributed to environmental mercury contamination. The World Health Organization (WHO) has set a maximum allowable level of 1 microgram per liter (1 $\mu g/L$) for mercury in drinking water (Azimi & Moghaddam, 2013) [3]. The U.S. Environmental Protection Agency (EPA) classifies mercury as a highly hazardous element because it remains in the environment for long periods and builds up in living

organisms. This accumulation leads to increased toxicity over time, posing severe risks to both ecological systems and human health (Saturday, 2018) [11].

Definition and Sources of Mercury Pollution

Mercury pollution refers to the contamination of the environment by mercury, a highly toxic element released from natural sources like volcanic eruptions and human activities such as industrial processes, mining, and fossil fuel combustion, resulting in significant ecological and health hazards on global scale due to its persistent and bio accumulative nature.

Mercury pollution sources can be classified into two main categories: natural and anthropogenic, are briefly described below.

1. Natural Sources

Natural sources of mercury emissions to the atmosphere arise solely from natural processes without human influence. These include geothermal activities, volcanic eruptions, natural volatilization from ocean surfaces, and weathering of mercury-containing minerals etc. The contribution of natural sources of mercury pollution are depicted in fig. 1.

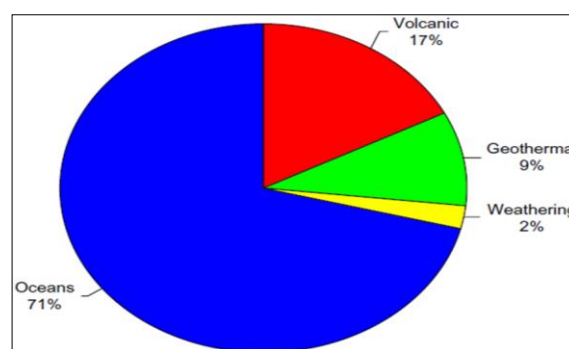


Fig 1. Relative contributions of estimated mercury emissions to the atmosphere from natural sources (Source: Varekamp and Buseck, 1986) [12]