MERCURY REMOBILIZATION FROM MARINE SEDIMENT AND FROM SOIL

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Introduction

Over centuries mercury has been used by humans in various production processes, as well as in many devices. Following deadly mercury poisonings, its use began to be limited in the second half of the twentieth century, and as a consequence its emission into the natural environment was reduced. Nevertheless, such prolonged use of mercury has resulted in the presence of this element in landfills, close to factories that used Hg in the past, as well as in soil or in marine sediments. With erosion or leaching through rain, the metal can be introduced into rivers and the sea. Also, from marine sediments mercury can become remobilized into near-bottom water or benthic organisms. As a result, mercury is included in the trophic chain (Bełdowska, 2015) and, at present, the main route of Hg introduction into the human organism is via the consumption of fish and seafood.

Methods

The studies were conducted in the Gulf of Gdańsk region, including the Puck Bay. Once a month in the period between December 2011 and May 2013, macrophyobenthos and zoobenthos were collected. Analyses of total mercury concentrations were performed using the atomic absorption spectrometry method (AAS) on an AMA 254 mercury analyzer.

Results

Nowadays, when anthropogenic Hg emission is being actively limited, an important role is beginning to be played by the remobilization of this metal from sediments where it had been deposited for decades. The lack of icing on the Puck Bay on the one hand allows for unrestricted growth of phyto- and zoobenthos, and on the other, extends the period within a year in which mercury undergoes secondary reintroduction into the marine trophic chain. Taking into account the mean yearly concentration of the studied metal in the benthos biomass of the Puck Bay coastal zone, it was estimated that in a year without an ice layer the mean annual Hg concentrations in phytobenthos biomass and in zoobenthos biomass are respectively 30% and 25% higher than the values estimated for a year with an ice layer persisting for 90 days, which was a usual

occurrence in the period between 1946 and 1991 (Bełdowska et al., 2016a). In this way climate changes contribute to the purification of water and sediment of toxic substances, but at the same time help to transfer mercury, which is relatively inaccessible biologically when accumulated in sediments, to higher trophic levels. Under the influence of anomalous meteorological-hydrological phenomena, mercury deposited on land over decades also becomes remobilized and transported into the marine environment. This process is all the more unfavorable as a relatively large load of toxic mercury can penetrate into the coastal zone of the sea, which is potentially harmful for organisms developing in this area. A flood in the Vistula River drainage basin that was the most severe in 160 years occurred in 2010 and increased the annual mercury load transported into the Gulf of Gdansk five-fold in comparison with previous years (Saniewska et al., 2014). Elevated Hg in surface sediments of the Gdansk basin persisted for nearly two years following the flood. An increase in Hg was observed not only in the sediments of the coastal zone but also in deposition areas located at a distance from the coast (Saniewska et al., 2014). Elevated concentrations were also found in mussels and fish caught one year after the flood. At present, apart from a rise in the intensity of rains, more frequent and stronger storms are also observed (HELCOM, 2013). These contribute to the elution of the shore, particularly along the southern part of the Baltic coast, an example of which is the crumbling cliff at Gdynia Orłowo (Gulf of Gdansk). The mercury concentration assayed in the freshly uncovered sediment of the cliff was more than twenty times higher than the Hg concentration in the sediments of the coastal zone of the Gulf of Gdansk.

Conclusion

Climate changes occurring in the Southern Baltic region contribute to the remobilization of mercury deposited for decades, both from marine sediments and from land. Lack of icing on the gulf extends the period during which mercury is released from sediments and absorbed by benthic organisms. Extreme phenomena such as floods or strong storm winds, occurring more and more frequently, also contribute to the reintroduction of mercury from land into the sea. As a consequence, despite the introduced restrictions concerning the release of Hg into the environment, its concentration does not decrease proportionately.

References

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