THE IMPACT OF MILITARY ACTIVITIES ON THE CONCENTRATION OF MERCURY IN MARINE SEDIMENTS AND SOILS OF MILITARY TRAINING GROUNDS

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Introduction

Mercury as a metal situated on the top of the most dangerous global pollutants, still remains an important problem for the natural environment(Boening, 2000). The main sources of mercury in the Baltic Sea are overland runoff, remobilization from sediments, atmospheric deposition and inflow from the North Sea(Bełdowska et al., 2009). Despite many natural sources, Hg is introduced to the environment by anthropogenic activity. The ammunition can be a new potential source of Hg in both terrestrial and marine environment because of mercury fulminate content in blasting caps, which were not removed from some of those ammunition. An increase of concentration of Hg in soil samples was a result of military activities as well.

Methods

Soil samples were collected from inactive military training grounds, shooting ranges and reference areas located 300m and 1000m away from such facilities. In total, 30 samples were collected in three soil horizons -5cm, 20cm and 30 cm. Sediment samples were collected from r/v “Oceania” in areas of munition dumpsites in the Baltic Sea, by means of ROV attached sampler and box corer. Samples were collected at ca. 0.5m and 100m from identified munitions.

All samples were preserved at -12 °C until the time of chemical analysis. The samples had been homogenized and freeze dried before analyzing. The concentration of mercury was determined by AMA-254. Recovery of the method amounted to 98%, whereas standard deviation was below 5%. The limit of quantification was 0,01 ng/g. Additionally, a grain size analysis was performed by sieve analysis and the content of organic matter was obtained by loss of ignition in 550 °C.

Results

A significant increase of concentration of Hg was detected in areas of Gdansk Deep, Gotland Basin and Bornholm Basin. The highest increase of mercury concentration in ammunition dumpsites was observed in western part of Gotland Basin as compared to the reference station (increase about 206%). This increase of concentration of mercury in marine dumpsites could be a result of content of organic matter or fine grain(Jędruch, Bełdowski, & Bełdowska, 2015). However, after taking into account these factors, increase of concentration of mercury still remains on high level in station with CWA. Differences in level of concentration of Hg in ammunition dumpsites were probably caused by degree of corrosion of weapons in question, and presence/absence of mercury fulminate primers. An increase of concentration of mercury was not detected in any station located in Vistula Mouth area. It was likely connected with the fact that dumped ammunition was not found in this area. CWA which were detected there could be a result of transporting these compounds by bottom trawling. Moreover, the important fact is that Vistula mouth is an area of transport but not accumulation of pollutants (Zajaczkowski, Darecki, & Szczucinski, 2010). Exemplum concentrations of mercury in CWA affected sediments and control sediments are presented in Figure 4

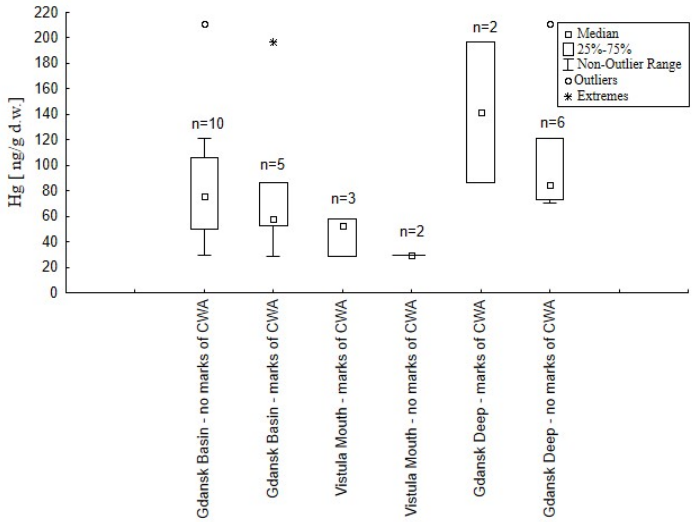

Figure 4 Statistical characteristics of mercury concentration [ng/g d.w.] in Gdansk Basin divided

An increase of concentration of Hg in soil samples was a result of military activities as well. Significantly increased concentration of Hg in area of active gun range compared to the reference station was a result of using firearms there. Unclear downward trend of concentration of HgLOI could be a result of annual cleaning of the soil in area of shooting position. Despite the fact that military activities in Poland had finished several dozen years ago, higher concentration of Hg in area of inactive training grounds are still noticeable. Concentration of mercury in these zones of former gun ranges (Hel Peninsula area) was higher compared to the references stations

Conclusion

Both military training grounds and shooting ranges can clearly became a source of mercury to the environment due to reemission, in case of floods, or outgassing to the atmosphere. Sea dumped munitions can also be considered local mercury sources, as confirmed by elevated mercury concentrations there. In the Baltic Sea alone, more than 200 000 tons of various munitions were dumped, while global numbers are probably close to several million tonnes (1.6 M tonnes in German waters only) and vast military training grounds are located in many coastal areas. Therefore further studies are needed to assess the impact of military sources on mercury budget in the environment.

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