LONG TIME VARIATIONS OF MERCURY IN SURFACE WATERS OF THE TURKISH STRAITS SYSTEM

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Abstract
Long time variations of total mercury (Hg) in the Sea of Marmara (St.1) and the Dardanelles (St.2) were investigated in relation to the physical water quality parameters such as temperature, salinity and pH between March 2002 and December 2005. Hg concentrations at St.1 ranged from 2.08 to 7.85 µg L^{-1} (average: 4.49±1.39 µg L^{-1}), whereas the concentrations at St.2 ranged from 2.68 to 24.5 µg L^{-1} (average: 5.25±3.27 µg L^{-1}). Although average Hg concentrations at both stations were nearly similar to each other, the variations at both stations were different from each other.

Keywords: Marmara Sea, Dardanelles, Surface waters, Mercury, Pollution

The Turkish Straits System (TSS) including the Bosphorus (IS), Marmara Sea (MS) and Dardanelles (CS) is located between the Black Sea (BS) and Mediterranean Sea (AS). The TSS has two flow systems reverse to each other [1]. MS takes in both the BS surface waters and the Mediterranean deep waters via two Straits. Therefore, biogeochemical cycles of the MS are influenced by neighboring seas [1]. Therefore, TSS receives a number of pollutants originating from different sources such as direct and indirect discharge of land based pollutants, sewage etc. TSS is highly contaminated by the Black Sea which accepts wastes in many urban and industrialized areas of the many countries, ended with severe eco-toxicological impacts. To determine Hg levels of two stations of the TSS, long temporal variations of Hg were carried out connected with some CTD parameters in the period of March 2002 and December 2005. This study was derived from 92 Hg surface water sampling materials carried out during four years between March 2002 and December 2005 in the framework of "DIE-DPT project of 2000K100210, Turkey. While CTD parameters were measured by using YSI 6600 MPS, Hg concentrations were measured according to UNEP [2].

CTD results showed that while surface temperature values ranged from 5.83 to 29.8 °C (average: 17.33±6.94 ºC) at St.1, the values ranged from 5.83 to 26.6 ° C (average: 16.1±6.37 ºC) at St.2. Due to two flow systems reverse to each other, surface salinity values varied between 21.1 and 28.8 ppt (average: 23.8±1.79 ppt) at St.1, whereas the salinity ranged from 21.9 to 37.1 ppt (average: 25.3±2.71 ppt) at St.2. Concentrations of dissolved oxygen were generally close to saturation limit (average: 8.79±1.69 mg L^{-1}). pH levels were in limit values and ranged from 7.68 to 8.67 (average: 8.26±0.18). While Hg levels were correlated with temperature and pH (R=430) in positive manner, the levels of Hg were correlated with temperature (R=-292) and salinity (R=-253) in negative manner. However, it is known that Hg resolution increase in high temperature and pH levels in water [3].

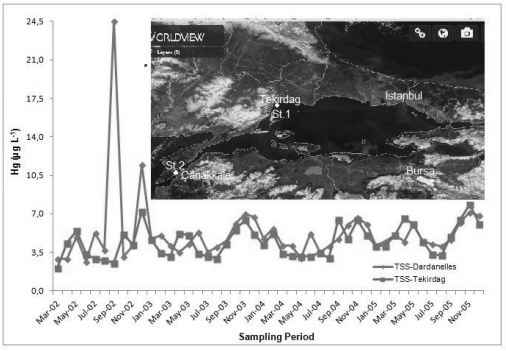

Fig. 1. Temporal variations of total Hg in the coastal waters of the Sea of Marmara

Hg concentrations in the Sea of Marmara (St.1) varied between 2.08 and 7.85 µg L^{-1} (average: 4.49±1.39 µgHgL^{-1}), whereas the concentrations in the Dardanelles (St.2) ranged from 2.68 to 24.5 µg L^{-1} (average: 5.25±3.27 µg L^{-1}). During the long sampling period, while average Hg concentrations at both stations were nearly similar to each other, the Hg variations at St.2 were higher than St.1. Hg concentrations in the study area were dramatically higher (average: 4.92±1.97 µg L^{-1}) than background levels in the oceans (0.005 µg L^{-1}) [3]. On the other hand, the concentrations in the Dardanelles (St.2) were higher (average: 5.25±3.27 µg L^{-1}) than the concentrations in the Sea of Marmara (St.1) (4.49±1.39 µg L^{-1}) (Fig. 1). Hg levels exceeded the levels of Marine General Quality Criteria given in Turkish Water Pollution Control Regulation (2004).

Bray-Curtis cluster similarity index results between years revealed that while the lowest similarity at St.1 was higher (similarity index: 80,3%) than the lowest similarity at St.2 (similarity index: 67.8%) (Fig.2), the highest similarity was above 90.0% for both stations. On the other hand, both stations were only in rate of correlation of 0.123. Both the similarity index and correlation results also showed that temporal variations of Hg in the Dardanelles (St.2) suggest the existence of additional pollution sources according to Tekirdag station (St.1). The addition source/s is/are probably mercury pollutants in the domestic and industrial waste waters of Canakkale.

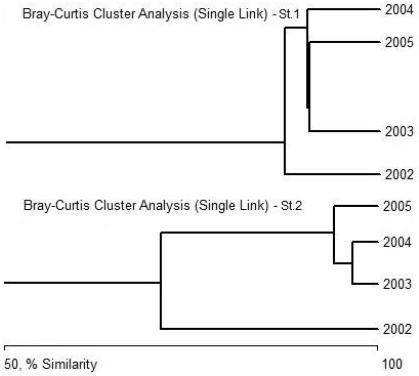

Fig. 2. Bray-Curtis cluster similarity analysis results according to annual Hg distribution

In light of the very high levels of Hg, TSS are underneath risk of the heavy metal pollution due to the urban waste waters of Istanbul and North West Black Sea surface waters more polluted by Danube. When considered that various heavy metal pollutant sources are roughly similar, the system is under risk not only in view of Hg, but also other heavy metal pollutants.

References

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