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Metal (Pb, Cd and Hg) inputs via the rivers to the Southern Marmara Sea Shelf, Turkey

Güney Marmara şelfinde nehirlerle metal (Pb, Cd ve Hg) girdisi

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Abstract

A chemical study of the major river waters of Southern Marmara Sea Shelf, Turkey, was carried out on the metal distributions and sources. The distribution of metals (Pb, Cd and Hg) was measured as ''Total'', dissolved and in the suspended matter. The concentrations obtained show that the high metal concentrations in the Erdek Bay waters are mainly due to the land-based natural inputs from the erosion products of mineralized zones to the bay by two rivers (Biga and Gönen). However, the relatively high metal concentrations in the Gemlik Bay waters suggested some anthropogenic (domestic + industrial) inputs via the Kocasu (Susurluk) to the southern shelf. Generally dissolved metal contents are higher than in the suspended matter throughout the water column. Especially Cd contents are lower than the detection limit of the method (<0.01 μg/l) in the suspended matter except in Biga and Gönen waters.

Keywords: metal, Marmara Sea, river, atomic absorbtion spectrophotometer

Introduction

The Marmara region accommodates 46 cities of various sizes and most of the industry in the country. The southern shelf is roughly 30 km in width. It receives the major riverine input into the Marmara Sea from Biga, Gönen

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and Kocasu (Susurluk) Rivers. Biga and Gönen Rivers are the main transport routes for some pollutants, including metals from mines and municipal effluents to the Erdek Bay (Balkıs and Çağatay, 2001). They have drainage areas of 2100 and 1200 km^2, respectively, which include some Cu-Zn-Pb and Hg mineralized zones. Kocasu River also includes the high anthropogenic (domestic and industrial) inputs from its surrounding area (Algan *et al*., 2004).

Materials and Method

The water samples were filtered through 0.45 µm filters using metal cleaning techniques (Bruland, 1979). The samples were stored in polyethylene bottles (LDPE) that were acid cleaned using methods described by Patterson and Settle (1976). After collection, the samples were acidified to a pH between 1.5 and 2.0 using HNO_3. Dissolved heavy metal concentrations (Pb and Cd) were measured by an atomic absorption spectrophotometer (AAS) following preconcentration with ammonium 1-pyrrolidinedithiocarbamate (APDC) by an organic extraction (Bruland, 1985). Hg was analyzed by the Hydride Generator-AAS. TSS metal contents (Pb and Cd) were determined by an atomic absorption spectrophotometer (AAS) after a "total" digestion by HNO_3 , $HClO_4$, HF acid mixture.

Results and Discussion

Dissolved Oxygen contents measured in December are the highest values due to its increasing solubility with decreasing temperatures in winter. As expected values the lowest values are obtained in September.

Total Solid Suspended values changed along the water column similarly for all the metals in Biga, Gönen and Kocasu Rivers. The highest values are measured in December due to rainfalls. When the river mouths are considered we can ordered the Kocasu, the Biga and the Gönen Rivers in terms of TSS.

The surface water circulation pattern is given in Figure 1 on a satellite image of the Sea of Marmara taken on June 25, 2003. The current line bending clockwise as the jet of the strait propagates in the catchment area forms the skeleton of the surface circulation (Beşiktepe *et al.,* 1994). Also as it twists small loops accompanied the main stream. The trace of the Kocasu, the Biga and the Gönen rivers can be noticed from the satellite image (Figure1). Mixing with seawater, the water of the rivers follows the circulation pattern.

The highest dissolved Pb contents are found in Kocasu River water. In addition, Biga River includes the second high Pb values. The results suggested a terrestrial anthropogenic input from its drainage area to the southern shelf. Similarly, Hg contents are higher especially in Biga River. The source of the high values is the presence of Hg mineralized zones localized in Biga River's drainage area.

Generally the highest metal contents were measured in the Kocasu River. This can be explained by the condensed industrial activities in the drainage area of this river.

Figure 1. The satellite image of the Marmara Sea taken on June 25, 2003 with the general surface circulation pattern illustrated on

Metal contents in the suspended solid matter are lower than the dissolved metal values. Most of the time, the concentrations measured are under the detection limit of the method (< 0.01µg/l).

Conclusion

The main source of high Pb and Hg in the Erdek Bay water is the erosion products of mineralized zones in the drainage basin of Biga and Gönen Rivers. Although, the relatively high metal concentrations in the Gemlik Bay water suggested some anthropogenic (domestic + industrial) inputs via Kocasu (Susurluk) River to the southern shelf. Generally, dissolved metal

contents are found higher than the values found in suspended matter throughout the water column. Especially Cd contents are lower than the detection limit of the method (<0.01 µg/l) in the suspended matter except for Biga and Gönen waters.

Özet:

Bu çalışmanın amacı Marmara Denizi Güney Şelfi'ne dökülen nehir sularında metal dağılımlarını ve kaynaklarını araştırmaktır. Erdek Körfezi'nde toplam (suda çözünmüş ve askıda katı maddede adsorblanmış) metal (Pb, Cd ve Hg) sonuçları yüksek metal değerlerinin başlıca kaynağının körfeze dökülen akarsularla (Biga ve Gönen) taşınan karasal kökenli doğal kırıntı malzemesi (erozyonla mineral zonlarından olan aşınımlar) olduğunu göstermiştir. Buna karşılık Gemlik Körfezi'ndeki yüksek metal değerleri ise Kocasu nehri vasıtasıyla olan antropojenik (evsel + endüstriyel) girdilere işaret etmektedir. Genellikle su kolonu boyunca çözünmüş metal içerikleri askıda katı maddedeki içeriklerinden daha yüksek bulunmuştur. Özellikle Cd değerleri Biga ve Gönen suları dışında ölçüm limitlerinden (<0.01 µg/l) daha düşüktür.

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