

ARSENIC SPECIATION AND ECOLOGICAL RISK ASSESSMENT IN MARINE SEDIMENTS OF IZMIR BAY, EASTERN AEGEAN SEA, TURKEY

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Abstract

Total arsenic, As(III) and As(V), Fe, and Mn were measured in 17 surface sediment samples from Izmir Bay. Σ As ranged from 8.87 to 28.3 $\mu\text{g g}^{-1}$ dry weight (96.5-99.9% as inorganic As). Arsenite (As(III)) was the most dominant form followed by As(V), while organic arsenic represented a minor constituent (0.03 to 3.49%). The highest concentration of Σ As was observed at Gediz River estuary and exceeded threshold effects level (TEL). Besides, the levels of As were $>$ TEL and $<$ PEL at all stations, suggesting that As may not currently impose ecologically dangerous impacts in the sedimentary environment of Izmir Bay.

Keywords: Sediments, Chemical speciation, Geochemistry, Pollution, Izmir Bay

Introduction

Today, our knowledge of arsenic cycling and speciation in marine sediments is limited. Most studies of arsenic in sediments have centered on determining total arsenic concentrations and not the concentrations of arsenic species present. Both natural and anthropogenic sources of As have led to elevated levels in the environment [1]. Therefore, determining the level of As in sediment is an important method of assessing As contamination and risk in aquatic environments. Izmir Bay (Eastern Aegean) is one of the great natural bays of the Mediterranean Sea. The Gediz River, which flows into the outer part of Izmir Bay, is the second biggest river along the Eastern Aegean coast and includes extensive agricultural lands and numerous industrial areas. The objective of this study was to quantitatively estimate the distribution of As with its speciation, to evaluate factor(s) that affect spatial distribution of As and its species, and to assess potential risks for arsenic contamination in sediment samples. To the best of our knowledge, this is the first report on the characterization of As in sediments from the Eastern Aegean.

corroborated the hypothesis that natural sources of As were important. The present findings also endorse the phenomenon where inorganic As exclusively predominate in the sediments (98-100%), with only a trace amount of organic arsenic in all of the samples, suggesting a relatively low biotransformation due to microorganism activity. Moreover, due to the reducing conditions of the sediment, As(V) represented less than 26% of the Σ As concentration, and As(III) was the predominant species, representing between 74 and 84% of Σ As present in sediments. Σ As levels in the sediment were significantly and positively correlated with the levels of As(III), As(V), Fe, Mn, and clay ($p < 0.01$), indicating that Fe, Mn, and clay retained As in the sediment. According to the established sediment quality guidelines [3], the levels of As were in the intermediate category ($>$ TEL and $<$ PEL) at all stations.

Conclusions

As(III) and As(V) were the most common arsenic species in sediments. The results showed that As(III) was the dominant species, which is more toxic and more mobile than As(V). Nevertheless, at the mouth of Gediz River, arsenic concentrations were higher than the other stations. Thus, it is possible that at least part of the arsenic in the Izmir Bay is also derived from anthropogenic sources due to Gediz River inputs. Eventually, it may be summarized that As will not impose ecologically hazardous impacts in the sedimentary environment of Izmir Bay at the present.

References

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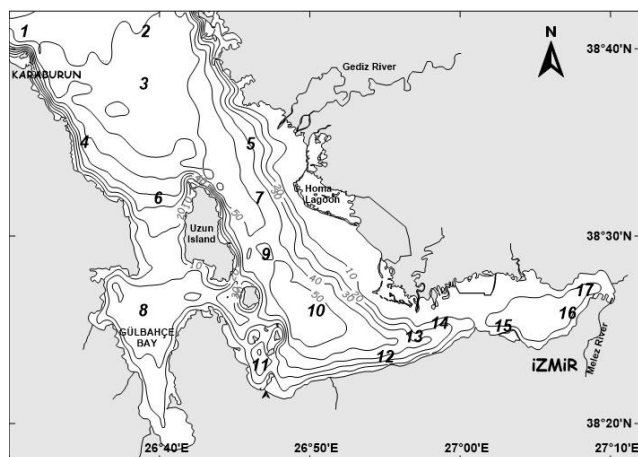


Fig. 1. Sampling stations in marine sediments from Izmir Bay

Material and Methods

In April 2014, sediment samples were collected from Izmir Bay using a Van-Veen Grab sampler. 17 sampling points were distributed along the Izmir Bay as shown in Figure 1. Σ As concentrations were measured in ICP-MS. Accuracy of ICP-MS and validity of the processes tested with a reference material (IAEA-433). As(III), As(V) and organic arsenic concentrations were determined in sediment samples by ICP-MS, following the EPA 1632A method [2].

Results and Discussion

Σ As concentrations in sediments are 8.87-28.3 $\mu\text{g g}^{-1}$ dry wt. High levels of As at the mouth of the Gediz River suggested that discharge from this river was one of the major sources of anthropogenic input into Izmir Bay. The strong correlation between Σ As concentration and Fe concentration ($p < 0.01$, $r = 0.79$)