

ARSENIC CONTENT IN THE SEDIMENTS OFF BOMBAY REGION

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ABSTRACT

The results of a survey for arsenic in nineteen sediment samples from ten stations off Bombay region are reported in this paper. Arsenic content in the sediments varied between 3.7 and 10.1 ppm. Nearshore sediments contained relatively high concentrations. The possible factors responsible for the differences in arsenic content in the sediments are discussed.

INTRODUCTION

Arsenic and several of its compounds have long been known to be highly toxic substances. The element occurs in rocks and soils and its presence in natural water systems has been recognised as a public health hazard when it reaches higher than certain concentration limits. Considerable amounts of arsenic and its compounds find their way into marine environment through land drainage. Sediments play an important role in fixing much of the arsenic in solution by ion exchange or absorption processes and recycling the same into the overlying waters thus controlling the arsenic levels in the medium. In the regions of high industrial activity, the accumulation of toxic metals in the sediments may prove hazardous to the marine organisms. Fishes concentrate enough arsenic to render them dangerous for food consumption in places where arsenic compounds are released in considerable quantities into the sea.

As a part of the investigations on arsenic content in coastal and offshore regions of the Arabian Sea and Bay of Bengal, the present study was under-

taken on the concentration of total arsenic in some sediment samples off Bombay which is a thickly populated and highly industrialized area. Large quantities of domestic and industrial wastes are discharged into the adjacent sea.

METHODS

Nineteen sediment samples from ten different stations were collected off Bombay region during the sixth cruise of R. V. *Gaveshani* in May 1976. Station locations are shown in Fig. 1. Surface sediment samples were collected using

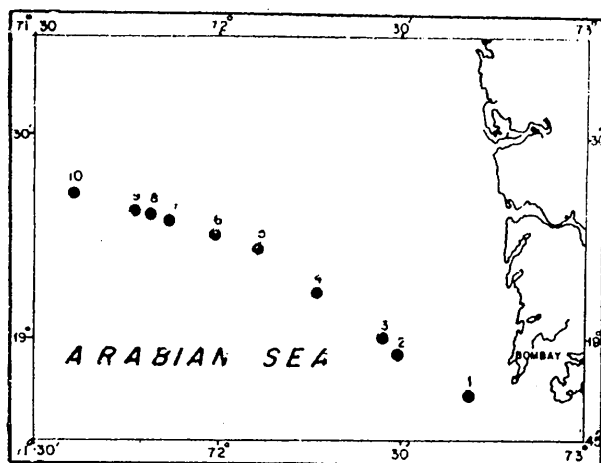


Fig. 1. Map showing the station location-

a La Fond Dietz Snapper and the cores by a piston gravity corer. All sediments were dried at 80°C after removing the gravel. The dried sediments were then ground to a fine powder and then digested with nitric and sulphuric acids (Sandell, 1959). The total arsenic was then determined spectrophotometrically using the technique developed by Vasak and Sedivec (1952).

RESULTS AND DISCUSSION

Table I gives the total arsenic content in the sediment samples. In general, arsenic content in the sediments off Bombay region varied between 3.7 and

10.1 ppm. No information is available on the arsenic content in the sediments of Indian Ocean excepting some preliminary studies made by Fondekar and Reddy (1975). They studied the arsenic content of the inshore and estuarine sediments of Goa and reported the range of variation between 4 and 14 ppm. Arsenic values in the region under study are comparable with those reported from other areas, *i.e.*, 3.2 to 12.7 ppm from the Azov Sea (Fedosov, 1940), 6.2 to 14.0 ppm from the waters of Japan (Onishi and Sandell, 1955) and 4.0 to 16.4 ppm from the Atlantic Ocean (Portmann and Riley, 1964).

Table I. Total arsenic in the sediments off Bombay Region.

Station No.	Date	Nature and horizon (cm) of samples	Texture	Arsenic (ppm)
1	21.5.76	Snapper (0-5)	Clay	9.8
		Core (36-46)	Clayey sand	3.7
2	21.5.76	Snapper (0-5)	Silty clay	10.1
		Core (191-201)	Silty clay	7.7
3	19.5.76	Snapper (0-5)	Clay	9.2
		Core (193-203)	Clay	6.2
4	19.5.76	Snapper (0-5)	Clay	6.7
		Core (284-294)	Clay	6.4
5	19.5.76	Snapper (0-5)	Clay	7.6
		Core (280-290)	Silty clay	6.4
6	19.5.76	Snapper (0-5)	Clay	7.3
		Core (256-266)	Silty clay	6.2
7	19.5.76	Snapper (0-5)	Silty clay	6.2
		Core (66-76)	Clayey sand	4.3
8	19.5.76	Snapper (0-5)	Silty clay	7.5
		Core (273-283)	Clay	8.0
9	20.5.76	Snapper (0-5)	Clayey sand	5.3
		Core —	—	—
10	20.5.76	Snapper (0-5)	Silty clay	6.4
		Core (205-215)	Clayey sand	5.3

Arsenic content in the sediments

Maximum levels of arsenic were found in surface sediments at stations 1, 2 and 3 which were closer to the coast. There was a sharp decrease from station 4 onwards and the values remained more or less uniform which is understandable as these locations were farther away from the coast. The core samples showed erratic variations which were partly due to the length of the sediment column taken for the analysis and partly because of the differences in the diagenetic activity at the collection sites.

High values of arsenic observed in the nearshore region is a positive proof of significant uptake of arsenic by the sediments due to the discharge coming from land. Also the concentrations of arsenic in the waters of nearby coastal region were found to be much higher ranging between 10 to 105 $\mu\text{g/l}$ (Zingdepersonal communication) as compared to the values from the inshore region of Goa which ranged between <1 to 43 $\mu\text{g/l}$ (Fondekar and Reddy, 1974). It is interesting to mention here that the high values of arsenic in the sediments off Bombay are also comparable with the values of the sediments found around Goa (Fondekar and Reddy, 1975). Thus, inspite of heavy industrialization of Bombay region as compared to Goa region, the near uniform concentrations of arsenic in the sediments of both the regions reflect perhaps on the nature of sediments in their capability to adsorb and retain arsenic. From the available literature, the maximum concentration of arsenic reported in the mud is as high as 20 ppm (Hamaguchi, Ohta, Onuma and Kawasaki, 1960). The maximum values of arsenic as observed in the present case is only 10 ppm. Hence it appears that the sediments of the

Bombay region may either have a lower absorption capacity for arsenic or this element might be in a mobile form in the sediments.

It can be seen from Table I, the arsenic content in the sediment varied with the texture of the sediment. Clay and silty clay sediments retained high concentrations of arsenic whereas clayey sand sediments had low concentrations of arsenic. A close observation also indicates that clays retain maximum arsenic.

A comparison of arsenic content in the surface sediments with those of sediments coming from deeper parts (cores) showed that the surface sediments have a greater concentration of arsenic than the bottom sediments. This is obviously the result of diagenetic activity within the sediments which alters the distribution of metals in its solid and solution phase and allows the metals to diffuse through pore solutions and thus enriches the surface sediments (Elderfield and Hepworth, 1975).

From the foregoing account, it is clear that the enrichment of nearshore sediments with arsenic is largely due to the effect of land discharge. The concentrations of arsenic in the nearshore areas are nearly one and half times greater than the offshore samples. The present levels of arsenic in the coastal waters off Bombay do not suggest an alarming effect of pollution in respect of this toxic element. However, the rapid increase in the industrialization of this region suggests that regular monitoring of arsenic in the waters, sediments and marine organisms of Bombay must be carried out.

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