

## ARSENIC IN THE SHELF AND SLOPE SEDIMENTS ALONG THE EAST COAST OF INDIA

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### ABSTRACT

Arsenic contents in the sediments of the east coast of India (between Lat.  $11^{\circ}00'N$  and  $17^{\circ}29'N$ ) were determined. Marked variations were found in the concentration of arsenic with location and texture of sediments. In general, the inner shelf and slope sediments, having a high percentage of clay contained a high concentration of arsenic. However, around Visakhapatnam, higher concentrations were found to be associated with sediments having a high percentage of sand. The concentrations over the entire area ranged between 0.2 and 8.7 ppm. The factors determining the distribution of arsenic in the sediments of this region are discussed.

Some data on the arsenic content of the sediments in the coastal and offshore regions of the Arabian Sea have been presented earlier (Fondekar and Reddy, 1975 & 1977). The total arsenic concentrations in the sediments along the east coast of India are presented in this paper. Along the east coast, several large rivers open into the coastal waters contributing to heavy metal load of terrestrial origin. The distributional aspects of arsenic in the sediments in relation to the texture, location and time are important to understand the extent of accumulation of the element within the sediments and the regulation of the concentration of the same in the sea.

Twenty-five surface sediment samples were collected along the east coast of India during VIII and IX cruises of R. V. *Gaveshani* in September-October, 1976. The station locations are shown in Fig. 1. Samples were collected using a La Fond Dietz Snapper. Total arsenic was determined on the bulk samples by the analytical technique described earlier (Fondekar and Reddy, 1977).

Table I gives the concentrations of arsenic along with the texture of the sediment and depth. Texturally, the sediments showed a well defined zonation along the coast. Generally, the inner shelf sediments were found to contain silty clays followed by a zone of silty or clayey sands. An examination of arsenic levels in the sediments indicated that major portion of arsenic is tied up with clay or silty clay than that of the silty or clayey sand. High concentrations of arsenic were normally encountered in the inner shelf and slope sediments containing high percentage of clay. This is in conformity with the fact of greater adsorption of heavy metals by silt and clay. The only exception to the normal rule was observed off Visakhapatnam (Stns. 70 & 71) where the texture of the sediments was silty/clayey sand containing higher quantity of arsenic. Reddy and Sankaranarayanan (1972) during their studies on the "regenerative activity of phosphate in the muds" observed that the sediments containing low silt clay with a high percentage of fine sand are conducive to active regeneration of phosphorus.

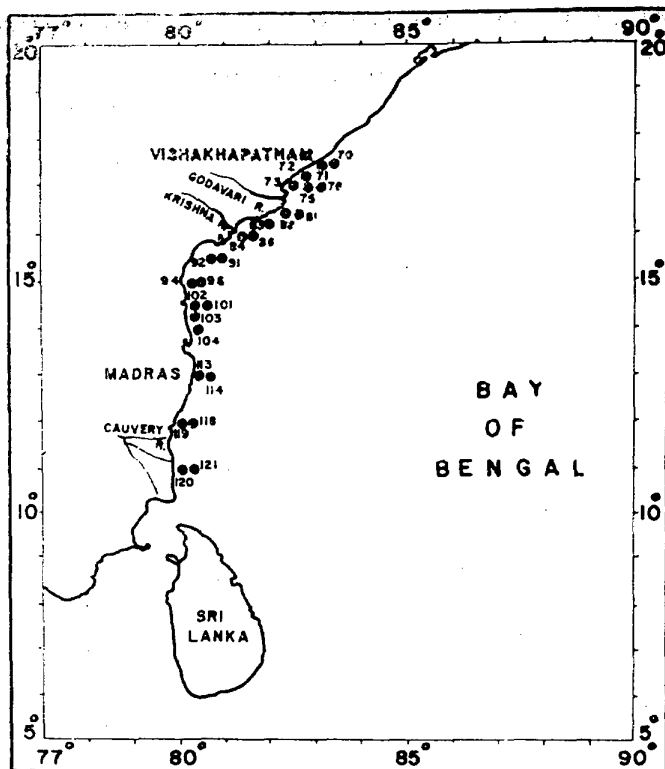


Fig. 1. Map showing the station locations.

Chemical resemblance of arsenic with phosphorus strongly suggests that similar active regeneration may be taking place. Since Visakhapatnam is a thickly populated and industrialised city, considerable quantities of arsenic in particulate or soluble form reach the coastal region through effluents and domestic wastes. Active cycling of this element within this particular type of the sediment retains high levels of arsenic in the interstitial waters.

In general, the concentrations of arsenic in the sediments of the Bay of Bengal varied from 0.2 to 8.7 ppm and the range is lower than those studied in the sediments of Goa and Bombay region where it ranged between 4 and 14 ppm (Fondekar and Reddy, 1975) and 3.7 and 10.1 ppm (Fondekar and Reddy, 1977) respectively. It is worth noting that inspite of large river systems opening into the Bay of Bengal as compared to the Arabian Sea, the low arsenic content of the sediments of the Bay of Bengal suggest that in this region, the rivers do not seem to contribute much to this element.

Arsenic content of the sediments was found to be greater in the northern section, from stations 70 to 83 (av. 6.2 ppm) as compared to the southern section from station 96 to 121 where it was on an average 3 ppm. The sharp delineation in the concentrations of arsenic in the sediments reflects the nature of the sediments and

Table I. Arsenic concentrations in sediments from the Bay of Bengal.

Stn. Nos.	Depth m	Sediment characteristics*			Arsenic ppm
		Texture	Sand %	Silt & Clay %	
70	61	Clayey sand	54.2	45.8	6.9
71	23	Silty sand	72.7	27.3	7.1
72	35	Sandy silt	21.9	78.1	7.5
73	22	Silty sand	69.3	30.7	6.1
75	103	Silty sand	60.8	39.2	2.5
76	276	Clay	9.6	90.4	6.2
81	710	Clay	3.8	96.2	3.7
82	50	Clay	—	—	7.4
83	35	Clay	4.2	95.8	8.7
84	35	Clay	5.7	94.3	0.4
86	504	Clayey silt	3.9	96.1	0.9
91	480	Clay	0.2	99.8	1.5
92	350	—	—	—	0.2
94	40	Clayey sand	36.4	63.6	0.2
96	201	Clay	0.8	99.2	4.5
101	250	Clay	—	—	6.7
102	36	Sand	99.2	0.8	2.8
103	27	Silty clay	2.8	97.2	4.3
104	63	Silty sand	68.1	31.9	2.5
113	40	Sandy silt	9.8	90.2	2.7
114	210	Clayey sand	48.1	51.9	1.9
118	260	Clay	6.5	93.5	3.3
119	35	Sand	88.7	11.3	3.6
120	39	Sand	87.3	12.7	0.6
121	213	Sand	83.7	16.3	0.8

\*Data obtained from Ansari, Harkantra, Nair and Parulekar (1977).

the discharges contributed by the rivers in general. The relatively high values in the northern region (north of River Godavari) are probably because of the discharge from the River Godavari during the monsoon months. However, higher arsenic levels close to Visakhapatnam harbour may be because of land drainages as mentioned earlier.

It is interesting to note that between stations 84 to 94, the values are extremely low (0.2 to 1.5 ppm). This includes the estuarine region of the river Krishna which apparently does not contribute significantly to this element. The nature of the bottom in this region is entirely clay which normally should be associated with higher percentage of arsenic if the total arsenic material contributed by the river is significant. Thus, the observed variations in the concentrations of the sediments at these locations, suggest that only the local land drainage influences the distribution of this element considerably.

Further south upto station 119, the values showed a sharp increase with erratic trend. It can be seen from Table I that the texture of the sediments is also found to be variable in this region which might be responsible for this erratic distribution. In the extreme southern stations, the sediments are again characterised by very low values of arsenic (0.6 to 0.8 ppm) which are predominantly sands.

In spite of the high degree of variations noticed in the arsenic content of the coastal sediments of the Bay of Bengal, the general levels are very low indicating that

the effect of arsenic pollution, if there is any, is quite insignificant in this region for the present.

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