

Trace metals (Fe, Mn, Zn and Cu) in sediments from the Gulf of Mannar region, southeast coast of India

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The distribution of trace metals (Fe, Mn, Zn and Cu) in the reef sediments and seagrass sediments of islands Manalli and Hare in the Gulf of Mannar region has been monitored for a period of one year. Attempt has also been made to relate the sediment particle size with the concentrations of metals. The determined metal concentrations were in the following order : $Fe > Mn > Zn > Cu$. The differences between seagrass bed and coral reef bed were statistically determined in each island using ANOVA.

Coral reefs seem to be a highly sensitive and suitable ecosystem for studying human disturbances in the coastal area¹. Despite a number of references^{2,3} suggesting that reef sediment might be used as indicators for trace metal pollution, there was no report on trace metals in the islands under present study. The continuous water flow between Gulf of Mannar and Palk Bay may cause continuous changes in the levels of metals in the sediments hence, the present work was initiated to determine the monthly variations of trace metals such as Fe, Mn, Zn and Cu, in coral reef sediments and seagrass sediments. It also facilitates the influences of seagrass and coral reef beds in governing the distribution of metals in their environment. Investigations have also been made to study the differences in the levels of trace metals in relation to grain size.

Four stations (two stations in each island) were selected in two islands viz. Manalli (station 1 is coral bed and station 2 is seagrass bed) and Hare (station 3 is coral bed and station 4 is seagrass bed) (Fig. 1). Sediment samples were collected every month during the period of July 1994-June 1995 using PVC liner corer, the top 4 cm was removed for the trace metal analysis. Sediments were digested using the method described by Guzman & Jimenez⁴. Small aliquotes of the digested samples were aspirated into the AAS (Varian 1475 model

Atomic Absorption Spectrophotometer). Known amount of sediment samples were screened through different sieves (>0.2 , >0.1 , >0.0625 , >0.025 and <0.025 mm mesh sizes) for textural analysis (Loring)⁵.

The present investigation on the concentrations of metals such as Fe, Mn, Zn, and Cu in the sediments from the Gulf of Mannar region are given in Table 1. Soil texture difference between these two environment has been studied and it revealed that the percentage of silt and clay was higher at seagrass bed than the coral reef bed. In contrast the percentage of coarse sand was higher at coral reef bed than seagrass bed (Table 2). Soil texture also plays a major role in distributing the

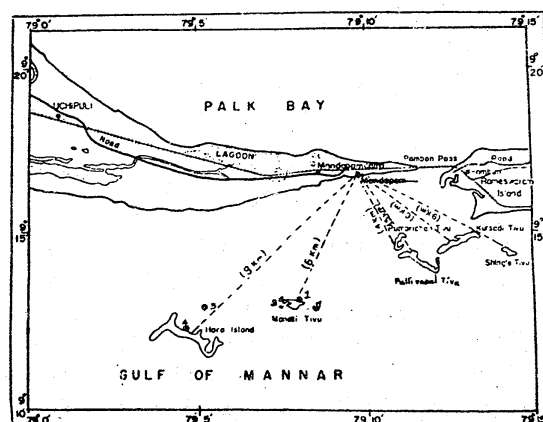


Fig. 1—The study area

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Table 1—Monthly variation of trace metal concentrations (ppm) in sediments from Gulf of Mannar

Trace metal	Station	Jul'94	Aug	Sep	Oct	Nov	Dec	Jan'95	Feb	Mar	Apr	May	Jun
Iron	1	4158	3180	2645	3125	4051	3512	2758	3118	3753	1648	3179	4235
	2	3708	3869	2928	5756	2455	2636	2924	3152	2247	1756	2236	2648
	3	2554	2132	2247	2429	1152	1444	2715	2554	2589	1572	2452	1860
	4	5262	4156	3272	4269	5465	4606	2924	2729	2288	2943	3433	4254
Manganese	1	62.8	66.5	108.9	125.6	77.9	74.9	88.7	65.6	115.6	72.1	77	109.6
	2	79.6	59.8	84.4	128.4	75.9	66.8	74.6	52.1	84.6	67.7	89.2	116.2
	3	55.2	46.2	67.8	76.5	67.8	55.5	60.9	48.5	66.2	60.8	66.4	70.8
	4	80.2	96.4	65.6	110.4	73.3	72.6	68.2	69.4	86.3	105.2	72.5	85.5
Zinc	1	21.5	23.4	22.3	25.5	28.5	15.8	18	22.8	19.5	20.6	21.9	21.3
	2	22.4	20.5	23.6	23.8	30.8	28.2	24.2	28.5	19.8	26.5	25.1	23.5
	3	23.9	19.2	21.4	15.2	21.4	16.9	20.1	24.4	16.7	19.8	20.6	21.4
	4	26.6	22.8	23.5	26.9	27.5	25.5	25.3	28.3	25.2	22.5	25.0	28.8
Copper	1	12.6	18.4	15.5	17.2	16.4	17.7	13.8	9.8	10.9	8.8	13.7	10.7
	2	13.8	14.2	13.7	13.4	17.3	18.2	14.2	11.3	14.5	12.5	11.8	14.8
	3	11.6	12.6	12.9	12.5	15.7	12.5	9.9	7.5	9.7	7.6	8.2	9.4
	4	14.8	12.2	12.6	18.2	19.8	19.5	15.2	12.4	12.8	10.9	11.5	12.3

Table 2—Soil texture in percentage of the Gulf of Mannar

Station	Stones & Gravels (>0.2mm)	Coarse sand (>0.1mm)	Medium sand (>0.0625mm)	Fine sand (>0.025mm)	Silt & Clay (<0.025mm)
1	20.74	25.42	16.12	35.78	1.94
2	2.97	17.68	36.49	37.86	5.00
3	22.48	30.90	21.56	24.24	0.62
4	1.24	11.48	32.63	47.80	4.28

metals at various levels in the sediments, which is evidenced from the present observation that the seagrass bed contains higher levels of metals than the coral reef bed. In general, all these elements in this study are relatively lower than those of values reported by Bruce *et al.*⁶ for Fe, Zn and Cu.

The iron (Fe) level was found to be the highest among all the metals in all stations studied. (Table 1). The iron concentrations showed a range from 1152 ppm at station 3 (coral bed) to a maximum of 5756 ppm at station 2 (sea grass bed). Unlike reef sediments which are coarse, fine coral pieces and shells, sand and silt, the accumulation and stability of metals are more in the fine grain sediments^{7, 8}. It corroborates the present study as the increasing particle size reduced the metal concentrations and vice versa. In reef sediments, the values of these elements recorded during the present investigation were comparable to the values reported by Guzman. &

Jimenez⁹ in Caribbean coast of Central America. The values of manganese in the present study varied between 46.2 ppm at station 3 (coral reef bed) and 128.4 ppm at station 2 (seagrass bed) (Table 1). In the study area, the levels of Zn and Cu are quite normal, indicating that the anthropogenic input is not significant in the region under study. The zinc values ranged from 15.2 ppm at station 3 to a maximum of 30.8 ppm at station 2 (Table 1). The lower value of 7.5 ppm (station 3) and higher value of 19.8 ppm (station 4; seagrass bed) for copper were recorded during the present study (Table 1).

ANOVA (Analysis of variance) has been made between sampling locations (seagrass and coral reef beds) for all the metals analysed in order to know how the metals are being governed by these two different areas (Table 3). These two areas are playing a significant role in distributing the metals,

Table 3—Analysis of variance of trace metal concentrations in the coral reef bed vs sea grass bed in Manalli and Hare islands of Gulf of Mannar

Trace metal	Station	Mean Value	Standard deviation	D.F	F Value	P Value	F Crit
Iron	1	3280.17	736.36	1.22			
	2	3026.25	1050.15	1.22	0.4706	0.5	4.30094
	3	2141.16	511.84	1.22			
	4	3800.08	1020.72	1.22	25.059	5 E-05	4.30094
Manganese	1	87.07	21.93	1.22			
	2	81.6	21.96	1.22	0.3711	0.5	4.30094
	3	61.88	9.12	1.22			
	4	82.01	14.95	1.22	16.046	0.000596	4.30094
Zinc	1	21.75	3.3	1.22			
	2	24.74	3.27	1.22	4.94	0.036832	4.30094
	3	20.08	2.77	1.22			
	4	25.65	2.24	1.22	31.26399	1.27 E - 05	4.30094
Copper	1	13.79	3.27	1.22			
	2	14.14	2	1.22	0.099705	0.75516	4.30094
	3	10.84	2.52	1.22			
	4	14.35	3.16	1.22	9.02	0.006531	4.30094

Station 1—Coral reef bed; Station 2—Sea grass bed-Manalli island; Station 3—Coral reef bed; and Station 4—Sea grass bed-Hare island

due to their differential nature of ecosystem and nature of sediments.

Comparison is made between the calculated F value with that of the critical value of F. Significant variations were found for Fe, Mn and Cu between seagrass bed and coral bed of Hare island. In Manalli island Fe, Mn, and Cu have been showing insignificant variation between coral reef bed and seagrass bed indicating the same pattern of distribution throughout the year. The seagrass and coral reef beds in Manalli island are located at short distance, and hence showed similar pattern of distribution. Zinc shows significant monthly variation between coral reef bed and seagrass bed both in the Manalli island and Hare island indicating that there is a wide difference in the distribution of Zinc every month.

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