

Distribution of Various Forms of Cd, Pb & Cu in the Wadge Bank Region (Arabian Sea)

M D GEORGE

National Institute of Oceanography, Dona Paula, Goa 403 004

Received 2 December 1985; revised received 17 July 1986

Labile, nonlabile and particulate forms of Cd, Pb and Cu were determined in 29 water samples collected from a depth of 5 m, from the Wadge Bank area. Labile Cd varied from 0.1 to 0.2 $\mu\text{g.l}^{-1}$ while nonlabile fraction was in the range 0.1 to 0.3 $\mu\text{g.l}^{-1}$. Nonlabile form of Pb was not detectable at most of the stations and the labile form was within the range 0.78 to 3.5 $\mu\text{g.l}^{-1}$. Labile Cu varied from 0.1 to 1.0 $\mu\text{g.l}^{-1}$ while nonlabile form was in the range 0.2 to 2.2 $\mu\text{g.l}^{-1}$. Particulate Cd, Pb and Cu ranged from 0 to 17.9, 11.3 to 81.8 and 9.5 to 130.0 $\mu\text{g.g}^{-1}$ (dry wt) respectively.

The importance of various chemical forms of the element present in the natural environment is stressed. The chemical forms, rather than the total concentration of the metal, provide a meaningful information about the biological effects and geochemical transformation and also indicate the availability of the metal to organisms^{1,2}.

The Wadge Bank area, a shallow region off the southern tip of the Indian peninsula, is very fertile and rich in fishery. No study on trace metals and their characteristics has been conducted in this area so far. The studies in the Arabian Sea pertain only to the total concentration of metals^{3,4} except from the western Arabian Sea⁵. Therefore an attempt has been made to study the distribution of labile, nonlabile and particulate forms of Cd, Pb and Cu in this area. The labile fraction of the metal includes the metal ions plus complexed metal which can dissociate very rapidly to the electroreducible form yielding an Anodic Stripping Voltammetry (ASV) signal while the nonlabile metal is that fraction of the bound metal which becomes ASV labile when the sample is UV oxidised⁸. Particulate matter is the residue obtained when the sample is filtered through a membrane filter paper of 0.45 μm pore size.

Samples from different stations (Fig.1) were collected during the 96 cruise of *RV Gaveshani* (Sept. 1981) using 5 l all PVC Niskin water sampler. In order to avoid contamination from the 3.5 m deep metal hull of the ship the samples were collected only from 5 m depth. The samples were stored prior to filtration in polyethylene carbuoys precleaned with nitric acid and conditioned for 1 week in artificial seawater⁶. Immediately after collection, the water was filtered through a membrane filter paper (0.45 μm). The

filtered samples were stored at 4°C till analysis⁷. The analysis was done by differential pulse anodic stripping voltammetry and the labile and nonlabile concentrations were determined⁸. The standard deviation was found to be 13,19 and 11% respectively for Cd, Pb and Cu.

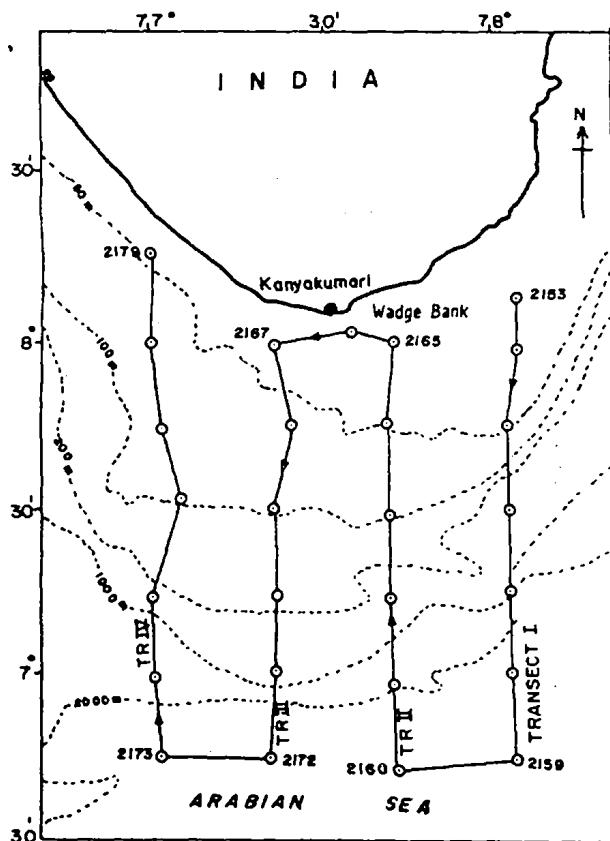


Fig. 1— Station locations in the Wadge Bank area

The filter papers with particulate matter were dried at 60°C, cooled in a desiccator and weighed. These were analysed for Cd, Pb and Cu by atomic absorption spectrophotometry³ (Hilger and Watts Atomspek model H1550).

Concentration of labile and nonlabile forms are given in Fig.2. At most of the stations labile Cd was in the range 0.1 to 0.2 $\mu\text{g.l}^{-1}$. The highest labile and nonlabile concentrations were 1 and 0.3 $\mu\text{g.l}^{-1}$ respectively. In many samples nonlabile form was non detectable. There was a general decrease of this form offshore and at the nearshore stations a higher concentration was frequently observed. The particulate Cd varied from non detectable level to 17.9 $\mu\text{g.g}^{-1}$ of the dry particulate matter (Table 1). As

compared to Cd, Pb concentrations were higher. The labile Pb varied from 0.78 to 3.5 $\mu\text{g.l}^{-1}$. At most of the stations the nonlabile form could not be detected. The highest concentration noticed was 1.67 $\mu\text{g.l}^{-1}$. As in the case of Cd the Pb concentration also decreased seawards. Particulate Pb (Table 1) was between 11.3 and 81.8 $\mu\text{g.g}^{-1}$ of the dry particulate matter. The labile Cu was in the range 0.1-1 $\mu\text{g.l}^{-1}$ whereas the total concentration varied from 0.2 to 2.2 $\mu\text{g.l}^{-1}$. The nonlabile Cu ranged from 0.15-1 $\mu\text{g.l}^{-1}$. In contrast to Cd and Pb almost all samples contained the nonlabile Cu. The particulate Cu was in the range 9.5 to 66.7 $\mu\text{g.g}^{-1}$ of the dry matter (Table 1).

In general all the 3 metals decrease towards seawards indicating the influence of natural and

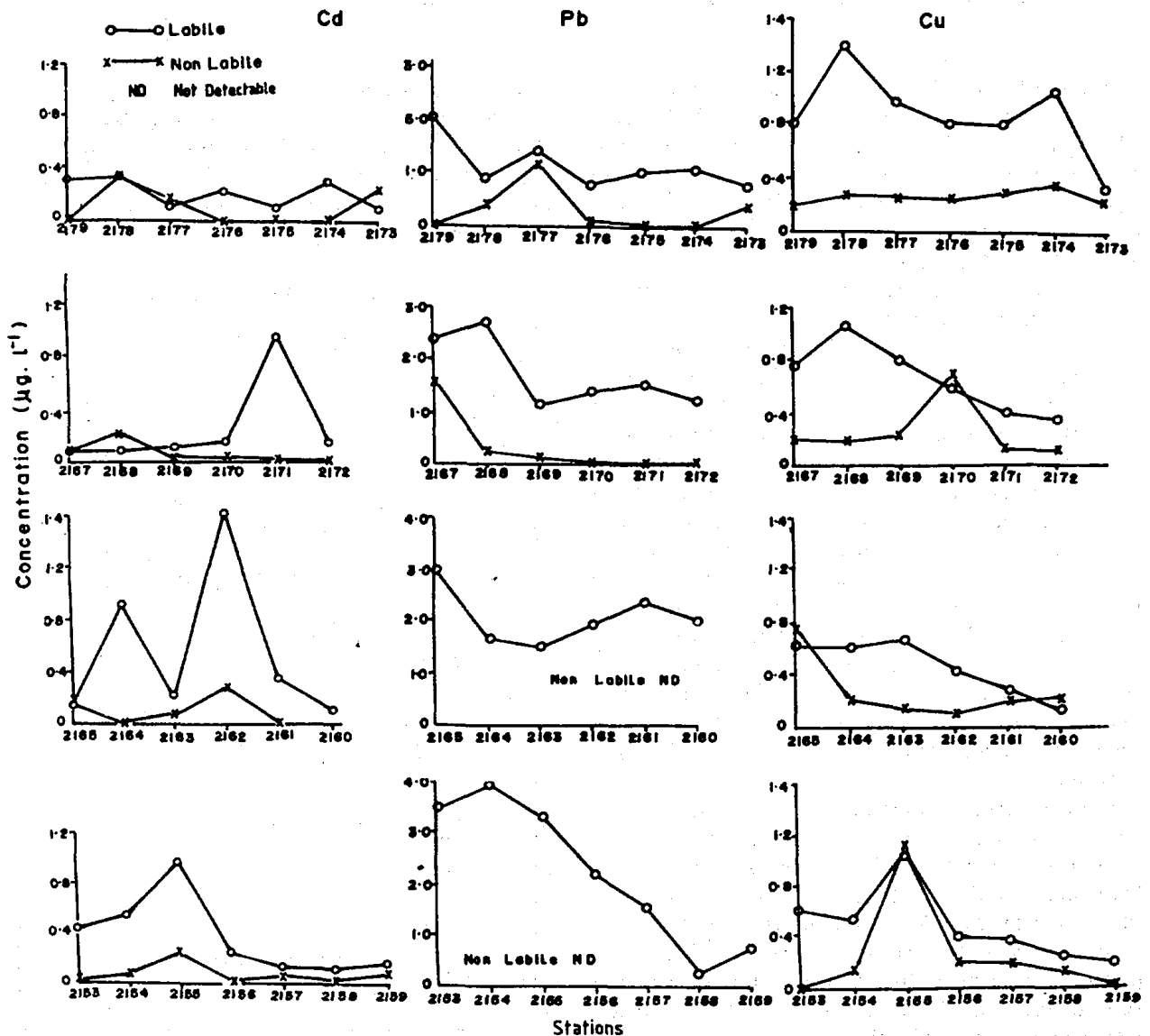


Fig. 2— Distribution of labile and nonlabile forms of Cd, Pb and Cu

Table 1— Concentration of Cd, Pb and Cu in Seawater

Station	Cd		Pb		Cu	
	D	P	D	P	D	P
2153	0.41	16.3	3.05	63.3	0.82	28.6
2154	0.60	16.9	3.08	43.1	0.70	20.0
2155	1.21	17.9	4.57	52.2	2.17	28.4
2156	0.25	5.6	2.22	22.2	0.60	10.0
2157	0.19	6.9	1.58	34.5	0.58	46.6
2158	0.09	N.D.	0.23	11.3	0.40	15.5
2159	0.22	8.3	0.85	21.7	0.20	13.3
2160	0.21	4.8	1.20	53.2	0.34	38.7
2161	0.34	12.1	1.54	36.2	0.47	17.2
2162	1.69	16.4	1.76	77.5	0.54	39.0
2163	0.25	7.1	0.85	13.1	0.79	9.5
2164	0.43	6.3	1.36	27.0	0.80	25.4
2165	0.28	10.5	4.12	44.2	1.37	12.8
2166	—	5.6	—	23.9	—	33.8
2167	0.16	6.6	4.00	50.0	0.95	66.7
2168	0.22	5.6	2.93	29.6	1.23	16.9
2169	0.16	14.9	1.28	21.3	1.03	27.7
2170	0.20	10.2	1.40	33.9	1.30	18.6
2171	0.95	7.9	1.50	63.5	0.54	9.5
2172	0.18	6.0	1.25	19.4	0.46	28.4
2173	0.34	10.4	2.20	81.8	0.58	55.8
2174	0.29	7.5	1.08	53.8	1.40	130.0
2175	0.12	6.6	1.02	24.6	1.08	39.3
2176	0.26	8.1	0.87	16.1	1.05	17.7
2177	0.28	8.9	2.61	59.5	1.24	15.2
2178	0.68	16.4	1.24	21.3	1.67	26.2
2179	0.29	16.3	1.75	12.8	1.00	23.3

 D—Dissolved ($\mu\text{g.l}^{-1}$)

 P—Particulate ($\mu\text{g.g}^{-1}$ dry wt)

anthropogenic source of fluxes like riverine input, discharge from municipal as well as industrial waste combined with atmospheric fallout⁹.

The results in this study show a higher concentration of all the metals in Wadge Bank region compared to those reported⁵ for coastal waters of the Gulf and the western Arabian Sea. The present observations were carried out in Sept. towards the end of the prolonged SW monsoon (June-Sept.). Local geological and climatological variations may affect trace metal inputs to the coastal waters and this combined with the differences in the sampling and analytical techniques may account for these differences.

The author thanks Dr H N Siddiquie, Director for his keen interest and Dr R Sen Gupta for his advice.

References

- 1 Allen H E, Hall R H & Brisbin T D, *Environ Sci Technol*, 14 (1980) 441.
- 2 O'Connor T P & Kester D R, *Geochim Cosmochim Acta*, 39 (1975) 1531.
- 3 Sanzgiry S & Moraes C, *Indian J Mar Sci*, 8 (1979) 254.
- 4 Sen Gupta R, Singbal S Y S & Sanzgiry S, *Indian J Mar Sci*, 7 (1978) 295.
- 5 Fowler S W, Huynh-Ngoc L & Fukai R, *Deep-Sea Res*, 31 (1984) 719.
- 6 Nurnberg H W, Valenta P, Mart L, Rasport B & Sipos L, *Fresenius Z Anal Chem*, 282 (1976) 357.
- 7 Batley G E & Gardner D, *Water Res*, 11 (1977) 745.
- 8 George M D, Sawkar K & Reddy C V G, *Indian J Mar Sci*, 13 (1984) 64.
- 9 Spivack A J, Husted S S & Boyle E A, in *Trace metals in seawater*, edited by C S Wong, E Bogle, K W Bruland, J D Burton & E D Goldberg (Plenum Press, New York) 1983, 505.