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Biochemical composition of suspended particulate matter in the shelf waters between Visakhapatnam and Bhimavaram coast, central east coast of India

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Suspended particulate matter (SPM), particulate organic carbon (POC), particulate carbohydrate (PCHO) and chlorophyll *a* (chl *a*) were measured from 46 water samples collected at 18 stations during September 1988. In the stations off the river Godavary, particulate matter contained more of POC with increasing depth up to 100 m. POC of the surface was dominated by PCHO containing phytoplanktonic matter, while at depths, it was dominated by detrital matter.

Organic fraction of suspended particulate matter (SPM) in the sea plays a major role in the food web. The quantification and characterisation of SPM of the waters of the Bay of Bengal have received relatively less attention, eventhough major rivers which are important sources of SPM drain into it. Studies dealing with estimation of SPM[1,2], particulate organic carbon[3-6] (POC), chl *a*[7,8] and particulate carbohydrate[9,10] (PCHO) on samples of different regions of the Bay of Bengal have been reported. In the present study, these constituents have been measured simultaneously on samples collected at 18 stations situated closely along the continental shelf area between coastal reference points of Visakhapatnam and Bhimavaram on the east coast of India (Fig. 1).

Materials and Methods

Seawater samples at different depths (0, 30, 100 and 200 m) were collected with Niskin water samplers during cruise No. 201 of *R V Gaveshani* from 9-14 September 1988. Water samples (0.5-2 l) collected were filtered immediately onto 4 different GF/C glass fibre filters under low vacuum. The filters were washed twice with deionised water to remove salts and were immediately frozen until further analysis. Filters meant for the estimation of SPM were dried at 60°C until no further weight loss occurred and were weighed. The other 3 filters of each sample were directly used for the spectrophotometric (Shimadzu: UV-260) analysis[11] of POC (by wet oxidation method), PCHO (by anthrone method) and chl *a* (by acetone extraction). Chl *a* values are not corrected for phaeophytin.

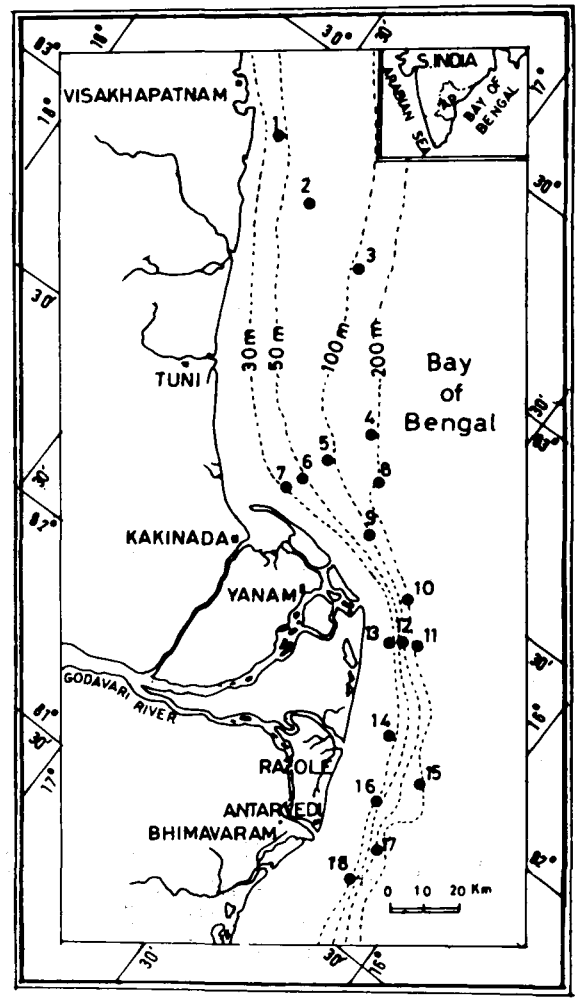

Fig. 1—Station locations

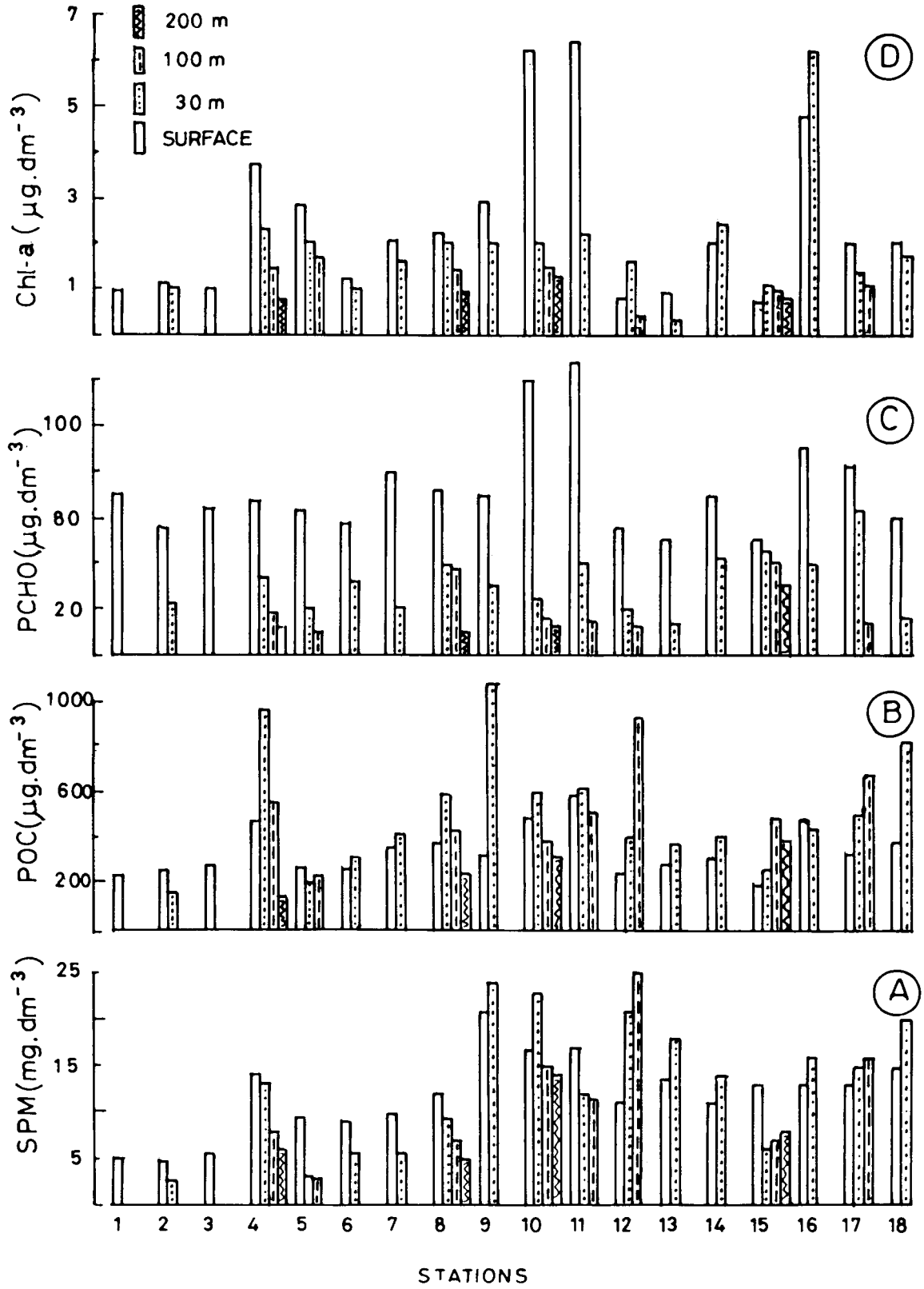

Fig. 2—Distribution of A-SPM, B-POC, C-PCHO, D-Chl *a*

Results and Discussion

Suspended particulate matter—SPM (Fig. 2A) of the study area varied from 2.25 (st 55) to 25.5 mg.dm^{-3} (st 12), both values occurring at 100 m depth. Lower values occurred in waters of the northern half, while in waters of south, they were uniformly higher due to the influence of the Godavary river water. Of the two main distributaries of the river, Gautami contributes more suspended matter (cf. sts 9-12) than the Vasishta (sts 13-18). The depth profiles of SPM showed a steep fall with increasing depth in the coastal waters north of Uppada, while south of it, the waters off the Godavary mouth showed a reverse trend which often extended down up to 200 m depth. This phenomenon was earlier explained in terms of shoreward bottom currents which resuspend the fine grained sediments into the overlying water column[12,13].

Particulate organic carbon—POC (Fig. 2B) values varied from 160 (st 2) to 1076 µg. dm^{-3} (st 9), both values occurring at 30 m depth. At all stations in the vicinity of the mouth of the Godavary, POC was maximum at 30/100 m depth. POC showed a significant correlation with SPM in all samples ($r = 0.63$, n = 46, $P = 0.01$). The r values gradually increased from surface ($r = 0.56$, n = 18, $P = 0.06$) to 30 m depth ($r = 0.64$, n = 16, $P = 0.05$) and to 100 m ($r = 0.86$, n = 8, $P = 0.04$), indicating that the SPM was composed uniformly of POC up to this depth in the shallow waters of the study area as in the case of the coastal waters of Goa[14]. Accordingly, the ratio of POC to SPM was lowest in surface ($\bar{x} = 3.14 \times 10^{-2}$) but increased at 30 m (4.61×10^{-2}) and 100 m (5.6×10^{-2}). It however, fell at 200 m (3.51×10^{-2}). Thus, it appears that in the entire depth column, POC (mostly detrital) constitutes highest fraction of SPM at 100 m depth.

Chlorophyll a—The values (Fig. 2C) ranged from 0.74 (st 15) to 6.40 µg.dm^{-3} (st 11) in the surface waters, from 0.27 (st 13) to 6.20 (st 16) at 30 m depth, from 0.40 (st 12) to 1.70 (st 5) at 100 m depth and from 0.80 (sts 4 and 155) to 1.30 (st 10) at the bottom waters. Chl *a* decreased moderately with depth, the range that was highest at 30 m also decreased in either direction. It did not correlate well with POC or SPM when the data of all samples were analysed together. However, by analysing the surface values only, an excellent correlation was obtained between chl *a* and POC ($r = 0.91$, n = 18, $P = 0.05$). Thus, the surface POC appeared to be contributed mostly by living planktonic matter (phytoplankton), while the POC of deeper regions, as shown earlier, appeared to be dominated by resuspended matter.

A plot of POC/chl *a* ratios on chl *a* (Fig. 3) showed an inflection of the latter at about 1.55 µg. dm^{-3}, below which the ratio increased steeply and beyond which it decreased slowly. Similar trends were noticed earlier from the waters of southwest Bay of Bengal[4] and Visakhapatnam harbour[15].

Particulate carbohydrate—PCHO (Fig. 2D) values ranged from about 50 (sts 2, 12, 13 and 15) to 129 µg. dm^{-3} (st 11) in the surface and from 13.69 (st 13) to 63.63 µg.dm^{-3} (st 17) in the subsurface water. PCHO showed good correlation with chl *a* ($r = 0.62$, n = 46, $P = 0.01$). The correlation was excellent in the surface waters ($r = 0.91$, n = 18, $P = 0.006$) indicating that chl *a* of surface water is best associated with the production of PCHO containing phytoplanktonic matter, while in the deeper waters, much of the PCHO may be originating from the detrital component of POC. The same is borne out by the fact that it is only in the surface that PCHO correlated with POC ($r = 0.83$, n = 18, $P = 0.01$), while at all other depths, correlation was poor.

The linear regression fits of POC (Eq. 1) and PCHO (Eq. 2) with chl *a* in the surface waters are:

$$\text{POC} = 203.18 + 56.38 \times \text{chl } a \quad \ldots (1)$$

$$\text{PCHO} = 46.27 + 11.02 \times \text{chl } a \quad \ldots (2)$$

Eqs 1 and 2 indicate that the living component of the two was 40.36 and 36.73% (from the average surface

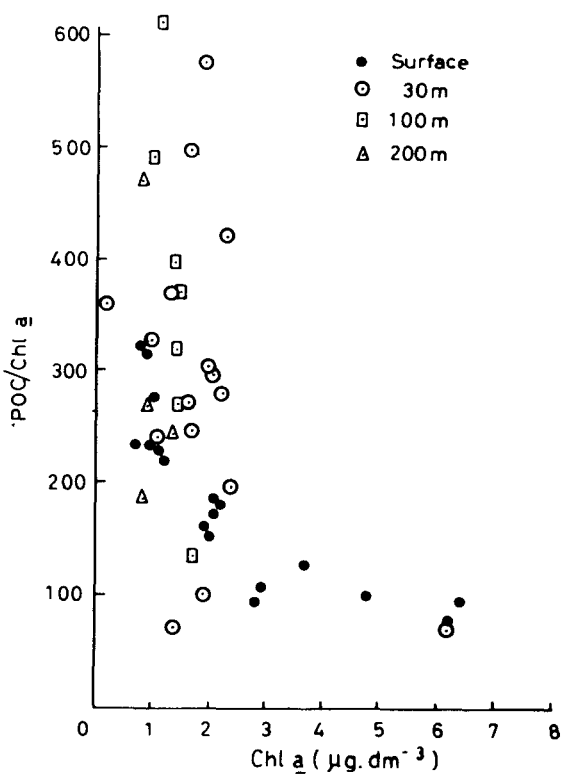

Fig. 3—Plot of (POC/chl *a*) *vs* chl *a*

values of POC and PCHO of 340.66 and 73.14 μg. dm^{-3} respectively). The corresponding detrital components (of POC and PCHO) may be put at 59.64 and 63.27% respectively. In the earlier studies conducted in the Bay of Bengal[3-10], no such significant correlations were found for PCHO[10] or POC[6] eventhough the values of SPM, POC, PCHO and chl *a* of the study area are within the range of reported values. Present results would indicate a positive role for subsurface and deeper water SPM as a reservoir of detrital POC for feeding by secondary organisms which are known to be abundant in the study area[16].

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