

Short Communications

## Particulate organic constituents of surface waters of east coast of India

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Received 6 July 1992, revised 8 February 1993

Particulate matter collected from surface seawater (~ 1 m) samples from 11 coastal (depth < 200 m) and 40 oceanic (depth > 200 m) stations was studied for particulate organic carbon (POC), particulate carbohydrate (PCHO), particulate protein (PP) and particulate lipid (PL) fractions. High values of chlorophyll *a* (chl-*a*) characterized the coastal waters. In coastal waters, POC was dominated by PCHO containing detrital matter, whereas actively growing phytoplankton significantly contributed to the protein and lipid pools of particulate matter. Detrital component contributed small fraction to the carbohydrate pool in the oceanic waters, whereas its contribution to protein and lipid pools was significantly high. Results suggest that large riverine runoff by major rivers play a significant role in controlling the distribution of biochemical constituents in the east coast of India.

Suspended particulate organic matter (POM) plays an important role in influencing the chemical composition of marine environment. A detailed knowledge of POM is, therefore necessary to understand its role in geochemical circulation of elements in the ocean. However little information on the constituent fraction of POM is available from the Bay of Bengal eventhough major rivers discharge into it<sup>1</sup>. Reports on the detailed distribution of particulate carbohydrate (PCHO) are available but studies on other important fractions like proteins and lipids are scanty<sup>2,3</sup>. Present paper reports distribution of POM collected from surface (~ 1 m) waters of 11 coastal and 40 oceanic stations in the east cost of India during summer monsoon period, when riverine discharge and also sediment input from 6 major rivers into the bay are at the maximum. An attempt has been made to highlight the influence of riverine discharge on the concentration of particulate constituents in the study area.

Surface seawater (~ 1 m) samples were collected from 11 coastal (depth < 200 m) and 40 oceanic (depth > 200 m) stations (Fig. 1) during the 53rd cruise of *ORV Sagar Kanya* (July-Aug. 1989) in the east coast of India. Immediately after collection, duplicate 4 aliquots of 1 to 2 l were filtered through precombusted (450°C for 3 h) and pre-weighed GF/C glass fibre filters. Filters were then washed twice with distilled water to remove salts and kept deep frozen at -20°C until further analyses. Particulate matter left on the filters was analysed for dry weight, particulate

organic carbon<sup>4</sup> (POC), particulate carbohydrate<sup>5</sup> (PCHO), particulate protein<sup>6,7</sup> (PP) and particulate lipid<sup>4</sup> (PL). Suspended matter (SM) was determined after drying the filters in an oven at 60°C until a constant weight was obtained. Chlorophyll *a* (chl-*a*) was determined fluorometrically after overnight extraction in 90% acetone<sup>4</sup>. Coefficients of variation for duplicate analysis 16.4%, 12.4%, 11.3%, 14.8% and 10.2% were observed for POC, PCHO, PP, PL and chl-*a* respectively.

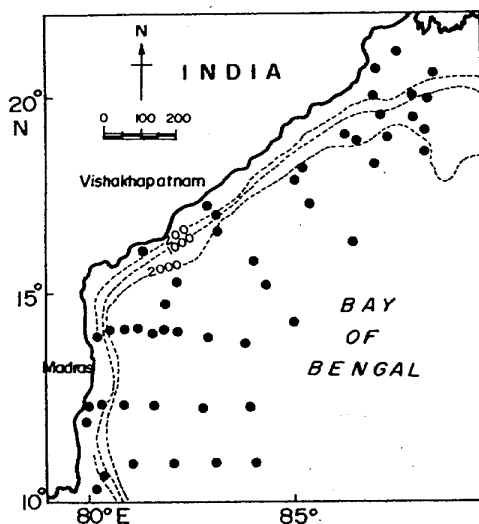


Fig. 1—Location of sampling sites

**Suspended matter (SM)**—In coastal waters SM values varied from 6.8 to 17.4  $\text{mg.l}^{-1}$  ( $\bar{x} = 11.8 \pm 4 \text{ mg.l}^{-1}$ ) and in oceanic waters from 4.3 to 20.5  $\text{mg.l}^{-1}$  ( $\bar{x} = 10.6 \pm 4.3 \text{ mg.l}^{-1}$ ) (Fig. 2A). Values progressively increased from south to north probably due to greater riverine discharges at the head i.e. north of the bay, which was evident from salinity values which diminished progressively from 34 in the south to  $23.25 \times 10^{-3}$  in the northern bay. Recent sediment trap studies conducted in the Bay of Bengal documented that the total particle fluxes decreased from north to south off the bay<sup>9</sup>. Thus riverine discharge and sediment input do play a role in the distribution of SM in the bay. However no significant correlation between distance from the coast and SM values, was observed.

**Particulate organic carbon (POC)**—Coastal stations showed high values of POC compared to oceanic stations (Fig. 2B). The values ranged from 113 to 650  $\mu\text{g C.l}^{-1}$  ( $\bar{x} = 380 \pm 16 \mu\text{g C.l}^{-1}$ ) in coastal waters and from 117 to 690  $\mu\text{g C.l}^{-1}$  ( $\bar{x} = 331 \pm 142 \mu\text{g C.l}^{-1}$ ) in oceanic waters. It was reported that about 30% of the total suspended load brought down by the

river settles down at the confluence of river and sea<sup>8</sup>. Furthermore, it was reported<sup>2</sup> that phytoplankton and zooplankton contribute only 8.4% of POC in the Bay of Bengal. Insignificant correlation was recorded between POC and chl-*a*, and SM suggesting that the detrital matter brought down by the rivers largely dominate the distribution of organic matter in the Bay of Bengal.

**Chlorophyll *a***—Coastal waters showed significantly (CV,  $P < 0.01$ ) high values of chl-*a* than offshore waters (Fig. 2C). It was reported that during summer monsoon (i.e., the present study season) nutrient inputs from rivers and from entrainment of subhalocline layers through turbulent mixing, enhances primary production especially in the river plumes<sup>9</sup>. No significant correlation was observed between chl-*a* and POC.

**Particulate carbohydrate (PCHO)**—Values of PCHO varied from 26 to 167  $\mu\text{g.l}^{-1}$  and from 20.2 to 183  $\mu\text{g.l}^{-1}$  in coastal and oceanic waters, respectively (Fig. 2D). Only in oceanic waters PCHO showed good correlation with chl-*a*, implying that living phytoplankton contributes significantly to PCHO

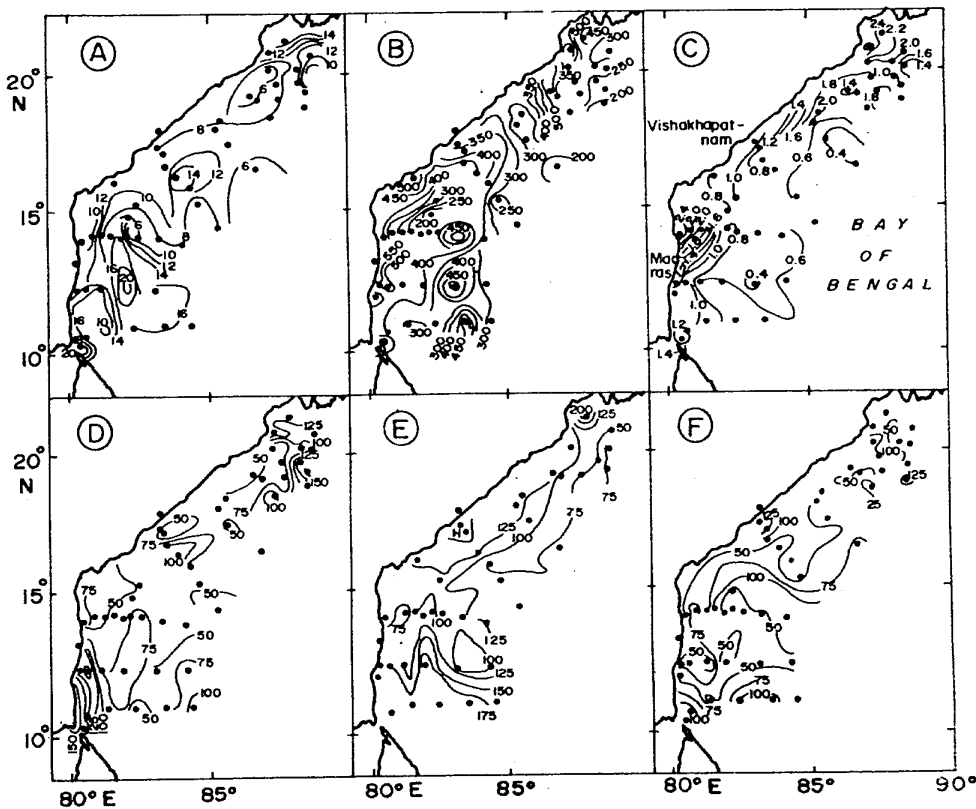


Fig. 2—Distribution of: A) Suspended matter ( $\text{mg.l}^{-1}$ ); B) particulate organic matter ( $\mu\text{g C.l}^{-1}$ ); C) chlorophyll *a* ( $\mu\text{g.l}^{-1}$ ); D) particulate carbohydrate ( $\mu\text{g.l}^{-1}$ ); E) particulate protein ( $\mu\text{g.l}^{-1}$ ); F) particulate lipid ( $\mu\text{g.l}^{-1}$ )

pool in the oceanic waters and in coastal waters, PCHO was dominated by detrital matter in the form of microzooplankton, bacteria, allochthonous inputs such as wood fragments etc. This corroborates the earlier reports in the waters of the east coast of India<sup>2,3</sup>.

**Particulate protein (PP)**—Coastal stations showed high values of PP than oceanic stations ( $P < 0.01$ , Fig. 2 E). In coastal waters the values varied from 50.5 to 251  $\mu\text{g.l}^{-1}$  ( $\bar{x} = 141 \pm 62 \mu\text{g.l}^{-1}$ ) and in oceanic waters from 64 to 241  $\mu\text{g.l}^{-1}$  ( $\bar{x} = 124 \pm 46.4 \mu\text{g.l}^{-1}$ ). A ratio of 2.88 for chl-*a* : PP-N was observed for pure phytoplankton cultures and unialgal cultures<sup>10</sup>. For calculating PP-N ( $\mu\text{g-at N.l}^{-1}$ ), values of PP ( $\mu\text{g.l}^{-1}$ ) were divided<sup>11</sup> by 87.5. Any decrease in the value indicates the presence of non-plant protein in the system besides living phytoplankton<sup>10</sup>. Based on this ratio, the contribution of phytoplankton to PP in coastal waters ranged from 15 to 40% ( $\bar{x} = 25 \pm 8.5\%$ ) whereas in oceanic waters plant material contributed by half, i.e., between 7 and 23% ( $\bar{x} = 19.05 \pm 8.5\%$ ).

**Particulate lipid (PL)**—PL in coastal waters varied from 20 to 180  $\mu\text{g.l}^{-1}$  ( $\bar{x} = 72 \pm 44 \mu\text{g.l}^{-1}$ ) and in oceanic waters from 12 to 159  $\mu\text{g.l}^{-1}$  ( $\bar{x} = 72 \pm 44 \mu\text{g.l}^{-1}$ ) (Fig. 2 F). No correlation between the distance from the shore and distribution of lipid was observed and it corroborates with those reported from different areas<sup>12</sup>. The present PL values for coastal waters are similar with those reported from off Bombay coast<sup>13</sup>. A good correlation ( $r = .6$ ) observed between chl-*a* and PL substantiates that

most of the lipid in the coastal waters is of plant origin.

The results indicate the positive role of summer monsoon (June-September) in regulating the distribution of organic matter in the east coast of India. The present study also highlighted that the riverine discharge is so strong that it masks any correlation with local plant matter and concentration of the particulate compounds.

Authors are grateful to Dr. B N Desai, Director, for providing necessary facilities and for constant encouragement.

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