

## Dissolved & Particulate Lipids in the Arabian Sea Off Bombay Coast

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Concentrations of dissolved lipid ranged from 20-140  $\mu\text{g.l}^{-1}$  in the surface and 30-150  $\mu\text{g.l}^{-1}$  in near bottom waters while particulate lipid varied from 6-109 and 29-133  $\mu\text{g.l}^{-1}$  respectively in surface and bottom waters. Dissolved lipid contributed 39-92% of total lipid. No relationship was evident between lipid distribution and distance from shore. Contribution of plankton lipid carbon to total lipid carbon varied from 0.9-27%. Results indicate that lipid originates either from detritus matter or from anthropogenic sources.

Some information<sup>1-7</sup> is available on the distribution of lipids in the marine environment. In this communication, surface and vertical distribution of dissolved and particulate lipids in the Arabian Sea and the lipid contribution from phytoplankton to the total lipids are presented.

### Materials and Methods

Seawater samples were collected using Van Dorn or Niskin water samplers in the Arabian Sea during 148 cruise of *R V Gaveshani* from 30 Jan. to 5 Feb. 1985 (Fig. 1). Seawater samples (10 and 20 l) from various depths (Table 1) were filtered through a glass fibre filter (Whatman GF/C) precombusted at 450°C for 3 h. The particulate matter collected on the filter was kept frozen at -20°C until analysis.

Filtered seawater was transferred into clean 5 l glass containers and pH adjusted to 2 by adding conc. HCl. For the determination of the dissolved lipid, seawater was extracted 3 times with chloroform. The combined extract was dried over anhydrous sodium sulphate. Chloroform was removed at 40°C under reduced pressure and the residue weighed on a Mettler monopan microanalytical balance. Variations of 2.4-4.8%, 1.7-7.9% and 5.5-28% for duplicate analysis were observed for surface, middle and bottom samples respectively.

Particulate matter collected on the filter was analysed for particulate organic carbon<sup>8</sup> (POC), chlorophyll *a*<sup>8</sup> (chl *a*) and particulate lipid<sup>9</sup>. Variations of 2.9-20.5%, 0.8-37.7% and 6.1-26.9% for duplicate analysis were observed for surface (1 m) middle (10-20 m) and bottom (> 20 m) water samples using the above methods.

### Results and Discussion

Concentration of chl *a* decreased as the distance from the shore increased (Fig. 2). The concentration

of POC also decreased as the distance from the shore increased, atleast, along transects 1 and 2 (Fig. 3). However, in transects 3 and 4 values increased as the distance from the shore increased (Fig. 3).

Concentrations of dissolved lipid (Fig. 4) were 20-140  $\mu\text{g.l}^{-1}$  in surface waters and 30-150  $\mu\text{g.l}^{-1}$  in bottom waters (Table 1). At some stations (3378, 3379, 3380 and 3381, Fig. 1) however, very high concentrations of dissolved lipid ranging from 3590 to 4090  $\mu\text{g.l}^{-1}$  were observed. Apparently, these high values were due to oil slick which was visible at these stations during sampling and may not represent the natural levels of lipids in the Arabian Sea and accordingly these values were discarded.

Data presented in Table 1 show that much of total lipids are present in the dissolved form. Dissolved lipid values reported here are comparable to those reported from the Gulf of Mexico<sup>3</sup>, Wadden Sea<sup>5</sup>, Pacific and Atlantic Oceans<sup>10</sup>.

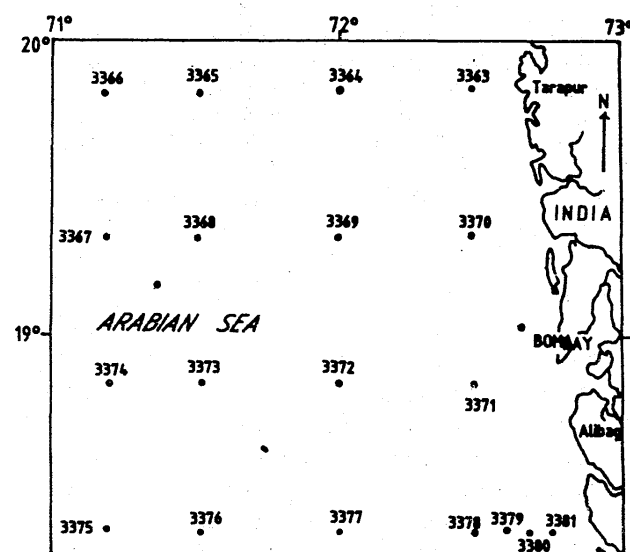


Fig. 1—Sampling location

Concentrations of particulate lipid were 6-109  $\mu\text{g.l}^{-1}$  in surface (Fig. 5) and 29-133  $\mu\text{g.l}^{-1}$  in near bottom samples (Table 1). They constituted 2.61-25.68% of particulate organic carbon by weight [gravimetric weight  $\times 100$ /particulate organic carbon concentration].

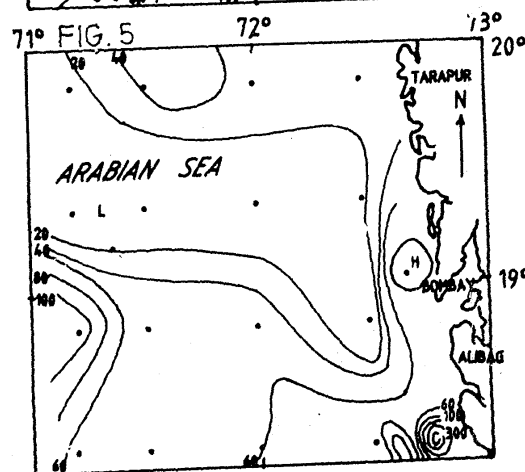
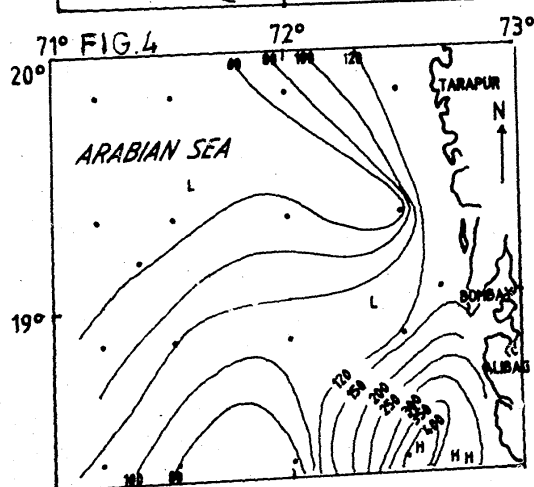
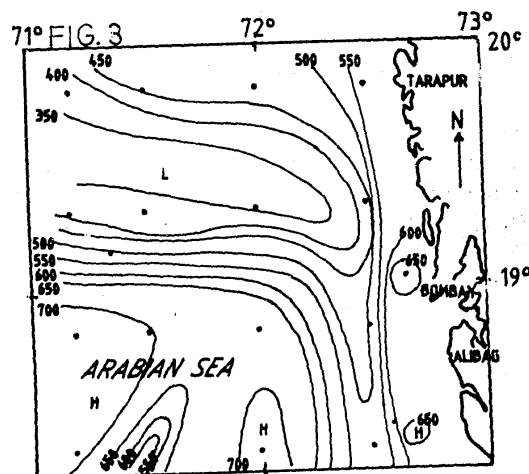
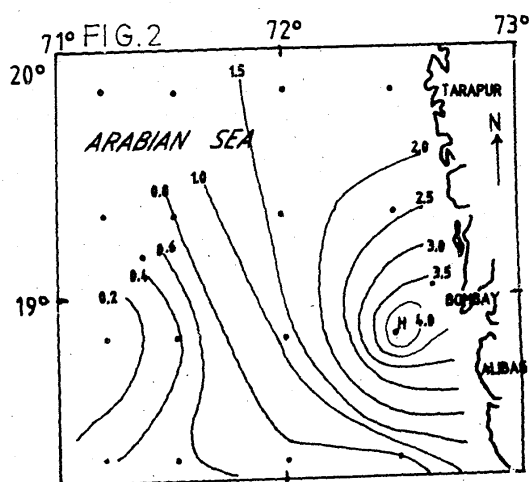
No correlation between the distance away from the shore and the distribution of lipid was observed. While, in transect 1, values for dissolved and particulate lipids decreased with increase in the distance away from the shore, in transect 3, it was observed only for dissolved fraction (Figs 4 and 5). However, in other transects (Fig. 1) such variability was not observed and it corroborates with those reported from different areas<sup>1-3</sup>.

For few stations the contribution of plankton lipid to the total lipid was calculated. First the lipid values were converted to lipid carbon by multiplying<sup>5</sup> with factor 0.5. Phytoplankton carbon was then calculated using chl *a* and POC values and assuming that POC/chl *a* ratio for phytoplankton<sup>11</sup> is 30. Zooplankton

Table 1—Vertical Distribution of Dissolved, Particulate Lipids, Chlorophyll *a* and Particulate Organic Carbon  
(Values are expressed in  $\mu\text{g.l}^{-1}$ )

St	Depth (m)	Dissolved lipid	Particulate lipid	Chl <i>a</i>	POC
3362	1	140	97	3.52	662
	18	110	72	4.00	638
3363	1	130	33	1.60	562
	10	90	29	2.96	496
	20	90	—	—	286
3366	1	—	11	—	469
	20	20	47	—	359
	50	30	31	—	426
3369	1	80	—	1.64	342
	20	80	—	2.20	464
	35	150	44	4.88	543
3371	1	120	10	4.32	475
	30	—	—	2.69	499
3374	1	70	109	0.04	733
	25	70	191	0.56	743
	75	110	133	0.56	697

— = No data.



Figs 2 to 5—Distribution of chl *a* (2), particulate organic carbon (3), dissolved lipids (4) and particulate lipids (5) in surface waters  
[values are in  $\mu\text{g.l}^{-1}$ . H = high and L = low]

Table 2— Contribution of Plankton Lipid Carbon to Total Lipid Carbon in the Arabian Sea

(Values are expressed in  $\mu\text{g.l}^{-1}$ )

St	Total lipids	Plankton lipids (zoo. + phyto.)	Plankton lipid as % of total lipids
3362	118	26.0	22.0
3363	81	5.0	6.0
3371	65	6.0	9.2
3373	74	0.7	0.9
3375	84	1.0	1.2
3377	65	18.0	27.0

carbon was calculated from its biomass data<sup>12</sup>. Further, it was assumed that 10 and 15% of phytoplankton and zooplankton carbon respectively is lipid carbon<sup>13</sup>. Based on these assumptions plankton lipid carbon was calculated (Table 2). The contribution of plankton lipid carbon varied from 0.9 to 27% (Table 2) which means that 73-99% of lipid carbon is not of planktonic origin.

The above data showed that the contribution of plankton lipid to total lipid is very small (0.9 to 27%), this suggests that the concentrations of the lipid in the area studied is governed by detrital and/or anthropogenic sources. This seems likely because the area under study is very close to the oil production platforms and also receives large amount of waste (260 MLD).

The lipids appear to originate either from detritagenous or anthropogenic inputs in the area. This was

confirmed by the insignificant correlation ( $r=0.23$ ) between lipid and chl *a*.

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### References

- 1 Williams P J, in *Chemical oceanography*, Vol. 2, edited by J.P. Riley & G. Skirrow (Academic Press, London), 1975, 301.
- 2 Jeffrey L M, in *Symposium on organic matter in natural waters*, edited by D.W. Hood (Inst. Mar. Sci., Alsaka, Occ. Publ. No. 1), 1970, 55.
- 3 Kennicutt M C & Jeffrey L M, *Mar Chem*, **10** (1981) 367.
- 4 Kennicutt M C & Jeffrey L M, *Mar Chem*, **10** (1981) 389.
- 5 Laane R W P M, *Estuar Coast Mar Sci*, **10** (1980) 589.
- 6 Bhosle N B, D'Silva C & Reddy C V G, *Indian J Mar Sci*, **12** (1983) 242.
- 7 Holm-Hansen O, *Inst Italiano di Indrabiol Dott Macro de Marchi*, **29** (1972) 37.
- 8 Strickland J D H & Parsons T R, *A practical hand book of sea water analysis* (Fisheries Research Board of Canada, Bull No. 167), 1972, 207.
- 9 White D C, Bobbie R J, Morrison S J, Dosterhof D K, Taylor C W & Mecter D A, *Limnol Oceanogr*, **22** (1977) 1089.
- 10 Romankevich E A, *Geochemistry of organic matter in the ocean* (Springer-Verlag, Berlin, Heidelberg), 1984, 235.
- 11 Strickland J D H, *Measuring the production of marine phytoplankton* (Fisheries Research Board of Canada, Bull No. 122), 1960, 172.
- 12 Selvakumar A (personal communication).
- 13 Parsons T R, Takahashi M & Hargrave B, *Biology of oceanographic processes* (Pergamon Press, New York), 1977, 40.