

Distribution of Particulate Carbohydrate in the Eastern Arabian Sea along 15°N

K NANDAKUMAR, N B BHOSLE & A B WAGH

National Institute of Oceanography, Dona Paula, Goa 403 004, India

Received 23 September 1987; revised received 23 May 1988

The concentration of particulate carbohydrate varied from 38-158 $\mu\text{g.l}^{-1}$ and 19-239 $\mu\text{g.l}^{-1}$ in shelf and slope waters respectively. At 10 m water column the concentration of particulate carbohydrate increased with the distance from the shore and the values generally decreased with depth.

Carbohydrate is the most important source of energy (60%) for many organisms^{1,2} and also forms an important constituent of dissolved (10-40%) and particulate (7-32%) organic matter present in seawater^{1,2}. Generally, there is a good correlation between living phytoplankton biomass and the concentration of particulate carbohydrate (PCHO) in seawater^{3,4}. Such correlation, is not found in detritus rich areas^{5,6}. It is also reported that PCHO generally decreases with depth due to heterotrophic uptake and/or respiration by phytoplankton sinking below the euphotic zone^{3,7}.

As compared with other seas and oceans, very little information is available on the distribution of particulate organic matter and its composition in the Arabian Sea^{8,9}. In this paper, distribution of PCHO in the Arabian Sea is presented.

Water samples were collected using Niskin water samplers from 5 shelf (lat. 15°N; long. 72°45', 73°00', 73°15', 73°30', 73°45'E) and 2 slope (lat. 15°N; long. 72°30', 72°15') stations during 165 cruise of *R V Gaveshani* from 14-28 March 1986. Water samples (0.1 to 1 l) from different depths were filtered in triplicate through precumbusted GF/C filter papers. Particulate matter thus obtained above was analysed for carbohydrate³. The mean standard deviations for triplicate analysis of PCHO ranged from $\pm 0.3-7.1\%$.

The PCHO concentration for the shelf waters at surface were less as compared to the slope stations (Table 1). In the slope waters, the PCHO decreased with the depth in the upper 500 m water column while values generally decreased with depth in shelf waters.

Table 1—Particulate Carbohydrate in the Shelf and Slope Waters

| Depth (m) | Shelf stations* | | | | | | | | | | Slope stations† | | | |
|--------------|-----------------|------|------|------|------|------|-------|------|-------|------|-----------------|------|-------|------|
| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | |
| | A | B | A | B | A | B | A | B | A | B | A | B | A | B |
| 0 | 58.5 | 15.4 | 88.8 | 33.2 | 65.7 | 35.3 | 158.9 | 53.6 | 104.9 | 26.3 | 233.1 | 30.5 | 112.5 | 26.3 |
| 10 | 53.1 | 15.3 | 82.4 | 43.9 | — | — | 140.0 | 58.8 | 148.5 | 36.2 | 178.2 | 30.1 | 239.4 | 48.8 |
| 25 | 38.7 | 9.0 | 70.7 | 37.1 | 49.5 | 18.1 | — | — | 95.0 | 19.7 | 86.4 | 19.1 | 72.0 | 17.5 |
| 50 | | | 69.8 | 46.6 | 78.8 | 26.5 | 122.9 | 48.0 | 80.1 | 18.8 | 58.5 | 11.9 | 64.8 | 17.2 |
| 100 | | | | | | | 88.2 | 36.2 | 139.5 | 23.8 | 46.8 | 7.6 | 22.1 | 5.4 |
| 250 | | | | | | | | | | | 34.7 | 5.8 | 73.4 | 16.6 |
| 500 | | | | | | | | | | | 33.8 | 5.5 | 19.4 | 4.7 |
| 750 | | | | | | | | | | | 45.9 | 10.9 | 64.8 | 14.7 |
| 1000 | | | | | | | | | | | 61.7 | 12.0 | 69.3 | 14.2 |

*—lat. 15°N; long. at sts (1) 73°45' (2) 73°30' (3) 73°15' (4) 73° (5) 72°45'

†—lat. 15°N; long. at sts (6) 72°30' (7) 72°15'

A = Particulate carbohydrate, $\mu\text{g.l}^{-1}$

B = PCHO as percent of particulate organic carbon

— = No sample

The chlorophyll *a* concentration during the present study were higher in the slope region (0.8 mg. m⁻³, av. of sts 6 and 7) as compared with shelf waters (0.56 mg. m⁻³, av. of stations 1-5). The high phytoplankton biomass is probably responsible for the higher concentrations observed in the former case^{3,4}. Another important feature of PCHO in slope waters was an increase below 500 m depth (Table 1). This increase is probably due to the transport of organic matter from shelf to slope waters and its accumulation due to low oxygen content at these depths⁶. These observations are more or less similar to those reported for dissolved carbohydrates from Arabian Sea¹⁰.

About 73-75% of surface carbohydrate is removed between surface and 50 m (Table 1) at sts 6 and 7. This suggests that the organic matter is labile and highly degradable at these stations. As compared with this, in shelf waters about 21-34% of PCHO is removed between surface to 50 m indicating PCHO in this region is relatively inert as compared with the slope. This is probably because organic matter is derived from terrestrial as well as marine sources in the shelf waters and the former is considered to be more resistant to mineralisation by biological process¹¹.

The depth distribution of PCHO at sts 3, 5 and 7 generally shows an increase in subsurface waters followed by a decrease at greater depths. This might be due to inhibitory effects of surface radiations. Primary productivity studies in the Arabian Sea also suggested higher primary production within subsurface waters as compared with surface waters⁸ and

attributed this to inhibition due to high surface radiation. It is interesting to note that concentration increases at 10 m depth with the distance from the shore (Table 1).

Relative PCHO concentration as a percentage of organic carbon varied from 4.7 to 58.8% (Table 1) compared to the values reported earlier^{4,7,12}. The higher values observed here might reflect species and or nutrient limitation effects.

Authors thank the Director for facilities and encouragement and their colleagues for help in sample collection.

References

- 1 Romankevich E A, *Geochemistry of organic matter in the ocean* (Springer-Verlag, Berlin) 1984, 199.
- 2 Thurman E M, *Organic geochemistry of natural waters* (Martinus Nijhoff/Dr W Junk Publishers, Dordrecht) 1985, 18.
- 3 Hitchcock G L, *Deep-Sea Res.* **24** (1977) 83.
- 4 Ittekkot V, Degens E T & Brochman U, *Limnol Oceanogr.* **27** (1982) 770.
- 5 Biggs R B & Wetzel C D, *Limnol Oceanogr.* **13** (1968) 169.
- 6 Bhosle N B, D'Silva C, Shirodkar P & Reddy C V G, *Maharashtra Bull Natn Inst Oceanogr.* **14** (1981) 251.
- 7 Handa N, in *Organic matter in natural waters*, edited by D.W. Hood (University of Alaska, Alaska) 1970, 129.
- 8 Radhakrishna K, Bhattathiri P M A & Devassy V P, *Indian J Mar Sci.* **7** (1978) 94.
- 9 Bhosle N B, Dhople V M & Wagh A B, *Proc Indian Acad Sci: (Earth Planet Sci)*, Communicated.
- 10 Dhople V M & Bhosle N B, *Indian J Mar Sci.* **16** (1987) 43.
- 11 Degens E T & Ittekkot V, in *Transport of carbon and minerals in major world rivers*, edited by E.T. Degens, S. Kempe & R. Herrera (Palaeontol Inst. Univ. Hamburg, SCOPE/UNEP, Sonderbd. 58) 1985, 7.
- 12 Liebezeit G, *Polar Biol.* **2** (1984) 225.