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CHEMICAL CHARACTERISTICS OF THE WATERS AROUND ANDAMANS DURING LATE WINTER

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ABSTRACT

Water samples from standard depths (0-500m) around Andamans collected during December, 1988 to January, 1989 were analysed for various hydrographic parameters and nutrients. A study of hydrographic parameters showed that the thickness of the surface mixed layer was less around North Andaman and eastern side of Little Andaman. The distribution of nutrients showed that the surface concentrations of silicate and phosphate were high and comparable to those in other world oceans. However, the deeper values were less. But it is striking to note that the NO_3N concentration in the surface layers (0-50m) was very low and almost undetectable. This is well in accordance with the reported low primary productivity of Andaman waters. The lower inorganic nitrogen concentration in the surface may be due to the slow process of regeneration of nitrogeneous matter and absence of adequate supply of inorganic nitrogen from the deeper layers due to limited mixing.

INTRODUCTION

Compared to the other regions of Indian Ocean, Andaman Sea remains the least explored. The Andaman and Nicobar group of islands located in the southeastern Bay of Bengal between lat. 06° & 14°N and long. 91° & 94°E comprise of 321 islands collectively having an area of 8,293 km². All the islands of this archipelago have, in general, steep slopes and hence oceanic conditions prevail even in the near shore areas. Andaman and Nicobar islands separate the Andaman Sea from the Bay of Bengal and the latter is connected to the former by three main channels viz., (1) The Preparis Channel in the north (2) the Ten Degree Channel in the middle between Car Nicobar and Little Andaman and (3) The Great Channel in the south between Great Nicobar and Sumatra. Besides these, the Strait of Malacca maintains the connection of Pacific Ocean water flowing through the South China Sea to the Bay of Bengal.

The Andaman Sea is known to be rich in marine wealth and is of considerable interest to marine scientists. But very few investigations have been conducted in this area since the pioneering work of Sewell (1928, 1929, 1932). However, certain aspects of its oceanographic characteristics were studied during the International Indian Ocean Expedition and recently by certain other research vessels. During the 56th cruise of FORV *Sagar Sampada*, a survey was conducted around the Andaman Islands. The area covered lay between lat. 09° & 13° N and long. 92° & 94° E (Fig. 1).

MATERIALS AND METHODS

Water samples were collected from standard hydrographic depths (0-500 m) using reversing Nansen Bottles. Temperature was measured by reversing thermometers. Salinity, dissolved oxygen and nutrients were found out using standard analytical methods. (Grasshoff, 1976; Strickland and Parsons, 1968).

RESULTS AND DISCUSSION

Salinity

The surface salinities are in general high. The surface values which varied from 33.22 to 34.58 ‰ showed an increasing trend from south to north on the western side as well as on the eastern side. The salinity - depth profile is not uniform at all stations. At stations 1587, 1590, 1591 and 1593, salinity reached a near maximum value around 50 - 100m. Another feature of importance was the feeble salinity maximum observed in depths around 300m (Ramaraju *et al.*, 1981). The salinity showed a depthwise increasing trend (Fig.2). Different water masses were identified in this region with the help of T-S diagrams. Upto 150m depth three water masses are present; the northern dilute water, a transition water and southern Bay of Bengal water. Among these, the transition water dominated in the Jan. - Feb. period around Andaman Island (Murty *et al.*, 1981).

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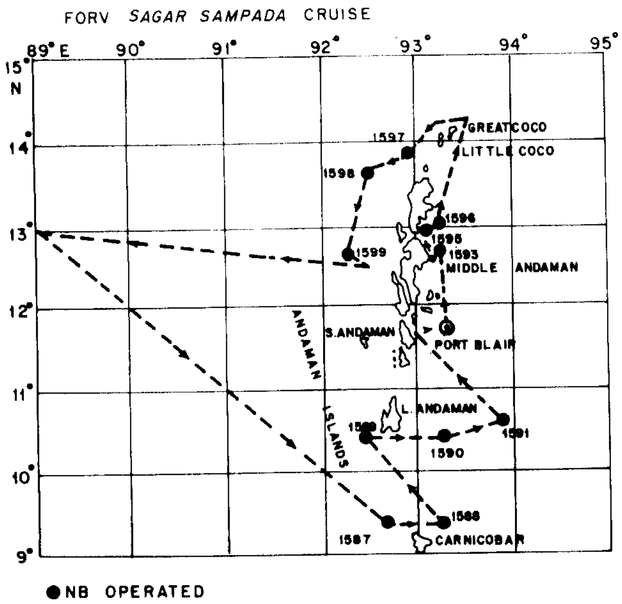

Fig. 1. Cruise Track of Cruise No. 56 of FORV *Sagar Sampada*.

In the absence of a clear picture of the circulation pattern during this season, no convincing conclusions can be arrived at. Besides, the Andaman Sea which has a very uneven bottom topography, receives very large and variable quantities of fresh water and is connected to the South China Sea through Strait of Malacca. Non-homogeneous mixing and incursion of low density water also contribute much towards the observed salinity maxima at various depths for different stations.

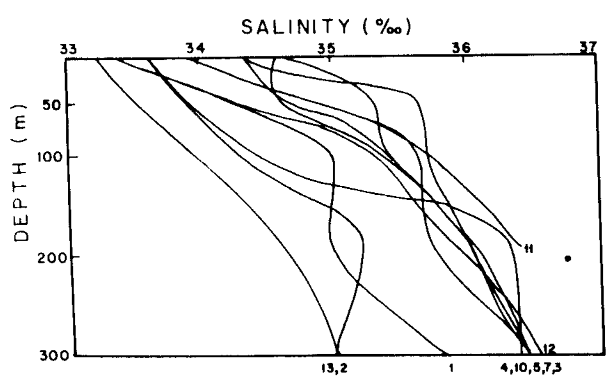

Fig. 2. Distribution of salinity with depth.

Temperature

The sea surface temperature varied from 26.00° to 28.00°C. Both on the eastern side and western side, the temperature showed a northward decreasing trend. Relatively warm surface water was observed at stations south of Little Andamans. These stations are located just above the 10° Channel. Another feature of importance was the occurence of inversions at two stations—Stn. 1595 at 12° 56'N & 93° 05'E and Stn.1599 at 12° 31.5'N & 92° 31.5'E (Fig. 3). At these stations comparatively low surface temperatures were recorded (26.30° and 26.00°C respectively). At Stn.1595 an inversion of 0.40°C occurred well within the surface layer i.e. in the upper 10m itself and then upto 50 m depth an isothermal water column existed. At Stn. 1599, the inversion recorded was 0.50°C in the depth range of 0.50m. These surface layer inversions could occur possibly through differential mixing of Andaman Sea waters with those coming from the adjoining seas. The intense evaporation occurring in this area coupled with the incursion of low density water also contributes to the same condition (Ramaraju *et al.*, 1981).

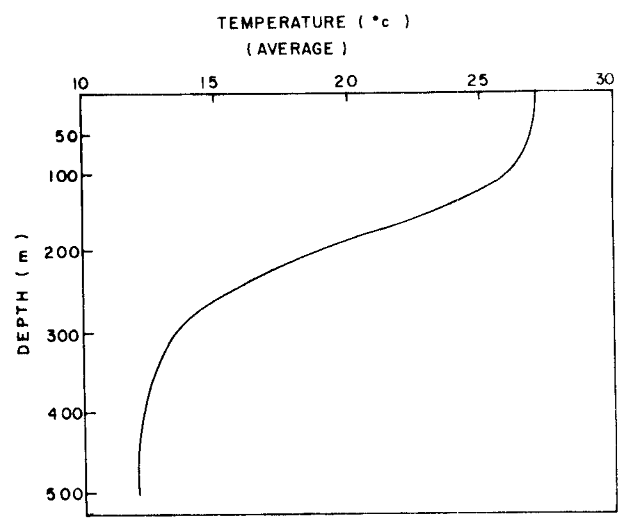

Fig. 3. Distribution of temperature with depth.

Spatial and temporal distribution of nutrients

In oceanic environment, the term nutrient has been applied exclusively to silicon, phosphorous and inorganic nitrogen although most of the major constituents of sea water and a large number of essential trace metals present together with them are also nutrient elements. The present study is confined to the vertical distribution of dissolved silicon, inorganic phosphate and nitrate at selected locations in the waters surrounding Andaman Islands. Rock weathering, decay of organic material and discarded wastes are the major sources of nutrient elements in the sea to which they are carried by land drainage. The geochemical and geophysical processes influence the concentration of nutrients in the sea by addition and removal. The primary agencies for the biological removal of nutrients from sea water are the unicellular algae of phytoplankton.

Silicate

The silicon in solution in sea water exists mainly in the form of silicic acid. The surface concentration of dissolved silicon was in the range 3.86 µg at Si/l to 10.04 µg at Si/l during the present study (Fig. 4). The relatively higher concentration was observed only at one station. These values are comparable to the values reported earlier from this area (Sen Gupta *et al.*, 1981) and to the concentration found in other world oceans (Armstrong, 1965). Though the concentration showed a depth wise increase in general, lesser concentrations were observed for all standard depths other than the surface when compared to the earlier values. The highest concentration recorded for the present cruise was 28.34 µg at Si/l at 500 m depth whereas 50 µg at Si/l was reported by Sen Gupta *et al.* in 1979. But it is found that the concentration of dissolved silicate in solution in the sea varies than that of any other element (Spencer, 1956). The increase in concentration of dissolved silicate with depth is not always regular. River water usually contains higher concentrations of silicic acid than does sea water and hence the dissolved silicon content in coastal regions is higher than that of open ocean surface waters (Stefanson and Richards, 1963). Moreover dinoflagellates are the important primary producers since they are able to thrive in oligotropic tropical waters unlike diatoms (Devassy and Bhatathiri, 1981). The diatoms are the major consumers of silicates. The coastal waters where nutrient values are relatively high, can sustain a richer diatom population. The observed values go well in accordance with the above mentioned factors.

Inorganic phosphate

The concentration of dissolved inorganic phosphate (orthophosphate) in the surface layers of oceans is variable, but over large areas the maximum concentrations are in the range of 0.5 to 1.0 µg at P/l (Sverdrup *et al.*, 1942). The surface values observed for Andaman waters were also within these extremes. (0.47 µg at P/l to 0.68 µg at P/l) (Fig. 5).

Reddy *et al*. (1968) have reported a very high concentration of inorganic phosphate (12 µg at P/l)

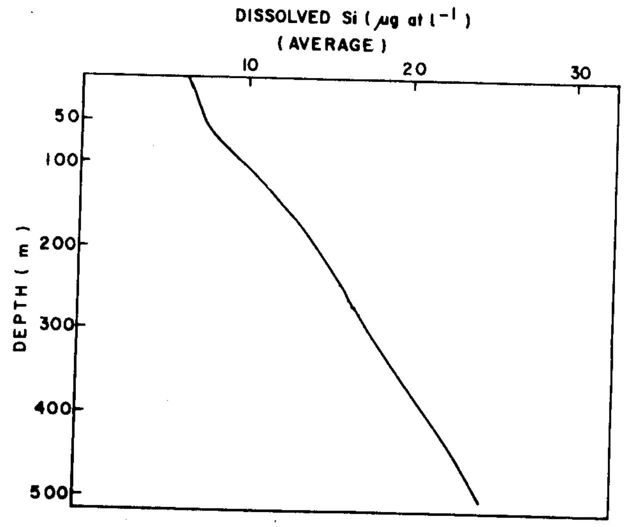

Fig. 4. Distribution of dissolved silicon with depth.

at all depths in the waters around Andaman Islands. Later Sen Gupta *et al.* (1981) reported a maximum of 3 µg at p/l. For this cruise the highest value recorded was 0.98 µg at P/l at 500m depth. The higher concentrations of phosphate in coastal water when compared to offshore waters may be attributed to enrichment by fresh water drainage. Inorganic phosphate is lost from the water column at a considerable rate and regeneration will limit the rate of primary production.

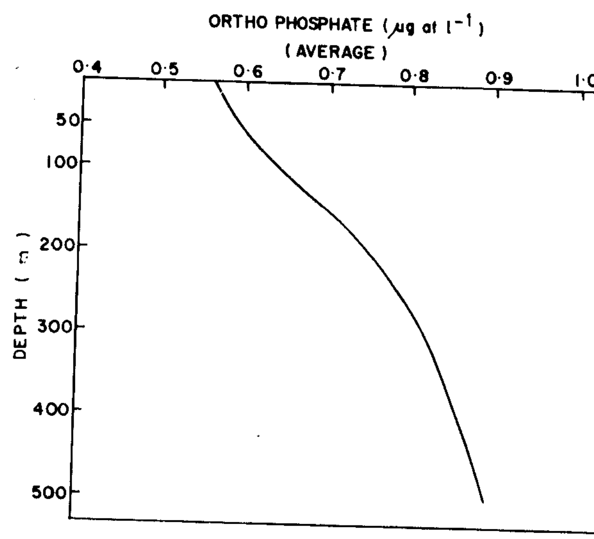

Fig. 5. Distribution of orthophosphate with depth.

Nitrate-N

Nitrate-N is the stable form of combined inorganic nitrogen and the variation in the concentration is mainly due to biological factors (Spencer, 1956). In the upper 50m, the nitrate-N present is almost undetectable (Fig. 6). This matches well with the reported low primary productivity of Andaman waters (Parulekar and Ansari, 1981). It was earlier reported that nitrogen consuming blue green algae (*Trichodesmium thiebautii*) occured at various depths, while *Trichodesmium erythraeum* was found mainly at surface (Devassy and Bhattathiri, 1981). The process of regeneration of nitrogeneous matter is slow and the supply of nitrogen from the deeper layers is almost absent due to lack of mixing on account of steepness of the continental slope. Sharp stratification (Ivanov, 1964) of water is a characteristic feature of the Andaman Sea. The very stable stratification except for shelf region (Massellinikov, 1973) and limited mixing between surface, subsurface and bottom water inhibit the influx of nutrients to the surface (Sen Gupta *et al.*, 1981).

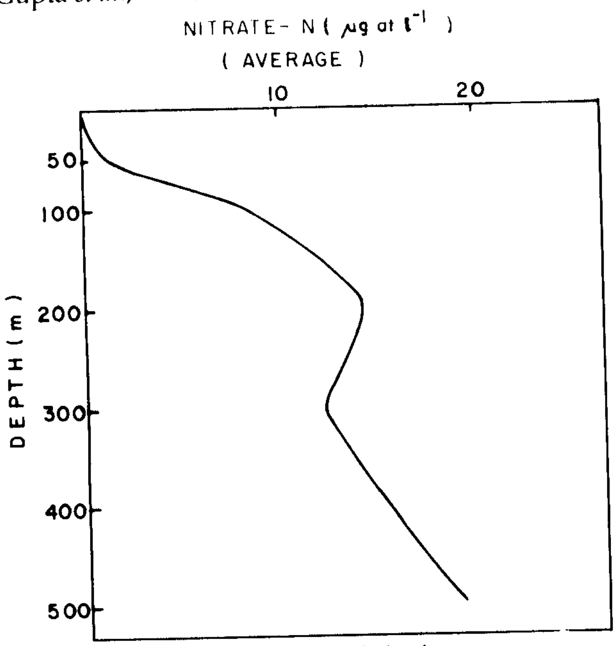

Fig. 6. Distribution of nitrate - N with depth.

Conclusions

The surface concentration of dissolved silicon is comparable to those reported earlier from this area but deeper values showed a marked deviation and its concentration in coastal regions is higher than that of open ocean surface waters. The dissolved inorganic phosphate also follows the same trend as silicate. The nitrate-N is almost undetectable in the upper layers. The enrichment of nutrients from deeper waters is almost absent possibly due to limited mixing and sharp stratification.

Acknowledgement

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