

Iodate in Inshore & Offshore Waters of Central Bay of Bengal

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Biological stripping of iodate in the surface waters is noticed in the inshore and offshore waters of Bay of Bengal. A good correlation is observed between iodate and phosphate and nitrate and the molar ratios determined being $\text{NO}_3 : \text{PO}_4 : \text{IO}_3 = 88 : 13 : 1$. The values of ΔI , in these waters confirm iodate, as the major species present in deeper waters. The per cent depletion of iodate in the surface waters is calculated from the values of specific iodate, which are more or less constant in the inshore waters.

Although considerable work has been done on the iodine system in the sea¹⁻³, studies on the behaviour of iodine in the inshore waters are meagre. Truesdale⁴ has studied seasonal changes of iodate and total iodine in the temperate inshore waters. Distribution of iodate in seawater and its involvement in biological processes have been reported^{5,6}. This communication presents the distribution of iodate and its behaviour in the inshore waters and offshore waters, Bay of Bengal.

Materials and Methods

Seawater samples were collected using polythene coated Nansen bottles at various stations (Fig. 1) during the 121 cruise of *R V Gaveshani* (June 1983) in the nearshore waters of estuarine regions of Godavari and Vamsadhara. Immediately after collection, the samples were filtered through 0.45 μm membrane filter and kept frozen. Iodate concentration was estimated by spectrophotometric method of Johansson⁷ as modified by Truesdale⁸. The precision of the method was $\pm 3\%$. Standard analytical methods⁹ were used on board for the analysis of dissolved oxygen, phosphate and nitrate. Salinity was estimated by the argentimetric titrations in the laboratory. The analysis of total iodine was made using its ability to catalyse the reduction of ceric ions by arsenious acid¹⁰. This method has the advantages of requiring only small seawater samples (10 ml), minimising certain interferences and giving stable colours for spectrophotometric determinations. An excess of sodium chloride was added to the samples to eliminate the interference of chloride already present in seawater by attaining a stable maximum chloride concentration that sensitizes the reaction. The formation of non catalytic forms of iodine and the inhibitory effects of silver and mercury are also reduced by the addition of sodium chloride. The precision of this spectrophotometric method was $\pm 5\%$.

Results and Discussion

The stations are divided into a shallow (0-200 m) and a deep (> 500 m) water groups so that major changes obtained in the distribution of iodate may be compared between the inshore and offshore waters. The vertical distribution of iodate at offshore stations are similar with that of nutrients viz. phosphate and nitrate (Fig. 2). The iodate concentration is lowest in the surface (0.15-0.25 μM) and it increases with depth to about 0.4-0.45 μM . A mid depth maximum of iodate is noticed corresponding to phosphate maximum and oxygen minimum which may probably be due to the remineralisation of organisms as reported earlier^{4,11}. The maximum difference in the concentration of iodate between surface and 150 m is about 0.3 μM and below this depth, significant variation is not observed either with depth or with location. The surface

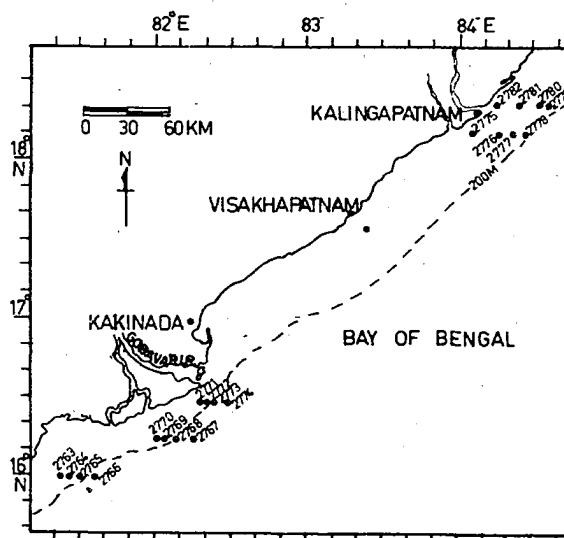


Fig. 1 - Station locations.

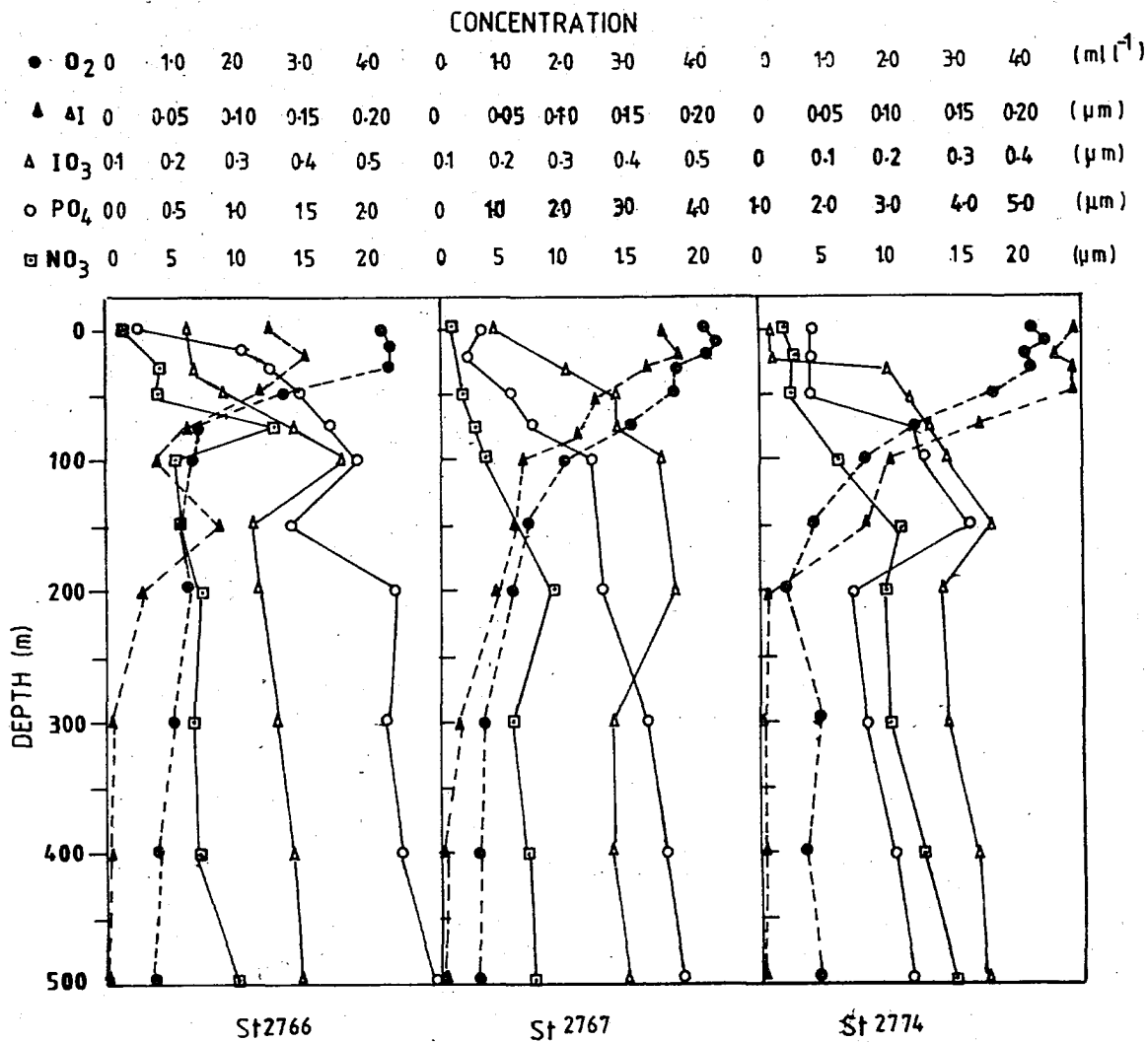


Fig. 2—Vertical distribution of O₂, ΔI, IO₃, PO₄ and NO₃ at 3 offshore stations.

concentration of iodate increases southward in the study region. The low iodate concentration in the surface layers at offshore stations may be caused by biological stripping of total iodine, loss of iodine to the atmosphere or being associated with the presence of high concentration of iodide. Analysis of total iodine in the offshore stations reveals that the difference between total iodine and iodate i.e. ΔI, is decreasing with deeper waters. This observation confirms iodate as the major species present in deeper waters. It is observed that above oxycline region phytoplankton production is high as indicated by high dissolved oxygen concentration and low nutrient levels (Fig. 2). From the values of ΔI, it is presumed that iodide may also be present in the surface waters because of phytoplankton turn over¹². High concentration of

iodide in the warm surface waters in tropical Pacific areas of high biological activity have also been reported earlier⁵.

The correlations between iodate and phosphate ($r = 0.904$) and between iodate and nitrate ($r = 0.78$) are good. The corresponding molar ratio NO₃:PO₄:IO₃ = 88:13:1 obtained here is in good agreement with that of earlier studies in waters of southwestern Bay of Bengal⁶. It is also apparent that there is a good correlation between AOU (apparent oxygen utilisation) and iodate ($r = 0.68$) with a ratio of 1325:1.

Distribution of iodate along a transect off Godavari (Fig. 3a) showed that the nearshore waters are having higher concentrations ($0.3 \mu\text{M}$) even up to 200 m water depth (st 2773) and thereafter decreases towards the deeper sea (st 2774). The distribution pattern at the

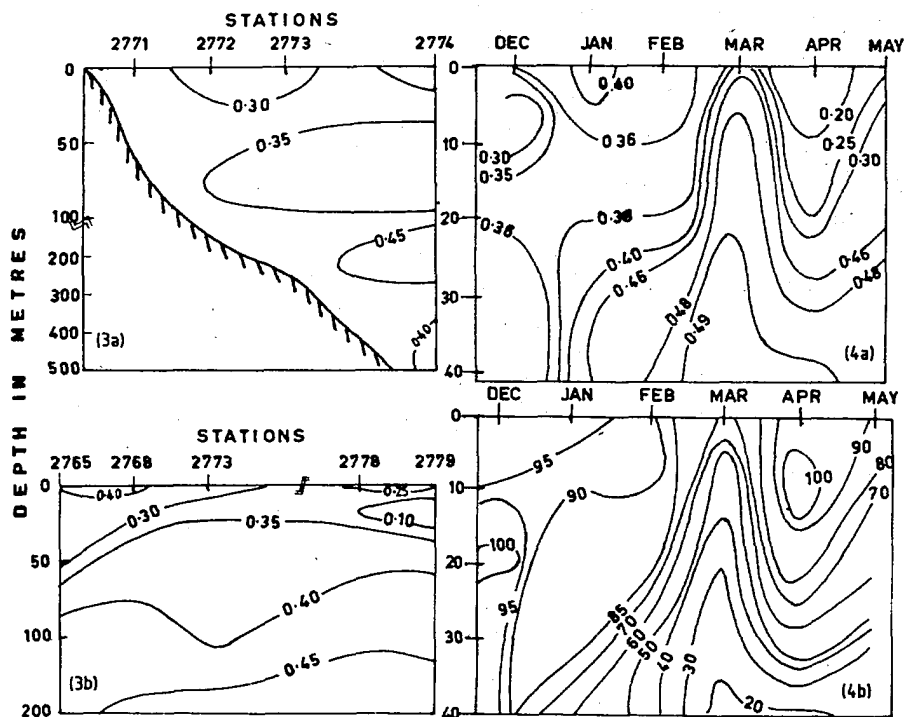


Fig. 3 – Distribution of iodate along (a) 16°28'N off Godavari and (b) 200 m depth.

Fig. 4 – Monthly changes of (a) iodate, μM and (b) per cent oxygen saturation, off Waltair (40 m depth).

inshore stations (sts 2765, 2768, 2773, 2778 and 2779), almost parallel to the coast along 200 m depth (Fig. 3b) is complex and observed irregular variance may be due to the suspended organic and inorganic particulates influenced by the river run off. The high concentrations of iodate up to 60 m at sts 2765, 2768 and 2773 probably show the estuarine influence into the nearshore waters. Studies¹³ on the speciation of iodine in estuaries revealed that iodine carried by rivers in the form of iodide is oxidised to iodate in the sea subsequently.

The specific iodate, ratio of iodate to salinity, varies noticeably from surface down to oxycline in the offshore stations and this depletion in surface waters may be caused by the uptake of iodate by organisms. The average per cent depletion of iodate and total iodine in these surface waters is 37 and 10% respectively in contrast to the observations made by Wong and Brewer² and Elderfield and Truesdale¹². However, in the nearshore waters, out of 91 measurements made for iodate, most of the values lie between 0.3-0.42 μM . Similarly, the salinity values in the inshore waters range from 33.42-34.74 ($\times 10^{-3}$). By expressing the iodate values in $nM.l^{-1}$ and salinity in $g.l^{-1}$, the average specific iodate value is 11.70 $nM.g^{-1}$ in the inshore waters. The lack of correlation

between iodate and nutrients in these inshore waters is probably due to decreased breakdown of the phytoplankton detritus in an active production zone of sorption of iodine from solution¹⁴.

Though the iodate values in the inshore waters clearly indicate the uneven distribution, detailed studies on the distribution of iodate at nearshore station (40 m depth off Waltair) during Dec. 1979 to May 1980 show the reduction of iodate in the surface waters during April. This is in contrast to the observation made by Truesdale⁴ in the inshore waters of Menai Straits. The distribution of iodate and oxygen saturation is shown in Fig. 4. More or less similar average concentration of iodate is observed from Dec. to March, whereas depletion of iodate is found during April. The distribution of oxygen in the coastal waters is the net result of biological oxygen consumption and physical replenishment by advection and mixing. Thus the depletion of oxygen during the premonsoon season is due to the prevailing upwelling processes^{15,16} and these coastal waters are reported to be highly productive. The increase of oxygen saturation during April indicates the plankton growth¹⁷ and further, onset of plankton blooms reduce the iodate concentration. The distribution of iodate shows the involvement of persisting physical

and biological processes occurring during the season and thus extensive studies will be needed to get an integrated picture on the speciation of iodine in the inshore waters with regional and temporal variations.

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