Distribution of chlorophyll and nutrients in Izmir Bay (Aegean Sea)

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SUMMARY : In two subregions of İzmir Bay, TIN, phosphate, silicate and chlorophyll-a concentrations were measured between the years 1984-1985. In the Inner Bay which has been polluted Si:N:P ratios were 4.68:7.02:1 while they waere 51.45:20.55:1 in an unmpolluted region, Gülbahçe Bay. From these ratios and nutrient-chlorophyll correlations, it was suggested that TIN and Phosphate may be the limiting nutrients in the Inner Bay and Gülbahçe Bay respectively.

INTRODUCTION : The knowledge of the nutrient levels and nutrient ratios in the Aegean sea were reported by Mc GILL (1963), FRILIGOS (1981), BÜYÜKIŞIK (1983), BÜYÜKIŞIK and ERBIL (1987) but chlorophyll observations in the eastern part of Aegean Sea have not been reported. This paper will give the unique observations of chlorophyll concentrations and nutrient levels in the eastern part of Aegean Sea.

MATERIAL AND METHODS : Sampling were made vertically at the stations given in figure 1 between 1984-1985. Chlorophyll-a were measured using three chromatic method. Nutrients were determined according to STRICKLAND and PARSONS (1972). Totally 30 samples were taken in Gülbahçe Bay at the date of 30th May, 13th August, 14th November 1984. 44 samples were also taken in Inner Bay at the date of 25th May, 14th August, 15th November 1984 and 27th February 1985.

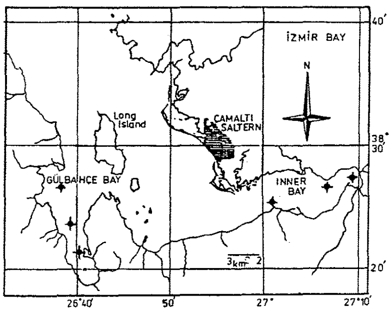

Figure 1: İzmir Bay and location of stations.

RESULTS AND DISCUSSION :

In the Gülbahçe Bay, the chlorophyll-a concentrations were low in May (mean:0.85 µg/l., range: 0.45-1.37) and increased in August (1.87,1.09-3.18). In November, mean value decreased again (0.20,0.02-0.34). The mean nutrient concentrations and ranges were the following: Total inorganic nitrogen (2.26 µg-at/l., 0.5-5.3), reactive phosphate (0.11 µg-at/l ., 0.00-0.37), reactive silicate (5.66 µg-at/l., 0.99-17.37).

In the Inner Bay, while the mean chlorophyll-a's value was 5.33 µg/l (1.61-9.36) in May, it increased to 13.32 µg/l. (2.29-24.22) because of the diatome growth (BÜYÜKIŞIK and ERBİL, 1987) in August and decreased to 4.07 µg/l. (0.5-7.69) in November. By the end of February, another diatome bloom raised the value to 28.04 µg/l. (1.68-61.87). The mean nutrient concentrations were the following: TIN (10.11 µg-at/l.,0.4-35.9), reactive phosphate (1.44,0.0-4.6), reactive silicate (6.74 µg-at/l.,0.3-35.7).

There was a good correlation between TIN, P and Si in the Inner Bay. The relationships were expressed as [TIN] = 9.76 [P] -3.07 (cor.:0.927) and [Si] =3.728[P] + 1.379 (cor.:0.731). These two equations express that Phosphate and silicate will still be present while TIN were consumed completely. From these results, it follows that TIN is likely to be a limiting nutrient in the Inner Bay. Si:N:P ratios were low (4.68:7.02:1) in the Inner Bay. The low Si:P ratio arise from the silicate depletion of diatomes and from slower turnover rate than that of phosphate. The Si:N:P ratios in Gülbahçe Bay were 51.45:20.55:1. These high ratios are due to the phosphate deficient waters of Gülbahçe Bay. Phosphate is more limiting to phytoplankton than total inorganic nitrogen and silicate. The following relationship proves that result too: [Chl-a(µg/l)] =2.559[P(µg-at/l)] +0.780 (cor.:0.366). TIN and silicate were inversely related with chlorophyll because of the fact that phosphate deficient waters, containing low chlorophyll-a, have high nitrogen and silicate. Hiperbolic relationships were found in the Inner Bay due to the high biological productivity.

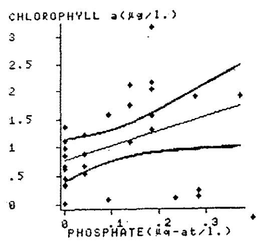

Figure 2: The phosphate/chlorophyll-a relationship in Gülbahçe Bay.

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Dissolved nutrients in the Levantine Basin of the Eastern Mediterranean Sea

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The Mediterranean Sea has been described as the most impoverished large body of water in terms of dissolved nutrients (Redfield et al., 1963). There are a number of studies which have determined the nutrient concentrations in the western and central Mediterranean Sea. In this study, dissolved nutrient data are presented from a cruise of the R/V Shikmona in the Levantine basin of the Eastern Mediterranean Sea south of Cyprus in August-September 1987. Mesoscale eddies have been recognized and studied as potentially important oceanographic features. Recently, similar eddy features have been discovered in the Levantine basin of the eastern Mediterranean Sea (Robinson et al., 1987). Fox and Kester (1986) noted that dissolved nutrients can be used to identify and delineate such mesoscale eddy features. We have used analysis of dissolved nutrient as well as temperature profiles to search for the presence of such eddy features within this region of the Levantine basin.

The temperature and salinity measurements were measured in situ by a Neil Brown CTD. The nutrient determinations were carried out in the lab on samples which had been preserved by freezing on a rapid flow analysis Alpkem system. For a complete description of the methodology used see Krom et al (in prep).

The temperature and salinity profiles were typical of previous data from this region of the Eastern Mediterranean in summer. There was a 30-50 m deep mixed layer. At a depth of 70 m there was a salinity minimum of N. Atlantic water. From 100 to 500 m the Levantine intermediate water was found which was underlain by deep water which continues down to as far as was sampled (2000 m). This pattern was also observed using nitrate and A.O.U. data to calculate "preformed" nitrate. The upper layers, to a depth of 150 m, had low nutrient content. The deep waters below 500 m reached levels of 5.5.-6.3 uM nitrate and 10-12 uM silica. These values of dissolved nutrients at depth were much lower than those found typically at similar depths in other oceans: 40 uM nitrate in the Pacific and Indian Oceans and 20 uM nitrate in the Atlantic Ocean, 130 uM silica in the Pacific and Indian Oceans and 40-100 uM silica in the Atlantic Ocean (Spencer, 1975).

Fig. 1a and b represents the vertical distribution of temperature, salinity and dissolved nutrients across two of the three major E-W tracks of this cruise. On the southerly track (32.5°N) there was very little variation between stations (Fig. 1a). Based on the temperature and salinity profiles which were measured every 50 kms on this leg, there was no evidence of any mesoscale eddy features in this region.

On the more northerly track (33.5°N), two eddy features were encountered and can be clearly defined (Fig. 1b). The major structure was centered on station 338. It is a warm core eddy in which the thermocline and nutrient iso-concentration lines are depressed by 350 m relative to the adjacent areas. It is not possible on the basis of temperature and salinity contouring alone to determine how deep the feature extends, because the temperature and salinity are essentially constant below 500 m. However, the contours derived from the silica profiles show clearly that the eddy extends down to at least 2000 m depth. A second mesoscale feature centered on station 335 was also observed.

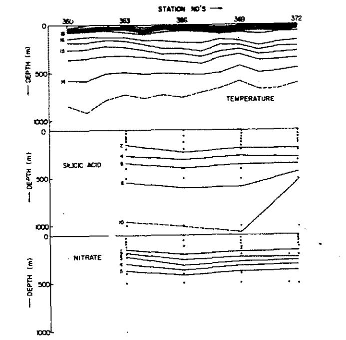
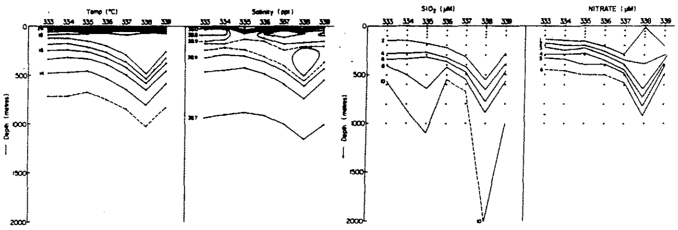


Fig. 1. Section in the Eastern Mediterranean (Aug. 1987). Isopleths indicate temperature, salinity, silicic acid and nitrate. See Krom et al. (in prep.) for precise station locations.
(a) at 32.5°N,
(b) at 33.5°N, showing a warm core eddy.



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