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The emission of humic acid fluorescence by phytoplankton

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ABSTRACT

The chlorophyll-α and humic acid fluorescence of phytoplankton cultures and of samples of coastal sea water from the Northeastern Mediterranean have been measured. Cultures of phytoplankton were maintained under sterile conditions at 25 °C. The number of cells present was determined periodically by optical microscopy. Humic acid concentations were determined spectrofluorometrically using 360 nm exitation and monitoring 455 nm emission according to the procedure given by Balkaş *et al.*, (1983) and commercial soil humic acid was used as a standard. Chloropohyll-α concentrations were also determined spectrofluorometrically using exitation at 425 nm and monitoring emmision at 660 nm according to the procedure of Strickland and Parsons (1968) and using coproporhyrin as a standard.

The phytoplankton culture generated humic acid fluorescence as soon as cells started to die. Figure 1 shows typical generation of humic acid fluorescence by *Nitzia Longissima* diatoms and the number of living intact cells in the culture. Probably all species of phytoplankton generate "humic acid" fluorescence as is suggested in Figure 1 by the rise in emmission when a culture of mixed phytoplankton was added to the sterile nutrient-humic acid solution. In a healthy colony of phytoplankton birth and death will be occuring simultaneously, growth being the excess of births over deaths. These results suggest that the intensity of "humic acid" fluorescence may be usable as a measure of death rate.

Statistical measurements of the intensity of humic acid fluorescence from samples of surface water collected from the NE Mediterranean resulted that in the coastal region humic acids occur non randomly in clumps.

Further insight into the distribution of humic acid in coastal waters of the NE Mediterranean was obtained from its depth profiles with the chlorophyll-α profiles (Figure 2). At some locations and at the same time the humic acid and chlorophyll-α concentrations were in phase, maximum and minimum concentrations of both compounds occured at the same depths and the concentration of humic acid was approximately proportional to the concentration of chlorophyll-α. The laboratory studies of phytpoplankton suggest that such results should be interpreted as observations of healthy colonies of phytoplankton, the concentrations of humic acid being consequence of the more or less stable rate of mortality within the colony. Sometimes humic acid and chlorophyll-α concentrations were out of phase, humic acid maxima occuring at the same depths as minima in the chlorophyll-α concentrations. In these instances it is natural to regard the humic acid as arising from decayed or decaying vegetation. Thus it would seem that in these unproductive coastal waters much of the humic acid fluorescence of the sea generated from colonies of living phytoplankton and from decaying vegetation and that in consequence it is distributed non randomly in clumps

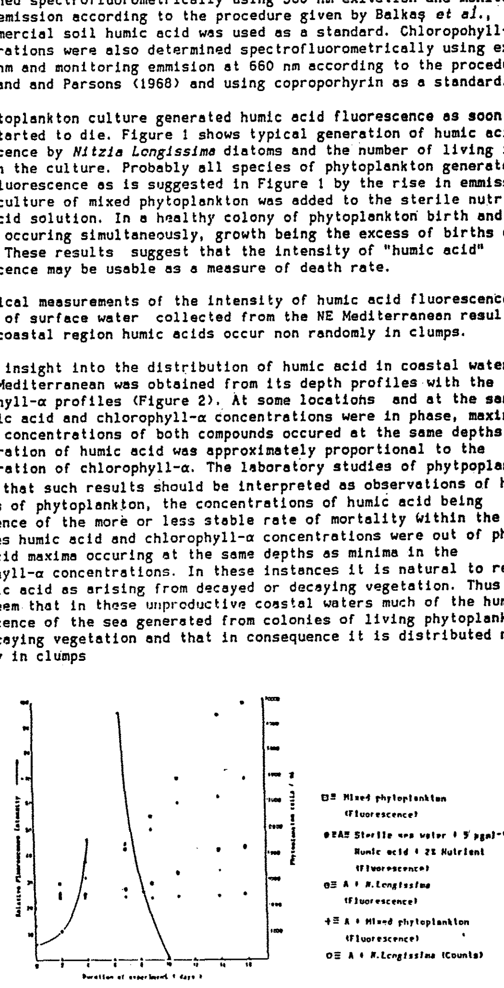

Figure 1. Development of fluorescence from phytoplankton culture

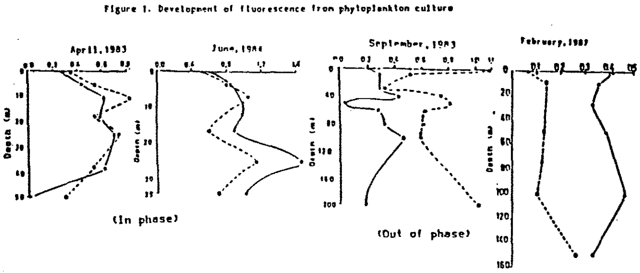

Figure 2. Humic material and chlorophyll-α profiles in the Northeastern Mediterranean
Humic material (------) chlorophyll-α (——)

REFERENCES:

Balkaş,T.I. *et al.*,(1983),"Comparison of five humic acids",Fuel, 62, 373-379

Strickland, J.D.H. and Parsons, T.R., (1968), A Practical Handbook of Sea Water Analysis, Bull. Fish. Res. Bd., Canada, 167, 311.

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Distributions of nutrient elements in the Northeastern Mediterranean : physical factors affecting the distribution

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The Mediterranean Sea, particularly the eastern Mediterranean, has long been known as an impoverished body of water (McGill, 1961,1965 and 1969; Schink,1967; Miller et al.,1970 and Morcos,1972) due to the low levels of nutrient elements. Incoming Atlantic surface waters are already low in nutrients, and therefore unable to replenish losses due to outflow of the relatively nutrient-rich intermediate water through the Strait of Gibraltar. While the oceanographic data related to the levels of nutrient elements within the southern and southeastern sections of the eastern Mediterranean are considerable (Israel Report,1985; Morcos,1972; McGill,1961, 1965; and Emara,1973), there is only one set of data within the northeastern basin of the Mediterranean which was obtained during the October-November,1961 cruise of R/V Chain.

In order to fill the gaps in the data related to the levels and horizontal distributions of nutrient elements within the eastern Mediterranean, levels of nutrient elements, namely ortho-phosphate (o-PO_4), molybdate reactive silicate ($Si(OH)_4$) and total oxidized nitrogen compounds (NO_3+NO_2) (ONC) were measured seasonally within the coastal and off-shore regions of the northeastern Mediterranean during the 1986-1987 cruises of R/V BILIM. Data were taken in April, June and November, 1986 and in February-March, June and September, 1987. Concentrations of nutrients were found to be very low within the upper 100m depth layer and rapidly increased below 100m down to 800m. The concentration ranges for the ortho-phosphate, reactive silicate and oxidized nitrogen compounds (ONC) for the upper layer waters were found to be in the range of 0.04-0.50 µg-at P/l, 0.50-3.0 µg-at Si/l, and 0.50-3.0 µg-at N/l, whereas those of deeper layers were 0.10-0.50, 4.0-5.0, and 4.0-10.0 µg-at/l, in respective orders. The striking feature in both horizontal and vertical distributions of nutrient elements is the good correlation with the circulatory features of the region. The presence of meso- to large-scale cyclonic and anticyclonic gyres in the region affects the distribution of nutrient elements within the area. The Rhodes gyre is a well known and relatively large scale cyclonic gyre located in the western section of the northeastern Mediterranean. Nutrient-rich deep waters in this region are transported upward into the upper euphotic zone by vertical movements at the center of the gyre. The consequence of this upwelling is the enhancement of primary productivity and standing stock of the area. The anticyclonic gyres found in the offshore regions of the Antalya Bay and Iskenderun Bay are the areas where reverse processes in the nutrient distribution are observed.

REFERENCES

H.I.Emara, Y.Halim and S.A.Morcos,1973: Oxygen,phosphate and oxidizable organic matter in the Mediterranean waters along the Egyptian coast. Rapp. Comm. int. Mer Medit., v.21(7), p:345-347.

Israel Report,1985: "Multidisciplinary studies of the Eastern Mediterranean Basin, 1984-1985; An annual report on physical, chemical and biological investigations", Israel Oceanographical and Limnological Research Ltd.

D.A. McGill,1961: A preliminary study of the oxygen and phosphate distribution in the Mediterranean Sea. Deep-Sea Res. v.9, p:259-269.

D.A. McGill,1965: The relative supplies of phosphate, nitrate and silicate in the Mediterranean Sea. Extrait des Rapports et Procès des rèunions de la C.I.E.S.M.M., volume XVIII,fasc.3.

D.A.McGill,1969: A budget for dissolved nutrient salts in the Mediterranean, Can. Oceanogr., v.21, p:543-554.

A.R. Miller, P.Tchernia, H.Charnock and D.A. McGill,1970: Mediterranean Sea Atlas, Woods Hole Oceanographic Institution, Woods Hole,USA.

S.A. Morcos,1972: Sources of Mediterranean intermediate water in the Levantine Sea. In: A.L.Gordon (Ed.), Studies in Physical Oceanography, Vol.2, p:185-206, Gordon and Breach, N.Y.

D.R. Schink,1967: Budget for dissolved silica in the Mediterranean Sea, Jour. Mar. Research, v.10(1), p:128-152.