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Dissolved Organic Matter - Index of Increased Biological Productivity Zones

by

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**ABSTRACT**

The contents of the dissolved organic matter (DOM) and proteinogenic amino acids in it constituted 2.7-4.3 mgC/l and 0.7-3.8 mgC/l, respectively during the period of phyto- and zooplankton development in the photosynthesis layer in the North Atlantic and Norwegian Sea areas. The variability of the percentage content of separate amino acids groups was specified by area and time of sampling, the latter factor was paramount. The investigations conducted in the offshore zones of the ocean allowed to correlate the high concentrations of carbon and amino acids in DOM and increased productivity of separate zones of the areas observed.

**INTRODUCTION**

Hydrochemical parameters, in particular, the elements of biogenic cycle, effected the biocoenosis development, played great role among the ecological factors, formed biotopes of sea and oceanic areas. But the sea water contains in great quantities the dissolved organic matters (DOM), which are genetically related with organisms inhabited there and serve for them as source of food, vitamins and also as an index of information on external environment. The first in the world literature generalisation of investigations on organisms' metabolism with the participation of dissolved metabolites in sea water, was presented in monograph by K.M.Khailov (Khailov, 1971).

Data on content of the integral index of DOM - organic carbon and its components (amino acids, elements of primary structure of nucleic acids and others) are of practical trend because high concentrations of components of dissolved fraction, as a rule, are concentrated in the animals and vegetable organisms areas.

#### MATERIAL AND METHODS

The investigations were carried out in the photosynthesis layer during spring 1969-1983 in the North Atlantic waters: on the Reykjanes Ridge, Grand Bank, in the Davis Strait and also in the Norwegian Sea.

The settling of DOM for subsequent determination of the amino acid component was made on zirconium phosphates with well expressed coagulation and adsorption properties (Zlobin, Perlyuk, Orlova, 1973). The separation of amino acids in hydrolyzates of the sediments obtained, was conducted by chromatographic method, the remainders of nucleic acids - by electroendosmosis method.

#### RESULTS AND DISCUSSION

The analysis of quantitative characteristics of summarized content of free and linked amino acids in DOM, collected in a 0-50 m layer in different areas of the Atlantic Ocean in spring 1969-1971 showed that the amino acids concentration in DOM varied from 0.73 to 3.86 mgC/l (Fig. 1). If we take into account A. Krog's data (Krog, 1935), that proteinaceous matters in DOM constitute about 30% and consider the availability "protein-like" compounds, then the mean DOM concentration in a 0-50 m layer over the area investigated will be equal to 3.2-4.3 mgC/l. High DOM concentrations were observed in the regions of phyto-, zooplankton and fish aggregations areas, in particular, along the slopes of the Grand Bank (Fig. 2).

Due to the data for July 1970-1971 DOM in the Norwegian Sea was equal to 2.7-3.6 mgC/l. The highest content of amino acids in DOM was registered in the cold East Icelandic Current waters and in the mixed waters zone (Fig.3). The data obtained are correlated with the conclusions by A.F. Timokhina (Timokhina, 1972) and mixed waters, and also about concentration of the major mass of zooplankton Calanus finmarchicus in the upper 0-50 m layer.

High concentrations of amino acids in DOM are caused by mass development of phyto- and zooplankton, as consequence of which sea water is intensively enriched with the dissolved organic matter (DOM) due to data by A.Morris and P.Foster (Morris, Foster, 1971) - up to 7 mgC/l. The amino acids component accounts for a considerable part of DOM. For instance, the microphytes of Nitzschia ovalis Arn type precipitate out at the logarithmic phase of growth up to 77% of biomass of amino acids, and zooplankton Calanus finmarchicus - up to 50%. Due to data by L.Prosser and F. Brown (Prosser, Brown, 1967), the amino acids constituted over 30% of invertebrates excretions.

The analysis of percentage composition variability of separate groups of amino acids in DOM showed that this index was sufficiently stable and did not depend upon the spatial allocation of the stations analysed, but depended upon the time of material collecting. The amino acids groupings such as aspartic and glutamic acids, theonine, serine, glycine, which are free in water and are considered to be available for assimilation by heterotrophic organisms were registered in the greatest concentrations in offshore waters of the ocean.

Along with the amino acids component the elements of primary structure of nucleic acids (adenine, guanine, nucleotides, nucleosides), determined in cell the synthesis of the proteins needed and its regulation) had been revealed in DOM. For instance, due to the data of O.Holm-Hansen et al. (Holm-Hansen, Booth, 1966), desoxyribonucleic acid content in the oceanic water is the function of dry weight of microphytes and can be used as phytoplankton biomass index.

As a result of the investigations carried out in the offshore zones of the ocean it was possible to correlate the high concentrations of carbon and amino acids in the dissolved organic matter along with other indices and increased productivity of separate zones of the areas observed. Composition and content of DOM, as an index of fecundity grounds, can favour the scouting of fish concentrations and none-fish fishery objects, in addition to the traditional methods of primary production assessment.

#### CONCLUSIONS

1. In spring the contents of the dissolved organic matter and proteinogenic amino acids in the photosynthesis layer of the oceanic waters constitute 2.7-4.3 mgC/l and 0.7-3.8 mgC/l, respectively. The greatest concentrations were registered in the phyto-, zooplankton and fish aggregations areas.

2. Composition and content of the dissolved organic matter are the indices of increased bioproductivity zones and can be used as an indicator for scouting the fish concentrations along with other characteristics of environment.

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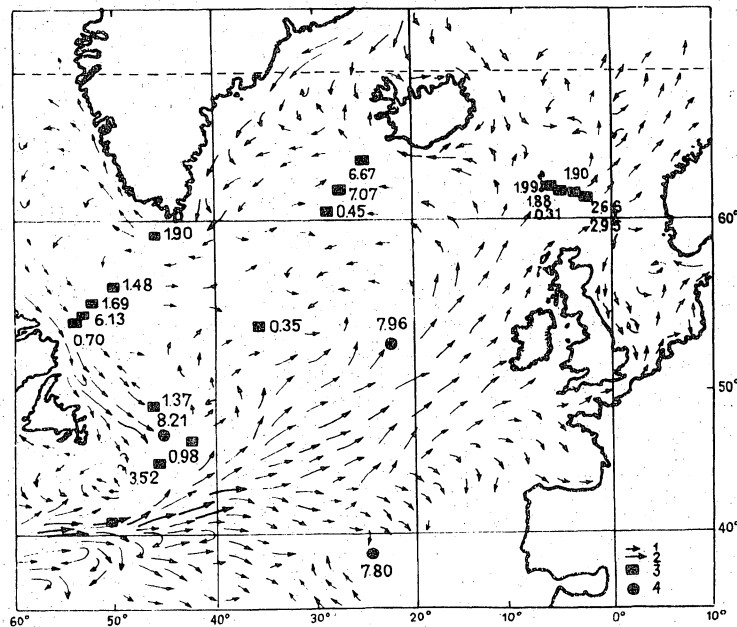


Fig. 1 Mean content of free and linked amino acids (mg/l) in the dissolved organic matter in the North Atlantic: Davis Strait, Grand Bank, Reykjanes Ridge in 1969-1971  
Currents: 1 - unstable 3 - 0-100 m  
2 - sufficiently stable 4 - 0-50 m

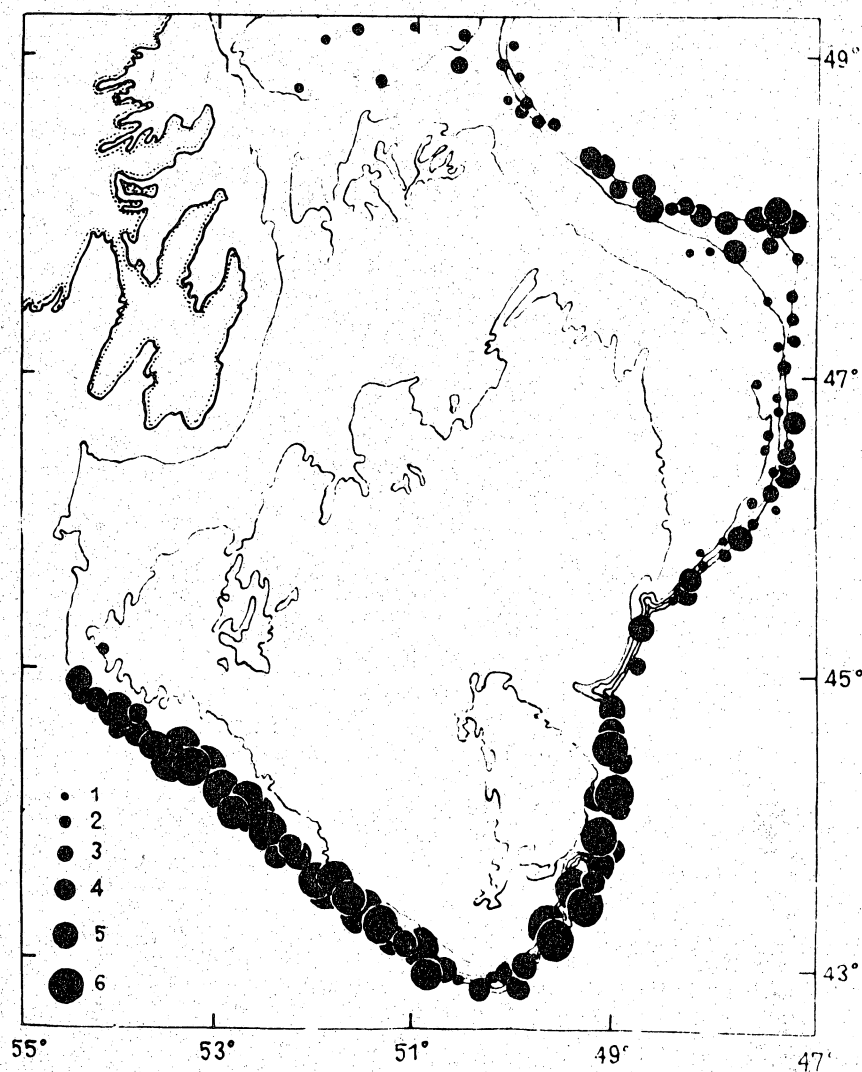


Fig. 2 The redfish Sebastes mentella  
distribution on the Grand Bank  
in 1970-1971  
(number of fish in catches  
are shown by circles)  
1 - 1-100 spec. per hour trawling  
2 - 101-500                    "-"-  
3 - 501-1,000                "-"-  
4 - 1,001-5,000             "-"-  
5 - 5,001-10,000            "-"-  
6 - 10,000                    "-"-

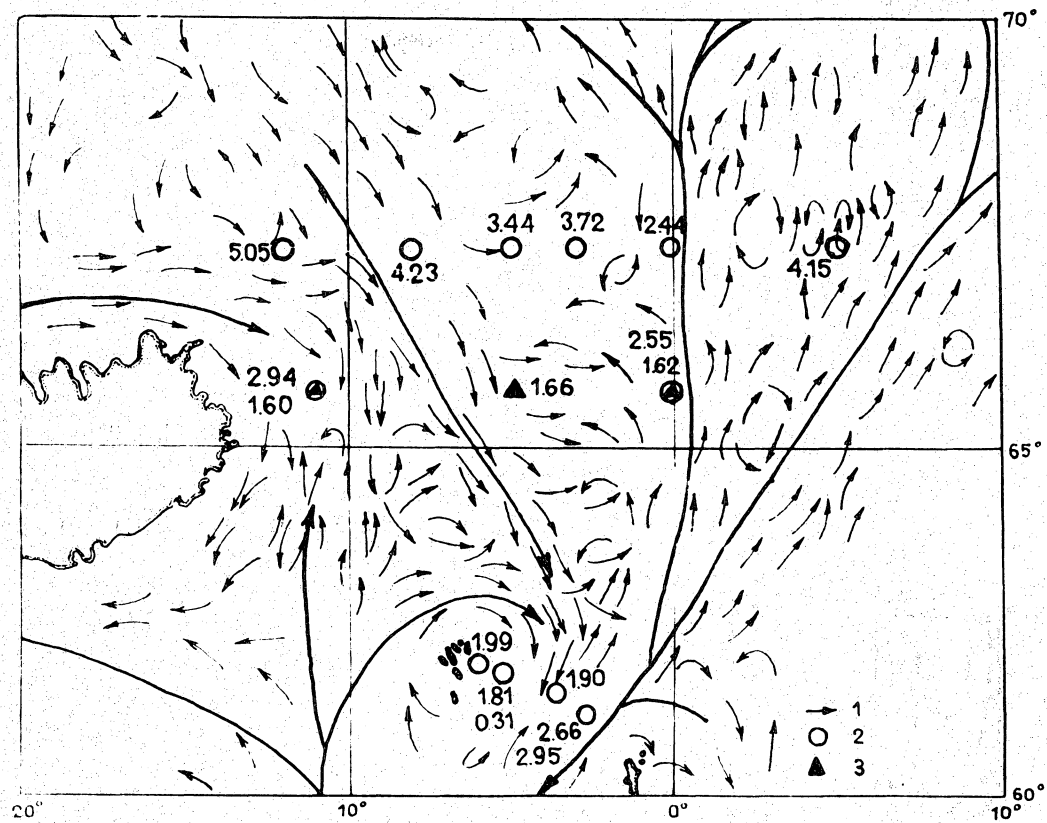


Fig. 3 Mean content of free and linked amino acids (mg/l) in the dissolved organic matter in the Norwegian Sea in 1970-1971  
1 - currents  
2 - 0-50 m  
3 - 10 m

