CHEMISTRY OF THE SEA SURFACE MICROLAYER IN THE BLACK SEA

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Abstract

The study is based on bi-monthly monitoring in Varna Bay, which is affected by anthropogenic pressure. Nutrients (TP, IP, N_{NO2}, N_{NO3}, Si), suspended matter, oxidizability, metals (Fe, Mn) were measured in both layers: SL and SML. A maximum accumulation for most of investigated parameters in Summer-Autumn period was observed. The highest coefficient of accumulation for nitrate N was established.

Keywords: Black Sea, nutrients, oxidizability, surface microlayer

As an area of exchange of matter and energy, the sea surface microlayer (SML) is an important boundary that either affected by global change. The sea SML has unique chemical and biological characteristics very different from those of underlying water. This thin sea-surface film receives material input from atmospheric, terrigeneous and marine sources, leading to elevated concentrations of both natural compounds and anthropogenic contaminants (1). There is still a lack of knowledge about phisico-chemical processes governing the formation and properties of SML and. The aim of the study is to assess the capacity of SML to accumulate nutrients and organic matter.

The study is based on bi-monthly monitoring at one station in Varna Bay, one of the most affected by anthropogenic pressure regions along the Bulgarian Black Sea coast. The following parameters: total phosphorus (TP), inorganic phosphorus (IP), nitrite and nitrate nitrogen (N_{NO2}, N_{NO3}), silica (Si), suspended matter (SM), oxidizability Fe and Mn were determined by standard methods. The accumulation in SML is presented by ratio between concentration in SML and surface (SL): $Ka=C_{SML}/C_{SL}$.

The data reveal that sea SML is enriched in organic and inorganic substances relative to the surface water. The nutrients distribution in SML follows that in SL (Figs. 1, 2). Their microlayer concentrations occasionally exceed the permissible limits (Water quality criteria for the coastal sea water). The comparison of nutrients distribution in SL and SML shows a good correlation for N (r^2=0.47). A similar situation is observed for SM (r^2=0.45). According to the coefficient of accumulation (K_a) the microlayer enrichment for N during all seasons is the highest. Maximum of K_a for the whole period of investigation is as follows: 8 for N_{NO3}; 2.8 for N_{NO2}; 4 for TP and oxidizability; 3 for IT; 2 for SM, 5 for Fe and 9 for Mn). The coefficient of accumulation for metals, phosphorus and SM is comparable with those found in other area, where similar investigations were carried out (2,3). Concerning inner annual distribution, we can note, that the more significant enrichment of the SML (with exception of phosphorus) was established during the summer–autumn period (Figs. 1, 2, 3). The calculated N/P ratio is the highest in both layers in March, when maximum N-content was detected. Analogously, maximum Si/P ratio was in January, in relation to Si content, respectively.

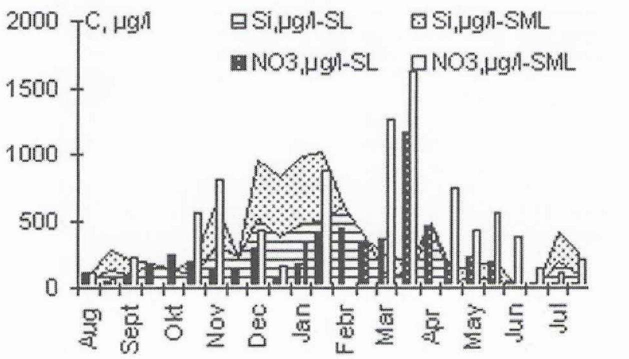

Fig. 1. Silica and nitrate N in the surface microlayer (SML) and surface layer (SL).

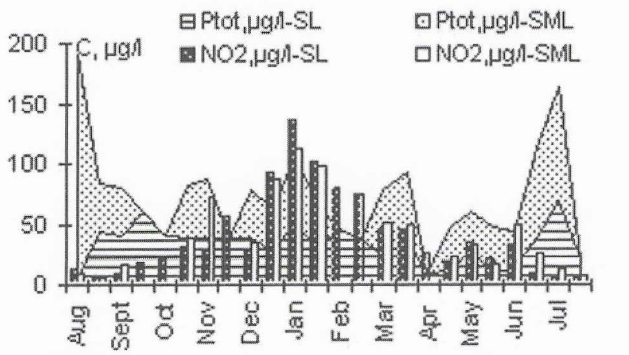

Fig. 2. Total P and nitrite N in the surface microlayer (SML) and surface layer (SL).

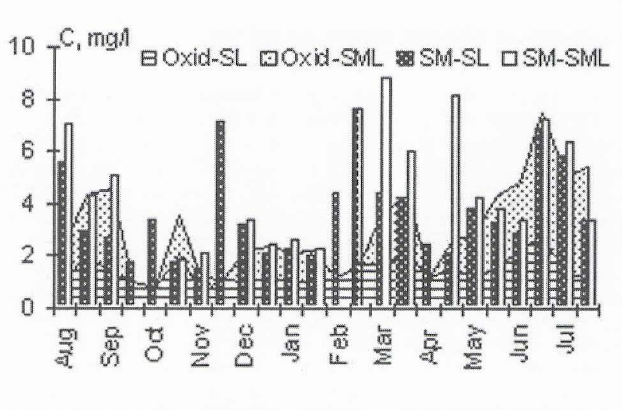

Fig. 3. Oxidizability and SM in the surface microlayer (SML) and surface layer (SL).

The data presented suggest the following conclusions, which at the stage of investigation should be considered preliminary:

A microlayer enrichment for all parameters (nutrients and organic matter) is observed. The capacity of SML accumulation for N is the highest in comparison with the other nutrients. The seasonal distribution is characterized with maximum accumulation for most of investigated parameters in Summer-Autumn period. These preliminary results could be used for subsequent investigations to improve our understanding of the processes at natural phase boundaries.

References

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