ECTOENZYMATIC HYDROLYTIC ACTIVITIES IN THE SEA SURFACE MICROLAYER

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Abstract

The skin of the sea, known as the sea surface microlayer (SML) has attracted considerable interest as a potential factor regulating the exchange between the ocean and the atmosphere. It is known that trace metals, inorganic nutrients and dissolved organic compounds are enriched in the SML as compared to the underlying waters, making the SML a "hot spot" for biological activity. However, most of this knowledge comes from coastal areas, which may be not representing the bulk of the global ocean's surface. Here we present the diel dynamics of bacterial heterotrophic activity in the SML of a Mediterranean eddy.

Keywords: surface microlayer, interface, Mediterranean Sea, bacteria, neuston

The SML is the part of the ocean most directly exposed to solar radiation and therefore it is potentially subjected to strong diel perturbations. In order to characterize the diel dynamics of the SML, samples were taken in the early morning, at noon and right before dusk using glass plate samplers. Samples of the underwater layer (UWL) were collected from a depth of about 30 cm at the same locations and times.

The SML has been reported to be significantly enriched in phosphate (1), carbohydrates and peptides (2) as compared to the underlying waters. Therefore the bacterial hydrolytic activities involved in the bacterial degradation of these compounds, (α- and β-glucosidase, aminopeptidase and phosphatase) were chosen as an estimate of bacterial heterotrophic activity.

The SML samples always showed higher levels of inorganic nutrients than those of the UWL as reported previously (1), however, ammonia and nitrate exhibited higher enrichment factors than phosphate (Table 1), resulting in much higher N:P ratios in the SML than in the UWL. Although there was a considerable variation between the different SML samples collected, bulk enzyme activities in the SML were generally several times higher than those in the underlying waters (Table 1). However, bacterioneuston abundances (SML) were not significantly higher than those of bacterioplankton (UWL), which resulted in much higher cell-specific activities of bacterioneuston as compared to bacterioplankton. The higher N:P ratios observed in the SML were matched by the ectoenzymatic activity pattern resulting in higher aminopeptidase:phosphatase in the UWL as compared to the SML. Thus there are remarkable differences between the two environments that are reflected in the response of their respective bacterial community.

Table 1. Enrichment factors (SML/UWL) of the different parameters measured (n=13).

	Average	Minimum	Maximum
Phosphate	3.7	1.6	10.6
Ammonia	11.5	3.0	28.6
Nitrite	3.2	2.4	5.0
Nitrate	80.8	2.7	355.5
Bacterial abundance	1.1	0.9	1.3
α-glucosidase	3.7	0.6	20.6
β-glucosidase	6.6	0.2	65
Aminopeptidase	2.5	0.7	8.9
Phosphatase	4.8	0.7	15.6

The highest levels of ectoenzyme activity were found in the early morning or in the evening samples and a marked inhibition of enzymatic hydrolysis was generally detected at noon for both bacterioneuston and bacterioplankton (Fig. 1). This pattern suggests a dramatic effect of UV radiation on enzyme activity on both communities as previously hypothesized. These data and the results of other analyses currently in progress will be presented and discussed.

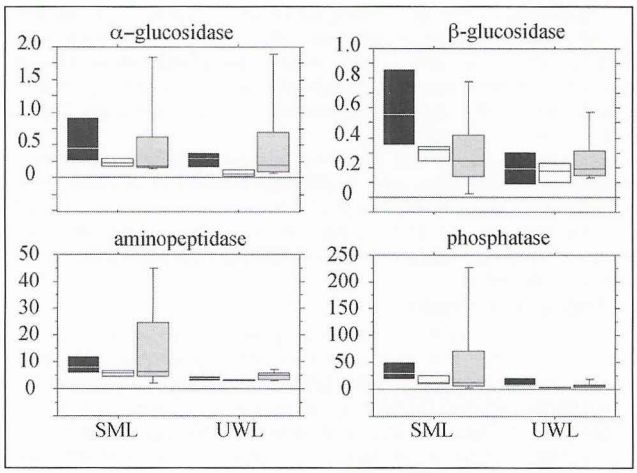

Fig. 1. Box plots and whisker plots of the diel variations in ectoenzyme activity for the SML and the UWL. Error bars represent the range, and the lines inside the boxes represent the median values. Samples collected in the morning are in black, those at noon in white, evening values are in gray.

References

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