

SPATIAL VARIABILITY OF MICROPLANKTON RESPIRATION IN THE ROSS SEA (ANTARCTICA) DURING AUSTRAL SPRING

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Abstract

Respiratory electron transport system (ETS) measurements of the microplankton were performed along a south-north transect from the marginal ice zone (MIZ) to the pack ice-covered zone. ETS activity ranged from 0.14 to 1.47 ml O₂ h⁻¹m⁻³ (mean value ± SD: 0.85 ± 0.35 ml O₂ h⁻¹m⁻³) under the ice and from 0.17 to 2.81 ml O₂ h⁻¹m⁻³ (mean value ± SD: 1.47 ± 0.80 ml O₂ h⁻¹m⁻³) in the marginal ice zone. The MIZ ecosystem was net autotrophic (P/R>1) while the pack ice zone was net heterotrophic (P/R<1).

Key-words: Ross Sea, ice-melting, microplankton, respiration

Introduction

Our knowledge on ecosystem metabolism of polar region is still rather poor compared to that of temperate latitudes. Recently this gap has been filled by several studies both in Antarctic and Arctic waters (1, 2, 3). However, little information is available regarding the impact of retreating pack-ice zone on remineralization processes and the balance between photosynthesis and respiration.

Research during ROSSMIZE cruise focused on the sea ice-covered zone and its northern edge during early spring. The aim of this study was to measure respiratory activity of microplankton in the water column under the pack-ice zone and in the marginal ice zone (MIZ), in order to improve the understanding of respiratory losses of newly formed organic carbon in these two subsystems.

Material and methods

The ROSSMIZE cruise was carried out from 16 November to 16 December 1994, on board the R/V *Italica* in the Ross Sea (Fig. 1).

Microbial respiratory activity (<200 μm) was determined according to the ETS (Electron Transport System) assay, corrected to in situ temperature using an Arrhenius activation energy of 11 Kcal mol⁻¹ (4) and converted to carbon dioxide production rates using a respiratory quotient of 1 (1). Sampling depths were selected according to optical levels (50, 20, 10, 5, 1 and 0.1% of incident irradiance) in the upper 100 m using a SBE 32/24 Carousel; a surface sample was also included.

Results and discussion

On the base of pack-ice cover, two main zones were distinguished on different spatial scales along a S-N transect: an area with pack-ice in its northern part (PIZ) and the marginal-ice zone (MIZ) in the southernmost part, characterized by drifting fragmented ice (Fig. 1).

In the PIZ, characterized by a prevalence of microphytoplankton (5), ETS activity ranged from 0.14 to 1.47 ml O₂ h⁻¹m⁻³ (mean value ± SD: 0.85 ± 0.35 ml O₂ h⁻¹m⁻³). A higher ETS activity was found in the MIZ (range: 0.17 to 2.81 ml O₂ h⁻¹m⁻³; mean value ± SD: 1.47 ± 0.80 ml O₂ h⁻¹m⁻³) where the picoplankton prevailed. The median ETS activity was 0.93 ml O₂ h⁻¹ m⁻³ for the PIZ subsystem and 1.47 ml O₂ h⁻¹ m⁻³ in the MIZ (Fig.2). Mean depth integrated values of ETS activity in the PIZ and the MIZ were as mean 77.9 and 117.2 ml O₂ h⁻¹m⁻², respectively, confirming the different respiratory levels calculated on meter cubic basis. All these values fall in the same range of other published data for polar regions (2).

The different levels of respiratory activity observed in the two subsystems were statistically different (ANOVA test: MIZ versus PIZ *p*<0.01) and reflected the spatial variations of phytoplankton biomass and productivity determined on the same cruise (5).

ETS activity correlated (*r*=0.42; *n*=44) with primary production (5), revealing a coupling between productive and consumptive processes according to previous field studies in the Antarctic Ocean (1, 3). With the aim to determine the overall system's metabolism of the two subsystems, the ratio between photosynthesis and respiration (P/R) was calculated. Our results show a different scenario for the MIZ and the PIZ, with ratios P/R=1.9 and P/R=0.3, respectively. These results are consistent with that of Martinez and Estrada (1) reported for the ice edge and below the ice cover of the Wedell Sea.

In conclusion this study indicates that: A) Levels of respiratory activity are lower under the ice and enhanced in the MIZ. B) The MIZ ecosystem was net autotrophic (P/R>1) while the PIZ was net heterotrophic (P/R<1) during the investigation period.

References

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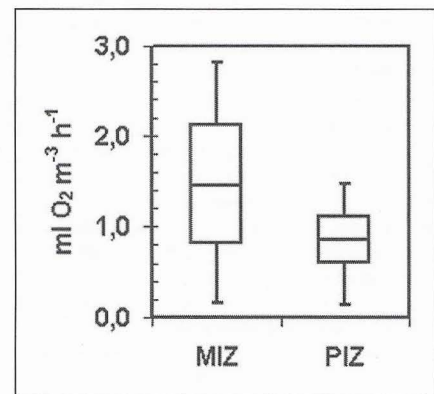


Fig.2. Box-and-whisker plots showing the range and the median ETS activity in MIZ and PIZ.

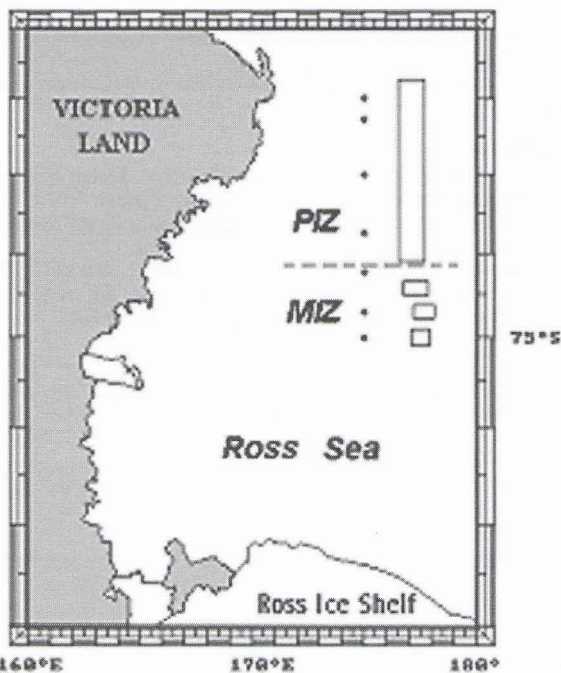


Fig.1. Map of sampling locations and pack ice typology.