DEEP MICROBIAL REMINERALIZATION IN THE ROSS SEA: EVIDENCE FOR POC SOURCE AS MAIN ORGANIC FUEL OF BIOLOGICAL PUMP.

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Abstract

Carbon dioxide production rates (CDPR) of micro-organisms were monitored through their electron transport system (ETS) activity in the deep Ross Sea. The depth-integrated CDPR amounted to 28,2 mg C $m^{-2}d^{-1}$ in the depth range 100-1000 m. Comparing CDPR determined in this study with that obtained by sediment traps in the Ross Sea resulted that about 63% of organic carbon remineralized by respiration derived from POC pool. Such evidence highlighted POC source as main organic fuel of biological pump in the Ross Sea.

Key-words: Ross Sea, Microplankton, Respiration

Introduction

Recent studies have demonstrated that dissolved organic carbon (DOC) is an important component of the biological pump that assumed in the deep waters a key role as main organic fuel of microbial respiration (1, 2). Such evidence seem overturned in the Southern Ocean, where Wiiebinga and De Baar (3), by estimates of apparent oxygen utilization and DOC, asserted that DOC pool accounted for < 10 % of the remineralization in deep waters. Another study demonstrated (4) that the euphotic zone of the Ross Sea yielded only a small portion of primary production as DOC (11%), so that DOC removal by deep convection could be not an important export term due to the small quantity of DOC that accumulates there. Furthermore other authors (5) also by sedimet trap studies suggested, that very little organic remineralization occurred between 250m and the bottom in the Ross Sea, which implies a rapid delivery and/or reduced bacterial remineralization.

The purpose of this study was to investigate the supply and utilization of organic carbon in the aphotic zone of Ross Sea by evaluation of microplankton respiratory activity and to compare the vertical carbon balance to different estimates of export production from the same area and other oceanic regions.

Material and methods

The oceanographic cruise, in the context of the BIOSESO II project, was carried out from 5 January to 27 February 2001, on board the R/V Italica (Fig. 1). Microbial respiratory activity (<200µm) was determined according to the ETS (Electron Transport System) assay and converted to carbon dioxide production rates (CDPR) using the factors described in Christensen *et al.* (1).

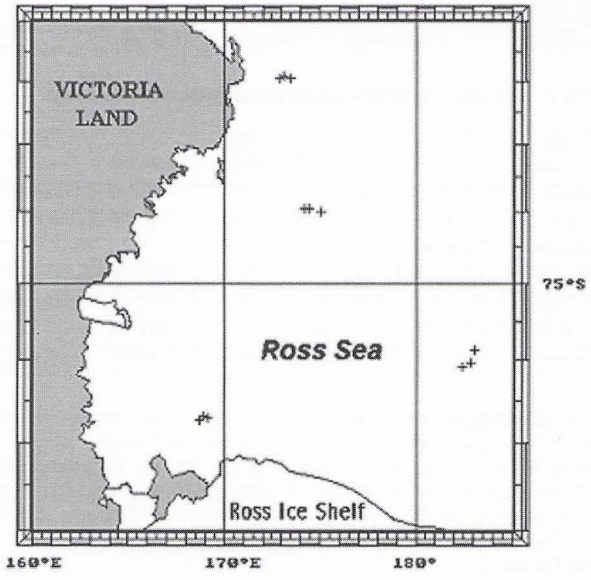

Fig. 1. Map of sampling locations.

Results and discussion

The ETS data points versus depth are shown in figure 2 together with the curves computed for Ross Sea and oceans. Microplankton ETS activity ranged from 0.012 to 0.139 µl O_2 $m^{-3}h^{-1}$ on a volume basis in the layer between 100 and 1000m.

ETS-based CDPR calculated in the Ross Sea, decreased with depth according to the power function:

$$CDPR\ (mg\ C\ m^{-3}d^{-1}) = 0.7207\ z^{-0.517},$$

where z is in meters, r^2=0.351 and n=73. The depth-integrated CDPR calculated by the above power function, amounted to 28,2 mg C $m^{-2}d^{-1}$ in the depth range 100-1000 m. Our CDPR later summer estimates were enclose in the range of ETS-derived $CDPR_{(200\text{-}1000m)}$ (21.8-105.6 mg C $m^{-2}d^{-1}$) determined in the Indian sector of Southern Ocean during early spring (6), but was 2,5 fold lower of their averaged CDPR.

In figure 2 the curve illustrating the above calculated function, is compared to those determined in the oceans (1). CDPR calculated in the Ross Sea were 3 and 7 fold lower than in the Atlantic and Pacific Oceans, respectively.

Finally comparing CDPR determined in this study with that obtained by sediment traps in the Ross Sea (5) resulted that about 63% of organic carbon remineralized by respiration derived from POC pool. Such enough large percentage should be too higher observing that daily sediment trap study was derived from an annual research while CDPR study regarded two months and neglected the remaining more poor months of year.

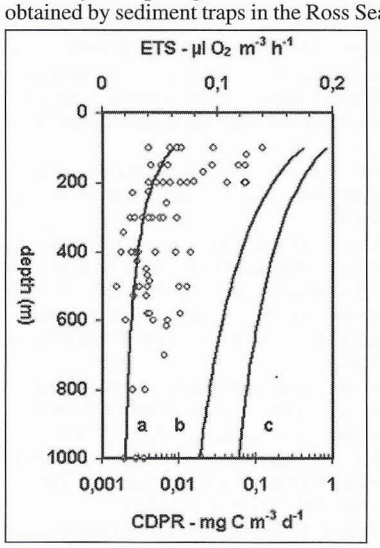

Fig. 2. ETS versus depth and comparison for the best-fit functions representing the depth dependence of CDPR in the Ross Sea (a), Atlantic Ocean (b) and Pacific Ocean (c).

Future studies on remineralization and the fate of organic matter of Ross Sea must primarly asses the amount of POC and DOC exported and oxidized in the deep sea and furthermore highlight the relationship between the very low flux of carbon through the DOC pool in the euphotic zone and the very high percentage of POC pool oxidized in the aphotic zone as registered in this study.

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