

DIATOM COMMUNITY IN THE DEPTHS OF THE SOUTH ADRIATIC: AN INJECTION OF CARBON BY BIOLOGICAL PUMP

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Abstract

Vertical distribution patterns of marine planktonic diatoms and the particulate organic carbon (POC) were investigated in the South Adriatic Pit in winter 2015. Diatoms were found in aphotic zone up to 400 m of depth, probably due to the phenomenon of the open sea vertical convection, but not followed by increased concentration of POC.

Keywords: *South Adriatic Sea, Deep waters, Diatoms, Carbon*

Introduction

Marine diatoms are the key players in the ocean carbon cycle and the sinking of cells after intensive bloom episodes is one of the proposed mechanisms for carbon injection by the biological pump. There is evidence of ubiquitous presence of healthy photosynthetic active diatoms across the global oligotrophic ocean at bathypelagic depths down to 4000 m [1]. Their vertical transportation rate is estimated to 124 - 724 m/day, i.e. time of few days to few weeks to reach the depths of the dark ocean [1]. A range of biological mechanisms can accelerate diatom cell sinking rates in situ such as formation of cell aggregates or by zooplankton faecal pellets, but also much faster physical mechanisms such as downwelling or wind-induced deep convection events. The general objective of this study was to analyse the distribution patterns of particulate organic carbon (POC) and couple it with diatom abundances in well mixed and highly dynamic situation during winter in the southern Adriatic Sea.

Methods

Sampling was carried out in March 2015 at 4 stations in the eastern part of the South Adriatic Pit: P600 42°24' N, 17°55' E; P1000 42°21' N, 17°47' E; M1000 42°21' N, 17°47' E; M600 42°27' N, 17°22' E. At each station CTD probe (SEA-Bird Electronics Inc., USA) casts were performed. The probe was additionally equipped with WET Labs FLNTU and Sea-Bird photosynthetically active radiation sensor (PAR). FLNTU was used to measure chlorophyll *a* (Chl *a*) fluorescence and turbidity that was converted to optical particulate backscattering (b_{bp}) needed for estimation of POC [2]. Water samples were collected by Niskin bottles at sampling depths indicated in Fig. 1A, determined *in situ* based on respective CTD profile. Sub-samples (200 mL) for phytoplankton analyses were preserved with hexamine-neutralized formaldehyde (final concentration of 1.4%). Cells were identified and enumerated using the Utermöhl protocol with the Zeiss Axiovert 200 inverted microscope.

Results and discussion

The surveyed area demonstrated circulation dependent high patchiness in distribution of surface Chl *a*. The analyses of satellite measurements obtained from MODIS satellite show a drop in surface chlorophyll for 20%, from Feb 20th to Mar 3rd 2015. The phenomenon of the open sea vertical convection, known for the South Adriatic Pit, is important due to the transport of nutrients from the deep reservoir into euphotic zone, enabling high phytoplankton production. Conversely, these events transport surface organic particles, including phytoplankton cells, to the deep sea at much faster rate than by regular sinking mechanisms. In our study, Chl *a* signal was detected up to 400 m depth (Fig. 1B), indicating recent subduction of the surface water. The measured PAR depths ranged from 66.5 to 74.5 m therefore the convective event brought phytoplankton cells down to the aphotic zone. The phytoplankton community at these depths was strongly dominated by diatoms found up to 500 m (Fig. 1A), corroborating findings from recent study by Batistic et al. [3]. These diatoms are referred to as "shade flora", a part of larger, deep dwelling phytoplankton community found up to 500 m of depth. Species of South Adriatic Pit "shade diatom flora" found at depths greater than 250 m are mostly large colonial forms such as *Pseudo-nitzschia pseudodelicatissima* (P600) with abundances up to 1900 cells L⁻¹, *Asterionellopsis glacialis* (M600) with 4500 cells L⁻¹ and *Thalassionema frauenfeldii* up to 380 cells L⁻¹ at M1000 and M600. However, high number of different single-celled pennate species was present in deep samples, preliminary identified as *Navicula cf. distans*, *N. cf.*

directa and species belonging to *Nitzschia cf. bicapitata* complex. Most of the members of "shade flora" found at great depths appeared in good physiological/morphological state indicating their recent origin from shallow waters as diatom cell viability can range from 6.8 - 24 days [1]. Such diatom cells would eventually die due to the lack of light necessary for photosynthetic processes, but their carbon load was transported to depths. The results from optical measurements showed that POC was generally low, but with a peak at 300 m depth at M600, not corresponding with either Chl *a* concentration or diatom abundances. These results indicate that the sources of POC are either heterotrophic organisms or marine snow aggregates. Herbivorous zooplankton was rather abundant in the surveyed area (D. Lucic, pers. comm.) and most likely consumed the great portion of the diatom biomass. These further enhanced the diatom transfer to depths via packaging in faecal pellets, and injecting the diatom carbon and silica to the bottom layers of the water column in the South Adriatic Pit.

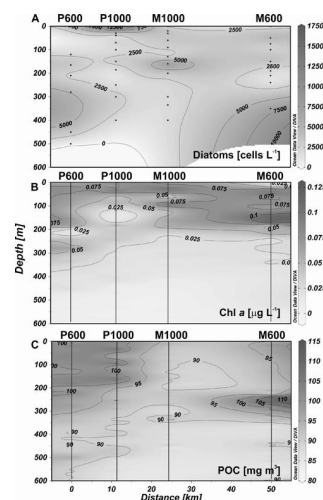


Fig. 1. Vertical distribution of: A) diatom abundances (sampling depths indicated with dots), B) chlorophyll *a* and C) POC.

Acknowledgements

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References

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