CARBON FLOW MEDIATED BY MICROBIAL COMMUNITIES IN THE EASTERN MEDITERRANEAN SEA

A. Zoppini [1]*, S. Amalfitano [1], S. Fazi [1], S. Tugrul [2], Z. Uysal [2] and A. Puddu [1]
[1] IRSA-CNR (Italy) - zoppini@irsa.cnr.it
[2] IMS-METU (Turkey)

Abstract

Planktonic microbial communities play an important role in controlling the CO_2 flux between the atmosphere and the ocean. C-uptake (primary and bacterial production) have been analysed more extensively than mineralization processes (community respiration). This has given rise to a gap for a complete knowledge of C-flux in the marine environment. The research activity conducted in the frame of the EU Project SESAME (WP 3.8.2) provided new data on biological processes in the Cilician Basin. This area showed the heterotrophic nature of the off-shore site (P/R<1) with the potential to represent a consisting CO_2 source.

Keywords: Bacteria, Primary Production

The net flux of CO_2 between the atmosphere and the ocean is mostly controlled by the balance among three key processes mediated by the microbial communities: 1) uptake by phytoplankton photosynthesis (CO_2 uptake) 2) mineralization processes (CO_2 emission) 3) export toward the ocean depths. Phytoplankton is responsible for roughly half of the CO_2 fixation on the earth and at least 50% of the fixed C is channelled through the microbial food web in the dissolved phase [1]. In pelagic ecosystems heterotrophic bacteria mediate a significant conversion of dissolved organic carbon to biomass, which is then transferred to the food web. Only a small fraction of this organic matter is buried in marine sediments being the bulk of the produced organic matter remineralised trough respiration [2]. As a consequence oceans can act as net source or sink of carbon depending on the production or decomposition of organic matter due to biological activities. Recent comparative studies have suggested that respiration may systematically exceed production in large areas of the oceans [3]. The E Mediterranean Sea is considered one of the most oligotrophic regions in the world, in terms of both primary productivity and autotrophic biomass [4]. The Cilician Basin occupies the NE part of the Levantine Basin (Fig.1) and so far no data on primary production, bacterial production and community respiration rates are available.

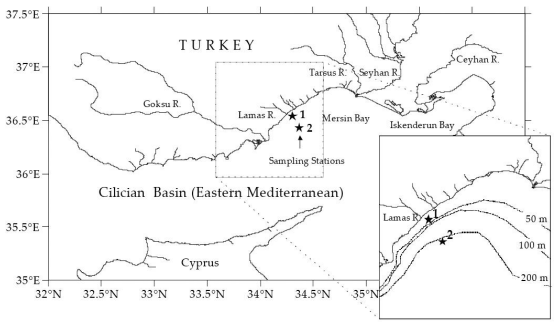

Fig. 1. Cilician Basin: location of samplig sites utilized in the EU project SESAME

To fill this gap, two short cruises (March 2008 and February 2009) have been carried out in the Cilician Basin, on board of R/V Bilim-2 of IMS-METU, and samples were taken from two sites representative of mid-shelf and offshore conditions. Depth profiles of the microbial community activities were analyzed in terms of primary production (PP, $NaH^{14}CO_3$ uptake), bacterial carbon production (BP, ^{3}H-leucine inc.) and community respiration (CR, changes in dissolved oxygen by Winkler method) along with bacterioplankton and phytoplankton cell abundances. Bacterial community composition was analyzed by CARD-FISH along with phytoplankton composition. The frequencies of cells with DNA de novo synthesis were determined by thymidine analog 5-bromo-2-deoxyuridine (BrdU). Chlorophyll a and nutrients were also analyzed along with organic matter concentration. Chemical parameters revealed the ultraoligotrophic conditions of these sites. Chlorophyll a reached the highest concentration (0.2 mg m^{-3}) in the mid-shelf station. In the off-shore site photosynthetic C-uptake accounted for 1.6-2.1 mmol C m^{-2} h^{-1} whereas bacterial C-uptake accounted for 0.03-0.08 mmol C m^{-2} h^{-1}. PP and BP rates measured in this survey were comparable with those reported for the near E Mediterranean areas [5-6] for the ultra-oligotrophic Cyprus Eddy and for the oligotrophic Cretan Sea, respectively. The C-release due to community respiration accounted for 3.5-17.3 mmol C m^{-2} h^{-1}. The mid shelf site differed for a higher C-uptake (PP 2.7-6.5 and BP 0.10-0.15 mmol C m^{-2} h^{-1}) and a lower C-release (CR 2.0-2.8 mmol C m^{-2} h^{-1}). The heterotrophic nature of the off-shore site is described by the PP/CR ratio <1. These preliminary results define this area as a potential CO_2 source.

References

1 - Ducklow H.W., Carlson C.A., 1992. Oceanic bacterial production, in "Advances in Microbial Ecology" (K.C. Marshall Ed.), Plenum Press, New York, Vol. 12: 113-181.

2 - Ducklow H.W., 1995. Ocean biogeochemical fluxes: New production and export of organic matter from the upper ocean. *Rev. Geophys. Suppl.*: 1271-1276.

3 - Duarte C.M., Agusti S., Aristegui J., Gonzales N., Anadon R., 2001. Evidence for a heterotrophic subtropical northeast Atlantic. *Limnol. Oceanogr*. 46(2): 425-428.

4 - Psarra S., Tselepides A., Ignatiades L., 2000. Primary productivity in the oligotrophic Cretan Sea: seasonal and interannual variability. *Prog. Oceanogr*. 46: 187-204.

5 - Psarra S., Zohary T., Krom M.D., Mantoura R.F.C., Polychronaki T., Stambler N., Tanaka T., Tselepides A., Thingstad T.F., 2005. Phytoplankton response to a Lagrangian phosphate addition in the Levantine Sea. *Deep-Sea Res*. II 52: 2944-2960.

6 - Van Wambeke F.V., Christaki U., Bianchi M., Psarra S., Tselepides A., 2000. Heterotrophic bacterial production in the Cretan Sea. *Prog. in Oceanogr*. 46: 205-216.