DINITROGEN FIXATION IN WESTERN MEDITERRANEAN SEA: A SIGNIFICANT NITROGEN INPUT FOR BIOGEOCHEMICAL BUDGET.

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Abstract
Nitrogen fixation (^{15}N method), investigated in the Northwestern Mediterranean Sea, was detectable all over the year with rates ranged from 2 to 17 nmoles.l^{-1}.d^{-1}. Highest values were obtained during spring associated with the phytoplankton bloom. High rates were also measured during the oligotrophic summer period. This biological nitrogen input could balance the annual biogeochemical budget in the Mediterranean Sea and could explain the high nitrate/phosphate ratio observed in deep waters.
Keywords : Gulf Of Lions, Cyanobacteria, Primary Production.

While any direct nitrogen fixation data are still unavailable, δ^{15}N data in settling particles suggest that dissolved atmospheric N_2 may act as a significant new nitrogen source in the Western Mediterranean basin[1]. To test this hypothesis, N_2-fixation experiments were carried out during 12 cruises in the Ligurian Sea at one station named DYFAMED (43°25'N, 7°52'E- MELISSA program, 2003-2004) and in the Gulf of Lions during the BIOPRHOFI cruise (May 2006). Dinitrogen fixation and primary production rates were simultaneously determined at surface or at 6 level depths using the dual labelling ^{13}C/^{15}N procedure.

Figure 1 reveals vertical profiles of nitrogen fixation observed along the year at the Dyfamed site. In autumn and winter, primary production rates were weak and variable while nitrogen fixation was very low (<2 nmoles.l^{-1}. d^{-1}) and often close to the detection limit (<0.5 nmoles.l^{-1}. d^{-1}). During the spring period, nitrogen fixation increased concurrently to primary production reaching 17 nmoles N.l^{-1}. d^{-1} in March 2003 and 4 nmoles N.l^{-1}.d^{-1} in April 2004. In summer, primary production rates were low, close to those measured in winter, while nitrogen fixation seemed to be more variable with high rates (>4 nmoles.l^{-1}. d^{-1}) measured in surface in July and August.

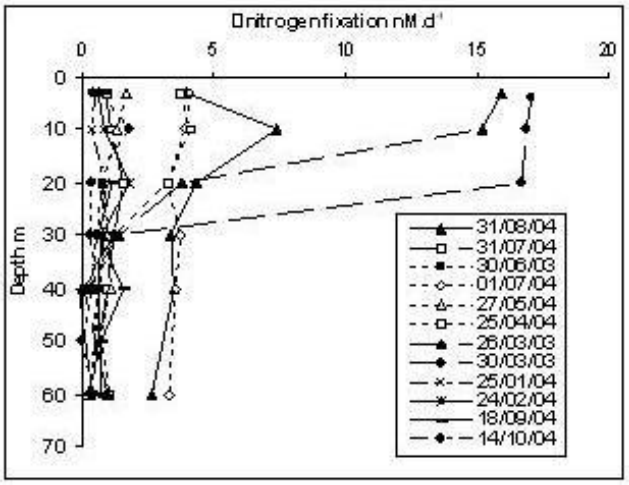

Fig. 1. Dinitrogen fixation vertical profiles in the 0-60 m upper layer obtained in the Western Mediterranean.

Areal dinitrogen fixation rates were around 40 to 100 μmoles N.m^{-2}.d^{-1}along the year, but could reach 400 μmoles N.m^{-2}. d^{-1}in spring. Dinitrogen fixation generally represented less than 5% of new production. But, under oligotrophic conditions, this process contributed significantly to new production, up to 40%. Data obtained during BIOPRHOFI confirm the importance of this process in the Mediterranean during spring: high rates (4 to10 nmoles.l^{-1}. d^{-1}) were measured in the total fraction, as well as in the less than 10 μm fraction.The calculated annual fixation rate (34 mmoles N.m^{-2}.year^{-1}) could have implications in the long-term biogeochemical functioning of the Mediterranean Sea as proposed by and Béthoux et al. (1998) [2]. According to the these authors, our annual budget of atmospheric N_2 fixation could balance the nitrogen budget for the whole Mediterranean Sea or for the western basin [3], and could explain in part the high nitrate/phosphate ratio observed in deep waters.

References

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