THE EFFECT OF NUTRIENTS AND IRON ADDITIONS ON THE PHYTOPLANKTON DYNAMIC IN THE NORTHWESTERN MEDITERRANEAN SEA

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Abstract

The impact of atmospheric inputs on phytoplankton dynamic was investigated in the Northwestern Mediterranean Sea. Using microcosms incubation experiments performed with surface seawater collected during the stratified period, we studied the impact of macronutrients, iron and Saharan dust on the primary production and composition of the phytoplankton community. By using taxonomic pigments as size class markers of phototroph groups we show that different degree of limitation control pico-, nano- and microphytoplankton growth. Considering the whole community, the primary production was maximum both when adding macronutrients and simultaneously macronutrients and iron suggesting that iron was not a limiting factor.

Keywords : atmospheric inputs, phytoplankton dynamic, iron limitation, taxonomic pigments.

Studying the impact of atmospheric inputs in the water column is essential to understand the biogeochemical cycles in the ocean. The atmosphere is actually an important way for the nutrients to enter the ocean. Indeed, it is one of the major sources of iron in the ocean and probably the dominant one (1).

The impact of atmospheric inputs on phytoplankton dynamic was investigated in the Northwestern Mediterranean Sea. The cruise took place the 1st and 2nd August 2003 at the permanent time-series DYFAMED station (France-JGOFS) (43°25'N, 07°52'E) in the Ligurian Sea. This station, located at 28 nautic miles off Nice, France, is an open-sea site (2350m depth) protected from coastal inputs by the presence of the coastal Ligurian current. This date were chosen because this is the period characterized by a stratified water column and a low primary productivity: during this period, the surface mixed layer is isolated from deeper waters, and the atmosphere is the main source of nutrients such as iron and phosphorus to the surface waters (2).

Incubation experiments were performed with surface seawater collected at 10 meter depth with acid-cleaned polyethylene tubes using an Osmonics solid Teflon diaphragm pump. Unfiltered seawater was transferred to 4L polycarbonate microcosms under a laminar flow hood. The 44 microcosms were immediately amended with Fe, N, P, Si, Saharan dust with different combinations reported in Table 1. One unamended treatment served as control. Each fertilization were realized in duplicates.

Table 1. Different combinations of additions in the microcosms. The concentrations of nutrients added were those encountered in the winter season in the mixed layer at the DYFAMED site in order to obtain non limiting conditions.

Additions	*Concentrations added*
+ Fe	2.5nM
+ N/P/Si	3µM/0.18µM/2.7µM
+ Fe/N/P/Si	2.5nM/3µM/0.18µM/2.7µM
+ Fe/P	2.5nM/0.18µM
+ Saharan dust	0.25mg.L^{-1}

By using taxonomic pigments as size class markers of phototroph groups we show that different degree of limitation control pico-, nano- and microphytoplankton growth. Considering the whole community, chorophyll *a* and primary production were both maximum when adding macronutrients and simultaneously macronutrients and iron, suggesting that iron was not a limiting factor (Fig. 1, Fig. 2). Indeed, the concentration of dissolved iron before additions was surprisingly high (1nM) as only a very small Saharan event have been recorded since the beginning of the stratified period. We suspect a 'fertilization' of the water column by the smokes originating from the huge biomass burnings that occurred in South of France and in Corsica at this time. This hypothesis was tested by analysing the concentrations of total iron and labile iron (dissolution experiments) in aerosols collected in Corsica and in South of France during this summer.

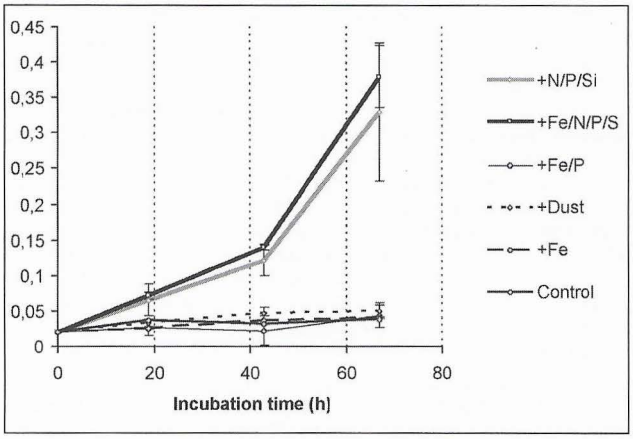

Fig. 1. Concentrations of Chlorophyll-a in the course of the incubation. The error bar represents the standard deviation from duplicates incubations.

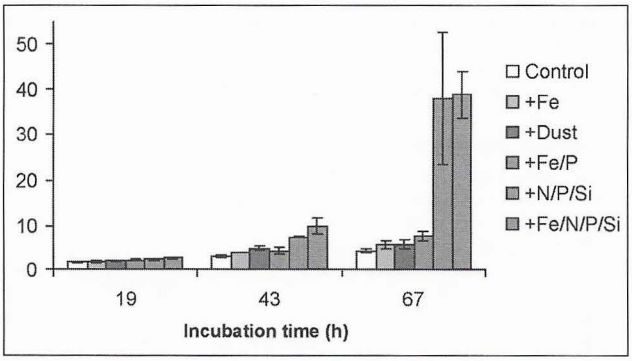

Fig. 2. Primary production along the time of incubation. The error bar represents the standard deviation from duplicates incubations.

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