CELL LYSIS DURING COCCOLITHOPHORID BLOOMS IN THE NORTHERN BAY OF BISCAY

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INTRODUCTION

Phytoplankton cell lysis occurs in natural populations and is often associated with viral activity and zooplankton grazing. Cell lysis rates are expected to increase towards the decaying phase of the bloom and may be associated with enhanced microbial activity and export of particulate matter to the seafloor.

In the framework of the Belgian Federal Science Policy Office project PEACE (Role of pelagic calcification and export of carbonate production in climate change, http://www.co2.ulg.ac.be/peace), field investigations, supported by remote sensing data, were conducted in recent years during late spring in the Northern Bay of Biscay, where frequent and recurrent coccolithophorid blooms are observed.

Cell lysis rates were determined in surface waters based on the method of Riegman et al. (2002). Estimation of the lysis rates was based on the measurement of esterase (a cytoplasmic enzyme) activity expected to appear in the water only after cell breakage. Other relevant biogeochemical parameters (temperature, particulate organic and inorganic carbon, transparent exopolymer particles, nutrients, chlorophyll a,…) were followed at different depth of the water column in order to investigate phytoplankton dynamics in relation to coccolithophorid development. We present results from the first and the second PEACE cruises carried out in June 2006 and May 2007.

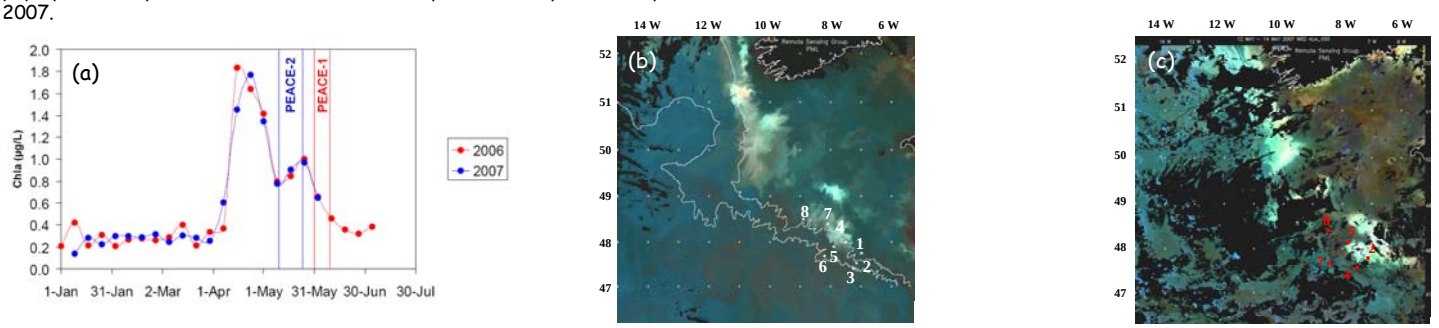

Fig. 1: (a) Chlorophyll-a (Chl-a) concentrations (µg L^{-1}) over time for 2006 (red) and 2007 (blue) from SeaWifs images, Lat=[47.0°N,49.0°N], Long=[9.0°W,6.0°W] (Courtesy of A. V. Borges); Locations of the sampling stations on a reflectance satellite images (b) on the 5th of June 2006 (c) on the 14th of May 2007 in the northern Bay of Biscay (Courtesy of Steve Groom). The high reflectance patches are represented by blue-white areas on the reflectance image.

RESULTS AND DISCUSSION

The Seawifs Chl-a in the study area indicate that seasonal cycles of phytoplankton biomass were remarkably similar in 2006 and 2007 (Fig. 1a). The first Chl-a peak is associated to diatoms while the second peak is associated to coccolithophorids. During both cruises, an extensive bloom of coccolithophore was observed at the shelf break in the northern Gulf of Biscay as represented on the reflectance images as blue white areas (Fig. 1b for 2006 and 1c for 2007).

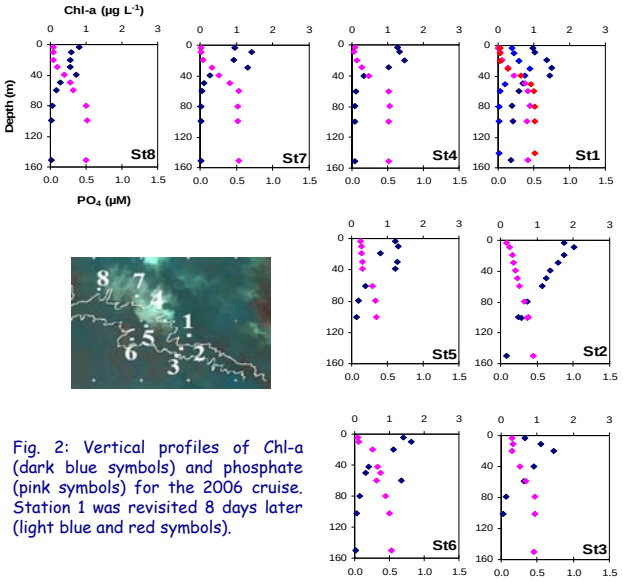

Fig. 2: Vertical profiles of Chl-a (dark blue symbols) and phosphate (pink symbols) for the 2006 cruise. Station 1 was revisited 8 days later (light blue and red symbols).

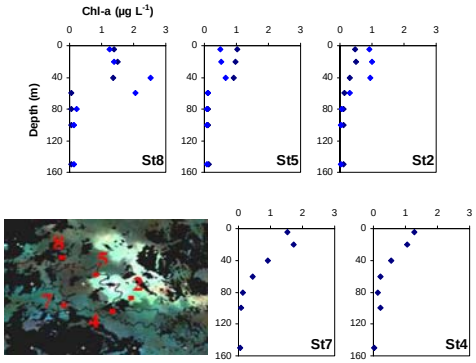

Fig. 3: Vertical profiles of Chl-a for the 2007 cruise. Station 8, 5 and 2 were revisited during the 2nd leg (light blue).

Figure 2 (blue symbols) shows the vertical distributions of Chl-a concentrations, measured by fluorimetry in 2006. The Chl-a exhibited higher concentrations in the upper 40 m of the water column. Phytoplankton development in surface waters had led to the depletion in phosphate with concentrations close to 0 at surface at several stations (Fig. 2). A similar vertical distribution of Chl-a concentrations can be observable in the 2007 cruise (Fig. 3).

The lysis rates measured within these surveys match with values previously described by Riegman and Winter (2003) after a spring bloom in the North Sea. The highest lysis rate was measured at station 1bis in 2006, associated with low Chl-a concentration in surface waters, which corresponded probably to the grazing/viral lysis activity and the decline of the coccolithophore bloom at this station. This value is significantly higher than other estimates during both cruises but agrees with the values reported for a stratified Mediterranean Bay (Agusti and Duarte, 2002). In 2007, values of lysis rate were relatively high and most probably due to the end of a diatoms blooms. At station 8b, 8 days after the initial visit, conditions did not change significantly. The results suggest the importance of cell lysis as an important loss factor for phytoplankton in spring in the Northern Bay of Biscay.

Table 1: Dissolved esterase activity and cell lysis rate for the June 2006 and the May 2007 cruise in the Bay of Biscay

Cruise	Station	DEA (d^{-1})	Lysis rate (d^{-1})
PEACE 2006	2	44.634	0.320
	4	52.176	0.253
	8	38.537	0.318
	7	51.216	0.178
	1b	26.649	1.339
PEACE 2007	5	31.907	0.582
	8	23.166	0.543
	8b	36.951	0.410

References: Agusti, S., and C. M. Duarte. 2000. Strong seasonality in phytoplankton cell lysis in the NW Mediterranean littoral. Limnol. Oceanogr. 45(4): 940-947; Riegman, R., J. D. L. van Bleijswik, and C. P. D. Brussaard. 2002. The use of dissolved esterase activity as a tracer of phytoplankton lysis. Limnol. Oceanogr. 47: 916-920; Riegman, R., and C. Winter. 2003. Lysis of plankton in the non-stratified southern North Sea during summer and autumn 2000. Acta Oecologica 24: S133-S138.

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