Cell cycle of *Emiliania huxleyi* under enhanced atmospheric CO_2 and its relation to calcification

IFM-GEOMAR
Leibniz-Institut für Meereswissenschaften an der Universität Kiel

M. N. Müller, A. N. Antia, J. LaRoche and U. Riebesell

Leibniz Institute for Marine Sciences; Kiel, Germany

Contact: mnmueller@ifm-geomar.de

Introduction

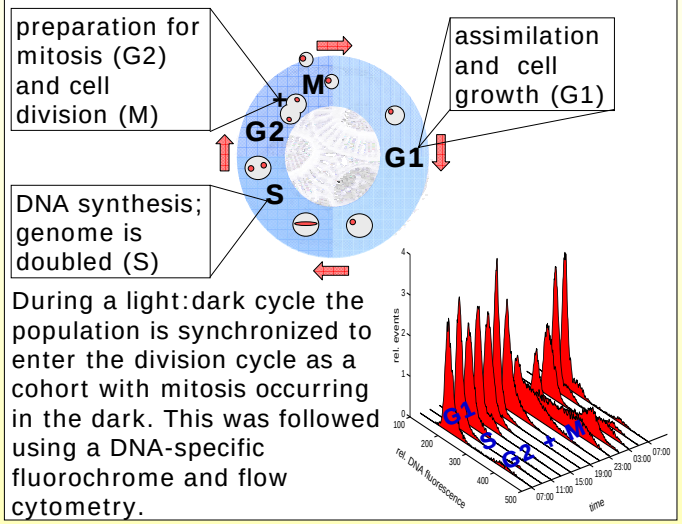
The coccolithophorid *Emiliania huxleyi* is a cosmopolitan, bloom-forming unicellular calcifying alga. It plays an important role in the marine carbon cycle because calcification shifts the carbonate system towards CO_2 and therefore counteracts the effect of CO_2 fixation by photosynthesis.

In this study we investigated calcification in relation to the cell cycle of *Emiliania huxleyi* using batch cultures under a 12h:12h light:dark cycle. The influence by growth limiting factors on calcification and the cell cycle was examined under continuous light in controlled lab experiments.

Additionally, the cell cycle was followed during the PeECE III mesocosm study under three different CO_2 concentrations (380 ppm, 750 ppm and 1150 ppm).

If calcification is restricted to one or more specific phases of the cell cycle an influence on the cell cycle by either rising CO_2 concentrations or certain limitations may alter the degree of calcification in coccolithophores.

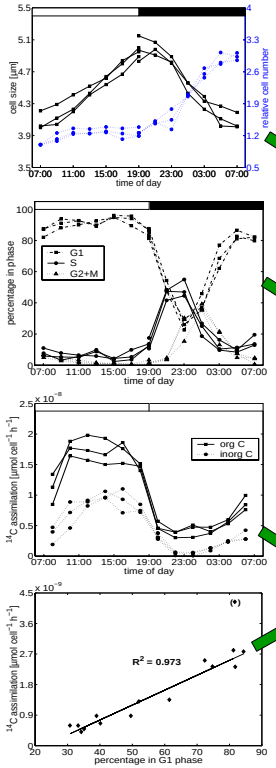
The cell cycle



During a light:dark cycle the population is synchronized to enter the division cycle as a cohort with mitosis occurring in the dark. This was followed using a DNA-specific fluorochrome and flow cytometry.

Lab results

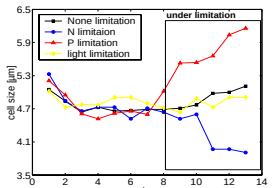
Cell cycle experiments



LIGHT	DARK
In the light, cells grow in size. High N:P uptake ratio (17:1)	In the dark, cell division takes place. Low N:P uptake ratio (6:1)
In the light, cells are predominantly in G1	In the dark, a cohort of cells enter S, complete G2+M and return to G1
Calcification is tightly linked to the % of cells in G1	

CALCIFICATION OCCURS DURING THE G1 PHASE OF THE CELL CYCLE

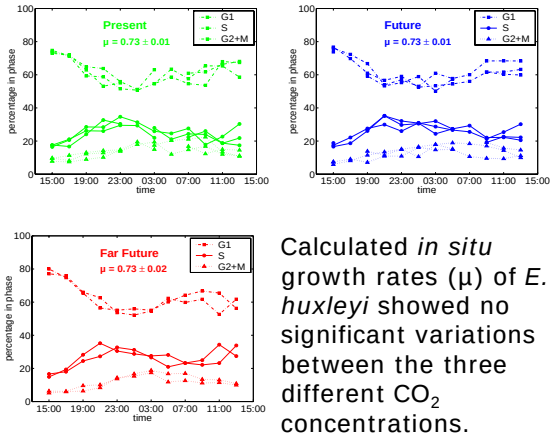
Limitation experiments



Limitation	% in G1	Ca [pg cell^{-1}]	PIC:POC
Without	75	120	0.35
Nitrogen	88	147	1.27
Phosphate	87	705	1.30
Light	77	121	1.08

PIC = particulate inorganic carbon
POC = particulate organic carbon

Field results



Calculated *in situ* growth rates (μ) of *E. huxleyi* showed no significant variations between the three different CO_2 concentrations.

Conclusions

- No significant effect of enhanced CO_2 on the cell cycle of *E. huxleyi*
- Calcification is linked to the G1 phase
- In the light: high demand for N ⇒ assimilation processes and energy storage
- In the dark: high demand for P ⇒ DNA synthesis
- Cells arrest mainly in G1 under limitation of N or P but for different reasons