PEACE

Role of pelagic calcification and export of carbonate production in climate change

DURATION OF THE PROJECT
Phase 1: 15/12/2005 – 14/12/2007
Phase 2: 15/12/2007 – 31/01/2010

BUDGET
1.059.650 €

KEYWORDS
Calcification, carbon dioxide, dimethyl sulfide, marine carbon cycle, ocean acidification, climate change

CONTEXT

Carbon dioxide (CO_2) is one of the most important greenhouse gases. Due to human activities, the atmospheric CO_2 concentration has recently been increasing at an alarming rate, leading to global warming. The oceans, covering two-thirds of the earth surface, play an essential role in the global carbon cycle, and have been shown to absorb more than one-third of the anthropogenic CO_2. The uptake of excess CO_2 not only disrupts the marine carbon cycle and ecosystems, but also leads to acidification of the seawater. This process has adverse effects on various important groups of marine organisms such as coccolithophores and corals that form calcareous skeletons ($CaCO_3$). There is an urgent need to understand the interaction between the functioning of marine calcifiers and climate change in the light of altering ocean chemistry, in particular ocean acidification.

PROJECT DESCRIPTION

Objectives

The overall objective of the PEACE project is to evaluate the role in climate regulation of calcification, primary production and export processes during blooms of coccolithophores, an important group of calcifying phytoplankton. We aim specifically

1) to study the net ecosystem dynamics during these blooms
2) to unravel the link between the bacterial community, grazing, transparent exopolymer particle (TEP) dynamics, carbon export and dimethyl sulphide (DMS) cycling
3) to assess the effects of ocean acidification on coccolithophore metabolism and TEP production and
4) to model coccolithophore dynamics and their impact on ocean dissolved inorganic carbon (DIC) chemistry

Methodology

We will use a transdisciplinary approach that combines process-oriented field investigations with laboratory experiments and modelling tools.

Field investigations, supported by remote sensing data, will be conducted in the Northern Bay of Biscay (one of the main coastal European marine areas) where coccolithophore blooms are regularly observed. This region has been visited by the Belgian biogeochemistry community since the late 1980s within the framework of the PPS Science Policy "Global Change" and SPSD-II "Climate" programmes, and the EU OMEX I and II projects. Long-term series of physical, biological and chemical variables are available for model validation. A suit of fundamental physico-chemical variables will be measured in the water column. In addition, during both field and laboratory studies, attention will be paid to determine key parameters of calcification and associated processes such as algal characterization and bacterial community structure and diversity, rate of organic and inorganic carbon production, degradation and export, and air-sea exchange of CO_2 and DMS. The role of TEP in CO_2 sequestration during coccolithophore blooms will be evaluated as well.
Synthesis of the acquired data and future projections in relation to increasing pCO_2 and ocean acidification will be achieved through a biogeochemical model that will explicitly describe the DIC and coccolithophore dynamics (primary production, calcification, $CaCO_3$ and organic carbon export). The model will be specifically tuned with the newly and previously acquired field and laboratory data and will be coupled with a hydrodynamic model of the region.

INTERACTION BETWEEN THE DIFFERENT PARTNERS

All partners participate in field investigations in the Northern Bay of Biscay and are involved in laboratory culture experiments designed to study the impact of ocean acidification on coccolithophore metabolism and TEP production. They all contribute to the modelling work.
The coordinator, ULB-LOCGE, will focus its efforts on studying processes controlling primary production and calcification, as well as pelagic $CaCO_3$ dissolution. In addition, attempts will be made to evaluate the DMS cycling. It is also responsible for batch culture experiments and organisation of cruises.
ULg-COU will devote its activity to air-sea exchange, ocean

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DIC dynamics, pelagic and benthic organic carbon degradation and benthic $CaCO_3$ dissolution. It is also responsible for hydrodynamic-ecological modelling and for the maintenance of the project's website.
UGent-PAE will concentrate on the phytoplankton and zooplankton dynamics. It will also study bacterial community structure, its relationship with TEP dynamics and the impact of grazing on the dynamics of the microbial ecosystem.
AWI-Glo Car group is responsible for the study of TEP dynamics, including their abundance and production. The size spectrum of the dissolved precursors will in addition be characterised. It also takes the lead in chemostat experiments of coccolithophore cultures.

Link with International Programmes

The PEACE project is closely linked to the following international programmes of the IGBP (International Geosphere-Biosphere Programme) and SCOR (Scientific Committee on Oceanic Research): SOLAS (The Surface Ocean - Lower Atmosphere Study), IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) and GLOBEC (Global Ocean Ecosystem Dynamics). All aims at a better understanding of the key biogeochemical-physical interactions and feedbacks between the ocean and the atmosphere in the context of climate and environmental change.

EXPECTED RESULTS AND/OR PRODUCTS

The present project will contribute to a better understanding of the response of the marine calcifying ecosystems to ocean acidification and climate change, as well as the associated feedback mechanisms. Data produced in the project could be used in models to establish future scenarios related to changing ocean chemistry and global warming.

PARTNERS - ACTIVITIES

Université Libre de Bruxelles (ULB) - LOCGE
has a long-standing expertise in biogeochemical cycles of organic carbon, carbonate and nutrients in aquatic systems. It specialises in kinetics of water-mineral interactions and developments of methodologies in the field of aquatic and sedimentary geochemistry.

Université de Liège (ULg) - COU
has a broad expertise in the DIC cycle and related air-sea CO_2 fluxes in the coastal zone and open ocean and in biogeochemical modelling.

Universiteit Gent (UGent) - PAE
specialises in ecophysiological, molecular and genetic investigations of microbial eukaryotes (protists).

Alfred Wegener Institute for Polar and Marine Research (AWI) - Glo Car group
has an extensive experience in marine carbon cycle and particularly in marine aggregate studies.

CONTACT INFORMATION

Project website:
www.co2.ulg.ac.be/peace/

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Follow-up Committee

For the complete and most up-to-date composition of the Follow-up Committee, please consult our Federal Research Actions Database (FEDRA) by visiting http://www.belspo.be/fedra or http://www.belspo.be/ssd

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