CALMARS II

Critical evaluation of marine calcareous skeletons as recorders of global climate changes

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

BUDGET
1.099.867€

KEYWORDS
Palaeoclimate, Carbon Cycle, Climate Change, Sea Surface Temperature

CONTEXT

To determine the appropriate responses to climate changes, we should improve our knowledge of the respective impacts of natural multidecadal climate variability and of human-induced climate changes. Our previous project (CALMARS 2001-2005) demonstrated that CALcareous MARine Skeletons of marine invertebrates can be used as environmental recorders, since they integrate ecological information without interruption from various time scales. Those skeletons will help reconstructing climate evolution and producing a predictable model for the future. However, because the composition of biogenic carbonates is also clearly influenced by biological factors, the correct interpretation of these chemical archives requires a precise understanding of the processes controlling the incorporation of elements, and hence, biomineralization.

PROJECT DESCRIPTION

Objectives

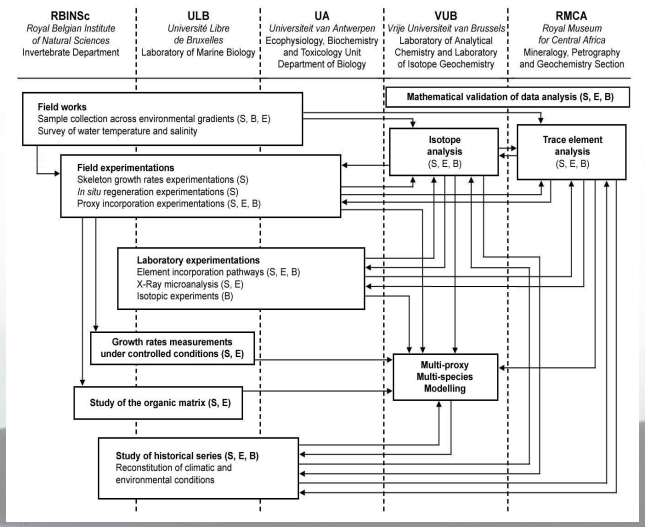
Five Belgian institutions have set up a project aiming to produce a predictive mathematical model using climatic data recorded by calcareous skeletons from three different taxa of marine invertebrates. These taxa, selected for their contrasted characteristics (lifetime, growth rate, etc.), are hypercalcified sponges, bivalves, and echinoderms. The originality of this project resides in four new perspectives:

1) A better understanding of biomineralization and pathways of element incorporation in the skeleton that will increase the confidence in the proposed proxies.
2) The study of the new proposed proxies will improve the separation of salinity and temperature signals (δD in the skeleton organic matrix) and offer an insight in the levels of river discharges and the associated weathering processes (δMg in the carbonate).
3) A precise understanding of the barium signal in carbonates will give the keys to describe the estuarine barium cycling, an important aspect for the oceanic Ba proxy.
4) Our multi-specific and multi-proxies model of climatic reconstitution will clarify the reconstitutions carried out to date and, for example, allow a deconvolution of temperature and salinity signals, which commonly act on the same proxy.

Methodology

CALMARS II approach is based on a combination of field work, laboratory experimentation and mathematical modelling. Field work implies regular sampling of specimens from selected sites of the North Sea and the Mediterranean Sea. Environmental conditions are continuously monitored at the same locations in order to define the influences of the seasonal variations on the skeleton formation. Specimens are also collected along environmental gradients to define relationships between proxies recording and environmental parameters. Selected proxies are analyzed by high resolution Laser-ablation ICP-MS. For each group, the influence of environmental parameters on skeletal growth rates is investigated in laboratory and on the field. *In situ* experiments of regeneration are carried out during the same periods. The pathways of proxy incorporation are studied in laboratory after addition of radioactive isotopes. The role of the organic matrix in the processes of biomineralization is also considered. A mathematical model will be deduced after data integration. The analysis of historical specimens from Museum collections will validate this model and lead to paleoclimate reconstitutions.

INTERACTIONS BETWEEN THE DIFFERENT PARTNERS



S = hypercalcified sponges; B = bivalves; E = echinoderms.

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EXPECTED RESULTS AND/OR PRODUCTS

CALMARS II aims at improving and extending the records of global change in the oceanic domain with a peculiar interest for the climate databases. Through a network of biologists and geochemists of complementary experience, *CALMARS II intends to:*

1) Improve the comprehension of the mechanisms of calcification and the physiological and biological effects related to incorporation of proxies in the skeleton of hypercalcified sponges, bivalves and echinoderms
2) Develop a multi-proxy approach permitting to distinguish the signals from temperature and salinity and to reconstruct the evolution of these parameters on the basis of fossil specimens
3) Understand the specificities of the barium (Ba) proxy to reconstruct Ba inputs from estuaries back through time, contributing to a better interpretation of the oceanic paleoproductivity and paleoalkalinity
4) Develop a Toolbox software from a multi-species multi-proxy approach. This software will present three applications:
   a) Optimize the empirical relations between the environmental proxies and the parameters
   b) Infer paleoclimates on the basis of proxy data sets
   c) Detect artefacts (e.g. aberrant data, breakdowns, digenesis, etc.) using new mathematical tools

Development of educational aspects from this research is planned. It implies the regular update of the web site set up during the CALMARS project (2001-2005) to describe the principal developments of this second project.

PARTNERS - ACTIVITIES

RBINSc
has a long experience on Caribbean sclerosponges (ultrastructure and *in situ* growth rate measurement). Its implication in the *CALMARS* project *(2001-2005)* increased its expertise in the biomineralisation processes of hypercalcified sponges.

ULB
has a large experience in biomineralization processes of echinoderms through morphological, biochemical, physiological and environmental approaches, both in the field and in the laboratory.

UA
performs research on bioavailability, bioaccumulation and effects of metals in aquatic organisms and studies effects of environmental conditions on kinetics of metal accumulation.

RMCA & VUB-DSCH have developed together expertise for trace element analysis by Laser Ablation ICP-MS.

VUB-DGLG
has a long-standing experience in stable isotope geochemistry as applied to climate change.

CONTACT INFORMATION

Project website:
http://www.vub.ac.be/calmar/index.html

Coordinator

Philippe Willenz
Royal Belgian Institute of Natural Sciences (RBINSc)
Department of Invertebrates
Rue Vautier 29, B-1000 Brussels
Tel: +32 (0)2 627 42 53
Fax: +32 (0)2 627 41 41
philippe.willenz@naturalsciences.be
www.naturalsciences.be

Promoters

Luc G.R. André
Royal Museum of Central Africa (RMCA)
Section Petrography-Mineralogy-Geochemistry
Leuvensesteenweg 13
B-3080 Tervuren
Tel: +32 (0)2 769 54 59
Fax: +32 (0)2 769 54 32
lucandre@africamuseum.be
www.africamuseum.be

Philippe Dubois
Université Libre de Bruxelles (ULB)
Marine Biology Laboratory - CP 160/15
Avenue F.D. Roosevelt 50
B-1050 Brussels
Tel: +32 (0)2 650 28 39
Fax: +32 (0)2 650 27 96
phdubois@ulb.ac.be
www.ulb.ac.be/sciences/biomar/

Frank Dehairs
Vrije Universiteit Brussel (VUB)
Analytische en Milieuchemie (ANCH)
Pleinlaan 2
B-1050 Brussel
Tel: +32 (0)2 629 32 60
Fax: +32 (0)2 629 32 74
fdehairs@ vub.ac.be

Ronny Blust
Universiteit Antwerpen (UA)
Department of Biology
Ecophysiology, Biochemistry and Toxicology Group
Groenenborgercampus
Groenenborgerlaan 171
B-2020 Antwerpen
Tel: +32 (0)3 265 03 44
Fax: +32 (0)3 265 04 97
ronny.blust@ua.ac.be

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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Belgian Science Policy • Wetenschapsstraat 8 Rue de la Science • B-1000 Brussels
Tel. +32 (0)2 238 34 11 • Fax +32 (0)2 230 59 12 • www.belspo.be/ssd
Contact: Martine Vanderstraeten