7th call for proposals, 2010

Darwin Center for Biogeosciences

1. Darwin Center Mission

The Darwin Center has the following mission, which governs all its activities:

The Darwin Center aims to advance Biogeosciences through focused research on biosphere-geosphere interactions in the geological past and present. Through excellence in science, the Center will be highly visible and attract excellent local and foreign students. The Center will stimulate dissemination of Biogeosciences, and the enhanced visibility should lead to increased co-operation with industrial and societal partners.

2. Aims of the Darwin Center and background to this call

Within the Darwin Center we seek to advance knowledge and understanding of:

1. Biogeochemical dynamics of System Earth;
2. Biological proxies to better achieve paleoenvironmental reconstructions.

Firstly, these two themes have in common that they both require intensive co-operation between earth scientists and biologists, and that Dutch research groups play a prominent role in each theme. The potential for co-operation at the interface of Earth and Life Sciences is still strongly under-exploited in the Netherlands.
Secondly, biogeochemical cycling is at the base of the functioning of our planet, and human action is rapidly impacting on its natural course. We are far from understanding how biogeochemical cycles are regulated and how possible feedbacks operate, have operated in the past and will operate in the future. If we can reconstruct how these cycles have changed, and what has controlled them during the geological past we can make a proper evaluation of current feedbacks that control or further disrupt biogeochemical cycles. Accurate paleo-environmental reconstructions, specifically for periods of rapid change, are of paramount importance. To obtain these, more and better constrained proxies are required, and consequently there is an urgent need for the biological validation of proxies.

This call will be open for both Darwin Center themes, the text of which is appended to this call. This is the last call for proposals of the Darwin Center based on the now available resources. The aim is to fill the last 10 positions by granting 5 program proposals, each of 2 fte (see under (4)).

3. Application procedure and time frame

Digital versions of the program proposals should be sent to the Darwin Center Office. A signed hard copy should also be submitted <u>no later than one week</u> after the deadline for digital submission.

The time frame is as follows:

Steps in procedure	*No later than*
Call for proposals	January 15, 2010
Deadline for submissions	**April 15, 2010, 12.00 hours**
Individual reviews by panel members	Week 17, 2010
Rebuttals	Week 19, 2010
Meeting of review panel	Week 20, 2010
Meeting of steering committee	Week 22, 2010
Final decision by Board	Week 24, 2010
Start of projects	As soon as possible

4. Project evaluation and selection

Monodisciplinary projects will not be funded. In order to achieve the Darwin Center's mission, proposed research programs should involve biosphere-geosphere interactions and have an interdisciplinary character. Collaboration between disciplines should ideally be sought within the Center itself in order to strengthen the Center's function as a meeting point for scientists involved in biogeological research. Groups from outside the Darwin Center may be invited to collaborate, however. The institutions to which these external groups belong must agree to comply with the Center's rules for financial matching (see Darwin Center web site for matching rules for this specific call).

Applications should include a detailed description of the research program as a whole, as well as the individual projects, and should be submitted in a format used by NWO-ALW (Netherlands Organization for Scientific Research, division Earth and Life Sciences). Application forms can be downloaded from the web site. For this call a program will involve two positions to be funded by the Darwin Center in case of 50-50 matching; or one position in case of post-post matching (see the web site for detailed rules for matching for this call). The biogeological character of the proposed program should be evident; in addition, the application should discuss the added value of combined biological and geological research.

The Managing Director and the Darwin Center Office will establish a review panel, consisting of four to six members (preferably from outside the Netherlands), both biologists and earth scientists. Reviews will be provided by at least two experts on the basis of a list of criteria that will include:

1) Scientific value (innovation, feasibility, interdisciplinarity);
2) Thematic fit and biogeological significance of the proposal;
3) Cohesion of the research within the program and the added value of the intended collaboration.

A minimum of two full reviews is required before a decision on funding can be made. The panel members with the most relevant experience in the area of proposed research will be requested to prepare full reviews by assessing an application on the basis of the above criteria; and to give a score on a scale of 1 to 5 (1 = excellent, 2 = very good, 3 = good, 4 = reasonable or 5 = poor). The panel members will also provide an overall opinion on all submitted proposals. The main applicant will receive the full reviews via the Darwin Center Office and will have one week to submit a rebuttal.

At the panel meeting the review panel will agree upon an overall assessment for each proposal, for which the rebuttals will also be taken into account. Lastly, the panel will rank all proposals and state whether or not they are considered fundable. The Darwin Steering Committee will review the panel's rankings and, on the basis of the full application round, will advise the Darwin Center Board which proposals should be awarded a research grant.

5. Criteria for applications

Given the above, programs submitted must meet at least the following conditions:

1. Proposals submitted should involve at least one group participating in the Darwin Center, and apply for two Darwin Center positions in case of 50-50 matching, or one Darwin Center position in case of position-position (post-post) matching (for further information see matching rules on the web site);
2. Proposed programs should involve interaction and/or feedback between biological and earth system components;
3. Proposed programs should address biogeosphere interactions in the geological past and the present, and/or the coupled dynamics of living and non-living compartments.

6. Proposal themes

Descriptions of the Darwin research themes 1 and 2 are appended to this call. Reviewers are specifically asked to assess how successfully a program proposal matches the scientific scope of the Darwin Center, based on the descriptions of the research themes of the Darwin Center and the highlights mentioned above.

7. Budgets

Budgets should cover salary costs calculated in accordance with fixed norms (from July 1st, 2009 and based on 1,0 fte: PhD student: k€200 for four years / Postdoc: k€200 for three years, all including matching). Funding will be granted only for PhD students and/or postdocs; requests for non-scientific personnel will be excluded. A fixed fee (€5000 a year, including matching) can be claimed for miscellaneous items, without any further explanation being required.

8. Matching rules

The rules for matching can be downloaded separately from the Darwin Center's web site.

9. Who can submit proposals?

Only Darwin scientists can submit program proposals; a maximum 50% of the available positions can be awarded to researchers from institutes not formally participating in the Darwin Center.

10. Contact

For further information, please contact dr. Tanja Kouwenhoven, Darwin Center for Biogeosciences, Email t.kouwenhoven@geo.uu.nl; Phone +31-(0)30-2535169; or send an Email to darwinfo@geo.uu.nl.

Research Themes of the Darwin Center

Theme 1 Biogeochemical dynamics of System Earth

Background:

(Micro-) organisms govern virtually all geochemical cycles at the earth's surface and have major consequences for heat balance, water flow and sediment transport and stability, which in turn govern the dynamics of organisms and communities. An understanding of the transformation processes carried out by (micro-) organisms is consequently essential for a meaningful analysis and quantitative description of the biogeochemical dynamics of System Earth. Microbial life has colonized every habitat on the planet by using virtually every thermodynamically favorable redox couple. This accomplishment reflects a fundamental linkage between genome evolution and the geochemical environment. The evolution of life on Earth has not only been shaped by changing environmental conditions determined by geological forces, but life itself has played a decisive role in this process through its impact on the biogeochemical cycling of key elements (C, H, N, O, P, S, Fe, Si). This indicates that, for a full understanding of the evolution of life, we need to reconstruct the rise and, in some cases, decline of the key players in biogeochemical cycling.

Organisms are subject to changing environmental conditions, but in turn may also influence environmental conditions, both in the geological past and at present. Global warming may cause melting of permafrost, changes in plant communities and changes in methane and carbon-dioxide fluxes, which in turn may affect global climate. Similarly, climate changes may affect aquatic systems, with consequences for the production and exchange of climate-active gases such as carbon dioxide, methane, nitrous oxide and dimethylsulfide. Warming of oceans and lakes has consequences for dissolved oxygen inventories, while high atmospheric carbon dioxide induces ocean acidification, with consequences for marine organisms, in particular calcifiers, and global biogeochemical cycles. Both hypoxia and ocean acidification have occurred in the geological past and are of societal concern at present.

System Earth has experienced major environmental changes in the past, some of them abrupt due to external forces and some of them abrupt due to internal feedbacks, while others have been more gradual. Organisms and communities have shown differential sensitivity (in terms of loss) and differences in resilience (in terms of recovery from major environmental disturbances), both in the geological past and in the present time. The role of organisms in system recovery and the re-establishment of ecosystem functioning requires integration of studies on recent and past community dynamics.

Challenges

The application of molecular techniques will deepen our fundamental understanding of the coupling between (micro-) biology and biogeochemistry. Molecular biological approaches will allow us to identify the key players in biogeochemical cycles and to study the responses of microbial communities to environmental changes. Through the combination of activity measurement and molecular tools it may be possible to link microbial activity and biogeochemical fluxes with the identity of the organisms involved. Such knowledge is essential when developing the next generation of predictive models for global and regional biogeochemical cycling.

How do climate and environmental change (warming, changes in precipitation patterns, higher N and S deposition, elevated carbon-dioxide levels) affect ecosystems and their functioning and how do changes in ecosystems feed back (via, for example, emission of climate-active gases) on climate change? Although there is some information on individual components of climate change, we have little if any understanding of compensating mechanisms and synergetic effects. For instance, aquatic systems are subject to elevated atmospheric carbon dioxide and global warming and we have to collect knowledge on the combined effects on organisms and ecosystems. The two-way interactions between organisms and biogeochemical cycles operate on micro-, macro-, and mega-scales. Ecosystem engineers (i.e. organisms that substantially modify the physical structure or material flows of their habitat, and thus directly or indirectly change the availability of resources to other species) can have a major impact on the appearance (pattern formation) and functioning of ecosystems. Vegetation and animals, for instance, can modify water flow and in that way optimize their performance and influence other organisms and biogeochemical cycles. Bacteria, algae and metazoans can also influence sediment deposition and erosion and thus shape their local environment. Microbial mats may or may not induce calcification and we have little understanding of the governing factors.

Most environmental changes imposed on ecosystems are gradual (carbon-dioxide increase, global warming etc.); yet recent and historical observations and the geological record show that gradual changes in forcing can over time result in abrupt and major (and sometimes even catastrophic) changes in community structures. It is important to identify whether tipping points exist (a certain critical carbon-dioxide level, for example) and whether these tipping points may be deduced from the geological record or from experimental and modeling studies of the coupled dynamics of biosphere-geosphere interactions.

Theme 2 Biological proxies to better achieve paleoenvironmental reconstructions

Background

The Earth is a continuously changing system of interacting components: plates, oceans, icecaps, atmosphere and biota. Plate collision leads to mountain building during which oceans are created or obliterated. This has a direct bearing on ocean and atmospheric circulation and hence on climate as one of the major driving forces of the evolution of life. The history of environmental change is archived in sedimentary sequences. The challenge is to open and read those archives, because they reflect System Earth's responses to its own inherent changes. They also contain the response to catastrophic events such as volcanic eruptions, sudden and massive release of gas hydrates or meteorite impacts. Many of the predicted scenarios for the Earth’s future (e.g. climate change, sea level rise, CO_2 increase) are not unique in its history. By studying the geologic record we are able to answer questions on boundary conditions, dynamics and rates of change as well as resilience and response of biotic and abiotic systems. Such studies also allow clarifying the role of man in the present climate debate: are there significant differences between perturbations of the system due to natural causes versus perturbations caused by man?

Challenges

Our ability to accurately reconstruct palaeo-environments and their dynamics is still relatively limited. In part this is due to the so-called no-analogue problem, e.g. the discrepancy between modern and past environmental conditions and biota. The biota of a Cretaceous ice-free world have no recent analogue. However, many physical and chemical variables (temperature, salinity, precipitation, wind strength) are similar and can directly be compared. In view of the threats the world is facing in the 21st century and beyond, the major challenge of palaeo-environmental reconstruction is to gain a better understanding of the System Earth by learning from the past. In that respect essential periods are those that exhibit abrupt changes from ice-house to greenhouse or fast warming steps in an icehouse world comparable to those that we experience now. In that context the development of new proxies, in particular those that allow quantitative reconstructions, is essential.

It must be stressed that palaeo-environmental studies and related development of proxies are multidisciplinary by nature; the greatest advances are expected by combining observational, experimental and modeling research. Key proxies for marine, freshwater and terrestrial research are those that are related to the major biogeochemical cycles (C, P, N, S, O_2, Si, and Fe). Important are proxies that describe the state of the system, as reflected in physical parameters such as the vigor of ocean circulation and transport of heat. Outstanding among them are the physical reconstruction of climate and climate related parameters. Finally, proxies that describe bioproduction and the state of ecosystems (biodiversity, ecosystem stability, complexity of the web) are important as well.

Biotic proxies are traditionally based on remains of organisms, and isotopic and elemental patterns, but recently the application of molecular markers (lipids, DNA) has shown its potential. Molecular biomarkers bridge between the life and earth sciences and can therefore play a prominent role in the biogeological research of the Darwin Center. However, for a wider application of molecular markers in biogeosciences further insight is needed on the lipid composition of archaea, bacteria and eukaryotes, their specificity and the relationship with the molecular phylogeny of these organisms and their preservation potential. Moreover, this research should be combined and confronted with classical paleontological and geochemical approaches. This will not only provide a cross validation of existing and novel proxies, but also detailed, accurate reconstruction of ecosystem dynamics in the geological past.

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