

Office of Science
Notice 00-04

Biotechnological Investigations - Ocean Margins Program
(BI-OMP)

Department of Energy
Office of Science

Office of Science Financial Assistance Program Notice 00-04: Biotechnological Investigations - Ocean Margins Program (BI-OMP)

AGENCY: U.S. Department of Energy (DOE)

ACTION: Notice inviting grant applications.

SUMMARY: The Office of Biological and Environmental Research (OBER) of the Office of Science (SC), U.S. Department of Energy (DOE), hereby announces its interest in receiving research applications involving the use of molecular biological and biogeochemical techniques to understand the linkages between carbon and nitrogen cycles (primary production and microbial processes) in ocean margins. This information is critical to understanding carbon fixation and sequestration in ocean margin ecosystems and global biogeochemical cycles. Applications must involve mutually collaborative partnerships between institutions with a strong tradition of research in marine sciences and those institutions with developing research capabilities in marine science. Partnerships are particularly encouraged with institutions that traditionally have served groups under represented in the sciences. The goals of such collaborative research projects are to enhance the research capabilities of both institutions, to promote significant interactions between institutions, to foster long-term collaboration among investigators, and to advance understanding at the molecular and biogeochemical level of the linkages between nitrogen cycling and carbon fixation and sequestration in coastal oceans.

DATES: To permit timely consideration for awards in Fiscal Year 2000 and early Fiscal Year 2001, formal applications submitted in response to this notice must be received by 4:30 p.m., E.S.T., February 10, 2000.

ADDRESSES: Formal applications referencing Program Notice 00-04 should be forwarded to: U.S. Department of Energy, Office of Science, Grants and Contracts Division, SC-64, 19901 Germantown Road, Germantown, MD 20874-1290, ATTN: Program Notice 00-04. This address also must be used when submitting applications

by U.S. Postal Service Express Mail or any commercial mail delivery service, or when hand-carried by the applicant.

FOR FURTHER INFORMATION CONTACT: Dr. Anna Palmisano, Environmental Sciences Division, SC-74, Office of Biological and Environmental Research, Office of Science, U.S. Department of Energy, 19901 Germantown Road, Germantown, MD 20874-1290, telephone: (301) 903-9963, e-mail: anna.palmisano@science.doe.gov, fax: (301) 903-8519. The full text of Program Notice 00-04 is available via the Internet using the following web site address: <http://www.sc.doe.gov/production/grants/grants.html>.

SUPPLEMENTARY INFORMATION: The primary research goal of the Biotechnological Investigations - Ocean Margins Program is to establish a more thorough understanding of the molecular to global scale links and feedback mechanisms between solar irradiance, marine microbial activity, primary productivity, carbon and nitrogen cycles and remotely-sensed ocean color data. Specifically, DOE seeks applications to:

I. Apply new and innovative techniques in marine molecular biology and marine biotechnology to assess fixation of carbon dioxide from the atmosphere, determine the mechanisms and processes that control the dynamics of nitrogen fixation or denitrification in coastal waters and sediments, define the coupling and/or decoupling of carbon and nitrogen cycles in coastal environments, and determine the linkages between the function and structure of microbial communities mediating carbon and nitrogen cycling in coastal environments, and

II. Examine the environmental factors (including nutrient availability, temperature, irradiance, and biopolymer lability) that affect the linkages between primary productivity, the utilization of particulate and dissolved organic matter (POM and DOM) by bacterial populations, and nitrogen cycling in coastal areas.

This information is crucial to understanding the responses of marine biological systems to changes in atmospheric radiative budgets and global biogeochemical cycles.

Program Relationships

The Biotechnological Investigations - Ocean Margins Program is expected to build on past research results and accomplishments within the Ocean Margins Program (OMP) component of the Biological and Environmental Research (BER) program. The main

objective of OMP was determining whether primary productivity on continental shelves is quantitatively significant in removing carbon dioxide (CO₂) from the atmosphere. Other objectives of the OMP were: 1) Quantifying the ecological and biogeochemical processes that affect the cycling, flux, and storage of carbon and other biogenic elements at the land/ocean interface; and 2) Defining ocean margin sources and sinks in global biogeochemical cycles.

Under the first phase of BI-OMP, molecular biological techniques were developed, adapted, and applied to determine how biological processes are regulated and controlled by genetic limitations and environmental variables. Research emphasis was placed on molecular regulation of photosynthetic carbon reduction by phytoplankton; molecular diagnostic markers of bacterial growth, production, and nutrient limitations to growth, and; molecular techniques for elucidating metabolic pathways.

Research in Biotechnological Investigations - Oceans Margins Program will complement ongoing OBER efforts in the area of ocean carbon sequestration. The Carbon Management Science Program is funding a DOE Center for Ocean Carbon Sequestration Research jointly lead by the Lawrence Berkeley National Laboratory and Lawrence Livermore National Laboratory. The Center is performing research necessary to evaluate the feasibility, effectiveness and environmental acceptability of sequestration of carbon in the ocean, either through direct injection of carbon dioxide to ocean depths or by fertilization of the ocean with limiting nutrients such as iron. The Carbon Management Science Program also is supporting the sequencing of microorganisms involved in ocean carbon cycling including *Prochlorococcus marinus*.

Biotechnological Investigations - Ocean Margins Program (BI-OMP)

BI-OMP is an outgrowth of the Ocean Margins Program (OMP). It places an increased emphasis on the application of modern molecular tools to marine microbes and their role in carbon and nitrogen cycling, and processes affecting global change. Photosynthetic rates in the ocean, and sequestration of atmospheric CO₂ by marine primary production greatly depend on the availability of fixed inorganic nitrogen. Three major external sources of fixed inorganic nitrogen are cultural eutrophication of the coastal zone; atmospheric deposition of anthropogenic and naturally produced oxides of nitrogen; and nitrogen fixation from the atmosphere by microorganisms.

Research in Temperate and High Latitude coastal areas indicates that the availability and cycling of nitrogen is likely to be the major control on primary productivity and carbon cycling in these areas. Moreover, it appears that denitrification (the reduction of fixed nitrogen to N₂) overwhelms nitrogen fixation by cyanobacteria in Northern Latitude waters and sediments. In these areas, there does not appear to be paucity of iron (Fe) to limit nitrogen fixation, but nitrogenase activity may be inhibited by the

elevated concentrations of ammonia (NH₃) that occur in Arctic waters following phytoplankton blooms. Since little is known about the rates of nitrogen fixation, primary productivity, and bacterial respiration in cold water areas, this notice calls for applications to help understand the molecular to global scale links and feedback mechanisms between solar irradiance, marine microbiology, coastal nitrogen and carbon cycles, primary productivity, and remotely-sensed ocean color data in the low-temperature waters, such as those off Alaska and the Pacific Northwest.

Although it is anticipated that most of the research performed will be laboratory-based, if field studies are necessary, they should be conducted in the coastal waters, including those off the North Slope of Alaska and Pacific Northwest; or, in the estuarine and shelf waters of the Mississippi River and Gulf of Mexico; Savannah River and South Atlantic Bight; or Chesapeake Bay and Mid-Atlantic Bight. Applications that are solely concerned with the taxonomic characterization or distributions of bacteria, or the identification of new biochemicals or enzymes from marine organisms, are excluded from consideration within this notice.

Application of Molecular Tools to Microbes Mediating Carbon and Nitrogen Cycling

This notice encourages applications that use molecular approaches to study marine microbial processes, in particular, carbon and nitrogen cycling. Insights can be gained from application of biotechnological tools to carbon sequestration and storage, nitrogen fixation and denitrification. Knowledge of the genes responsible for these processes, and most importantly, the expression of these genes in marine environments is needed. The mechanisms by which environmental factors regulate gene expression in ocean margin environments will help us to understand the natural controls on these processes.

The advent of modern molecular biology has provided powerful tools for examining genes and gene expression. Molecular methods are now being applied to research problems in marine biology, including the enzymes involved in carbon fixation (e.g., ribulose biphosphate carboxylase), nitrogen fixation (e.g., nitrogenase) and denitrification (e.g., nitrate reductase). Examples of enabling biotechnologies include in situ polymerase chain reaction (PCR) to amplify specific catabolic genes within bacterial cells, and fluorescent in situ hybridization (FISH) to elucidate genotypes in microbial communities. A fundamental knowledge of molecular regulatory mechanisms of photosynthesis and nitrogen cycling in the oceans is needed.

Environmental Factors That Affect Linkages Between Carbon and Nitrogen Cycling

Environmental factors such as nutrient availability, temperature, irradiance, and biopolymer lability affect the coupling and decoupling of primary production, bacterial respiration, POM and DOM formation, and nitrogen metabolism in coastal areas. The impact of individual environmental factors and synergistic effects of multiple environmental factors, on these processes is poorly understood. This notice encourages applications that address the environmental controls on carbon and nitrogen cycles, and their coupling and decoupling. An understanding of these linkages is critical to monitoring and predicting potential changes due to physical, chemical or biological factors, and may ultimately contribute to the development of algorithms for use in interpreting remotely sensed ocean color data.

Collaborative Partnerships

Research applications shall include a mutually collaborative partnership between institutions that have a strong tradition of research in the marine sciences and those institutions with developing research capabilities in marine science. Participation of institutions with a high proportion of groups that are under represented in the sciences are particularly encouraged. Examples of collaborative activities include co-investigator status, periodic exchanges of researcher-in- residence between institutions, and joint supervision of research students. It is critical that both institutions have key roles in the collaboration. One institution should serve as the primary applicant with a subcontract to the collaborative institution. The applications should:

- Clearly state the nature of the collaborative research agreement between the institutions;
- Define respective research roles and responsibilities of scientists at each institution;
- Describe how the partnership between the institutions will be effected (e.g., team meetings, shared students, etc.); and
- Provide separate institutional budgets.

In addition, the applicants will need to show how their proposed collaborative research addresses the goals stated in this notice and convey a commitment to developing research partnerships between respective institutions. Additional information on collaboration is available in the Application Guide for the Office of Science Financial Assistance Program that is available via the Internet at <http://www.sc.doe.gov/production/grants/Colab.html>.

It is anticipated that a total of up to \$2 million will be available for multiple grants awarded in FY 2000 and FY 2001, contingent upon availability of appropriated funds. Applications may request project support up to three years, with out-year support

contingent on availability of funds, progress of the research and programmatic needs. Annual budgets are expected to range from approximately \$50,000 to \$500,000, depending on the number of partnerships involved and the nature of the research proposed. Applications should include detailed budgets for each year of support requested.

Applications will be subjected to formal merit review (peer review) and will be evaluated against the following evaluation criteria which are listed in descending order of importance codified at 10 CFR 605.10(d):

1. Scientific and/or Technical Merit of the Project;
2. Appropriateness of the Proposed Method or Approach;
3. Competency of Applicant's personnel and Adequacy of Proposed Resources;
4. Reasonableness and Appropriateness of the Proposed Budget.

The evaluation will include program policy factors such as the relevance of the proposed research to the terms of the announcement and the agency's programmatic needs. Note, external peer reviewers are selected with regard to both their scientific expertise and the absence of conflict-of-interest issues. Non-federal reviewers may be used, and submission of an application constitutes agreement that this is acceptable to the investigator(s) and the submitting institution.

Information about the development, submission of applications, eligibility, limitations, evaluation, the selection process, and other policies and procedures may be found in 10 CFR Part 605, and in the Application Guide for the Office of Science Financial Assistance Program. Electronic access to the Guide and required forms is made available via the World Wide Web at:

<http://www.sc.doe.gov/production/grants/grants.html>. In addition, for this notice, the Project Description must be 20 pages or less, exclusive of attachments, and the application must contain a Table of Contents, an abstract or project summary, letters of intent from collaborators (if any) and short curriculum vitae consistent with National Institutes of Health guidelines. On the SC grant face page, form DOE F4650.2, in block 15, also provide the PI's phone number, fax number, and E-mail address. Lengthy application appendices are not encouraged.

The Office of Science as part of its grant regulations requires at 10 CFR 605.11(b) that a recipient receiving a grant and performing research involving recombinant DNA molecules and/or organisms and viruses containing recombinant DNA molecules shall comply with NIH "Guidelines for Research Involving Recombinant DNA Molecules," which is available via the world wide web at:

<http://www.niehs.nih.gov/odhsb/biosafe/nih/rdna-apr98.pdf>, (59 FR 34496, July 5, 1994,) or such later revision of those guidelines as may be published in the Federal Register.

The Catalog of Federal Domestic Assistance Number for this program is 81.049, and the solicitation control number is ERFAP 10 CFR Part 605.

John Rodney Clark
Associate Director of Science
for Resource Management

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