Date: October 31, 2003

To: File

From: Assistant Director for Geosciences

Subject: Selection of OCE OS/MGS & OTIC COV Members

The credibility of the COV mechanism rests, in a large measure, on the selection of credible, independent experts who are able to provide balanced and impartial assessments to NSF. Prior to sending out the letters of invitation to serve on the OCE Oceans Section (OS), Marine Geosciences Section (MGS), and Oceanographic Technology & Interdisciplinary Coordination (OTIC) program COV, the Division Director for Ocean Sciences, the Section Heads of the Oceans and Marine Geosciences Sections, and all the Program Directors in the Sections were consulted regarding potential COV candidates.

While efforts to recruit female members were successful, significant difficulty was encountered in recruiting members from other underrepresented groups. Two potential COV members from underrepresented groups were contacted, but declined NSF's invitation to participate. Suggestions for additional potential members were solicited from a director at the Naval Research Laboratory, and from the Naval Oceanographic Office in Mississippi, but these efforts did not yield positive results. Ultimately, the Division successfully arranged for Dr. Francisco Chavez of the Monterey Bay Aquarium Research Institute, a member of the Advisory Committee for Geosciences, to participate on the Committee.

The Committee represented a broad segment of the disciplines consistent with the scope of activities supported by the programs under review. The Committee contained expertise in geophysics, physical oceanography, marine chemistry, ocean technology, and biological oceanography, ranging from the global perspective to the molecular and genomic level. This diverse Committee with three female participants, a Canadian scientist, a member from private industry, and an employee of another Federal agency reviewed and evaluated both the research awards and declinations of the two Sections and the OTIC program along with extensive summary data provided by OCE staff. All committee members were familiar with the many aspects of the Ocean Sciences enterprise and most have had various levels of association in the past. Four of the COV members (44%) have not been applicants to OCE programs for over five years. Dr. Robert Detrick, who co-chaired the COV, and Dr. Francisco Chavez are members of the Advisory Committee for Geosciences.

Other than conflicts arising from members' home institutions, Dr. DeGrandpre noted an institutional conflict with Woods Hole Oceanographic Institution arising from an adjunct appointment. COV members did not review any jackets for which they were conflicted.

COV members present during the meeting were:

Dr. Robert S. Detrick, Jr., Woods Hole Oceanographic Institution (WHOI) (co-chair)
Dr. Michael R. Roman, Horn Point Laboratory (co-chair)
Dr. Mary G. Altalo, SAIC
Dr. David L. Bradley, Pennsylvania State University
Dr. Francisco Chavez, MBARI
Dr. Meghan F. Cronin, NOAA/PMEL/OCRD
Dr. Michael DeGrandpre, U of Montana
Dr. Kathryn M. Gillis, U of Victoria, Canada
Prof. Warren L. Prell, Brown University

2003 COMMITTEE OF VISITORS REPORT FOR THE NSF OCEAN SCIENCES DIVISION

Date of COV: June 18-20, 2003
Programs: Ocean and Marine Geosciences Sections; Ocean Technology and Interdisciplinary Coordination Program
Division: Ocean Sciences
Directorate: Geosciences

Committee Membership:

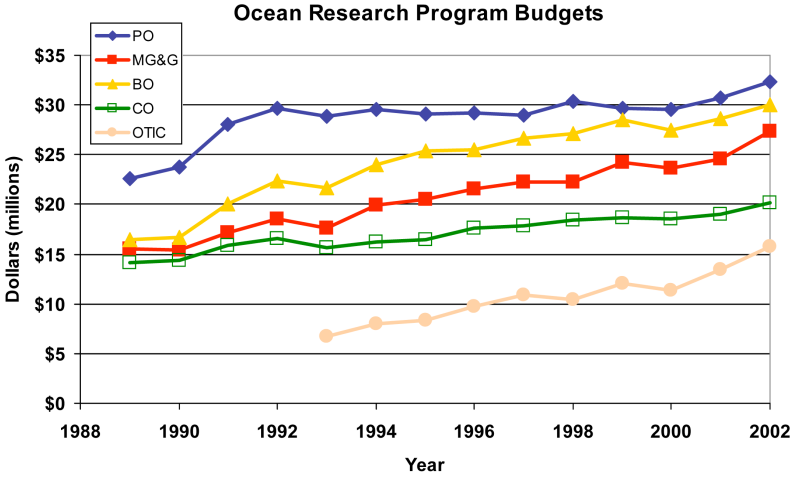
Robert S. Detrick, Co-Chair, Woods Hole Oceanographic Institution
Michael R. Roman, Co-Chair, University of Maryland
Mary G. Altalo, Science Applications International Corporation
David L. Bradley, Pennsylvania State University
Francisco Chavez, Monterey Bay Aquarium Research Institute
Meghan F. Cronin, NOAA/PMEL/OCRD
Michael DeGrandpre, University of Montana-Missoula
Kathryn M. Gillis, University of Victoria, Canada
Warren L. Prell, Brown University

Table of Contents

2003 COMMITTEE OF VISITORS REPORT FOR THE NSF OCEAN SCIENCES DIVISION

1. Overview of Findings/Recommendations

Integrity and Efficiency of Program's Process and Management. The NSF Ocean Sciences Division (OCE) Committee of Visitors (COV) finds that the research programs in the Ocean and Marine Geosciences Sections, and the Ocean Technology and Interdisciplinary Coordination (OTIC) Program, are well managed and efficiently run, and support an exceptionally broad portfolio of outstanding and innovative research. Dedicated program directors have successfully administered large numbers of individual research projects and nurtured and sustained a balanced portfolio of ocean research. The Division's management is commended for significant increases in the Division's research budget over the past three years and for their leadership and vision in developing IODP and OOI, two major new infrastructure and science programs that promise to enable a new generation of ocean research.



Funding history (core + focused programs) for programs reviewed by the COV (actual dollars)

The recent re-organization of the Division into two research sections (Ocean and Marine Geosciences), together with the existing Integrated Programs section, has been successful at distributing the workload at the section head level among three people rather than two, and more effectively integrating ocean drilling research with other marine geoscience research programs. Despite the large number of proposals handled by the Division's research programs (~1300/yr), final decisions on over 87% of these proposals are made within 6 months of submission, an exemplary record. A review of the proposal jackets indicates that in virtually all cases the program officers have documented a clear rationale for their funding decisions with due consideration for programmatic balance, the career development of new investigators and diversity. A much higher proportion of mail reviewers are now addressing both merit review criteria, although reviewers often interpret Review Criterion 2 rather narrowly only in terms of educational or public outreach activities.

Outputs and Outcomes. The research NSF/OCE has supported in biological, chemical and physical oceanography, marine geosciences, and ocean technology and instrumentation, has fostered a vibrant and innovative research community that has maintained U.S. leadership in

the ocean sciences. A number of exciting new research directions have emerged in the past few years in areas such as marine microbiology, ecosystem processes, abrupt climate change, ocean mixing and mantle dynamics. Oceanography is a highly interdisciplinary science and the Division has supported a large number of interdisciplinary projects through programs such as GLOBEC, JGOFS, RIDGE2000, CoOP, and MARGINS as well as through its participation in NSF-wide (e.g. Biocomplexity) and GEO-wide (e.g. Biogeosciences, Water Cycle) programs. The Division is also host to the Ocean Drilling Program, which since 1985 has involved over 1500 scientists from 40 nations in more than 100 separate drilling legs. The Division invests about $15M/yr in developing new ocean technology and instrumentation. Major accomplishments in this area include the development of new sensors for *in situ* biological and chemical measurements, gliders and autonomous vehicles for remote characterization of ocean and seafloor properties, and a new generation of mooring technology.

Earlier this year, two OCE-supported investigators (Penny Chisholm of MIT and Jody Deming of the University of Washington) were elected to the National Academy of Sciences. Other OCE-funded investigators receiving major awards this past year include John Hayes (winner of both the Goldschmidt Medal of the Geochemical Society and the American Chemical Society's 2003 Geochemistry Division Medal), Jeffrey Nystuen (2003 Medwin Prize in Acoustical Oceanography from the Acoustical Society of America), Kurt Polzin (European Geophysical Society's Fridtjof Nansen Medal), and Robert Weller (American Meteorological Society's Sverdrup Gold Medal). The Division is nurturing the next generation of ocean scientists, and promoting the development of a more scientifically literate workforce, by annually supporting over 160 postdocs, 600 graduate students and nearly 300 undergraduate students in various research projects and programs.

Recommendations. The greatest concern of the COV regarding the proposal review and management process in OCE is the increasing workload on the program staff due both to the large number of proposals submitted to the core programs and the increasing burden of participation in various NSF-wide and GEO-wide interdisciplinary programs. This understaffing is negatively affecting the time program directors have to communicate with PIs, visit institutions, track program trends, and attend professional meetings and workshops. The Division is strongly encouraged to increase the number of permanent program directors and/or IPAs to reduce the workload on the existing program staff. Increasing the number of Science Assistants in the Division would also help reduce the burden on program management. Other recommendations of the committee include: (1) a re-examination by NSF, and the home institutions of IPAs, of the financial and career incentives they provide to facilitate the recruitment of the highest quality individuals into IPA positions; (2) a reevaluation by the Division of the mix of expertise required on the support staff, as well as staff training needs, in light of the move toward electronic proposal processing; (3) clarifying for investigators and reviewers the variety of ways Review Criterion 2 can be met; (4) encouraging OCE program managers to increase the utilization of SGER grants for funding small, high-risk, or rapid response, proposals and publicizing this opportunity to investigators; (5) providing sufficient travel funds for program managers to attend meetings, workshops and institutions to meet with investigators, especially young investigators; (6) continuing to encourage and facilitate participation of under-represented groups in ocean research programs; (7) securing a significant increase in funding for ocean drilling and ocean observatory-related research in order to fully realize the potential of the major infrastructure investments the Division will be making in these areas over the next few years; (8) placing a greater emphasis on compiling and publicizing major scientific achievements that result from NSF research support; and (9) increasing the efficiency of the COV process by providing the next COV with a written Division overview and a more complete set of information on proposals and funding history as detailed in Part C, Item C.5 (p. 27) of this report.

2. COV Review Process

The COV for NSF's Ocean Sciences Division met at NSF on June 18-20, 2003 to review research programs in the Division's Ocean Science (OS) and Marine Geosciences (MG) Sections, and the Ocean Technology and Interdisciplinary Coordination (OTIC) program in the Division's Integrated Programs Section. The COV did not review the Division's Ship Operations, Oceanographic Instrumentation and Technical Services, Facilities and Education Programs.

The COV meeting began with an overview of the COV process and the NSF conflict of interest policy. Director James Yoder provided a useful overview of the Division's research programs and presented a set of figures with information on OCE research program budgets and proposal statistics for the period 1998-2002. On the afternoon of the first day, the COV divided into two subgroups to hear presentations on program performance and results over the review period (2001-2003) from the program directors of the OS and MG sections. These program directors were Phillip Taylor (Biological Oceanography), Donald Rice (Chemical Oceanography), Eric Itsweire (Physical Oceanography), Bilal Haq, David Epp, and Rodey Batiza (Marine Geology and Geophysics), and James Allan and Paul Dauphin (Ocean Drilling Program). On the 2nd day of the meeting, the COV met with the OTIC program director, Alexandra Isern. On the 2nd day the COV also held separate meetings with the Division's program directors, IPAs and Science Assistants, and two section heads (Larry Clark and Bruce Malfait) in order to obtain their perspective on the management and operation of the Division's research programs. In addition to these presentations and meetings, the COV divided into groups for the review of proposal jackets for 53 projects submitted to the programs under review during the period 2001-2003. The committee as a whole discussed the results of these jacket reviews during the preparation of its report.

This COV report follows NSF's recommended format for 2003, including Core Questions for Parts A, B and C of the Review Template. These questions address the efficiency and integrity of the program's proposal processing and management, and the outcome of these investments in terms of NSF's goals in People, Ideas and Tools. We have completed the Template based on an evaluation of the Division's research programs as a whole. This report also includes a summary of the Division's response to the last COV (in 1998), specific comments pertaining to the OS, MG and OTIC programs, and a summary of the COV's findings and recommendations.

The COV wishes to thank the program management and staff, especially Brian Midson and Kandace Binkley, for their assistance in assembling the background proposal and budget information necessary for the committee to do its work.

3. Response to Previous COV Report

The 1998 COV on the Division's Ocean Science Research Section (OSRS) made a number of recommendations related to the COV and the review process. The overall intent of these suggestions, as stated in the previous COV report, was to "help insure that the next COV can meet its duties as fully and effectively as possible". This COV supports these recommendations and suggests they all be implemented for the next COV review.

1. Increase the percentage of women, younger scientists and/or underrepresented minorities on the COV to better represent the diversity of the ocean science community.
   This recommendation was implemented for this COV review.

1. Include 1 or 2 members from the previous COV in the membership of its successor to bring some history and continuity to the process.
   This recommendation was not implemented for this COV review.

1. Compile a list of the recommendations from the report and document the subsequent response to each recommendation for review by the next COV.

   This recommendation was not implemented for this COV review.

1. The 1998 COV benefited from an expanded (3 day) meeting and the sessions with the OSRS staff.

   This recommendation was implemented for this COV review.

1. The OSRS staff should provide more material on aspects of the performance of their programs if future COV's are to more effectively evaluate the program's achievement of NSF performance goals. Such material should include:
   a. A brief self-assessment of the OSRS performance under the NSF GPRA goals.
   a. Several paragraphs on the primary results of the past 3 years that, in the view of the OSRS staff and leadership, have had the greatest impact.
   a. A short description of critical science and/or management challenges faced by the OSRS.
   a. A partial list of significant recognition accorded to NSF-funded grantees, staff and NSF programs since the previous COV including medals, special awards, major accolades, Nature, Science and Scientific American articles, major pieces in popular media, etc.

   This recommendation was only partially implemented for this COV review.

1. The 1998 COV recommended a number of data sets (budget history of OSRS research programs; award history; success rates; mean panel and mail review scores, mean duration and funding level of awards, etc.).

   This recommendation was implemented for this COV review.

2003 Report Template for NSF Committees of Visitors (COV's)

Date of COV: June 18-20, 2003
Program/Cluster: Ocean and Marine Geosciences Sections; Ocean Technology and Interdisciplinary Coordination (OTIC) Program
Division: Ocean Sciences
Directorate: Geosciences
Number of actions reviewed by COV[1]: Awards: 29 **Declinations:** 24 **Other:**
Total number of actions within Program/Cluster/Division during period being reviewed by COV[2]: 3860 **Awards:** 1125 **Declinations:** 2735 **Other:**
Manner in which reviewed actions were selected: Proposal jackets were pulled for proposals involving 53 different projects distributed among the following categories for the Ocean and Marine Geosciences sections and the OTIC program: • highly ranked/not funded • lower ranked/funded • proposals with a large difference between mail and panel rankings • small, high risk (SGER) and large (>$1M) proposals • randomly selected

[1] To be provided by NSF staff.
[2] To be provided by NSF staff.

4.0 PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM'S PROCESSES AND MANAGEMENT

A.1 Questions about the quality and effectiveness of the program's use of merit review procedures. Provide comments in the space below the question**.** Discuss areas of concern in the space provided.

QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCEDURES	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
Is the review mechanism appropriate? (panels, ad hoc reviews, site visits) **Comments:** We find that the present procedures for handling proposals are appropriate. In particular, we commend the Division for taking such a high proportion of proposals to panel (>80% overall; >90% for several programs). The number of No Discussion (ND) proposals that have been through mail review but are not taken to panel is minimal, and these proposals can be discussed at the request of any panel member. Site visits are not conducted due to workload and time constraints, and the large number of institutions funded by the Division. To compensate for this, the Division welcomes visits from PIs. Program directors are also encouraged to attend workshops and meetings to meet with PIs.	Yes
Is the review process efficient and effective? Comments: We found the review process to be remarkably efficient and effective, especially considering large number of proposals that are handled each year (>1300).	Yes
Are reviews consistent with priorities and criteria stated in the program's solicitations, announcements, and guidelines? Comments: While the COV did not consider this question in detail, our impression from a review of the program jackets is that reviews (both mail and panel) are consistent with the stated goals of the program.	Yes
Do the individual reviews (either mail or panel) provide sufficient information for the principal investigator(s) to understand the basis for the reviewer's recommendation? Comments: In reviewing the proposal jackets, the COV found the information provided by	Yes

mail reviews and panels concerning the intellectual merit of proposals (Criterion 1) was generally quite adequate whereas the information provided regarding broader impacts (Criterion 2) was more variable.	
Do the panel summaries provide sufficient information for the principal investigator(s) to understand the basis for the panel recommendation? Comments: The COV found the panel summaries in the jackets that it reviewed were often rather cursory. We believe this documentation should be expanded in order for the PI to understand the basis for the panel's recommendation. On some panels, a panel member prepares the panel summaries (instead of the program director), which may provide improved documentation of panel discussions	No, not always
Is the documentation for recommendations complete, and does the program officer provide sufficient information and justification for her/his recommendation? Comments: Yes, the program officers provide sufficient documentation and justification in the file for their funding decisions. However, we found that communications with PIs are not consistently documented in the proposal jackets. Our understanding is that program directors communicate by phone or email with PIs to explain the rationale for each funding decision. The COV applauds this, but is concerned that with the current workload pressures some program directors may find it hard to spend as much time communicating results to PIs as they did in the past. We encourage the program directors to continue their practice of being especially proactive in providing input to junior investigators.	Yes
Is the time to decision appropriate? Comments: The COV considers the time to decision for the Ocean and Marine Geosciences sections, and the OTIC program, to be excellent given the large number of submitted proposals. The time to decision is within 6 months for 87% of the submitted proposals, which far exceeds the NSF average. We note that proposals with a longer time to decision usually involved large interdisciplinary programs or ship scheduling issues.	Yes
Discuss issues identified by the COV concerning the quality and effectiveness of the program's use of merit review procedures: The COV notes that the utilization of *both* mail and panel reviews by the Ocean and Marine Geosciences sections in making funding decisions for nearly all proposals is greatly appreciated by the community and distinguishes NSF from other agencies.	

A.2 Questions concerning the implementation of the NSF Merit Review Criteria (intellectual merit and broader impacts) by reviewers and program officers.

Provide comments in the space below the question. Discuss issues or concerns in the space provided.

IMPLEMENTATION OF NSF MERIT REVIEW CRITERIA	YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE
Have the individual reviews (either mail or panel) addressed whether the proposal contributes to both merit review criteria? Comments: Intellectual merit (Review Criterion 1) is generally well addressed by both the mail and panel reviews. There was more variability in how Review Criterion 2 (broader impacts) was addressed. It appears that the breadth of Criterion 2 is not well understood by the reviewing community at large, with an over-emphasis on the educational aspects of Criterion 2. There seemed to be more understanding of the two merit review criteria by panels, which most probably reflects the explanation of the criteria by program directors during the panel session. It also appears that the application of the Criterion 2 is uneven, with some reviewers (mail primarily) not addressing the issue at all. The panel normally addresses this issue, though sometimes superficially. Since this criterion has not been emphasized until recently, it is anticipated that this issue may be resolved over time as the community becomes more familiar with this criterion.	Yes
Have the panel summary reviews addressed whether the proposal contributes to both merit review criteria? Comments: The panel summaries address both review criteria. Criterion 1 is generally addressed in more detail than Criterion 2. The COV felt this was appropriate since Intellectual Merit should be the most important factor in funding decisions.	Yes
Have the *review analyses* (Form 7s) addressed whether the proposal contributes to both merit review criteria? Comments: Form 7s was found to specifically address both review criteria in all of the jackets reviewed from the past year (when it has been a requirement).	Yes

Discuss any issues or concerns the COV has identified with respect to NSF's merit review system.

The COV wishes to reinforce the concept that Intellectual Merit (Criterion 1) should be the most important criterion for selection of awards. COV members also expressed some concern that many reviewers (and PIs) do not understand the variety of ways the "broader impact" criterion (Criterion 2) can be satisfied.

A.3 Questions concerning the selection of reviewers. Provide comments in the space below the question. Discuss areas of concern in the space provided.

SELECTION OF REVIEWERS	YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE
Did the program make use of an adequate number of reviewers for a balanced review? Comments: No statistical information was provided to the COV on the average number of reviews returned per proposal. In reviewing the jackets, all proposals had the minimum of 3 mail reviews as required by NSF policy, but it was noted that some programs had significantly fewer returned reviews than others and it was sometimes necessary for panelists to provide a written review. In talking with the program directors, it was ascertained that a proactive approach yields more returned reviews. This includes contacting a potential reviewer before the proposal is assigned and reminders before the return deadline. The COV recognizes that many factors affect mail review return rates and that the volume of proposals handled by some programs would preclude this approach. However, an automated reminder system might be a useful approach that could increase return rates without placing a major new burden on the program directors.	Yes
Did the program make use of reviewers having appropriate expertise and/or qualifications? Comments: Yes, in general. There was only one example in the jackets reviewed where the mail reviewer was deemed to be not qualified. The growing number of conflicts as more collaborative and multi-PIs proposals are submitted exacerbates this issue.	Yes

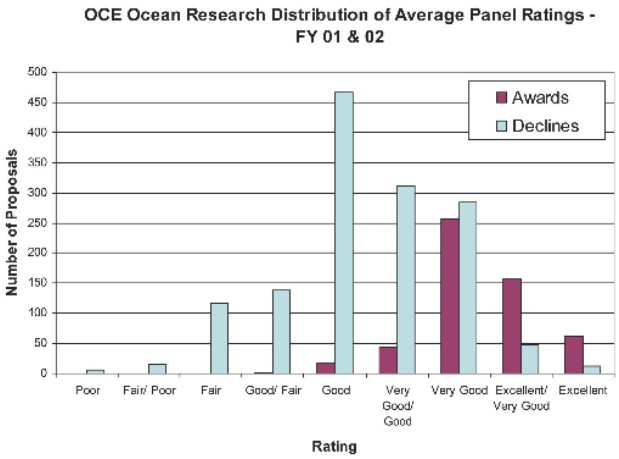
Did the program make appropriate use of reviewers to reflect balance among characteristics such as geography, type of institution, and underrepresented groups? Comments: This is difficult to assess by looking at only 53 jackets from the nearly 4000 proposals submitted over the past 3 years, although based on our limited review the program appears to be utilizing an appropriate distribution of reviewers. The COV would have found a table or statistics on reviewer information such as this useful in addressing this question.	Unable to Assess
Did the program recognize and resolve conflicts of interest when appropriate? Comments: Generally, the program did recognize and resolve conflicts. The COV believes that the suggestion by program directors to require a single table in a proposal summarizing the conflicts of all investigators involved in a proposal is an excellent idea, particularly for collaborative and multiple PI proposals, and would make it much easier for the program to recognize and avoid conflicts. This page is required by the Biocomplexity program but could be required for all "Collaborative Research" proposals.	Yes

Discuss any concerns identified that are relevant to selection of reviewers.

There is general agreement that the review community is overloaded, particularly with the creation of a number of new initiatives and panels. This contributes to the low mail review return rate, especially in some fields. An NSF-wide database for the assignment of reviewers would be useful so program directors do not assign one individual an inordinate number of proposals to review in a given year. Coincident panels also add to this burden.

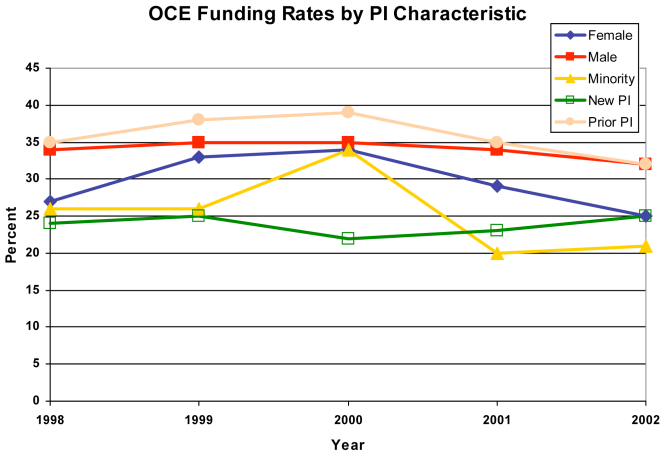
A.4 Questions concerning the resulting portfolio of awards under review. Provide comments in the space below the question. Discuss areas of concern in the space provided.

RESULTING PORTFOLIO OF AWARDS	APPROPRIATE, NOT APPROPRIATE, OR DATA NOT AVAILABLE

Overall quality of the research and/or education projects supported by the program. Comments: The quality of research funded by the Division has been extremely high. We note that the number of very high quality proposals (rated very good-to-excellent or excellent) is nearly 30% larger than the number of proposals funded from those categories in FY01 & FY02. Highlights of recent results are described in Part B. Educational projects were not reviewed by the COV.  	Appropriate
Are awards appropriate in size and duration for the scope of the projects? Comments: The COV commends the Division for increasing mean annual award size by almost 20% since 1998 (to ~$120,000), although it notes that award size has decreased slightly since 2000. The average duration of awards funded in OCE has remained relatively steady, with MG&G at the low end (at 2.3 years) and PO at the high end (3.2 years). The COV believes that in some cases PIs submit proposals that are smaller or shorter in duration than required to complete the project because they fear that expensive, multi-year proposals will reduce their chance of funding. In other cases, program directors may be reluctant to fund large, multi-year proposals because of their effect on overall proposal success rates when budgets are relatively flat and not wanting to mortgage future budgets by spreading project costs over several years. Despite these pressures, the COV strongly supports efforts to increase the duration of awards as it will ultimately translate into fewer proposals submissions and thus reduced workload on program directors and scientists. However, increasing grant size and duration, without a decrease in success rate, will require a significant increase in core program funding.	See comments

Does the program portfolio have an appropriate balance of: • **High Risk Proposals?** Comments: The use of SGER proposals by OCE is low (~1% of research program budget). This many reflect a lack of awareness of this program by many investigators or a misunderstanding of what is appropriate for support in SGER proposals. Program directors reported some SGER proposals were inappropriate (e.g. seeking funding for a postdoc) and therefore have been declined. It may be useful to inform the community on the proper use of SGERs in the Division Newsletter, or by other means. The COV was not provided with enough information to determine the overall balance of high-risk proposals in the portfolio. It may be useful to develop a risk metric (e.g. new PI, new kind of experiment or instrument), and provide this information to the next COV. The COV encourages program directors to support SGER and other high-risk proposals.	Data not available
Does the program portfolio have an appropriate balance of: • **Multidisciplinary Proposals?** Comments: The COV was not provided with information to evaluate this quantitatively. It is clear, however, that OCE is supporting a large number of multidisciplinary proposals within the Division (through special OCE programs such as RIDGE2000, CoOP, JGOFS, and GLOBEC), and through both NSF-wide (e.g. Biocomplexity) and GEO-wide (e.g. Biogeosciences, Water Cycle) programs.	Appropriate
Does the program portfolio have an appropriate balance of: • **Innovative Proposals?** Comments: The program consistently funds a portfolio of high-quality and innovative proposals.	Appropriate
Does the program portfolio have an appropriate balance of: • **Funding for centers, groups and awards to individuals?** Comments: The Division has recently established Centers for Ocean Science Education Excellence (COSEE). Research funding goes almost entirely to individuals or groups of individuals.	Appropriate

Does the program portfolio have an appropriate balance of: • **Awards to new investigators?** Comments: The COV commends the program for supporting new investigators. Roughly 20% of proposals go to new investigators.	Appropriate
Does the program portfolio have an appropriate balance of: • **Geographical distribution of Principal Investigators?** Comments: There is an appropriate geographic distribution of PIs.	Appropriate
Does the program portfolio have an appropriate balance of: • **Institutional types?** Comments: Yes, a wide variety of private and public institutions are supported by OCE	Appropriate
Does the program portfolio have an appropriate balance of: • **Projects that integrate research and education?** Comments: A total of 606 graduate students, 163 postdocs, and 292 undergraduates were supported by the Division during 2002 amounting to a total investment of ~$17M. The program has also established the innovative Centers for Ocean Science Education Excellence (COSEE) program.	Appropriate
Does the program portfolio have an appropriate balance: ▲ **Across disciplines and subdisciplines of the activity and of emerging opportunities?** Comments: Yes, the program supports a diverse research portfolio in physical, chemical, and biological oceanography, the marine geosciences, and ocean technology development. The program is also supporting a number of emerging new research areas and approaches ranging from marine geomicrobiology to the establishment of a global ocean observing system.	Appropriate

Does the program portfolio have appropriate participation of underrepresented groups? Comments: The committee was not provided with information on participation of underrepresented groups in ocean sciences research programs in comparison with their presence in the field as a whole. Proposal success rates for underrepresented groups were provided, and both minorities and women have lower success rates than men. The success rate for both women and minority PIs has declined relative to men since 2000. The Division should watch this trend carefully and take appropriate action if necessary.  	See comments
Is the program relevant to national priorities, agency mission, relevant fields and other customer needs? Include citations of relevant external reports. Comments: Yes, the program has addressed the priorities listed in the GEO2000 plan.	Appropriate

Discuss any concerns identified that are relevant to the quality of the projects or the balance of the portfolio.

Some information needed for assessing the quality and balance of the Division's research portfolio was not available to the COV (e.g. a thematic classification for all awards and declines for each program, and the success rate for thematic areas within each program, with trends over the past 5 years). Although the COV recognizes the large workload of the program directors, the program is encouraged to track various metrics of the portfolio in order to be able to provide this information to future COVs (see recommendations in C.5) and for self-assessment.

A.5 Management of the program under review. Please comment on:

Management of the program.
Comments:

The research programs in the Ocean Sciences Division have had strong and effective management. Dedicated program directors have efficiently administered individual research projects and nurtured and sustained a balanced portfolio of outstanding and innovative research in the ocean sciences.

The senior management of the Ocean Sciences Division are to be commended for their leadership and vision in obtaining a 33% increase in funding for the Division over the past 3 years and for developing both IODP and OOI, two major new infrastructure and science programs that promise to enable a new generation of ocean research.

The recent restructuring of OCE (separating MG&G and ocean drilling from other ocean sciences) has provided some advantages including 1) reducing the workload at the section head level, and 2) more effectively integrating ocean drilling research with other marine geoscience research programs. Separation of Marine Geosciences from the Ocean section was not perceived as a limitation on multidisciplinary research by division management or by the majority of program staff.

OCE needs to work with NSF management to reduce the workload of the permanent program staff and IPAs originating from the increasing numbers of proposals submitted to the core programs and the burgeoning number of cross-division initiatives.

Responsiveness of the program to emerging research and education trends.
Comments:

The Division has been very responsive in recognizing and responding to emerging new trends in research and education. Examples include the Ocean Observatories Initiative, IODP, SOLAS, and the regional education and outreach programs created through the Centers for Ocean Science Education Excellence (COSEE).

Program planning and prioritization process (internal and external) that guided the development of the portfolio under review.
Comments:

The Division has been very effective at distributing information to guide research proposal requirements and directions. Information venues include newsletters, web pages, and informational meetings at conferences (e.g. AGU Ocean Sciences). Research planning has been documented in many programmatic and divisional publications including OEUVRE, FUMAGES, FOCUS, APROPOS, and the *Ocean Sciences the New Millennium* report. Program managers participate in many community workshops, planning meetings and research conferences.

Discuss any concerns identified that are relevant to the management of the program.

The workload for program directors has increased considerably in recent years due to increased proposal pressure on the core programs, and an increasing number of NSF-wide and GEO-wide competitions and panels. This understaffing is negatively affecting the time program managers have to communicate with PIs, visit institutions, track program trends, and attend professional meetings and workshops. Additional permanent program staff would help reduce this workload.

IPAs and Science Assistants are very important in reducing program director workloads, improving the intellectual atmosphere in the Division by injecting new ideas and perspectives, and helping to develop closer ties between NSF and the community. More IPAs, and Science Assistants are needed in the Division. There is also a need to improve recruitment of IPAs through greater financial and career incentives.

The very limited travel funds available to the program has, in some cases, curtailed the ability of program directors and IPAs to attend meetings and workshops, and visit the investigators and facilities they support. These interactions are crucial for both investigators and the program, and the COV strongly recommends that additional resources be identified for program director travel.

5.0 PART B. RESULTS: OUTPUTS AND OUTCOMES OF NSF INVESTMENTS

B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes (nuggets) as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.

B.1 NSF OUTCOME GOAL for PEOPLE: Developing "a diverse, internationally competitive and globally engaged workforce of scientists, engineers, and well-prepared citizens."

Awards to NSF-Supported Ocean Scientists

One outcome of the investments the Ocean Sciences Division has made in people are the awards and honors that OCE-supported investigators have received. Earlier this year, two OCE-supported scientists (both women) were elected to the National Academy of Sciences:

Sallie "Penny" Chisholm (Massachusetts Institute of Technology) - Chisholm was recognized for her pioneering studies on plankton in the relatively unproductive parts of the world's oceans. Her work linking molecular biology, physiology, and biogeochemistry provides a strong foundation for understanding current patterns and future changes in ocean production. Recent awards: OCE-0107472, a SGER and OCE-0000330 (SOFeX).

Jody Deming (University of Washington) - Deming has made major contributions to the understanding of life in extreme environments from polar regions to the deep sea floor. Her studies have explored the limits of microbial life, including the effects of extremes in pressure and temperature on microbial life in these ecosystems. Recent award: OCE-9813728 (LEXEN)

Other major awards received by OCE-supported investigators this past year include:

John Hayes of the Geology and Geophysics Department at Woods Hole Oceanographic Institution (WHOI) was winner of both the Goldschmidt Medal of the Geochemical Society and the American Chemical Society's 2003 Geochemistry Division Medal. Hayes was recognized for his contributions to an understanding of organic geochemistry, cosmochemistry, isotope geochemistry and paleoenvironmental analysis. Relevant OCE awards supporting Dr. Hayes research: 9986727, 9809264, 9807266

Jeffrey A. Nystuen of the Applied Physics Laboratory, University of Washington was been selected as the recipient of the 2003 Medwin Prize in Acoustical Oceanography from the Acoustical Society of America. He received the Prize for the development and effective use of measurements of underwater sound generated by rain to determine rainfall rate and type at sea. Relevant OCE awards supporting Dr. Nystuen's research: 0241245, 9818726, 9503896

Kurt Polzin, an associate scientist in the Department of Physical Oceanography at Woods Hole Oceanographic Institution, received the European Geophysical Society's Fridtjof Nansen Medal, one of the society's highest honors, in recognition of his pioneering contributions to the measurement of mixing in the deep ocean. Relevant OCE awards supporting Dr. Polzin's research: 0118401, 9906731, 9727701, 9401223

Robert A. Weller of the Woods Hole Oceanographic Institution was honored by the American Meteorological Society (AMS) for his contributions to understanding the interactions between the oceans and atmosphere with the award of the AMS's Sverdrup Gold Medal. Weller was honored for scientific leadership and sustained excellence in the development and use of innovative measurement techniques in the air-sea boundary layer. Relevant OCE awards supporting Dr. Weller's research: 9525844, 9204034, 9201886, 9110559, 9110554.

Increasing Minority Participation in the Ocean Sciences

The Ocean Sciences Division supports several projects aimed at improving minority participation in the field. Faculty in the OCE-funded Minorities in Marine Science Undergraduate Program (MIMSUP) at Shannon Point Marine Center/Western Washington University received three awards recently:

1) Presidential Award for Excellence in Science, Math and Engineering Mentoring - selected by NSF/EHR

2) Coastal and Ocean Resource Management Excellence Award from NOAA awarded to **Brian Bingham** for promoting diversity

3) A national Role Model Award from the nonprofit education organization, Minority Access Inc awarded to **Brian Bingham**

Of 103 MIMSUP participants, 73 have now received bachelor's degrees with the rest nearing completion. Of those who have their bachelor's, 42% have received, or are seeking, master's degrees; 12% are pursuing professional degrees in fields such as medicine; and 10% have completed or are seeking Ph.Ds. Two are in post-doctoral internships with the National Institutes of Health. Relevant OCE award: 0228618 to Brian Bingham.

PODS: Inaugural Physical Oceanography Dissertation Symposium

The Physical Oceanography Dissertation Symposium (PODS) held its inaugural meeting in Breckenridge, Colorado, June 17-21, 2002. This program is designed to introduce new PhD graduates to each other and the physical oceanographic community and to promote the exchange of recent research results and ideas. PODS selected 21 participants from a diverse

set of institutions, ranging from University of North Carolina to University of Hawaii with far reaching participants from the University of Reading, UK and the University of New South Wales, Australia who will be doing their postdoctoral studies in the United States. Dr. Walter Munk gave the keynote presentation, "The Evolution of Physical Oceanography in the Last 100 Years". The meeting featured detailed presentations from each of the new graduates intermixed with discussion sessions on topics relevant to young investigators, such as new directions of science, proposal-writing, and how to initiate research programs. The research topics discussed reflected current scientific and societal priorities including the energetics of the thermohaline circulation and its role in climate, the structure of estuarine and coastal exchanges, the role of internal tides in energy dissipation in the ocean, the formation of water masses in subtropical oceans, and the processes governing mixing and air-sea interaction. The symposium participants published an EOS article describing the results of the meeting and have also presented a paper on the optimum graduate student education, resulting from discussions at PODS. The second PODS will be held September 28–October 4, 2003, Waikoloa, Hawaii (see http://www.pods-symposium.org/). PODS is supported by OCE-0130570

B.2 NSF OUTCOME GOAL for IDEAS: Enabling "discovery across the frontier of science and engineering, connected to learning, innovation, and service to society."

The Ocean Sciences Division supports innovative research across a broad spectrum of the ocean sciences including biological, chemical and physical oceanography, and the marine geosciences. Over the past three years a number of exciting new research areas have emerged in these fields including:

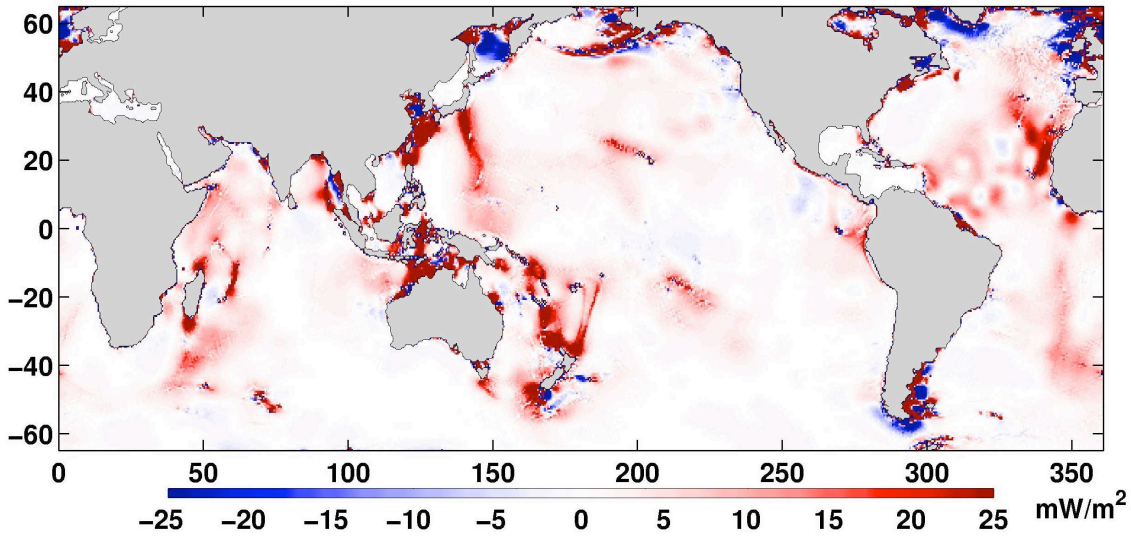
- Microbiology (upper ocean, twilight zone, subsurface biosphere)
- Ecosystem processes (with implications for fisheries management)
- Coastal ocean circulation
- Ocean mixing (topographic effects; salt fingers; shelf break fronts)
- Synthesis of global circulation
- Role of iron and other micronutrients in ocean productivity
- Synthesis of ocean carbon cycle
- Magmatic, hydrothermal, biological interactions at mid-ocean ridges
- Methane hydrates
- Abrupt climate change and decadal climate variability
- Margins geological processes
- Ocean mantle dynamics

In this section, we present several examples of significant outcomes of research funded by the Division.

The Hawaii Ocean Mixing Experiment (PI: R. Pinkel, Scripps Institution of Oceanography, OCE- 9819529)

The results and observations from satellite altimetry led Munk and Wunsch to revise the ideas in the classic 1966 paper "Abyssal recipes" which called for a diapycnal diffusivity of 0.1 cm^2/s to maintain the abyssal stratification against the global upwelling associated with deep water formation. Rather than requiring high uniform mixing rates in the abyssal ocean, it appears that sufficient amounts of tidal energy can be converted into mixing over seamounts and ridges. When combined with global wind mixing and frictional tidal mixing in shallow seas, these new sources of abyssal mixing could be sufficient to balance global upwelling.

Modern techniques of space geodesy--altimetry, satellite laser ranging, lunar laser ranging--have converged to an energy dissipation rate of 3.7 TW, with 2.5 TW from the principal lunar tide, but attempts to account for the dissipation by bottom drag in shallow seas have always come up short. From the divergence of the energy flux, and the rate of work of gravitational and surface forces on the ocean, oceanographer Gary Egbert, Oregon State University, and colleague Richard Ray have computed localized estimates of dissipation. Their calculations reveal that approximately 30% of the tidal dissipation (or about 1 TW) occurs in the open ocean over rough topography (e.g., the mid-Atlantic ridge, or the Hawaiian island chain). The most plausible explanation of this energy loss over topography is that energy is transferred from the large-scale surface tide into internal waves in the stratified ocean.



Map of estimated global tidal dissipation showing high dissipation rates over rough topography

The details on how the energy conversion from tides to internal waves and mixing take place was the subject of investigation by a comprehensive, multi-institution, NSF-funded field program led by Rob Pinkel and colleagues near the Hawaiian Ridge (HOME: Hawaiian Ocean Mixing Experiment). HOME represents a total investment of about $20M over 7 years (science and facilities) by NSF. The divergence of internal tidal energy flux observed along the Hawaiian Ridge agrees with that predicted by internal tide models. Large internal tidal waves of up to 300m peak-to-peak amplitude occur on the ridge. Internal wave energy is enhanced, and turbulent dissipation is more than 10 times open ocean values in the region surrounding the ridge. This turns out to have potentially important implications for the ocean, and possibly for long term climate variations: tidal energy converted to internal motions may be an important factor in vertically mixing the ocean, and hence maintaining the abyssal stratification and the thermohaline circulation which transports heat in the ocean from equator to pole. This experiment is described in an *EOS* article (*EOS* vol. 81, No. 46, Nov 14, 2000, p545-553) and in an article currently in press in *Science*.

Southern Ocean Iron Enrichment Experiment (K. Coale, Moss Landing Marine Laboratory, OCE-9911481)

The Southern Ocean is characterized by two major biogeochemical provinces, the northern regions are characterized by low silicate concentrations < 5 □M and the southern regions are characterized by high silicate concentrations >60 □M. Silicate is thought to exert a dominant

control on community structure thus may differentially influence carbon export from these waters. In this study, high and low silicate waters of the Southern Ocean were seeded with traces of iron to examine the possible role of this metal in controlling phytoplankton growth and the drawdown of atmospheric carbon dioxide during the last glacial maximum. Multiple iron additions were performed both north and south of the Antarctic Polar Front Zone and were tracked by three research vessels to provided extensive observation of the two experiments. Phytoplankton blooms, covering several hundred square kilometers, were induced in both locations as a direct result of iron enrichment, with a concomitant increase in carbon flux, the first ever observed for experiments at these latitudes. Production exceeded the climatological mean for this region and significant depletions in carbon dioxide were also observed. These results support the role of iron in controlling carbon uptake and export from both high and low silicate regions, thus greatly increasing the areal capacity of iron supply to regulate the drawdown of atmospheric carbon dioxide in Southern Ocean waters. The results are described in a paper currently under review for publication in *Science*.

Smectite Incubation of Organic Molecules in Seafloor Hydrothermal Systems (L. Williams, Arizona State University, OCE-0210954, SGER)

How life originated on earth is not well understood. One possibility is that primitive life could have originated at deep-sea hydrothermal vents in primordial oceans. If so, then complex organic molecules must be created from simpler compounds available in the environment. A potential problem with this scenario is that the high temperatures in the vicinity of the vents could cause the breakdown of complex organic compounds and thus prevents abiotic synthesis of complex organics. One way around this problem might be to somehow "protect" these delicate molecules from high temperatures so that they can survive and polymerize further. In this project, Williams et al. are exploring the idea that complex organic molecules can be grown and protected within tiny "bottles" consisting of gaps between the layered structure of the clay mineral smectite. The idea is that as the smectite reacts with hydrothermal fluids to a more stable mineral (illite or chlorite), the reaction kinetics provides a potential mechanism for organic polymerization. In this way, the smectite interlayers behave as "nano-incubators "early in the reaction path, allowing complex organic molecules to grow larger. The expandable clay incorporates metal ions and primary organic molecules (e.g., alcohols) in the interlayer where gradual changes in the electrochemical environment may catalyze bio-oligomers that form the essential components of life. Their hypothesis is that organic molecules are protected and polymerized in the smectite interlayers and will be expelled as the clay approaches equilibrium with the hydrothermal environment. This hypothesis will be explored by means of laboratory experiments that simulate the pressure, temperature, and chemical conditions of deep-sea hydrothermal vents. If this mechanism proves viable, it could mean a major step forward in understanding how life arose on planet Earth.

NSF-DOE Collaborative to Study Deep-Sea Gas Hydrates (ODP Leg 204) (A. Trehu, Oregon State University, OCE-0002410; N. Bangs, University of Texas, OCE-0002487)

Marine deposits of gas hydrates represent an enormous reservoir of sequestered carbon. As a result, these deposits are of interest both as a potential energy source and as an agent of past climate change. Better calibration of regional estimates of gas hydrate and free-gas volumes based on geophysical mapping and modeling is of critical importance in estimating the global abundance of hydrate.

Leg 204 of the Ocean Drilling Program, off the coast of Oregon in July-September 2002, drilled through hydrates in a variety of settings with different seismic characteristics, measured *in situ* physical properties, and conducted a series of nested seismic experiments to calibrate

various techniques for remote sensing of hydrate distribution and concentration. Scientists on Leg 204 represented the United States, Germany, Japan, Canada, Spain, Norway, the United Kingdom, Taiwan, the People's Republic of China, and South Korea. As part of this effort, ODP worked with the Department of Energy (DOE) to develop special tools that allowed recovery and preservation of gas hydrates. Special coring devices were used that maintained high pressures needed to keep cores of gas hydrate from dissociating as they were brought from the seafloor to the surface.

During Leg 204 a series of holes were dedicated to the rapid recovery and preservation of hydrate-bearing sediment cores for a study co-funded by DOE and NSF/ODP. Approximately 50 meters of hydrate-bearing core was recovered and stored in steel pressure vessels at 4°C and 600 psi using methane gas. Thirty-five meters of hydrate-bearing core was recovered and stored in 8 liquid nitrogen cryo-freezers (160 liter capacity each). These preserved samples of gas hydrate will allow scientists, for the first time, to study the physical properties and the chemical and biological characteristics of the hydrate in the laboratory in order to better understand the formation and distribution of hydrate beneath the seafloor.

Blue Crabs and the Health of Southeastern U.S. Salt Marshes (PI: M. Bertness, Brown University, OCE-0111472)

Southern salt marshes stretch from Chesapeake Bay to the central-Florida coasts and are some of the most productive grasslands in the world. The marshes temper coastal flooding, filter mainland run-off and act as nurseries for commercially important fish and other species. The marshes also protect barrier islands, which buffer shorelines from erosion. In experiments along the Virginia and Georgia coasts, Brown University researchers supported by the National Science Foundation (NSF) manipulated local populations of marsh animals. They found that when blue crabs disappeared from a salt marsh, their main prey - periwinkle snails - flourished. Once free of predation from blue crabs, the snails ate all of the cordgrass in the marsh. Cordgrass dominates the southern marsh, anchoring it and providing its animals with habitat. Without the plants to bind sediment and protect wildlife, the salt marsh ecosystem collapses, the scientists found. In fact, the study shows that overgrazing by periwinkle snails will convert a southern salt marsh into a barren mudflat within 8 months.

Hundreds of miles of southern salt marshes have died in recent years, particularly in Louisiana and Florida. Bertness and colleague Brian Silliman surveyed several of the dead and dying marshes and found relatively high densities of periwinkle snails, but few blue crabs. The researchers believe the effects shown in the experiments may already be at work in the southern marshes. For more than 50 years, ecologists assumed that the 1/2- to 3/4-inch long, black or gray periwinkles ate only dead and dying plant materials in southern salt marshes. But Silliman and Bertness found that unchecked populations of the snail readily ate living cordgrass. Moreover, the greater the nitrogen content of the grass (nitrogen is the prime nutrient in mainland run-off), the more attractive the grass is to the periwinkles. For decades, the prevailing model of marsh ecology was that bottom-up forces, such as currents and nutrient flow, primarily determined plant productivity. But this new study indicates that a top-down process - the control of grazers (snails) by consumers (crabs) - chiefly establishes the growth of

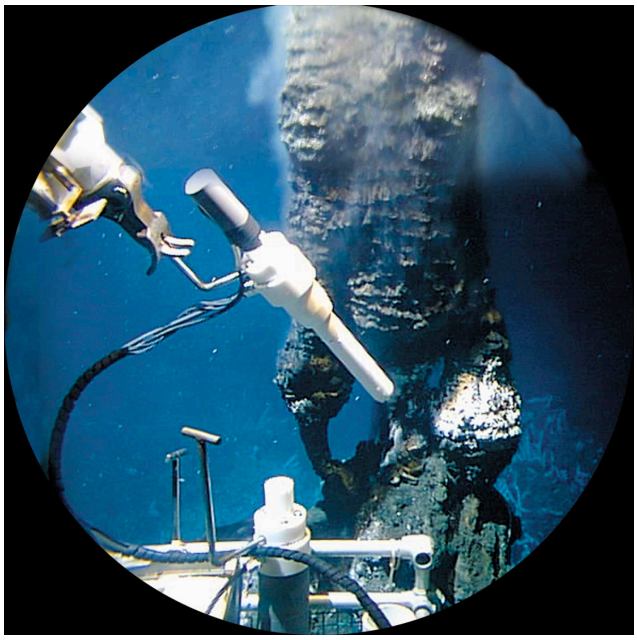
marsh grass. According to the researchers, this top-down phenomenon implies that over-harvesting of snail predators, such as blue crabs, may be an important factor contributing to the massive die-off of salt marshes across the southeastern United States.

B.3 OUTCOME GOAL for TOOLS: Providing "broadly accessible, state-of-the-art and shared research and education tools."

The Ocean Sciences Division invests in the development and acquisition of wide variety tools such as new sensors, instrumentation and equipment, multi-user facilities, a specialized drilling vessel and various systems for observing the oceans. In addition, the Division is supporting the establishment of data libraries, and the computational systems to disseminate oceanographic and geological data to researchers, students, teachers and the general public. In this section several examples of recent OCE-supported projects that have developed new tools and techniques for studying the oceans are described.

Deployable *in situ* Electrochemical Analyzer for Remote and Automatic Analysis of O_2, H_2S and Sulfur Species at Hydrothermal Vents (PI: G. Luther, University of Delaware, OCE-0136671)

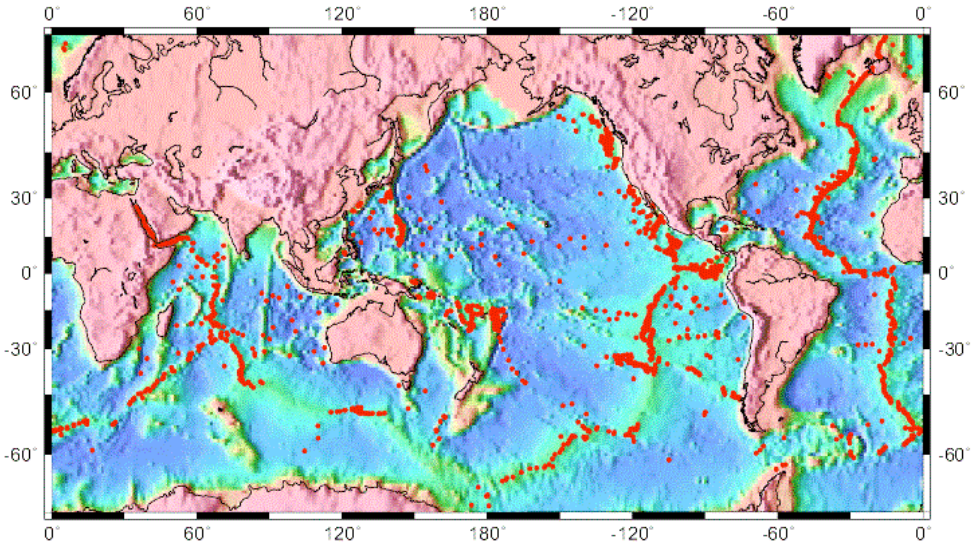
There is currently a great need in the oceanographic community for chemical sensors that can be deployed in varied environments. To help meet this need and provide the ocean-ographic community with an enhanced ability to understand the nature of biogeochemical changes in the natural environment an electrochemical analyzer has been developed. This sensor can simultaneously determine biologically important redox species by voltammetry at a gold-amalgam solid-state working electrode during one potential scan. These species include O_2, H_2S, thiosulfate, polysulfides, iodide, Fe(II), Mn(II), and FeS. No chemical or sampling manipulations are necessary for these measurements so the system is capable of detecting chemical species in real time. Voltammetry is an ideal technique for monitoring ecosystem health in several important regimes. These include the monitoring of seasonal anoxia in nearshore environments (stagnant bays, estuaries and basins) and of changes in sulfur and iron chemistry at hydrothermal vents. This sensor package can also be used to study the chemistry of lakes and rivers. Funds are being provided to further the development of this instrumentation so that it can be operated remotely from vehicle such as ALVIN or from instrument nodes on ocean observatories.



PetDB, An Oceanic Petrologic Database (PI: C. Langmuir, Columbia University, Lamont-Doherty Earth Observatory, OCE-9530137; OCE-0222537).

Ocean crust covers most of the earth, yet its origin at mid-ocean ridges is still not completely understood. The material that comprises ocean crust is called mid-ocean ridge basalt (MORB) and its composition varies, depending partly on the depth of melting in the earth's mantle that

produces it. Other variables such as changing mantle composition can also affect the chemistry of MORB, which means that the ocean crust can serve as a "window" to understanding the history and processes in the underlying mantle of the earth. A variety of fundamental earth processes thus hinge on the variable chemistry of MORB. Getting answers to these questions is greatly facilitated by having a central database of MORB chemistry available on-line. C. Langmuir and colleagues at Lamont-Doherty Earth Observatory developed and maintain the largest on-line database of ocean basalt chemistry in world. Scientists in the US and around the globe carry out research projects utilizing these valuable data. The database is available at (http://petdb.ldeo.columbia.edu) and is linked with many other diverse databases, creating opportunities for new discoveries about the earth's mantle and the ocean crust that is produced from it by melting.



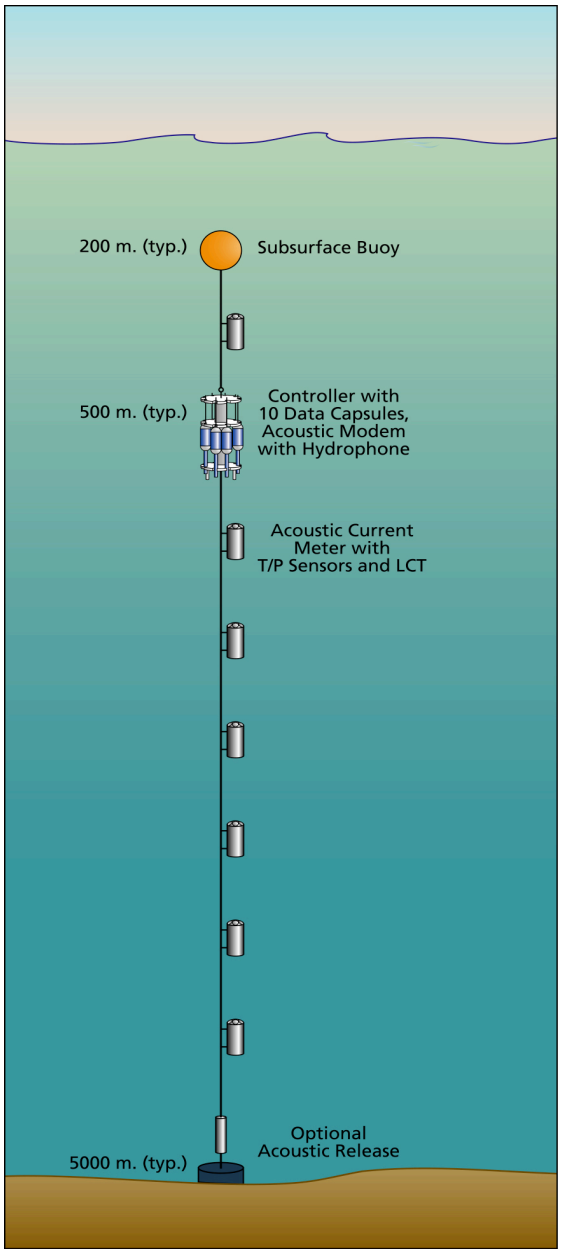
Locations of rock samples used in the PetDB database

Searching for Evidence of Life Deep Within the Oceanic Crust (J. Cowen, University of Hawaii, OCE- 9817616)

University of Hawaii researcher, Dr. James Cowen has succeeded in developing methods to sample deep within the environment of oceanic crust and with collaborators has demonstrated that crustal fluids support a diversity of microbial life. The finding of rich biotic communities at seeps, thermal vents, and hot springs on the deep ocean bottom has fueled speculation that life could, in fact, flourish deep within the ocean crust. This hypothesis, "the deep biosphere hypothesis", has been difficult to test because the technology to obtain samples from deep within the ocean crust was lacking.

Cowen and collaborators used NSF support to begin to develop new ways of obtaining uncontaminated samples and environmental data from deep ocean environments. They then received an exploratory research award (SGER) to develop biochemical and molecular methods to search for evidence of life within fluids from deep within the ocean crust. Cowen and colleagues were able to apply these new methods to examine samples collected from circulating crustal fluids from within 3.5-million-year-old ocean crust from the area of the Juan de Fuca Ridge in the northeast Pacific Ocean. By using both molecular and microscopy methods they were able to show that microbial life is present in these aging crustal fluids. The results of this project were recently reported in *Science*.

ULTRAMOOR (PI: N. Hogg, Woods Hole Oceanographic Institution, OCE-9810641; 0307695)



The goal of this project is the development of a new-generation mooring system that enables longer-term deployments. Present mooring technology is generally limited to systems that can only operate reliably for up to two years. These moorings must be deployed and maintained by specialized technicians and much of the instrumentation deployed on them represents technologies that are increasingly becoming obsolete. Because of maintenance issues and labor costs, these moorings are expensive to use. The increasing demand for fixed-point time-series measurements to investigate issues, such as global climate change and ocean circulation has prompted the development of a new generation of sub-surface mooring; ULTRAMOOR. ULTRAMOOR was designed to be easily deployable, for five years or longer, from ships of opportunity, using limited manpower. The PIs have concentrated their development effort on maximizing the length of deployments through incorporation of specialized materials into the mooring design, and developing a method to telemeter data from beneath the surface. The prototype ULTRAMOOR design consists of a subsurface mooring that supports 10 or more acoustic current meters. Each current sensor is equipped with a small, low power acoustic transmitter that transfers compressed data from its instrument to a receiver located below the euphotic zone (nominally at 500-m depth). The acoustic receiver forwards these data to an array of up to 10 expendable data capsules. In a typical scenario a capsule would release every 6 months over a 5-year deployment interval. Each capsule contains 4 Mbytes of solid-state memory and an Argos transmitter, which transfers the data via satellite as the capsule drifts away from the mooring. A Creativity Extension was recently awarded to the ULTRAMOOR PIs to enable them to continue the innovative work on this project. As part of this extension the capability to utilize the Iridium system for data telemetry will be added, a higher data rate acoustic link will be incorporated, and the present acoustic receiver will be replaced with a lower power receiver.

6.0 PART C. OTHER TOPICS

C.1 Please comment on any program areas in need of improvement or gaps (if any) within program areas.

The COV notes that to take full advantage of the large infrastructure investments being made for IODP and OOI, and to avoid funding shortfalls that might impact other areas of ocean science research, a significant increase in the Division's science budget will be required over the next few years. In this context, OTIC is likely to need additional program support staff to manage the OOI program.

The COV urges OCE to pursue more effective communication with EAR and ATM in order to increase joint funding of programs of mutual interest including ESH, MARGINS, and Continental Dynamics, as well as the development of new programs such as Ocean Mantle Dynamics.

The COV urges OCE to pursue more integrated, multidisciplinary climate studies.

Support for coastal geology is spread across a number of different programs in the Directorate. The value of a more coordinated coastal geology research program should be examined.

C.2 Please provide comments as appropriate on the program's performance in meeting program-specific goals and objectives that are not covered by the above questions.

See Section 7 of this report

C.3 Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.

The workload of NSF program directors is quite high due to the large number of proposals submitted to the core programs and the many interdisciplinary and agency-wide programs in which they participate to provide new funding opportunities for the research community. This high workload is manifested in decreased communications with PIs and participation in their respective fields. To address this problem, NSF should increase in the number of program directors, IPAs, and science assistants. NSF needs to re-evaluate its policies and work with home institutions to make IPAs more attractive for the very best people to spend time at NSF.

Both the Programs and the COV need better data and metrics to track trends in the thematic evolution of the science and the risk-taking nature of proposals.

The COV agrees with the NSF goal of increasing award duration and size while not negatively impacting proposal success rates.

C.4 Please provide comments on any other issues the COV feels are relevant.

See Section 7 of this report

C.5 NSF would appreciate your comments on how to improve the COV review process, format and report template.

The CORE QUESTIONS and REPORT TEMPLATE for the COV should be streamlined with a smaller number of questions focused on key issues.

The COV could provide a much more effective overview of the Division's research portfolio with better documentation of proposal attributes, and program budgetary and programmatic trends. The availability of data tables and graphs with proposal and budgetary information keyed to the questions posed in the Report Template would also prove extremely useful in responding to these questions. Given the objectives of the COV, we recommend that the following types of data and metrics should be prepared as both tables and graphics and available to the COV prior to their review.

1. Proposal history data: A list of awards, declines, and associated information so that COV can evaluate the broad perspective of OCE activities
2. Budget history of OS and MG sections and programs, including both focused and core programs, in current and constant dollars
3. Program award data: the number of proposals submitted and awards by program, mean annual award size in current and constant dollars, mean duration of award by program, and success rate.
4. Program balance data: A summary of the thematic classification for all awards and declines for each program and the success rate for thematic areas within each program.
5. A summary (tables and plots) of panel and mail review scores by program for all awards and declines.
6. Focus programs: A list and summary of the number of awards and declines by program and mean annual award size in current and constant dollars
7. Award yield: the amount requested versus funded for all awards in each program.
8. Proposal submissions and success rates for women, minorities, recent PhDs, ship proposals, and multidisciplinary proposals for all OCE programs

The COV report and the Division's response to it should be provided to the next COV prior to their review. Likewise, the COV report should be circulated to the program directors.

7. COV Section/Program Comments

The committee made the following specific observations regarding the proposal review process and the management of the research portfolios in the Division's two research sections and the OTIC program.

7.1 Marine Geosciences Section (MGG and ODP programs)

The Marine Geosciences Section supports research on processes that occur on and below the seafloor and at the water/sediment/rock interface. It supports major focused programs such as RIDGE2000, MARGINS, and MESH and major facility-based programs such as the Ocean Drilling Program.

Plaudits:

- The COV was impressed with the quality of the work, judgment, skills, and fairness exhibited by the Program Directors and Associate Program Directors in the management of the MGG program.

- The Section Head and ODP program directors have done an outstanding job in nurturing and developing IODP while continuing to manage ODP and its science support program.

- The COV commends the leadership of the Division and the Marine Geosciences Section for increasing the MGG core program budget by ~30% since 2000

- The MGG section has continued to be responsive to the community by supporting the development of new programs like MARGINS and RIDGE2000 and the establishment of the national OBS facility and long piston coring capability.

- The reorganization that brought MGG and ODP together in the Marine Geosciences section has been effective and has provided closer links between ODP science and the core geoscience research programs.

- The COV commends the MGG program for spearheading a long needed effort to establish repositories for the archiving and distribution of marine geoscience data.

Issues/Concerns:

- The processing of ~450 proposals per year, plus time spent on interdisciplinary proposals, facilities oversight, etc., is placing a huge demand on the program directors time.

- Despite the recent growth in the MGG core budget, a continuing concern is the low success rate (~22%) for proposals submitted to the MGG core program. The average MGG grant size is the lowest, and grant duration is the second lowest, among the programs within the Division.

- Funding levels for the MARGINS and RIDGE2000 programs will have to be increased in order to achieve the goals established by these programs within a reasonable timeframe.

- Given the emphasis within the MESH/ESH program on Holocene climate change, there is concern that there is an overemphasis on this same topic within the core program.

- The MGG program needs to work more closely with EAR and ATM on the development and joint funding of programs of mutual interest such as ESH and MARGINS, and proposed programs such as Ocean Mantle Dynamics.

7.2 Ocean Section

The Ocean Section of the Division of Ocean Sciences funds projects dealing with the disciplinary sciences of biological, chemical, and physical oceanography and interdisciplinary research in areas such as marine ecosystems, climate change, carbon cycle, biogeochemistry and coastal oceanography.

Plaudits:

- The COV was impressed by the advocacy role that the program directors in the Ocean Section have assumed to promote ocean research in the broader marine science community and to create new opportunities for research and collaboration. We encourage continuation and expansion of these activities to include inter-agency and international collaborative research.

- Strong interactions between the programs within the Ocean Section, and with the Marine Geosciences Section, is evident, and a continuation of these jointly funded efforts is encouraged.

- The response of Ocean Section programs to the recommendations of the Ocean Futures workshops (OEUVRE, FOCUS, APROPOS) in terms of program planning and emphasis is commendable.

- The data policy and data management implemented with the global change programs have made the results of these programs broadly available to the scientific community and provided new opportunities for synthesis and insights. These exemplary data policies should be continued in future focused research programs.

- The synthesis and modeling activities funded through the JGOFS program have been highly successful due in part to the data policy and management programs. These modes of research activity should be continued in Ocean Sciences through standard awards and Accomplishment Based Renewals.

- The Ocean Science COSEE program is highly innovative and a novel approach towards educating the broader community in ocean science.

Issues/Concerns:

- It would be easier for COVs, the scientific community and program managers to assess the scientific breadth of their programs if metrics were kept on Ocean Section sub-disciplines, under represented groups, degree of scientific risk and inter-disciplinary and collaborative nature of submitted and funded proposals.

- There appear to be significant differences in the return rate of mail reviews in different Ocean Section programs. Programs with low return rates need to be more proactive in soliciting proposal reviews.

- Ocean Sciences should have a key role in the planning and implementation of ocean observatories under the OOI. Both facilities development and research must be partners in the planning and implementation of ocean observatories.

- Increased interactions between Ocean Sciences and the Atmospheric Science Division can lead to new opportunities for the oceanographic community in climate and global change research programs.

- The funding growth rate of the Division's research programs have differed significantly over the past decade; the Section Head and Division Director are encouraged to examine the causes of these trends.

7.3 Ocean Technology and Interdisciplinary Coordination (OTIC) Program

The OTIC program is responsible for the following activities: (1) ocean technology development. Platforms such as Ultramoor and ABE were developed with OTIC support, as have been sensors such as those for measurement of hydrogen sulfide at hydrothermal vents; (2) Coastal Ocean Processes (CoOP). This science program was placed under OTIC because of its interdisciplinary nature; (3) National Oceanographic Partnership Program (NOPP). NSF's contribution to this program is carried under OTIC and supports ocean technology development such as automated detection of organisms on the basis of DNA content; and (4) Ocean

Observatories Initiative (OOI). OTIC has taken a leadership role in planning for the OOI MRE. In addition a small amount of support has been allocated to OTIC in 2003 to support observatory science.

Plaudits:

- The COV felt that management of OTIC has been excellent and the program director has brought a strong element of leadership and enthusiasm to the program.

- The OTIC program has played an important role in developing instrumentation and platforms that support scientific research in both the Ocean and Marine Geosciences sections.

- The COV commends the management of OTIC and the Division for their strong leadership role in the development of the Ocean Observatories Initiative (OOI). Ocean observatories will be a critical component of the Division in the coming years.

Issues/Concerns:

- The OOI initiative will place a significant burden on the OTIC program and it will need an additional program manager or IPA.

- The investment strategy of OOI in global, regional and coastal observatories is an issue in some parts of the community. OTIC, working with the Ocean and Marine Geosciences sections and the broader community, should continue to take a strong leadership role in the development of that strategy.

- The OOI will require significant scientific and instrumentation support beyond the MRE funds to realize its full potential. It is critical that the Ocean and Marine Geosciences Sections work closely with OTIC to exploit the scientific use of OOI. The evolution of CoOP should be reactive to the scientific aspects of the coastal component of OOI.

- The relationship between the research-based OOI initiative and the more operational US Integrated Ocean Observation System (IOOS) needs to be formalized, perhaps by working through the NOPP process.

8. COV Findings and Recommendations

Based on the background material provided to the committee, its review of proposal jackets, and its discussions with program staff, the committee presents the following findings and recommendations regarding the research programs within NSF's Ocean Sciences Division.

Findings

- The research programs in the Ocean and Marine Geosciences Sections, and the Ocean Technology and Interdisciplinary Coordination (OTIC) Program, are well managed and efficiently run, and support a broad portfolio of outstanding and innovative research.

- The leadership of the research sections in OCE has been strong and effective. Dedicated program directors have successfully administered individual research projects and nurtured and sustained a balanced portfolio of research that has maintained U.S. leadership in the ocean sciences.

- The Division's management is commended for significant increases in the Division's research budget over the past three years and for their leadership and vision in developing IODP and OOI, two major new infrastructure and science programs that promise to enable a new generation of ocean research.

- The recent re-organization of the Division into two research sections (Ocean and Marine Geosciences), together with the existing Integrated Programs section, has been successful at distributing the workload at the section head level among three people rather than two, and more effectively integrating ocean drilling research with other marine geoscience research programs. The COV found no evidence that the reorganization has negatively affected interactions among ocean and geoscience program directors.

- Given the ~1300 proposals submitted to OCE research sections annually, and the increasing burden of participation in various NSF-wide and GEO-wide focused interdisciplinary programs, the workload on OCE program directors has become excessive. This understaffing is negatively affecting the time program directors have to communicate with PIs, visit institutions, track program trends, and attend professional meetings and workshops.

- Despite the large number of proposals handled by the Division's research programs, final decisions on over 87% of these proposals are made within 6 months of submission. A review of the jackets indicates that in nearly all cases the program officers have documented a clear rationale for the funding decision. OCE program directors are commended for this exemplary record.

- A much higher proportion of mail reviewers are now addressing both the intellectual merit (Criterion 1) and broader impact (Criterion 2) review criteria, although reviewers often interpret Criterion 2 rather narrowly only in terms of educational or public outreach activities. Panel summaries and review analyses address both review criteria, although in some cases the panel summaries lack sufficient detail.

- There are significant differences in mail review return rates among different OCE programs (>80% in PO; <60% in BIO and MG&G). A more proactive approach with reminders to reviewers appears to increase return rates.

- SGER proposals, which support small, high-risk proposals, or rapid response studies, are being underutilized, constituting only ~1% of the program's proposal portfolio.

- IPAs and Science Assistants are invaluable assets to the Division both in terms of personnel work loads and intellectual dynamics.

- In order to address the range of questions in the present NSF COV Review Template additional information such as longer-term thematic program trends, program balance, thematic proposal pressure, joint program funding and proposal risk are needed.

Recommendations

- The Division of Ocean Sciences is strongly encouraged to increase the number of permanent program managers and IPAs, and to expeditiously fill existing openings, to reduce the increasing workload on program management staff. Science Assistants

provide valuable assistance to program directors and increasing their number in the Division would also help reduce the workload on program management staff.

- NSF and the home institutions of IPAs should re-examine the financial and career incentives they provide for IPAs to facilitate the recruitment of the highest quality individuals into IPA positions.

- Given the move toward electronic proposal processing the Division needs to reevaluate the mix of expertise required on the support staff, as well as staff training needs.

- The program should take steps to clarify for investigators and reviewers the variety of ways Review Criterion 2 (broader impacts) can be met. This might be done through the Division's Newsletter or through a letter sent to all OCE investigators.

- OCE program managers should be encouraged to increase the utilization of SGER grants for funding small, high-risk or rapid response proposals and to publicize this opportunity to investigators.

- Although recognizing that program management time demands continue to grow, program managers should be encouraged to attend meetings, workshops and institutions to meet with investigators, especially young investigators. These interactions between program staff and investigators are invaluable and the limited travel funds currently available to support travel by program directors should be augmented.

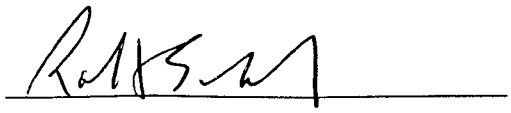
- The Division should continue to encourage and facilitate participation of under-represented groups in ocean research programs, and monitor trends in this participation. Of particular concern is the decline in the success rate of women and minority PIs relative to men since 2000.

- In order to fully realize the potential of the major infrastructure investments the Division will be making over the next few years in ocean observatories and ocean drilling, constant communication will be required among scientists, engineers and program directors, and a parallel increase in the Division's science budget will be required.

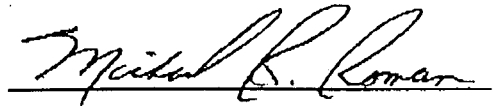
- The Division should place a greater emphasis on compiling and publicizing the major scientific achievements that result from NSF research support, and make this information broadly available.

- To increase the efficiency of the COV process it is recommended that a written Division overview and a complete set of information on proposals and funding history as detailed in Part C, Item C.5 (p. 27) be provided to the COV prior to their next meeting.

SIGNATURE BLOCK:



For the Ocean Sciences Division COV
Robert S. Detrick, Co-Chair



For the Ocean Sciences Division COV
Michael R. Roman, Co-Chair