

Conference on U.S. Participation (CUSP) in IODP*

*An Activity of the United States Science Advisory Committee (USSAC)

A Report to the U.S. National Science Foundation by the CUSP Steering Committee and USSAC

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Executive Summary

The initial science plan *Earth, Oceans, and Life* of the Integrated Ocean Drilling Program (IODP) proposes bold new themes and initiatives that focus on: environmental change, processes, and effects; the deep biosphere and the subseafloor ocean; and solid earth cycles and geodynamics. IODP will have a major impact on marine-related science over the next decade. The current international Ocean Drilling Program (ODP) is already one of the most successful and pervasive scientific activities in the geosciences, and U.S. scientists have been leaders in all aspects of the program. The leadership and broad participation of U.S. scientists in ODP have enhanced our fundamental knowledge in the geosciences. IODP holds even greater promise.

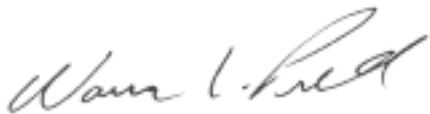
We emphasize from the outset that an essential component of U.S. success in scientific ocean drilling has been the consistent and flexible financial support directly from the National Science Foundation (NSF) and through the U.S. Science Support Program (USSSP). Given the broad participation and impact of scientific ocean drilling on the U.S. geosciences community, USSAC (**U. S. Science Advisory Committee**) seeks to ensure that U.S. scientists are adequately supported to participate in the new IODP and to enable the U.S. science community to take full advantage of the scientific opportunities envisioned for IODP.

In this context, the CUSP report, based on the Conference on U.S. Participation in IODP (CUSP), and on follow-on discussion and activities (e.g., web-based questionnaire), addresses the support

needs of U.S. scientists to fully participate in the international IODP. The report describes the indispensable elements of support for U.S. scientists to be administered by the NSF, and to define the characteristics and structure of the anticipated successor to the current USSSP, which has supported U.S. participation in the ODP.

We discuss the goals of providing support, summarize the programmatic and organizational changes, both international and national, that impact U.S. participation in IODP, and then summarize views of the U.S. scientific community and USSAC on a number of activities and issues concerning the support required at NSF and in a USSSP-successor program, culminating in a series of specific recommendations. These focus on the policy and principles of participation and support, rather than on the details of implementation and budgets. The recommendations identify new, emerging, and ongoing activities that need to be supported by NSF and a USSSP-successor program. The ocean-drilling community, responding to the online questionnaire, has expressed strong support for the CUSP recommendations (see Appendix 1).

U.S. support for participation in IODP should engage the broadest possible range of U.S. scientists, enabling them to participate completely and successfully in all aspects of the IODP. We should continue to ensure that all aspects of support for scientific ocean drilling foster high-quality, peer-reviewed science, producing comprehensive data sets that address scientific goals and objectives of fundamental importance and providing a visible and coherent scientific legacy.



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For the Members of the CUSP Steering Committee and the 2002-2003 USSAC

Scientific Ocean Drilling in the Twenty-First Century:

The *Integrated Ocean Drilling Program* and U.S. Participation

The current international Ocean Drilling Program (ODP) is one of the most successful and pervasive scientific activities in the geosciences. The ODP's scientific themes range from the composition of the mantle and dynamics of the lithosphere to fluid transport through the oceanic crust to geochemical and environmental history recorded in marine sediments. U.S. scientists have been leaders in all aspects of the ODP and their broad participation in ODP has enhanced our fundamental knowledge in the geosciences. Quantitative information^[1] about U.S. scientists' participation in ODP and the relationship to National Science Foundation (NSF) funding document part of this impact. Of the nearly 600 U.S. scientists receiving NSF Marine Geology and Geophysics (NSF/MG&G) funding from 1988-2002, ~30% have participated in an ODP expedition at least once. U.S. scientists have filled >1200 shipboard berths for ODP Legs 100-201, with >650 individual U.S. scientists having been shipboard scientists at least once during that time. Of these >650, nearly three out of ten have received NSF/MG&G funding at least once during the 1988-2002 interval. U.S. graduate students and postdoctoral scientists have had significant participation as integrated members of the international ODP science parties, representing ~25% of total U.S. berths. Over 1,000 individual U.S. scientists have had a total of nearly 5,000 sample requests filled since program inception. A critical element in the U.S. success has been the consistent and flexible financial support from NSF and USSSP.

The United States Science Advisory Committee (USSAC; Table 1) consists of volunteer scientists who advise the Joint Oceanographic Institutions, Inc. (JOI) on the operation of the United States Science Support Program (USSSP) associated with the ODP. USSSP, which is funded by the NSF Ocean Drilling Program^[2] (NSF/ODP) through a cooperative agreement with JOI, directly supports U.S. participation in the ODP (Table 2). NSF/ODP also provides funding for highly ranked, unsolicited proposals generally in support of activities affiliated with scientific ocean drilling including regional geological and geophysical studies and drill site characterization.

USSSP supports the participation of U.S. scientists in drilling expeditions, and includes travel to expeditions, salary support for expedition participation, and relatively modest post-expedition funding [3] targeted at fulfilling immediate post-cruise science obligations [4]. Although most of the budget is focused on these direct participation activities, USSSP also sustains a broad range of affiliated activities that enable wide and successful U.S. participation in ODP (Table 3).

Compelling scientific objectives continue to require ocean drilling as a means of acquiring samples of sediments, rock, biota, and fluids from beneath the seafloor, of deploying instruments for down hole measurements in boreholes, and of conducting sub-seafloor experiments and establishing observatories to address questions of fundamental significance in the geosciences. The needs for continued scientific ocean drilling and for a multi-platform approach within an international framework have been recognized explicitly in a number of U.S. and international planning documents over the past decade and more. These culminated in planning for the Integrated Ocean Drilling Program (IODP), with the scientific and organizational framework for IODP's first decade described in its Initial Science Plan (ISP), *Earth, Oceans and Life: Scientific Investigations of the Earth System Using Multiple Drilling Platforms and New Technology* (see www.iodp.org). U.S. leadership in this program begins with U.S. provision of a principal drilling vessel for the program, a continuous coring, non-riser drilling vessel, supported by multi-year U.S. funding contributions to IODP's annual, international operating costs. U.S. scientific achievement in the international IODP depends as well on strong national programs to support the participation of U.S. scientists, building on the successes of past support and addressing newly identified needs defined by the new era of scientific ocean drilling. This report addresses scientific support needs for U.S. scientists for future scientific ocean drilling, identifying areas to continue and areas to modify or improve, along with new types of support needed.

Goals in Providing Support for U.S. Participation in IODP

U.S. support for participation in IODP should engage the broadest possible range of U.S. scientists, enabling them to participate fully

and successfully in all aspects of the international program. We should continue to ensure that all aspects of scientific ocean drilling science support foster high-quality, peer-reviewed science, producing comprehensive data sets that address scientific goals and objectives of fundamental importance and providing a visible and coherent scientific legacy. To that end, the total U.S. program must accomplish the following:

- Support efforts of U.S. scientists to plan, initiate, and formulate drilling proposals, to participate across the full range of IODP activities, and to meet their obligations as international IODP participants;
- Support efforts of U.S. scientists to produce and contribute to comprehensive data sets that document core/sample, logging, and geophysical measurements associated with specific sites, geographic regions, and thematic areas, along with other relevant measurements;
- Support efforts of U.S. scientists to develop regional, thematic, and other syntheses of ODP and IODP data and results;
- Support and leverage efforts of U.S. scientists in publication, education, and outreach; and
- Support participation and leadership of U.S. scientists in national and international scientific ocean drilling advisory structures.

To help achieve these goals, USSSP provides a flexible funding mechanism that can respond rapidly to evolving program needs (such as rapid staffing of multiple expeditions), to a variety of small and non-traditional requests, while retaining a high level of community involvement and review.

Programmatic and Organizational Changes that Impact U.S. Scientist Participation in IODP

IODP will deploy multiple drilling platforms

Operation modes, staffing needs, and the very nature of participation will vary among the riser drilling vessel (the Japanese-funded vessel "Chikyu"), the continuous coring, non-riser drilling vessel (the U.S.-funded replacement for *JOIDES Resolution*-type

vessel), and mission-specific platforms (e.g., see Joint European Ocean Drilling Initiative [JEODI], www.jeodi.org). The U.S. programs must accommodate the increased scope and complexity of the IODP and the greater level and range of participation by U.S. scientists in field programs associated with these multiple platforms. Preparing mature drilling proposals for multiple platforms requires timely and adequate funding for regional site characterization studies. Oversight and management of U.S. participation in the IODP will be more complex and will require additional resources.

ODP/IODP drilling proposals are receiving increased levels of peer review by the scientific advisory structure and by external evaluators.

IODP, like ODP, is fundamentally a proposal-driven program, with drilling proposals evaluated within the context of the overall science plan for the program. Given the level of international panel and external peer review of drilling proposals and the scope of the proposed science goals and objectives, approved drilling programs are scientific/thematic program plans that have been given high priority by the international ocean drilling community. In this context, U.S. funding agencies should recognize the high priority science objectives of these drilling programs and support highly ranked U.S. proposals that address the international program's scientific goals.

Multi-leg proposals from organized scientific groups/programs and complex drilling programs (CDPs) are becoming more common.

U.S. scientists, as individuals and as groups of proponents, must be able to compete successfully with other national and disciplinary group drilling proposals. They will need funds for site characterization and development to be successful in preparing mature drilling proposals for the international science advisory structure. As larger and more organized programs emerge, such as Complex Drilling Programs (CDPs), which anticipate the use of multiple platforms and multiple legs, the U.S. must encourage broad, community-based participation in these long-term efforts and active participation in all stages of proposal preparation.

U.S. partnership in IODP will likely be 33%, versus >50% in ODP

The fully operational IODP will have an annual, international operating budget of approximately \$160 M, three times that of ODP, with an estimated annual U.S. contribution to the international program operating costs estimated to be ~\$50 M, primarily for operation of the non-riser drilling vessel. The relative proportion of U.S. participation in expedition parties, as co-chief scientists, and in the advisory structure, will decrease in the transition from ODP to IODP. The absolute number of U.S. participants, however, will likely increase because of the opportunities afforded by the multiple platforms of IODP. This reduction in the proportion of U.S. participation of each science party will have implications for staffing of IODP projects (expeditions). For example, selection of U.S. participants should no longer be used to balance or buffer the disciplinary needs of scientific parties. U.S. scientific community oversight and coordination of scientific staffing issues will be needed to insure the effective participation of U.S. scientists in IODP. The U.S. national committee may need to review U.S. participant applications and provide advice to the international program on U.S. staffing.

The ODP publication policy has changed substantially, with electronic publications and with publication in the external literature for scientific results.

Assuming that similar policies will be adopted by IODP, the goal is to have all scientists publish their post-cruise science results in the open literature, rather than in scientific results volumes published by a program entity. Currently, the support associated with U.S. ODP scientist shipboard participation is inadequate, in most cases, to meet fully the labor needs and analytical demands associated with publication in leading national and international journals, the obligation incurred by the participant. If appropriate support is not provided, scientists will likely meet their obligations by publishing gray literature (e.g., data reports in program-published journals), rather than scientific papers in respected journals. Although publication of post-cruise data reports addresses the goal of ensuring complete and accessible data sets, it does not address the larger issue of scientific accountability and visibility for U.S.

participation.

Educational and outreach requirements of the program will increase in IODP.

Although USSSP has undertaken modest and targeted educational efforts, these areas, in both the national and international programs for ODP, have not been developed as widely as many view appropriate. These are expected to be priority activities of the international program. Effective approaches will differ by national context, and the U.S. support programs need to address these in partnership with the international program and with other national sources of support for education and outreach.

NSF has created a new Marine Geosciences Section that unites the previously separate *Ocean Drilling Program* and the *Marine Geology and Geophysics Program* as co-equal partners.

This reorganization, with Bruce Malfait as the recently named section head, places NSF/ODP within a research section (rather than in facilities) and should establish a funding base to support IODP-related science at levels more appropriate to the science proposed.

NSF anticipates outsourcing of some parts of the U.S. program for scientist support in IODP.

Entities similar to USSSP and USSAC will be integral parts of the U.S. IODP support effort, complementing support programs housed at NSF Marine Geosciences. We anticipate that NSF will fund these entities through an agreement with a JOI-like management organization.

The Conference on U.S. Participation in IODP: Charge to USSAC, Workshop Structure, and Report Preparation and Format

In response to these programmatic and organizational changes, USSAC has been considering the elements of support that will be required at NSF and in a USSSP-successor program for U.S. participation in IODP. In a dialog with NSF, we defined the charge for this task as follows:

- Formulate the characteristics, elements, and tasks of the entire U.S. program required to foster and sustain the full range of research and educational activities needed for successful U.S. participation in the IODP.
- Identify and describe the optimal structure and resources for this program as well as the key entities, their connections, and their respective sets of authority, responsibility, and accountability.

To carry out this charge and to augment the ongoing USSAC discussions, we held an open invitation, community based workshop June 11-14, 2002 in Washington, D.C. The steering committee for this workshop consisted of the current and incoming USSAC chairs and four other members, including two scientific community members who are not current USSAC members (Table 4). Workshop attendees provided a brief statement of interest with respect to U.S. support needs for IODP participation. As background material, workshop attendees were provided with copies of various documents or web links to them (Table 5). At the meeting, we also discussed the timelines and transitions in drilling programs and U.S. support programs from ODP to IODP (Table 6).

Workshop attendees (Table 7) were also provided with a CUSP Philosophy Statement document on *Support for U.S. Participation in IODP*, which provides much of the introductory content and overall structure of this report. In particular, this document posed a series of questions about U.S. support activities in various areas, asking for responses indicating the relative priority of each activity, whether the activity should be managed at NSF or in a USSSP-successor

program, defining the required level of review for that activity, and asking how proactive USSAC should be in that activity.

The workshop opened with an evening session summarizing the background and goals, with presentations from USSAC, NSF, and JOI. During the workshop, we divided the >60 participants (50 workshop attendees, 15 liaisons/guests/observers) into four groups for focused discussions of U.S. support needs in these areas over the course of two days, with each discussion followed by plenary sessions reporting on the discussions in the individual groups (Table 8). In addition, a "seismic needs breakout group" met in the evening of the first full day, reporting on the final day. On the final day, we also discussed the preliminary overall outcomes of these discussions and mechanisms to solicit broader community input on our recommendations. Outcomes from these discussion groups and plenary sessions were used to draft this report, which was discussed in preliminary form at the July 2002 USSAC meeting and subsequently reviewed in complete draft form by the CUSP Steering Committee members and by USSAC members during August 2002. The revised version presented here has been circulated to CUSP attendees and posted to the web for community comment via response to a questionnaire based on the report with responses summarized in an appendix to this report (Appendix 1).

The CUSP workshop and this report divided the anticipated IODP activities into five broad categories reflecting the cascade of activities associated with proposing, planning, implementing, and publishing the field results and most immediate scientific achievements of a drilling program. In each of these categories, we identify activities and issues that need to be evaluated and prioritized in light of their contribution to effective U.S. participation in IODP. In general, these activities should be applicable to all IODP drilling platforms. The categories are:

- Program Development and Pre-Platform Activities,
- Platform Participation Activities,
- Post-Expedition Activities,
- Publication of IODP Results, and
- Education and Outreach Activities.

In the following, we identify a variety of planning, operational, and research activities and issues facing U. S. scientists and offer one or more recommendations to address the anticipated need in IODP. We use USSSP in the recommendations to mean the USSSP-successor program, USSAC to mean the successor to USSAC, and NSF to mean the equivalent of existing NSF programs (e.g., NSF/ODP or NSF/MG&G). Where appropriate, we identify the relative priorities of these activities, the level of review required, and the degree to which the U.S. national committee should be proactive in addressing that activity/issue. We characterize whether views at CUSP and among USSAC members were relatively unanimous on the recommendation or more mixed, and summarize the range of opinions on topics for which broad consensus was not reached.

Introduction to the CUSP Recommendations

USSSP has been a critical and successful component of U.S. participation in the ODP. USSSP has enabled and assisted U.S. scientists in planning, implementing, and pursuing ODP-related research on a wide variety of topics. NSF/ODP has been critical, providing support for site characterization efforts needed to formulate drilling proposals and to interpret their results. The NSF/MG&G community of scientists has greatly benefited from the support available from the USSSP and NSF/ODP. These CUSP/USSAC recommendations provide community guidance on the issues/activities that need to be addressed in the USSSP-successor program and recommend principles and policy to NSF Marine Geosciences for its continued support of U.S. scientific ocean drilling. This report is not an implementation plan that seeks to define specific levels of activity and funding. Rather, it is a community statement on the need to support various activities by U.S. scientists in the IODP and for flexibility to address the evolving and more complex activities in the IODP.

Mechanisms for providing IODP support: NSF and USSSP

The CUSP recommendations reflect two mechanisms for providing support to U.S. scientists in IODP: direct NSF support and indirect NSF support through USSSP. From nearly 20 years of experience,

the US scientific community has recognized the value and effectiveness of this two-component system to support US participation in the international ODP. The first component is direct support from NSF for certain activities, such as regional geophysical studies that are necessary to plan drilling campaigns, and large-scale resources for post-drilling scientific research. The second component is indirect support, in the form of a focused and long-term support program that is managed by an entity external to the NSF. Specifically, the US Science Support Program (USSSP) affiliated with the Ocean Drilling Program managed by JOI Inc. through a cooperative agreement with the NSF.

Why should the NSF outsource a support program to a corporation, such as JOI, Inc.? In brief, JOI/USSSP has a structure and governance that enables cohesive program management in a rapid and flexible manner, yet remaining under the auspices of NSF and responsive to community advice. A support program for ODP and IODP must manage many aspects of participation in a timely manner relative to cruise participation, ranging from travel logistics, personnel support, planning activities, educational activities, publication, and communication, to "back-office" activities such as subcontracting, purchasing, financial oversight, and audit compliance. Many of these activities are administrative and logistical in nature and often require rapid responses. Additionally, many of these actions, on an individual basis, involve small amounts of funds, often smaller than the standard NSF grant. As such, we think that JOI/USSSP support, rather than direct NSF support, is better suited to manage these aspects of IODP. Also, JOI/USSSP works with flexible proposal deadlines necessitated by the ongoing nature of the research expeditions, can respond rapidly to funding requests, both solicited and unsolicited, and is flexible in its response mechanisms. All these characteristics make JOI/USSSP an efficient, flexible and appropriate mechanism for supporting many of the operational aspects of U.S. participation in IODP.

Although much of the success of large-scale international scientific research programs, like the ODP and IODP, is based upon long-term planning, equal importance should be given to the flexibility and agility with which a support program is managed. As program plans evolve into operations, flexibility is needed in order to take

advantage of rapidly changing conditions, altered staffing plans, and evolving opportunities. In this partnership, the support program activities managed by JOI complement the direct support managed by the NSF. We recommend continuation of this two-component system in the IODP. This program, which will likely be significantly more complex than ODP, given the multiple-platform approach, and will continue to require a balance between long-term planning and support from the NSF, and rapid, flexible response from a USSSP.

Program Development and Pre-Platform Activities

Activity/Issue: How should USSSP use workshops to initiate and facilitate a range of intellectual activities related to IODP scientific planning?

CUSP/USSAC Recommendation 1. USSSP should increase its support of U.S. workshops to help foster the planning required for innovative drilling-related themes and approaches. Workshops should enhance the scientific vitality of the IODP, help maintain the flow of high-quality U.S. drilling proposals to the IODP, and encourage broad participation of the U.S. scientific community in all phases of scientific ocean drilling.

Workshops are viewed as a cost-effective mechanism to address a number of planning issues in IODP. They can be used to define new thematic areas and to fill out details in already identified drilling objectives. They can serve as venues for initiating complex drilling campaigns (see also Recommendation 2). The complexity of multiple drilling platforms and multiple leg drilling programs will require more community coordination and interaction to fully exploit these opportunities. In this context, workshops might be used as proposal planning groups. USSSP support should allow U.S. scientists to be assertive in proposing new topics and in planning drilling objectives. In general, workshops should be community-based planning activities open to broad U.S. national participation. They should be open to international participation (with other sources of funding required for the international participants) and, in some cases, should be jointly funded by IODP. The flexibility of USSSP and its ability to quickly respond to small proposals makes it an ideal

mechanism to fund workshops and to promote broad participation by the U.S. scientific community.

Activity/Issue: The long-term nature and complexity of some IODP programs will require new approaches and new funding mechanisms to provide the continuous scientific planning, technological development, and monitoring of scientific progress.

CUSP/USSAC Recommendation 2. USSSP should develop mechanisms for planning and monitoring U.S. scientific community interests in multi-year, multi-platform, and multi-leg programs. For example, this could include support for small teams of U.S. scientists focused on the scientific, technological, and engineering aspects of complex drilling programs to promote community-based planning activities.

The anticipation of large-scale or complex drilling programs that will use multiple platforms, multiple legs, and other activities over a number of years will require new management tools for the planning, implementation, monitoring, and evaluation of these programs. One possibility is the creation of small, long-term planning/monitoring groups to follow a program from its planning through its implementation and publication. Such groups would not duplicate or replace IODP advisory groups, but would provide a mechanism for U.S. interests to be developed and nurtured. Such a long term commitment and the level of effort likely involved will require some salary support and travel funds and administrative support for a small number (perhaps two-four) of U.S. principal investigators. USSSP should be responsive to the U.S. community in identifying the programs that require such support and in enabling several long-term planning groups. Planning activities may often need to be initiated well in advance of anticipated drilling to develop proposals sufficiently mature to be highly ranked and scheduled by the IODP. USSSP's efficient management of such small-scale but long-term efforts make it an appropriate support mechanism to support these planning and monitoring activities.

Activity/Issue: How should USSSP use workshops to initiate and

facilitate a range of intellectual activities related to IODP scientific assessment, synthesis, and legacy development?

CUSP/USSAC Recommendation 3. USSSP should increase its support of efforts to assess and synthesize drilling results by U.S. scientists, and to promote interaction with scientists from allied disciplines. This could include thematic symposia on drilling-related topics that produce peer-reviewed publications.

Documentation of the legacy of scientific ocean drilling is key for assessing progress and accountability, for defining the impact of scientific ocean drilling results on the broader geosciences, and for defining new activities. Support should be made available for U.S. scientists to initiate and participate in activities focused on synthesis and evaluation of IODP results. These efforts should be open to the broad U.S. scientific community, and should include international collaboration whenever possible (although other sources of funding will be required for international participants). Interaction with allied U.S. scientists from affiliated disciplines will ensure that scientific results from ocean drilling can appropriately impact multidisciplinary work, and that multidisciplinary approaches can be more effectively melded into future program planning. The ability of USSSP to quickly review proposals and to assist with the administrative and logistical aspects make it an ideal mechanism to support synthesis activities.

CUSP/USSAC Recommendation 4. NSF/ODP should continue to support regional geological and geophysical characterization and survey proposals for potential drilling regions. The U.S. funding needs for regional site development and characterization are anticipated to be greater in the multiple-platform IODP than in the ODP. Early and appropriate support of these regional studies is critical to the preparation of competitive drilling proposals.

Activity/Issue: requirements for site characterization, including syntheses and various levels of geophysical surveys, for multiple

drilling platforms in IODP will be more comprehensive and expensive overall.

Site characterization will need significant additional resources in NSF/ODP, USSSP, and IODP, and new approaches are needed especially in support of geophysical site characterization for riser drilling. Although site-specific safety studies for identified drilling sites are an IODP responsibility, scientific characterization of potential drill sites is the responsibility of individual national programs, and is a key component in bringing a drilling proposal to scientific maturity. The needs for scientific site characterization will be significantly greater in IODP, given multiple platforms operating in a broad range of environments that were previously inaccessible to scientific ocean drilling in ODP (e.g., deep passive margins, Arctic Ocean, shallow epeiric seas, deep convergent margins). Full stand-alone regional surveys should be administered by NSF/ODP, as in the current structure. Given the increase in site characterization effort required, the U.S. community needs to better link initial, maturing, and mature scientific drilling proposals with site characterization efforts to adequately identify the scientific issues at proposed drilling sites and to best integrate drilling results with geophysical surveys. Timely and appropriate support of these activities is necessary to best define drilling targets and interpret their scientific results. Given the size and long lead time of these ship-based studies, direct NSF support is the most appropriate funding mechanism.

CUSP/USSAC Recommendation 5. USSSP should continue to support small to moderate size proposals from U.S. scientists for drill site development efforts including those linked to maturing drilling proposals and therefore requiring relatively rapid response. USSSP funding needs for these efforts are anticipated to be larger in the IODP than in the ODP.

USSSP is viewed as an efficient mechanism to support small to moderate studies that augment identification or characterization of

specific drilling targets. The cutoff for small to moderate varied somewhat in discussion, but these programs would have total budgets typically <\$100,000 and often <\$50,000. Often, these proposals will be responding to specific questions from the science advisory structure, in particular with regard to site survey and pollution prevention and safety requirements. USSSP provides the flexibility to fund proposals with short timelines and therefore requiring flexibility in submission deadlines. USSSP can also support small to moderate proposals by U.S. scientists that address special experiments related to ocean drilling (e.g., tools, sampling, monitoring). The existing flexible USSSP categories for site augmentation efforts, distinct from the full-scale regional studies supported by NSF/ODP, are viewed as appropriate starting points for this USSSP activity in IODP. This aspect of the USSSP program needs to have flexibility and responsiveness, as these proposals are often specific to particular challenges of specific regions and sites and a wider range of U.S. activities related to IODP may require support. The U.S. needs in this category, as in the regional site characterization efforts funded by NSF/ODP, are anticipated to be larger in the IODP.

Activity/Issue: What role should USSSP play in the development of new technology and in the application/modification of existing technology in support of IODP drilling objectives, regardless of platform?

CUSP/USSAC Recommendation 6. USSSP should support small conceptual or "seed" money proposals from U.S. investigators to develop or adapt new technology for scientific ocean drilling. USSAC should work with IODP advisory panels to identify technology needs in the service of drilling objectives where U.S. support could be appropriately focused. The NSF Marine Geosciences Section should be a source of funding for major technology development related to scientific ocean drilling.

USSSP is not viewed as the prime resource for technology development issues in the IODP, and these activities are most

appropriately housed at NSF or in the international program. Recognizing that technology development for IODP is not solely a national issue, USSSP can provide "seed" money to initiate new technological developments by U.S. scientists for IODP. Major technology development proposals are more appropriate for the NSF Marine Geosciences Section or IODP.

Activity/Issue: The complexity of planning and implementing the IODP (multiple platforms, multiple operators, and U.S. participation ~one-third of total) will require greater coordination between the U.S. drilling community and the IODP planning, advisory, and management structures.

CUSP/USSAC Recommendation 7. The USSAC-successor should operate as the U.S. national committee for ocean drilling-related activities (National Committee for Ocean Drilling, NCOD). NCOD activities should include coordination of scientific staffing nominations for drilling legs and science advisory panels, mentoring U.S. drilling proposals, and initiating opportunities for U.S. scientists to participate in IODP.

Given the more complex IODP, the increased total, but lower relative, participation of U.S. scientists, and the expanded education and outreach activities, the USSAC-successor (NCOD) will need to take a more active part in the initiation, support, and oversight of U.S. participation in the IODP. NCOD will need to foster communications between U.S. members of international advisory panels and the U.S. national committee. NCOD will need to be more active in tracking and mentoring U.S. proposals within the advisory structure. Many CUSP participants thought the NCOD should have a strong role in coordinating and prioritizing the U.S. nominations for scientific staffing for drilling expeditions, but some thought that the NCOD should have no such role and that the platform operators and co-chief scientists should be free to choose any U.S. scientist applicants as expedition members. The final science party selections will always lie with the platform operators, but the U.S. should put forward the strongest and most appropriate slate of U.S. scientists

for each expedition. CUSP participants favoring a role by the NCOD in U.S. scientific staffing also noted that increased resources at the JOI-successor would be necessary to help manage this process

Activity/Issue: How should USSSP support the participation of U.S. scientists in national and international advisory structures related to the IODP, including as chairs of panels and committees?

CUSP/USSAC Recommendation 8. USSSP should compensate U.S. chairs of advisory panels and committees through appropriate salary or honorariums, and should provide appropriate administrative support funds to chairs.

CUSP/USSAC Recommendation 9. USSSP should support the travel needs for U.S. scientists to participate in meetings of the national and international science advisory structures for IODP.

As the planning, advising, and monitoring of IODP activities becomes more complex and time consuming, U.S. scientists are being asked to volunteer substantial amounts of time as panel chairs and as participants of standing and ad hoc national and international committees. In many cases, the amount of time causes hardships for both hard and soft money scientists. In some cases, appropriate individuals decline to serve as chairs because of the significant uncompensated time commitment. The issue of compensation for panel/committee chairs was raised at the CUSP workshop by a number of participants who noted the increasing time commitment of accepting a national or international leadership role in IODP. In the interest of having the best and most appropriate U.S. scientists serve as chairs in the national and international advisory structures, some salary support or honorarium was thought critical by many participants. Administrative support funds will allow chairs to accomplish required tasks and responsibilities (e.g., preparing

meeting minutes, communicating with members and other bodies, photocopying, mailing, etc.) The travel should be funded for U.S. scientists to participate in national and international advisory bodies affiliated with IODP. USSSP's efficient management of small projects and its logistical support make it the appropriate support mechanism for these advisory activities.

Platform Participation Activities

Activity/Issue: In the IODP, which will have multiple platforms and drilling scenarios, what will constitute participation in the science party?

CUSP/USSAC Recommendation 10. Platform participation in IODP should be defined as on-site (platform or onshore) activities by scientists for the initial documentation of cores, samples, and boreholes resulting in contributions to an *Initial Reports*-like volume. The definition of participation must be flexible to account for the different times, extents, and nature of activities conducted on different IODP platforms.

Staffing models for riser drilling campaigns and mission-specific platform expeditions are unclear relative to the more familiar continuous coring, non-riser vessel expeditions of ODP. The operational definition of participation in the scientific party will need to be flexible so that the U.S. support program can adapt to the different drilling modes. However, the concept of participation in the scientific party must imply significant shipboard or equivalent shore-based activity that results in a contribution to the initial documentation and report of the expedition. For purposes of participation-based support, these activities would be distinguished from shore-based party members who merely work on post-expedition samples. The intent is to define a range of participation that reflects expedition and post-expedition responsibilities. These definitions of participation are similar to recent interim Scientific Measurements Panel (iSCiMP) resolutions which considered the Shipboard Party to be "*All scientists selected by IODP to produce*

initial, openly shared data associated with the project." The Auxiliary Party was considered to be "All other scientists selected by IODP that receive samples or data within the moratorium period."

Activity/Issue: What level of USSSP salary support should U.S. scientific party members receive for expedition participation?

CUSP/USSAC Recommendation 11. USSSP salary support for U.S. scientific party members in IODP drilling expeditions should reflect their platform-related responsibilities and time commitments to the expeditions. Greater pre- and post-expedition responsibilities should be reflected in greater salary support and a range of salary support may exist within a scientific party. As a general rule, the minimum support package for a U.S. scientific party member should reflect time on the drilling platform (including travel to and from the platform) plus an increment to meet pre- and post-expedition responsibilities related to characterization and description of drilling results for an *Initial Results*-type volume.

Definitions of appropriate salary support for a U.S. scientist participating in an IODP drilling expedition varied significantly. Consensus was clearly reached that salary support for time spent on the drilling platforms (or in equivalent drilling-related expedition activities for mission-specific platforms with limited on-platform capabilities) was required, including for time traveling to/from platforms. U.S. scientific party members may also spend time in pre-expedition activities (e.g., training for shipboard responsibilities) and in post-expedition activities (e.g., archiving data, refining composite sections, editing of *Initial Results*-type volumes, sampling parties) that are directly related to their shipboard responsibilities and to fully characterizing and documenting the materials recovered. A wider range of opinion was expressed about how much salary support, in addition to expedition time, was required for this component. Models include support for time-on-platform plus 50% (e.g., a total of 3 months for a two-month expedition) to time-on-platform plus 100% (e.g., a total of 4 months). Flexibility will be required in these

definitions to accommodate the different expedition definitions for different drilling platforms. For example, for mission-specific platform drilling, some were recommendations to define a minimum time increment (e.g., two weeks) for these programs even if drilling time is only a few days.

The wider range of opinion on this issue partially reflected perceptions that current models of support for U.S. scientists were, at least at times, inadequate to meet expedition obligations. This issue also had interplay with discussions about the funding of scientific research carried out after the expedition to meet the obligations of participation (see Recommendation 14). Clearly, USSSP needs to integrate the issues of participation-based salary support and the salary support available from post-expedition science grants. This recommendation, however, deals exclusively with support for expedition participation. In general, participants wanted the level of salary support to reflect the actual time commitments and responsibilities of the scientific party participants for expedition participation, with the recognition that these may vary among scientific party members in IODP and across different IODP platforms. A number of participants noted that the current salary levels for expeditions may not be enough for university academics to "buy out" teaching time for one term and thus limit their expedition participation to summers or sabbaticals. We anticipate that 60 to 100 U.S. scientists will participate in IODP each year and that their roles will be diverse and that many will be selected on relatively short time scales. Hence, the USSSP mechanism is very appropriate for the logistics and support for this critical element of U.S. participation.

Activity/Issue: What level of USSSP salary support should U.S. co-chief scientists receive for expedition participation?

CUSP/USSAC Recommendation 12. USSSP salary support for expedition participation for U.S. co-chief scientists should reflect the level of effort and responsibilities for the planning, implementation, research coordination, and synthesis and publication of IODP expedition results over the multi-year time span of commitment to the expedition.

A number of past ODP co-chief scientists indicated that the co-chief responsibilities were long-term and the current salary support model did not reflect the effort required to plan the drilling legs, edit the *Initial Results* volume, coordinate and edit the *Scientific Results* volume, and complete the required and desired synthesis papers. Although some participants felt no increase was needed over the present funding level (i.e., time on platform +200%, typically six months support for a two month non-riser leg), some thought that increased support was appropriate. Some noted that soft-money participants were at a disadvantage because they spent so much unfunded time on the pre- and post-expedition activities. IODP may have a longer pre-cruise planning cycle, with an earlier commitment by the co-chief scientists. Some suggested phased salary support over several years would address the long-term commitment by co-chief scientists.

Activity/Issue: What role should USSSP play in the long-term support, routine maintenance and data collection from sea floor observatories that are associated with scientific drilling?

CUSP/USSAC Recommendation 13. USSSP should support small proposals from U.S. scientists to coordinate appropriate seafloor observatories with IODP drilling plans. Implementation and long-term operational and maintenance support for these facilities should come from NSF or other agencies.

Seafloor observatories are recognized as an important new initiative in ocean and earth sciences. The planning and implementation of these observatories may involve ocean drilling and face many of the same needs for rapid responses and flexible timelines as site augmentation activities. In this context, USSSP should consider small proposals to coordinate seafloor observatories with drilling-related plans and activities. USSSP is not the appropriate source for funding data collection and long-term maintenance of these sea floor facilities. Several participants suggested that JOI might propose an USSSP-like structure that could efficiently manage both short-term

and long-term support for sea floor observatories and facilities. USSAC encourages JOI to develop a proposal for a program for the management of seafloor observatories that could be submitted to the NSF or other appropriate agencies. The establishment and operation of seafloor observatories will entail significant equipment, implementation and operational funds that will generally have long lead times. Direct NSF funding for these larger projects with some coordination by USSSP is thought to be the appropriate balance of support activities.

Post-Expedition Activities

Activity/Issue: The level of post-expedition science support is considered inadequate to complete the obligation of a peer reviewed publication or to accomplish the science objectives of the program. Further, the similar size of many post-expedition awards and high funding rate are perceived to be at odds with extensive peer review of these post-expedition proposals.

CUSP/USSAC Recommendation 14. USSSP should develop a tiered system for post expedition science support for U.S. scientists, with the goal of providing appropriate, adequate, and timely funding to promote high quality research related to expedition objectives. Flexibility in how funding is allocated is needed in all tiers of USSSP support.

The issue of post-expedition science support is probably the most contentious and widely debated topic, and recommendations 14 and 15 both deal with this issue. Almost all scientists indicate that the level of participation-based support currently available is not adequate to bring the science to the level of a peer-reviewed contribution, the obligation incurred to the international program by a U.S. participant, or to address the scientific objectives of each cruise in a timely manner. They also note a significant time delay (usually a year or more after the expedition) before funds can be obtained through the normal NSF proposal route. The financial

resources are required in a timely manner to meet the scientific expectations of competitive, peer-reviewed, high quality science. The losses to U.S. science as a consequence include reduced number/quality of peer-reviewed articles published in a timely fashion on scientific ocean drilling results and a limited ability to synthesize and integrate drilling-related results. In addition, insufficiently funded research must then be subsidized by other, unrelated programs. This is in stark contrast to some non-U.S. scientists who arrive at the drilling platform with research funds in hand, and are thus in stronger negotiating positions when sample allocation discussions occur on drilling platforms.

To address the problems of level and timing of post expedition support, almost all CUSP participants suggested some variation of a multi-tiered support system. The first tier of post-expedition support would be funding available to essentially all expedition participants submitting reasonable proposals. The next tier or tiers would have larger awards, based on proposals from U.S. scientists eligible to receive samples or data in expedition moratoria intervals, and would require significantly greater review. Consensus was clear that adequate, appropriate, and timely post-cruise research support was needed to allow U.S. IODP science to flourish. However, a considerable range of opinions was expressed about what should constitute the different tiers and the distinction between USSSP and NSF funding, although both types of funding are clearly required. The discussion of the level of post-expedition support was often mixed with discussion of the level of salary support for participants discussed in Recommendation 11, although we have attempted to separate them clearly here. Discussions assumed that IODP expedition participants would incur post-cruise research obligations similar to those in ODP, and that there would be moratoria in which only expedition participants would be eligible to receive IODP data/samples. Definitions of these protected time windows will be more complex for the full range of IODP drilling platforms.

The first tier of USSSP research support received relatively unanimous endorsement. This was defined as participation-based research support to allow U.S. scientists to meet their post-cruise research obligations to the expedition. The possible definitions of obligation ranged from a data report to a fully peer-reviewed journal

contribution. Suggestions for the average size of these awards ranged from \$20K to \$40K, with most participants wanting a more competitive process that resulted in a wider range of award sizes within a scientific party and from expedition to expedition. Opinions on the review process for these post-expedition participation USSSP awards ranged from essentially internal review (JOI program manager, U.S. co-chief scientist or other lead U.S. scientist, and USSAC) to full peer review of the package of proposals or of individual proposals. Those participants suggesting internal review only mostly considered this level of funding as part of the expedition package that is intended to meet the obligations incurred by participation, and noted that the drilling program and its objectives had already undergone extensive external review. In addition, some tied this to more extensive national screening and review of expedition applicants by the NCOD. Many participants preferred larger post-expedition research awards than at present, noting that current typical awards of \$22K are not adequate in all fields to produce a peer-reviewed paper. All agreed that there should be as few restrictions as possible on how funds can be budgeted. USSSP is the best mechanism for this support due to its ability to rapidly respond to proposals once the expedition is complete and the relatively small amount of individual funds (below the average NSF/MG&G grant).

The proposal for a second tier of USSSP post-expedition support was more controversial. This tier seeks to provide larger amounts of funding on a timely basis for a more limited number of U.S. scientists who are actively pursuing the scientific objectives of the expedition on a sustained basis. Many participants suggested that these proposals would receive full peer review, much like NSF proposals, with more competition for these funds, with perhaps only one to three of these proposals funded per expedition. These would compete for USSSP funds that were dedicated to the objectives of IODP, and this funding would be timelier relative to expedition participation than possible for NSF funding. In this context, some participants suggested that USSSP should allocate different amounts of post-expedition research funds depending on the complexity and level of U.S. participation. Definition of the size of these second tier proposals ranged, with some participants thinking that any proposal larger than \$50K should be handled at NSF, and

others anticipating a USSSP Tier Two award size range up to \$100K.

An alternative solution to larger post-expedition research funding in USSSP Tier Two is to request that the NSF Marine Geosciences Section adopt a rolling submission basis and more timely review for post-expedition or even pre-expedition proposals. This would help address the problem of receiving funds for post-expedition research in a timely manner relative to drilling. This suggestion anticipates NSF Marine Geosciences funds that are broadly allocated to the science objectives of IODP expeditions and that are available for competition immediately after each expedition. This concept is still Tier Two funding on a timely basis and is separate from the more general objective-based IODP research discussed in Recommendation 15.

Activity/Issue: Many U.S. scientists perceive that ODP/IODP-related proposals submitted to NSF/MG&G do not receive a balanced review that takes into account the degree of review and prioritization inherent in the JOIDES review of the science, at least in some areas of the field. Also, the perception that NSF/MG&G funds are biased toward "hot" topics is thought to decrease the funds available for many ODP/IODP-based proposals. Finally, a significant increase in funds is needed to accommodate the increase in proposals related to the expansion of U.S. scientific interests in the IODP.

CUSP/USSAC Recommendation 15. Significant post-expedition science support for U.S. scientists beyond the tiered USSSP structure should be funded by NSF, primarily through the Marine Geosciences Section. The budget anticipated for IODP-related science should be significantly increased to adequately and appropriately fund the expanded levels of participation, the wider scope of science, the increased analytical demands, and the more complex science programs planned for IODP.

As program-based proposals have broader goals and higher funding needs, the U.S. IODP funding structure needs to insure that

highly ranked science is being adequately and appropriately funded across the broadest sweep of disciplines. With the expansion in the scope of IODP and multiple drilling platforms, the funding levels need to drastically increase if U.S. scientists are to fully participate in the science of IODP, rather in just the drilling expeditions. Proposals for program-based research should be direct funded through the NSF Marine Geosciences Section. As proposal objectives and funding levels increase, the U.S. IODP community recognizes the need for competitive proposals with full peer review and community involvement. In this context, proposals that reflect the science objectives of successful ODP/IODP reviewed drilling proposals should be considered as part of a community accepted program plan (similar to RIDGE or MARGINS program plans). Several participants suggested a scientific ocean drilling related panel to provide a knowledgeable resource for advice to NSF on scientific ocean drilling related proposals.

Publication of IODP Results

Activity/Issue: What publication mode for the *Initial Reports* and *Scientific Results* volumes are most useful to researchers, students, and legacy issues?

CUSP/USSAC Recommendation 16. The *Initial Reports* volume is highly valued by the U.S. scientific community, and IODP *Initial Reports* should be published electronically and in traditional print media. The *Scientific Results* volumes should be electronic compilations of all papers published on a particular expedition, including those published in the external literature.

Publication policy is probably the second most debated issue in ODP/IODP. Many scientists thought that publication of both traditional print form and electronic versions of the *Initial Reports* volumes would be beneficial to many activities in both research and teaching. Suggestions were made for an electronic IODP journal that would publish all IODP-related papers or a virtual *Scientific Results* volume that would collect or link to all published IODP-related papers

and data reports.

Education and Outreach Activities

Activity/Issue: What role should USSAC/USSSP play in developing and producing educational materials for K-12, undergraduate, and general outreach audiences?

CUSP/USSAC Recommendation 17. USSAC/USSSP should increase its efforts to initiate and foster educational activities and should partner with educational agencies and researchers to conduct the detailed development and production of educational materials.

Many CUSP participants think the current level of USSSP activity in the fields of education and outreach is inadequate and should be increased in the new IODP. However, participants also indicated that education activities should be via partnerships with appropriate educational researchers and agencies to leverage the small "seed" money grants the USSSP could provide. CUSP strongly supported USSAC's role in identifying educational opportunities and initiating educational materials based on the ODP/IODP operations and results. Several discussion groups noted that one or more specialists in education/outreach would be needed at the JOI-successor to develop contacts with educational researchers and agencies, generate educational and outreach products based on IODP results, and seek funding for educational efforts. Additional suggestions were that USSAC should have a standing committee on education, and that a workshop on ODP/IODP-related education and outreach should be supported by USSAC.

Activity/Issue: What should be the level of Schlanger fellowships for ODP/IODP graduate student support in IODP?

CUSP/USSAC Recommendation 18. USSSP should continue support for the Schlanger fellowships during the ODP/IODP transition and should, in the IODP, at least double the number of fellowships currently awarded by USSSP for the ODP.

CUSP discussions strongly supported the Schlanger Fellowships as a successful and cost-effective outreach and development of the next generation of IODP researchers. Suggestions were made to both increase the number of fellows each year and to lengthen the tenure to two years. Some participants felt that the fellowship program should be modeled after the NSF or NASA fellowship programs and that both external review and USSAC review were needed. Other participants asked that the goals and objectives of the fellowship program be clarified for the community. Is it to recognize excellent ODP/IODP-related science, to recruit new ODP/IODP researchers, or as general scientific ocean drilling outreach?

Activity/Issue: What should be the level of effort in the USSSP-funded U.S. Distinguished Lecturer Series in the IODP?

CUSP/USSAC Recommendation 19. USSSP should continue support for the U.S. Distinguished Lecturer Series during the ODP/IODP transition and in the IODP.

Discussion: CUSP participants thought that the U.S. Distinguished Lecturer program was a cost-effective mechanism for getting the ODP/IODP message out to parts of the broader academic community. Participants also felt that this program was important

during the transition between ODP and IODP, regardless of whether new drilling platforms are yet in operation, so that the levels of interest in the new program would not lag behind the needs of IODP.

Summary of Recommendations

We offer a series of specific recommendations, summarized below, about the total U.S. support program for IODP, including those elements to be housed at NSF and those in a USSSP-successor program. Some recommendations reflect widespread, nearly unanimous agreement and therefore reflect group consensus. Other recommendations represent topics on which a much broader range of opinions were expressed, and the recommendations are not necessarily unanimously supported. The discussion presented in the text of the report with each recommendation therefore summarizes the range of views expressed as context.

PROGRAM DEVELOPMENT AND PRE-PLATFORM ACTIVITIES

CUSP/USSAC Recommendation 1. USSSP should increase its support of U.S. workshops to help foster the planning required for innovative drilling-related themes and approaches. Workshops should enhance the scientific vitality of the IODP, help maintain the flow of high-quality U.S. drilling proposals to the IODP, and encourage broad participation of the U.S. scientific community in all phases of scientific ocean drilling.

CUSP/USSAC Recommendation 2. USSSP should develop mechanisms for planning and monitoring U.S. scientific community interests in multi-year, multi-platform, and multi-leg programs. For example, this could include support for small teams of U.S. scientists focused on the scientific, technological, and engineering aspects of complex drilling programs to promote community-based planning activities.

CUSP/USSAC Recommendation 3. USSSP should increase its support of efforts to assess and synthesize drilling results by U.S. scientists, and to promote interaction with scientists from allied disciplines. This could include thematic symposia on drilling-related topics that produce peer-reviewed publications.

CUSP/USSAC Recommendation 4. NSF/ODP should continue to support regional geological and geophysical characterization and survey proposals for potential drilling regions. The U.S. funding needs for regional site development and characterization are anticipated to be greater in the multiple-platform IODP than in the ODP. Early and appropriate support of these regional studies is critical to the preparation of competitive drilling proposals.

CUSP/USSAC Recommendation 5. USSSP should continue to support small to moderate size proposals from U.S. scientists for drill site development efforts requiring relatively rapid response, including those linked to maturing drilling proposals. USSSP funding needs for these efforts are anticipated to be larger in the IODP than in the ODP.

CUSP/USSAC Recommendation 6. USSSP should support small conceptual or "seed" money proposals from U.S. investigators to develop or adapt new technology for scientific ocean drilling. USSAC should work with IODP advisory panels to identify technology needs in the service of drilling objectives where U.S. support could be appropriately focused. The NSF Marine Geosciences Section should be a source of funding for major technology development related to scientific ocean drilling.

CUSP/USSAC Recommendation 7. The USSAC-successor should operate as the U.S. national committee for ocean drilling-related activities (National Committee for Ocean Drilling, NCOD). NCOD activities should include coordination of scientific staffing nominations for drilling legs and science advisory panels, mentoring U.S. drilling proposals, and initiating opportunities for U.S. scientists to participate in IODP.

CUSP/USSAC Recommendation 8. USSSP should compensate U.S. chairs of advisory panels and committees through appropriate salary or honorariums, and should provide appropriate administrative support funds to chairs.

CUSP/USSAC Recommendation 9. USSSP should support the travel needs for U.S. scientist to participate in meetings of the national and international science advisory structures for IODP.

PLATFORM PARTICIPATION ACTIVITIES

CUSP/USSAC Recommendation 10. Platform participation in IODP should be defined as on-site (platform or onshore) activities by scientists for the initial documentation of cores, samples, and boreholes resulting in contributions to an *Initial Reports*-like volume. The definition of participation must be flexible to account for the different times, extents, and nature of activities conducted on different IODP platforms.

CUSP/USSAC Recommendation 11. USSSP salary support for U.S. scientific party members in IODP drilling expeditions should reflect their platform-related responsibilities and time commitments to the expeditions. Greater pre- and post-expedition responsibilities should be reflected in greater salary support, and there may be a range within a scientific party. As a general rule, the minimum support package for a U.S. scientific party member should reflect time on the drilling platform (including travel to and from the platform) plus an increment to meet pre- and post-expedition responsibilities related to characterization and description of drilling results for an *Initial Results*-type volume.

CUSP/USSAC Recommendation 12. USSSP salary support for expedition participation for U.S. co-chief scientists should reflect the level of effort and responsibilities for the planning, implementation, research coordination, and synthesis and publication of IODP expedition results over the multi-year time span of commitment to the expedition.

CUSP/USSAC Recommendation 13. USSSP should support small proposals from U.S. scientists to define or initiate seafloor observatories related to IODP drilling. Implementation and long-term support for these facilities should come from NSF or other agencies.

POST-EXPEDITION ACTIVITIES

CUSP/USSAC Recommendation 14. USSSP should increase the funds available for post-expedition science and should develop a tiered system for post-expedition science support for U.S. scientists, with the goal of providing appropriate, adequate, and timely funding to promote high quality research. Flexibility in how funding is

allocated is needed in all tiers of USSSP support.

CUSP/USSAC Recommendation 15. Significant post-expedition science support for U.S. scientists beyond the tiered USSSP structure should be funded by NSF, primarily through the Marine Geosciences Section. The budget anticipated for IODP-related science should be significantly increased to adequately and appropriately fund the expanded levels of participation, the wider scope of science, the increased analytical demands, and the more complex science programs planned for IODP.

PUBLICATION OF IODP RESULTS

CUSP/USSAC Recommendation 16. The *Initial Reports* volume is highly valued by the U.S. scientific community, and IODP *Initial Reports* should be published both electronically and in traditional print media. The *Scientific Results* volumes should be electronic compilations of all papers published on a particular expedition, including those published in the external literature.

EDUCATION AND OUTREACH ACTIVITIES

CUSP/USSAC Recommendation 17. USSAC/USSSP should increase its efforts to initiate and foster educational activities and should partner with educational agencies and researchers to conduct the detailed development and production of educational materials.

CUSP/USSAC Recommendation 18. USSSP should continue support for the Schlanger fellowships during the ODP/IODP transition and should, in the IODP, at least double the number of fellowships currently awarded by USSSP for the ODP.

CUSP/USSAC Recommendation 19. USSSP should continue support for the U.S. Distinguished Lecturer Series during the ODP/IODP transition and in the IODP.

CUSP QUESTIONNAIRE

A 26-question survey (Appendix 1) was developed from the CUSP report and the recommendations therein. The survey first solicits demographic information, and then seeks opinions on the CUSP report and recommendations. The final question solicited text responses (versus multiple choice) regarding any other pertinent comments about ODP, USSSP, or the CUSP document. The questionnaire was distributed electronically in the following manner.

- On October 11th and 21st, email messages were sent from JOI, on behalf of the CUSP co-chairs, to two large groups of people. The first includes scientists directly involved with the ODP and USSSP, such as: (a) US members of JOIDES and iSAS panels, committees, and groups; (b) USSAC members; (c) participants in the CUSP workshop; and (d) members and alternates of the JOI Board of Governors. The second includes over 2000 individuals included on the JOI/ODP electronic listserver, most of whom are located in the U.S.
- The listserver messages directed the recipients to a JOI web site (<http://www.joiscience.org/USSSP/iodp/cusp.html>) that contained the CUSP report, background materials, and a brief description of the CUSP initiative. The JOI web site directed respondents toward the online survey, which was hosted on a website managed by SurveyLogix". This survey was active, or "live," in the sense that respondents could answer questions, and data were collected, for a three week period ending October 31, 2002.
- The survey was also announced directly on the JOI website (www.joiscience.org).

Demographic profile of respondents

The first seven questions in the survey focused on demographic information. The survey indicated that over 95% of the 149 respondents were affiliated with a US-based organization. Most (80%) were very familiar with the ODP and, in each of the following cases, over 50% of the respondents had: (a) used ODP samples and/or data; (b) been a proponent on a JOIDES drilling proposal; (c)

served on a JOIDES advisory panel; and (d) been a member of an ODP scientific party. With regard to shipboard experience, the respondents showed a wide range, spanning from 32% with no prior experience, to 33% having sailed more than twice. The remaining third had sailed once or twice. Regarding experience with USSSP, in each of the following cases, over 50% of the respondents: (a) are included on the JOI/ODP electronic listserver; (b) had used a USSSP educational product (e.g., CD-ROM); (c) are included on the *JOI/USSAC Newsletter* mailing list; (d) have participated in a USSSP-sponsored planning workshop; and (e) attended a talk given by a JOI/USSAC Distinguished Lecturer. In short, survey respondents are scientists closely affiliated with the ODP and USSSP. Nevertheless, based on text comments, a few respondents were not familiar with the ODP and are not professionally associated with marine geology and geophysics.

Opinions expressed on the CUSP report

The second part of the survey presented the 19 CUSP recommendations and provided respondents five choices (Agree Strongly, Agree, Neither Agree nor Disagree, Disagree, and Disagree Strongly) to express their opinion. The survey results reveal strong support for each of the CUSP recommendations. The percentage of respondents that "agree" and "agree strongly" with each recommendation ranges from 71% to 97%; in other words, the U.S. ocean-drilling community strongly and uniformly supports the CUSP recommendations. Details are available in Appendix 1.

The 26 text responses provide a revealing cross-section of supplemental opinion. These comments are provided, unedited (except for anonymity) and unabridged, in Appendix 1. Some argue for greater resources, others for the same amount as is currently available. Some of the respondents expressed a view or mentality of abundance, in that they perceive that greater resources for IODP will not come at the expense of other activities in the NSF Ocean Sciences Division. Others were less sanguine, believing that expansion of one scientific endeavor requires contraction in another. Other comments were contributed on the topics of: (a) the scope of responsibilities for the new US National Committee; (b) publications (e.g., electronic vs. paper); (c) educational activities; and, among

others (d) the two-tiered system of post-cruise funding.

SUMMARY

The sum of these recommendations and the response to the questionnaire conveys the sense of the U.S. ocean drilling community on the importance of various participation issues and support activities to the full participation of U.S. scientists in the IODP. These recommendations are intended to serve as the basis for more specific program plans, for the structure of the USSSP-successor program, and for implementation plans that will define the specific levels of effort and support for the various activities.

Table 1. United States Science Advisory Committee (USSAC) Membership October 2001-30 September 2002

Nathan Bangs

Institute of Geophysics
University of Texas

Barbara Bekins

U.S. Geological Survey
Menlo Park

Timothy J. Bralower

Department of Geology
University of North Carolina

Margaret Delaney (Chair)

University of California, Santa
Cruz

Peter B. deMenocal

Lamont-Doherty Earth
Observatory
Columbia University

Earl Doyle

Industry consultant

Jeffrey Gee

Geosciences Research Division
Scripps Institution of
Oceanography

Albert Hine

College of Marine Science
University of South Florida

Jonathan B. Martin

Department of Geology
University of Florida

Tommy J. Phelps

Environmental Sciences
Division
Oak Ridge National
Laboratory

Warren L. Prell

Department of Geological
Sciences
Brown University

Carolyn Ruppel
 School of Earth and
 Atmospheric Sciences
 Georgia Institute of Technology

Deborah K. Smith
 Department of Geology and
 Geophysics
 Woods Hole Oceanographic
 Institution

John M. Sinton
 Department of Geology and
 Geophysics
 University of Hawaii

Ellen Thomas
 Department of Earth and
 Environmental Sciences
 Wesleyan University

Table 2. NSF Support of U.S. Participation in the Ocean Drilling Program

Activity	Amount*
International Program Operations <ul style="list-style-type: none"> • ~\$47.6M commingled funds • NSF (U.S.) contribution, ~65% of total 	\$31.0M
Focused NSF Funding, ODP Expedition Science	
NSF/ODP	\$10.3 M
JOI/U.S. Science Support Program	\$6.4 M
Other NSF Funding, ODP-Related Science	
Various Geosciences Programs especially Marine Geology and Geophysics	Total unknown

**Amounts are FY2002 for NSF funds and USSSP Program Year 18, March 2002-February 2003, for USSSP funds.*

Table 3. United States Science Support Program, USSSP Year 18, March 1, 2002-February 28, 2003

Activity*	Percent of Total Yr 18 Budget(\$6.4 M)
Scientist Support Includes travel to/from drilling vessel, salary support for expedition time, immediate post-expedition science grants for science party members (shipboard participants and designated shore-based scientists)	65%
Program Administration Includes support for USSAC travel, USSAC Chair's office, ODP Science Operator's costs for administering elements of scientist support, JOI office	23%
Planning Activities Includes support for workshops, travel for U.S. participants in JOIDES Advisory Structure (ODP) and interim Science Advisory Structure (ISAS) for IODP, JOIDES Panel Chair support	8%
Educational and Outreach Activities Includes Schlanger Ocean Drilling Fellowship Program, JOI/USSAC Ocean Geosciences Distinguished Lecturer Series, curriculum enrichment activities	3%
Site Development Activities Includes site augmentation activities, data syntheses, and mini-workshops	<1%
DP Enhancements Includes results symposia	<1%

Table 4. CUSP Steering Committee

Member	Institution
Warren Prell CUSP Co-Chair (Current USSAC Chair)	Brown University
Margaret Delaney CUSP Co-chair (Former USSAC Chair)	University of California, Santa Cruz
Nathan Bangs	University of Texas, Austin
Bob Duncan	Oregon State University
Earl Doyle	Industry Consultant
Terry Quinn	University of South Florida

** Special Engineering Development is a program element in the USSSP Program Plan, but there has been no funding in this item since USSSP Year 14. The last activity in this category was the Wireline Reentry System.*

Table 5. Background Documents for the CUSP Meeting

Topic	Documents
U.S. participation goals for IODP	<i>A New Vision for Scientific Ocean Drilling, A Report from COMPOST-II: The U.S. Committee for Post-2003 Scientific Ocean Drilling</i>
	<i>The Structure of the U.S. Component of a Future Scientific Ocean Drilling Program: Report of the Ad Hoc USSAC Committee, JOI/USSAC Newsletter 11(3), p. 21, 1998</i>
Justification of participation of U.S. scientists in IODP	<i>Understanding Our Planet Through Ocean Drilling: A Report from the United States Science Advisory Committee</i> (web document http://www.joiscience.org/USSSP/UPOD.html)
	<i>United States Participation in the Integrated Ocean Drilling Program 2003-2013</i> (brochure based on web document)
Current USSSP and USSAC	USSAC Background Description
	Year 18 USSSP Program Plan
	Current USSAC member list

Table 6. Timelines and Transitions: ODP to IODP

Drilling Programs		U.S. Support Programs		
ODP	IODP	NSF/ODP	USSSP	USSSP Successor
Drilling operations end 9/30/03		Continues throughout, focus of activities will evolve	Budget decreases for 3/03-2/04 Year 19 to reflect shorter drilling operation year*	
Wind-up activities continue through 2007 (U.S. NSF Funding)	Program initiates 10/1/03			
	Mission-specific platform drilling may begin in 10/03-9/04 time window		Annual budgets from 3/04 to program end are minimal, solely close-out activities	
	Non-riser vessel operation begins ~10/04-3/05 time window			
	Riser vessel <i>Chikyu</i> in international operation ~10/07			Goal: 3/04 start, spin-up activities from ODP/USSSP and initiate new activities as needed by platform operations

* Planned budget for 3/03-2/04 includes planning, education, and site development activities.

Table 7. CUSP Attendees

Name	University/Organization	E-mail Address
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[1] We compiled information on NSF/MG&G awards from 1988-2002, inclusive, from the NSF Fastlane Database. There have been 1,711 grants to 589 unique principal investigators (PIs) in that time interval, totaling \$311M. Of the 589 unique NSF/MG&G recipients, 181 (or 31%) have been a member of an ODP scientific party at least once for Legs 100-201 inclusive (1985-2002). NSF/MG&G awards to these PIs from 1988-2002 total \$114M, although not necessarily on ODP-related science, representing 37% of total NSF/MG&G funding over that time interval. A review of JOI/USSSP and ODP/TAMU databases identified 1,204 U.S. shipboard berths total, including U.S. ODP Staff Scientists and U.S. Borehole Research Group (BRG) Logging Scientists, for Legs 100-201 inclusive. At the time of sailing, ~209 berths were identified as being filled by graduate students and ~92 by post-doctoral fellows or postdoctoral research scientists, representing ~25% of total U.S. berths. There were 659 unique U.S. participants filling these berths for Legs 100-201, with the majority sailing only once. Comparison of the NSF/MG&G and list of U.S. shipboard scientists indicated that ~27% of U.S. shipboard scientists (181/659) received NSF/MG&G funding in the 1988-2002 time interval. ODP/TAMU records document 4,957 total sample requests from U.S. scientists from program inception through August 2002, from 1,101 individual scientists (i.e., some scientists had more than one sample request during that interval).

[2] In the Marine Geosciences Section of the Ocean Sciences Division at NSF, "Ocean Drilling Program" is the name of the NSF program that supports unsolicited proposals related to scientific ocean drilling, primarily for investigations of potential drilling regions, especially by means of regional geological and geophysical field studies; the feasibility and initial development of down hole instruments and techniques; and down hole geophysical and geochemical experiments. To distinguish this from the international Ocean Drilling Program referred to as ODP, this will be identified as NSF/ODP. The statistics given in Footnote 1 do not include scientists uniquely supported by NSF/ODP. Many scientists contribute to site characterization efforts related to scientific ocean drilling, but do not necessarily participate as shipboard scientists in drilling expeditions.

[3] For example, for twenty recent ODP legs (Legs 175-194), the average USSSP post-cruise science award to individual PIs was \$22,461, with a range of award size from \$5,027 to \$47,607. This average excludes awards to multiple PIs submitting proposals with single, combined budgets.

[4] The obligation of any U.S. scientist as an invited participant on an ODP cruise, in addition to fulfilling shipboard responsibilities to the scientific objectives of the cruise, is to use samples or data from the leg s/he participated in to conduct post cruise research and to publish associated results in (a) a peer-reviewed scientific journal or book that publishes in English or (b) the Scientific Results volume (data report or paper) by specified times after cruise completion. We anticipate similar obligations in IODP.