18 April 2012

Written Testimony of Dr. David Divins, Program Director, Integrated Ocean Drilling Program – United States Implementing Organization (IODP-USIO)
Vice President and Director Ocean Drilling Programs, Consortium for Ocean Leadership

UNITED STATES HOUSE OF REPRESENTATIVES
Subcommittee on Research and Science Education

NSF Major Multi-User Reasearch Facilities Management: Ensuring Fiscal Responsibility and Accountability

Chairman Brooks, Ranking member Lipinski, and distinguished members of the Subcommittee, thank you for the opportunity to testify about the management and and operations of multi-user research facilities. My name is David Divins, I am the Program Director and Principal Investigator of the System Integration Contract for the Integrated Ocean Drilling Program (IODP–USIO). I also serve as Vice President and Director of Ocean Drilling Programs within the Consortium for Ocean Leadership.

I will begin with an overview of the Integrated Ocean Drilling Program (IODP) from its inception to operations today and a brief introduction of the facility, the JOIDES Resolution, which I am responsible for. My testimony also will address the questions posed to me by the committee.

Overview – Integrated Ocean Drilling Program

Scientific ocean drilling represents one of Earth sciences' longest running and most successful international collaborations.

The first phrase of scientific ocean drilling, the Deep Sea Drilling Project (DSDP), began in 1968 and operated using the D/V Glomar Challenger. This was the first NSF Multi-user facility for scientific ocean drilling. DSDP sampled the global seafloor by deep ocean coring and downhole logging, and its accomplishments were striking. Research based on the samples strongly supported the hypotheses of seafloor spreading—the relationship of crustal age to the record of Earth's magnetic reversals—and plate tectonics.

In 1985, JOIDES Resolution replaced the Glomar Challenger at the start of a new program, the Ocean Drilling Program (ODP). ODP was truly an international cooperative effort to explore and study the composition and structure of the Earth's subseafloors. During ODP, the JOIDES Resolution, a larger and more advanced drilling ship, was used to conduct 110 expeditions with 2000 holes from major geological features located throughout the ocean basins of the world.

Integrated Ocean Drilling Program (IODP) builds upon earlier successes of the Deep Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP) to revolutionize our view of Earth history and global processes through ocean basin exploration. The program, begun in 2003 and scheduled to run through 2013, distinguishes itself from its legacy programs by employing multiple drilling platforms, *JOIDES* Resolution (US), Chikyu (Japan) and Mission-Specific-Platforms (Europe) and collaborating with 25 worldwide nations.

IODP's mission is to advance the scientific understanding of the Earth by monitoring, drilling, sampling, and analyzing subseafloor environments. IODP draws samples of rock, sediment, living organisms, and fluids from beneath the seafloor to study the interdependence of geological, physical, chemical, and biological processes in the Earth system. IODP research focuses on factors controlling climate change, the vast circulation of fluids within Earth's crust, the nature of life on and within Earth, and the dynamics of the formation of the Earth. Most IODP research, therefore, takes place in the fields of geology, geochemistry, plate tectonics, paleoclimatology, and chemical oceanography.

Scientific ocean drilling's long history of discovery continues with IODP. For more than 40 years, stretching over hundreds of scientific expeditions, and involving thousands of researchers, the outcomes of scientific ocean drilling have significantly advanced our understanding of the Earth. Reliable information about how our planet works—and has worked in the past—is recorded in great clarity in the sediments and rocks that form the global ocean floor. The pristine samples of subseafloor sediments and rocks, brought to the surface by scientific ocean drilling, are indispensable to scientists expanding mankind's knowledge of environmental change, earthquake genesis, volcanic processes, the evolution of life on earth, and more.

***JOIDES* Resolution Overview**

The *JOIDES* Resolution serves as the riserless drilling research platform for the science community as well as the United States' contribution to support the scientific mission of the IODP. After 20 years of service, the *JOIDES* Resolution, the pioneering scientific ocean drilling vessel that allowed scientists to retrieve samples of the Earth's crust and sediments from deep beneath the ocean, was modernized and retrofitted with funding provided by the NSF Major Research Equipment and Facilities Construction (MREFC) Account.

During its history, the *JOIDES* Resolution has been adapted and upgraded with minor modifications several times. But the scale of the latest conversion was beyond any past upgrades. The *JOIDES* Resolution, also known as the JR, is renowned for its global capability, versatility and operational flexibility. The JR can operate in water depths from 75 to 8,200 meters, with as much as 2 kilometers of subseafloor penetration. After 133 scientific drilling expeditions, the JR underwent a $115 million renovation supported by the NSF and came back into service in 2009. This comprehensive renovation, which extended the JR's life by 20 years, included the replacement of all structures forward of the derrick as well as the upgrade or replacement of all major drilling and downhole logging systems. A new multifloor laboratory was installed, and the majority of the science systems were renovated or replaced. The ship now holds state-of-the-art analytical equipment for onboard core descriptions and equipment for a wide variety of microbiological, geotechnical and analytical chemistry investigations.

In the three years since its return to operations, the JR has shown its versatility, with global operations that include high-resolution paleoceanographic expeditions, investigations into the evolution and formation of a large igneous province, mantle dynamics, global sea-level change, Antarctic glaciation history, subseafloor hydrogeology and microbiology. Its new drilling capabilities have directly led to scientific coring penetration records, including the deepest scientific ocean sediment hole drilled to 1,928 meters. On each expedition, a staff of about 55 scientists and technicians process the core and completely characterize the recovered material by conducting detailed chemical, geotechnical and microbiological analyses.

The new and improved JR enables IODP to continue to expand the boundaries of ocean drilling research by collecting unique subseafloor samples and data that would otherwise remain inaccessible to researchers.

IODP United States Implementing Organization

The Consortium for Ocean Leadership and its partners, the Lamont-Doherty Earth Observatory (LDEO) of Columbia University and Texas A&M University (TAMU), were selected by NSF to be the IODP United States Implementing Organization (IODP-USIO), providing the *JOIDES* Resolution to IODP. Ocean Leadership, the USIO Systems Integration Contractor, is responsible to NSF and IODP Management International (IODP-MI) for the overall program leadership, education and outreach, technical, operational, and financial management, and delivery of services. USIO Science Services, TAMU, under subcontract to Ocean Leadership, is responsible for providing a full array of science services, ranging from vessel and drilling operations to ship- and shore-based science laboratories, core repositories, and publication. USIO Science Services, LDEO, under subcontract to Ocean Leadership, is responsible for logging-related shipboard and shore-based science services and for leading an international logging consortium to participate in scientific ocean drilling operations. The objectives of the USIO are to provide leadership regarding the U.S. interests in IODP as the challenges and demands of a multiplatform drilling program present themselves. The USIO also seeks to ensure that services are provided in a cost-effective and responsive manner to facilitate comprehensive, integrated, and flexible management that involves a broad array of stakeholders.

IODP science planning is supported by the Science Advisory Structure (SAS), an independent structure that involves approximately 100 scientists and engineers on five standing committees and panels. IODP-MI, formally hosting SAS, supports the SAS by managing the submission and review of drilling proposals, assisting SAS committee chairs, and organizing and maintaining public records of SAS activities. The IODP-MI-hosted Operations Task Force (OTF) assists in the SAS process, and has representatives from the SAS, the Implementing Organizations and IODP-MI. OTF's primary function is to define fiscally and operationally feasible drilling plans, based on SAS scientific priorities, and present its findings for final inclusion in the annual science plan.

All IODP science is motivated by community input in the form of proposals that are reviewed and prioritized by the IODP SAS. All proposal submissions are reviewed by the Proposal Evaluation Panel (PEP), which in turn will receive program-external peer-review of mature proposals before being considered for implementation by OTF. Science plans approved by SAS need funding agency approval before actually being carried out.

Why does the federal government contribute funding for IODP?

As Earth's population expands, changing climate conditions, increasing demand for resources, and the risks of geohazards such as earthquakes and tsunami demonstrate the need for better understanding of the close connection between the Earth system and daily human life. Millions of years of Earth system change—devoid of human influence—are recorded in the sediments and rocks located beneath the seafloor, providing a baseline record against which we can compare current and future planetary change. The seafloor itself contains potentially valuable new resources and hosts novel microbial communities that live at the limits of habitability. The flows of mass and energy from Earth's deep interior to the surface create new crust, build volcanoes and islands, and generate earthquakes and landslides. Scientific ocean drilling provides the only means to access valuable historical information, collect samples and data, conduct experiments, and monitor conditions and active processes as they occur in remote marine environments. Scientific ocean drilling addresses the fundamental questions about Earth's climate, deep life, geodynamics, and geohazards, and facilitates a long-term, global perspective on some of today's most pressing environmental issues.

What is the return on investment from the facility or equipment for the U.S. taxpayer?

Without scientific ocean drilling we would not understand how our planet is forming and our climate history as well as we do today. It is difficult to put a price tag on the knowledge gained through scientific ocean drilling.

While the science of IODP is priceless, we could be getting more. As mentioned earlier, NSF invested $115 million to renovate and upgrade the *JOIDES* Resolution. The "new" JR is a state of the art floating university with laboratory capabilities not found at most U.S. universities. However the global economic situation took a change for the worse during the time the JR was in the shipyard with oil prices sky rocketing. The impact of the ever increasing oil prices on the fuel and lubricants the JR needs, and also on shipping and other related costs has been devastating, reducing our ability to operate the facility at an optimal level. At the time the JR was returning to operations, within NSF there appeared to be a shift in the way facilities were funded and all operations and maintenance costs for new facilities (like the JR) were to be accounted for within existing divisional budgets. The result on the facility was a decrease in operations from 12 months to 8 months per year. The reality is that for a 20% increase in funding we could deliver 40% more fundamental and groundbreaking science and be operating our facility at an optimal level.

Please describe how and why foreign entities, non-profit organizations, industry, or other organizations are involved in the facility, including financial support.

IODP's initial 10-year life span is supported by seven funding entities, including the U.S. National Science Foundation and Japan's Ministry of Education, Culture, Sports, Science, and Technology (the Lead Agencies), the European Consortium for Ocean Research Drilling (Contributing Member), and the following Associate Members: the People's Republic of China

(MOST), the Interim Asian Consortium (Korea), The India Ministry of Earth Science (MoES), and the Australia-New Zealand IODP Consortium (ANZIC). Platform Operation Costs are supplied directly to the Implementing Organizations by the national agencies that support them. Co- mingled funds from these sources are used for the Science Operation Costs of all IODP program activities.

Lead Agencies

IODP is primarily supported by the two Lead Agencies (NSF and MEXT). Each Agency has equal membership rights and responsibilities, contribute core capabilities to the IODP, determine total program costs, and contribute equally to the total program costs. The Lead Agencies provide budget guidance to the Central Management Office (IODP Management International) and review and approve the annual IODP Program Plan prior to implementation.

Members

IODP members are expected to make appropriate annual payments to the National Science Foundation. The annual payments are then co-mingled and turned over to the Central Management Office for distribution in support of science-operating costs. Annual payment must be at least equal to one full “participation unit”. The amount of a participation unit is adjusted annually to meet the demands of specific program objectives (the amount is about $5.6 million). To attain membership in IODP, a minimum annual contribution amount equal to one participation unit is required. A member’s expected level of participation in the IODP is proportional to the number of participation units represented by that member’s contribution to the IODP.

One participation unit entitles an IODP member to the right to (1) have two of its scientists participate in each drilling cruise; (2) be represented on all planning and advisory panels; (3) have access to all data, samples, scientific and technical results, all engineering plans, data or other information produced under contracts supported as program costs; (4) have access to all data from geophysical and other site surveys performed in support of the program which are used for drilling planning; (5) submit proposals to the Science Advisory Structure for drilling or engineering developments in support of IODP science; and (6) be represented on the IODP Council.

The European Consortium for Ocean Research Drilling (ECORD) Managing Agency is currently a member of IODP (in addition to the Lead Agencies). The consortium represents 17 European nations and Canada. The European Consortium provides the IODP scientific community with access to mission-specific platforms, in the form of funding and implementation, in addition to the participation unit(s) contributed for science-operating costs.

Associate Members

Associate IODP members are those that contribute an amount less than one participation unit and equivalent to at least 1/6 participation unit. Associate IODP members may elect to have scientific participation and representation on Science Advisory Structure service committees, panels, or working groups in proportion to their contributions. However, associate members do not have representation on the Science Advisory Structure Executive Authority. Participation in drilling operations is prorated based on the fraction of participation unit contributed by an associate member (one full participation unit corresponds to inclusion of two scientists in all drilling operations).

Non-Profit

Recently the Gordon and Betty Moore Foundation provided funding for the instrumentation and partial infrastructure for the seafloor observatories installed on an IODP expedition. Third party support, especially non-profit organization is a means of increasing the scientific return on NSF's investment in ocean drilling. The instrumentation needed for IODP's seafloor observatories is becoming increasingly difficult to fund through NSF program dollars. Foundation, like the Moore Foundation can make a major contribution to ocean drilling and our understanding of the longterm processes in the subseafloor.

The Consortium for Ocean Leadership, the prime contractor for IODP is a non-profit organization and represents more than 100 universities, consortia, and government and private entities.

Industry

Historically the role of industry in IODP has been as members of the Science Advisory Structure and members of scientific expedition parties. IODP is looking to industry for cost saving opportunities. Industry use of the JOIDES Resolution would save NSF day rate and other costs, freeing funds to be used to add operational days or seafloor observatories.

What steps are being taken to ensure the best stewardship of American tax dollars at IODP? How do you ensure federal funding is properly spent, managed and accounted for?

The IODP-USIO has a hierarchical structure, with the Consortium for Ocean Leadership (a non-profit) as the 'prime' and each partner as a 'subawardee.' A Contract between Ocean Leadership (OL) and the NSF establishes a set of terms and conditions for the project, which flow down to each subawardee. The IODP-USIO Program Management Office at Ocean Leadership is responsible for project compliance to those terms and conditions, including reporting of financial status and technical progress against milestones. On a functional basis, the program management office monitors and coordinates the work within the expedition-driven project schedule through daily interactions between Ocean Leadership and each major subawardee. Several teleconferences are conducted each week by the Program Management Office to facilitate communications across the geographically-distributed team.

Discussions and meetings occur with NSF frequently. The development and submission of quarterly reports by the Program Management Office to the NSF also serves as an important management tool for the Program Management Office.

What role do you play in the scientific, budget, and management components of IODP, including monitoring and evaluating the facility or equipment and/or work conducted through IODP? What role does NSF play?

I serve as the IODP-USIO Director, coordinating leadership actions with the senior staff at each partner organization, and communicating on a regular basis with the NSF. I report to the CEO of the Consortium for Ocean Leadership. The IODP-UISO Senior Management Team, composed of myself with the Directors at our partner organizations, Texas A&M University and Lamont Doherty Earth Observatory of Columbia University, has responsibility for overall project management and implementation of the operational schedule. I have ultimate budget responsibility and work closely with the senior management team to set budgets and spending priorities.

Under the Contract, IODP-USIO has specific reporting and procurement compliance responsibilities to the NSF. In addition, prudent project management dictates that the IODP-USIO maintains open channels of communication with the NSF about all project activities. We therefore have frequent interaction and information exchange. This level of interaction has been extremely beneficial.

I also work closely with the IODP Science Advisory Structure (SAS) to implement the highest priority science identified by the ocean drilling community. The IODP-USIO actively participates in all SAS meetings to make sure that the facility delivers what the scientific community requires within the limits of the resources at our disposal. I visit the facility on a regular basis to meet with IODP-USIO staff as well as the onboard science participates to listen to and collect feedback about their experience on the JR. These informal meetings prove to be the most effect means to ascertain the effectiveness of the IODP-USIO.

Regular communication and collaboration with NSF is essential to maintain our effectiveness, our flexibility, and our level of service to our scientific community.

How do you plan for the life-cycle of the facility or equipment, including possible ramp-down? How is NSF involved in the planning? Please describe the recompete history of IODP and the current status of the contract.

At the beginning of IODP, as part of the IODP Systems Integration Contract, a new scientific ocean drilling vessel was planned. As described above, the JR was completely modified for use by the IODP science community. The expected lifetime of the new JR is 20 years, that includes the 10 years of IODP and a potential program renewal of 10 additional years. The initial contract for use of the JR is 10 year contract (2004-2013) with a series of 10 one year extensions possible for a future drilling program. The option to exercise the one-year options is the IODP-USIO and NSF's.

As part of our annual planning process in collaboration with NSF, we perform routine replacement and upgrade of laboratory and drilling equipment within the budget guidance for a given fiscal year. Unfortunately, given a flat funding scenario, we are not able to update our systems as frequently as we believe they should be. However, the safe operation of the facility is our number one priority.

Currently we are in the 9th year of a 10 year contract. NSF is in the process of seeking National Science Board Approval for a new phase of scientific ocean drilling. Initially they are seeking approval for a one year contract extension. It is envisioned that following the one year extension, NSF will ask for a competition for a 5 year cooperative agreement for the management of the IODP systems Integration functions. Historically, the program management and vessel operation functions have been carried through a series of competed 10 year contracts.

What major obstacles or challenges has IODP faced, and how have the problems been resolved?

IODP and its successor programs have been and continue to be very successful scientific programs. The biggest challenges faced have all be related to funding. During IODP the conversion and modernization of the JR was hampered by increased costs at global shipyards and a fixed MREFC budget. The IODP-USIO, with NSF redefined the scope of the conversion to deliver the a “new” vessel within the existing hull.

The soaring prices of oil have dramatically raised the costs associated with operating the IODP facility while NSF funding has remained essentially flat. Working with NSF and the international community, the IODP-USIO reduced its service levels to pre-IODP levels and reduced the number of operational months from 12 to 8. The struggle to continue to deliver 8 months of operations continues to loom large. IODP-USIO, NSF, and the international IODP science community continue to work on efficiencies and planning activities that allow the JR to be operated as cost effective as possible while delivering the maximum science possible for the funding received.

Major Accomplishments of IODP

At the request of the National Science Foundation, the National Research Council appointed an expert committee to review the scientific accomplishments of U.S.-supported scientific ocean drilling: Deep Sea Drilling Project, Ocean Drilling Program, and Integrated Ocean Drilling Program. They also assessed the potential for future transformative scientific discoveries from Illuminating Earth’s Past, Present, and Future: The International Ocean Discovery Program Science Plan for 2013-2023.

The committee identified Deep Sea Drilling Project, Ocean Drilling Program, and Integrated Ocean Drilling Program scientific accomplishments and analyzed their significance. Their list of accomplishments is summarized in the table to the left. They also examined the fields of inquiry that were enabled due to scientific ocean drilling capabilities. The committee then considered the scientific ocean drilling programs’ contributions to capacity building, science education, and outreach activities.

U.S.-supported scientific ocean drilling programs have been very successful, contributing significantly to a broad range of scientific accomplishments in a number of earth science disciplines. Scientific ocean drilling has advanced understanding of solid Earth cycles, revealed the flow of fluid and microbe ecosystems within the seafloor, and gathered extensive information on Earth's climate history. In addition, scientific ocean drilling has spurred technological innovations that have strongly influenced further advancements in both the research community and the private sector.

Some of the major accomplishments of scientific ocean drilling include:

Solid Earth Cycles

- Verification of the seafloor spreading hypothesis and plate tectonic theory
- Development of an accurate geological time scale for the past 150 million years
- Confirmation that the structure of oceanic lithosphere is related to spreading rate
- Exploration of the emplacement history of submarine large igneous provinces
- Contributed to a new paradigm for continental breakup due to studies of rifted margins
- Confirmation that subduction erosion as well as accretion occurs in subduction zone forearcs

Fluids, Flow, and Life in the Subseafloor

- In situ investigation of fluid flow processes, permeability, and porosity in ocean sediments and basement rocks
- Characterization of the sediment- and rock-hosted subseafloor microbial biosphere
- Study of subseafloor water-rock interactions and the formation of seafloor massive sulfide deposits in active hydrothermal systems
- Examination of the distribution and dynamics of gas hydrates in ocean sediments

Earth's Climate History

- Reconstruction of global climate history for the past 65 million years, based on ocean sediments
- Development and refinement of the Astronomical Geomagnetic Polarity Timescale
- Documentation of the pervasive nature of orbital forcing on global climate variability
- Recognition of past geological analogues (for example, thePaleocene-Eocene Thermal Maximum) for Earth's response to increases in atmospheric carbon dioxide
- Discovery of the history of polar ice sheet initiation, growth and variability, and their influence on fluctuations in global sea level

---

Mr. Chairman and members of the Subcommittee, I wish to thank you for this opportunity to answer questions about Major Multi-User Reasearch Facilities Management processes and the Integrated Ocean Drilling Program. I would be happy to discuss any of these topics with you during the hearing.