Fiscal Year 2006 Annual Report

Integrated Ocean Drilling Program
U.S. Implementing Organization

Fiscal Year 2006 Annual Report

Integrated Ocean Drilling Program
United States Implementing Organization

JOI Alliance

Joint Oceanographic Institutions, Inc.

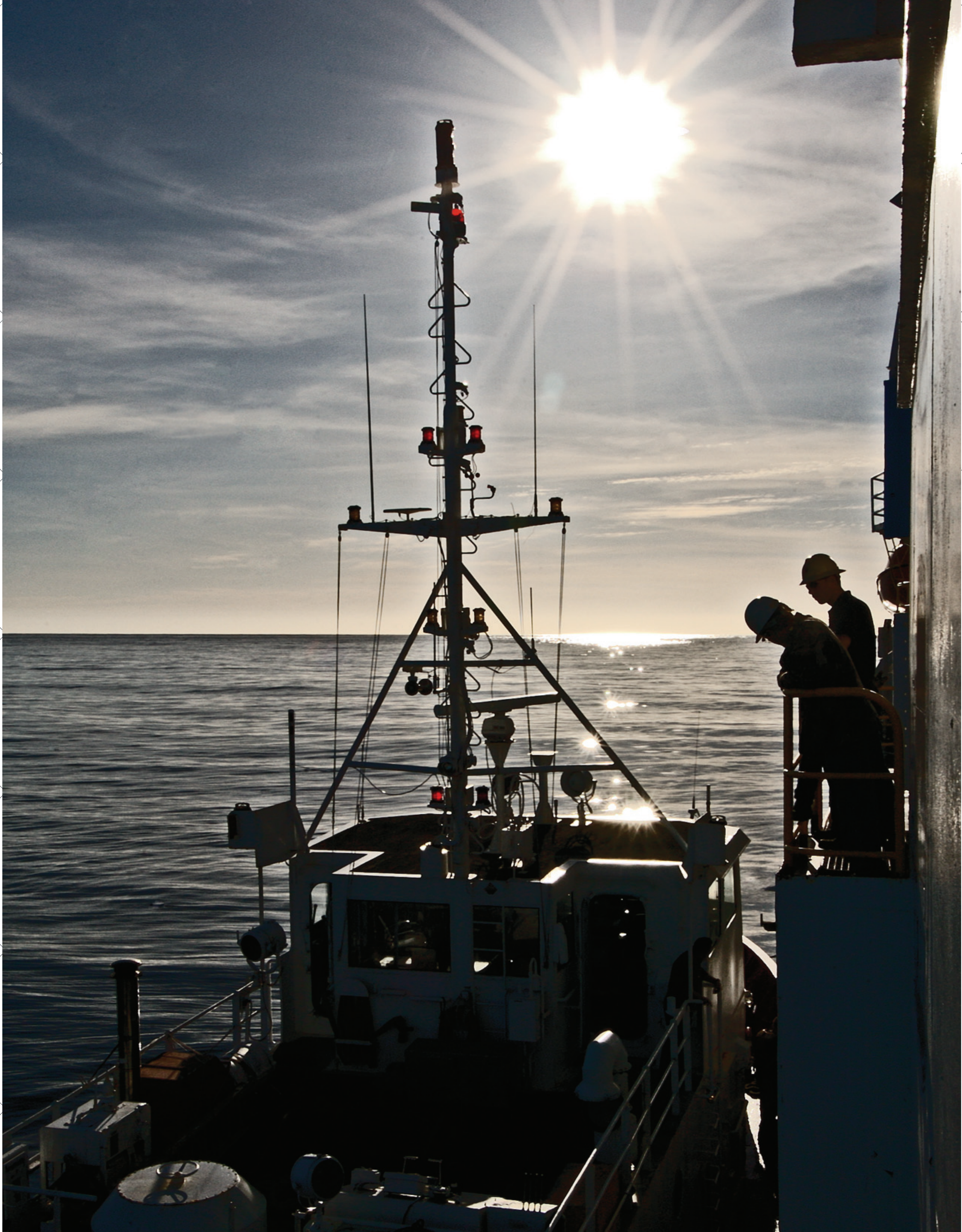
Lamont-Doherty Earth Observatory
of Columbia University

Texas A&M University

NSF Contract OCE-0352500

1 October 2005–30 September 2006

Table of Contents



Executive Summary

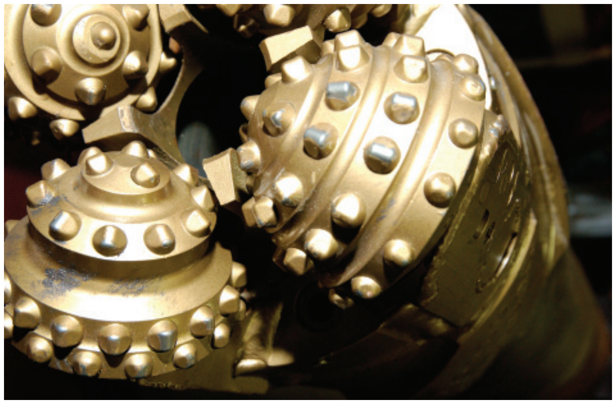
This Integrated Ocean Drilling Program (IODP)-U.S. Implementing Organization (USIO) Fiscal Year 2006 Annual Report covers activities undertaken in support of the National Science Foundation (NSF) Contract OCE-0352500 during the period from 1 October 2005 to 30 September 2006.

The executive summary provides an introduction to IODP and the USIO along with an overview of FY06 activities. Deliverables outlined for FY06 are detailed in the FY06 IODP-USIO Program Plan and its Appendix. Operational achievements in support of these deliverables are presented in the following chapters, which highlight some of the major challenges met during FY06. Contractual information and financial tables describing the execution of the FY06 IODP-USIO Program Plan are provided in the final chapter. Additional information on FY06 accomplishments is available in the USIO quarterly reports.

IODP Organizational Structure

IODP is an international marine research program that conducts seagoing expeditions to explore the Earth's history and structure as recorded in seafloor sediments and rocks and to monitor subseafloor environments. IODP builds upon the earlier successes of the Deep Sea Drilling Project (DSDP) and the Ocean Drilling Program (ODP), programs that revolutionized our view of Earth's history and global processes through ocean basin exploration. IODP's principal research themes are outlined in the Initial Science Plan: "Earth, Oceans and Life: Scientific Investigations of the Earth System Using Multiple Drilling Platforms and New Technologies."

IODP greatly expands on the previous programs by simultaneously using multiple drilling platforms—a riserless drilling vessel, a riser drilling vessel, and mission-specific platforms—to achieve its scientific goals. The riserless drilling vessel allows IODP to drill more deeply than is possible with the other platforms



while continuing to expand the global sampling coverage and disciplinary breadth that were characteristic of DSDP and ODP. The riser drilling vessel allows IODP to drill for months to a year or more at a single location. Mission-specific platforms allow drilling in environments unsuitable for either the riserless or riser vessel, such as near the shoreline in shallow-water areas and in climatically sensitive, ice-covered regions.

Three implementing organizations (IOs) serve as science operators for the various platforms: the USIO is responsible for operating the riserless drilling vessel *JOIDES Resolution*, Japan's Center for Deep Earth Exploration the riser drilling vessel *CHIKYU*, and the European Consortium for Ocean Research Drilling Science Operator (ESO) the mission-specific platforms. Staff Scientists from all three IOs participate as members of each science party, providing consistency from one expedition to the next.

IODP Management International, Inc. (IODP-MI), a nonprofit U.S. corporation with an international membership of academic institutions, serves as the central management organization for IODP and is responsible for Program-wide science planning and oversight, as well as provision of continuous performance evaluation and assessment of all elements of IODP. Science planning is provided by the Science Advisory Structure (SAS), which involves many scientists and engineers on multiple standing committees and panels. Each of the IOs provides liaisons with appropriate expertise to interact with SAS panels and other IODP-MI working groups and task forces.

Joint Oceanographic Institutions, Inc. (JOI), and its partners, the Lamont-Doherty Earth Observatory (LDEO) of Columbia University and Texas A&M University (TAMU), compose the JOI Alliance, which serves as the IODP USIO. JOI is the prime contractor with ultimate responsibility for all contractual obligations entered into by the USIO. LDEO and TAMU contribute distinct but complementary capabilities that collectively support the full range of activities necessary for implementation of riserless drilling vessel scientific drilling programs. Administrative services in support of TAMU activities are managed by the Texas A&M Research Foundation.

IODP-USIO FY06 Activities

During FY06, the USIO completed the last two Phase 1 scientific drilling expeditions aboard the *JOIDES Resolution*, prepared for Phase 2 drilling programs, and provided postexpedition deliverables related to Expeditions 301–312. In addition, the USIO actively sought to establish and strengthen connections with the other IOs and with IODP-MI.

The two FY06 expeditions achieved both technical and scientific successes. During Expedition 311, Cascadia Margin Gas Hydrates, the USIO researched the occurrence and formation of gas hydrate deposits by coring a transect across the entire area where gas hydrate is present in an accretionary prism. Results from Expedition 311 changed our understanding of how gas hydrates occur in nature, as their distribution proved to be much more heterogeneous in this active continental margin than was previously anticipated. Expedition 312, Superfast Spreading Rate Crust 3, was the third part of the scientific program that began with ODP Leg 206 and continued with IODP Expedition 309. During this expedition, a complete section of the upper oceanic crust was successfully drilled, extending Hole 1256D into the underlying gabbros and reaching a fossil magma chamber 1.4 kilometers beneath the seafloor. Further research related to these expeditions will increase our knowledge regarding the formation of ocean crust, a process key to plate tectonics. The USIO's efforts to ensure a variety of media attention for the scientific accomplishments of

Expeditions 311 and 312 were rewarded with a proliferation of news stories and coverage in publications such as *Nature* and *Science*.

While the USIO supported FY06 expeditions, preparation for Phase 2 operations was under way within the USIO in collaboration with IODP-MI, the other IOs, and the Program's scientific advisory groups. In conjunction with planning for future scientific drilling projects, the USIO participated in the planning of Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE) Project Stage 1 operations. This experiment will, for the first time ever, attempt to drill into, sample, and instrument the seismogenic portion of a plate boundary fault or megathrust within a subduction zone where great earthquakes have repeatedly occurred. Modifications and enhancements were developed for tools and analytical systems that will be used during upcoming expeditions, and the USIO began development of longer term engineering and analytical planning methodology. Additionally, many USIO staff members participated in U.S. Scientific Ocean Drilling Vessel Major Research Equipment and Facility Construction Project planning and development work, focusing on the design and organization of substantial upgrades to the *JOIDES Resolution* in the face of budgetary, logistical, and time constraints.

The USIO managed a two-part demobilization of the *JOIDES Resolution* after the last USIO Phase 1 expedition. During initial demobilization, all government-owned equipment was removed from the vessel except for items the USIO loaned to Overseas Drilling Limited (ODL) , with NSF and JOI approval, for use in ODL's India Gas Hydrate program. USIO representatives remained on board as custodians for the loaned equipment during the program, after which final Phase 1 demobilization activities were completed. Demobilization was completed by late FY06.

Throughout FY06, the USIO's collaboration with other branches of IODP was a continuing effort that spanned the diverse services of the organization. Projects included coordination of strategic planning, training, and development; implementation of the DSDP/ODP Core Redistribution Project; production of expedition-related reports and publications for ESO; and participation in IODP Data Management Coordination Group projects.

FY06 proved to be a successful yet challenging year. The USIO worked to effectively deliver the USIO programmatic services provided to IODP and to develop collaborative working relationships with other IODP entities while carrying out planning and development to ensure that the USIO is prepared to implement Phase 2 riserless operations and science support. At the conclusion of FY06, the USIO stands in a stronger position to assist IODP and the scientific drilling community with the achievement of even greater scientific successes in the years to come.

“… the USIO stands in a stronger position to assist IODP and the scientific drilling community with the achievement of even greater scientific successes in the years to come.”

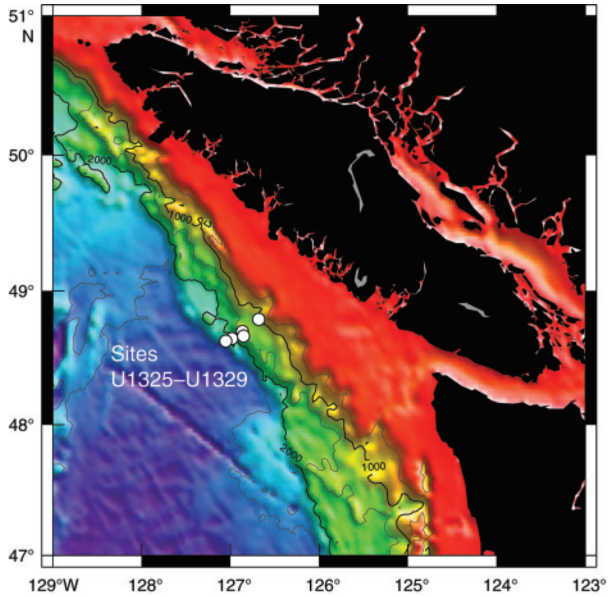
Expeditions

Two Integrated Ocean Drilling Program (IODP)-U.S. Implementing Organization expeditions were completed during FY06: Expedition 311, Cascadia Margin Gas Hydrates, and Expedition 312, Superfast Spreading Rate Crust 3. Expedition 311 provided insight into the formation of gas hydrate deposits, and Expedition 312 achieved a drilling goal long held by scientists. Further research regarding the findings from these expeditions promises even greater understanding of plate tectonics and the formation of ocean crust.

Expedition 311: Cascadia Margin Gas Hydrates

Gas hydrate deposits are typically found below the seafloor in offshore locations where water depths exceed 500 meters and in Arctic permafrost regions. A geologic hazard, gas hydrate is primarily natural gas that remains stable only at low temperatures and under relatively high pressure. Gas hydrate may have a significant impact on global climate change and could serve as an alternate fuel—yet there is much we do not understand about its formation and occurrence.

Building on work completed during Ocean Drilling Program Legs 146 and 204 off the coast of Oregon, the primary objective of IODP Expedition 311 (28 August–28 October 2005) was to constrain geologic models for gas hydrate formation in subduction zone accretionary prisms. A transect of four sites (U1325, U1326, U1327, and U1329) representing different stages in the evolution of gas hydrate across the northern Cascadia margin was cored to study gas hydrate occurrences and formation models for accretionary complexes. In addition to the transect sites, a fifth site (U1328), representing a cold vent with active fluid and gas flow, was investigated. A related objective of Expedition 311 was to characterize the deep origin of methane in the region, its upward transport and incorporation in gas hydrate, and its subsequent loss to the seafloor.



Throughout Expedition 311, special efforts were made to better define the depth of the base of gas hydrate stability. The occurrence of gas hydrate has historically been inferred from the presence of a bottom-simulating reflector (BSR) in seismic images, and gas hydrate occurrence can be documented by a variety of methods. The most obvious and fundamental method is by direct visual observation of cores; however, because gas hydrate, especially disseminated gas hydrate, begins to dissociate and may completely decompose during core recovery, direct visual observation may not be possible. Therefore, indirect or proxy methods related to the physical and chemical consequences of dissociation were used to define this boundary and to compare it to the predicted BSR depth.

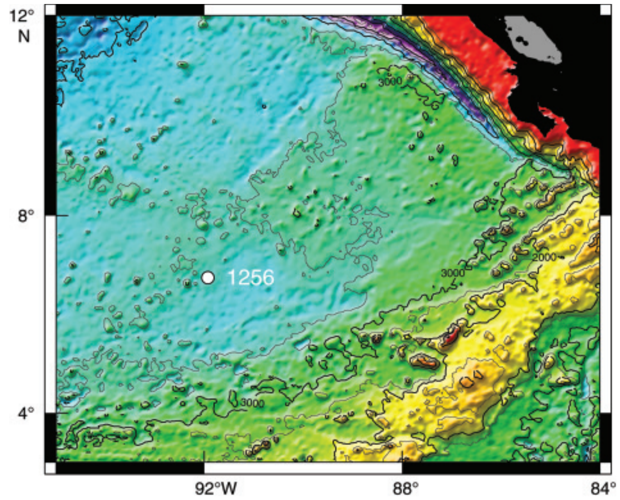
During Expedition 311, indirect evidence of the presence of gas hydrate included increased electrical resistivities and *P*-wave velocities on downhole logs and low-salinity interstitial water anomalies, numerous infrared cold spots, decreases in void gas C_1/C_2 ratios, and gas hydrate–related sedimentological moussy/soupy textures in recovered cores. Gas hydrate was also observed directly in the recovered cores, and more than 31 gas hydrate samples were preserved in liquid nitrogen for shore-based studies.

Prior to this expedition, scientists predicted that gas hydrate would be more concentrated in widespread seafloor-parallel layers of dispersed gas hydrate just above the base of the predicted stability field and evenly distributed regardless of sediment grain size. Contrary to established expectations of how gas hydrate deposits form, anomalous occurrences of gas hydrate in high concentrations were found at relatively shallow depths, 50–120 meters below the seafloor. In addition, repeated recovery of high concentrations of gas hydrate in sand-rich sediment layers provides strong support for sediment grain size as a controlling factor in gas hydrate formation. The Expedition 311 science party, supported by IODP, published their peer-reviewed findings, "Gas Hydrate Transect across Northern Cascadia Margin," in the 15 August 2006 edition of *Eos, Transactions of the American Geophysical Union*.

Gas hydrate is characterized by unique chemical compositions and distinct electrical resistivity and acoustic physical properties. It is therefore possible to identify and further characterize gas hydrate–bearing sediment properties (e.g., porosities and gas hydrate saturations) with downhole logging tools. In the case of Expedition 311, the standard downhole wireline logging program was augmented with a precoring measurement-while-drilling (MWD)/logging-while-drilling (LWD) dedicated logging program, which surpassed all expectations. The newly developed MWD/LWD safety protocol provided an effective means to deal with concerns associated with shallow gas hazards. The logging data guided special tool deployments (Pressure Core Sampler, Fugro Pressure Corer, and HYACE Rotary Corer) in addition to providing high-quality downhole measurements used to identify and characterize gas hydrate concentrations. Infrared imaging and some of the pressure coring of hydrate-bearing cores were supported by external funding to Joint Oceanographic Institutions, Inc., from the U.S. Department of Energy's National Energy Technology Laboratory.

In addition to MWD/LWD safety protocols, new health, safety, and environmental protocols were established for specific procedures undertaken during Expedition 311. Recovery of core in hydrocarbon-rich areas required refinement of new data collection and tool string combinations, as well as new approaches to ensure both safe handling and preservation of gas hydrate samples.

Expedition 311 provided, for the first time, direct insight into the evolution of a gas hydrate system along an active continental margin by coring a transect of four sites through the entire region of gas hydrate occurrence in the northern Cascadia margin. Acquired data have yielded a better understanding of the geologic controls, evolution, and ultimate fate of gas hydrate in an accretionary prism as an important contribution to the role of gas hydrate methane gas in climate change and slope stability.



> "Expedition 311 provided, for the first time, direct insight into the evolution of a gas hydrate system along an active contental margin. . . ."

Expedition 312: Superfast Spreading Rate Crust 3

More than 60 percent of the Earth is covered by oceanic crust formed at mid-ocean ridges, all of which formed within the last 200 million years, yet our understanding of crustal accretion at mid-ocean ridges and evolution on the ridge flanks has been severely limited by the extreme difficulty of direct sampling. The Superfast Spreading Rate Crust mission was designed to drill deeply at a location with the fastest possible spreading rate, testing the theory that the upper crust at that location would be thinner, thereby minimizing the cost, time, and technical challenges of deep drilling.

IODP Expedition 312 (28 October–28 December 2005) was the third cruise in the multiphase drilling project that began with Ocean Drilling Program Leg 206 and continued with IODP Expedition 309. Drilling in Hole 1256D during Leg 206 resulted in the successful construction of the borehole infrastructure required for deep drilling into the oceanic basement. Expeditions 309 and 312 were planned as a joint science program to deepen the hole by rotary core barrel coring to the maximum depth possible. The primary objective was to drill, for the first time, a complete section of the upper oceanic crust from the extrusive lavas, through the dikes, and into the underlying gabbros. With the achievement of this objective during Expedition 312, a goal that scientists have pursued for more than 40 years was finally attained. The section of crust drilled during this expedition will provide previously unavailable knowledge about the geological, geochemical, and geophysical structure of the oceanic crust and the processes responsible for its accretion and evolution. The Expedition 309/312 science party, with the support of IODP, published their peer-reviewed findings, "Drilling to Gabbro in Intact Ocean Crust," in the 20 April 2006 edition of *Science*.

Formation of ocean crust is a key process in the cycle of plate tectonics; it constantly "repaves" the Earth's surface. Obtaining a sample from a deep fossil magma chamber allows comparison of its composition to overlying lavas, which will help explain whether ocean crust, which is about 6–7 kilometers thick, is formed from one high-level magma chamber or from a series of stacked magma lenses. Geophysical theories have long projected that oceanic magma chambers freeze to form coarse-grained black rocks known as gabbros. Although gabbros have been sampled elsewhere in the oceans, where faulting and tectonic movement have brought them closer to the seafloor, this was the first time gabbros were recovered from intact ocean crust.

The success of these expeditions has been attributed in part to the location of the site. Drilling took place in a 15-million-year-old region of the Pacific Ocean that formed when the East Pacific Rise was spreading at a "superfast" rate (more than 200 millimeters per year), faster than any mid-ocean ridge on Earth today. Scientific theory held that crust formed at this fastest spreading rate would be closest to the Earth's surface, and scientists would not have to drill as deeply to reach gabbros. The theory was correct. After three years of research, preparation, and multiple trips to the site, it took nearly five months at sea to drill to the magma chamber. The rocks directly above the frozen magma chamber were extremely hard because they had been baked by the underlying magmas, much like tempered steel. Twenty-five hardened steel and tungsten carbide drill bits were used before the combined expedition work was complete.

Other goals were also met: scientists determined the lithology and structure of the upper oceanic crust for the superfast-spreading end-member, investigated interactions between magmatic and alteration processes, and studied the nature of the melt lens. The presence of granoblastic textures resulting from contact metamorphism of the lowermost ~50 meters of dikes by intrusion of underlying gabbros evidences a type of metamorphism that has previously been described only locally in ophiolites; this discovery constitutes an important new finding.

Expedition 312 results, coming from the structural heart of Pacific crust, confirm ideas from seismologic interpretation about how fast-spreading oceanic crust is built, refine scientists' understanding of the relationship between seismic velocity and crustal rock composition, and open new perspectives for investigating the origin of lower oceanic crust. IODP scientists believe that drilling deeper into the unearthed magma chamber will bring additional revelations.

"Expedition 312 results . . . open new perspectives for investigating the origin of lower oceanic crust."


CLICK ACQUIRE
You will need to name your image
and save it to the 312 School of Rock folder
on the desktop using:
Leg-site-hole-core-interval-sample
PHOTOSHOP will immediately open and display your image.
Click SHIFT F8 - This will sharpen your photograph
Click FILE, Save As, and save into the SOR Edit microphoto
27-RP-82
120V
CARL ZEISS INC.
12V 100W
SAMSUNG
SAMSUNG

Technology

The Integrated Ocean Drilling Program (IODP) U.S. Implementing Organization (USIO) interacts with the Science Advisory Structure committees and other implementing organizations (IOs) to integrate information technology, data management, and engineering development efforts across IODP, with coordination by IODP Management International, Inc. (IODP-MI). During FY06, the USIO participated in the development of the IODP engineering technology roadmap while continuing to work on engineering and analytical developments in support of Phase 1 and Phase 2 operations and playing a major role in ongoing IODP data management efforts in preparation for Phase 2.

The infrastructure for engineering development efforts is the IODP engineering technology roadmap, an evolving document, guided by the Engineering Development Panel, that provides a long-term vision of priorities in engineering developments that are vital to achieve IODP science goals and also serves as a final critical step in the proposal evaluation process.

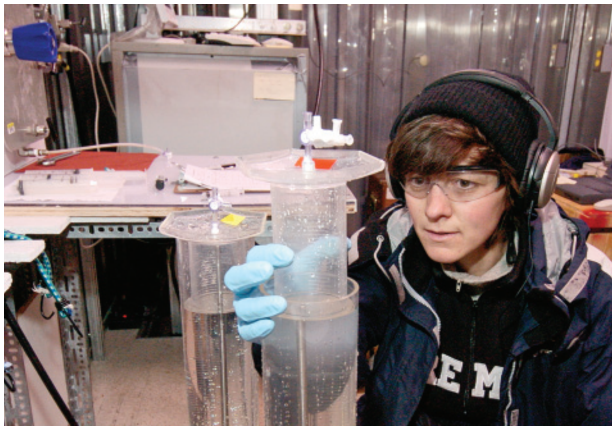
Design and Development

Expedition-Related Tools

Development of several tools in support of FY06 USIO expeditions was undertaken by the USIO. Work in support of Expedition 311 included installing two temporary laboratory vans on the *JOIDES Resolution*, as well as making special adaptations for pressure coring tools to meet the expedition's science objectives, including design and implementation of a 3 meter vertical ice bath mounted in the moonpool to stow pressurized core barrels after recovery, fabrication and use of aluminum core barrels and pressure housings for the pressure core sampler to allow X-ray logging under pressure, and deployment of a special boom crane to quickly and safely lift pressurized cores from the rig floor to the refrigerated van on top of the lab stack.

In addition, the USIO began design work on engineering developments for USIO Phase 2 expeditions, including a stacked advanced circulation obviation retrofit kit (CORK)/CORK II to be installed in a single borehole on the NanTroSEIZE 2 expedition and on a CORK II to be deployed on the Juan de Fuca Hydrology 2 expedition.

Measurements and Testing



Among the developments in logging tools and instrumentations, the USIO made significant progress on the Simulated Borehole Test Facility and a new natural gamma measurement system.

The Simulated Borehole Test Facility at Texas A&M University was relocated and refurbished, and research, design work, and testing of the consolidation chamber were accomplished. The Borehole Test Facility at Lamont-Doherty Earth Observatory was enhanced in preparation for Phase 2 with the purchase of shock testing capabilities, a supplement to existing temperature and pressure autoclave testing capabilities, to simulate stresses that most wireline and core-mounted downhole tools endure during deployment at sea.

A new natural gamma measurement system was designed that will meet shipboard measurement requirements despite time constraints and provide data needed for the correlation of core and downhole measurement data. In addition, a conceptual plan was created for development of multiple core loggers that will use the same Common Instrument Interface, motion control hardware, and software architecture. The loggers currently being constructed or refurbished include an enhanced whole-round multisensor logger that will implement the existing gamma ray attenuation, magnetic susceptibility, *P*-wave velocity, and resistivity sensors; a new section-half visual light line scan imager; and an upgraded section-half multisensor logger that will allow simultaneous use of a reflectance spectrometer and a point magnetic susceptibility sensor.

Data Management

The USIO worked to develop several technologies that will help to streamline and improve data management. The Descriptive and Interpretative Information (DESCINFO) System was planned to replace multiple inadequate description and interpretation capture, database, and data access/visualization solutions from the Ocean Drilling Program and IODP Phase 1. Development of an Inventory Asset Management System was initiated that will operate as a single, fully integrated ship- and shore-based system that performs requisitioning, inventory control, and shipping functions. The IODP Sample Materials and Curation System (SMCS) Sample Request Management component, a Web-based sample and data request and approval system, was specified and prototyped. The USIO also prepared a scope of work and preliminary design for the SMCS Central Inventory (SMCS-CI), which will allow all IOs to store sample identity information in a central database and retrieve that information as needed.

In addition, the USIO worked through the IODP-MI Data Management Coordination Group with members of other data management groups including CHRONOS, the Australian Commonwealth

Scientific and Research Organization, the Geosciences Network, the University of Bremen, and the CoreWall Consortium to develop strategies for implementing data capture and analysis tools.

Communications

Final modifications were made in early FY06 to the videoconferencing equipment located at all shore-based USIO facilities and on the *JOIDES Resolution*. Ship-to-shore videoconferencing capabilities were tested during Expedition 312, and the system was used for communications during the School of Rock Expedition transit. Videoconferencing routinely provides an economical and efficient means for IO staff members to meet.

Acquisitions

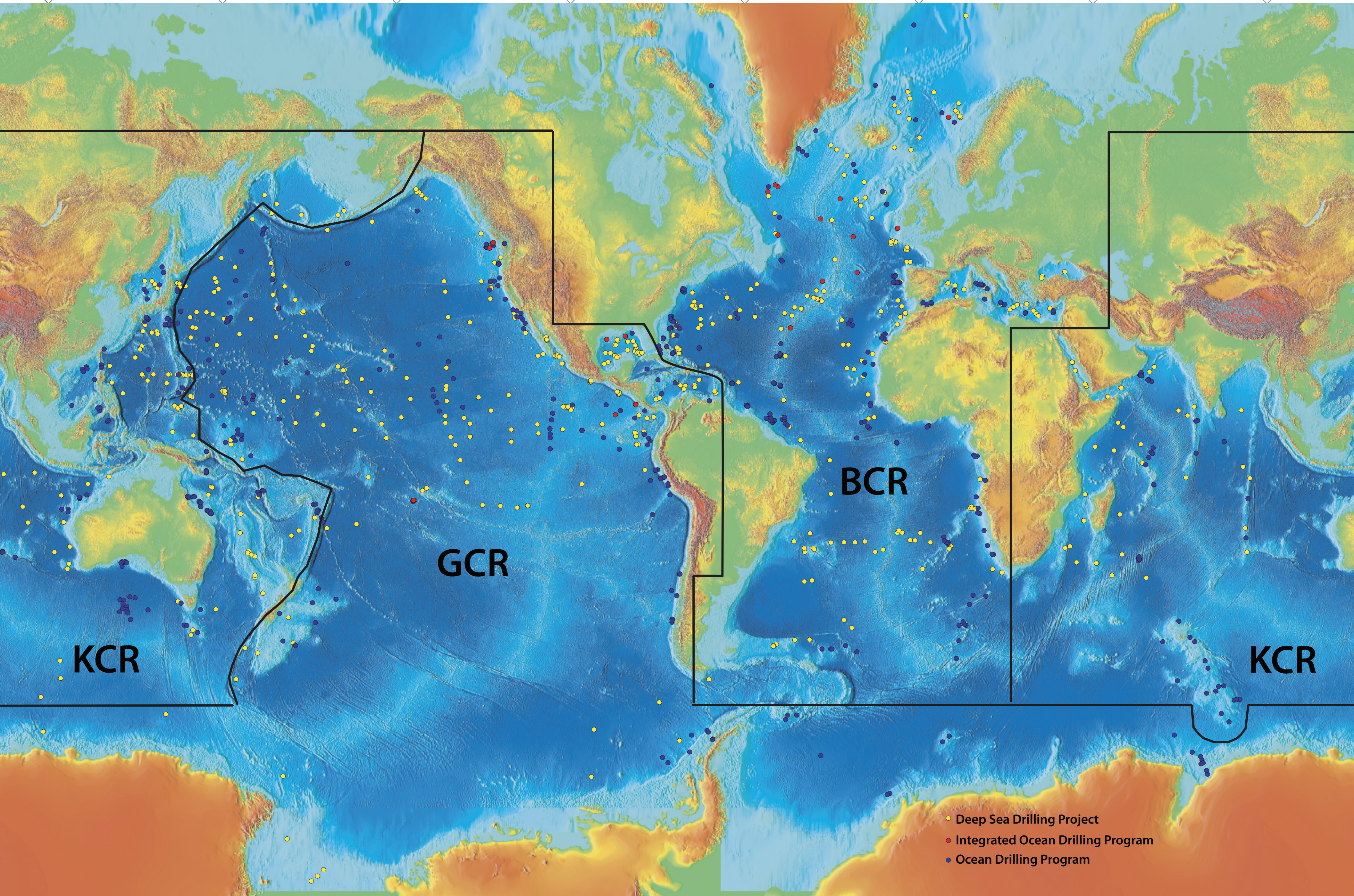
Among the notable technological acquisitions for the USIO were the Mettler Toledo balances that replaced the electronic dual balance systems, six Micromeritics cells that replaced the Quantachrome Pentapycnometer, and the commercial LabWare Laboratory Information Management System (LIMS) software package.

The LIMS will be used for collecting and archiving data and managing quality control, analytical methodology, and reporting. Beginning in Phase 2, all future USIO sample and analytical data will be loaded and stored in the LIMS, providing unprecedented options for quality control, Web-based interfaces, and more.

“

… the IODP engineering technology roadmap … provides a long-term vision of priorities in engineering developments that are vital to achieve IODP science goals. …

”



KCR
GCR
BCR
KCR
Deep Sea Drilling Project
Integrated Ocean Drilling Program
Ocean Drilling Program

❖ Establishing IODP Repositories ❖

In early 2005, the National Science Foundation and the Ministry of Education, Culture, Sports, Science and Technology informed the Integrated Ocean Drilling Program (IODP) U.S. Implementing Organization (USIO) that redistribution of Deep Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP) legacy cores would follow the same geographic distribution model recommended for the IODP core collection by the Science Advisory Structure. This geographic distribution model assigns cores to one of the three IODP core repositories according to the sample's origin, regardless of which program acquired the sample.

The DSDP/ODP Core Redistribution Project ensures that the entire collection will be housed at the following IODP core repositories: the Bremen Core Repository (BCR) at University of Bremen, Germany; the Kochi Core Center (KCC) at Kochi University, Japan; and the Gulf Coast Repository (GCR) at Texas A&M University, United States. In the IODP geographic distribution model, the BCR will house 135 kilometers of DSDP and ODP core and all IODP core collected in the Atlantic and Arctic Oceans north of the Bering Strait; the KCC will house 83 kilometers of DSDP and ODP core and all IODP core collected from the Pacific Ocean (west of the western boundary of the Pacific plate), the Indian Ocean (north of 60°S), and all of the Kerguelan Plateau; and the GCR will house 106 kilometers of DSDP and ODP core and all IODP core collected from the Pacific Ocean (Pacific plate east of western boundary), the Caribbean Sea and Gulf of Mexico, and the Southern Oceans (south of 60°S except the Kerguelan Plateau). The plan calls for closure of the ODP East Coast Repository (ECR) at Lamont-Doherty Earth Observatory of Columbia University and the West Coast Repository (WCR) at Scripps Institution of Oceanography, University of California, San Diego.

The DSDP/ODP Core Redistribution Project is divided into four main projects:

- Purchasing supplies and equipment and securing labor at all repositories;
- Redistributing core to the BCR;
- Redistributing core to the KCC; and
- Redistributing core to the GCR.

The USIO worked with the other implementing organizations to refine the proposed schedule for execution of the DSDP/ODP Core Redistribution Project. Because the BCR was fully staffed and equipped to receive core, after project approval the USIO first undertook the tasks of packing and shipping cores from the ECR to the BCR.

Curatorial Training

Because standardized training of curatorial staff on IODP curation procedures is critical to the successful operation of the three IODP repositories, the USIO worked with representatives from IODP Management International, Inc. (IODP-MI), and the Center for Deep Earth Exploration (CDEX) to develop a training plan for new KCC curatorial staff in preparation for the next task in the DSDP/ODP Core Redistribution Project timeline: the transfer of legacy cores to the KCC.

The USIO developed training requirements and details of the implementation plan and hosted CDEX staff at the GCR and WCR for one week at each repository, providing training in curatorial procedures, policy, and repository management. USIO curatorial staff also sailed on the *CHIKYU* shake-down cruises in the summer of 2006 to provide shipboard advice on core flow and curatorial techniques and procedures and visited the KCC.

DSDP/ODP Core Redistribution Schedule

At the initiation of the project, the original schedule for shipping core containers from the ECR to the BCR was posted on the IODP-MI Web site in order to keep the IODP science community informed of the availability of cores for sampling. Information on current and upcoming activity for the repositories that are closing, cores that are currently being packed or in transit, and cores that are ready for sampling at their new location is routinely updated.

> “This geographic distribution model assigns cores to one of the three IODP core repositories according to the sample’s origin. . . .”


JUN

Building Bridges: Integrating IODP

During FY06, the Integrated Ocean Drilling Program (IODP) U.S. Implementing Organization (USIO) continued to provide integrated management for all riserless drilling vessel operational activities for IODP. Responsibilities included strategic planning, oversight of USIO mission delivery, prioritization of resources, Annual Program Plan development, and planning and implementation of USIO deliverables.

Operational Planning and Integration

The USIO played a leadership role in working with the Science Advisory Structure (SAS), the IODP central management office (IODP Management International, Inc. [IODP-MI]), Program Member Offices, and the other implementing organizations (IOs) to coordinate planning, training, and development activities. The USIO provided liaisons with appropriate expertise to interact with SAS panels and other IODP-MI working groups and task forces. This enabled the USIO to work with staff members who have parallel duties within the other IOs, gain a deeper understanding of each IO's operational procedures, identify shared procedures and associated documentation that can be developed, and begin collaborative work on shared projects and tasks. In addition, the USIO hosted and participated in Program-wide scientific meetings and sent representatives to more than a dozen professional scientific meetings and conferences.

The USIO met with the Center for Deep Earth Exploration (CDEX) to review activities proposed by each IO in their FY07 Annual Program Plans in an effort to establish a framework for higher levels of integration within IODP; facilitate coordinated strategic planning for IODP; and coordinate planning, training, and development activities with the other IOs where feasible. The results of the meeting were shared with the

European Consortium for Ocean Research Drilling Science Operator (ESO), setting the stage for greater IO collaboration in FY07 and beyond.

Logging

The USIO headed the Logging Consortium for riserless activities and worked with members to coordinate cross-platform logging activities and ensure the highest degree of compatibility among the platforms. In addition, the USIO and ESO began discussions regarding archiving logging data collected on mission-specific expeditions. ESO will provide data files and metadata that adhere as closely as possible to those used by the USIO, which will allow reuse of existing data management scripts and a common Web interface for both the USIO and ESO data sets.

Data Management

The USIO engaged in a variety of activities through the IODP-MI Data Management Coordination Group that were deemed critical to the delivery of quality data to the IODP scientific community as well as the smooth functionality of the Program's multiplatform, multidatabase, multirepository structure. These activities included ongoing planning of the IODP data information portal called Scientific Earth Drilling Information Service; planning and initial development of the IODP Sample Materials and Curation System; and initial discussions regarding establishment of Program-wide protocols for use of quality assurance/ quality control procedures, paleontological dictionaries, depth scale standards, and core description procedures.

Laboratories and Curation

The USIO provided opportunities for technical information exchange and training between IOs during FY06. A CDEX technician sailed on Expedition 312 to learn about laboratory techniques and core-handling procedures, USIO staff members sailed on *CHIKYU* shake-down cruises to provide technical reviews of laboratory and curation procedures, and USIO staff members trained CDEX curatorial staff members and advised CDEX and Kochi University personnel regarding preparation of the Kochi Core Center facility.

Publications

The USIO participated in a series of IODP-MI Publications Task Force meetings and assisted with finalizing and implementing the IODP Sample, Data, and Obligations Policy and developing implementation requirements for IODP reports and publications.

The USIO edited and produced IODP Phase 1 scientific reports and publications for ESO this fiscal year (the Expedition 302 volume of the *Proceedings of the Integrated Ocean Drilling Program* and the Expedition 310 *Preliminary Report*). The USIO also edited and formatted the NanTroSEIZE Project Stage 1 scientific prospectus and forwarded it to IODP-MI for publication on the IODP Web server.

Education and Outreach

The USIO fostered Japanese museum partnerships and educational programs, including the Japan/U.S. Public Understanding of Research (PUR) pilot program. The PUR pilot program was initiated during Expedition 312, sailing an American informal educator and a Japanese museum educator to facilitate real-time education and outreach activities.

> "This enabled the USIO to … gain a deeper understanding of each IO's operational procedures, identify shared procedures and associated documentation that can be developed, and begin collaborative work on shared projects and tasks."


School of Rock
JOIDES Resolution
2005

Expanding IODP Outreach

Developing a strong outreach network through which the Integrated Ocean Drilling Program (IODP) U.S. Implementing Organization (USIO) can increase visibility of riserless drilling operations and IODP scientific and technological accomplishments was a top priority for the USIO during Phase 1. Many USIO education and diversity-enhancing activities that focus on U.S. audiences were developed in conjunction with U.S. Science Support Program (USSSP) education activities (both programs are coordinated by Joint Oceanographic Institutions, Inc. [JOI]). Completed initiatives reached a wide array of scientists and educators and created new and innovative ways to communicate science to target audiences.

Public Affairs Outreach

The USIO devoted considerable effort to laying the groundwork for a strong media network and conducting outreach activities designed to promote USIO expeditions and resulting scientific achievements. The USIO also worked collaboratively with media staff members at IODP Management International, Inc. (IODP-MI), and the other implementing organizations that promote IODP.

As part of a new model for USIO media outreach, two new efforts were initiated. An all-purpose communications planning template was drafted for IODP expeditions and USIO expedition port calls that can be adapted to specifically targeted opportunities for outreach activities. In addition, a communications plan was designed and executed for the School of Rock Expedition that included customized media advisories to local news media organizations in the hometowns of participating educators and invitations to freelance journalists to join educators on board to report on the expedition first hand. The USIO plans to utilize this model for Phase 2 science expeditions.

Educational Outreach

USIO educational outreach covered a broad range of activities, including fostering collaborations between staff and informal education groups, developing and distributing educational tools and learning activities featuring IODP science, and disseminating a content inventory and evaluation survey that will be used for future program development.

The two most significant accomplishments in educational outreach this year for the USIO were the development of a single portal (JOI Learning) for educators to locate materials related to the drilling program and the extremely successful delivery of the School of Rock Expedition pilot program that utilized the *JOIDES Resolution* during a nonscience transit as a science and educational learning laboratory for informal and formal educators.

JOI Learning

The USIO developed the JOI Learning Web site in collaboration with USSSP as a means to provide a well-designed and easy-to-use portal for science educators and outreach professionals to access materials related to the drilling platform and drilling technology, scientific results from 40 years of ocean drilling history, and careers that support this field of science and engineering. These resources have achieved national recognition from the National Science Digital Library, the Digital Library for Earth System Education (DLESE), the Association for Advancement of Computing in Education, and Bridge (a Centers for Ocean Sciences Education Excellence partner supported by SEAGRANT and the National Marine Educators Association).

School of Rock Expedition Pilot Program

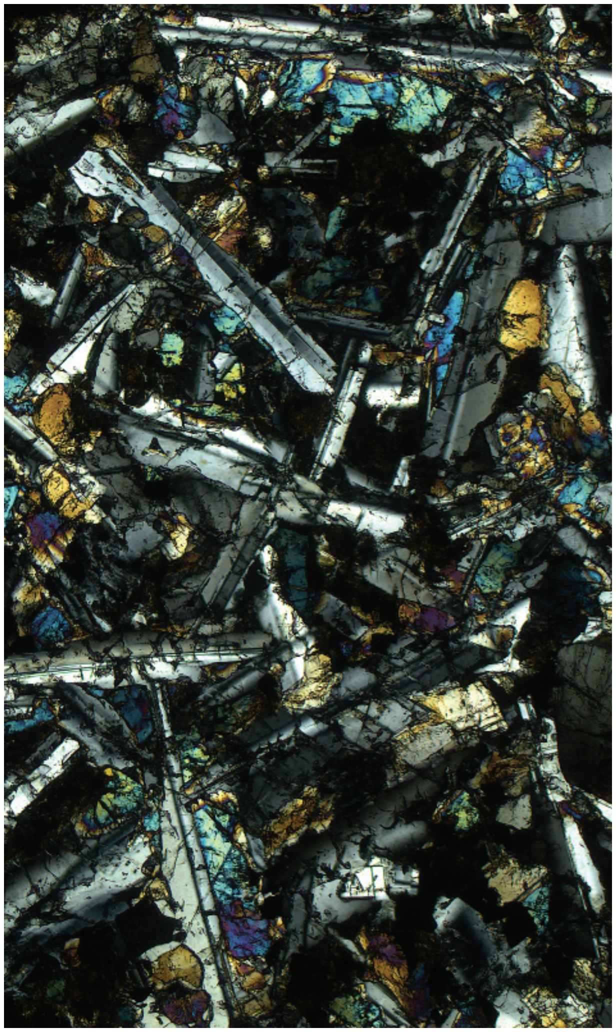
School of Rock: An Ocean-Going Research Expedition for Earth and Ocean Science Teachers, a pilot program for a series of teacher education expeditions, took place from 28 October to 12 November 2005 during the transit portion of Expedition 312. Program participants included ten earth science teachers (representing grades 5–12), two museum educators, and a science textbook consultant. The educators received instruction from a staff that included two scientists with extensive scientific ocean drilling experience and four education and outreach specialists, together with a team of professional marine technicians.

The goal of the School of Rock Expedition program was to provide American educators with experience on a research drilling vessel, and the program was specifically designed to increase the educators' knowledge of IODP, scientific methods conducted during actual ocean drilling expeditions, and specialized studies within geoscience; develop a suite of teaching materials related to ocean drilling research; and engage participants in disseminating IODP science education. The participants were introduced to all facets of ship operations on a typical expedition. They conducted laboratory work using cores and published data from Deep Sea Drilling Project/Ocean Drilling Program/IODP expeditions, received daily science lectures from scientists both on the ship and at the shore-based USIO facility (through videoconferences transmitted via satellite), and communicated daily with shore-based students through the Expedition Blog and Video Question & Answer features on the program Web page. Ten new college-level activities were developed by the science staff; the educators created 15 precollege activities, 25 career profiles, and instructional laboratory demonstration videos, all of which will be published on the JOI Learning Web site.

After the School of Rock Expedition, each educator was required to conduct outreach related to the program on a local, regional, or national level. The participants conducted 17 outreach events during FY06, ranging from short talks and presentations to posters at scientific conferences and a five-day graduate course for teachers at Western Michigan University. The program has been covered in 25 print and Web-based publications, including two trade books, *GeoTimes, Scientific Drilling,* and *Eos, Transactions of the American Geophysical Union.* School of Rock Expedition content has been added to the DLESE and the National Science Digital Library.

A School of Rock postexpedition meeting was held at the Gulf Coast Repository to conclude the pilot program with outreach updates, peer review of new School of Rock Expedition materials, and a presentation on paleoclimate research in the context of School of Rock Expedition experiences.

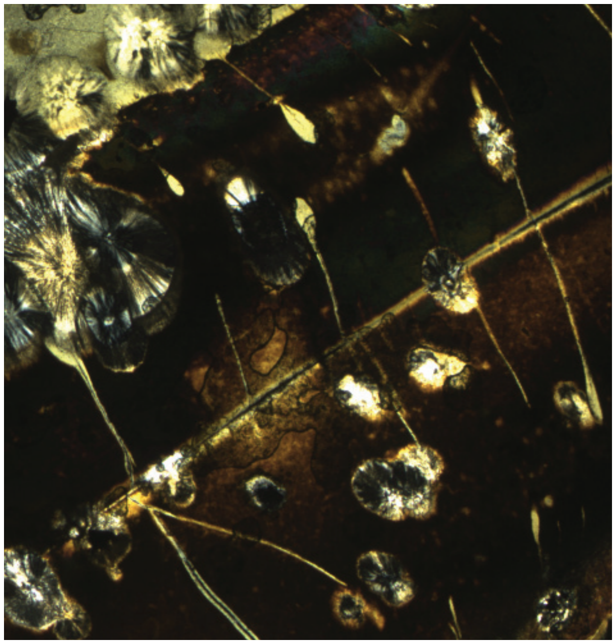
Early evaluations suggest the pilot program was hugely successful and could impact as many as 300,000 students over the next five years. It is our hope that this program will continue with assistance from a variety of funding sources and will serve as a model for future educator-focused expeditions aboard the *JOIDES Resolution* and also for hands-on activities at the USIO repository.



Museum Outreach and Partnerships

During Expedition 312, a pilot program tied to the National Science Foundation–supported Japan/U.S. Public Understanding of Research program was carried out to foster formal collaborations in Japanese and U.S. informal educational outreach. A pair of informal educators, one American and one Japanese, sailed on the expedition to facilitate real-time education and outreach activities related to the new scientific goals being achieved on the expedition. The results of their work were broadcast during the expedition in English on the Science Museum of Minnesota's Science Buzz Web page and in Japanese on Japan's National Museum of Emerging Science and Innovation (Miraikan) Web site. After the expedition, a video about IODP was produced in Japan, featuring information about the *CHIKYU* and the *JOIDES Resolution*. The video is available in English and Japanese.

Also, in an effort to relate the importance of ocean drilling science to the general public on a national and international level, the USIO continued collaborative efforts with IODP-MI on the development of a video that will highlight ocean drilling in the Smithsonian Institution Natural History Museum's new Ocean Hall. The exhibit, slated to open in 2008, is expected to serve an audience of as many as six million visitors per year.



Minority Outreach

Under NSF's direction, efforts continued to promote career awareness in the field of ocean sciences to minority students and to provide opportunities for participation in the program. Fellowships related to this endeavor were offered for students studying at select Historically Black Colleges and Universities. Two fellows were selected from Howard University (Washington, D.C.) for the 2005–2006 academic year. Their efforts were dedicated to support of USIO outreach and education activities, including planning a special project with the Washington, D.C., area public schools.

In addition, the USIO is a partner in the Minorities Striving and Pursuing Higher Degrees of Success in Earth System Science initiative, based at the University of South Florida. This initiative provides minority undergraduate and graduate students with opportunities for increased exposure to, interaction with, and participation in the earth system science community. This year the USIO cosponsored one undergraduate and six graduate students to attend the IODP Science Steering and Evaluation Panel meeting in May 2006, where the students were mentored regarding scientific proposal development and evaluation and how science can serve a diplomatic function in the international sphere.

Conference Outreach

Throughout this fiscal year, the USIO was represented at conferences and meetings through activities that included promotion of USIO science, distribution of JOI Learning materials, presentation of lectures at conferences, participation in conference-related teacher workshops, and presentation of highly interactive and innovative booths representing the USIO and the science of scientific ocean drilling. Estimates show that more than 5000 educators were reached through conference outreach.

“Completed initiatives reached a wide array of scientists and educators and created new and innovative ways to communicate science to target audiences.”


CARVER
LABORATORY PRESS
29X-4

❖ Contractual and Financial Overview ❖

The Integrated Ocean Drilling Program (IODP) is funded by four entities acting as international partners:

- The U.S. National Science Foundation (NSF) and Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) are lead agencies.
- The European Consortium for Ocean Research Drilling is a contributing member.
- The People's Republic of China Ministry of Science and Technology is an associate member.
- Interim Asian Consortium, represented by the Korea Institute of Geoscience and Mineral Resources, is an associate member.

The IODP U.S. Implementing Organization (USIO) provides all deliverables through contracts with the IODP central management office (IODP Management International, Inc. [IODP-MI]), for science operating costs (SOCs) and with NSF for platform operating costs (POCs). The commingled funds that provide the SOC budget come from the international partners as part of their membership fees used for the conduct of IODP science. POCs for each implementing organization are the responsibility of the agency supplying the platform capability.

USIO Contractual Relationships

Since FY04, Joint Oceanographic Institutions, Inc. (JOI), has had subcontracts with the College of Geosciences at Texas A&M University (TAMU), through the Texas A&M Research Foundation (TAMRF), and Lamont-Doherty Earth Observatory (LDEO) of Columbia University. These subcontracts formally establish the JOI Alliance as the IODP USIO.

Fiscal and contractual administration is provided through each of the three USIO institutions, and the organizational structure employed by the USIO is designed to mirror the work breakdown element accounting structure used by IODP. This structure also aligns the organization to efficiently and economically provide the full array of USIO deliverables.

USIO Prime Contractor

JOI is the prime contractor with ultimate responsibility for all contractual obligations entered into by the USIO. As the U.S. Systems Integration Contractor, JOI is responsible to NSF and IODP-MI for overall program leadership; technical, operational, and financial management; and delivery of services for the *JOIDES Resolution* and related activities. JOI leads long-term planning development for the USIO and represents the USIO and the Program as a whole, when appropriate.

USIO Subcontractors

LDEO and TAMU contribute distinct but complementary capabilities that collectively support the full range of activities necessary for implementation of a riserless scientific drilling program. LDEO 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. LDEO contracted with Schlumberger to provide downhole logging equipment and engineering support.

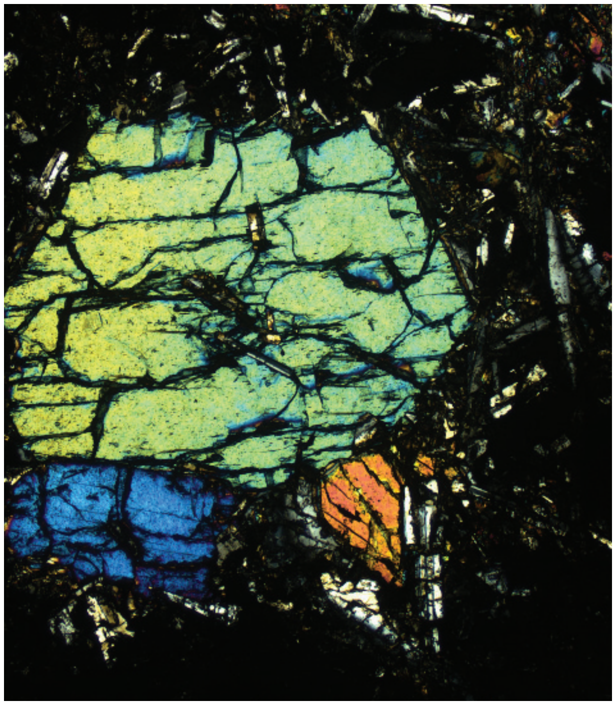
TAMU is responsible for services that are directly related to the scientific and engineering activities necessary to support science cruises (vessel and drilling operations, ship- and shore-based science laboratories), as well as managing cruise-related shore-based functions (data management, core curation, and publications). Administrative services in support of TAMU activities are managed by TAMRF. On behalf of the USIO, TAMRF contracted with Overseas Drilling Limited for the services of the *JOIDES Resolution* as the USIO riserless drilling vessel for the last two USIO Phase 1 expeditions.

USIO FY06 Program Plan

FY06 USIO contractual requirements for SOCs and POCs are outlined in the IODP-USIO FY06 Program Plan; U.S. Systems Integration Contract (SIC) costs, including activities related to the Phase 1 demobilization of the *JOIDES Resolution* as well as other required tasks, are outlined in the FY06 Program Plan Appendix. The IODP-USIO FY06 Program Plan was executed with particular attention focused on maintaining close oversight of the demobilization and operational expenses as the USIO entered into the hiatus in drilling and transition leading to the conversion of the U.S. Scientific Ocean Drilling Vessel (SODV). Changes in the demobilization scope of work led to significant cost avoidance because of the reduced time required for demobilization activities and reduced requirements for fuel during this phase of operations.

The financial tables accompanying this section provide more insight into the complexities of FY06 fiscal issues, with contract action adjusting the operating budgets for POC and SIC activities.

The IODP-USIO FY06 Program Plan and Appendix set forth the goals of the USIO, the scope of USIO work for IODP deliverables, definitions of projects, and details of required budgets that incorporate funding allocations from NSF or IODP-MI for science operations and from NSF for platform operations and U.S.-sponsored tasks (education and outreach projects, the Historically Black Colleges and Universities fellowship, and future planning for maintenance of U.S. scientific ocean drilling capability). The Annual Program Plan, which was based on the mission forecast made during the previous fiscal year, illustrates that the complex nature of IODP operations requires multiyear Annual Program Plans to establish priorities and allow for the procurement of long–lead time equipment and services.



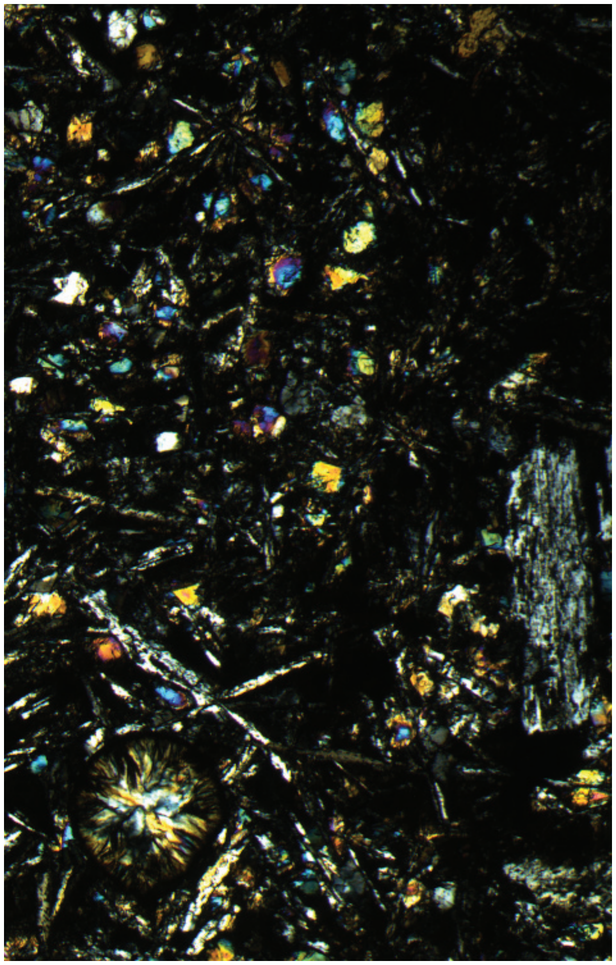
USIO FY06 Budget

The USIO used a 21 December 2004 directive and subsequent advice from the lead agencies and IODP-MI to guide the FY06 budget development process. Annex 1 of the bilateral cooperative agreement between MEXT and NSF concerning cooperation on the Integrated Ocean Drilling Program provided definitions of SOCs and POCs.

POCs were interpreted to be costs involved in safely making and completing a hole, with installation of subseafloor hardware, as well as management and oversight of POC items. When developmental tools and drilling equipment become operational, funding for these items, in principle, changes from SOC to POC.

Specific items identified as POCs included

- Costs of the drilling crew and ship's crew;
- Catering services;
- Fuel, vessel supplies, and other related consumables;
- Berthage and port call costs;
- Waste disposal;
- Crew travel;
- Inspections and insurance;
- Drilling equipment, supplies, and related consumables;
- Engineering or geophysical surveys and data acquisition and laboratory analyses required for the safety of platform and drilling operations; and
- Administration and management costs of the platform operators.



Specific items identified as SOCs included

- Technical services;
- Computer capability;
- Storage and distribution of data;
- Description, archiving, and distribution of data and samples;
- Deployment of a standard suite of logging tools;
- Development of new drilling tools and techniques required by IODP research;
- Production of program publications;
- Costs of consumables (exclusive of those identified under platform operations costs);
- Costs required for administration and management, including the central management office; and
- Education and outreach.

The lead agencies also encouraged scientific participants to contribute additional funds to IODP activities through links and funding obtained from other scientific programs and initiatives, including national IODP programs. Third-party tool development represents an outstanding example of such additional contributions. Many USIO education and diversity-enhancing activities that promote activities

within the U.S., implemented using NSF-specific funding, were developed in conjunction with U.S. Science Support Program education activities (both programs are coordinated by JOI).

Most of the analytical development projects during the fiscal year were planned as part of the U.S. SODV Major Research Equipment and Facility Construction Project. Labor costs were primarily funded by the SODV Project but, because of SODV delays and the availability of excess FY06 SIC funds, nonlabor costs were primarily SIC supported.

Financial Tables

The following financial tables provide a detailed overview of the FY06 IODP-USIO Program Plan budget, the FY05 carry-forward of obligated and unobligated funds, the budget modifications that took place throughout the fiscal year, the expenditures that were made to execute the program plan, and the end-of-year totals of obligated and unobligated funds pending approval for transfer to FY07.

These tables individually represent

- IODP-USIO FY06 end-of-year financial summary, which encompasses SOC, POC, and SIC budgets for the USIO with detail provided for each JOI Alliance institution (JOI, LDEO, and TAMRF/TAMU);
- IODP-USIO FY06 end-of-year summary for the POC budget;
- IODP-USIO FY06 end-of-year summary for the SIC demobilization budget (for additional U.S.-sponsored activities funded by NSF);
- IODP-USIO FY06 end-of-year summary for the SIC nondemobilization budget (for additional U.S.-sponsored activities funded by NSF);
- IODP-USIO FY06 end-of-year summary for the SOC (NSF and IODP-MI) budget; and
- IODP-USIO FY06 end-of-year summary for the SOC (IODP-MI only) budget.


JOIDES Resolution
MONROVIA

Please contact info@joiscience.org for hard copies of the financial pages (pp. 42-60).

Images

The following photos were taken by IODP-USIO staff photographers and expedition participants.

Cover, upper left: H_2S catwalk drill.
Cover, upper right: Viewing microfossils.
Cover, center: JOIDES Resolution *at night.*
Cover, lower left: Core samples.
Cover, lower right: Drill bit.
Page 8: Transferring logging tools and personnel to the JOIDES Resolution.
Page 10: Rig floor operations.
Page 10: Derrick.
Page 10: Drill bit.
Page 12: Porthole.
Page 14: Expedition 311 site map.
Page 14: Gas hydrate.
Page 15: Expedition 309/312 site map.
Page 15: Drill bits before and after drilling during Expedition 312.
Page 16: First gabbro drilled during Expedition 312.
Page 17: Examining photomicrographs.
Page 18: Display of drill bits and cutting shoes.
Page 20: Degassing a pressure core.
Page 20: Chemistry laboratory.
Page 22: Repository locations for DSDP, ODP, and IODP cores.
Page 24: Gulf Coast Repository.
Page 25: Core laboratory.
Page 26: Rig floor operations.
Page 28: Preparing a sample for chemical analysis.
Page 28: Examining rock samples.
Page 30: School of Rock Expedition participants.
Page 32: Core samples.
Page 32: Degassing a pressure core.
Page 33: Photomicrograph of Sample 1256D-122R-1, 119–124 cm.
Page 33: Photomicrograph of Sample 1256D-86R-3, 94–97 cm.
Page 34: Filling nitrogen dewers.
Page 35: Extracting interstitial water for chemical analysis.
Page 36: View from the JOIDES Resolution.
Page 38: Derrick.
Page 39: Photomicrograph of Sample 1256D-85R-3, 77–81 cm.
Page 39: Photomicrograph of Sample 1256D-94R-1, 86–89 cm.
Page 40: Derrick.
Page 40: Helicopter landing pad.
Page 41: Drill pipe at port.

For more information

IODP U.S. Implementing Organization (USIO): iodp-usio.org/

IODP Expeditions: iodp.org/expeditions/

IODP Repositories: iodp.org/repositories/

DSDP/ODP Core Redistribution Plan: iodp.org/core-redistribution-plan/

IODP in the news: iodp-usio.org/Newsroom/news.html

Lamont-Doherty Earth Observatory Laboratory for Ocean Drilling, Observation, and Sampling (LODOS): www.ldeo.columbia.edu/res/div/mgg/lodos/

Texas A&M University Ocean Drilling and Sustainable Earth Science (ODASES): odases.tamu.edu/

JOI Learning Web site: www.joilearning.org/

INTEGRATED OCEAN DRILLING PROGRAM
JOI ALLIANCE

United States Implementing Organization
www.iodp-usio.org

Joint Oceanographic Institutions, Inc.
1201 New York Avenue, NW
Suite 400
Washington DC 20005
USA
Tel: (202) 232-3900
Fax: (202) 462-8754

IODP-USIO Science Services
Lamont-Doherty Earth Observatory of Columbia University
PO Box 1000, Route 9W
Palisades NY 10964
USA
Tel: (845) 365-8341
Fax: (845) 365-3182

IODP-USIO Science Services
Texas A&M University
1000 Discovery Drive
College Station TX 77845-9547
USA
Tel: (979) 845-2673
Fax: (979) 845-1026