

INTEGRATED OCEAN DRILLING PROGRAM MANAGEMENT INTERNATIONAL



1 October 2008 – 30 September 2009

Annual Report

Contract No. NSF OCE 0432224

Submitted by IODP Management International, Inc.

to

The National Science Foundation

February 26, 2010

Blank Page

TABLE OF CONTENTS

MANAGEMENT AND ADMINISTRATION	4
TECHNICAL, ENGINEERING AND SCIENCE SUPPORT.....	8
ENGINEERING DEVELOPMENT	22
CORE CURATION.....	24
DATA MANAGEMENT.....	26
PUBLICATIONS.....	28
OUTREACH.....	29
IODP-MI ANNUAL REPORT DISTRIBUTION LIST.....	30
APPENDIX 1.....	30

MANAGEMENT AND ADMINISTRATION

CONTRACTUAL ACTIVITIES

NSF-CMO Prime Contract

NSF issued seven contract modifications during FY2009:

Modification #29 provided \$5 million of incremental FY 2009 funding.

Modification #30 provided an additional \$4 million funding to support contract activity through February 1, 2009.

Modification #31 revised contract section H.7 (small business subcontract reporting), approved the FY09 IODP APP, and provided \$9 million of incremental funding.

Modification #32 updated IODP-MI's subcontracting plan and approved the FY 2008 carry forward request.

Modification #33 provided \$5.6 million of incremental funding.

Modification #34 reduced one contract Key Personnel position.

Modification #35 decreased the FY09 Annual Program Plan (APP) budget by \$318,338 and provided incremental funds to fully fund that budget at \$26,970,094.

MAJOR SUBCONTRACT ACTIVITIES

Advanced Earth Science & Technology Organization (AESTO)

AESTO maintains the IODP-MI office in Sapporo, Japan. The Sapporo office continues to provide a full range of support functions to the Science Advisory Structure, including publications and data management.

Subcontract modification #9 (October) authorized the preliminary FY 2009 subcontract budget at the level of \$831,930. Modification #10 finalized the fully funded FY08 subcontract budget at the level of \$802,541

Bremen University

Subcontractor provides core repository services for IODP at the Bremen Core Repository. During the reporting period, the parties executed two modifications:

Modification #5 approved the FY09 subcontract budget at the level authorized in the APP.

Modification #6 approved the subcontractor's FY 2008 carry forward request.

British Geological Survey (BGS)

Through its subcontract with IODP-MI, BGS (acting as the coordinator responsible for overall ECORD science operations) undertakes Mission-Specific Platform (MSP) science operations on behalf of the IODP.

During the reporting period, the parties executed three subcontract modifications.

Modification #8 allotted \$2.7 million of incremental funding for the subcontractor's preliminary FY09 SOC budget.

Modification #9 approved the subcontractor's FY 2009 APP budget at the level of \$4,470,300.

Modification #10 approved the subcontractor's reprogramming request of June 8, 2009, reducing the FY09 budget by \$217,100 to \$4,253,200.

Japan Agency for Marine–Earth Science and Technology (JAMSTEC)

JAMSTEC serves IODP as the Japanese Implementing Organization (IO). Riser-equipped drilling capability, by way of the vessel *Chikyu*, is supplied by CDEX, part of JAMSTEC. CDEX also provides administrative services to the Kochi University Center for Advanced Marine Core Research (CMCR) repository.

During the reporting period, the parties executed subcontract modifications 7 through 9.

Modification #7 allotted \$2.5 million of incremental funding for the subcontractor's preliminary FY09 SOC budget. Modification #8 approved the subcontractor's FY 2009 APP budget at the level of \$12,809,544. Modification #9 approved the subcontractor's FY 2008 carry forward request.

Consortium for Ocean Leadership (COL)

COL serves IODP as the USIO. During the reporting period, the parties executed subcontract modifications 16 through 22.

Subcontract modification #16 (October) provided \$1 million to incrementally fund the subcontractor's preliminary FY 2009 SOC budget.

Modification #17 provided an additional \$1.6 million in incremental funding for the subcontractor's preliminary FY09 SOC budget.

Modification #18 approved the FY09 APP SOC non-operations subcontract budget at the level of \$3.9 million.

Modification #19 approved the subcontractor's FY 2008 "non-ops" carry forward request.

Modification #20 incorporated small business subcontract reporting requirements.

Modification #21 provided an additional \$1 million in incremental funding.

Modification #22 reduced the subcontract FY09 APP SOC non-operations budget by \$101,238 and provided incremental funds to fully fund that budget to the level of \$3,828,249.

University of California, San Diego (UCSD)

The Scripps Institution of Oceanography at UCSD is the subcontractor providing the services to receive and archive scientific ocean drilling-related electronic and digital data in support of the Site Survey Data Bank (SSDB). The IODP-MI Sapporo office oversees the technical work of the subcontractor and provides support and quality control of previously archived samples and data from the Deep Sea Drilling Project and the Ocean Drilling Program.

During the reporting period, the parties executed three subcontract modifications:

Modification #7 (October) authorized the subcontractor's preliminary FY 2009 scope of work at the budget level of \$270,000 for the continued operation and development of the Site Survey Data Bank.

Modification #8 revised the subcontractor's small business subcontracting plan.

Modification #9 approved the subcontractor's carry forward request in the amount of \$71,900 and de-obligated the uncommitted FY08 funding balance of \$6,156.

FINANCE REPORT

The annual financial report is attached (see Appendix 1).

Total contract funds approved:	\$26,970,094	This reflects all modifications made during the fiscal year.
Funds obligated from FY08	\$ 3,479,374	
Total funds expended:	\$23,453,807	
Funds remaining:	\$ 6,995,661	

Of the funds remaining, \$5,605,472 has been obligated. The balance of \$1,390,189 is unobligated. \$433,122 of unobligated funds is under consideration as a request for carry-forward to FY10.

PERSONNEL STATUS

A new President and Program Manager was appointed in May 2009. Planning was initiated to consolidate program services provided out of the Washington, DC and Sapporo, Japan offices into a single location in Tokyo, Japan.

The Intergovernmental Liaison and Advisor position became vacant at the end of June 2009, at the conclusion of a two-year assignment.

Implementation of the office consolidation began during the period of July – September 2009, with the departure of the following staff from the DC office: Deputy Program Manager for Science Operations, Outreach Director, Webmaster, and Executive Assistant. The office consolidation continues into FY10, with an expected completion date of April 1, 2010.

SAPPORO OFFICE

The main tasks of the IODP-MI Sapporo Office are to oversee and manage: (1) IODP Science planning process, site survey data and support of the Scientific Advisory Structure (SAS); (2) Scientific thematic reviews; (3) IODP scientific publications (including editing and production of the journal *Scientific Drilling*); (4) IODP Data Management; and (5) contribution to the IODP renewal process (science planning; added in 2008).

FY09 activities are reported according to this breakdown of work tasks with some outlook comments for FY10.

As a consequence of the ongoing consolidation of the IODP-MI Offices in Tokyo, a number of tasks that previously were conducted out of the DC office were assumed by the Sapporo

Office during the period July-September 2009. These include oversight of science operations and outreach.

SUPPORT FOR SCIENCE ADVISORY STRUCTURE (SAS)

The Sapporo team works with the chairs of SASEC and SPC on the broader issues of science planning and review of science achievements. In FY09 the chairs of SASEC and SPC were supported by the IODP-MI science coordinators in the following fields: meeting agendas, preparation of meeting agenda books, editing of material produced during the meetings and minutes of SPC meetings.

IODP-MI also provides coordination of all other SAS meetings including confirmation and distribution of meeting rosters and logistics, support at meetings for panel chairs and panelists and updates of the IODP web site with all SAS related information. For SPC, SSEP and SSP, IODP-MI edited proposal reviews, secured external reviewers, prepared and distributed proposal and site survey data packages in advance of meetings.

The IODP-MI Sapporo office in FY09 also oversaw data submission to the IODP site survey data bank (SSDB), received 39 drilling proposals submitted at the October 1st and April 1st deadlines, reviewed proposals for completeness and adherence to IODP guidelines, corresponded with proponents, secured and edited 25 external reviews applying to 5 proposals.

During the fourth quarter of 2008, a new science planning task for the Sapporo Office gained considerable momentum: Supporting the IODP renewal process in terms of the renewal conference INVEST (IODP New Ventures in Exploring Scientific Targets) and the writing of the new science plan following the INVEST meeting. The meeting was successfully held in Bremen, September 23-25, 2009, and was attended with close to 600 people. IODP-MI supported the meeting and a student program lifting number of young career scientist to well over ten percent of the participant.

The work task of Thematic Scientific Review of program progress that was added to the work portfolio of the Sapporo Office in 2007 included two thematic reviews in FY09: Ocean Crustal Structure in Oct. 2008 and Deep Biosphere in September 2009.

The IODP-MI Task Force on sub-seafloor life is overseen by the Sapporo Office. In FY09 special efforts were made to promote recommendations made by this task force to the SAS (STP and SPC) in order to facilitate a sampling policy and sample program for these kinds of samples. Communication with and within the task force was electronic.

Attended SAS meetings in FY2008 are as follows:

Date	Meeting	Meeting Place	Attendees
November 2008	SSEP #11	San Francisco, USA	Zelt and Kawamura
January 2009	SASEC #7	Lisbon, Portugal	Zelt, Larsen
February 2009	SSP #10	Busan, Korea	Zelt
February 2009	STP #8	Hawaii, USA	Kawamura
March 2009	SPC #13	Miami, USA	Zelt and Kawamura, Larsen
May 2009	SSEP#12	Utrecht, Netherlands	Zelt and Kawamura

June 2009	EPSP #10	Golden, USA	Zelt
June 2009	SASEC #8	Washington, DC, USA	Zelt, Larsen
July 2009	SSP #11	Austin, USA	Zelt
August 2009	STP #9	Jeju, Korea	Kawamura
August 2009	SPC #14	Kiel, Germany	Zelt, Kawamura, Larsen

TECHNICAL, ENGINEERING AND SCIENCE SUPPORT

IODP-MI

Platform Scheduling

Throughout the first quarter, IODP-MI worked closely with the OTF, the SAS, the IOs and the NanTroSEIZE PMT to adjust operational schedules to accommodate the changing readiness and availability dates for the *JOIDES Resolution*, *Chikyu* and the MSP to be contracted for the New Jersey Shallow Shelf work. To arrive at the final schedule, the OTF worked very effectively and efficiently through email communications; a report summarizing the discussions and decisions made is available at <http://www.iodp.org/otf/>.

In association with the SPC meeting, the Operations Task Force met in Kiel, Germany August 25, 2009. This meeting focused on scheduling options for *Chikyu*, *JOIDES Resolution*, and MSPs for late FY2010 through FY2011. The meeting was the first OTF meeting within the new structure of IODP-MI. New OTF chair is Vice President of IODP-MI, Hans Christian Larsen.

A memo by the incoming SPC chair Gabe Filippelli addressing potential options to compress different science projects into typical expedition length (i.e., 2 months) windows was briefly discussed, but deferred to SPC for further discussion and comments before impacting OTF work.

The full meeting report showing all possible scheduling options is available online at www.iodp.org/otf/.

Project Scoping

NanTroSEIZE PMT Meeting #14 was held prior to AGU in San Francisco, CA on December 14, 2008. The meeting focuses on the effects of the loss of 30 days of operational time and closely examined the priority of operations given the delayed start date and consequential loss of operations. The PMT Meeting #14 meeting agenda and action items is available at: <http://www.iodp.org/project-scoping-groups/>.

NanTroSEIZE PMT #15 was April 19-21 in the JAMSTEC Tokyo office. The main topics of discussion revolved around planning and implementation of Stages 3 and 4 as well as the riserless observatory operation. The meeting agenda and action items can be found on the IODP website at: <http://www.iodp.org/project-scoping-groups/>

Expedition Operational Assessment

The IODP-MI Operations Review Task Force met on January 8-9 at the offices of the Consortium for Ocean Leadership in Washington D.C. to review the operational aspects of

the NanTroSEIZE Stage 1 expeditions (314-316). The review concentrated on “lessons learned” from the expedition, with an emphasis on “what should be done differently in the future.” The committee review was based upon confidential reports submitted by Center for Deep Earth Exploration (CDEX), Expedition 314-316 Co-Chief Scientists, and the NanTroSEIZE Specialty Coordinators.

The meeting began with summary oral presentations by the Co-Chief Scientists of each expedition, a single presentation summarizing the five Specialty Coordinator reports, and a series of presentations by CDEX representatives summarizing *Chikyu* drilling operations, achievements, operational issues and mitigation strategies. Following these oral presentations, the Task Force examined the issues that were identified in the written and oral reports and developed a series of recommendations for implementation by CDEX and other IODP entities. This report, which can be accessed at: <http://www.iodp.org/ortf/>, contains these recommendations.

CDEX

The year started with *Chikyu* laboratory dry runs, the Operation Review Task Force meeting for the completed NanTroSEIZE Stage 1, and completion of NanTroSEIZE Stage 1 expedition initial reports. After repair work on thruster gears and riser tensioners were completed, *Chikyu* left Kobe for Suruga Bay and Kumano-nada on February 15 on a training cruise, to train riser handling, HPCS coring and microbiology sampling. The geotechnical cores taken then kept the lab staff busy until Expedition 319 and 322 became the major activity in the second half of 2009.

Pre-expedition meetings for Expedition 319 and 322 were held in January and February at CDEX in Yokohama, attended by co-chiefs and NanTroSEIZE Specialty Coordinators.

Laboratory preparations continued well into Expedition 319, on which an average of 14 lab technicians sailed to assist the onboard scientific effort. In addition, two EPMs and 3 logging staff scientists were in rotation during this multi-stage expedition.

The cryogenic magnetometer was shipped to vendor for repairs before Expedition 319. It was reinstalled between Expeditions 319 and 322, but failed again during Exp. 322.

NanTroSEIZE Stage 2: Expedition 319

Azimuth thruster repairs and replacement delayed preparation for the first expedition in NanTroSEIZE Stage 2. Despite this issue, *Chikyu* was able to leave port by May 10 and set out on the first riser-expedition in the history of scientific ocean drilling. The expedition was complex in itself, with two separate science parties rotating mid-expedition, and no less than four co-chiefs. The onboard science plan included unprecedented suites of experiments and measurements, including in situ measurement of pore pressure, permeability and minimum principal stress magnitude, as well as real-time mud-gas analysis. Also, cuttings were collected and introduced as a new sample type. While delays were many, due to equipment and weather issues, it was possible to finish the expedition successfully and on time, due to the ample contingency time allotted.

Site C0009 saw the undertaking of riser drilling with Logging-While-Drilling (LWD) to 1600 mbsf. Combining LWD data with results from mud-gas and cuttings analysis allowed for a strong dataset to be built to support the subsequent down-hole logging effort. After the borehole was cased, it was the focal point for a long-offset (30 km) two-ship active seismic experiment: In collaboration with the JAMSTEC R/V *Kairei*, *Chikyu* performed a walk-away

vertical seismic profile (VSP) centered on C0009. This was done to image the mega-splay and decollement, and to evaluate seismic velocity and anisotropy of the forearc basin/accretionary prism sediments at the site. Integration of all this data, as well as results from cores from a limited depth interval, allowed definition of a single set of stratigraphic units. This will facilitate comparison with the future ultra-deep riser hole at Stage 1's Site C0002, and help elucidate the evolutionary history of the forearc basin.

Site C0010 was target for riserless operations, including Measurement-While-Drilling (MWD)/LWD across the mega-splay down to 555 mbsf, casing of the hole and placing of screens across the fault. *Chikyu* performed dummy observatory runs to test future strain- and seismometer monitoring systems for future observatory installation. A temporary observatory (the "SmartPlug") was installed as well, the first observatory installation in the NanTroSEIZE complex drilling program.

Site C0011 was LWD drilled in preparation of Expedition 322, providing data to plan the coring at the same site. Also, beacons were left in place as *Chikyu* left for port on August 30, to save operational time for Expedition 322.

NanTroSEIZE Stage 2: Expedition 322

The second expedition of NanTroSEIZE Stage 2, Expedition 322 "Subduction Inputs" did not suffer from delays or changes in preparation due to repair work. This is an entirely riser-less expedition using RCB coring and targeting input sites of sediment that will be transported into the Nankai Trough seismogenic zone in the future. Planning went smoothly, with the Science Party selected 5 months in advance. The expedition began on September 1st, to leave port by September 4th for Site C0011, which was already prepared for drilling during Expedition 319.

Site C0011 coring commenced on September 8, reaching 881 mbsf 15 days later. The coring was plagued by slow penetration rates, varying recovery and poor core quality. Subsequent in-situ pressure measurements with SET-P and wire-line logging were therefore canceled. The coring issues seem related to a difficult substrate for drilling as well as a faulty drill bit.

Site C0012 coring commenced on September 25, eventually reaching 576 mbsf below the sediment/basalt interface and well into the basement. After a drill bit change, the rate of progress is higher and the core less disturbed than at the previous site. A complete record of material at the input site is the goal for Site C0012.

Data collected on Expedition 322 will provide key constraints on the initial conditions for the "subduction conveyor", which transport the incoming sediment and basaltic oceanic crust to higher pressure/temperature environments. It is hypothesized that these initial conditions are an important control on the onset of seismogenic fault behavior.

ESO (BGS)

Expedition 313 New Jersey Margin

During late FY2008, tenders for a drilling contractor and platform were assessed and a meeting was held with a potential contractor in August. Subsequently from the start of FY2009 discussions continued with a view to starting the New Jersey Expedition at the beginning of May 2009. Discussion proceeded slowly before a contract was signed in late January 2009 with DOSECC Inc. This involved DOSECC subcontracting the liftboat *Kayd* from Montco as a platform. The contract was to begin in Gulf of Mexico on April 7th when the

Kayd would sail for the mobilization location in Atlantic City to begin around April 28th. The expedition would then start on or around May 2nd and end in late July.

Early in FY2009 Jean Noel Proust was appointed as a replacement for Steven Hesselbo (UK) who had withdrawn from the position of New Jersey Co-chief Scientist due to conflicting commitments, although remaining in the Science Party. The Science Party was kept informed of developments, and some new members were sought from PMOs following a few withdrawals from the science party as a result of the delays in implementation. All posts were eventually filled.

The contracted drilling system did not allow the deployment of LWD tools; however, following discussions with IODP-MI and the Co-chief Scientists, it was clear that there is a strong desire to use LWD at the start of the expedition, although a provisional risk analysis by ESO identified potential high-risk issues. As the system to be contracted cannot deploy LWD, it was agreed that once the contract was signed, the contractor would provide a new proposal for deploying LWD and that a contract amendment could be made if all parties agreed to the use of LWD. It was decided on March 5th that LWD would not be implemented for the following main reasons:

- No viable rig and associated equipment were offered by the contractor.
- Largest rig suggested did not have enough pull to operate the safety jar.
- Rig too large to accommodate on the *Kayd* with other equipment.
- Uncertainties over details of the Schlumberger contract.

An ESO planning meeting was held in Edinburgh on March 9th, followed by a Co-Chief Scientists meeting on March 10th and 11th. Several ESO staff attended both meetings. The Scientific Prospectus published in April included the complete staffing list and the measurements plan. The MSP Data Portal (<http://iodp.wdc-mare.org/>) was made available for 313 scientists to share expedition Sample Requests as well as information on scientist's profiles, logistics, maps, expedition-related papers and the Expedition Scientific Prospectus. Also a webpage which summarizes all the equipment and procedures for offshore curation and analyses was made publicly available; this has proved to be a very useful tool for more easily sharing information and discussing procedures with members of the Science Party.

By the end of March the ESO mobile laboratory containers (core curation, clean lab, petrophysics) were packed and on their way to the US to meet the platform *L/B Kayd* for mobilization in Atlantic City. After much iteration, an offshore roster was developed for the expedition and an Onshore Liaison roster also.

The contract with DOSECC duly began on April 7th when the *Kayd* began its transit from the Gulf of Mexico to Atlantic City for its mobilization. Due to favorable weather the *Kayd* arrived in Atlantic City ahead of schedule on April 24th, and the mobilization was then undertaken. There was considerable outreach activity during the mobilization, following which the *Kayd* sailed on 30th April for the first location and the first core was taken on May 2nd.

A weekly transfer boat departing from Staten Island, New York enabled the changeover of crew and supplies during the expedition, and additional journeys were undertaken when required for personnel or equipment transfer.

The objective was to drill 3 holes to maximum depths of 750 m.

The first hole drilled was M0027A that reached a TD of 631 mbsf; 224 cores were taken, drilling a total length of 555.3 m (otherwise open holing or spot coring) with core recovery of 471.59 m or 84.93% despite difficult coring conditions. A through-pipe gamma ray log was acquired for the complete borehole and high-resolution VSP in the upper half. Open hole logging with 5 logging sondes was undertaken in 2 intervals.

The second hole was M0028A with a TD at 674 mbsf. 170 cores were collected out of the total length cored of 476.78 m with recovery of 385.29 m, or 80.81%. Through-pipe gamma logs and VSP at high-resolution were run through-pipe for the entire borehole. Open hole logging and VSP data were obtained from the lower part of the borehole.

The final hole, M0029A reached TD at 756.65 m. 609.44m was cored, of which 454.31 were recovered, giving 74.55% recovery. Logging in M0029A began with spectral gamma through pipe and also VSP data were acquired through pipe. Open hole logging was carried out in three intervals and included conductivity, sonic, magnetic susceptibility and acoustic images. Technical problems with the winch affected the time available to carry out the full planned logging program in this hole. In addition, development of several bridges in the upper sections caused difficulties in logging the upper intervals

Five media crews as well as the IODP-MI and DOSECC presidents visited the platform on the 23rd June. ESO conducted marine mammal observation throughout the periods of VSP logging; all involved had previously undertaken mammal watching training.

At the completion of operations, the *Kayd* sailed for the demobilization port of Atlantic City where demobilization was completed on July 17th after 79 days of operations. Microbiology deep-frozen (-80°C) samples were safely couriered to Bremen and then distributed farther as necessary, and the reefer container with the 1311.40 m of core was shipped to Bremen for the Onshore Science Party to begin on November 6th. The cores arrived in Bremen on August 14th.

Prior to the Onshore Science Party (OSP) the Geotek MSCL-XYZ and P-wave Frame were delivered to the BCR and pre-OSP core logging (NGR, thermal conductivity measurements and testing equipment for the OSP.) started at BCR on September 28th.

Compiling of an internal offshore expedition assessment began in preparation for the Operational Review Task Force and planning continued for the Bremen OSP, including an ESO meeting in London on 16th and 17th September.

Logging: Planning and implementing the logging and petrophysics program for the New Jersey Expedition was the major activity of the year for EPC. Early in the year specific activities included logging discussions in Edinburgh in October, modification of the logging information in the scientific prospectus, preparation of logging tools, many discussions between Montpellier and Leicester universities, meeting at LDEO with Co-chief Scientist Greg Mountain, EPC meeting at AGU to confirm expedition plans, staffing and responsibilities, and meeting with Doug Schmitt at AGU and several conference calls with him at the University of Alberta to discuss VSP work.

Assessment of LWD for the New Jersey Expedition was a significant part of the EPC effort, leading up to a final decision that it would not be possible on the *Kayd* justified in an LWD Assessment produced at the end of February.

Prior to the expedition, seismic data analysis packages for the VSP data were assessed, final checks of the EPC Petrophysics container were made, preparation and calibration of logging tools carried out and Health & Safety documentation completed.

Downhole geophysical measurement tools were delivered to the Atlantic City port area on April 29 – 30, 2009 and EPC provided petrophysicists for the expedition and the logging team from Montpellier undertook the downhole geophysical measurements.

The Montpellier logging team ran five logging tools in the first Hole (MAT_1A), including resistivity, spectral gamma ray, sonic velocity, acoustic imagery and magnetic susceptibility in open-hole and high-quality data was gained through two intervals (347-195 m and 634-430 m below sea floor - mbsf). Total Gamma Ray measurements were taken through the drill-pipe for the entire length of the hole (631 m). VSP data were retrieved in open-hole from 634 to 195mbsf and then through pipe to the top of the hole.

Through-pipe spectral gamma ray was run for the full length of the second hole (MAT_2D) in two runs (674-390 mbsf and 309-0 mbsf). The bottom 223m (674-451 mbsf) were logged in open-hole using the resistivity, magnetic susceptibility and acoustic imaging tools. A second stage of open-hole logging was conducted for the interval 425-396 mbsf using the resistivity and acoustic imaging tools. This yielded high quality data. VSP data were acquired for MAT_2D from 674 to 451 mbsf with excellent results. A through-pipe VSP run was conducted for the interval 396 to 22 mbsf which yielded good data, with the exception of the interval 334-294 mbsf where pipe reverberations interfered with the signal.

Logging in the third hole, M0029A, began with spectral gamma through pipe. This provided similarly high-quality data to the previous holes and was again processed rapidly and used to guide decisions in where to pull pipe to for future logging sections. VSP data were acquired through pipe. Open-hole logging was carried out in three intervals and included conductivity, sonic, magnetic susceptibility and acoustic images. Technical problems with the winch affected the time available to carry out the full planned logging program in this hole. In addition, development of several bridges in the upper sections caused difficulties in logging the upper intervals.

Downhole geophysical measurement tools were returned to Montpellier following disembarkation at Atlantic City. The VSP equipment returned to DWSII at Corpus Christi and the EPC container with the MSCL were returned to BGS.

Four principal measurements were taken on the Multi-Sensor Core Logger (MSCL); gamma density, P-wave velocity, non-contact resistivity and magnetic susceptibility. All cores recovered from the 3 holes were logged on the MSCL, almost all with a measurement interval of 1cm.

MSCL data quality is influenced by core quality which varies in response to lithology, consolidation, infiltration of drilling fluid and various parameters relating to drilling and hole conditions. The EPC petrophysics team worked to better quantify the influence of core quality on MSCL data quality to ensure consistency throughout the dataset and to make the data as user-friendly as possible for the science party. The final dataset was being prepared for presentation at the OSP; it appears that there are some good correlations between core logging and downhole logging measurements particularly for the magnetic susceptibility and density datasets.

Onshore Science Party: Began for the onshore phase including negotiations for purchase of an MSCL-XYZ scanner, a P-Wave Frame and provision of thermal conductivity system. An advert was placed for a short term position for a Technician to assist with the Onshore Science Party.

Great Barrier Reef

Tenders for a drilling vessel and drilling services for this expedition had been received in early August (FY2008) and subsequently assessed. A preferred contractor was identified and contractual discussions continued, including face-to-face meetings on February 12th and March 17th.

In September 2008, ESO had held a meeting with the Great Barrier Reef Marine Park Authority (GBRMPA), following which ESO submitted a new permit requesting more holes and a permit extension to December 30, 2010. GBRMPA anticipated that these new terms would be acceptable and the new permit was received on January 21, 2009. Also following a suggestion from GBRMPA, the name of the expedition was modified to Great Barrier Reef Environmental Changes.

An application for a Marine Scientific Research (Public Service Vessel) permit to carry out a scientific cruise in Australian waters was submitted in January and discussions on this matter continued throughout the remainder of the year, although there was good communication with the Australian ministry.

Following the call for applications for the GBR Science Party and the invitation process, the Science Party for this expedition was eventually filled and the offshore team finalized. The Science Party for this expedition is large and comprises 8 Japanese, 8 from the USA, 8 from ECORD, 2 Australians, 1 Indian and 1 Chinese. Some changes were made after the reporting year in response to the delay in the offshore operations.

SSP and EPSP approval for the sites were granted and following the SPC approval of 728-APL2 in August 2008, the operational implications of implementing the proposal were investigated despite the APL not being yet properly forwarded to OTF as it had insufficient site survey information. In order to obtain a permit from the Papua New Guinea Government, a permit application needed to be submitted at least 6 months ahead of time. Consequently the proponent was advised that ESO would need to be advised of SSP and EPSP approval for the sites by mid-March 2009 if the APL were to be included in the GBR expedition. No additional site survey data were submitted for the 728-APL2 before for SSP meeting in February, so that the APL was not forwarded to OTF by SPC in March and was not included with the GBR expedition.

An ESO planning meeting was held in Edinburgh on March 2nd, followed by a Co-chief Scientists meeting on the 3rd and 4th of March. The Scientific Prospectus was submitted to TAMU in late June.

A contract was signed with Bluestone Offshore of Singapore on May 11th to use the drilling vessel *Bluestone Topaz*. Preparations for the offshore expedition then continued in co-operation with Bluestone and the Great Barrier Reef Marine Park Authority. The provisional plan was to mobilize in Singapore in early October, and for the science party to embark at Townsville in late October for a cruise that is expected to last about 45 days before disembarkation in Townsville in early December.

In August ESO representatives met with the drilling contractor Bluestone at their Singapore office. The discussion was based around the proposed November 1st start from Townsville as agreed in our contract.

A few days later a meeting was held with the Great Barrier Reef Marine Park authority at their Townsville headquarters. Many points were discussed, based around the Environmental Management Plan, following which was agreed to make a number of amendments and to drop 2 sites that Ribbon Reef that were deemed by marine advisers from the Australian Maritime Safety Agency to be too close to the reef.

On return from Australia a brief meeting was held on August 20 in Singapore with the Chief Executive of Bluestone in order to update him of our discussions with GBRMPA. Unexpectedly, he advised ESO that the *Bluestone Topaz* had developed serious engine failure and he proposed an alternative better vessel, but that this vessel would not be available to ESO until at least December 1st.

Subsequent to that meeting there was considerable discussion and negotiation, eventually leading to a proposal that a newly built vessel, the *Greatship Maya*, be used and arrive in Townsville on the 4th or 5th of January following mobilization of the ESO containers in Singapore in late November. Work began on making consequent amendments to the existing contract.

In Bremen the reefer container as well as the ESO curation and ESO geochemistry containers were unpacked from Expedition 313 (New Jersey Shallow Shelf) and newly equipped within 5 days for GBREC and shipped to meet the end-of-September mobilization deadline in Singapore. Following the delay, these containers were temporarily stored in Singapore.

A consequence of the new timetable was the necessity to delay the Onshore Science Party (OSP) that had been scheduled for April 16 as there was insufficient time to ensure that the core would be delivered to Bremen in time. Following consideration of several factors including pre-OSP measurements on the full cores, it was decided to start the Onshore Science Party on July 2, 2010.

Logging: Regular conference calls between Aachen, Montpellier and Leicester have taken place during preparations for wireline logging on this expedition, which is to be carried out by the Montpellier group. The MSCL equipment was tested prior to shipping and investigation has continued into the documentation and other requirements for the transportation of the MSCL and the Gamma Source to the Great Barrier Reef National Park. The logging information in the scientific prospectus was modified and preparation and calibration of logging tools carried out.

Other

Informal discussions have taken place with the proponents of the Baltic Sea proposal for MSPs that has been at SSEP. A meeting with 2 proponents was held in Edinburgh in February, and an ESO representative attended a Magellan Workshop on the topic on March 7-8, 2009.

Throughout the year ESO has continued to implement QA/QC within MSP operations as asked by IODP-MI. Various work packages related to this topic which encompass overall policies and procedures for QA/QC including are in progress.

Improvements have been made to the ESO containers used as offshore laboratories and offices. These include the planning and implementation of the most flexible power solution.

Online tutorials for both the offshore operations and the Onshore Science Party (OSP) have been compiled and published on the web.

USIO

Along with two working transits, the U.S. Implementing Organization (USIO) completed three full expeditions during FY09 and began a fourth. Over the course of these expeditions, the USIO drilled in locations that have not been drilled previously, added detail to existing transects to test hypotheses regarding massive magmatic episodes, and collected continuous sediment sequences that will allow completion of high-resolution age-diagnostic studies and refinement of the timeline of Earth's climatic changes.

Expedition Planning

USIO operational planning during FY09 included working with the Operations Task Force (OTF) to develop a revised FY09 operations schedule based on U.S. scientific ocean drilling vessel (SODV) progress, planning and staffing for IODP Phase 2 expeditions, and acquiring clearances needed for those expeditions. A new operations schedule was published in October 2009 based on a revised SODV delivery date of January 25, 2009 from the shipyard, with international operations commencing in March 2009. The USIO accommodated changes to the operations schedule with revised *Scientific Prospectuses* that reflected increased operations time for the Pacific Equatorial Age Transect program and incorporated Ancillary Project Letter 739, which added a microbiological program to the Bering Sea Paleooceanography Expedition. Science staffing was reevaluated based on the revised operations schedule, and the USIO worked with Program Member Offices (PMOs) and Co-Chief Scientists to fill vacant Science Party positions. Science staffing for the rescheduled expeditions was completed during FY09.

Clearances

Territorial clearance was obtained to operate in Canadian and New Zealand waters for the Juan de Fuca cementing operations and the Canterbury Basin Expedition, respectively. Clearance from Russia to drill two primary sites during the Bering Sea Expedition was not obtained despite U.S. State Department efforts that continued into the expedition until it was no longer operationally feasible to occupy the sites.

Environmental assessment

A third-party company was contracted to produce an environmental assessment for seismic activities for the Bering Sea Expedition (although approval was not obtained in time), and approval was secured from the New Zealand Department of Conservation to use only USIO marine mammal observers during the Canterbury Basin Expedition.

Expedition 320/321: Pacific Equatorial Age Transect

Expeditions 320 and 321, sailing from March 5 to May 4, 2009 and May 4 to June 22, 2009, respectively, were two parts of a single science program designed to study ocean circulation and productivity in the tropical Pacific, one of the largest and most climatically important ocean regions on Earth, and to fine tune the Cenozoic geological timescale with higher resolution data than have been previously available.

During these expeditions scientists recovered a series of continuous historical sediment records back to 53 Ma, including the warmest period of Earth's history during the Cenozoic, known as the greenhouse Earth. At that time there were no significant polar ice caps and greenhouse gas concentrations were several times higher than they are today. This period includes the best analogs for abrupt climate change, extreme climate events, and ocean acidification, giving insights into potential impacts of future climate changes.

Over the last 55 million years, global climate has varied dramatically from extreme warmth to glacial cold; these climate variations have all been imprinted on the biogenic-rich sediments that accumulate in the equatorial zone. The calcium carbonate compensation depth (CCD) in most of the Paleogene is very shallow, making it difficult to obtain well-preserved carbonate sediments. Using the strategy of drilling at the paleoposition of the Equator at successive crustal ages to overcome this challenge, Expedition 320/321 scientists were able to recover a unique sedimentary biogenic sediment archive for several important stratigraphic intervals, such as the Paleocene/Eocene boundary event, Eocene cooling, the Eocene–Oligocene transition, the “one cold pole” Oligocene, the Oligocene–Miocene transition, and the Miocene.

The continuous record recovered during Expedition 320/321 will help scientists understand how Earth was able to maintain very warm climates, relative to the 20th century, even though solar radiation received at Earth's surface remained nearly constant for the last 55 million years. Combined with seismic reflection studies of regional sedimentation, equatorial Pacific sediment history can be reconstructed with high confidence to improve upon earlier reconnaissance work.

Microfossil studies from equatorial Pacific sediments will help determine the rates of past environmental changes, including ice sheet expansion, which took place at about 34 Ma during a cooling period. At that time, ocean acidification decreased rapidly and the climate transitioned from warm to cool in less than 100,000 years, less than the time that humans have lived on Earth.

Studies of these sediments will contribute toward resolving questions of how and why paleoproductivity of the Pacific Equator changed over time, providing rare material to validate and extend the astronomical calibration of the Cenozoic geological timescale, determining sea-surface temperatures and nutrient profiles over time, enhancing our understanding of biostratigraphic and magnetostratigraphic datums at the Equator, and providing information about rapid biological evolution during times of climatic stress.

Expedition 320/321 collectively cored eight sites from the sediment surface to at or near basement, with basalt aged between 53 and 16 Ma, covering the time period following maximum Cenozoic warmth, through initial major glaciations, to today. The 6140 m of recovered sediments allow reconstruction of extreme changes of the CCD across major geological boundaries during the last 53 million years. Using this archive together with older Deep Sea Drilling Project (DSDP) and Ocean Drilling Program (ODP) drilling data from the equatorial Pacific, the position of the paleoequator and variations in sediment thickness can be delineated from about 150°W to 110°W longitude.

Downhole log measurements from Holes U1337A and U1338B were used to define three logging units in each hole. Variations in density, electrical resistivity, *P*-wave velocity, and natural gamma ray (NGR) were used to define these units. The downhole density and NGR measurements as well as resistivity images were instrumental for identifying and defining

chert layers that were only partially recovered in the cores. The vertical seismic profile (VSP) measurements provided the basis for a travel time-depth conversion that allows correlation of seismic reflectors to stratigraphic events.

Two major continuous, essentially complete Neogene equatorial Pacific sedimentary sections were recovered during Expedition 321 from Holes U1337A–U1337D (0 to >23 Ma) and Holes U1338A–U1338C (0 to >17 Ma), just above the Oligocene/Miocene boundary. These represent the only complete Neogene sections in the equatorial Pacific, possibly for all the tropics that have high enough sedimentation rates to resolve orbitally forced sediment cycles. One additional hole (U1338D) was drilled at Site U1338 to provide practice sediment cores for the upcoming Bering Sea Paleoceanography Expedition 323 Science Party. Expedition 320 drilled three other sites that also define Neogene sedimentation in the equatorial Pacific (Sites U1334–U1336).

The cores recovered from Expedition 320/321 provide the raw material to address Neogene PEAT objectives for the equatorial Pacific megasplice. Shipboard research provides the framework of studies to define the lithology, show continuity of the sediment section, and define the basic time framework. Shore-based work will refine the chronostratigraphy through orbital tuning and will measure proxies of surface and deep water change and paleoproductivity/carbon cycles to show how the modern equatorial Pacific developed as the icehouse world developed.

Logging: The generator-injector (GI) air gun used for vertical seismic profile (VSP) logging operations was successfully tested during coring operations at Site U1334.

During logging operations in Hole U1334, the transmission on the wireline logging winch failed while running the tool string into the hole, leaving the tool string at a depth of ~1.7 km inside the pipe. The tool string was successfully retrieved from the hole using t-bars, rig floor air tuggers, and the coring winch; however, no more logging was possible during Expedition 320.

During Expedition 321, two downhole tool string deployments in Hole U1337A provided measurements of natural gamma ray radioactivity, bulk density, electrical resistivity, elastic wave velocity, and borehole resistivity images in the depth interval 77–442 m WSF (wireline depth below seafloor). A third tool string deployment measured seismic waveforms in a VSP experiment at 16 stations between 214 and 439 m WSF.

Two wireline tool string deployments in Hole U1338B provided downhole measurements of natural gamma ray radioactivity, bulk density, electrical resistivity, elastic wave velocity, and borehole resistivity images in the depth interval 125–413 m WSF. A third tool string deployment measured seismic waveforms in a VSP experiment at 14 stations between 189.5 and 414.5 m WSF.

Expedition 321T: Juan de Fuca Hydrogeology Cementing Operation

During Expedition 321T, a working transit expedition that sailed from June 22 to July 5, 2009, the USIO cemented reentry cones around subseafloor borehole observatories (circulation obviation retrofit kits [CORKs]) in Holes U1301A and U1301B. These borehole observatories, originally installed during Expedition 301, were designed to seal and stabilize the open holes for future sample and data collection via remotely operated vehicle and submersible expeditions. The observatories serve as long-term monitoring points for large-scale crustal

testing. Observations since Expedition 301 have shown that both observatory systems were leaking.

Expedition 321T benefited from excellent weather and sea conditions in an area where working conditions can be poor, even during an optimal weather window. All planned operations were completed more quickly and with less difficulty than anticipated. Holes U1301A and U1301B were reentered and filled with cement without incident; observations with the subsea television showed cement pouring up and out of the holes on the platform, suggesting that both cones were successfully filled with cement.

Proponents visited the two CORKs in August 2009 with the submersible *Alvin* to download data, determine if the observatories remained sealed, and replace downhole instrument strings in preparation for completing the full suite of interdisciplinary experiments. Divers discovered that warm water is still venting around the outside of Hole U1301A and hypothesized that the cement did not set up quickly enough and thus sank down into the annular holes surrounding the wellhead and likely into the open hole. They were, however, able to recover the short instrument string from the CORK, replace it with a long instrument string, and download pressure data. Divers were also able to download pressure data from Hole U1301B, but they could not recover the instrument string, which will require the greater pulling force of the *JOIDES Resolution* during the planned Juan de Fuca expedition in FY10. Pressure data indicate that Hole U1301B cementing appears to have been sufficient to allow this hole to recover toward equilibrium conditions.

Expedition 323: Bering Sea Paleooceanography

Expedition 323, which sailed from July 5 to September 4, 2009, was designed to recover high-resolution paleoenvironmental and paleoclimatic records in the North Pacific—an area underrepresented in previous reconstructions. Data from Expedition 323 will provide the first comprehensive, high-resolution records of environmental and oceanographic conditions in the Bering Sea over the past 5 million years to reconstruct the history of this important marginal sea that connects the Pacific and Arctic oceans and study its role in global climate and oceanographic changes. The recovered sediments will also provide vital information on seafloor microbial activity and diversity in an extremely high productivity environment.

Over the last 5 million years, global climate has evolved from being warm with only small Northern Hemisphere glaciers and ice sheets to being cold with major Northern Hemisphere glaciations occurring every 100 to 40 thousand years (Milankovitch cyclicity). The reasons for this major transition and the mechanisms controlling glacial/interglacial- and millennial-scale climate oscillations are unknown. The Pacific is the largest ocean with arguably the largest potential to influence global climate. There are data to show that the Pacific experienced oceanographic reorganizations that were just as dramatic as those in the Atlantic, but the scarcity of data in critical regions of the Pacific has prevented an evaluation of the role of North Pacific processes in global paleooceanography and climate evolution.

Cores recovered during Expedition 323 provide a previously unavailable continuous sediment record of climate change in the Bering Sea. Higher latitudes like the Bering Sea offer more detailed sediment records because of high accumulation rates caused by glaciers grinding down rocks and depositing them as sediment. The Bering Sea is fairly isolated, so major climate changes in the past have caused major changes in sea ice, salinity, and biological activity, which are traceable in sediment cores. The Bering Strait is the main pathway for flux of heat, salt, and nutrients between the Pacific and Atlantic Oceans. Results

from Expedition 323 will help our understanding of transitions in global ocean heat and nutrients.

The Bering Sea offers the opportunity to constrain global models of organic-fueled subseafloor respiration, subseafloor biomass, and the impact of subseafloor microbes on global biogeochemical fluxes in an extremely high productivity region of the ocean. In addition to providing important sedimentary records of past climate change, the Bering Sea is a region of relatively high surface productivity, elevated intermediate and deepwater nutrient concentrations, and, presumably, microbial-mediated biogeochemical cycling. Thus, Expedition 323 provides the first examination of subseafloor biomass and microbial processes in a high-productivity region.

The approximately 5-million-year sediment record obtained during Expedition 323 will provide an understanding of the evolution of Pliocene–Pleistocene surface water conditions, paleoproductivity, and sea-ice coverage, including millennial- to Milankovitch-scale oscillations; the history of production of the Pacific intermediate and/or deep water masses within the marginal sea and its link to surface water processes; the interactions between marginal sea conditions and continental climate and the Pacific Ocean; and an evaluation of how the ocean/climate history of the Bering Strait gateway region may have affected North Pacific and global conditions.

The seven sites drilled during Expedition 323 covered three different areas: Umnak Plateau, proximal to the modern Alaskan Stream entry; Bowers Ridge, proximal to the glacial Alaskan Stream entry; and the Bering Sea shelf region, proximal to the modern sea ice extent. Thirty holes, including four deep holes that ranged in depth from 600 to 745 m, were drilled below seafloor, recovering a total of 5741 m of sediment spanning the last 5 million years in age. The water depths ranged from 818 to 3174 m to characterize past vertical water mass distribution and circulation.

Logging: Four of the Bering Sea Expedition sites were logged with a standard suite of wireline logging tools to record in situ physical and lithological properties. The logged sites were chosen to record the diversity of the environments drilled during the expedition.

Hole U1339D was located on the Umnak Plateau in the easternmost part of the Bering Sea; Hole U1341D was located on the western side of the Bowers Ridge, in the southern part of the Bering Sea; and Holes U1343E and U1344A were in locations proximal to the gateways to the Arctic Ocean along the edge of the continental shelf.

All logging operations took place under very favorable sea conditions, with the heave never exceeding 1 m. As a result, all the tool deployments were highly successful and generated high-quality data, but there was no opportunity to evaluate the heave compensation system and the significant improvements that were made to its software following the PEAT expeditions.

Expedition 324: Shatsky Rise Formation

Scientists participating in Expedition 324, which began on September 4, 2009 and is scheduled to end on November 4, 2009, traveled to one of the best locations on Earth to test competing theories on the formation of oceanic plateaus. Shatsky Rise, located ~1500 km east of Japan, is the only existing large oceanic plateau formed during a time of magnetic reversals. These reversals provide a record of spreading ridge locations, which will give Expedition 324 scientists insight into the formation of Shatsky Rise and, in turn, may answer

one of the most fundamental questions of modern geodynamics—whether oceanic plateaus like Shatsky Rise were formed from a deep-sourced mantle upwelling (mantle plume) or solely by interaction of plate boundaries and the lithosphere with the shallow mantle.

The formation of Shatsky Rise during a time of magnetic reversals permits its tectonic setting to be resolved. Magnetic lineations show that the plateau formed along the trace of a triple junction and its formation was intimately related to ridge tectonics. Existing data, however, demonstrate that several aspects of Shatsky Rise's history (e.g., massive, rapid initial growth, transition from large to small magma flux, capture of ridges) fit the plume model. On the other hand, the coincidence of volcanism with the triple junction, ridge jumps, and the lack of isotopic evidence for a hotspot-type mantle source can all be interpreted as favoring a plate-controlled origin.

Two of the Expedition 324 sites were occupied during the reporting period. Site U1346 was drilled to 191 m below seafloor with an average recovery rate of 29% overall and a recovery rate of 39% for basement. The hole was successfully logged with the triple combination tool string, but hole conditions and sea state were not appropriate for deployment of the Formation MicroScanner (FMS)-sonic tool. Site U1347 was drilled to 317.5 m below seafloor with an average recovery rate of 62% for basement. Preparations for logging were under way at the end of the reporting period.

Engineering Support

The USIO completed several engineering projects in FY09 and continued others, making significant progress with technology enhancements and providing tool support for others.

The USIO completed a number of technology enhancements in FY09 that will improve shipboard data acquisition and upgrade shore-based capabilities. Key accomplishments for the fiscal year are highlighted below.

Advanced piston corer temperature tool model 3: Two advanced piston corer temperature tool model 3 (APCT3) tools were calibrated and sent to Singapore for use during the shakedown cruise of the *JOIDES Resolution* and the first IODP Phase 2 expeditions. The APCT3 tools were run several times during Expeditions 320 and 321, with very good results.

Common downhole data acquisition system: Common downhole data acquisition (CDAQ) systems were installed in two sediment temperature (SET) tools that were tested during Expedition 320T sea trials and deemed ready for deployment. CDAQ system firmware was enhanced for use in the sediment temperature (SET) and sediment temperature and pressure (SETP) tools, and two SET tools were deployed successfully during Expeditions 320 and 321.

Telemetry projects: The USIO-Schlumberger tool string interoperability project was successfully completed during Expedition 320T sea trials with a test in Hole U1330A where the magnetic susceptibility sonde was deployed in a Schlumberger tool string. This combination was also successfully deployed in Holes U1331A and U1332A.

In a related effort, the multifunctional telemetry module (MFTM) was completed and successfully bench tested with the Schlumberger telemetry systems. The MFTM is expected to eventually allow any combination of third-party tools to run in a Schlumberger tool string and log data through Schlumberger logging systems.

Wireline heave compensator system: The new wireline heave compensator (WHC) system was tested during Expedition 320T sea trials and subsequent IODP expeditions. During Expedition 320, the hydraulic valve controlling pressure to the WHC and the Schlumberger winch transmission failed and required immediate repairs during the Expedition 321 port call. Four Schlumberger engineers and two Electro-Wave engineers attended the Expedition 321 port call to implement the repairs, and hardware was shipped back to the respective manufacturers for detailed failure analyses. An Electro-Wave engineer sailed during Expedition 321 to provide engineering and software support for WHC testing, during which a robust analysis of downhole tool dynamics relative to ship surface movement led to extensive changes to the controlling software. Logging operations were successfully completed during Expedition 321, indicating that the repair efforts were successful.

Lockable flapper valve project: A Lockable Flapper Valve Task Force (LFVTF) was established to draw on the professional experience of others to explore different options of addressing the recurring problem of the lockable flapper valve (LFV) unlatching prematurely. The LFVTF comprises engineering personnel from LDEO and TAMU, Schlumberger logging engineers, Overseas Drilling Limited core technicians, and a consultant from Stress Engineering. Several new designs of the flapper on the LFV were generated during FY09 and the LFVTF began reviewing the designs.

Geosciences laboratory (ODASES): TAMU collaborated with the Texas A&M University College of Geosciences in selecting an X-ray fluorescence (XRF) core logger for the Ocean Drilling and Sustainable Earth Science (ODASES) Geosciences Laboratory at IODP-TAMU. The College of Geosciences purchased and arranged installation of the XRF core logger, and IODP staff were trained in its operation and maintenance. Ownership of this instrument will be transferred to IODP as part of the ODASES-IODP agreement.

ENGINEERING DEVELOPMENT

Engineering Development Proposals —The third Engineering Development Proposal submission season ended April 15, 2009. Three proposals were received, shown below. The proposals were first reviewed by IODP-MI and then by the Engineering Task Force (ETF), which met April 27-28, 2009. The Engineering Task Force then decided to forward all three proposals to EDP for further review. One of the proposals was routed to EDP for review in competition for Science Operating Cost (SOC) funds; the other two were categorized as non-SOC-funded proposals but still routed to EDP for additional review.

Engineering Development Proposals Submitted by April 15 th , 2009		
Proposal No.	Title	Proponent, Institution
ED-2011-01-A	Wireline Hydraulic Testing and Imaging Tool	Cornet, U. CNRS – Institut de Physiqu du Globe de Strasbourg
ED-2011-01B	Replacement of Magnetic Susceptibility Sonde	Goldberg, LDEO
ED-2011-02B	Development of CFRP riser pipe for 4000m water depth	Watanabe, U. Tokai

Development of FY2011 Engineering Development Plan

Based on proposal ranking and discussion from the July 2009 EDP meeting, IODP-MI developed the FY2011 engineering development plan. This plan includes continuation of the simple observatory initiative and a second year of development for the Multi-sensor Magnetometer Module – a wireline magnetometer. No new proposals were selected for inclusion into the plan. SPC endorsed this pathway forward at its August 2009 meeting. Engineering Task Force – The Engineering Task Force met in Annapolis, April 27-28, 2009 to assist IODP-MI in assessing progress of the FY09 developments and in assessing technical merit of the Engineering Development Proposals received in April for consideration of FY11 funding. The meeting report can be found on the IODP website, <http://www.iodp.org/engineering-task-force/2/>.

Core Quality and Quantity Assessment

A contract was signed with Science Management International to run a detailed core quality and quantity analysis on the NanTroSEIZE Expedition 315 and 316 coring results. The study includes close examination of core quality and recovery, a comparison of core quality to drilling, vessel and environmental data, and a comparison of core quality to lithological controls or influence.

An additional consultant was selected to examine past and present coring and drilling technology. An excellent report has been submitted detailing coring and drilling technologies used throughout the program and in industry.

Both studies can be found online at: www.iodp.org/eng-dev.

Offshore Technology Conference

Through personal interface, booth visuals, brochures, and other handouts, the IODP Engineering Development initiative was successfully promoted at the Offshore Technology Conference (OTC) held in Houston, Texas, May 4-7, 2009.

Industry Collaboration/Partnership

The deliverables of the DeepStar-funded Riserless Mud Recovery™ System Feasibility Study were prepared, assembled and presented during FY2009. This effort was headed by IODP-MI in close cooperation with AGR Drilling Services and the USIO. Deliverables for the feasibility study include:

- (1) Feasibility Study Synthesis Document
- (2) *JOIDES Resolution* Feasibility Study
- (3) Riserless Mud Pump Feasibility Study, and
- (4) Well planning documents

Following the completion of the feasibility study, the next step is to procure the funding needed to conduct sea trials. If successful, the addition of the Riserless Mud Recovery™ System aboard the *JOIDES Resolution* would significantly increase the drilling depth capability and well control options by providing continuously circulated engineered mud, normally only obtained with the use of a marine drilling riser.

IODP-MI Managed Projects (Third-Party)

Motion Decoupled Hydraulic Delivery System (MDHDS): The contract to design and fabricate the bottom-hole assembly components of the MDHDS was finalized and fully executed in June. The project team held its kickoff meeting and completed the conceptual design for the system and is generating the full scale layout to confirm compliance with existing bottom-hole assembly components. The project team has completed the establishment of all subcontracts.

Simple Observatory Initiative (S-CORK and SCIMPI): Following the delayed approval of the FY2009 Annual Program Plan, the SCIMPI project team kicked off the project during the last quarter of FY2009. Since then, they have consistently held weekly conference calls to complete the conceptual design of the system.

A common deployment system for simple observatories is being designed in concert with the SCIMPI project team. Major elements of the common deployment system are also applicable to the MDHDS project thus communications with the MDHDS team have been facilitated.

CDEX

Long-Term Borehole Monitoring System (LTBMS)

Design Work. The downhole module design went through several iterations to optimize the modules' tolerance to heat, pressure, shock and vibrations. After component evaluation during the first quarter, they were delivered to test with the Experimental Prototypes (EXP). Testing and modifications have been ongoing, including high temperature and environmental life tests. Main Printed Circuit Board (PCB) chassis design was completed and a mock-up delivered for testing.

Telemetry System. Different memory configurations for the subsea module were tested for functionality and power consumption, then evaluated at 125 °C with prolonged testing. Despite some issues with power supply functionality, data generally migrated correctly to the software. 8 sets of EXP were then assembled and 6 sent for field-testing. All tests produced consistent data of quality within specified criteria.

System life tests have so far reached a lifespan of 1992 hours. High temperature tests of power supplies met with problems, and are undergoing troubleshooting. Shock/vibration test revealed need for small modifications to the downhole module design. High Temperature/High Pressure Tests on the downhole module at 135 °C and 16,000 psi for one hour were successful.

Related Activities. The LTBMS Project was presented at the AGU 2008 Fall Meeting. CDEX and Schlumberger K.K. visited *Chikyu* in Kobe to investigate in detail the deployment procures and the location of handling facilities.

CORE CURATION

Bremen Core Repository

Bremen Core Repository (BCR) experienced another busy year, with the major activities including regular sampling for scientists' requests and assimilating older DSDP core material received under the Core Redistribution Project as well as adapting the corresponding data. The period was also characterized by numerous outreach activities and a large number of prominent visitors. A total of 23,826 samples were taken at the BCR for 178 requests during this fiscal year (Table 1). BCR has a total of 78 visitors throughout the year. BCR has processed a substantial number of sample requests for DSDP and older ODP cores, but the

total number of samples taken is lower than in some past years due to the absence of new high-recovery paleoceanography expeditions within the reporting term. The DSDP/ODP Core Redistribution project was begun in 2006 and the last containers arrived in Bremen near the end of FY 2008. The cores we received have all been racked.

During this fiscal year, IODP Expedition 313 “New Jersey Shallow Shelf” was drilled in the Atlantic from May through July, bringing 1,322.11 m of new core to the BCR. The BCR inventory now reflects a total of 142 km of DSDP, ODP, and IODP cores.

Core Redistribution Project

According to the core redistribution scheme, the BCR will retain and receive all IODP cores from the Atlantic and Arctic Oceans and the Mediterranean Sea, the GCR will store cores from the Caribbean Sea and Gulf of Mexico, eastern and central Pacific, and Southern Oceans, and the KCC will be the repository for western Pacific and Indian Ocean cores. The transfer of existing Atlantic cores from the ECR to BCR was completed by the end of last fiscal year (FY08). The cores all arrived in good condition and were well-organized so that placing them into the racks in the correct order has been carried out with relative ease.

In addition to the Atlantic Ocean cores received from the ECR, BCR also received one container from the GCR with over 1,000 whole-round (not split into work and archive halves) sections from a large variety of DSDP legs. These are sections that were originally taken more-or-less routinely for the purpose of organic geochemistry analysis. They were stored frozen at the GCR for a period of time and then at some point, probably due to a lack of interest in sampling by the geoscience community, they were allowed to thaw but were still maintained as whole rounds. These cores have all been inventoried and documented and are now stored, still as whole rounds, in a 20-foot refrigerated container on the grounds of the MARUM. In addition, because the DSDP archive halves received from the ECR were not provided with red endcaps, BCR has carried out a project to print red section labels for all the DSDP cores and relabel the archive halves with these labels to protect against inadvertent sampling of the archive halves. This project was finished during FY09. The arrival of DSDP cores in Bremen has also revealed a deficiency in the existing JANUS corelog database – that is, the basic core and section length data for a large portion of the DSDP core collection has many mistakes that need to be corrected by looking at all of the core photos and entering the correct section numbers and lengths into a table. Student workers have been employed to carry out this relatively long-term project, and so far 10 DSDP Legs have been completed and the tables for each leg have been sent to the database group at TAMU for review and update of the JANUS database. When this project is complete, the corrected values will assure accuracy of the depth calculations of all samples when DIS is used for all BCR’s sampling (when Janus is switched to read-only status).

The overall amount of sampling activity for the DSDP and ODP redistribution material has steadily increased over the past couple of years with the addition of cores to our collection, with 1269 samples taken from them in FY07, 3751 in FY08, and 4471 in FY09.

CDEX

2009 saw the end of the Legacy Core redistribution program, the end of the NanTroSEIZE Stage 1 data and sample moratorium, and the execution of NanTroSEIZE Stage 2 expedition. Also, a new position as Bio-curator was established and filled to establish procedures for aseptic handling of Routine

Microbiological Samples (RMS), including curation of samples at temperatures of -80 and -160 °C. About 5800 m of core sections arrived to KCC from IODP Expedition 323 to the Bering Sea.

DSDP/ODP Core Redistribution Project

The beginning of FY2009 saw the arrival of the 51st and last shipment of legacy cores, this one the 33rd from the Gulf Coast Repository. This was celebrated with a formal ceremony at Kochi Core Center (KCC) attended by JAMSTEC President Yasuhiro Kato, IODP-MI Sapporo Office Head Hans Christian Larsen and many more from KCC, CDEX and JAMSTEC Headquarters. The Sample Material Curation System was reviewed for upgrades, to facilitate the incorporation of the JANUS-based legacy core data into J-CORES. Checking and rechecking of this data was completed during the third and fourth quarter, to prepare for testing of legacy core sample registration in J-CORES.

Sample Requests

78 legacy core requests were received and 60 completed. Of the last 33 NanTroSEIZE Stage 1 sample requests, 26 were completed. 133 requests from NanTroSEIZE Stage 2 expeditions have been received so far. After the Annual IODP Curatorial Meeting at KCC, pre-expedition sample requests for NanTroSEIZE Stage 2 began to arrive. The bulk of these arrived during the third quarter, with a few late arrivals being incorporated into the pre-expedition sampling plan during the expeditions of the fourth quarter. Requests for samples from legacy core, as well as NanTroSEIZE Stage 1 and 2 are still incoming. Sample requests for the legacy core collection have been steadily coming in throughout the year.

USIO

DSDP/ODP Core Redistribution Project

The Gulf Coast Repository (GCR) received the final core shipments from the West Coast Repository (WCR) and East Coast Repository (ECR) on October 2 and 3, 2008, respectively, and began rearranging and racking the entire GCR collection.

Sample Requests

During FY2009, the Gulf Coast Repository received 18,407 sample requests; a total of 145 scientists, educators and public relations liaisons visited the repository during the year.

DATA MANAGEMENT

IODP-MI data management services in FY09 included a number of important activities to increase the dissemination and integration of IODP and legacy program data and information resources. The second phase of development of the Scientific Earth Drilling Information Service (SEDIS) was completed in FY09. The SEDIS phase III RFP, issued in FY09, is currently under contractual negotiation with multiple vendors with the aim of selecting more than one vendor to complete deliverables within the sphere of expertise of the vendors. Development is planned to begin on SEDIS III by March 2010. SSDB operations continued in FY09 with the development work completed except for updates to existing code to ensure compatibility with existing browsers and component software versions.

Extension of the SSDB contract with Scripps Institute of Oceanography (SIO) has been proposed for FY11-13, with SIO to submit a technical and cost proposal in early 2010. Other data management projects completed in FY09 include a framework for SEDIS III web services, OGC web services for SEDIS metadata, borehole logging data web services, updating and maintenance of the IODP Google Earth database, Proposal Database, IODP Central Registry LDAP system, and internal office IT resource operations and maintenance.

IODP-MI is collaborating with the Implementation Organizations (IOs) and software developers in the geoinformatics community to provide access to integrated scientific drilling data using web service technologies. During 2009, IODP-MI completed efforts to develop Open GeoSpatial Consortium (OGC) standards-compliant web services for core measurements, borehole logging and SSDB data. IODP-MI has implemented the systems and methodologies to deliver legacy-program and future core measurements data and borehole logging data from all IOs to service-enabled software tools, such as GeoMapApp. SSDB data has also been made available via SEDIS using OGC standards-compliant web services. Building out these services to enable community software to analyze and visualize the data in various ways is the focus of SEDIS III in FY10.

During FY09, IODP-MI successfully launched SEDIS II with a searchable catalogue of IODP-published and IODP-related publications, links from publication metadata to publication data sets and back-end tools for managing publications metadata and publications obligations. The SEDIS II publications metadata is harvested from an American Geological Institute (AGI) GeoRef database. During FY10, IODP-MI will communicate with USIO Publications department to examine procedures for compiling and maintaining the IODP publications catalogue and the statistical tracking of IODP publications and citations by IODP-MI and the IOs.

An RFP for SEDIS Phase III was published in FY09, resulting in two bids and contract negotiations expected to result in contracts in FY10 with both vendors. Working with the two vendors, a consortium led by MARUM and a collaboration of LDEO and INSTAAR, will increase the efficiency of the project by allowing each group to focus on areas of greatest aptitude and leveraging existing infrastructure both within SEDIS and in the vendor organizations. SEDIS III development is anticipated to begin in March 2010 and to be completed by January 2011. SEDIS III will implement services oriented architectures (SOA) at IOs and IODP-MI source data systems to deliver relational data, file-based data, and core photo and other image data via web services with open discovery functionality along with pre-arranged integration with analytical applications currently in use within the IODP community.

IODP-MI has completed three projects that will serve as a basis for SEDIS III development. The SEDIS Service Oriented Architecture Framework project with Iowa State University established a model namespace for IODP web services data, generated web services for core relational data from JANUS and J-CORES, and documented the framework for further developments of the SEDIS web services. The logging data web services project with Columbia Lamont-Doherty Earth Observatory developed web services for the logging and LWD metadata from all IOs. The OGC web services for SEDIS metadata developed web services for all SEDIS metadata. These projects implement a strategy for the three major types of IODP data (i.e., relational data, logging data and binary image data files) and will serve as the basis for SEDIS III web services focused on presenting the measurements data as resource end-points behind the metadata services used to search, discover and visualize the geospatial information.

The post-expedition data capture project, started in September 2007, was completed with 2857 publications scanned, 1021 of them having data sets in tables, appendices, and supplements total of 3716 post-IODP/ODP/DSDP expedition data sets loaded to SEDIS with metadata. These data sets are now searchable via SEDIS keyword, geospatial and

controlled search functions, are available via OGC standards-compliant metadata, and are linked from publications metadata in the SEDIS system.

Other FY09 data management activities have included, management of SSDB operations and maintenance, operation of IODP Google Earth database, collaboration with USIO on development of systems specifications and development plans for version 2 of Sample Material Request System and Central Inventory, maintenance of IODP Central Registry used by IODP-MI managed data systems, and administration and maintenance of IODP-MI IT resources, including the IODP.org websites, email servers, and associated infrastructure.

PUBLICATIONS

Publications activities in FY09 included:

- 1) Publication of the program journal *Scientific Drilling*,
- 2) Oversight and coordination of program reports and proceedings,
- 3) Implementation of publication policies and procedures, and
- 4) Planning and preparation for further integration of publications and data management through SEDIS II.

During FY09, IODP published 8 Scientific Prospectuses for the following expeditions: Expedition 313, Expedition 317, Expedition 319, Expedition 321T, Expedition 322, Expedition 323, Expedition 324, and Expedition 325. IODP published 8 Preliminary Reports in FY09: Expedition 319, Expedition 320T, Expedition 320, Expedition 321T, Expedition 321T, Expedition 322, and Expedition 323. IODP also published Proceedings Report 303/306-210. Up-to-date publications information, including links to all FY09 IODP publications can be found here: <http://www.iodp.org/scientific-publications/>

The bi-annual journal *Scientific Drilling* that was launched jointly with the International Continental Scientific Drilling Program (ICDP) in September 2005 features articles about ongoing and finished drilling projects, as well as reports on technical developments and program outlook. *Scientific Drilling* returned to regular publication schedule in FY09. The print run of *Scientific Drilling* No.7 was 5,100 copies, and 4,900 copies for issue No. 8. It was distributed to subscribers and at conferences such as AGU, EGU and INVEST. An electronic version of the journal is available for download from the website of both IODP and ICDP. In addition to unique, single subscribers, a large number of printed copies are sent as bulk subscriptions to IODP related institutions (e.g., Program Member Offices) for a most cost effective distribution. A new program member office in Australia has established processes for handling and distributing the journal throughout the ANZIC community.

Editorial Review Board has been used efficiently for main articles since this system was established during FY08. Both issue No. 7 and No. 8 have two peer-reviewed science reports. Editors for the board were invited by IODP-MI and ICDP from the scientific drilling community, covering all main aspects and fields of *Scientific Drilling*, on land and in the ocean. The experience so far has been very positive, and the feedback to the authors improved manuscripts significantly.

Meetings:

- Publications assistant attended IODP Outreach Task Force Meeting in Bremen, Germany (Sep.22)
- INVEST meeting in Bremen, Germany (Sep.23–25)

OUTREACH

IODP-MI Communications and Outreach activities include outreach to the scientific program community, Lead Agencies and Program Members, media and the public. During FY09, Communications and Outreach at IODP-MI has been merged with Publications and Data and Information Management under the overall responsibility of IODP Data and Communications Manager. This consolidation will achieve efficiencies in management of Information and Communications Technology (ICT), including IODP.org websites, and in the use of IODP publications, including *Scientific Drilling* and other materials, in the outreach and information dissemination for the Program. The consolidation has created an open position for Outreach Manager from August 2009.

During FY09, IODP-MI Communications and Outreach was actively involved in facilitating media coverage for the Program as the IODP operated three drilling vessels simultaneously for the first time. IODP-MI coordinated video coverage aboard all platforms to capture the scientific operations of the Program for use in media coverage, informational videos, website features. IODP-MI began planning for integration of IODP video and photographic materials into a permanent and accessible archive of IODP activities to be implemented before the 2013 Program transition.

IODP-MI Communications and Outreach undertook a Content Management System re-engineering in FY09 to update the backend of the IODP.org website. The project is scheduled for completion in the 2nd quarter of FY10. In addition to migration of the existing site to a new CMS, daily updating and administration of the IODP.org website was performed as IODP-MI Communications and Outreach task.

IODP-MI issued many press releases this year and tracked the success of IODP press releases at reaching target publications and audiences. FY09 press releases included coverage of each of the Expeditions as all of the IOs operated drilling platforms during FY09, the successful INVEST meeting, and significant scientific findings of the Program during the FY09 period. In the 4th quarter of FY09, IODP-MI began an internal review of Outreach and Communications aimed at increasing coverage in national print and television media and Program member countries. The goal of this review is to further from the Program's success in reaching first rate peer-reviewed publications with regular coverage in mainstream media outlets.

Other FY09 IODP-MI Communications and Outreach activities included:

Outreach to Scientists

- Produced and distributed bi-monthly editions of IODP E-News.
- Produced and submitted two ads to Eos for publication, including:
 - 1) *Call for Nominations to write new Science Plan*
 - 2) *Calls for Scientific Ocean Drilling Proposals*
- Monitored Media Coverage
- Distributed Scientific Drilling to subscribers in North America: 962 copies to 659 organizational and individual addresses.

Design and Production

- Distributed English version of Drill Me a Painting to the first 50 Oceanography subscribers to respond to IODP promotion highlighting the program.

Media Outreach

- Released six news stories to the media; garnered over 13,000 “hits” from reporters via AAAS EurekAlert, e.g.,:
 - 1) *Researchers report successful riser-drilling operations in seismogenic zone (07/30/09)*
 - 2) *IODP introduces technology to support deepwater crustal drilling (08/04/09)*
 - 3) *Ocean-drilling expedition cites new evidence related to origin and evolution of seismogenic faults (08/17/09)*
 - 4) *Scientists return from first ever riser drilling operations in seismogenic zone (09/04/09)*
 - 5) *Unlocking the secrets of the seafloor: The future of scientific ocean drilling (09/29/09)*
- Monitored IODP and IODP-related news coverage.

Internal Communications

- Coordinated and set agenda for IODP Outreach Task Force Meeting in Bremen, Germany (September 21-22).

IODP-MI ANNUAL REPORT DISTRIBUTION LIST

J. Morris, NSF	R. Batiza, NSF
J. Allan, NSF	J. Walter, NSF
M. Rouse, NSF	

Appendix 1

Financial report