

# FY13 Annual Report



*Integrated Ocean Drilling Program*  
*U.S. Implementing Organization*



*Tripping pipe on the rig floor*

RESOLUTION

S

# Integrated Ocean Drilling Program

## *A historical perspective*

From 2003 through 2013, the international marine research program called Integrated Ocean Drilling Program (IODP) monitored seafloor environments and explored Earth's history and structure as recorded in seafloor sediments and rocks. IODP built upon the earlier successes of the Deep Sea Drilling Project (DSDP) and the Ocean Drilling Program (ODP), which revolutionized our view of Earth's history and global processes through ocean basin exploration. IODP represented the third generation of these highly successful scientific ocean drilling initiatives, with principal research themes outlined in the Initial Science Plan: "Earth, Oceans and Life: Scientific Investigations of the Earth System Using Multiple Drilling Platforms and New Technologies."

IODP expanded on the previous programs through the use of multiple drilling platforms—a riserless drilling vessel, a riser drilling vessel, and mission-specific platforms—operated by three implementing organizations (IOs) to achieve its scientific goals. The riserless drilling vessel *JOIDES Resolution*, operated by the U.S. Implementing Organization (USIO), allowed 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 *Chikyu*, operated by Japan's Center for Deep Earth Exploration (CDEX), allowed IODP to drill for several months at a single location. Mission-specific platforms operated by the European Consortium for Ocean Research Drilling (ECORD) Science Operator (ESO) allowed drilling in environments unsuitable for either the *JOIDES Resolution* or the *Chikyu*, such as locations near the shoreline in shallow-water areas and in climatically sensitive or ice-covered regions. Consistency from one IODP expedition to the next was ensured through provision of an Expedition Project Manager/Staff Scientist from the IO responsible for operating the expedition's platform.

IODP Management International, Inc. (IODP-MI), a nonprofit corporation with an international membership of academic institutions, served as the central management organization for IODP and was 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 was provided by the Science Advisory Structure (SAS), which involved many scientists and engineers on numerous standing committees and panels. Each of the IOs provided liaisons with appropriate expertise to interact with SAS panels and other IODP-MI working groups and task forces.

The USIO comprised the Consortium for Ocean Leadership, Inc. (Ocean Leadership), and its partners, Lamont-Doherty Earth Observatory (LDEO) of Columbia University and Texas A&M University (TAMU). As the prime contractor, Ocean Leadership had ultimate responsibility for all contractual obligations entered into by the USIO. LDEO and TAMU served as subcontractors that contributed distinct but complementary capabilities that collectively supported the full range of activities necessary for implementing scientific drilling programs on the *JOIDES Resolution*. Administrative services in support of TAMU activities were provided by the Texas A&M Research Foundation (TAMRF). In this document, references to TAMU include TAMRF.



*The JOIDES Resolution during a Valdez, Alaska, "midnight sun"*

# FY13 Annual Report

## Integrated Ocean Drilling Program

### United States Implementing Organization

*Consortium for Ocean Leadership, Inc.*

*Lamont-Doherty Earth Observatory of Columbia University*

*Texas A&M University*

National Science Foundation  
Contract OCE-0352500

IODP Management International, Inc.  
Contract IODP-MI-05-03

1 October 2012–30 September 2013



*Sunset off the JOIDES Resolution bow, at the end of the last IODP expedition*

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**Cover photo: The JOIDES Resolution in Valdez, Alaska**

**Back cover photo: Free fall funnel splashing down in the moonpool**



## **David Divins**

*Director of Ocean Drilling Programs  
Consortium for Ocean Leadership, Inc.*

David Divins joined the Consortium for Ocean Leadership (formerly Joint Oceanographic Institutions) in January 2006 as the Associate Director, Ocean Drilling Programs, and became Director, Ocean Drilling Programs, in August 2006. Divins came to Ocean Leadership from the National Oceanic and Atmospheric Agency's National Geophysical Data Center (NGDC) in Boulder, Colorado, where he was a member of the Marine Geology and Geophysics Division from 2000 to 2005. Before joining NGDC, Divins was a Research Scientist at the University of Colorado Cooperative Institute for Research in Environmental Science from 1991 to 2000. Divins received his B.A. from Boston University (1981) and his Ph.D. in Oceanography from Texas A&M University (TAMU) (1991). While at TAMU he was involved in many Ocean Drilling Program (ODP) activities, including sailing on an ODP expedition and working in the data management group.



## **David Goldberg**

*Director, Borehole Research Group  
Lamont-Doherty Earth Observatory of Columbia University*

Dave Goldberg joined the Lamont-Doherty Earth Observatory (LDEO) of Columbia University as a Research Scientist in 1987 and has served as Director of the LDEO Borehole Research Group since 1992. Goldberg earned his S.B. in Geophysics (1981) and S.M. in Marine Geophysics (1981) from Massachusetts Institute of Technology and his Ph.D. in Geophysics (1985) and M.B.A. (1989) from Columbia University. He has sailed on nine Deep Sea Drilling Project and ODP expeditions and is involved in many synergistic activities, including the Department of Energy's Methane Hydrate Advisory Committee; LDEO and Columbia University's Earth Microbiology Initiative; the LDEO Laboratory for Ocean Drilling, Observation, and Sampling; and the Integrated Ocean Drilling Program's (IODP's) International Scientific Logging Consortium.



## **Brad Clement**

*Director, Integrated Ocean Drilling Program  
Texas A&M University*

Brad Clement was appointed Director of IODP at TAMU in August 2009. Clement chaired the U.S. Advisory Committee for Scientific Ocean Drilling (USAC) and has a long history of involvement with IODP, having sailed on four expeditions, worked as an ODP Staff Scientist, and served on the JOIDES Ocean History Panel. Clement earned his B.S. in Geology from the University of Georgia (1979) and his M.A. (1981) and Ph.D. (1985) in Geology from Columbia University. He previously served as Associate Program Director for the Ocean Drilling Program in the National Science Foundation's Ocean Sciences Division from 2001 to 2003, as a Professor in the Department of Earth and Environmental Science at Florida International University from 1988 to 2009, and as Adjunct Associate Professor of Geophysics at TAMU from 1984 to 1988. Clement was Associate Editor of the *Journal of Geophysical Research* and has served on several American Geophysical Union committees.



# Executive Summary



*The JOIDES Resolution off Costa Rica*

**T**he Integrated Ocean Drilling Program (IODP) U.S. Implementing Organization (USIO) successfully completed four full-length cutting-edge expeditions and a fifth short expedition this year that will advance the global understanding of Earth systems. Over the course of these expeditions, the USIO collected exciting insights into the nature of seismogenesis and erosive plate boundaries, recovered the first drilled sections of primitive gabbroic rocks formed at a fast-spreading ridge, tested a third-party observatory instrument, documented continental margin sedimentation during a period of strong tectonic and climatic forcing, and set a new record for the most core recovered during any single IODP expedition.

The USIO also took advantage of a tie-up period in Victoria, British Columbia (Canada), to make significant improvements to the R/V *JOIDES Resolution* facilities, laboratory infrastructure, and database systems that will enable future expeditions to more easily examine new discoveries.

During Expedition 344, the *JOIDES Resolution* returned to the Costa Rica Seismogenesis Project (CRISP) study area to conduct the second expedition of CRISP Program A, a first step toward deep riser drilling through the seismogenic zone. Complementary to other deep-fault drilling projects (e.g., the San Andreas Fault Observatory at Depth [SAFOD], the Nankai Trough



*Carrying a core catcher from the drill floor*



*Cores equilibrating and waiting to be split*

Seismogenic Zone Experiment [NanTroSEIZE], and the Japan Trench Fast Drilling Project [J-FAST]), CRISP Program A investigated the seismogenic processes common to most faults and those unique to erosional margins. Expedition 344 recovered material across the Costa Rica erosive convergent margin offshore the Osa Peninsula and from the incoming Cocos plate, the toe of the margin, the midslope region, and the upper slope region. Expedition 344 downhole log measurements confirmed the principal horizontal stress orientations obtained on the upper slope during the previous CRISP expedition, and the sediment, basaltic crust, and tephra layers recovered during Expedition 344 are expected to yield new insights into the evolution of Central American volcanism.

The Hess Deep Rift was targeted as a key location for sampling lower crustal primitive gabbroic rocks that formed at the fast-spreading East Pacific Rise

and building on results from Ocean Drilling Program (ODP) Leg 147, which drilled there almost 20 years ago. Expedition 345 drilled into hard rock with a very thin sediment cover and water depths greater than 4,800 meters, collected data and observations required for use in testing models of magmatic accretion and the intensity of hydrothermal cooling at depth, and provided the first confirmation of predictions that fast-spreading lower oceanic crust is layered. The primitive layered olivine gabbros and troctolites also revealed significant unexpected mineralogical and textural relationships. As the only reference section to date for fast-spreading primitive ocean crust, the Expedition 345 core collection is expected to help scientists address fundamental questions about how fast-spreading ocean crust forms and interacts with hot hydrothermal fluids.

During Expedition 341S, the *JOIDES Resolution* traveled to the Cascadia margin and successfully conducted the first deployment of the Simple Cabled Instrument for Measuring Parameters In Situ (SCIMPI), a third-party observatory instrument designed to study dynamic processes in the seafloor using a simpler and lower cost approach. The SCIMPI is targeted for incorporation into the NEPTUNE observatory network, and data recovered from the SCIMPI data logger following the expedition will determine whether the SCIMPI is an option for future IODP studies. Although efforts



Monitoring the core-liner laser engraving process

during Expedition 341S to remove the circulation obviation retrofit kit (CORK) from ODP Hole 858G were unsuccessful, the CORK was undamaged and the scientific objectives may still be achievable in the future through use of a remotely operated vehicle (ROV).

Expedition 341 in the Gulf of Alaska drilled a high-depositional rate continental margin transect, recovering both important climate transitions recorded in the uppermost strata and challenging deep-penetration targets in both deep and shallow water depths. Preliminary analyses of recovered sediments led to new hypotheses about how long-term global climate change can affect the growth of mountain ranges. Data from this expedition may help to resolve mid-late Pleistocene changes in sedimentation and climate on glacial-interglacial and higher resolution timescales, as well as the question of how paleoceanography and sedimentation varied within and following the mid-Pleistocene transition (MPT) at exceptionally high (submillennial) temporal resolution.

## More from the numbers

### FY13 expedition operations

<i>Operations time (days)</i>	273.2
<i>Time on site (days)</i>	183.0
<i>Time coring/drilling (days)</i>	152.2
<i>Time logging (days)</i>	10.9
<i>Distance traveled (nmi)</i>	17,434.9
<i>Sites</i>	21
<i>Holes</i>	80
<i>Cores</i>	1,793
<i>Total penetration (m)</i>	16,938.2
<i>Interval drilled (m)</i>	3,099.8
<i>Interval cored (m)</i>	13,838.4
<i>Core recovered (m)</i>	10,921.3



View of the Blackstone Glacier in Prince William Sound from the deck of the JOIDES Resolution

Expedition 346 was the first scientific drilling expedition to focus exclusively on the East Asian Monsoon complex atmosphere-ocean climate system. Advances in drilling technology enabled the expedition to set several drilling records, including the deepest piston core in Deep Sea Drilling Project (DSDP)/ODP/IODP history (490.4 m) and the most core recovered during any single IODP expedition (6,135.3 m), and new analytical tools enabled the development of finely tuned comparisons between disparate geographic locations. Preliminary findings suggest that Expedition 346 retrieved an unparalleled record of climate cyclicity in the Miocene epoch, documented a consistent regional response to climate change in the Japan Sea/East Sea, and observed climate signals consistent with those found elsewhere in the world (e.g., Greenland ice cores). Climate signals recorded in Expedition 346 sediment are expected to lead to an understanding of the changes in patterns of rainfall and sediment discharge from on land and in surface water circulation and deep-water convection.

The USIO produced and published IODP scientific publications—the primary method of disseminating IODP research to the scientific community and the

public—for all three implementing organizations (IOs) during FY13. Provision of ISO images on the Publications website allowed the USIO to eliminate the cost of duplicating and distributing Expedition Reports DVDs to scientists and libraries worldwide—an economic streamlining initiative that could result in cost savings of \$25K–\$50K annually. The USIO continued its efforts to effectively document the impact of IODP science through publications, including producing the 2013 Ocean Drilling Citation Database Report and tracking the number of IODP Publications website visits (more than 300,000) and scientific publications citing primary IODP expedition research (more than 8,500). Progress continued on a “cited-by linking” project that will soon enable users to determine which journals or books have cited IODP publications.

The *JOIDES Resolution* continued to serve as a platform for education, with two School of Rock workshops conducted on board. USIO technical staff, Onboard Education Officers, and expedition participants promoted USIO expeditions and IODP science through the [joidesresolution.org](http://joidesresolution.org) website and other social media tools. A partnership with the European Consortium



*Fossil of a leaf at the end of a core*

for Ocean Research Drilling (ECORD) and shore-based group training for Onboard Education Officers resulted in an education team with an expanded capacity for outreach to both American and European audiences. More than 200 live ship-to-shore video broadcasts, innovative animations, and expedition video updates reached thousands of viewers worldwide. The [joidesresolution.org](http://joidesresolution.org) website received nearly 60,000 visits this year, and activity on other *JOIDES Resolution* and IODP Science News social networking sites increased steadily.

Shipboard press conferences for local media were conducted at each port call, and USIO staff hosted ship tours for hundreds of students, government officials, and scientific colleagues. Throughout the year, the USIO-published IODP community newsletter, *Core*

*Discoveries*, provided readers with timely updates and information on IODP activities. Ongoing alliances with science partners resulted in grant-funded development of educational materials, including a children's e-book about the *JOIDES Resolution* and regional IODP science-related events. In addition, a continuing USIO-supported diversity outreach initiative provided educational and career-building experiences to minority students.

This IODP-USIO Fiscal Year 2013 Annual Report details these accomplishments and other activities undertaken in support of National Science Foundation (NSF) Contract OCE-0352500 and IODP Management International, Inc. (IODP-MI), Contract IODP-MI-05-03 during the period from 1 October 2012 to 30 September 2013.

## More online

IODP-USIO website: [iodp-usio.org](http://iodp-usio.org)

IODP Science Plan: [iodp.org/isp](http://iodp.org/isp)

IODP-USIO FY13 Annual Program Plan: [iodp.tamu.edu/publications/PP.html](http://iodp.tamu.edu/publications/PP.html)

IODP-USIO FY13 Quarterly Reports: [iodp.tamu.edu/publications/AR.html](http://iodp.tamu.edu/publications/AR.html)



*View of the coast of Alaska and the Bering Glacier from the JOIDES Resolution*

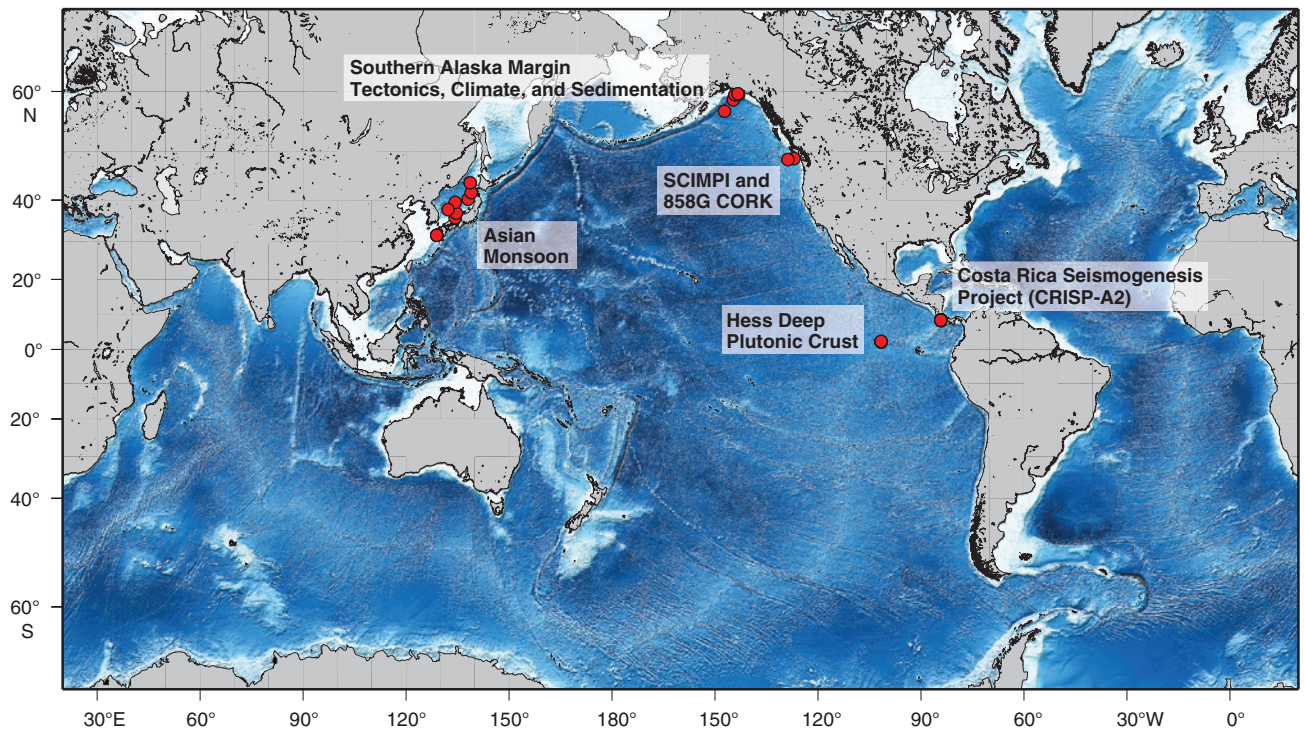
# IODP-USIO Expeditions

## *Expedition 344: Costa Rica Seismogenesis Project, Program A Stage 2*

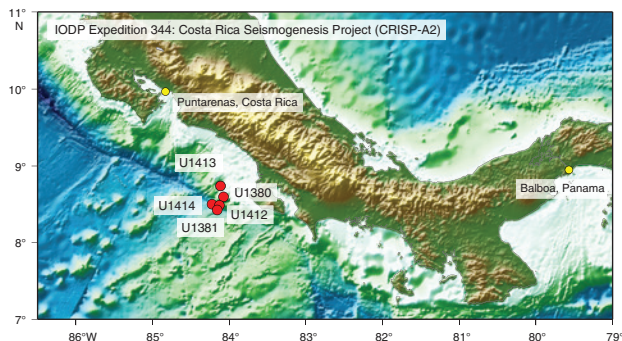
CRISP Program A was designed to elucidate the processes that control nucleation and seismic rupture of large earthquakes at erosional subduction zones. The CRISP study area is located offshore the Osa Peninsula where the incoming Cocos Ridge has lifted the seismogenic zone to within reach of scientific drilling. This area is characterized by low sediment supply, a fast convergence rate, abundant plate interface seismicity, and a change in subducting plate relief along strike. In addition to elucidating processes at erosional convergent margins, this project is complementary to other deep-fault drilling projects (e.g., SAFOD, NanTroSEIZE, and J-FAST).

Expedition 344 (23 October–11 December 2012) was the second expedition of CRISP Program A, a first step toward deep riser drilling through the seismogenic zone. The focus of CRISP Program A is on the shallow lithologic, hydrologic, stress, and thermal conditions that lead to unstable slip in the seismogenic zone. Together with data from Expedition 334, the first expedition of CRISP Program A, Expedition 344 data provide exciting insights into the nature of seismogenesis and erosive plate boundaries.

Expedition 344 was superlative, and with the exception of not reaching the décollement and the underthrust sediment at the toe site (U1412), exceeded expectations. Material was recovered across the Costa

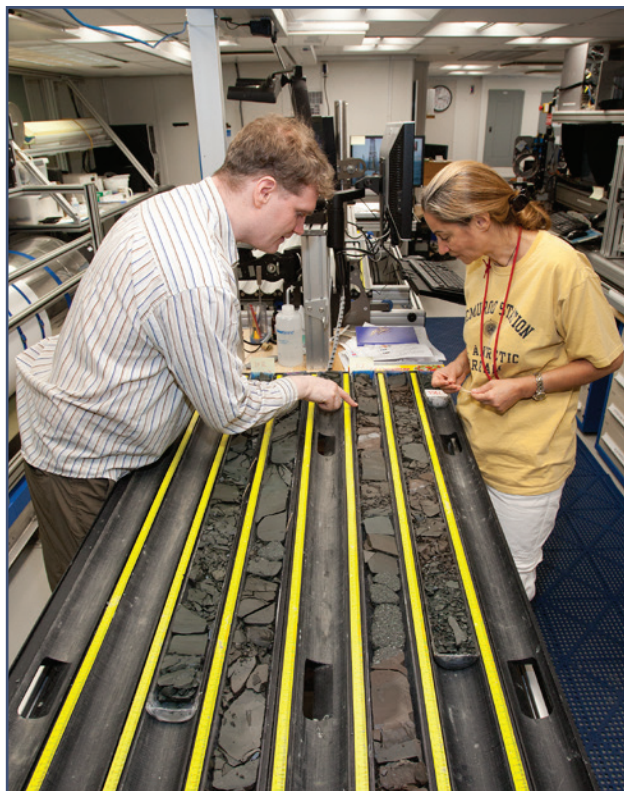


FY13 expedition sites



Expedition 344 site map

Rica erosive convergent margin offshore the Osa Peninsula and from the incoming Cocos plate (Sites U1381 and U1414), the toe of the margin (Site U1412), the midslope region (Site U1380), and the upper slope region (Site U1413). Recovered materials included 484 m of sediment, 96 m of basaltic crust, and an additional ~137 tephra layers. At Site U1381, 109 m of sediment and 81 tephra were recovered. At Site U1414, 375 m of sediment and 36 tephra were recovered, as well as 96 m of basaltic crust. At Site U1414, a gap in the tephra record between the mid- to late Pleistocene and the middle Miocene was likely recovered. Biostratigraphic analysis shows that sediment containing ~20 felsic tephra layers during this time period was recovered. Analyses of these tephra will yield new insights into the evolution of Central American volcanism, helping to answer the fundamental questions of whether Central American volcanism ceased with the arrival of the Cocos Ridge and how volcanism evolved subsequent to the arrival of the ridge. Wireline logging at the convergent margin sites of Expedition 344 was challenging because of collapsing boreholes. Notably, however, borehole images collected at the upper slope Site U1413 indicate breakouts, marking the principal horizontal stress directions. These directions agree with those obtained on the upper slope at Site U1379, which was



Inspecting a newly split section of core at the core description table

logged while drilling. Expedition 344 also recorded a continuous suite of logs at Site U1414 that span the intervals only partially recovered by core in the deeper sediments and at the top of the volcanic basement.

### ***Expedition 345: Hess Deep Plutonic Crust***

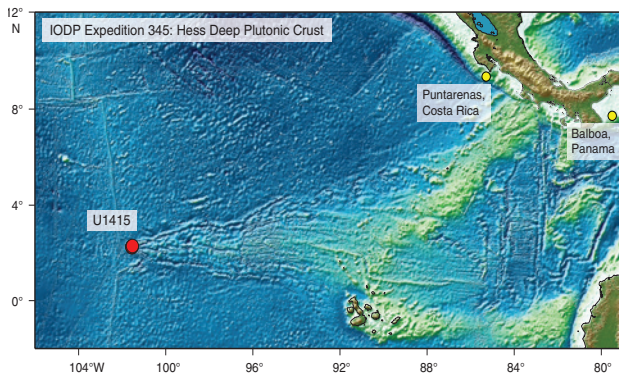
Expedition 345 (11 December 2012–12 February 2013) was designed to sample lower crustal primitive gabbroic rocks that formed at the fast-spreading East Pacific Rise (EPR) in order to test models of magmatic accretion and the intensity of hydrothermal cooling at depth. The Hess Deep Rift was selected to exploit tectonic exposures

## **More from the scientists**

*“There are a lot of subduction zones where we could drill—and have drilled—to study earthquake processes. However, the Cocos-Caribbean margin represents a particularly strategic opportunity to learn about shallow, erosive margins. What we learn here could potentially frame new research questions for decades to come.”*

—R. Harris, Expedition 344 Co-Chief Scientist





Expedition 345 site map

of young EPR plutonic crust, building upon results from ODP Leg 147 as well as more recent submersible, remotely operated vehicle, and near-bottom surveys. Here, the complex tectonic activity of the Pacific, Cocos, and Nazca plates has created a large, craggy underwater rift valley known as Hess Deep. At the center of this rift, the layers of the ocean's crust have been peeled away, like an onion sliced in half and pulled apart, revealing deep layers of oceanic crust that are difficult to access anywhere else.

The primary goal for Expedition 345 was to acquire the observations required to test end-member crustal accretion models that were in large part based on relationships from on-land ophiolites, in combination with mid-ocean-ridge geophysical studies. This goal was achieved with the recovery of primitive layered olivine gabbros and troctolites with many unexpected mineralogical and textural relationships, such as the abundance of orthopyroxene and the preservation of delicate skeletal olivine textures.



Celebrating in the core laboratory

Expedition 345 achieved its primary scientific goal of recovering the first drilled sections of primitive gabbroic rocks formed at a fast-spreading ridge. Drilling at Site U1415 provided the first confirmation of predictions that fast-spreading lower oceanic crust is layered and also revealed a diversity of layering whose characteristics have similarities and differences to both layered sequences in ophiolites and layered mafic intrusions. Moreover, the core revealed significant unexpected mineralogical and textural diversity, some of which has been rarely observed in the lower oceanic crust elsewhere or in ophiolites. The mineralogical and textural relationships show that in several respects the Oman ophiolite is not the ideal model for fast-spreading ocean crust and call into question some aspects of both of the end-member accretion models that were to be tested. The core from Expedition 345 will be a reference section, for now the only reference section, for fast-

## More from the scientists

*"These rocks represent one of the first reference sections for oceanic lower crust in a known tectonic setting. Future studies in other settings will be measured and compared against this one [Expedition 345], and past ones re-assessed. These samples could not have been acquired through any other means, highlighting the importance of ocean drilling as a technique for studying the evolution of our planet."*

—J. Snow, Expedition 345 Co-Chief Scientist



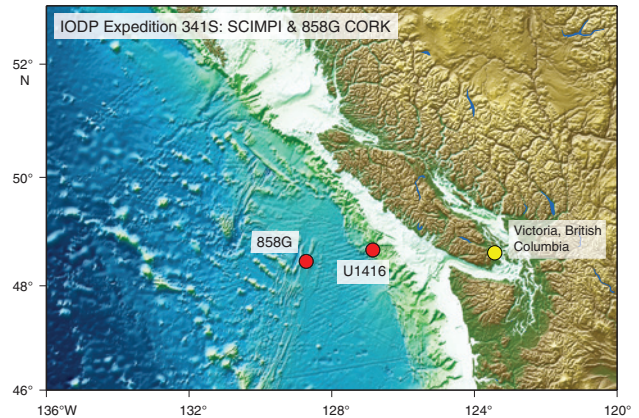
*Sunrise off the coast of Alaska*

spreading primitive ocean crust, which covers about half the Earth's surface.

### ***Expedition 341S: SCIMPI and Hole 858G CORK replacement***

Expedition 341S (19–29 May 2013) was an engineering expedition dedicated to two separate projects: (1) the first deployment of the SCIMPI on the Cascadia margin and (2) replacement of the CORK in ODP Hole 858G for formation pressure monitoring in the Middle Valley axial rift of the Juan de Fuca Ridge. Both installations were targeted to be incorporated into the NEPTUNE observatory network.

The SCIMPI is a new third-party observatory instrument designed to study dynamic processes in the subseabed based on a simple and low-cost approach. The SCIMPI was successfully installed in Hole U1416A using a surface-controllable electronic release system (ERS). The final tool string consisted of nine modules, with three of these including pressure sensors (modules 1, 5, and 9, at 8, 117, and 234 meters below seafloor, respectively). The second operation with the SCIMPI deployed a single module (with a seafloor connector and command module, dubbed SHRIMPI) in Hole U1416B. Following the expedition in September, the SCIMPI data logger from Hole U1416A was recovered and a new one installed. The data recovered are currently under



*Expedition 341S site map*

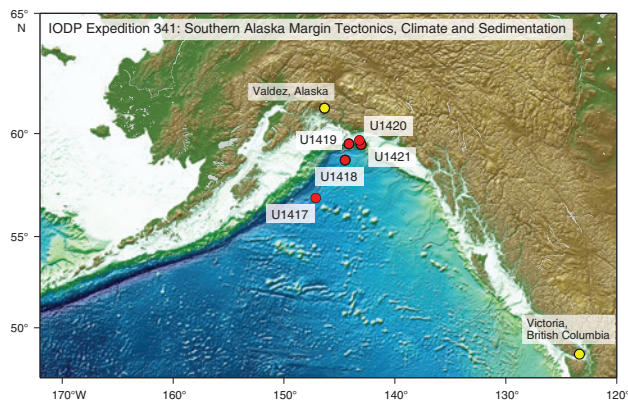
analysis and may show that the SCIMPI is an option for future studies.

The new CORK for Hole 858G was constructed with a simplified seal system designed to survive the overpressures and high temperatures at this location. Unfortunately, the old CORK could not be removed from Hole 858G and the new CORK could not be installed. Fortunately, the vigorous recovery operations appear to have resulted in no substantial damage to the CORK body, and there were no signs of leakage from any parts of the CORK. The scientific objectives may still

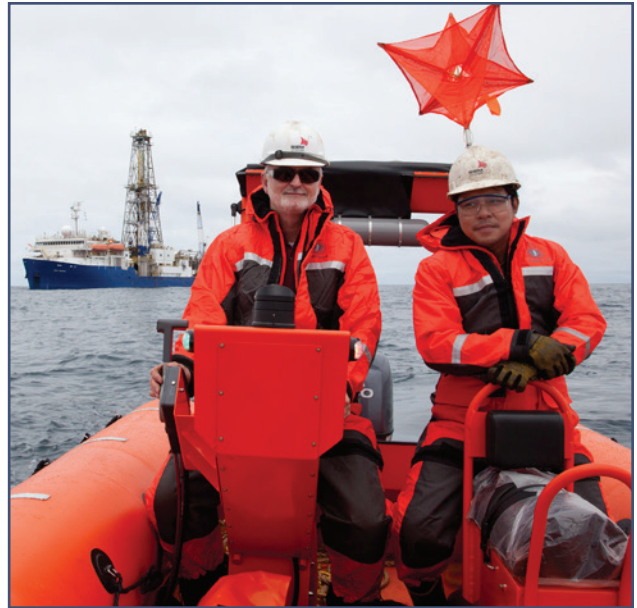
be achievable in the future through use of an ROV to deploy the pressure recording instrument on the wellhead platform and connect it to the valved fluid sampling port on the original CORK wellhead body. The unused new CORK body will be stored at IODP-Texas A&M University (TAMU) and be available for use in any other hole where single-interval pressure monitoring or fluid sampling is justified. Alterations may be necessary to ensure compatibility in holes with different casing hangers and internal diameters.

### ***Expedition 341: Southern Alaska Margin Tectonics, Climate, and Sedimentation***

Expedition 341 (29 May–29 July 2013) was an outstanding success in terms of sediment recovered and objectives addressed across the Gulf of Alaska margin. Regional seismic data indicate transitions in seismic facies and sequences within the Surveyor Fan and continental margin that led to interpretations of climate-driven increases in sediment transport and deposition with potential feedback on tectonics. Testing of these interpretations required recovery of sediment across this glaciated margin. Meeting the scientific objectives by drilling a high-depositional



Expedition 341 site map



Taking a radar reflector out in the Zodiac to determine distance for mammal watch

rate continental margin transect demanded essentially complete recovery of important climate transitions recorded in the uppermost strata and adequate recovery of challenging deep-penetration targets exceeding 700 m core depth below seafloor (CSF-A) in both deep (>4000 m) and shallow (<300 m) water depths. In both aspects, the resultant drilling was a notable success.

Material was recovered along a cross-margin transect from the deepwater Surveyor Fan at both distal (Site U1417) and proximal (Site U1418) locations, the midslope region (Sites U1419 and U1421), and the continental shelf (Site U1420). At Sites U1417–U1419, a complete stratigraphic splice was developed to depths exceeding 100 m core composite depth below seafloor

## **More from the scientists**

*“We expected to find detailed records of glacial deposition that fluctuate in accordance with the advance and retreat of glaciers and ice sheets. From what we’ve seen so far, these core samples exceed our expectations and provide critical data that were previously unavailable.”*

—S. Gulick, Expedition 341 Co-Chief Scientist



*Science Party boarding the JOIDES Resolution for Expedition 341*

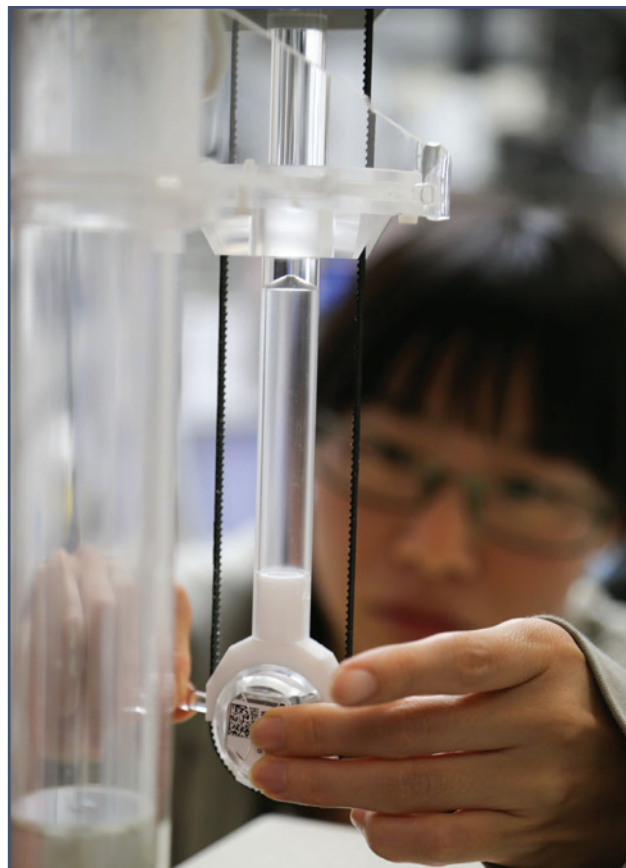
(CCSF-A), spanning a telescoping temporal record with increasing resolution from ~1.8 Ma at Site U1417 to ~0.2 Ma at Site U1418 and <0.3 Ma at Site U1419. The corresponding sedimentation rates (10–120 cm/k.y.) within the spliced intervals at the two fan sites provide the potential to resolve mid–late Pleistocene changes in sedimentation and climate on glacial–interglacial and higher resolution timescales. The sedimentary record from Site U1417 will enable examination of the paleoceanography, regional tectonics, and deep-sea sedimentary environment from the late Miocene to the present through key Neogene climatic transitional intervals, including the mid-Pliocene warm period, the early Pleistocene intensification of Northern Hemisphere glaciation, and the MPT. Tephra layers observed at Site U1417 record Neogene and Quaternary volcanic activity in the Gulf of Alaska and are expected to provide important independent chronological

constraints for the Pleistocene. Records from Site U1418 may help to resolve the question of how paleoceanography and sedimentation varied within and following the MPT at exceptionally high (submillennial) temporal resolution. Sites U1419–U1421 contain glacially influenced strata that have accumulated since the MPT on the shelf and slope and provide a chronostratigraphy and sedimentary record to test the expedition’s fundamental climate-tectonic hypotheses. The continuous spliced record at Site U1419 provides a key proximal record of contrasting intervals of glacial and biogenic sedimentation in the late Pleistocene at intermediate water depths. Downhole logs and seismic traveltimes measurements were acquired at Sites U1417, U1418, U1420, and U1421. These data complement information from the recovered cores and allow calibration of seismic reflection interpretation with the drilling results.

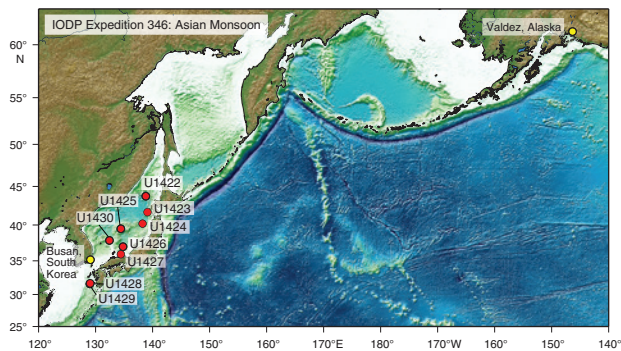
The overarching goal of Expedition 341 was to document continental margin sedimentation during a period of strong tectonic and climatic forcing. In this respect, Expedition 341 cores provide a unique opportunity to understand the interaction of tectonics, climate, and sedimentation on a high-latitude continental margin. The expedition's success demonstrates that scientific ocean drilling has the potential to recover similar records from other optimally located high-latitude settings.

### ***Expedition 346: Asian Monsoon***

Expedition 346 (29 July–27 September 2013) drilled seven sites covering a wide latitudinal range in the Sea of Japan/East Sea and two closely spaced sites in the East China Sea. This was the first scientific drilling expedition ever to focus exclusively on the climate system in this area, which is at once so critical yet potentially vulnerable to the challenges society faces in the coming years of global climate change. With the East Asian Monsoon directly affecting the water supply of one-third of the global population, the expedition scientific results and postexpedition research that will follow have direct bearing on society's understanding of this complex atmosphere-ocean climate system.



*Measuring anisotropy of magnetic susceptibility in a sediment sample cube*



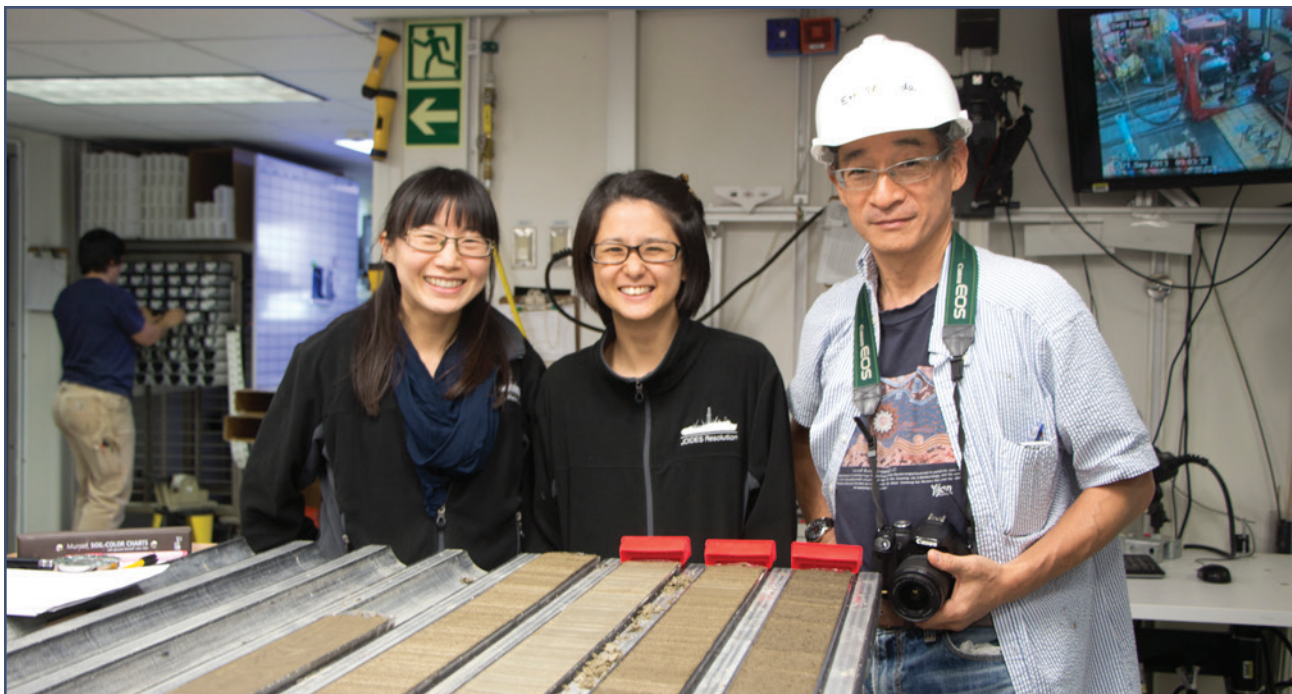
*Expedition 346 site map*

Recent and novel advances in drilling technology and newly developed analytical tools enabled collection and examination of sediment records that were impossible to acquire even a few years ago. The newly engineered half advanced piston corer (half APC) tool was used to recover the deepest piston core in DSDP/ODP/IODP history (490.4 m in Hole U1427A); that achievement was also the deepest continuously recovered piston-cored sequence, initiated at the mudline and penetrating

## **More from the scientists**

*"The [Expedition 346 results] will... reveal how climatic changes in the continent, together with sea level changes, affect oceanic conditions in marginal seas. Obviously terrestrial climate and sea level impacted nutrient and carbon cycles in the Japan Sea/East Sea, which could have been significant on a global scale."*

—R. Tada, Expedition 346 Co-Chief Scientist



*Admiring core from the record-setting Expedition 346 collection*

to ~500 m CSF-A. Although occasional intervals of incomplete recovery occurred, Expedition 346 also set a new record for the most core recovered during any single IODP expedition—6135.3 m of core, with an average recovery of 101%. Downhole logs were acquired at four of the nine sites drilled (U1423, U1425, U1427, and U1430), including high-resolution borehole images, that refine the lithology interpretation in these intervals.

Technological advances delivered a series of new surprises (e.g., pristine dark–light laminae from ~12 Ma sediment recovered by piston coring from 410 m CSF-A at Site U1425 and from 210 m CSF-A at Site U1430) that will stimulate new scientific inquiry into climate dynamics during a time frame and with a high fidelity that could have only been imagined by scientists even a short time ago. High-resolution geochemistry studies targeting the anaerobic oxidation of methane (AOM) and the relationships between metal chemistry and the degradation of organic carbon were performed to study the fate of organic carbon in the marine system

and constrain rates of microbial reactions in the deep biosphere with a novel fluid extraction technique. Finely tuned comparisons were developed between disparate geographic locations and demonstrated synchronicity in the Sea of Japan/East Sea's regional response to internal and external climate-related forcing.

The high quality of materials recovered during Expedition 346 and the complete documentation of their geological, geochemical, and geophysical context will lead to an unparalleled series of future studies by the Expedition Science Party as well as many other scientists over the coming decades. Cores obtained during the expedition will be used to test the hypothesis that Pliocene–Pleistocene uplift of the Himalaya and Tibetan Plateau, and the consequent emergence of the two discrete modes of Westerly Jet circulation, caused the amplification of millennial-scale variability of the East Asian summer monsoon (EASM) and East Asian winter monsoon (EAWM) and provided teleconnection mechanism(s) for Dansgaard–Oeschger cycles.

*IODP-USIO FY13 expedition coring and logging summary*

<b>Expedition</b>	<b>Meters cored</b>	<b>Cores recovered (number)</b>	<b>Core recovery (%)</b>	<b>Meters logged</b>	<b>Sites logged (%)</b>
344: Costa Rica Seismogenesis Project 2	2,017.6	253	72.9	608.0	40.0
345: Hess Deep Plutonic Crust	300.5	45	18.4	0.0	0.0
341S: SCIMPI and 858G CORK	0.0	0	0.0	0.0	0.0
341: Southern Alaska Margin	5,474.4	682	59.2	2,285.0	80.0
346: Asian Monsoon	6,045.9	813	101.5	1,478.0	44.4
<b>Totals</b>	<b>13,838.4</b>	<b>1,793</b>	<b>252.0</b>	<b>4,371.0</b>	<b>41.1*</b>

\*average calculated on four expeditions (341, 344, 345, 346)

## More online

IODP Expedition information: [iodp.tamu.edu/scienceops/expeditions.html](http://iodp.tamu.edu/scienceops/expeditions.html)

Proceedings of the Integrated Ocean Drilling Program: [iodp.org/scientific-publications](http://iodp.org/scientific-publications)

USIO expedition-related videos: <https://www.youtube.com/user/OceanLeadership>



*Siem Offshore rig floor crew assembling the free fall funnel for Hole U1414A on the moonpool doors*



# Operational and Technical Support

The USIO provided operational and technical support for four complete USIO expeditions during FY13 and continued to coordinate with and provide support for the Center for Deep Earth Exploration (CDEX) and the ECORD Science Operator (ESO). Significant improvements were made to *JOIDES Resolution* facilities, laboratory infrastructure, and database systems during a maintenance period in Victoria, British Columbia (Canada), and new capabilities were introduced this year through analytical system and engineering tool development and acquisitions, as well as information technology (IT) software development projects.

## *Expedition planning*

Pre-expedition planning meetings were held in College Station, Texas, for FY14 Expeditions 349 (South China Sea), 350 (Izu-Bonin-Mariana [IBM]: Rear Arc), 351 (IBM: Arc Origins), and 352 (IBM: Fore Arc). The starting port call for FY14 Complementary Complex Proposal (CPP) Expedition 349 (South China Sea) was changed to Hong

Kong (China), adding 2 days of operational time to the expedition. Logistical constraints led to dropping Okinawa, Japan, as the end port call for Expeditions 349 and 352 in favor of Keelung, Taiwan.

The USIO coordinated science staffing to fulfill specialized needs and made shipboard berths available to accommodate education and outreach efforts (see “Education” in “Broader Impacts”). Science staffing was completed this year for FY13 Expeditions 345 (Hess Deep Plutonic Crust), 341 (Southern Alaska Margin Tectonics, Climate, and Sedimentation), and 346 (Asian Monsoon), as well as FY14 Expedition 349. The first two scientists from newest member country Brazil sailed this year during Expedition 344 (Costa Rica Seismogenesis Project 2).

Clearance applications were submitted to the U.S. State Department for operation in the waters of Japan (Expeditions 346 and 350); Republic of Korea (Expedition 346); and China, Taiwan, Vietnam, and the

## *FY13 USIO expedition science staffing breakdown*

Member country/consortium	Expedition					Total
	344	345	341S*	341	346	
United States Science Support Program (USSSP)	10	8	4	9	9	40
Japan Drilling Earth Science Consortium (J-DESC)	8	8	0	7	8	31
European Consortium for Ocean Research Drilling (ECORD)	7	9	2	7	7	32
Korea Integrated Ocean Drilling Program (K-IODP)	1	0	0	1	2	4
IODP-China	2	0	0	1	2	5
Australia/New Zealand IODP Consortium (ANZIC)	1	1	0	2	1	5
India Ministry of Earth Science (MoES)	0	1	0	1	1	3
IODP-Brazil	2	1	0	2	1	6
<b>Total Science Party participants</b>	<b>31</b>	<b>28</b>	<b>6</b>	<b>30</b>	<b>31</b>	<b>126</b>

\*Because this was an engineering expedition, a minimum group of scientists was staffed from the proponent groups who were required to perform the installation, without regard to quotas.

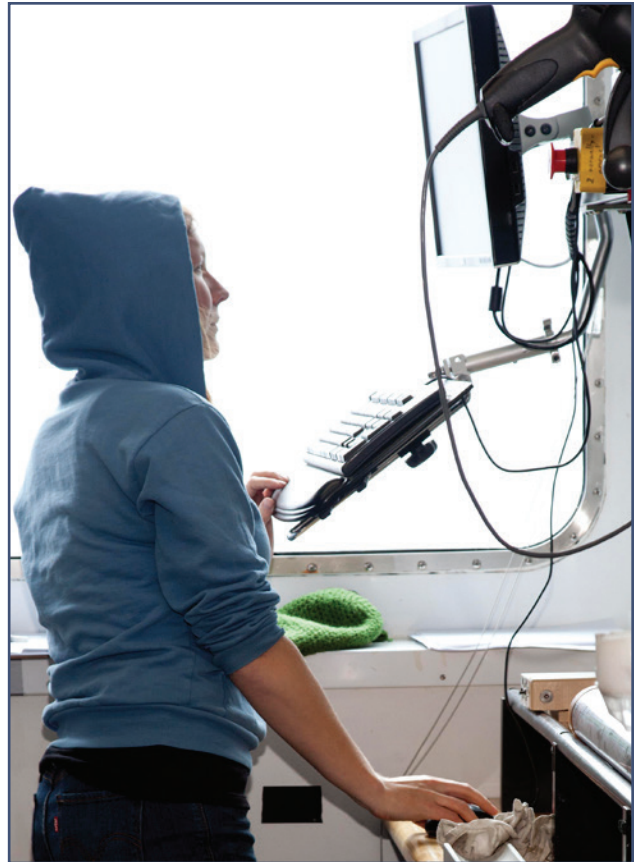
Philippines (Expedition 349). The Republic of Korea and Japan granted research authorization for Expedition 346, and an observer from the Republic of Korea sailed on the expedition. The USIO initiated direct negotiations with companies that have submarine cables in the vicinity of sites planned for Expeditions 350 and 351.

Requests were submitted to the Environmental Protection and Safety Panel (EPSP) and TAMU Safety Panel to add an alternate site to Expedition 346 and to drill without coring at a primary site during Expedition 349. Environmental evaluations for check shot surveys during Expeditions 341 and 346 were submitted to NSF.

The USIO acquired and shipped operational and laboratory supplies for restocking during all FY13 expedition port calls, completed logistical arrangements for a third-party 3.5 kHz profiler to be deployed on the camera system during Expedition 345, and tested third-party equipment (i.e., the ERS) required for release of the SCIMPI tool string prior to deployment during Expedition 341S.

### *Shipboard and laboratory improvements* **Laboratory working groups**

The Geochemistry, Geology, Geophysics, and Curation and Core Handling laboratory working groups (LWGs) comprise technical and science staff members who review cruise evaluations, expedition technical reports, and issues management communications to develop advice on corrective actions and potential developments on the *JOIDES Resolution* and on shore. The LWG technical and science leads attend TAMU Issues Management Team meetings to allow management to better prioritize the LWG efforts. The four LWGs advised equipment acquisition and upgrades,



*Checking physical properties data*

process improvements, maintenance period activities, and ongoing quality assurance work during FY13.

### **Shipboard systems and laboratories**

During the *JOIDES Resolution* maintenance period, USIO staff replaced old laboratory equipment (coulometers, balances), enhanced existing facilities

## **More from the expedition participants**

*"... [M]any of the processes that scientists are interested in operate on timescales longer than for which we have good records or, often, data of any kind. For scientists like those of us currently sailing on the *JOIDES Resolution*, that is what drives us and causes us to give up two months of time with family and loved ones, as well as time in our labs at home. It is the desire to unravel and piece together another part of the great historical puzzle that is Earth history, and from which we can gain knowledge that may help us better face our future."*

—L. Peterson, Expedition 346 sedimentologist

(scanning electron microscope [SEM]), and made repairs and modifications to laboratory and other shipboard science-use spaces. Improvements to the core laboratory included installation of a modified imaging logger frame with a significantly smaller footprint to create more space in the core description area, replacement of core refrigerator fan coil valves to correct a condensation “rain” issue in the core reefer hold, and completion of plumbing work in the core splitting room. Sound dampening was installed for the Haskris chiller unit in the X-ray diffraction laboratory, and gimballed tables in the chemistry laboratory were removed. The safety shower inside the paleontology preparation laboratory was relocated outside of the laboratory entrance, and air flow in the vent hoods was balanced to the proper flow rate. Covers for the fantail winch and crane were fabricated and installed to help protect the equipment from saltwater, coalescing oil traps were installed on the nitrogen generator to resolve oil leaks, and safety rails were installed on ladders in the USIO bunk areas. General maintenance was conducted throughout the laboratories, including replacing acoustic ceiling tiles and damaged floor tiles, refinishing countertops, and installing new cabinets where needed. Instrument host computers were replaced with new HP Z420 units, and instrument hosts were converted to Windows 7 64-bit where possible. Service calls were completed for the Natural Gamma Radiation Logger (NGRL), superconducting rock magnetometer (SRM), and microscopes, and USIO staff remobilized the laboratories after maintenance.

### Shore-based Geosciences Laboratory

The TAMU Ocean Drilling and Sustainable Earth Science (ODASES) Geosciences Laboratory housed at IODP-TAMU hosted scientists for X-ray fluorescence (XRF)



*Scraping the core face in preparation for core imaging*

scanning projects throughout the fiscal year, and visiting scientists also used the shore-based Section-Half Imaging Logger (SHIL) for imaging cores prepared for XRF analysis and the Whole-Round Multisensor Logger (WRMSL) for magnetic susceptibility measurements. Work continued on a time-available basis to add density by gamma ray attenuation and *P*-wave velocity capabilities.

### *Engineering and tool development and support*

#### **Vibration-isolated television**

USIO staff worked with the Siem crew on vibration-isolated television (VIT) system installation plan details and testing, with final software changes initiated based on the crew's input. The new VIT system was deployed and utilized during Expedition 341S without incident,

## More from the expedition participants

*“The coring process is unique and synchronous...the drillers and roughnecks so seamlessly connect strands of pipe working in harmony with huge props of humming machinery on the stage of a swaying ship. Every move is calculated and in unison with all of the drillers to get the core sample up and out onto the drilling floor to the waiting technicians. No moment is wasted and the same movements are carried out over and over again for each subsequent core. It’s a huge balletic enterprise. And so smooth are their moves that there hasn’t been an accident in nine years! That’s impressive considering all that could happen!”*

—C. Larson, Expedition 341 Onboard Education Officer



*Discussing samples to be taken from basement core sections*

the final end product (color inspection camera) was acquired during the last quarter, and plans were made for the deeper water test and cable de-torque during the transit to Subic Bay prior to dry dock. Finally, all existing VIT camera system surveys and reentry digital files were converted to a common format and archived, and all older VHS tapes were converted to digital files.

#### **Large-diameter pipe handling infrastructure**

Staff members from Howard & Associates Inc., Blohm & Voss (B&V), the USIO, and the Siem drilling crew reviewed detailed engineering drawings for the 350- and 500-ton elevators, handler, and stool; identified potential interferences; generated recommendations for the design of the handler; and developed a timeline for fabrication, land testing, and subsequent at-sea testing. The decision was made to build two 500-ton elevators to simplify operations, and a successful factory acceptance test of two 500-ton elevators, one stool, and one handler was conducted at the B&V facilities in Hamburg, Germany, in August 2013. At-sea testing was

scheduled to take place during the transit to Hong Kong in January 2014.

#### **Third-party tool support via the Multifunction Telemetry Module**

The USIO's Multifunction Telemetry Module (MFTM) is a wireline logging telemetry system that transmits third-party tool downhole data to the surface in real time and allows third-party tools to be run in combination with tool strings including Schlumberger tools. The MFTM was used during Expedition 341S as part of the field trial deployment of the SCIMPI, a new third-party observatory instrument. The SCIMPI was developed to provide an alternative to CORK subseafloor observatories, which can be complex, costly, and time consuming to install in soft sediment. During the Expedition 341S port call, USIO staff successfully redesigned the ERS to resolve problems encountered in preliminary shipboard bench tests of the cable head-ERS-MFTM-SCIMPI and the seven-conductor wireline, and the SCIMPI was successfully installed in



*Preparing samples for squeezing in the chemistry laboratory*

Hole U1416A during Expedition 341S (see “IODP-USIO Expeditions”).

### **Data management**

The USIO manages data in support of IODP activities, including expedition and postexpedition data; provides long-term archival access to data; and supports USIO IT services. Upgrades for IT infrastructure and science system services were implemented this year, along with planning and work toward several high-priority development projects.

### **Databases**

#### ***Laboratory Information Management System***

During expeditions, laboratory work on board the *JOIDES Resolution* produces a vast amount of data that are stored in the Laboratory Information Management System (LIMS). LIMS data collected during USIO



*Collecting the core catcher*

Expeditions 344, 345, 341S, and 341 were successfully transferred to shore, merged with the cumulative LIMS database, and made available online to participating scientists.

### ***Log database***

Standard and image data for USIO Expedition 344 and ESO Expedition 325 were processed and placed online this year. Sixty log summary plots of both standard and image data were generated for all logged holes from Expeditions 301–336 using a program created in-house.

### **Development projects**

Through TAMU’s project portfolio management process, teams were assigned and planning began for projects that will develop form reports for thin section data collected via DESClogik, enhance routine section-half imaging workflow, enhance stratigraphic correlation, improve support for whole-round line scan images and composites, and replace TAMU’s current web infrastructure with a modern, less complex system that supports more responsive patch management to protect against security holes identified by the IT industry. Two major projects neared completion this year: the LIMS Editing Tool, and the *JOIDES Resolution* microscope laboratory infrastructure renovation.



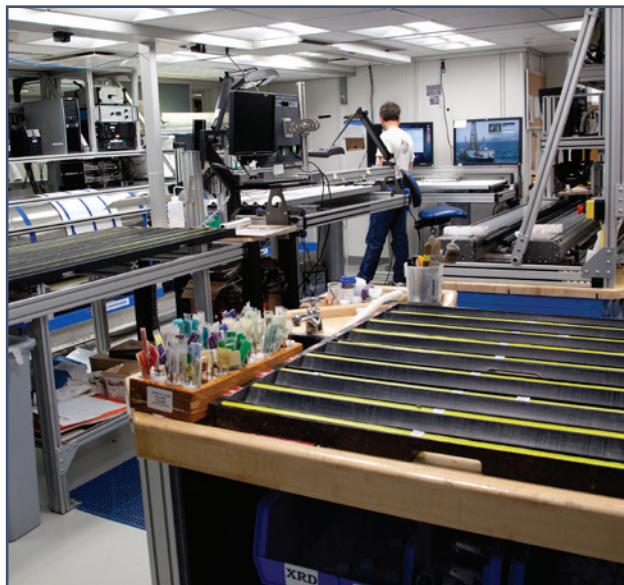
*Checking the servers in the IT office*

### **LIMS Editing Tool**

The LIMS Editing Tool (LIME) will give data review and editing capabilities to the technical user while maintaining the associations and relationships within the LIMS data structure. The technical user will be able to cancel samples, tests, and results (and any daughter samples, tests, and results) and will be able to reinstate them as well. When this project is complete, users should be able to (1) shift parentage of a sample and force the re-creation of label IDs for the sample and its daughters; (2) create new tests and results (and fill them in, if necessary), but not new samples (Sample Master already provides this capability); and (3) call up a set of samples, tests, and results and edit one or many of them in a single session. The first three phases were completed by the end of FY13, leaving the project on track for completion in early FY14.

### **JOIDES Resolution microscope laboratory infrastructure renovation**

This project was developed to create ergonomic distribution of workspace in the microscope laboratory with custom-built desks that fit wall contours, maximize use of space, and accommodate both right- and left-handed personnel. The project will also rearrange workstations and printers to resolve traffic issues and provide



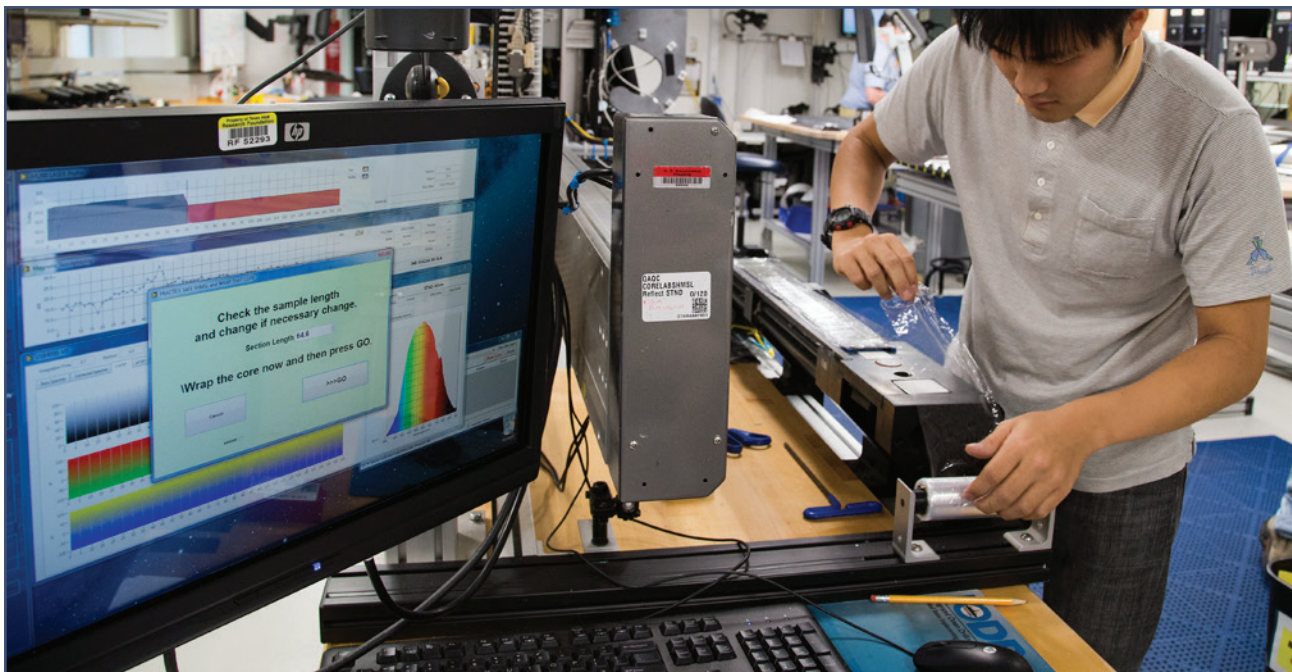
*Empty core tables awaiting the first core on deck*

space for additional storage, workstations, benches, and custom shelving to accommodate microscope stations. Project planning was completed during FY13, and execution was scheduled for the maintenance period beginning in early FY14.

### **System updates and backup**

The USIO installed a border firewall to protect the Borehole Research Group (BRG) VLAN in all buildings on the Lamont-Doherty Earth Observatory (LDEO) campus in Palisades, New York; installed a new Power Over Ethernet blade in the Borehole Building main Cisco switch to drive the new Aerohive Wi-Fi base stations; and replaced the BRG's aging Solaris-based servers. General maintenance was performed on all five logging programs (on shore and on board the *JOIDES Resolution*).

During the FY13 maintenance period, shipboard Logging Office computer systems were upgraded, servers were upgraded to OS X 10.7 Server, client machines were upgraded to OS X 10.8, application software on client machines was updated, and hardware and software upgrades to 19 shipboard instrument hosts were completed.



Testing core sections for magnetic susceptibility and color reflection

The USIO also successfully moved the Regional Test and Integration Facility (RTIF) to an off-site location in February 2013 to offer better options for responding to a catastrophic event should IODP-TAMU lose services in its main building in College Station, Texas.

### *Curatorial support*

The USIO provides services in support of IODP core sampling and curation of the core collection archived at the Gulf Coast Repository (GCR). During FY13, the new Sample and Data Requests (SaDR) system was deployed to the production server and received sample requests for USIO Expedition 346, CDEX Expedition 348, and CPP Expedition 349. USIO personnel gave IODP curation presentations at national meetings and traveled to the Bremen Core Repository to assist with the Expedition 342 sampling party. In addition, the GCR core collection was used for Program outreach through materials provided for display at meetings and museums, tours of the repository, and classrooms and educational programs hosted at the GCR.

Core legacy documentation projects continued throughout the year, including scanning of DSDP and ODP paper sample request files and thin section

archive samples for accessibility via the database and completion of an inventory of tens of thousands of DSDP, ODP, and IODP sample residues that scientists have returned to the GCR. The USIO also conducted digital imaging of all working-half sections that were pulled for sampling during the year, posting high-resolution images on the web to show the extent of working-half sampling to date.

### *Program integration and support for others*

The USIO continued to collaborate with and support CDEX and ESO during FY13, providing publication services and log database services, storage, and search capabilities for nonmatorium data to ESO and CDEX. The USIO also hosted informational materials from Japan Agency for Marine-Earth Science and Technology (JAMSTEC), CDEX, ECORD, and IODP-MI at the joint U.S. IODP exhibit booth at the 2012 American Geophysical Union (AGU) Fall Meeting and provided materials for distribution at the European Geophysical Union (EGU) 2013 General Assembly.

### *Planning for the future*

In preparation for the International Ocean Discovery Program, facility boards were established this year for



Drilling holes in the core liner to relieve gas pressure



Processing a core

each IODP platform to make or guide decisions on how the drilling facilities would fulfill the new IODP Science Plan objectives. The *Chikyu* and ECORD Facility Boards each include a USIO liaison, and the *JOIDES Resolution* Facility Board includes liaisons from ECORD and CDEX. Terms of Reference for the *JOIDES Resolution* Facility Board and the *JOIDES Resolution* Facility Advisory Panels were also developed this year.

USIO curators met with ESO and CDEX curators and the Chair of the Curatorial Advisory Board to develop a plan for the transition to the new International Ocean Discovery Program that will ensure uninterrupted curatorial services and similarity of services from each repository. Finally, the USIO developed a closeout plan that would enable simultaneous ramping down of current program activities and gearing up for the new program, with processes put in place to ensure a smooth transition to the future.

## More from the numbers

### Repository and sample statistics

	Visitors hosted	Samples taken
<i>Gulf Coast Repository</i>	543	22,553
<i>JOIDES Resolution</i>	~500	48,970

### Database statistics

	Visitor sessions	Query hits
<i>LIMS database</i>	6,681	102,181
<i>Janus web database</i>	12,468	332,407
<i>Log web database</i>	6,297	32,481





Working at sunset on the catwalk

## More online

IODP expedition schedule: [iodp.org/expeditions](http://iodp.org/expeditions)

Core database: [iodp.tamu.edu/database](http://iodp.tamu.edu/database)

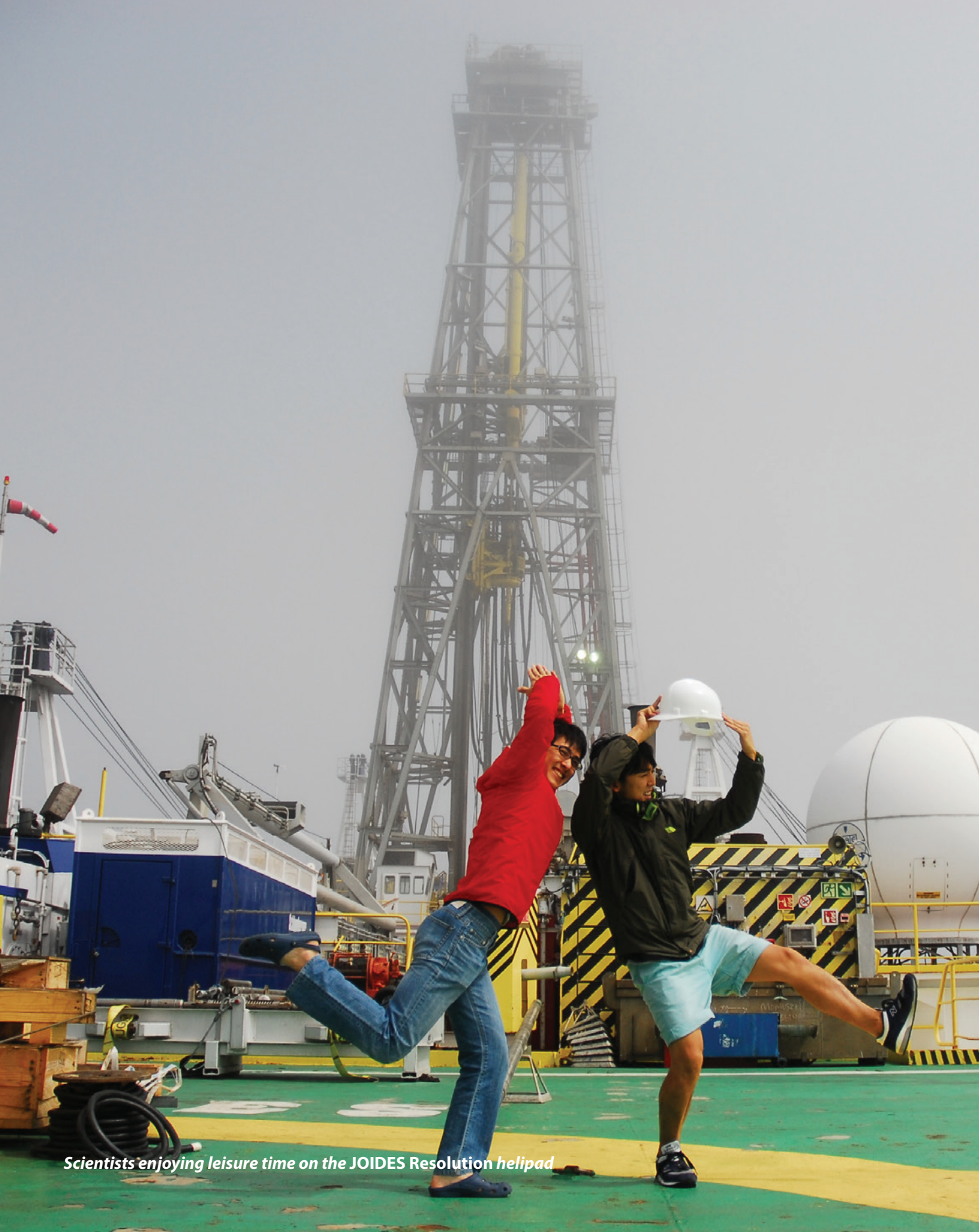
Log database: [iodp.ldeo.columbia.edu/DATA/index.html](http://iodp.ldeo.columbia.edu/DATA/index.html)

LIMS Reports: [web.iodp.tamu.edu/UWQ](http://web.iodp.tamu.edu/UWQ)

Sample requests: [iodp.tamu.edu/curation/samples.html](http://iodp.tamu.edu/curation/samples.html)

IODP-USIO FY13 Quarterly Reports: [iodp.tamu.edu/publications/AR.html](http://iodp.tamu.edu/publications/AR.html)

Illuminating Earth's Past, Present and Future: The Science Plan for the International Ocean Discovery Program  
2013–2023: [iodp.org/Science-Plan-for-2013-2023](http://iodp.org/Science-Plan-for-2013-2023)



*Scientists enjoying leisure time on the JOIDES Resolution helipad*

# Broader Impacts

**T**he USIO conducts ongoing publications, education, and outreach efforts to expand the visibility of IODP as a societally relevant, cutting-edge international Earth science research program. Diverse initiatives this year shared IODP contributions to the global understanding of Earth's ocean basins with a broad audience, educating the public about Earth's structure, microbiology, and history as understood through scientific ocean drilling.

## *Publications*

IODP scientific publications are the primary method of disseminating IODP research to the scientific community and the public. The USIO is responsible for

production of Program-wide scientific publications, reports, and technical documentation, and for archiving DSDP, ODP, and IODP publications.

## **Publishing IODP science**

The USIO produces and publishes *Scientific Prospectuses*, *Preliminary Reports*, and *Proceedings of the Integrated Ocean Drilling Program* for all three IODP implementing organizations. The *Proceedings* volumes include expedition reports and postexpedition research data reports and synthesis contributions. During FY13, the USIO produced six *Scientific Prospectuses* and six *Preliminary Reports*, coordinated postexpedition publications, and worked on *Proceedings* publications



*The JOIDES Resolution transiting the Panama Canal*



Broadcasting a web interview with a Co-Chief Scientist

for 12 expeditions. IODP *Proceedings* content published in FY13 included 26 data reports, as well as shipboard reports from 4 expeditions.

USIO efforts to facilitate production of IODP *Proceedings* volumes include sailing Publications Specialists to coordinate shipboard reports and hosting postexpedition meetings during which Publications staff coordinate science reviews of all expedition reports content and assist meeting participants with editing prior to publication. In FY13, Publications Specialists sailed during all USIO expeditions, a USIO Publications Assistant sailed on the *Chikyu* during CDEX Expedition 343/343T, and the USIO-TAMU office in College Station, Texas, hosted postexpedition meetings for three USIO expeditions and one CDEX expedition.

Moving forward, an IODP scientific publications survey that closed in October 2012 provided valuable feedback from the international scientific community. Responses from the survey will be considered during the design of scientific publications for the new International Ocean Discovery Program. The USIO began efforts toward developing a new *Proceedings* PDF layout and also

explored options for a permanent archive solution for legacy Program expedition publications.

### IODP publications accessibility and impact

The USIO is responsible for making Program scientific publications accessible to the public and documenting how postexpedition Program-related research is disseminated into the scientific community through publications.

All DSDP, ODP, and IODP scientific publications are accessible online through the IODP Publications website and, beginning this year, ISO disc images were made available, through which users can download or burn a replica of the Expedition Reports portion of any *IODP Proceedings* volume. Program scientific publications are also easily accessible through the Ocean Drilling Citation Database subset of the American Geological Institute GeoRef database and through CrossRef, an official digital object identifier (DOI) registration agency for scholarly and professional publications. The number of times Program publications were accessed through these resources gives an indication of the level of interest in IODP scientific publications. There were more than 300,000 visits to the IODP Publications website during FY13. Program publications accessed through CrossRef numbered more than 51,000 DOI resolutions for IODP publications and more than 92,000 DOI resolutions for DSDP and ODP publications. More than 10,000 queries were run on the Ocean Drilling Citation Database, and



A 3-way web broadcast to the *Chikyu* and Chiba University in Japan



Expedition 345 Onboard Education Officers scheduling video broadcasts

additional records for more than 5,400 citations were viewed.

The USIO continued its efforts to more effectively document the impact of IODP science through publications. The 2013 Ocean Drilling Citation Database Report summarized contents of the citation database and also recorded a 42% increase in the number of scientific publications citing primary IODP expedition research. Progress continued on a cited-by linking project that will enable users to initiate a web query from an IODP publication table of contents page to learn which journals or books have cited the publication.

### Education

The USIO used the *JOIDES Resolution* as a platform for education and produced new expedition-specific and thematic video and learning materials throughout the year. Professional development opportunities allowed teachers to experience IODP science in workshops and on board the *JOIDES Resolution*, while IODP scientists participated in shipboard and onshore educational

programming and planning. In addition, USIO representatives worked to develop and strengthen ongoing relationships with science partners and pursued an outreach initiative that exposed minority undergraduate students to careers in scientific ocean drilling.

### More from the numbers

<b>Websites</b>	<b>Site visits</b>	<b>Page views</b>
<i>U.S. Implementing Organization</i>	369,473	2,871,619
<i>ODP Legacy</i>	1,258,502	5,733,458
<i>DSDP Legacy</i>	289,906	1,042,275
<i>IODP Publications</i>	300,491	1,875,837
<i>Deep Earth Academy</i>	43,034	57,772
<i>JOIDES Resolution</i>	59,789	196,500
<b>Total Program-related websites</b>	<b>2,321,195</b>	<b>11,777,461</b>



"Drifty" buoy deployed during Expedition 345 from the JOIDES Resolution for French educational program "Argonautica"

### IODP science online presence and social networking

Information about IODP science is easily accessible online through expedition science reports posted on the USIO website, and the educational website "JOIDES Resolution: Science in Search of Earth's Secrets" promotes USIO expeditions and IODP science and serves as the hub for Program social networking on Facebook, Twitter, and YouTube sites. A new interactive ship tour was launched on the [joidesresolution.org](http://joidesresolution.org) website this year; the educator resources page was overhauled and improved for easy access to all materials, resources, and educational opportunities; and a new activity search tool was implemented. The [joidesresolution.org](http://joidesresolution.org) site received nearly 60,000 visits this year and activity on social networking sites grew, culminating in more than 3,600 "likes" on the JOIDES Resolution Facebook page and an increase in the number of @TheJR Twitter followers to nearly 1,300.

## More from the educators

*"One of the best parts of working as an Education Officer on the JR is interacting with so many interesting people. The scientists on board have a passion for their work and it shows, whether it's a scientific discussion in the lab, sharing their knowledge with students and adults during video broadcasts, or telling stories around the table in the galley.... In one video broadcast, students interact with 5–10 scientists and they are clearly impressed with their work. Taking science out of the classroom is pretty powerful and shows students that science really is cool."*

—A. Mote, Expedition 341 Onboard Education Officer

### Promoting IODP science from the JOIDES Resolution

Onboard Education Officers, USIO technical staff, and expedition participants reached out to global audiences during FY13 USIO expeditions through [joidesresolution.org](http://joidesresolution.org) website content, video broadcasts, and blog entries posted to JOIDES Resolution social networking sites. The USIO held a groundbreaking cohort training initiative this year to bring all four U.S. Onboard Education Officers together at USIO-TAMU in College Station, Texas, to exchange ideas for education plan development, meet USIO staff involved in their upcoming expeditions, and practice for video broadcasts. USIO assistance in placing and training Onboard Education Officers from ECORD countries led to an expedition education team with the capacity for extensive outreach to both American and European audiences.

Live ship-to-shore video broadcasting continued to expand this year, with more than 200 broadcasts to museums, special events, and classrooms around the world, reaching thousands of viewers. Shipboard videographers also produced short in-depth expedition videos (8–10 minutes); very brief (1 minute or less) explanatory videos; a series of "JR in a Minute" animations about the ship and how it works; and four new videos about sedimentology, structural geology, geochemistry, and downhole logging on the JOIDES Resolution. By the end of FY13, the animations had more than 800 views and the USIO expedition videos posted during the year had almost 6,000 views.

### Professional development: 2013 Schools of Rock

The School of Rock professional development program continued this year with two shipboard workshops. The first workshop, titled *Exploring Ocean Cores and the Geology of the Pacific Northwest*, was held 1–9 April on



The 2012–2013 Onboard Education Officers with Expedition Project Managers during training in College Station, Texas

board the *JOIDES Resolution* during the tie-up period in Victoria, British Columbia (Canada). USIO staff and instructors from Ohio State University and University of California, Santa Barbara, introduced 19 workshop participants to many aspects of ocean drilling science and provided engaging material for the participants to share with their students.

The second workshop, titled *Investigating Earth's History and the Deep Biosphere using Samples from below the Seafloor aboard the JOIDES Resolution*, was held 20–29 May 2013 during Expedition 341S. USIO staff; instructors

from the Paleontological Research Institution, Indiana University of Pennsylvania, and University of Southern California; and 13 participants observed the SCIMPI operations as they occurred and explored tectonics and climate change in the Gulf of Alaska. In a first for the School of Rock program, the participants were primarily from cyber-schools and focused on using scientific ocean drilling resources in that context.

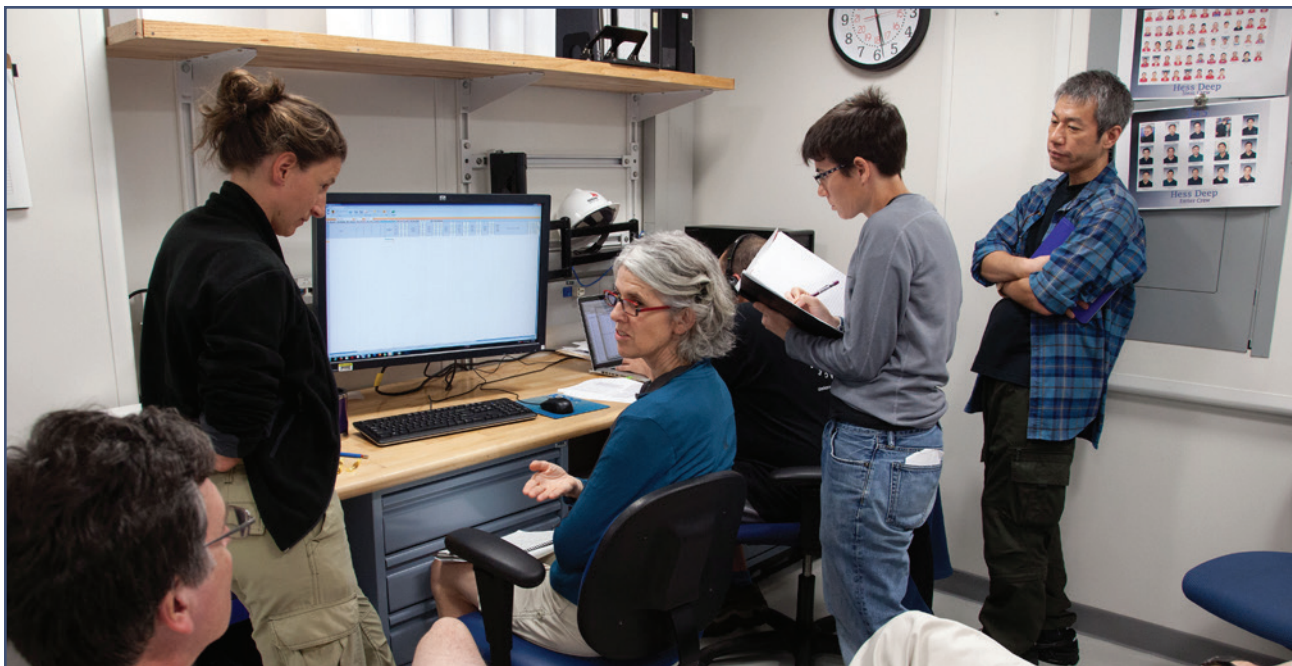
### **Strategic partnerships for education**

The USIO continued to foster partnerships and alliances with science partners with synergistic goals

## **More from the educators**

*“For those of us who imagined [that JOIDES Resolution] scientists mostly worked on their own in equipment filled labs sitting over microscopes in white lab coats, that’s purely myth. Here there is a friendly, collaborative and non-competitive approach to a common goal. The atmosphere and process is collegial and supportive. To see scientists work together on a plan that has been in place for many years, adding all their energy, expertise and enthusiasm is a beautiful thing to watch.”*

—C. Larson, Expedition 341 Onboard Education Officer



Shipboard scientists working on expedition reports

and objectives. The USIO partnership with the Center for Dark Energy Biosphere Investigations (C-DEBI) continued this year with production of microbiology-related materials and projects and adaptation of the Adopt-a-Microbe module as a stand-alone curriculum. C-DEBI also funded USIO-managed education and outreach programs conducted during a second expedition to the Juan de Fuca Ridge-Flank sites on the R/V *Atlantis* 11–26 July.

The NSF Informal Science Pathways grant called “Ship-to-Shore Science—the *JOIDES Resolution* as a Platform for Education” continued with four funded pilot projects including a Girl Scouts project, a museum interactive project, regional *JOIDES Resolution* events, and development of an e-book titled *Uncovering Earth’s*

*Secrets: Science and Adventure on the JOIDES Resolution*. Regional Ship-to-Shore Science hub network events this year featured hands-on activities, science lectures, career workshops for high school students, and live connections to the *JOIDES Resolution*.

### **IODP-USIO Diversity Internship**

The IODP-USIO Diversity Internship exposes minority students to careers in scientific ocean drilling by providing them with a 10–12 week educational and career-building experience at one of the USIO institutions. Partnering with LDEO, the USIO co-sponsored two minority undergraduate students who participated in LDEO’s Summer Intern Program as this year’s IODP-USIO Diversity Interns. The students worked with mentors from LDEO on research projects that used

## **More from the educators**

*“Although the recovery was minimal this expedition, we did get a lot of unexpected and cool rocks that will really make a difference in our understanding of fast-spreading crust. This is the stuff that can re-write the textbooks and that’s pretty awesome to be a part of it.”*

—N. Kurtz, Expedition 345 Onboard Education Officer





*Demonstrating smear slide preparation for students of the online school, Connections Academy*

scientific ocean drilling data and/or cores. One student compared diatom-rich samples of Eocene age from ODP sites with the diatom assemblage in the GISP2 ice core collected in Greenland to determine the likely source of diatoms in the ice core. The other student used a data set consisting of organic-rich matter content, age models, and temperature data collected at all sites drilled during DSDP, ODP, and IODP to address the question of how organic matter is consumed in marine sediments.

### **Outreach**

USIO Outreach activities are designed to build an easily accessible foundation of knowledge about IODP, to encourage interest in the Program, and to highlight the connection between emerging scientific knowledge and its positive contribution to society worldwide. The USIO accomplished these goals during FY13 through publicizing USIO expeditions, developing products designed to feature the Program's success,

and using forums such as the AGU Fall Meeting, the Geological Society of America (GSA) Annual Meeting, and the American Association for the Advancement of Science (AAAS) Annual Meeting to engage the science, education, and political communities in IODP research.

### **Port call outreach**

The USIO partnered with the Observatorio Vulcanológico y Sismológico de Costa Rica (Universidad Nacional) to coordinate outreach activities during the Expedition 344 port call in Puntarenas, Costa Rica, including a press conference for local media that welcomed reporters from three major Costa Rican television stations, the national newspaper *La Nación*, and Radio Pacifico. Tours of the *JOIDES Resolution* were hosted for journalists, students and faculty from Universidad de Costa Rica and Universidad Nacional, members of the public, and representatives from Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), the Costa Rican equivalent of NSF.



The IODP-USIO newsletter, Core Discoveries

More than 360 university and high school students, government officials, and scientific colleagues from throughout South Korea toured the *JOIDES Resolution* during the post-Expedition 346 port call in Busan, South Korea, where outreach activities were coordinated with the Korean IODP Office (K-IODP) and the Korean Institute of Geoscience and Mineral Resources (KIGAM).

### Outreach support and product development

The USIO collaborated with others conducting IODP outreach worldwide and developed media advisories, press releases, and outreach products designed to publicize long-term and recent achievements. Three issues of the full-color IODP community newsletter, *Core Discoveries*, were published during FY13, providing readers with timely updates and information on USIO activities and encouraging Program participation. Followers of the Twitter account @SeafloorSci, which shares news highlights targeted to the geoscience media and blogging community, numbered 500 by the end of FY13, reflecting an increase of 100% from last year.

## More online

IODP scientific publications: [iodp.org/scientific-publications](http://iodp.org/scientific-publications)

IODP-USIO FY13 Quarterly Reports: [iodp.tamu.edu/publications/AR.html](http://iodp.tamu.edu/publications/AR.html)

IODP-USIO FY13 Annual Program Plans: [iodp.tamu.edu/publications/PP.html](http://iodp.tamu.edu/publications/PP.html)

Ocean Drilling Citation Database: [odp.georef.org/dbtw-wpd/qbeodp.htm](http://odp.georef.org/dbtw-wpd/qbeodp.htm)

2013 Ocean Drilling Citation Report: [iodp.tamu.edu/publications/AGI\\_studies/AGI\\_study\\_2013.pdf](http://iodp.tamu.edu/publications/AGI_studies/AGI_study_2013.pdf)

Deep Earth Academy website: [oceanleadership.org/education/deep-earth-academy](http://oceanleadership.org/education/deep-earth-academy)

JOIDES Resolution website: [joidesresolution.org](http://joidesresolution.org)

JOIDES Resolution facebook page: [facebook.com/joidesresolution](https://facebook.com/joidesresolution)

JOIDES Resolution twitter page: [twitter.com/thejr](https://twitter.com/thejr)

JOIDES Resolution Tumblr page: [joidesresolution.tumblr.com](http://joidesresolution.tumblr.com)

IODP science news twitter page: [twitter.com/SeafloorSci](https://twitter.com/SeafloorSci)

USIO Newsroom website: [iodp-usio.org/Newsroom/default.html](http://iodp-usio.org/Newsroom/default.html)

USIO videos: [youtube.com/user/OceanLeadership](https://youtube.com/user/OceanLeadership)

Core Discoveries: [oceanleadership.org/programs-and-partnerships/scientific-ocean-drilling/core-discoveries-newsletter](http://oceanleadership.org/programs-and-partnerships/scientific-ocean-drilling/core-discoveries-newsletter)

IODP-USIO Diversity Internship: [oceanleadership.org/education/diversity/iodp-usio-diversity-internship](http://oceanleadership.org/education/diversity/iodp-usio-diversity-internship)



*Sunset at Hess Deep*



*Derrickman at sunrise on the JOIDES Resolution*

# Contractual and Financial Overview

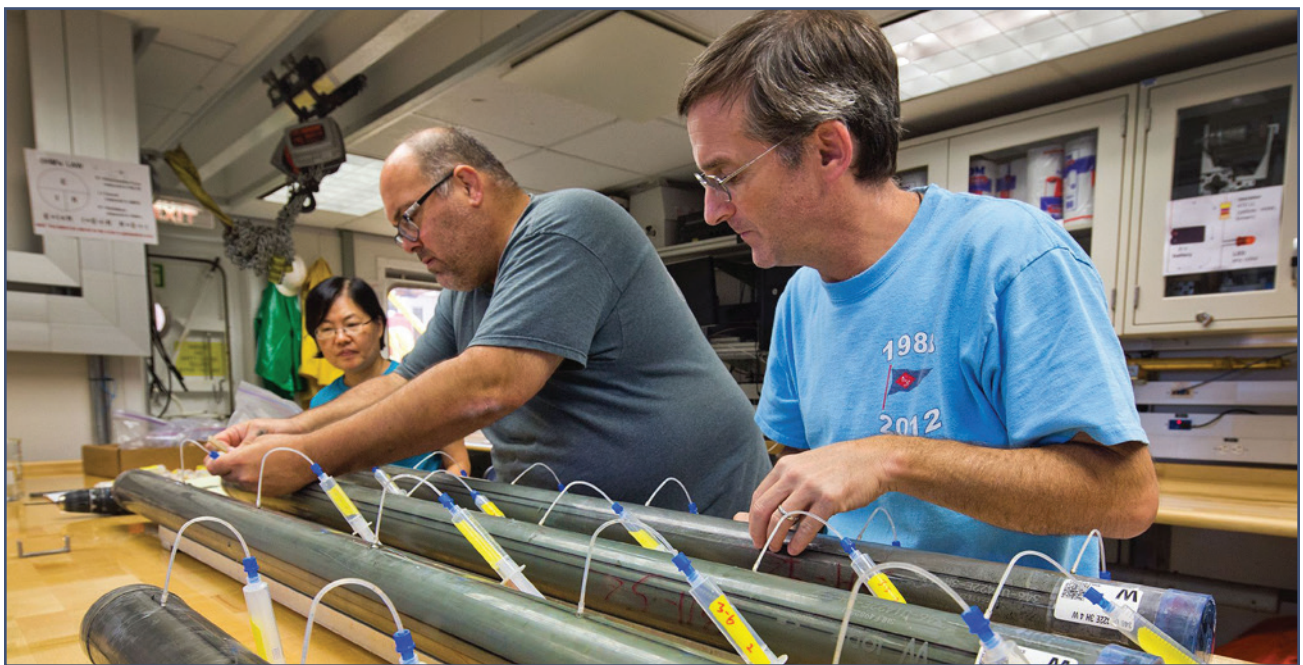
**IODP** is funded by several entities acting as international partners. NSF and Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT) are lead agencies, and ECORD and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior/Brazil (CAPES) are contributing members. Associate members include the People's Republic of China Ministry of Science and Technology (MOST); the Interim Asian Consortium, represented by KIGAM; the Australian/New Zealand Consortium funded by the Australian Research Council (ARC) and GNS Science (New Zealand); and the Ministry of Earth Sciences (MoES), India.

The USIO provides all deliverables through contracts with NSF for platform operating costs (POC) and other program integration costs (OPIC) and with IODP-MI for

science operating costs (SOC). The commingled funds that comprise the SOC budget come from IODP-MI's international partners as part of their membership fees used to fund IODP science. POC funding for each implementing organization is the responsibility of the agency supplying the platform capability.

## *USIO contractual relationships*

The USIO was formally established in 2003 when Ocean Leadership, formerly known as Joint Oceanographic Institutions, established subcontracts with LDEO of Columbia University and the College of Geosciences at TAMU through TAMRF. Each of the three USIO institutions (Ocean Leadership, LDEO, and TAMU) provides fiscal and contractual administration, and the organizational structure employed by the USIO accommodates the work breakdown element accounting structure used by IODP. This structure also



*Setting up Rhizon sampling, a method used to collect water across the sulfate–methane transition*



*Working on the rig floor of the JOIDES Resolution*

aligns the organization to efficiently and economically provide the full array of USIO deliverables.

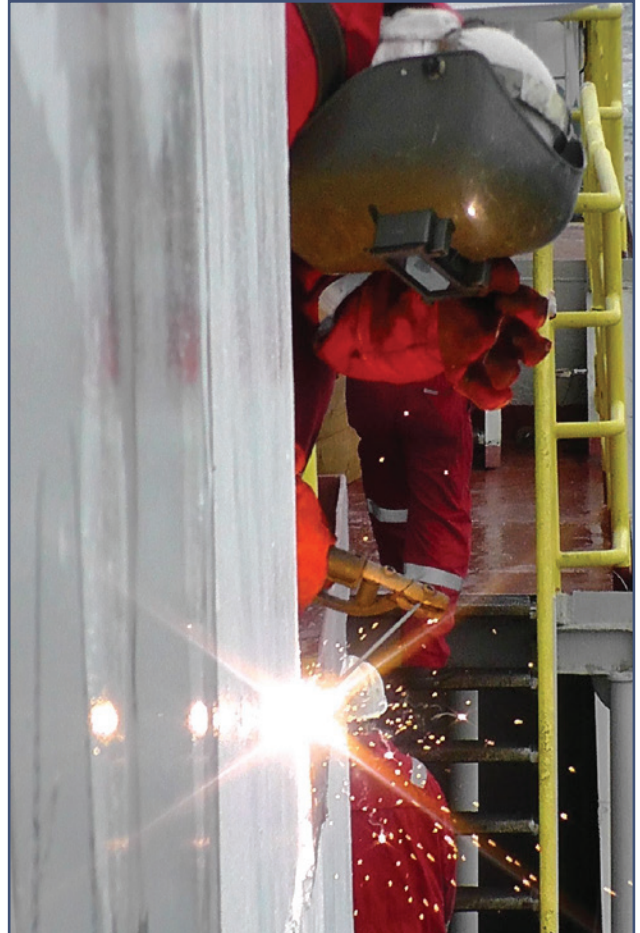
**USIO prime contractor**

As the U.S. Systems Integration Contractor, Ocean Leadership is ultimately 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. Ocean Leadership 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 directly support the full range of scientific and technical activities necessary for implementing a riserless scientific drilling program. LDEO is responsible for logging-related shipboard and shore-based science services and technological support and for leading an international logging consortium to participate in scientific ocean drilling operations. LDEO provides downhole logging equipment and engineering support through an ongoing contract with Schlumberger. LDEO contracted with Howard and Associates, Inc., for engineering oversight of the large-diameter pipe-handling infrastructure project.

TAMU is responsible for providing services directly related to the scientific and engineering activities necessary to support science cruises (vessel and drilling

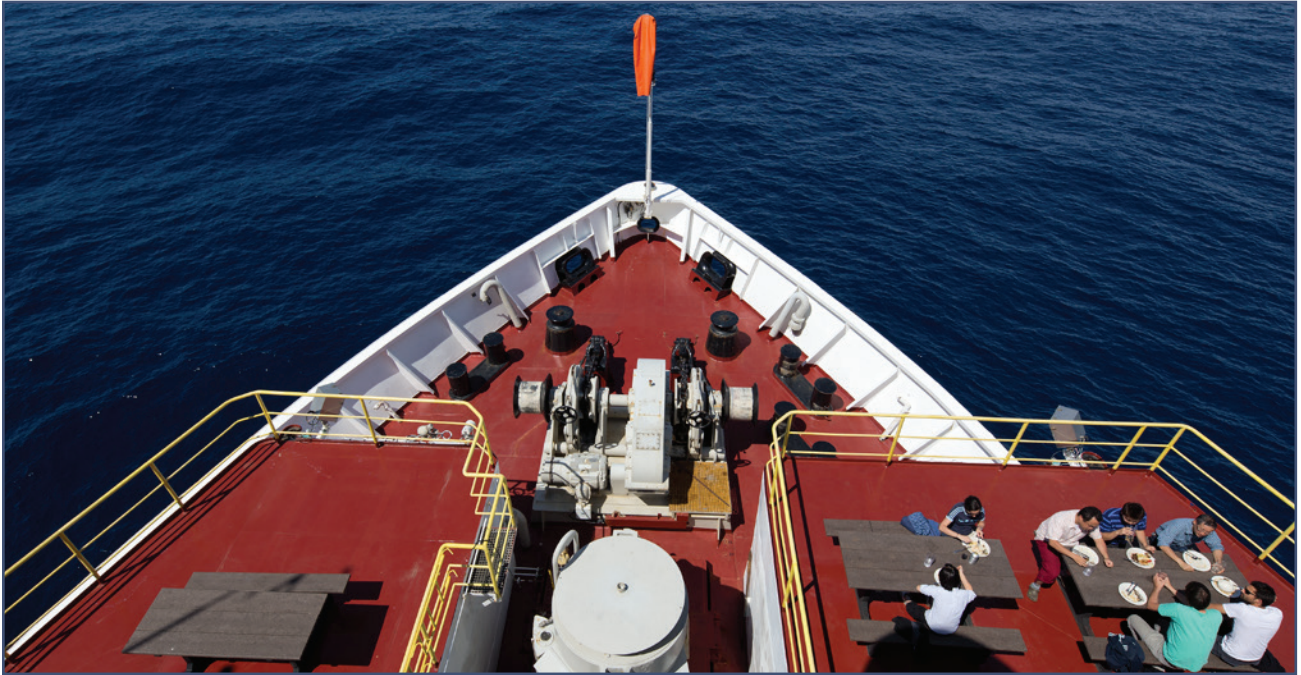


*Welding near the passage leading to the helideck on the JOIDES Resolution*

operations, ship- and shore-based science laboratories) and for managing expedition-related, shore-based functions (data management, core curation, and publications). Administrative services in support of TAMU activities are provided by TAMRF. On behalf of the USIO, TAMRF contracts with Overseas Drilling Limited for the services of the *JOIDES Resolution*, the riserless drilling vessel for USIO operations.

***USIO FY13 Annual Program Plans to IODP-MI and NSF***

FY13 USIO contractual requirements for SOC and POC funds are outlined in the IODP-USIO FY13 Annual Program Plan to IODP-MI; POC and OPIC budgets are combined in the systems integration contract (SIC) costs outlined in the IODP-USIO FY13 Annual Program Plan



*Enjoying a meal outside during Expedition 346*

to NSF. The Annual Program Plans set forth the goals of the USIO, 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 efforts and associated management and administrative support).

The complex nature of IODP operations requires Annual Program Plans that establish priorities and allow procurement of long-lead time equipment and services for activities that span multiple years. The FY13 Annual Program Plans were based on (1) the mission forecast provided on 20 March 2012 for the USIO by NSF, (2) the USIO operations schedule that was approved by the Operations Task Force (OTF) and Science Planning Committee (SPC) in August 2010, and (3) the revisions to the operations schedule approved by the OTF in June 2011. Budgets outlined in the Annual Program Plans included costs associated with the necessary planning and purchase of long-lead time items and additional items to support expeditions scheduled for FY13 and beyond.

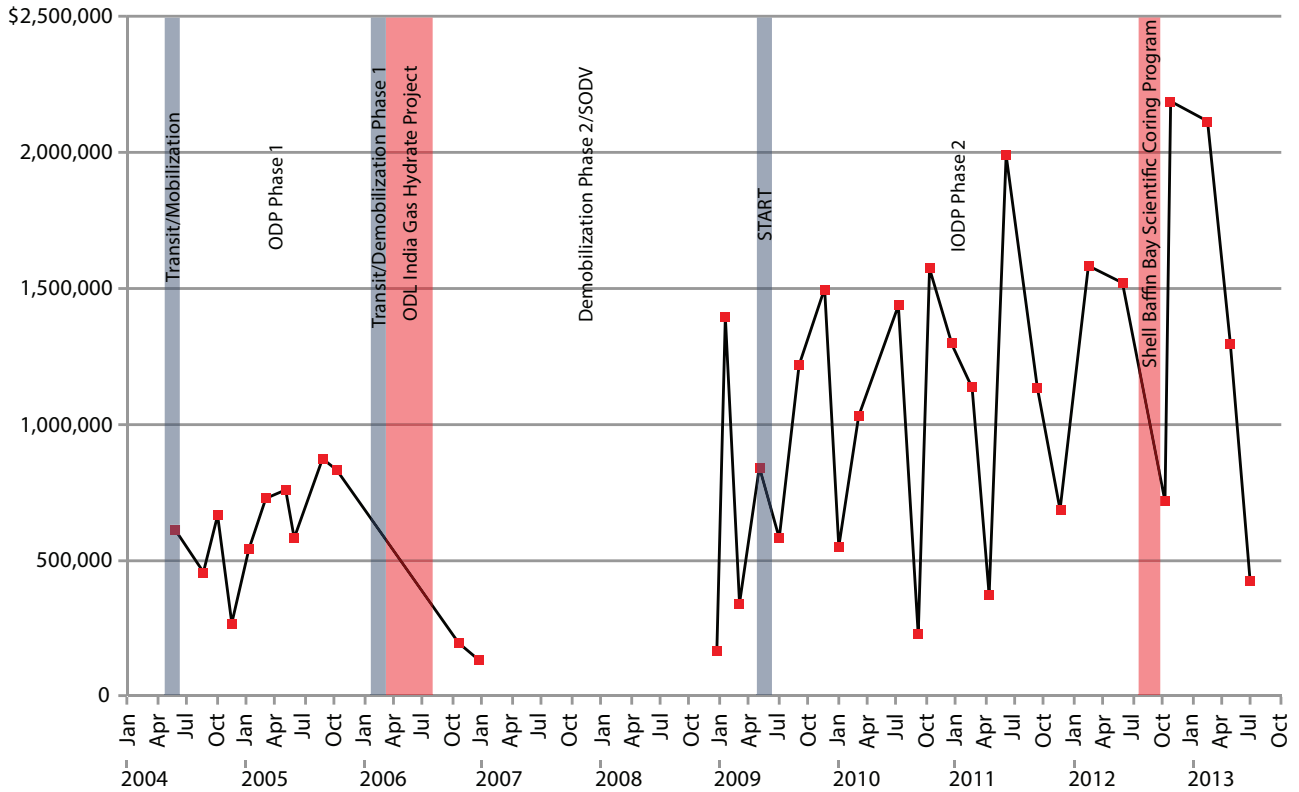
### ***Financial tables***

The following financial tables provide a detailed overview of the FY13 IODP-USIO Annual Program Plan budget, including FY12 carryforward of obligated and unobligated funds, budget modifications that took place throughout the fiscal year, expenditures that were made to execute the Annual Program Plan, and end-of-year totals of obligated and unobligated funds.

These tables individually represent the following:

- USIO FY13 end-of-year financial summary, which encompasses SOC and SIC budgets for the USIO with detail provided for each USIO institution (Ocean Leadership, LDEO, and TAMU);
- USIO FY13 end-of-year financial summary for the POC (NSF) budget;
- USIO FY13 end-of-year financial summary for the SOC (IODP-MI) budget; and
- USIO FY13 end-of-year financial summary for the SIC (NSF) budget.

*Actual fuel cost FY04–FY13*



**More online**

IODP-USIO website: [www.iodp-usio.org](http://www.iodp-usio.org)

IODP-USIO FY13 Annual Program Plan: [iodp.tamu.edu/publications/PP.html](http://iodp.tamu.edu/publications/PP.html)

IODP-USIO FY13 Quarterly Reports: [iodp.tamu.edu/publications/AR.html](http://iodp.tamu.edu/publications/AR.html)



Please contact [info@oceanleadership.org](mailto:info@oceanleadership.org) for hard copies of the financial pages (41–53).

## Acronym List

<b>Acronym</b>	<b>Definition</b>
ARC	Australian Research Council
CAPES	Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Brazil)
CCSF-A	core composite depth below seafloor
CDEX	Center for Deep Earth Exploration
CORK	circulation obviation retrofit kit
CRISP	Costa Rica Seismogenesis Project
CSF-A	core depth below seafloor
DOI	digital object identifier
DSDP	Deep Sea Drilling Project
ECORD	European Consortium for Ocean Research Drilling
EPR	East Pacific Rise
EPSP	Environmental Protection and Safety Panel
ERS	electronic release system
ESO	ECORD Science Operator
GCR	Gulf Coast Repository
half APC	half advanced piston corer tool
IBM	Izu-Bonin-Mariana
IO	implementing organization
IODP	Integrated Ocean Drilling Program
IODP-MI	IODP Management International, Inc.
IT	information technology
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
J-FAST	Japan Trench Fast Drilling Project
KIGAM	Korean Institute of Geoscience and Mineral Resources
K-IODP	Korean IODP Office
LDEO	Lamont-Doherty Earth Observatory
LIMS	Laboratory Information Management System
LWG	laboratory working group
MEXT	Ministry of Education, Culture, Sports, Science and Technology (Japan)
MFTM	Multifunction Telemetry Module
MoES	Ministry of Earth Sciences (India)
MOST	Ministry of Science and Technology (People's Republic of China)
MPT	mid-Pleistocene transition
NanTroSEIZE	Nankai Trough Seismogenic Zone Experiment
NSF	National Science Foundation
ODP	Ocean Drilling Program
OPIC	other platform integration costs
OTF	Operations Task Force
POC	platform operating costs
ROV	remotely operated vehicle
SAFOD	San Andreas Fault Observatory at Depth
SCIMPI	Simple Cabled Instrument for Measuring Parameters In Situ
SIC	systems integration contract (costs)
SPC	Science Planning Committee
TAMU	Texas A&M University
USIO	U.S. Implementing Organization
VIT	vibration-isolated television

## **PUBLISHER'S NOTES**

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- Ministry of Education, Culture, Sports, Science and Technology (MEXT), Japan
- European Consortium for Ocean Research Drilling (ECORD)
- Ministry of Science and Technology (MOST), People's Republic of China
- Korea Institute of Geoscience and Mineral Resources (KIGAM), South Korea
- Australian Research Council (ARC) and GNS Science (New Zealand), Australian/New Zealand Consortium
- Ministry of Earth Sciences (MoES), India
- Coordination for Improvement of Higher Education Personnel, Brazil

Citation:

Integrated Ocean Drilling Program United States Implementing Organization, 2014. FY13 Annual Report.

<http://iodp.tamu.edu/publications/AR/FY13AR.PDF>

## **DISCLAIMER**

Any opinions, findings, and conclusions expressed in this publication are those of the author(s) and do not necessarily reflect the views of the participating agencies, IODP-MI, or the Texas A&M Research Foundation.



*Welding a free fall funnel*



*JOIDES Resolution in what seems to be the perpetually gray Gulf of Alaska*



## Integrated Ocean Drilling Program, U.S. Implementing Organization

[www.iodp-usio.org](http://www.iodp-usio.org)

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