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Spring Time in Washington: IODP Plans Bloom

contributed by Steve Bohlen

IODP, CMO, IMI, RFP and the Future: An explanation from Washington, DC

For those who covet confusion and chaos, Washington DC has a special charm this time of year as the President submits his budget request to the Congress. Even though each budget is exceptional in one way or another, even hardened Washington veterans admit that the budget for Fiscal Year 2004 (FY04) is unusual as it had to be developed without a budget in place for FY03. Although Congress typically passes a budget by the beginning of the fiscal year in October, the FY03 budget was not passed until February 2003—over one-third of the way into the fiscal year. With the budget battles just beginning for FY04, the time is ripe to update you on the effects of this unique situation on progress towards launching the Integrated Ocean Drilling Program (IODP).

The Non-Riser Drill Ship

As many of you may know by now, funding for a new U.S. drill ship was not included in the President's budget proposal for FY04. The reason for this relates to problems created by the lack of a budget for FY03 rather than to a lack of commitment by the U.S. National Science Foundation (NSF). Due to the absence of an FY03 budget, federal agencies began preparing their FY04 budgets based on the FY02 budget. In straightforward terms, the lack of a FY03 budget required Federal agencies in general—and NSF specifically—to identify funds for items that were requested in FY03, but not yet appropriated.

With respect to the Major Research Equipment and Facilities Construction (MREFC) line item in NSF's budget, the FY03 budget proposal included funding to initiate two geoscience projects, EarthScope and NEON (National Ecological Observation Network), and to complete a third, the HIAPER (High-performance Instrumented Airborne Platform for Environmental Research) aircraft. In the absence of an FY03 budget and with the potential that the Congress might simply adopt a continuing resolution for all of FY03 (thereby holding spending for FY03 at FY02 levels and preventing the initiation of new projects), NSF again requested funding for these projects in its FY04 proposal. Hence, within a budget of approximately $200 M for the MREFC line item, NSF was in the difficult position of having to delay some high-profile and long-promised projects, such as the conversion of a vessel for use in IODP.

Following the release of the President's FY04 budget proposal, the Congress passed, and the President signed, an omnibus budget package for FY03. This appropriation includes funding for EarthScope and HIAPER, but not NEON. The net result is that the NSF's budget proposal for FY04 contains requests for projects already funded in FY03. Hence, there is the possibility that funds for the drill ship might yet be included in the FY04 appropriation because the vessel was identified in NSF's FY04 budget proposal as the Foundation's top priority for projects awaiting funding. Therefore, over the next several months JOI and the Consortium for Oceanographic Research and Education (CORE) will be working together to promote the new drill ship. JOI will make the Congress aware of the value of scientific ocean drilling, specifically IODP, and CORE will be an advocate for the vessel's initial funding in FY04, with the remainder in FY05. Even though some individuals may perceive this as pork-

continued on page 2

Inside

Cretaceous Climate-Ocean Dynamics 4
CORKing ODP Site 1200 5
East Asian Marginal Seas 6
Drill Bits: The Skinny on ODP 8
ODP in the News 9
Announcements 10
Robotic Underwater Drills 12
Fellowship Profile: Aradhna Tripati 14
Fellowship Profile: Kevin Theissen 15
Letter from the Chair 17
NSF Report 18
USSAC Members 19
Fishing for Words 20

barrel politics, this request follows logically from the connection of NSF's identification of IODP and the drill ship as its top priority and funding identified for other projects in FY04 that are already funded in FY03.

The Beginning of IODP

Even though the focus of attention is now on the Congress with respect to the FY04 budget, the unusual twists and turns of this budget year have clearly altered internal NSF strategy towards initiating IODP. For several years, NSF has stated consistently that there would be a hiatus in non-riser drilling of approximately 12 to 18 months between the ODP and the IODP. Furthermore, NSF has stated that a request for proposals (RFP) would be released to initiate a competitive process to identify a "systems integration contractor" to oversee the conversion of a new drilling vessel for scientific ocean drilling and U.S. ship operations as part of IODP. (FYI, JOI is the systems integration contractor for the existing ODP.)

However, most likely as a result of uncertainty concerning the appropriation for drill ship conversion, NSF has changed its strategy for implementing IODP. On March 19, 2003, NSF released the RFP for IODP (www2.eps.gov/spg/NSF/DCPO/CPO/DACS-03-00001/listing.html). Instead of seeking a systems integration contractor who will oversee the conversion of a vessel with drilling to commence in calendar year 2005, NSF has identified a three-step process with drilling to commence in June 2004. The three-step process includes identifying a systems integration contractor followed by selecting a laboratory-equipped vessel capable of non-riser scientific ocean drilling, ready to drill in June 2004, without significant government-funded alterations. The third step would involve converting a drilling vessel in FY05-06, using up to $90 M of government funds, to meet the specifications of the scientific community for achieving the goals of the IODP.

Considering the uncertainty of procuring funds for the drill ship conversion, the beauty of the NSF strategy is evident. Although there is a logical path to securing appropriations for the drill ship in FY04 and 05 that is consistent with NSF priorities, there are always uncertainties. The war with Iraq and its aftermath, large budget deficits, and simply the vagaries of the appropriations process cast doubt on all future funding. A promise in this fiscal year to fund something in the next fiscal year has no guarantee. Therefore, NSF's approach for IODP allows for the program to begin in October 2003 and for drilling to begin earlier than expected. Then when the appropriations gods smile upon the program and the funds necessary for ship conversion are in hand, a refurbished vessel can be readied for drilling as part of IODP. This is an outstanding strategy for the program and the scientists who wish to participate in it.

So what has JOI been doing to assure a successful strategy for the U.S. oceans community that it represents? The answer is quite a lot. Over a year ago, the JOI Board of Governors developed a plan to evaluate the ability of JOI member institutions to partner with JOI to develop a winning proposal to manage the U.S. vessel and provide a wide range of IODP science services similar to those services supplied by JOI's ODP subcontractors. As part of its internal review, JOI asked interested JOI member institutions to submit a letter of intent listing their qualifications for operating or supporting the U.S. vessel for IODP. Those institutions that responded were then asked for additional information indicating: 1) the institutional commitment of the financial, administrative, and logistical support that JOI and the international program should expect to be forthcoming; 2) the educational and intellectual resources and activities that would be integrated into the operation of the vessel; 3) the institution's strategic objectives that would be achieved by operating the vessel; and 4) the institution's overall scientific contributions to and planned growth in oceanography and marine geology and geophysics in the broad context of ocean drilling.

> "Considering the uncertainty of procuring funds for the drill ship conversion, the beauty of the NSF strategy is evident."

As part of the process, JOI invited a committee of prominent members of the community (David Scholl, USGS and Committee Chair; Peggy Delaney, UCSC and outgoing USSAC Chair; Terry Edgar, USGS; Barry Katz, Chevron-Texaco; Warren Prell, Brown University and incoming USSAC Chair; and Dick von Herzon, WHOI) to evaluate the letters of intent against a set of success criteria. Details of these success criteria were outlined in an article written by John Farrell, JOI, in the Summer 2002 *JOI/USSAC Newsletter*: www.joiscience.org/USSSP/Pubs/Pubs.html.

Letters of intent were submitted by the University of Rhode Island (URI) and by an alliance of Lamont Doherty Earth Observatory (LDEO) and Texas A&M University (TAMU). Following site visits to URI and TAMU, the Committee gave their evaluation to the Board of Governors at a special meeting in late September of 2002. Following the committee's presentation and Board deliberations, JOI announced that an alliance of LDEO and TAMU would partner with JOI to develop a community-based proposal to manage the U.S. vessel and provide science and logging services in IODP.

Since September, the staffs at JOI, LDEO, and TAMU have been preparing for the release of the much-anticipated RFP from NSF for U.S. activities in IODP. We have delineated what has gone well in ODP and in which areas performance could be improved. We have assessed our management structure and developed a new structure attuned to the needs of the program and the realities of a program with two and possibly three platforms in simultaneous operation. We have surveyed the universe of potential drilling vessels and have developed a process to engage prospective vessel suppliers. We have also looked to the future and developed plans to take advantage of technology at the cutting edge or still under development but with high promise to enhance science productivity within IODP in the near future. In short, we have spent the last year doing our best to prepare for what is upon us now, the opportunity to produce a compelling proposal for the U.S. component of IODP by May 5. JOI's internal process began with this end in mind. The initial letter of intent from "the Alliance" (LDEO and TAMU) that was evaluated by a committee of community leaders and our subsequent work has prepared us well for the task at hand.

Creation of the CMO

Finally, all of the activity concerning the release of the RFP for the non-riser vessel begs the question about the status of the Central Management Office (CMO) for IODP, including its role in the initial stages of IODP.

In the summer of 2002, representatives of the academic communities in the U.S. and Japan met to discuss the best ways to create the CMO. This group developed a strategy to found a new not-for-profit corporation to provide the legal and business framework for the CMO. To make a lengthy story short, with this model in mind, these representatives crafted draft by-laws for a membership organization (not unlike JOI) that would be registered in the U.S., have an international board of governors, and be representative of a diverse and large group of research and educational organizations worldwide. Just prior to the AGU Fall Meeting 2002, the representatives of twelve institutions—six in the U.S. and six in Japan—met to finalize plans for the founding of IODP Management International, Inc., (IMI). Since this initial meeting of founding members, a call for membership has been sent to institutions around the globe. Representatives from institutions interested in membership in the IMI met in Honolulu at the end of March 2003 to ratify the by-laws of the corporation, elect a board of governors, decide on the location of the IMI offices, and to initiate a search for senior IMI leadership.

> "In the next twenty-five years, quantitative models of an Earth system will be developed by geologists, oceanographers, and atmospheric scienctists working together."

Even though the creation of IMI is unfolding quickly, IODP will begin before the CMO is in place. How and when the CMO will develop and take over its role of program oversight, program plan development and distribution of funding for science operations is unknown (see Farrell, *JOI/USSAC Newsletter*, summer 2002 for more details about science operations costs and the role of the CMO). Given the challenges of establishing and staffing such an organization, I would guess that the CMO will be functioning in about a year from now. In the meantime, implementing organizations in the U.S. and Japan will be working closely with NSF and Japanese ministry of Education, Culture, Sports, Science, and Technology (MEXT) to initiate IODP.

JOI and the Future

In a few short months, NSF will choose the systems integrations contractor for the U.S. non-riser vessel, and hence the U.S. Implementing Organization for IODP. As noted above, JOI has labored to be well prepared to deliver a winning proposal to NSF before May 5. Assuming JOI is successful in its bid, what of the future and how does JOI see itself embracing the future?

A little over two years ago, when I first came to JOI, I urged the ocean drilling community to adopt a broad view of the future in which ocean drilling reaches out to the broader scientific community to create a future in which we develop a more comprehensive and quantitative understanding of how the Earth System works. In closing, I offer a few thoughts about how I see JOI moving into the future and working on your behalf.

During the century past, humans have emerged as a powerful geologic force on the planet. The human self-image as being at the mercy of natural forces is now mixed with the notion of the human ability to influence or alter the state of natural systems. As this latter view emerges, so does the debate of what, if anything, individuals and nations ought to do about the human influence on life-sustaining systems of the planet.

Public policy debates concerning climate change, energy, water and mineral use, land use practices, to name a few, are fueled by scientific information concerning processes affecting the evolution of the Earth, the natural variability of the Earth's environment, climate and sea level, and the formation and quantity of natural resources. JOI, through its management of programs in marine geology and geophysics and oceanography, promotes cutting-edge research in the areas of plate tectonic processes and geodynamics, paleoceanography, geomicrobiology, petrology and ocean crust hydrology, and other fields of inquiry. In so doing, JOI occupies an honored place at the intersection of program management, facilitation of scientific research for the oceans community, and translation of the significance of research discovery for the global citizenry.

For over twenty-five years, JOI has helped to lead the oceans research community. In the next twenty-five years, quantitative models of an Earth system will be developed by geologists, oceanographers, and atmospheric scientists working together. Such models will integrate the physical processes operating within, between, and among the solid Earth, the oceans, and the atmosphere. JOI looks forward to its role in facilitating this important cutting-edge endeavor.

The Author

Steve Bohlen—although still a research scientist at heart—is the President of JOI.

Cretaceous Climate-Ocean Dynamics: Future Directions for IODP

contributed by Karen Bice, Timothy Bralower, Robert Duncan, Brian Huber, R. Mark Leckie, and Bradley Sageman

Recent discoveries and new paleoclimatic data have renewed the science community's interest in the dynamics of the Cretaceous climate and oceans. Although we now have a more precise picture of the global distribution of temperature and its variations over time, our understanding of the forcing mechanisms of Cretaceous climate remains inadequate. In this exciting, multidisciplinary phase, researchers are integrating a variety of geological, geochemical, geophysical, and paleontological data and are incorporating them into climate models.

A JOI/USSSP, NSF-sponsored conference was designed to summarize our current understanding of the Cretaceous climate and oceans and to discuss future research priorities. Scientific ocean drilling has been crucial in our advances to date, and is critical for future success. The conference was held July 13-17, 2002 at The Nature Place in Florissant, CO—a conference center in the Rocky Mountains. Participants included a diverse group of 90 scientists (including 16 graduate students) from 11 countries.

The conference started with morning plenary sessions that provided overviews of our current understanding of Cretaceous climate. Afternoon poster sessions gave attendees ample time for discussion. Keynote addresses were given in the evenings. Mike Arthur, Elisabetta Erba, Hope Jahren, Bill Hay, Paul Valdes, and Roger Larson gave fascinating and provocative talks. A mid-conference excursion to the Rock Canyon Anticline near Pueblo, was led by Brad Sageman and Mark Leckie. This trip included the future stratotype for the Cenomanian/Turonian Boundary, one of the classic outcrops of the Oceanic Anoxic Event (OAE) that characterized this interval. Break-out group discussions on the last day focused on outstanding questions and problems, future research directions, and the role of IODP in advancing the field. This discussion included a list of drilling targets that will help achieve these goals.

The workshop's major theme sessions included: Cretaceous Climate as Revealed by Stable Isotopes; Biotic Records of Global Change during the Cretaceous; OAEs: Causes and Consequences; Sea Level and Mechanisms for Global Eustatic Change; Atmospheric and Ocean Circulation in a Greenhouse World; and Environmental and Biotic Consequences of Large Igneous Provinces. Major advances in our understanding of Cretaceous climate and ocean circulation were presented in each theme area:

- Several presentations focused on new stable isotopic records derived from glassy (well preserved) foraminifera. These records suggest sea surface temperatures that are more consistent with greenhouse forcing than previously thought. Significant stratigraphic and geographic gaps in these records currently prevent a global picture, however, future drilling should help resolve this.
- Detailed temporal records of biological diversity were presented for several major fossil groups. These data suggest that major pulses of biotic change occurred during OAEs, likely associated with changes in oceanic habitats.
- Much recent data suggest that methane from clathrates and carbon dioxide from Large Igneous Province (LIP) volcanism must be considered as potential triggers of OAEs. This debate raged at the conference and will likely continue for years, but we are closer to understanding these major environmental perturbations.
- Recent studies have developed far more precise records of sea level history. Participants presented tantalizing correlations between changes in sea level and geochemical shifts that are consistent with global ice volume fluctuations during the Cretaceous. However, more evidence for global synchroneity of these records is needed before ice-sheets will be widely accepted as a forcing mechanism for Cretaceous sea level change.
- Atmospheric and Oceanographic models have evolved greatly in the last decade. Presentations and posters using the new generation of more capable models proposed paradigms that depart significantly from the classic view of the Cretaceous as a warm, equable world forced by moderately high levels (4-6 times present-day) of atmospheric carbon dioxide and a reversed thermohaline circulation.
- Several speakers presented new age data for LIPs, which have been constrained significantly thanks to recent drilling efforts. These data allow precise stratigraphic correlation with perturbations such as OAEs and pulses of biotic turnover. However, the physical and biological mechanisms responsible for these relationships need to be explored further.

In summary, the field has evolved significantly since the first conference on Cretaceous climate held at The Nature Place in 1983 (when several of the organizers were graduate students). The conference in 2002 established a benchmark of our current knowledge and to use in planning for the future.

For a full report, visit www.joiscience.org/USSSP/Workshops/Workshop.html.

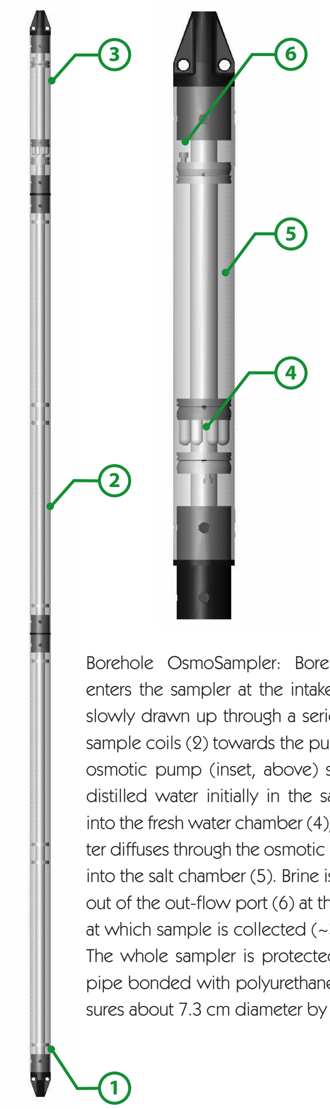
The Authors

Karen Bice, WHOI; Timothy Bralower, Penn State University; Robert Duncan, Oregon State University; Brian Huber, Smithsonian Institution; R. Mark Leckie, University of Massachusetts; and Bradley Sageman, Northwestern University.

One Year Down, One to Go: The CORK at ODP Site 1200

contributed by Geoffrey Wheat, Hans Jannasch, Patty Fryer, Earl Davis, Keir Becker, and Michelle Edwards

South Chamorro Seamount is a large (30-km diameter, 2-km high) active mud volcano on the Mariana Forearc. It is also one of several active serpentine and blueschist mud volcanoes in the forearc region that exhibit a range of pore water chemical compositions (Fryer et al., 1999). Compositions range from calcium-rich, low-alkalinity, low-magnesium, slightly basic fluids (>pH 9) to calcium- and magnesium-depleted, high-alkalinity (35-41 mmol/kg), high-pH (>12) and sulfide-rich (several mmol/kg) fluids. Fluids from South Chamorro Seamount are similar to those with high alkalinity and have the only documented megafaunal assemblage associated with this type of mud volcanism.



Borehole OsmoSampler: Borehole water enters the sampler at the intake (1) and is slowly drawn up through a series of Teflon sample coils (2) towards the pump (3). The osmotic pump (inset, above) slowly pulls distilled water initially in the sample coils into the fresh water chamber (4), where water diffuses through the osmotic membranes into the salt chamber (5). Brine is expressed out of the out-flow port (6) at the same rate at which sample is collected (~3 ml/week). The whole sampler is protected by a PVC pipe bonded with polyurethane, and measures about 7.3 cm diameter by 3.8 m long.

In August 2000, the JOIDES Science Committee scheduled drilling operations on South Chamorro Seamount in conjunction with the previously scheduled installation of seismic equipment in the West Philippine Basin (ODP Leg 195). The focus of this drilling was to establish a long-term observatory and to sample this unique and active environment. Goals for drilling this particular site fall within a broader program that will include drilling at several active mud volcanoes. The ultimate objectives of this effort are:

- To understand mass transport and geochemical cycling in non-accretionary convergent margins
- To define the spatial constraints of slab-related fluids within the forearc environment as a means for tracing water-rock reactions in subduction and supra-subduction zone environments
- To elucidate the metamorphic and tectonic history of nonaccretionary forearc regions
- To determine the role of biological activity associated with subduction zone material including its relationship to megafaunal assemblages
- To assess the temporal component of these processes

The goal of a long-term observatory at South Chamorro Seamount was to provide a temporal component for understanding processes related to nonaccretionary forearc regions. Six months before the leg, we decided the standard CORK design (Davis et al., 1992) would be appropriate to achieve the goals defined above. It would also provide flexibility for future deployments, which could include a cabled observatory network of seismic, physical and biogeochemical sensors. We determined that some of the equipment recovered from the ODP Leg 168 CORKed holes (thermistor string from ODP Site 1024 and a datalogger) could be used for this application, but additional tools and modifications were necessary. JOI/USSSP responded to this need with site augmentation funds to refurbish, purchase, and fabricate instruments.

After drilling two pilot holes, ODP Hole 1200C was drilled into South Chamorro Seamount to 266 mbsf. Although it was difficult to extend casing to this depth, the final configuration set the shoe of the casing at 202.8 mbsf and the screened section extended from about 148.8 mbsf to 202.3 mbsf. This section provides a conduit between pore fluids and instruments within the borehole. Borehole instrumentation includes a datalogger, pressure sensors, nine thermistors, and two OsmoSamplers. The datalogger was programmed to record date, time, borehole pressure, seafloor pressure, internal temperature, resistance of nine thermistors and two fixed, low-temperature-coefficient resistors once per hour. OsmoSamplers are continuous fluid samplers driven by the osmotic flow generated across a membrane that separates solutions of different salt content (Wheat et al., 2000). These instruments were designed to tolerate pore-fluid conditions with the hole, which include a high-pH and millimolar concentrations of hydrogen sulfide. On the basis of our experience with deployments on ODP Leg 168, and given the expected pore-fluid composition associated with serpentine muds in this environment, two OsmoSamplers were deployed above the screened section. One of these samplers has an expendable intake positioned near the middle of the screened section.

continued on page 16

Continent-Ocean Interactions within the East Asian Marginal Seas

contributed by Peter Clift, Pinxian Wang, Wolfgang Kuhnt, Robert Hall, and Ryuji Tada

Interactions between continents and oceans are a geoscience frontier in the 21st century because the first-order tectonic development of the planet has already been described. The nature of these interactions in the marginal seas of East Asia—the transition between the world's largest ocean and continent—was the focus of an American Geophysical Union (AGU) Chapman conference. This meeting, sponsored by JOI/USSSP, was held last November in San Diego, CA. The meeting objective was to highlight recent advances, especially those made by the Ocean Drilling Program (ODP), as well as to identify key future drilling goals for the Integrated Ocean Drilling Program (IODP). The types of continent-ocean interactions discussed were wide ranging, spanning the Cenozoic tectonic, climatic, and sedimentary evolution of the region. A full report is available online at www.joiscience.org/USSSP/ResultsSymp/ResultsSym.html.

Major Scientific Advances

Tectonics

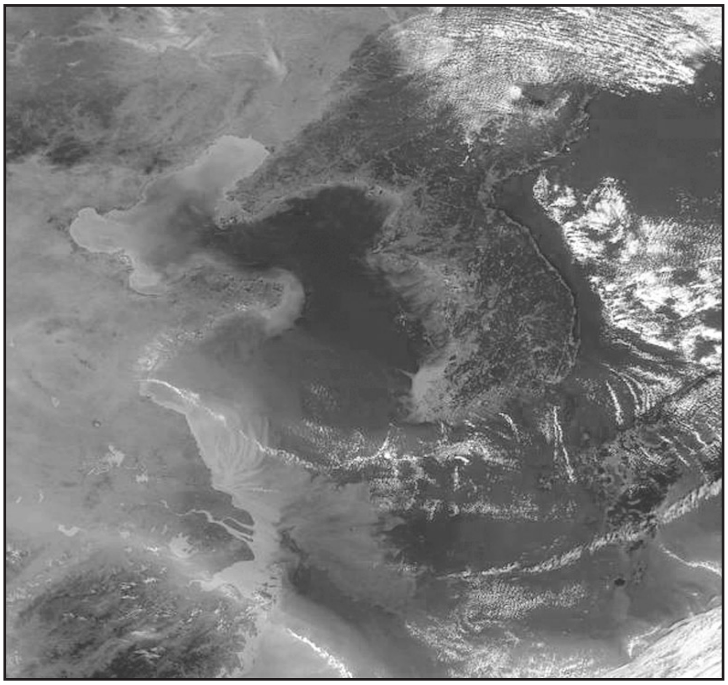
ODP results from the Sea of Japan and the South China Sea suggest that initial rifting of these marginal seas occurred between 30 and 35 Ma. This age is broadly consistent with the eastward extrusion of crustal blocks within Asia predicted by the basic tectonic extrusion model of Molnar and Tapponnier (1975). Although a first order correlation exists, the age constraints are insufficient to enable detailed, and thus, convincing comparison. Work in Tibet (e.g., Brown et al., 1998) is beginning to reveal strike-slip displacements far below the offsets predicted in the basic extrusion model, thus calling it into question. In addition, Sundaland—a large continent block comprising much of Borneo and the Malay Peninsula—has suffered strong deformation during the Cenozoic, counter to model expectations that it remained a rigid block. Finally, improved paleomagnetic constraints (e.g., Dupont-Nivet et al., 2002) on the motion of China and Indochina demonstrate rotation inconsistent with the extrusion model, thereby suggesting a more complex origin for the marginal seas.

The East Asian tectonic setting allows us to study the destruction of basins and passive margins as well as their formation. Taiwan is the best-documented example, in the modern global ocean, of a collision between an oceanic island arc and a passive continental margin. Such a collision is likely the dominant method by which active continental margins are initiated and continental crust grows. A key advance has been the recognition that northern Taiwan is experiencing extension and collapse along major detachment structures, culminating in the formation of the Okinawa Trough. As such, the trough may represent a new class of backarc basin in that it is controlled by collapse tectonics rather than trench rollback. Testing this hypothesis may be a prime target for IODP, by determining the nature and age of the basement to the Okinawa Trough through drilling.

Recent hypotheses (Clark and Royden, 2000) suggest that lower crustal flow accounts for much of the elevation of the Tibetan Plateau. Such flow, which does not result in significant upper crustal shortening, has important implications for understanding deformation within East Asia and sedimentation in the marginal basins. A 50 Ma erosional surface, essentially undeformed except for regional tilting, may be traceable onto the Tibetan Plateau. Drainage patterns suggest that the surface was deeply incised by gorges after 8 Ma and that drainage capture after the early Miocene may have led to the present pattern of rivers. If correct, these hypotheses imply significant changes in the provenance of sediment reaching the marginal seas since 10 Ma. Before this change in drainage, most Asian sediment would have been carried south by the Red River or towards the north by other Chinese rivers, a theory yet to be tested by deep drilling and dating of the major delta-fan complexes.

Paleoceanography

The sediments in the Asian marginal seas provide valuable paleoceanographic records because they accumulate at high rates (e.g., 870 m/my at ODP Site 1144) and thus better preserve carbonate microfossils and other pelagic materials. ODP and other piston cores show that surface water salinity, productivity, and bottom water oxygenation in the Sea of Japan have changed drastically over the past 300 kyr (Tada et al., 1999). These changes are closely linked, reflecting the influx of East China Sea Coastal Water (ECSCW), as well as the effects of changing eustatic sea level. Discharge from the Yangtze River is the major source of fresh water in ECSCW, most of which flows into the Sea of Japan. Because the riverine discharge has been strongly modulated by the Asian Summer Monsoon, the intensity of the monsoon indirectly influences the salinity and nutrient level of the surface water in the Sea of Japan. Recent studies indicate that summer monsoon intensity varies in association with Dansgaard-Oeschger Cycles (DOC) (Wang et al., 2001). The Sea of Japan appears to act as a nutrient trap for organic material delivered from the Yangtze and Huanghe rivers. The evolution of the Yangtze River discharge, and thus monsoon strength, could be reconstructed by future IODP drilling in the Sea of Japan that may document the organic carbon burial history during the Neogene. Tada et al. (1999) have already demonstrated that organic carbon-rich, dark layers were deposited in the Sea of Japan during DOC interstadials. Understanding the paleoceanographic



NASA satellite (MODIS) image of the Yellow Sea and the Bohai Sea, showing the plumes of sediment delivered by the Yellow and Yangtze Rivers. These rivers are some of the most important sources of fluvial sediment to the global ocean. While heavily influenced by human activity today, their historical discharge has been controlled by monsoon intensity and the progressive uplift of the Tibetan Plateau. River flux controls not only the stratigraphy of the marginal seas, but also the circulation of water and biogenic productivity in these seas and in the Sea of Japan.

effect of the Yangtze is important because water flux from this source has fallen due to human activity in China, and it will be further reduced by the Three Gorges Dam project. The effect of this change in Yangtze River discharge on the oceanography of the Sea of Japan is yet to be fully understood. This sea has also been acting as an eolian dust trap, and thus records the development of the winter monsoon. The relationship between the evolution of the summer and winter monsoons should be explored and correlated with the history of Tibetan uplift.

ODP results (Clift et al., 2002) from the northern margin of the South China Sea show that the clay mineral assemblage eroded from southern China changed prior to 15 Ma from smectite dominated to illite/chlorite dominated, indicating a switch from a dry to a wet climate. This switch in weathering regimes is probably linked to monsoon strengthening driven by the progressive uplift of the Tibetan Plateau prior to that time. Subsequently, carbonate dissolution strengthened and the thermocline depth shoaled around 11 Ma, possibly due to the closure of the Indonesian Seaway, forcing equatorial waters towards the north from the gateway into the South China Sea. Then, increases in biogenic productivity at about 7.8 Ma and 3.2 Ma were linked to further strengthening of the monsoon, reflecting additional Tibetan uplift around 8 Ma, and a link to global climatic deterioration prior to northern hemispheric glaciation around 3 Ma. In the southern South China Sea, a high-resolution isotopic study based on ODP Site 1143 has revealed 400-kyr eccentricity cycles in the oceanic carbon reservoir (Wang et al., 2003). The carbon reservoir changes preceded ice-sheet expansion in the Pleistocene, suggesting that low-latitude processes (e.g., monsoons) are modulating the glacial cycles though carbon reservoirs.

The West Pacific Warm Pool (WPWP) represents the largest surface water heat reservoir on Earth, and it plays a key role in regulating the global heat budget. The temporal and spatial variability of the WPWP is closely linked to the development of El Niño. The WPWP is partly governed by the Indonesian Throughflow, a stream of warm, low-salinity water from the Pacific to the Indian Ocean. Tectonic closure of the Indonesian Gateway since the middle Miocene has impacted circulation in the Pacific Ocean and thus global climate. Recent plate-tectonic reconstructions of SE Asia show that the Indonesian Gateway has been a region of intense tectonic activity from the middle Miocene to the present. A Pliocene restriction of the gateway, due to the northward displacement of New Guinea since ~5 Ma, may have switched the source of the throughflow waters from warm South Pacific to relatively cold North Pacific waters. Postulated consequences include decreased sea surface temperatures in the Indian Ocean, aridification of East Africa around 3 to 4 Ma, and reduced atmospheric heat transport from the tropics to high latitudes. These changes may have triggered rapid global cooling and the growth of ice sheets. Testing the timing of gateway closure and assessing its influence on regional climate will be a goal for future IODP operations in East Asia.

Future Research

The great sediment thicknesses on many of the continental margins bordering Asia have previously hampered the ability to sample long stratigraphic sections, extending back to the start of basin formation in this region. However, IODP will mark an important change in our ability to sample deep targets. The meeting made a series of recommendations for future drilling goals, which include the following.

1. To investigate the rift tectonics in the marginal seas, especially the South China Sea, and contrast them with both Atlantic vol-

continued on page 16

Drill Bits

Cite the Site

For scientific ocean drilling to survive and thrive, decisionmakers must be aware of its value. To accomplish this, every scientist should credit DSDP/ODP (and IODP in the future) as appropriate. To do this, simply follow the current policy about keywords and acknowledgements for any written material resulting from the use of Ocean Drilling Program (ODP) samples and data. The policy is presented below, and can be found on the ODP and JOI/USSSP websites. The bottom line: As you need ODP, ODP needs you! Therefore, when publishing, please include an appropriate keyword to credit.

Implementing this policy is important because the changes in the ODP publication policy over the years have meant that scientific results, even from immediate post-cruise research, largely reside in the external literature. Indeed, many influential publications may be published long after the immediate post-cruise research interval, and they often integrate across multiple sites, legs, and themes. This policy allows "you," the scientific community, to easily capture, demonstrate, and define the legacy of ODP and to find ODP-related publications through the GeoRef search engine. In other words, it is also in your own best interests (in more ways than one) to follow this policy!

Keywords. The words "Ocean Drilling Program", "*JOIDES Resolution*", "Leg ###" or "Site ##" (where ### is the leg or site number) should be used as one of the "keywords" provided to journal or book publishers of your manuscripts. This will allow the legacy of the ODP to be tracked by bibliographic databases (e.g., GeoRef).

Acknowledgements. "This research used samples and/or data provided by the Ocean Drilling Program (ODP). The ODP is sponsored by the U.S. National Science Foundation (NSF) and participating countries under management of Joint Oceanographic Institutions (JOI), Inc. Funding for this research was provided by ______________________."

(Note: fill in with this blank with the name of the appropriate funding agency).

ODP Highlights

Two full–color documents illustrating a few of the outstanding accomplishments of the international scientific ocean drilling community is now available from JOI. *Greatest Hits, Volume 2* is a web-based collection of key advances made by ODP since 1997, when the ever-popular *Greatest Hits* volume was published. *ODP Highlights*, a 32-page brochure, features a selection of "hits," scientific abstracts on microbiology, resources, climate change, architecture of the earth, and technology. It also includes a brief history of scientific ocean drilling, the "life of a core," a location map of all the ODP drilling legs, and a section addressing frequently asked questions.

This glossy legacy brochure is packed with information and resources, so we encourage you to share it with your colleagues and students. To obtain copies of *ODP Highlights*, contact: info@joiscience.org or download it from www.joiscience.org/greatesthits2. *Greatest Hits, Volume 2* will continue to evolve as scientific results from the final legs emerge. To submit an abstract, please contact Kasey White kwhite@joiscience.org.

ODP Celebrations

Plans are underway to celebrate the legacy of ODP at the final port calls in Bermuda, St. Johns, and Galveston, and in special events in Washington D.C. and San Francisco. In June, JOI/USSSP plans to sponsor a Capitol Hill reception during Oceans Week that will feature scientific advances made by ODP. The Bermuda and St. Johns port calls will include tours for local scientists and media, as well as special celebrations for the scientific advisory structure and operations staff, respectively. JOI is also in the initial stages of planning a celebration for ODP scientists during the AGU Fall Meeting in San Francisco. There will be an Ocean Drilling Day, with special sessions on ODP science, followed by a dinner, with special presentations and talks, open to all ODP scientists. Updates on these events will be announced in future newsletters and over the listserver.

Northern Highlight

Plans are underway to make proposed drilling in the heart of the ice-covered Arctic Ocean a reality in Summer 2004. A drilling proposal outlining the scientific goals of probing the Arctic's Lomonosov Ridge has been ranked #1 by JOIDES and by IODP's interim Science Advisory Structure (iSAS). In January 2003, the Europeans expressed their intent to spearhead the ambitious expedition, and plans are developing apace. In a collaborative effort, U.S. proponents have submitted a proposal to NSF/IODP for science operating costs. They should know the outcome in late May 2003. Meanwhile, a JOI/ODP contract with the Swedish Polar Secretariat to plan the expedition has been extended until February 2004.

The expedition is scheduled in August to September 2004 and will involve up to four vessels. Sweden will contribute their icebreaker *Oden*. Although a European Management Agency is yet to be selected, the British Geological Survey has been identified as an interim implementing organization for the expedition.

It will soon be clear whether the dream of Arctic Ocean drilling will occur in 2004.

Post-cruise scientist support

For everything you ever wanted to know about JOI/USSSP post-cruise science support, visit the JOI website at: www.joiscience.org/USSSP/SciSupport/SciSupport.html. The purpose of this funding support is to enhance the scientific output of the U.S. scientists involved with ODP, as well as to encourage the participation of a broader community of U.S. scientists in the future. JOI/USSSP supports costs associated with pre- and post-cruise scientific activities relevant to the drilling cruise and the preparation of contributions to the ODP *Scientific Results* volumes and/or to outside literature.

Data on all USSSP-sponsored participation in ODP and post-cruise research are now available in spreadsheet and html form at the website. These data include shipboard participation and USSSP post-cruise research awards. Send any comments or corrections to info@joiscience.org.

Wanted: IODP Science Proposals

The Integrated Ocean Drilling Program needs you!
Pre-proposals are encouraged.

For details, visit:
www.isas-office.jp

Next deadline:
October 1, 2003

ODP in the News

The purpose of this new feature is to highlight notable accomplishments of scientists in the ODP community.

The November 29, 2002 issue of *Science* included a perspective piece by **Ed Boyle**, Massachusetts Institute of Technology, and an articled authored by **Jess Adkins**, **Katherine McIntyre**, both of California Institute of Technology, and **Daniel Schrag**, Harvard University. Boyle's piece was titled "Ocean Salt Switch," and the Adkins et al. article was titled "The Salinity, Temperature, and $\delta^{18}O$ of the Glacial Deep Ocean." The latter used data from ODP Legs 162, 172, 177, and 181.

On December 7, 2002, *Science News* published an article on ocean observatories entitled "Ocean View: Scientists Are Going 24-7 in Their Studies of the Deep." This article quoted JOI Board of Governors Chair **Bob Detrick**, WHOI, and JOIDES SCICOM Chair **Keir Becker**, University of Miami.

The March 14, 2003 edition of *The Washington Post* highlighted an article titled "No Cataclysm Brought Down Maya." **Gerald Haug**, Potsdam Geoscience Center in Germany, and colleagues studied climate records preserved in ODP Leg 165 cores from the Cariaco Basin off Venezuela. They found evidence of significant regional droughts during the same time period in which Mayan civilization dramatically declined, suggesting that environmental stress may have contributed to the chaotic times in Mayan history.

At the 2002 fall meeting of the American Geophysical Union, **John Tarduno**, University of Rochester; **David Scholl**, USGS-Menlo Park; and **Bob Duncan**, Oregon State University, held a press conference to present results of ODP Leg 197 on hotspots. *The San Francisco Chronicle*, among other newspapers, has indicated that it plans to write a story on this topic.

Anil Gupta, Indian Institute of Technology, **David Anderson**, NOAA, and **Jonathan Overpeck**, University of Arizona, co-authored an article entitled, "Abrupt Changes in the Asian Southwest Monsoon during the Holocene and Their Links to the North Atlantic Ocean" in the January 23, 2003 issue of *Nature*. Their research was based on samples from Site 723, ODP Leg 117 "Oman Margin."

The January 2003 issue of *Sea Technology* published an article titled "ODP Installs Long-Term Observatories off Costa Rica." The article extensively quoted **Julie Morris**, Washington University, who was a Co-Chief Scientist on Leg 205, and mentioned other members of the Leg 205 shipboard scientific party.

In the February 21, 2003 issue of *Science*, **Kai-Uwe Hinrichs**, **Laura Hmelo**, and **Sean Sylva**, WHOI, co-authored an article titled "Molecular Fossil Record of Elevated Methane Levels in Late Pleistocene Coastal Waters." Their research used samples from ODP Leg 146, Site 893 in the Santa Barbara Basin.

And last, but not least, don't miss **Richard Kerr's** recent article on the Integrated Ocean Drilling Program in the April 18, 2003 issue of *Science*.

To help make "ODP in the News" a permanent feature of the *JOI/USSAC Newsletter*, send recent accomplishments and citations of ODP-related publications to Kasey White (kwhite@joiscience.org).

a n n o u n c

Visit the

IODP/ODP Exhibit Booth

Oceanology International

New Orleans, Louisiana
June 4-6, 2003

and

IODP Exhibit Booth

IUGG

International Union of Geodesy and Geophysics
Sapporo, Japan
July 1-4, 2003

for the latest news about ODP and IODP

Call for Interest and Nominations to the IODP Science Advisory Structure

USSAC invites expressions of interest and nominations to serve in the Science Advisory Structure (SAS) of the new Integrated Ocean Drilling Program (IODP). At its July 2003 meeting, USSAC will set rotation schedules for U.S. SAS members and appoint new SAS members where needed. The SAS includes the Science Planning Committee (SPC), an Operations Committee (OPCOM), two Science Steering and Evaluation Panels (SSEPs), a Scientific Measurement Panel (SciMP), a Site Survey Panel (SSP), a Pollution Prevention and Safety Panel (PPSP), a Technology Advice Panel (TAP), and an Industrial Liaison Panel (ILP). USSAC will also consider nominations for the U.S. Co-Chair of the SPC. Committee/Panel mandates and functions can be found at www.isas-office.jp. U.S. members will serve staggered three-year terms beginning October 1, 2003, the start of IODP.

If you are a U.S. scientist interested in representing the U.S. ocean drilling community in the IODP SAS, please send a two-page CV and a cover letter to: Margo Cortes at mcortes@joiscience.org. Successful nominees should have a demonstrable record of scientific leadership and a keen interest in ODP/IODP science and related activities. The nomination deadline is **June 25, 2003**.

For more information about this opportunity, please visit www.iodp.org or contact Warren Prell, USSAC Chair, at warren_prell@brown.edu.

GeoSCAN
Geophysical Site Characterization And Needs

A workshop jointly sponsored by JOI/USSSP and Industry
June 6, 2003 Houston, TX

One of the challenges facing the Integrated Ocean Drilling Program (IODP) is the geophysical surveying needed to help provide the scientific basis for drilling, and to characterize specific drilling sites. To address this topic and related issues, JOI/USSSP is jointly sponsoring a one-day workshop with Industry for interested members of the scientific community, to be hosted by British Petroleum in Houston, TX.

Purpose: To learn how geophysical surveying for drilling is conducted by Industry, and to discuss how the academic community can feasibly acquire seismic data of appropriate quality for IODP.

Goals: (a) To learn from Industry the critical considerations for acquisition, processing, and interpretation of high-quality 3-D seismic data. (b) To discuss how to feasibly acquire and process data to fulfill the IODP panel needs for the different platforms available in IODP. (c) To produce a white paper with recommendations to NSF on ways and resources necessary to acquire and process geophysical data appropriate for IODP needs.

Participation: This focused meeting will be attended by industry representatives and approximately 30 members of the academic geophysical community. Student participation is encouraged. To apply, please send a one-paragraph expression of interest (EOI) by **May 5, 2003** to Nathan Bangs, The University of Texas Institute for Geophysics (nathan@utig.ig.utexas.edu).

Limited JOI/USSSP support is available to U.S. Participants.

U.S. Shipboard Science Participants

Leg 207: Demerara Rise

TAMU Staff Scientist: Mitchell Malone
Debora Berti, Texas A&M University
Karen Bice, WHOI
Tom Janecek, Florida State University
Chris Junium, Penn State University
Ken MacLeod, Univ. of Missouri, Columbia
Philip Meyers, University of Michigan
Richard Norris, WHOI
James Ogg, Purdue University
Matthew O'Reagan, URI
Helen Sturt, WHOI
Sherwood Wise, Florida State University

Leg 208: Walvis Ridge

U.S. Co-Chief: James Zachos, UC, Santa Cruz
TAMU Staff Scientist: Peter Blum
Julie Bowles, Scripps Inst. of Oceanography
David Hodell, University of Florida
Susan Keller, UC, Santa Cruz
Daniel Clay Kelly, UW, Madison
Kyger Casey Lohman, University of Michigan
Micah Nicolo, Rice University
Christina Riesselman, Stanford University
Stephen Schellenberg, UC, Santa Cruz
Deborah Thomas, UNC, Chapel Hill
Ellen Thomas, Wesleyan University

Planning Workshop for Future Scientific Drilling of the Indian Ocean Submarine Fans

A Workshop Sponsored by: JOI/USSSP
July 23-25, 2003
The University of Colorado, Boulder

Purpose: The Indian Ocean submarine fans—the thickest and most extensive sedimentary bodies in the modern oceans—record the uplift and erosion of high topography following the India-Asia collision as well as subsequent changes in regional and global climate. This workshop will develop a science plan to study the fans in the context of the Integrated Ocean Drilling Program. Drilling objectives for both riser and non-riser drilling will be discussed, together with associated geophysical surveys.

Participation: Scientists working on tectonics, geomorphology, clastic sedimentology, stratigraphy, paleoceanography, and paleoclimate are encouraged to apply.

To Apply: Contact workshop conveners Peter Clift (pclift@whoi.edu; 508-289-3437) or Peter Molnar (molnar@cires.colorado.edu; 303-492-4936) by **May 1, 2003** with the following information: name, institution, contact information, a short (2-page max) CV, and a brief (half-page) statement of interest, including your potential contributions.

Limited JOI/USSSP support is available to U.S. participants.

For additional information, visit the workshop website at:
www.whoi.edu/pclift/IODP_IndianFans.html

Call for Interest and Nominations to USSAC

JOI is seeking nominees for the U.S. Science Advisory Committee (USSAC). USSAC provides guidance to JOI in managing the U.S. Science Support Program (JOI/USSSP), which supports U.S. participation in the current Ocean Drilling Program (ODP) and anticipates support for the new Integrated Ocean Drilling Program (IODP). At its July 2003 meeting, USSAC will nominate new USSAC members to be appointed by the JOI Board of Governors. The three-year term for the new USSAC members will begin October 1, 2003, the start of IODP.

If you are a U.S.-based scientist interested in serving on USSAC, please send a two-page CV and a cover letter to: Margo Cortes at mcortes@joiscience.org. Successful nominees should have a demonstrable record of scientific leadership and a keen interest in ODP science and related activities. The nomination deadline is **June 25, 2003**.

For more information about this opportunity, please visit www.joiscience.org/USSSP or contact Warren Prell, USSAC Chair, at warren_prell@brown.edu.

Schlanger Ocean Drilling Fellowship

In February 2003, USSAC's fellowship panel considered 17 fellowship proposals and granted three one-year shorebased awards.

Joshua Feinberg, University of California, Berkeley
"Magnetization of seafloor gabbros: Characterization of crystallographically oriented magnetite inclusions in silicates" (ODP Legs 118 and 176; Site 735)

Stephanie Healey, University of South Carolina
"A 500,000-year record of deep-sea temperature and ice volume based on benthic foraminiferal Mg/Ca and $\delta^{18}O$" (ODP Legs 138 and 172)

Ivan Savov, University of South Florida
"The role of forearc in subduction zone chemical cycles: Elemental and light isotope signatures of serpentinites from South Chamorro and Conical Seamount." (ODP Legs 125 and 195)

The next fellowship application deadline is
November 15, 2003
For more information, visit:
www.joiscience.org/USSSP/fellowship/fellowship.html

Call for Contributions

Contributions and ideas for the *JOI/USSAC Newsletter* are always welcome!

Please contact Andrea Johnson: ajohnson@joiscience.org.

Requirements for Robotic Underwater Drills in U.S. Marine Geologic Research

contributed by William Sager, Henry Dick, Patricia Fryer, and H. Paul Johnson

Twenty-five scientists and engineers, representing a variety of academic institutions and scientific interests, met on November 3-4, 2000, to discuss ways to make robotic underwater drills readily accessible to academic scientists. Although there were attendees from Europe and Canada, the primary focus of this NSF-funded workshop, co-sponsored by USSSP, was on the needs of U.S. marine geologic research. Following keynote presentations about past or existing drill systems, the attendees addressed the following questions:

1. What science problems require or would benefit from robotic underwater drills?
2. What capabilities and specifications are required to accomplish the science goals?
3. How many and what types of drills are needed?
4. How should robotic drills and their technical staff be supported?
5. How can a drill become a "proven" tool?

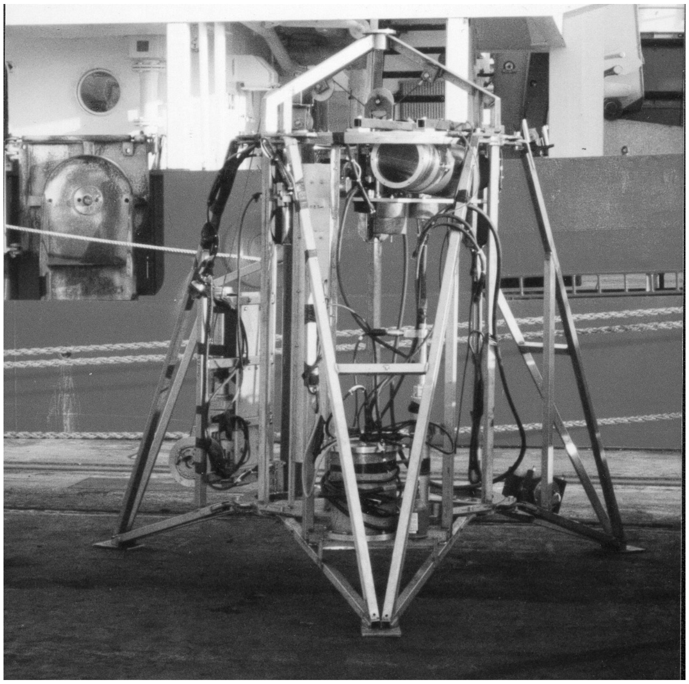
A broad spectrum of science applications was represented, including:

- sampling of the ocean crust at ridge-crests, transform faults, and megamullion complexes;
- sampling of seamounts and large igneous provinces; acquisition of oceanic paleomagnetic data;
- sampling of hydrothermal deposits, continental margin sedimentary deposits, carbonate banks, gas hydrate, and sediment cores for paleoceanographic studies.

Some scientists spoke of using arrays of small holes to install of seismometers and strainmeters for earthquake investigations, instruments to measure fluid flow in hydrothermal and other hydrologic cells, as well as to conduct geochemical studies of vent effluents. One scientist wished to recover cores from beneath the Antarctic ice sheets. Others were interested in sampling microbes inhabiting the sedimentary or igneous layers just beneath the seafloor.

In many cases, although seafloor samples might be obtained using a drill ship, the *JOIDES Resolution* was either inappropriate or unavailable for the project. Several scientists spoke of the frustration of working for years to obtain a place in the Ocean Drilling Program (ODP) operations schedule for their science program only to learn that there was not enough drilling time to address more than a small number of projects. Others found that the drill ship was either inefficient or incapable of addressing their scientific problem. For example, the *JOIDES Resolution* cannot operate safely atop carbonate banks in shallow waters or in ice-covered waters. Other applications—such as drilling beneath polar ice or in land-locked lakes—are impossible with a conventional drill ship.

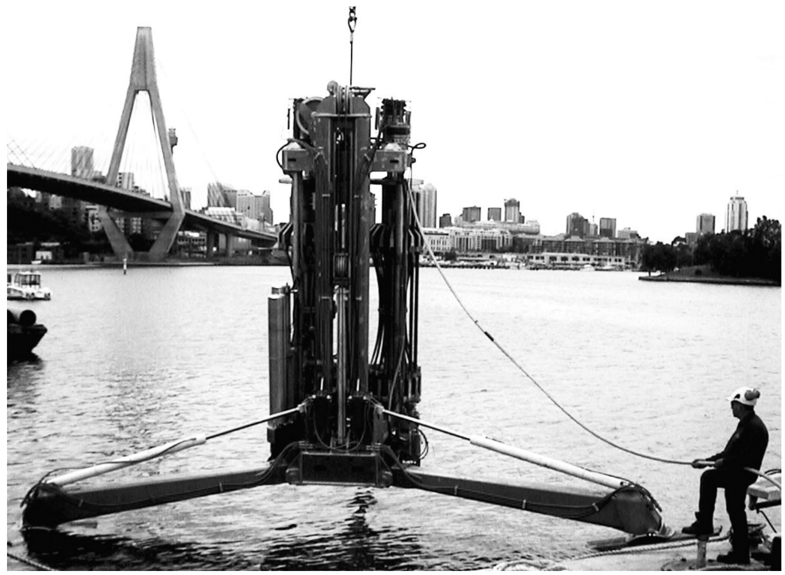
Most attendees shared a similar vision for underwater "robotic drills," devices that can be launched from the deck of a ship (or a platform) and lowered to the seafloor where they land and drill cores before being raised back to the surface. It was noted that several underwater drills have previously been built, but for one reason or another they were unavailable to the U.S. scientific community, their capabilities did not allow them to address some significant scientific problems, or they were not considered a "proven" tool. After considerable discussion, the group



The BRIDGE drill, operated by the British Geological Survey, is an example of the "mini" drill. It is approximately 1.5 m in height and weighs 900 kg in air. It operates from a standard 0.68-in cable, can drill a core 35 mm in diameter, 1 m in length, and can operate in water depths of at least 4500 m.

consensus was that there should be a large drill available that would address most scientific problems and two to three smaller, "niche" drills that are cheaper and more transportable for special applications.

The large Robotic Ocean BOttom (ROBO) drill was envisioned with the capability to drill in water depths of 3500 to 4500 m, to core 50 to 100 m beneath the seafloor, to take either hard rock or sediment cores, to install casing, and to be transportable and functional on the largest academic research ships. A smaller 3 to 5 m ROBO drill, designed to be simpler to use and handle, cheaper to operate, and more easily transported, would attack science problems that do not require deep penetration. For ready availability, several even smaller "mini" ROBO drills, with ~1 m penetration capability, were envisioned to be a part of the shipboard equipment pools of several academic institutions. These drills would be used primarily for programs where only small samples were needed, or where logistics and costs dictated that the drilling was an ancillary activity on a particular cruise. Finally, an ROV-mounted drill was seen as a necessary element of the robotic drill fleet because none of the other drills would be able to core vertical or steeply-dipping outcrops and because some applications would require a highly maneuverable drill with excellent imaging capabilities. The workshop attendees expressed greatest support for the largest and smallest drills. The 3 to 5 m drill fits the niche for which a scientist requires cores longer than 1 m, but logistics or costs make large drill use infeasible. Such a drill would gain greater support if a large drill were never built, but would lose support if the smallest drills could be stretched to several meters penetration capability. Currently, two investigators are proposing construction of an ROV drill and a mini drill. We know of no academic efforts to build a larger drill.



The PROD drill, operated by Benthic GeoTech Pty., Ltd., an Australian consortium, has the capability of penetrating to a depth of 100 m below the seafloor. It remotely assembles a drill string from joints stacked in rotary rack. It is 5.8 m in height, weighs 10 tons in air, and drills a 35-mm diameter core. Currently this drill is limited to water depths less than 2000 m.

The issue of how to support robotic drills was one of wide concern. To be successful, robotic drills must be routinely maintained, operated by trained technicians, and properly administered to ensure availability and continuity. The workshop attendees placed a high value on open access and capable maintenance. It was agreed that this is generally not possible with sporadic support to an individual investigator or small group of investigators. Therefore, the consensus was that there should be a robotic drill facility that would house, maintain, and operate the large ROBO drills and 3 to 5 m ROBO drill. Furthermore, the technicians employed by this entity would be a resource for expertise in maintenance and improvements of the micro-ROBO drills and ROV drills, which would be part of different equipment pools. Conference attendees also expressed concern about the high hurdles to drill development in a conservative, peer-review system. For instance, great expectations for immediate success and short grant durations might force a drill developer to prematurely bring a drill online that is not yet ready for routine operations. This potential situation might give the impression that the drill does not work properly, making continued support difficult to obtain. Therefore, a realistic, long-term plan to build one or more drills is necessary to develop them properly.

For a full report, visit www.joiscience.org/Workshops/Workshops.html

The Authors

Will Sager, Texas A&M University; Henry Dick, Woods Hole Oceanographic Institution; Patricia Fryer, University of Hawaii; and H. Paul Johnson, University of Washington.

Foram Mg/Ca Ratios Shed Light on the "Cool Tropics" Paradox

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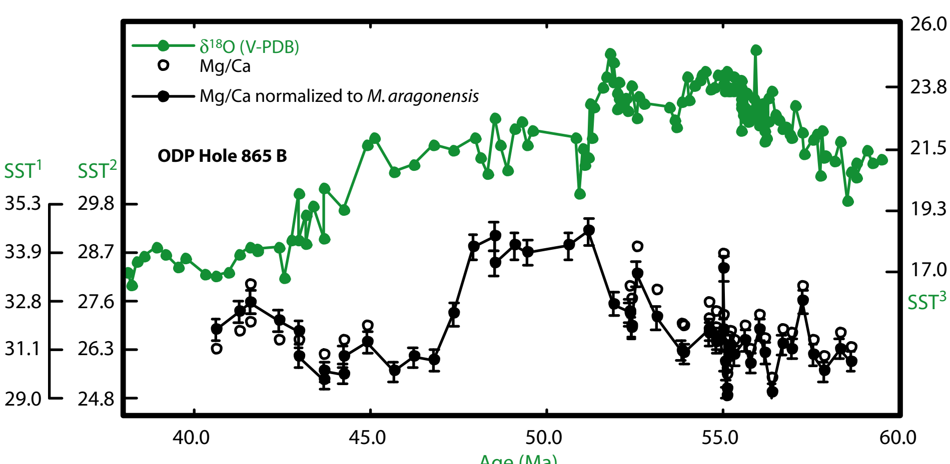
UC, Santa Cruz

Faculty Advisors
James Zachos
Margaret Delaney

Tropical sea surface temperatures (SSTs) during hypothesized "greenhouse" periods are an ongoing controversy in paleoceanography, with existing proxies yielding conflicting results. My fellowship research focused on a recently refined SST proxy, the Mg/Ca ratio of planktonic foraminifera. My objectives were to: 1) estimate absolute calcification temperatures and their long-term changes, and 2) assess the implications of foraminiferal Mg/Ca with respect to the conflict between existing proxy data and the origin of the "cool tropics" paradox.

SSTs have been reconstructed for the early Paleogene from both shallow-marine sequences (SMS) and from deep-sea sediments (DSS). The SMS records, which indicate stable and warm SSTs, are based on the $\delta^{18}O$ of planktonic foraminifera, faunal data, and coastal mollusc data. In contrast, the DSS records, also based on foram $\delta^{18}O$, indicate long-term tropical cooling of 7-8 C°. The discrepancy may stem from several factors. Recrystallization of the DSS foram tests may bias the $\delta^{18}O$-based SSTs towards cooler values. Alternately, because SST calculations are based on the salinity of the waters in which the foram lived, inaccurate estimates of salinity at either the DSS or SMS sites would affect results. Finally, the differences in SSTs may reflect true variations in temperature between the two geographic regions.

I measured the Mg/Ca in planktonic forams belonging to the extinct genus *Morozovella* from ODP Site 865 (Leg 143), in the western central Pacific Ocean, in sediments deposited 40.6 to 58.6 Ma. To calculate calcification temperatures, I assumed that the systematics governing the partitioning of magnesium are similar to those in modern taxa and I applied empirical Mg/Ca-temperature calibrations. I also assumed that carbonate dissolution had minimal impact on the results, as the paleodepths of Site 865 are estimated to have always been at least 1700 m above the carbonate compensation depth. Recrystallization may have impacted foram chemistry. Calculated diagenetic trajectories for Mg/Ca and Sr/Ca indicate up to 20-30% secondary calcite, using effective partition coefficients calculated at deep-sea sites (Baker et al., 1982). This implies that there may be a cool bias of up to 4 C° in Mg/Ca-reconstructed SSTs, and one of 4-6 C° in $\delta^{18}O$-reconstructed SSTs. Finally, absolute temperatures are sensitive to the seawater Mg/Ca ratio used. Though early Paleogene seawater Mg/Ca may have been offset from modern values, different histories of seawater Mg/Ca predict relatively constant values between 40.6 to 58.6 Ma (Wilkinson and Algeo, 1989).



[1]Mg/Ca-based paleotemps (Wilkinson & Algeo, 1989)
[2]Mg/Ca-based paleotemps assuming constant seawater Mg/Ca during Cenozoic
[3]$\delta^{18}O$-based in paleotemps (Bralower et al., 1995)

Mg/Ca values from Site 865 (see figure) resemble modern values for tropical/subtropical forams. Assuming constant Cenozoic seawater Mg/Ca ratios (5.1 mol/mol), I calculate calcification temperatures of 25-29°C. Using a model for secular changes in seawater Mg/Ca (3.0-3.5 mol/mol; Wilkinson and Algeo, 1989) that is driven by changes in overall hydrothermal activity and seafloor spreading rates, I calculate calcification temperatures ranging from 30 to 34°C. Long-term warming is observed into the early Eocene (54.8 to 49.0 Ma), with peak tropical SST estimated between 51.2 and 48 Ma and rapid cooling of 4 C° observed at 48 Ma.

My results imply relatively constant and warm tropical SSTs during the early Paleogene, similar to or warmer than modern SSTs, and consistent with the SMS proxy data (see references in Tripati and Zachos, 2002). These findings are inconsistent with the cool SSTs based on foram $\delta^{18}O$ estimated for Site 865 (Bralower et al., 1995) and other deep-sea sites (Savin, 1977; Zachos et al., 1994). The discrepancy between the Mg/Ca and $\delta^{18}O$-based calcification temperatures are likely due to the combined effects of diagenesis and salinity on $\delta^{18}O$.

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Exploring the Pleistocene Evolution of the East Antarctic Ice Sheet

Kevin Theissen
Ph.D. Institution
Stanford University

Faculty Advisor
Robert Dunbar

The East Antarctic Ice Sheet (EAIS) is the largest ice mass on earth and is of great importance to the global climate system. The Neogene size and stability of the EAIS has been variously interpreted and recent investigations—such as ODP Leg 188 in Prydz Bay, East Antarctica—have sought direct sedimentary evidence for changes in EAIS extent from the continental margins. To better characterize the EAIS during the Quaternary, I measured stable isotopes in *Neogloboquadrina pachyderma* (s.) planktonic foraminifera from ODP Hole 1167A drilled in the Prydz Channel Trough Mouth Fan, and examined the sedimentary record left by the Lambert Glacier Amery Ice Shelf System which drains ~16% of the EAIS. The isotopic record spans the Pleistocene and suggests long-term cooling and ice volume increase interrupted by at least one warm interglacial near the Mid-Pleistocene Transition (Theissen et al., in revision).

Trough mouth fans (TMFs) are paleoclimate archives that record glacial to interglacial transitions as changes from thick, coarse-grained debris flows deposited during periods of maximum ice sheet extent to thinner, hemipelagic clay intervals, deposited during ice-free conditions (Vorren and Laberg, 1997). The potential for slumps, unconformities, and other disturbances makes TMF depositional environments difficult to study. But the $\delta^{18}O$ record from Hole 1167A shows evidence of regular glacial-interglacial cycles. Comparison of resistivity values with the $\delta^{18}O$ values shows their similarity and indicates a relationship between TMF sedimentation and climatic factors (temperature, ice volume) (see figure).

Evidence for a "warm" interglacial based on $\delta^{18}O$ values that are lower than those measured in Holocene *N. pachyderma* specimens is supported by the presence of hemipelagic clay intervals at the same stratigraphic depths. Based on the available age control, this interglacial occurred between 0.9 and 1.38 Ma. Determining its exact timing would require better age control, but a 2-m-thick shelly, carbonate bank unit recovered in western Antarctica during Cape Roberts Project drilling suggests a particularly warm interglacial at ~1.07 Ma that may have been globally important (Marine Isotopic Stage 31) (Taviani and Claps, 1998; Scherer, 2002).

I closely examined the upper 50 m of the record after recognizing apparent glacial-interglacial cycles. There are only two cycles (MIS 16-19) recorded between the B/M paleomagnetic reversal (780 Ka) and a much younger age date near the top of the hole (36.9 Ka) implying a significant unconformity. This hiatus is undoubtedly due in part to erosional unconformities, but it may also indicate a significant reduction in the number of extreme advances of the ice sheet across the Prydz Bay Shelf (O'Brien et al., submitted). Other evidence from Leg 188, and from Antarctic continental records, reveal lowered sedimentation rates through the Neogene. This suggests that the EAIS has had fewer extreme advances, either because of climatic change (i.e., change in precipitation patterns) or due to changes in ice sheet movement (i.e., shelf excavation and entrenchment of the ice sheet).

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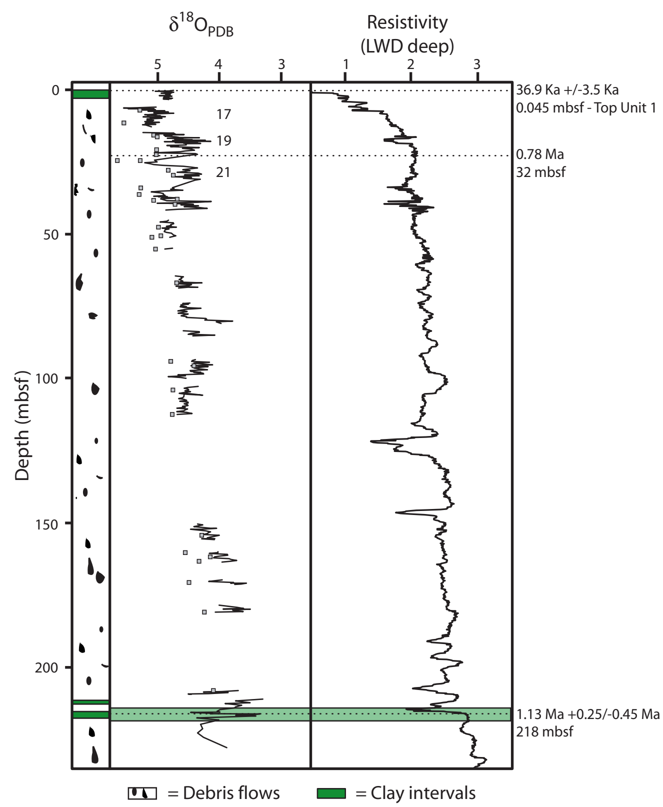

Oxygen stable isotopic values for *N. pachyderma* (s.) and resistivity values from Hole 1167A. Squares show limited $\delta^{18}O$ results for benthic forams (*G. Crassa*). Heavier $\delta^{18}O$ values indicate increased ice volume/colder temperatures. Only a few thin, clay intervals were recovered, but low-resistivity spikes indicate others. Higher $\delta^{18}O$ values (glacial intervals) tend to occur in debris flows (higher resistivity) while lower $\delta^{18}O$ values (interglacials) tend to occur with clay intervals (low resistivity). Suspected interglacial MIS numbers are noted for the upper 32 mbsf. The green area shows the inferred warm interglacial.

Continent-Ocean Interactions continued from page 7

canic and non-volcanic margins. Samples of the basement will allow us to constrain the loss of lower crust from under conjugate margins during break-up, testing models for strain accommodation.

2. To investigate the arc-continent collision zone of Taiwan and especially the formation of the Okinawa Trough. As the most dramatic arc-continent collision zone in the modern oceans, constraining its geodynamic evolution is significant for understanding the origin of the continental crust and the formation of active continental margins.
3. To study the delta and deep-sea fan complexes associated with the great rivers of East Asia (i.e., the Mekong, Red, Pearl, Yangtze and Yellow), which may record Tibetan topographic uplift, climate change, and the subsequent erosional response. The region is the single largest source of fluvial material to the oceans, yet its influence on global ocean chemistry and climate is poorly known.
4. To probe the carbonate reefs of the South China Sea, which may record high-resolution climate and sea-level change during the Neogene, including initiation of the WPWP.
5. To drill the Sunda Shelf to establish the long-term history of Neogene climate and sealevel changes and their relationships to atmospheric processes where the greatest ocean-atmosphere transfer of heat and moisture occurs.

Success in meeting these goals will require long-term commitment and planning by scientists from many disciplines working together with colleagues throughout the East Asian region.

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References

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One Year Down, One Year to Go

continued from page 5

On March 17, 2003 the R/V *Thompson* and the ROV *JASON 2* sailed eight hours from Guam to ODP Site 1200. The purpose of this cruise was to download pressure and temperature data and recover the data logger, thermistor string, and OsmoSamplers. This operation, which is jointly funded by NSF and JOI/USSSP, represents the first CORK-related mission for *JASON 2*. Daily updates of this operation are posted on the web at www.soest.hawaii.edu/expeditions/Mariana2003. Stay tuned!

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References

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Links Between the Ocean Observatories Initiative and the Integrated Ocean Drilling Program

A workshop sponsored by JOI/USSSP and NEPTUNE
July 17-18, 2003, Seattle, Washington

Purpose: To articulate the common scientific goals of the Ocean Observatories Initiative (OOI) and the Integrated Ocean Drilling Program (IODP), and to identify essential experiments and technologies to achieve them. The IODP planning structure is now being established, and an OOI community meeting is being planned for early 2004 to help craft the OOI Initial Science Plan, including coastal, regional, and global components. In addition to exploring links, we seek to enhance communication between OOI and IODP communities, and to encourage participation in both programs by a diverse group of scientists, technologists, and educators.

Participation: JOI/USSSP will provide partial travel support for a limited number of U.S. participants. International participation is invited. Young scientists and those who have not been involved previously in IODP or OOI are encouraged to apply. Information, logistical details, and applications for the IODP-OOI workshop are available at: www.neptune.washington.edu/pub/workshops/IODP_OOI/

Applications will be accepted until May 16, 2003. Please contact Andy Fisher (afisher@ucsc.edu) or Kevin Brown (kmbrown@ucsd.edu) with questions.

Educational Resources

Email info@joiscience.org
to receive free educational materials.

Gateways to Glaciation CD-ROM
ODP: From Mountains to Monsoons CD-ROM
Blast From the Past Poster

Don't Get Lost!

Send subscription requests and address changes for the *JOI/USSAC Newsletter*, *JOIDES Journal*, and JOI/USSSP email listserve to: info@joiscience.org

Thinking About Tomorrow

Don't stop, thinking about tomorrow, Don't stop, it'll soon be here,
It'll be, better than before, Yesterday's gone, yesterday's gone.

Why not think about times to come, And not about the things that you've done,
If ODP was good to you, Just think what IODP will do.

Paraphrased from *Don't Stop,* Fleetwood Mac

The recent USSAC and iPC meetings certainly brought the above thought to the forefront of our consciousness. At its next meeting, the interim Planning Committee (iPC) will morph into the IODP Science Planning Committee (SPC). At this same meeting, the SPC—as the highest science planning committee in the IODP structure—will rank proposals for non-riser coring/drilling in 2004!! The planning process has been accelerated even more by the recent NSF solicitation for an IODP Systems Integration Contractor to start Phase I non-riser coring by mid-2004. We anticipate that the NSF solicitation for the U.S. Science Support Program (USSSP) will follow within a few months, and that by the July USSAC meeting, NSF will have selected the U.S. Systems Integration Contractor and likely the USSSP implementer. USSAC is working toward ensuring that the recommendations from the CUSP report are embedded in any responses to the NSF.

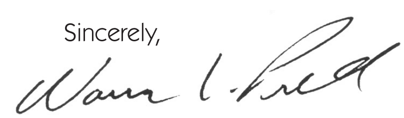
At USSAC's February meeting, we addressed new protocols for staffing U.S. scientists on IODP expeditions and for enabling U.S. scientists to develop long-term planning groups for especially complex or long riser drilling programs. We anticipate that these recommendations will be an integral part of the new USSSP. We are also exploring USSAC's role in education and outreach in the IODP. A workshop on May 6-7 (see www.joiscience.org/) will seek to identify the productive ways that USSAC can enable the exciting ODP/IODP science to be better incorporated into science curriculums and the public domain. We welcome your thoughts on these important topics.

One of the results of the new IODP Science Advisory Structure (SAS) is that the U.S. will need more scientists to serve on panels and committees. We extend an invitation (see announcement on page 10) for you to become intimately involved in the planning and implementation of the IODP. At its July meeting, USSAC will be setting the rotation schedule for all IODP panels, replacing members whose term has expired, and naming additional members to all panels and committees. We anticipate that each panel will have seven U.S. members. This is a prime opportunity to get in on the ground floor of planning for the next decade of ocean drilling. At the July meeting, nominations will also be made to replace four USSAC members whose terms expire September 30, 2003. The announcement for USSAC participation (page 11) seeks the broadest representation of the ocean drilling community. This is an excellent opportunity to participate in advising and planning many of the U.S. activities associated with the IODP.

As I indicated in the last newsletter, USSAC is in the process of becoming a more continuously operating national committee for the U.S. IODP community. USSAC members have agreed to serve as a pool of alternates for SAS panels and USSAC is developing standing subcommittees on IODP staffing, IODP nominations, education and outreach, and workshops/site augmentation. These subcommittees will enable USSAC to respond more quickly and develop a better corporate memory of the many activities that will occur in the more complex IODP

We are thinking about tomorrow and we invite you to do the same. Apply for a SAS panel or USSAC. Join the planning process for a bigger and better IODP.

Sincerely,



Warren Prell
Chair, USSAC

News and Views from NSF

contributed by J. Paul Dauphin, Program Director, NSF/ODP

Since the last *JOI/USSAC Newsletter*, Congress has passed the 2003 budget and the U. S. National Science Foundation (NSF) is no longer operating on a continuing resolution. Overall the NSF budget has seen an increase and how this increase translates itself at the program level remains to be seen. One of the consequences of not having a budget was a delay in our ability to release the Request for Proposal (RFP) for the U.S.-provided assets to the Integrated Ocean Drilling Program (IODP). The RFP has been released and can be viewed and downloaded at: www2.eps.gov/spg/NSF/DCPO/CPO/DACS-03-00001/Attachments.html.

The contract resulting from this RFP will be for the services of a System Integration Contractor (SIC) to provide long-term management and support of scientific and engineering capabilities, as well as shipboard and shore based scientific and staff support for the IODP. A principal task of the SIC will be to acquire, convert, and operate the non-riser drilling vessel for scientific research purposes. Because funds for conversion were not included in the President's Fiscal Year 2004 (FY04) budget request by NSF, this task will have to be separated into two phases. Subsequently, funds for vessel conversion are projected for inclusion in NSF's Major Research and Equipment and Facilities Construction Account (MREFC) for FY05.

The first phase of the SIC's task will include acquiring an acceptable vessel that will not require substantial modification for scientific ocean drilling operations during the initial period of the program. MREFC funds should become available in FY05 for the second phase to acquire/lease, convert, and equip a vessel for operations during the remainder of the program. This vessel is intended to meet or exceed the characteristics required by the scientific community and identified in the Conceptual Design Committee (CDC) report, which can be seen at www.joiscience.org/USSSP/cdc/.

Meanwhile, the U.S. NSF and the Ministry of Education, Science, Sports, and Technology (MEXT) of Japan are nearing the completion of a Memorandum that defines their relationship as co-equal lead agencies in the IODP. Formal signing of this document is anticipated in April in Japan. NSF and MEXT—as the IODP lead agencies—will also begin developing memoranda for IODP membership with interested countries or consortia. Associate membership discussions will follow.

Since the last time we reported on field programs supported by NSF/ODP, three new unsolicited proposals have been selected for support. These include:

1) A study of South Pacific Eocene paleoceanography. Mitch Lyle (Boise State Univ.) will lead this effort for which a coring and seismic profiling transect across the Eocene sub-Antarctic front in the south central Pacific Ocean is proposed.
2) A project to acquire high-resolution paleoceanography data from sediments deposited since the last Glacial Maximum from Alaskan Fjords and Continental Shelf. Allan Mix (Oregon State University) will lead this endeavor.
3) A study of eustatic and tectonic forcing on the development of forearc basin sequence stratigraphy. This study, led by Craig Fulthorpe (The University of Texas), will attempt to separate signals derived from sea level and tectonic activity in sediments on the Nicaraguan and Costa Rican active margins.

Two positions at NSF in the Ocean Drilling Program will become available soon so we urge you to consider serving your science community here in Arlington, VA. The Associate Program Director rotator position now occupied by Brad Clement will become vacant by the end of July this year and the ODP Program Director position now held by Paul Dauphin will become vacant by the first of October. Detailed announcements are available at the following URL: www.nsf.gov/oirm/hrm/jobs/. Applications for these positions are currently being accepted with closing expected in early May for the rotator position and mid-May for the Program Director position.

Position Openings

Associate Program Director for Ocean Drilling

This position will be filled on a visiting scientist, temporary, or IPA basis.

For application information: www.nsf.gov/pubs/2003/e20030043/e20030043.txt

Closing date 5/06/03

Associate Program Director/Program Director for Ocean Drilling

This is a permanent position.

For application information: www.nsf.gov/pubs/2003/e20030045/e20030045.txt

Closing date 5/13/03

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JOI/USSAC newsletter

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Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of NSF or JOI. To subscribe, contact: JOI/USSAC Newsletter, JOI, 1755 Massachusetts Avenue, NW, Suite 700, Washington, DC 20036-2102 USA; phone: 202-232-3900; email: info@joiscience.org. For more information about USSSP, visit: www.joiscience.org.

JOI/USSAC newsletter

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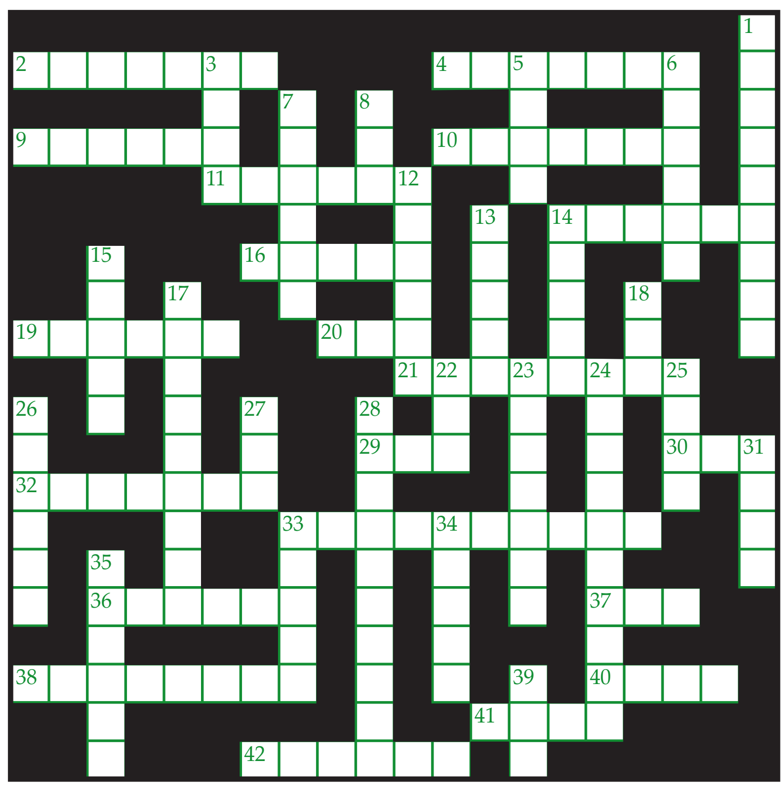
Fishing for Words

Across
2 Leg 210 start
4 Crossword's author
9 Below the crust
10 Page 6 river
11 "Blast from the Past" product
14 "A ___ in Motion"; ODP video
16 ___ tectonics
19 Leg 208 co-chief
20 Female deer interested in gas hydrates
21 Part of CORK
29 U.S. funding agency for ODP
30 Fun for pigs and sedimentologists
32 Gathering borehole data
33 Part of PPSP
36 Alphabetical support
37 Another word for ocean
38 One big hole on the ship that won't make it sink
40 It begins October 2003
41 Apex; also a conference
42 ___ *Resolution*

Down
1 They hold ship in place
3 Part of JOIDES
5 Region; seismogenic ___
6 70% of the Earth
7 Rock making up ocean crust
8 Page 4 acronym
12 Where cores bunk on board
13 Bread and oceanic ___
14 An ancient prefix
15 Top JOIDES panel
17 It's inside the core barrel
18 Emotional manager for ODP
22 European funding source
23 ___ cone; for returning
24 Schlanger Ocean Drilling ___
25 Science operator
26 ___ Ridge; Leg 208
27 Oil ___
28 The I in IODP
31 Precursor to ODP
33 Current USSAC chair
34 Science panel
35 Logging operator
39 Under; prefix



Prizes will be awarded to the first five correctly completed puzzles sent to JOI. Fax: (202) 462-8754, attn: Jennifer Anziano. If you have ideas for future Fishing for Words activities, please send them to: janziano@joiscience.org.