JOI/USSAC NEWSLETTER

News from the Joint Oceanographic Institutions/U.S. Science Support Program associated with the Ocean Drilling Program • Spring 1999 • Vol. 12, No. 1

# 2003: AN OCEAN ODYSSEY

contributed by John Farrell

What's up with plans to continue international scientific ocean drilling beyond 2003, when the Ocean Drilling Program (ODP) starts winding down? There's been much consideration, discussion, planning, and even rumor. More is surely to follow, as the future peeks over the horizon. Here I summarize recent activities and upcoming plans. My purpose is to inform you and encourage your participation. Before getting to the latest news, I remind you that the most ambitious model for a future international scientific ocean drilling program calls for multiple drilling and coring platforms, rather than just one. Such platforms would include a drillship with deepwater well control capabilities, and non-riser vessels with a wide variety of capabilities. Some would be similar to those of the ODP's *JOIDES Resolution*.

## JAPAN'S AMBITIOUS PLANS

As you may have read in the November 13th issue of *Science*, the Japanese are moving forward with a bold plan of spending the equivalent of about a half a billion U.S. dollars to construct a riser drilling vessel that would be capable of drilling in water depths up to 2,500 m initially, and ultimately 4,000 m. This vessel will be the keystone of a new Japanese program titled "Ocean Drilling in the 21st Century" (OD21), which was jointly proposed by the Science and Technology Agency (STA) of Japan and the Japan Marine Science and Technology Center (JAMSTEC). Among others, Masakazu Murakami, the Director of the Ocean and Earth Division of STA, foresees the evolution of OD21 into a new international program through close collaboration with ODP participants and the scientific community at large. This initiative, currently dubbed the "Integrated Ocean Drilling Program" (IODP), is envisioned as the successor to the ODP. A proposed moniker, popular in some circles, is "International Scientific Investigations of the Seafloor" (ISIS).

Late last year, the Japanese government decided to include the initial funding increment for construction of a riser drilling vessel in their draft budget for their fiscal year (FY) 1999, which begins in April. This was a very important step towards realizing their plans. Since then, the Ministry of Finance submitted this budget to the Japanese Diet, where it was approved. Ship design begins in April 1999 and will end with sea trials and experimental operation in FY 2004. Completion of the vessel will require additional appropriations over the next five years. But, Hajimu (Jim) Kinoshita, JAMSTEC's Director of Deep-Sea Research, was quoted in *Science* saying that his government "has never pulled the plug on a project that has reached this stage."

The three construction steps and associated costs, as currently estimated, are: (1) basic design and ship hull ($116 M); (2) shipboard drilling unit and electrical system ($230 M), and (3) the sub-sea system (riser, blowout preventer) and research facilities ($150 M). The steps begin in FY 1999 and overlap each other by one year, ending at the beginning of FY 2005.

## CAPABILITIES OF THE RISER SHIP

The proposed riser vessel would be about 190 m long, versus the 143 meters of JOID*ES Resolution*, and three times the gross tonnage (~30,000 tons). This ship would be able to drill much deeper below seafloor than *JOIDES Resolution*. The maximum hole depth might be as great as 7 km whereas the current *JOIDES Resolution* record is 2.1 km. The riser is essentially a pipe with a mud circulation system that encloses the drill pipe and

## INSIDE

enables "well control." This means that the drillers will be able to manipulate conditions within the hole that they cannot with JOID*ES Resolution*, which drills open holes. In a nut shell, well control allows the drillers to: (1) penetrate further into the formation, because they can flush heavy debris from the bottom of deep holes; (2) buttress the walls of holes drilled in unstable sediments; and (3) protect against blowouts that could arise when the drill bit penetrates oil or gas deposits. For a more detailed discussion of riser drilling, please see Dale Sawyer's article in the November 1996 issue of this newsletter.

Conventional riser drilling has limitations. At a JOIDES-sponsored workshop held in Houston last November, industry representatives described a technology barrier that they've recently hit. Conventional riser technology cannot be used in water depths greater than 3,000 m. This is because the mud column in a riser that long can put a stress on the formation that's higher than the strength of the formation rock, causing problems at the bottom of the hole. Industry engineers are currently developing "riser-less" well control technology that uses massive seafloor pumps connected to a drillship through a flexible hose. A report from the workshop is at www.joides.geomar.de/houston_report.html.

## Who's at the Helm?

Returning to the post-2003 program (which I'll refer to as ISIS), we at JOI have been asked "who's steering the ship?" so to speak. If you step back from this question, it can be asked of any large national or international scientific (or other) program. The question's a classic, probably because the answer isn't necessarily clear and therefore simple. One response I've heard, and call the "top-down, bottom-up," divvies up the responsibility of steering between those "at the top," who decide the flow of taxpayer funds to meet the needs of the nation, and those at the "grass roots level," who propose scientific programs to meet those needs or, in other cases, to create them. Clearly, this is an oversimplification. Determining a nation's needs and priorities is not an easy task and decision makers in funding agencies face a wide range of pressures, including political. Successful researchers manage to conduct science by helping to create new funding streams, or by flexibly adapting their scientific foci to existing streams.

A second answer to this question, which builds on the first, returns specifically to who's at the helm of scientific ocean drilling, is the JOIDES advisory structure. In a sense, it's a hybrid of the "top-down, bottom-up" in that scientific ideas from any researcher can be introduced at various points in the structure and JOIDES leaders, senior personnel from large institutions, generally have a credible understanding of funding agency needs and capabilities.

Planning efforts for ISIS were recently formalized within JOIDES by the creation of the IODP Planning Sub-Committee (IPSC, the cognoscenti, who force acronymization, are pronouncing it "ip-sick"). This subcommittee of seven, including chair Theodore Moore from the University of Michigan, will begin their work this spring. IPSC, which is responsible for defining the scientific, technical, operational and budgetary requirements for the new program will report through SCICOM to EXCOM and the "International Working Group" (IWG). The IWG is co-chaired by Michael Purdy (NSF) and Masakazu Murakami and includes representatives from funding agencies in nations that will form the future policy and funding committee for ISIS.

## Who's Gonna Pay?

The Japanese will pay all capital costs to build the riser vessel, and half a billion dollars isn't anything to sneeze at. Because there's been no decision yet on any non-riser vessels for ISIS, the costs cannot be determined with precision. Some have asked if JOID*ES Resolution* will be in ISIS. We simply don't know at this point. There are other, newer ships that could be converted for *JOIDES Resolution*-type research. And what about other platforms? All options are being considered. Decisions will be based, in part, on the outcome of the upcoming Conference On MultiPLatform EXploration (COMPLEX), to be held May 25-29 in Vancouver, Canada.

Regarding the payment of annual operating expenses of ISIS, the current thinking is an even, three-way split of the costs among Japan, the U.S., and Europe plus other participating countries. The plan is that Japan and the U.S. will be equal partners, in whatever percentage of the total cost. The annual price of a two-ship program is difficult to estimate, but the best guess figure may be three times the current cost of ODP, thus about $150 M.

The Japanese commitment is clear. A U.S. commitment requires further definition. In the *Science* article, Michael Purdy said it was "unclear" as to how the U.S. contribution to the new program would be financially supported, although he also said, "there's a good possibility that a strong justification could be made for a multiplatform program." Therefore, estimates for a U.S. contribution to ISIS range from $50 M to $60 M, which is greater than the current contribution for ODP.

## What's Afoot in the U.S.?

So, how's tricks at home? Overall, our sense is that the U.S. scientific community is cautiously optimistic about the plans for post-2003. It goes without saying that there is a wide range of strong opinions in the U.S.; after all we're not known for our reticence. On one end of the spectrum, some say the U.S. needs access to a riser vessel because it's what we've never had, but always needed. On the other end, there are those who wonder whether the scientific return is worth such a large and arguably disproportionate expenditure.

All scientists would like to know where the increase in funds would come from to pay for ISIS. The presumed source is the NSF, and specifically the Ocean Sciences Division (OCE). Two schools of speculation have arisen among scientists. One, we dub the "closed sum," is based on the premise that there is a fixed flow of funds into OCE/NSF, and thus a fixed flow out. If more is spent on a drilling program, then less will be spent on other areas supported by OCE. Conversely, if fewer funds were spent on ocean drilling, then more would be available for other OCE-funded activities. Those favoring this hypothesis point to the fact that the OCE budget changes little on a year-by-year basis.

The other school doesn't think in terms of fixed budgets. Instead, adherents believe that funds are primarily allocated on the basis of merit and justification. Thus, if a new, strongly argued and worthy program is put forward, and if it's considered a high priority, then it can, and may, be funded. The converse is that when such a program ends, the funding stream does too; the funds are not necessarily redistributed within the same division or directorate, and they may not even be appropriated to the NSF. In my opinion, this outlook is more consistent with public comments made by NSF personnel.

Returning the finger to the pulse of the scientific community, we take as a very positive sign for a new drilling program and, for earth sciences in general, the fact that our community has been most responsive to requests for participation. We're impressed by the grass roots response to calls for participation, particularly "white papers" for the upcoming COMPLEX meeting. The co-chairs of the COMPLEX meeting (Nick Pisias and Asahiko Taira) received over 300 white papers and a greater number of participants are expected at this conference. Our own USSAC, traditionally a bastion of leadership, has also stepped up to the plate. They have been publishing commentaries and editorials on the future of scientific ocean drilling in *Eos* and in scientific journals. They have led and participated in community discussions and promotional activities at recent meetings of the International Conference on Paleoceanography (booth), the Geological Society of America ("Hot Topics at Noon"), and the American Geophysical Union ("Town Meeting" and Union sessions).

## What's Next?

Planning for future scientific ocean drilling is incremental and constantly evolving, as with any large program. A timeline that's still generally accurate was published in the November 1998 issue of this newsletter. The next big event is COMPLEX. Conference participants will discuss the various scientific objectives that can be met by drilling into the seafloor by whatever means available, but primarily with non-riser drilling ships. The conference is being organized into 14 theme sessions. For more information, see www.oceandrilling.org/COMPLEX.

COMPLEX complements the other international planning conference "CONCORD" (Conference on Cooperative Ocean Riser Drilling), that focused on riser drilling, and was held in Tokyo in 1997. The outcome from these two conferences will set the scientific framework for ISIS. The report from the COMPLEX meeting will also be used to formulate a request for proposals for a conceptual design of the non-riser vessel. As denoted on the timeline, the design phase is planned to begin later this year.

## Concluding Matters

First, a misconception needs to be cleared up. The prime contract from NSF to JOI for the overall management of the ODP, and the subcontracts from JOI to TAMU and LDEO for science and logging services, as well as all lower tier subcontracts (e.g., TAMU to Schlumberger for leasing JOID*ES Resolution*) may end in 2003. If ISIS comes to fruition in the interim, then the contracts for science management and services will be rebid by the NSF. The general framework for ISIS will be defined in early 2000. Soon after, the contractual and management structures of the new program will be determined and the current contractors will have the opportunity to bid, along with any other interested organizations.

Second, in closing, indulge us as we bang the drum again. Large international science programs, like ODP, are created, nurtured, and flourish only with the active (and we stress "active") support of the scientific community. That support takes many forms. It can include simply remembering to acknowledge the ODP in your publications. It can also take the form of proposing and sailing on drilling legs, reviewing JOIDES drilling proposals, holding and attending planning workshops and meetings, participating in ODP "town meetings," serving on JOIDES panels and committees, and making the case for support to funding agencies. Big programs don't rise up on their own. They have to be created, "top-down and bottom-up," by hard work that involves thoughtful planning, scientific justification, and, in the words of the AGU, unselfish cooperation. "A rising tide lifts all boats" may be a cliche, but it's apropos. Your participation and support are evident, keep up the good work. Only with these efforts will ISIS become a new program in 2003.

## The Author

John Farrell is the Associate Director of the ODP and the Director of the U.S. Science Support Program at JOI. John's been out on ODP Leg 184, in the South China Sea, continuing his managerial responsibilities (as demonstrated by his whopping e-mail bill), while conducting his scientific duties as a stratigraphic correlator. He apparently mastered the ability to survive without sleep for he was also a special correspondent for a Leg 184-based contribution to the ABC News web site.

# DRILL BITS

## HONG KONG, AHOY!

For the first time in ODP's history, *JOIDES Resolution* sailed into Hong Kong for a port call. The April 13 to 17 visit provided a perfect opportunity to showcase both the drillship and ODP science for China—our newest member. The visit also provided the Chinese scientific community a chance to display their scientific participation in the program and the benefits of their ODP membership to a broad local audience. Five scientists officially represented China on Leg 184, China's inaugural ODP voyage, which preceded the port call. The Chinese ODP office and ODP Public Affairs organized a series of port call activities which included ship tours, a VIP reception, a scientific conference, and a press conference.

## GATEWAYS TO GLACIATION

JOI's new educational CD-ROM, "Gateways to Glaciation," is not yet complete, but is certainly on its way. Its progress has continued since the previous newsletter but not quite as quickly as we had hoped. The CD was briefly described in this column in the November 1998 issue so we won't rehash the details this spring. However, once the CD's target release date is firm, we'll be sure to fill you in on the details.

## POLICY WONKS UNITE

A *JOIDES Journal* special issue, the revised "A Guide to the Ocean Drilling Program," is hot off the press and available from the JOI office. The *Guide*, which will provide you with the latest versions of various ODP policies and procedures, is being distributed to all regular subscribers to the *JOIDES Journal*. To request your own copy, please contact JOI, Suite 800, 1755 Massachusetts Ave., NW, Washington, DC 20036-2102 (e-mail: joi@brook.edu). The *Guide* will also be available on the JOIDES Office web site: www.joides.geomar.de.

## THE ABCS OF ODP

John Farrell from JOI and Steve Clemens from Brown University recently served as special shipboard correspondents to the ABC News web site during Leg 184 to the South China Sea. Johanna Adams from JOI coordinated these efforts with ABC onshore. As participants in the expedition, they described scientific adventures, drilling operations, and daily life aboard the *JOIDES Resolution*. By the time you read this newsletter, the series will have run its course, but the pages are still available on archive at: abcnews.go.com/sections/science/DailyNews/exped_schinasea990319_part1.html. These chronicles are also available on the ODP web site.

## STUDENTS TO SET SAIL

A Student Trainee Program has been created to provide undergraduate earth science students with the unique opportunity of participating in ODP cruises aboard *JOIDES Resolution*. A full description of this new program can be found in the revised "A Guide to the Ocean Drilling Program" and on the web at: www.oceandrilling.org/Participating/StudentTrain.html. Student Trainee positions will be available on an opportunity basis and will not displace other scientific, technical or engineering positions on the drillship. Each year, the ODP Science Operator at TAMU will aim to identify at least three student trainee positions. As they become available, they will be announced in the *JOIDES Journal* and through ODP member country/consortium offices. Applications will be available soon. Students must send their completed applications to their national ODP offices. In the U.S. this is JOI/USSSP, of course.

The student trainees' duties will depend on their backgrounds and experience, but can include assisting the shipboard scientists by rotating through the laboratories and helping with processing of cores and scientific analyses. A shipboard mentor, in consultation with the Co-Chief Scientists, the Lab Officer, and the trainee, will define specific responsibilities for the student. The trainees will be expected to participate in the watch system adhered to by scientists and technicians, and to carry out all the tasks which they are assigned. The ODP Science Operator will staff the trainee positions in consultation with the Co-Chief Scientists based on the student's skills, balanced with the requirements of the leg. Final selection of individuals to fill these positions is the responsibility of the ODP Science Operator.

## FACING THE FUTURE: TECHNOLOGY AND OPERATIONS

A JOIDES-sponsored "Technical and Operations Workshop" was held in Houston, Texas on November 17-18, 1998. It was the first step towards addressing the technical and infrastructure issues the scientific community will face in preparing for a future ocean drill-

ing program. The workshop was chaired by Susan Humphris (JOIDES SCICOM Chair at that time) and Kensaku Tamaki (Chair, OD21 Technical Operations Planning Group and SCICOM member).

ODP recognizes that advances are being made by the exploration industry in developing deep-water drilling capabilities. To that end, industry experts were invited to share their experience and offer advice on the most effective mechanisms to determine the technical requirements and infrastructure of the proposed new program. Attendees to the workshop included about 50 individuals representing the oil industry, service companies, the logging and geotechnical measurement fields, and the JOIDES community. For the full workshop report, visit www.joides.geomar.de/houston_report.html.

## Evaluating ODP

The contract between the National Science Foundation and JOI calls for regular evaluations of the performance of the ODP. Every three years, a Performance Evaluation Committee (PEC) is formed. The committee is comprised of eminent scientists and engineers who are familiar with the program but not presently involved in JOIDES or operational activities. The members of the current (the fifth) PEC are: Nori Nasu (Chair), Tom Loutit (Vice-Chair), Earl Doyle, Hans Duerbaum, Dan Karig, Amos Nur, and Karl Turekian.

PEC-V is focusing on ODP's progress toward meeting the scientific goals of the 1996 Long Range Plan; the mechanisms in place for making budgetary decisions; the operation of the new JOIDES advisory structure; and the progress of the present program in preparing for a new scientific ocean drilling program beyond 2003. If you would like to offer your insights, please contact PEC-V via their committee coordinator, Jenny Ramarui (jramarui@brook.edu).

## Riding the Tokyo Tide

Following ODP Leg 185, Izu-Mariana, the *JOIDES Resolution* will ride the tide towards Tokyo for a port call in June. The ship will dock in Yokohama because a low bridge was recently constructed over Tokyo Bay. The ODP/Japan Secretariat and ODP Public Affairs are developing several high-profile port call events. These events will highlight Japan's contributions to ODP and their enthusiastic support for the future of scientific ocean drilling. Planning for a new riser drill ship, the keystone to the Japanese national program, OD21, is well underway. Government officials, local scientists, and several hundred students will be invited to visit the drillship.

## A Moniker is Born

### ISIS

International Scientific Investigation of the Seafloor

For several reasons, Isis, an ancient Egyptian goddess, may be a very appropriate name for our new scientific ocean drilling program in 2003.

- The symbol of Isis in the heavens is the star Sirius. In ancient times, the star's appearance marked the beginning of the new year and brought renewed wealth and prosperity. Renewed scientific wealth starting in the new year, 2003, is one of the primary goals for our future program.
- Isis was believed to be a mighty earth goddess, the light-giver (did she scoop Milankovitch?), the producer and giver of life (biocomplexity, here we come!), and the goddess of water from which all life sprang. She possessed the powers of a water goddess, an earth goddess, and a star goddess.
- Isis used words of power that compelled others to listen and fulfill her requests. This power of words and conviction may be her most compelling attribute, as it will be one that is essential to make the strong cases needed for future funding of our dynamic new program.

Many thanks to Dave Goldberg, LDEO, for suggesting the ISIS acronym.

# Documenting the Past to Model the Future: MIS Stage 11

contributed by André Droxler, Lloyd Burckle, and Richard Poore

Unlocking the past may reveal the future, but first we must find the key. To forecast short-term atmospheric events, meteorologists draw upon data collected by weather bureaus. Similarly, climatologists — who try to constrain predictive models and forecast long-term weather patterns — seek paleoclimatologic records. Some of the best are extracted from marine sediments, when climate was warmer than present. Paleoclimatologists are drawn to Marine Isotope Stage 11 (MIS 11, an interval between 420-360 ka), which was likely the longest and warmest interglacial interval of the past 500 ky (see review in Howard, 1997 and references therein). This interval is characterized by warm sea-surface temperatures in high latitudes, strong thermohaline circulation, unusual carbonate production in high latitudes, higher than present sea level, coral reef expansion, and generally poor pelagic carbonate preservation.

An international workshop on MIS 11 was sponsored by the Joint Oceanographic Institutions/U.S. Science Support Program and U.S. Geological Survey (JOI/USSSP and USGS) and was held on December 5, 1998 in San Francisco. About thirty participants attended the workshop, which was convened by Richard Poore (USGS), Lloyd Burckle (LDEO), and Andre Droxler (Rice U). The workshop had three main goals: (1) to summarize established and conflicting knowledge on MIS 11, (2) to define objectives of future research programs on MIS 11, and (3) to determine specific sampling needs to conduct these research programs. Morning talks and afternoon posters generated lively discussions which focused on three main questions: (1) How did MIS 11 come about and how long did it last? (2) Was the Earth warmer? and (3) Was sea level demonstrably higher?

MIS 11 shows the highest-amplitude deglacial warming during the past 5 My (see Figure 1). In contrast with most other late Quaternary interglacials, MIS 11 cannot easily be explained and modeled solely within the context of Milankovitch forcing mechanisms. Computer models cannot accurately reproduce the unusually large amplitude of MIS 11 as found in many paleoclimatic records, because the summer insolation within 60 to 70 degrees north was too low during this interval. At the workshop, Richard Muller (UC Berkeley) presented an "orbital-inclination/dust" hypothesis, as an alternative to the Milankovitch insolation theory, to explain the cyclicity of the Quaternary and he argued that the MIS 11 "problem" disappears in his model.

Low-amplitude insulation variability at the precessional (19-23 ky) frequency creates a 10 to 20 ky uncertainty in the estimated age and overall duration of the MIS 12/11 deglacial interval. The midpoint of this interval falls at 415 ka in the Shackleton orbitally-tuned time scale. This timing contrasts with the 423-427 ka range in the age models of SPECMAP and others. Gary Karner (UC, Berkeley) presented some $^{40}Ar/^{39}Ar$ ages of about 430 ka from a series of tephra layers deposited during the MIS 11 transgression in the Tiber River valley. Such discrepancies indicate that the duration of the stage 12/11 deglaciation is uncertain and might vary between 30 ky and 12 ky in length.

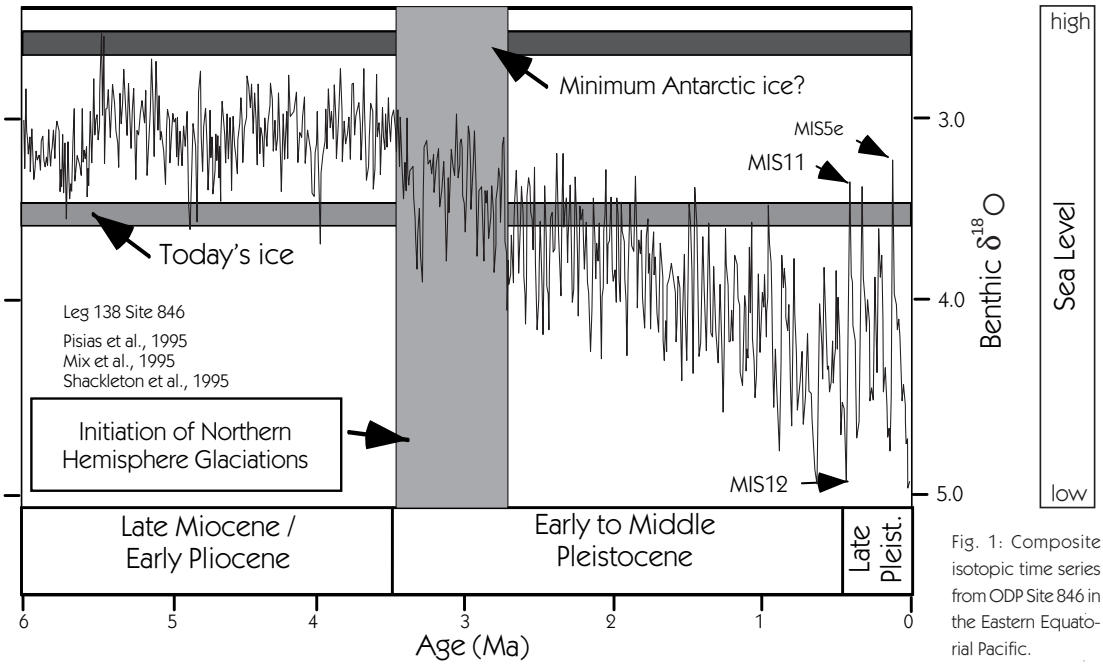



Fig. 1: Composite isotopic time series from ODP Site 846 in the Eastern Equatorial Pacific.

The evidence—derived from marine, terrestrial, and ice-core records—for the magnitude of MIS 11 warming remains complex. The most recent isotopic and planktic faunal data sets from high-accumulation rate marine sequences in the North and South Atlantic, presented by several workshop participants (Will Howard, U Tasmania; Delia Oppo, WHOI; Dave Hodell, UFl), suggest that MIS 11 was slightly cooler than the Holocene, rather than warmer. In contrast, terrestrial data, such as European pollen records, presented by Denis-Didier Rousseau (U Montpellier, France) suggest that MIS 11 was warmer than the Holocene and MIS 5.

Geochemical and isotopic analyses of the 3,500 m-long Vostok ice core from Antarctica were presented by Dominique Raynaud (LGGE, Grenoble, France). The paleoclimate record from the core includes four complete glacial-interglacial cycles characterized by strong 100 and 40 ky frequencies. Among these cycles, MIS 9 and MIS 5e clearly correspond to the warmest interglacials and have the highest $CO_2$ and $CH_4$ concentrations. Raynaud was reluctant to compare these four interglacials with MIS 11 because, if it was recorded at Vostock, it is likely to have been disturbed by ice flows.

Julie Brigham-Grette (U Mass) discussed northern Alaska, where exposed shorelines dated at about MIS 11 by amino acid racemization (AAR) correspond to a sea-level highstand of about 20 m above today's level. Similar highstands have been reported from wavecut platforms near Sussex (UK). Paul Hearty and Pascal Kindler (U Geneva, Switzerland) reached comparable conclusions by studying carbonate beach sediments deposited on tectonically stable coastlines of Bermuda and the Bahamas that have been dated by AAR and thermal-ionization mass spectrometry. These data sets support the hypothesis of a collapse of the West Antarctic Ice Sheet (WAIS) during the middle Brunhes Chron. To account for a 20 m increase in sea level, ice sheets would have had to melt in Greenland and the West Antarctic (together corresponding to a 12 m sea-level rise) as well as in East Antarctic (8 m equivalent). Reed Scherer (Uppsala U, Sweden) recently proposed, based upon occurrences of young diatoms and high concentrations of $^{10}Be$ beneath grounded ice in the Ross Embayment, that the WAIS recently collapsed during the mid Brunhes. Dietz Warnke (CSU, Hayward) and Jerry McManus (WHOI) showed that the total absence of non-volcanogenic ice rafted debris during a 23 ky-long interval is unique to MIS 11 in the North Atlantic (ODP Sites 982 and 980) and may suggest total deglaciation of Greenland.

From discussions generated by the workshop presentations, it's clear that considerable uncertainties remain in the documentation and understanding of MIS 11. To improve our knowledge of the mid-Brunhes climatic conditions, we propose that future MIS 11 research programs focus on: (1) the spatial and temporal distribution of the apparent warming and its magnitude; (2) the amplitude and frequency of climate variability, especially during the first half of MIS 11; (3) sea-level fluctuations and the related history of ice sheets in Greenland and Antarctica; (4) recovering complete ice-core records of this interval; and (5) the impact of carbonate production (in reef, low-latitude neritic, and high-latitude pelagic environments) on marine and atmospheric carbon reservoirs.

To address these objectives, stratigraphies must be developed on a sub-millennial scale in cores with accumulation rates exceeding ~10 cm/ky. Because such sequences are typically beyond the reach of conventional piston cores, ODP coring techniques are necessary. By obtaining high-accumulation-rate sequences to document and understand environmental conditions and variability during MIS 11 and other late Quaternary interglacial stages, ODP would contribute significantly to high-priority national and international global change research efforts. Workshop participants suggested regions where drilling would be invaluable, these include: the northwest, northeast, and eastern equatorial Pacific, the Sulu and the South China Seas, the Western Gulf of Mexico, with an emphasis on the Orca Basin, and the North Atlantic (Feni Drift).

Other areas of interest are around Greenland and the Western Antarctic Ice Sheets and modern barrier reefs and carbonate banks in the Caribbean (Belize, northern Nicaragua Rise, Bahamas), the Great Barrier Reef, and the Maldives. For example, scientific studies of existing ODP cores reveal that thick late Pleistocene sequences—in enclosed and semi-enclosed basins—on the northern and northwestern slopes of the Gulf of Mexico were deposited very rapidly. These sediments record the timing and magnitude of deglacial events, fluctuations in bottom waters, changes in surface water faunas, and regional volcanic activity. Furthermore, the Eastern Equatorial Pacific is an important region to test hypotheses about the timing and extent of the MIS 11 warming. It serves as one end of the east-west equatorial system, including El Niño/La Niña variability, and records fluctuations in the Pacific's coldwater eastern boundary currents.

As a final comment, international participation and interdisciplinary communication have a role in promoting the comparison of seafloor sedimentary data sets to high-resolution sequences recovered from ice cores and terrestrial environments. Such collaboration made our workshop a success and should be emphasized in developing a future research program focusing on MIS 11.

## THE AUTHOR

André Droxler is an Associate Professor at Rice University, in Houston, Texas.

## REFERENCES

Howard, W.R., A warm future in the past, *Nature, 388,* 418-419, 1997.

Mix, A., J. Le, and N. Shackleton, Benthic foraminiferal stable isotope stratigaphy of Site 846: 0-1.8 Ma, In Pisias, N. et al. (Eds.), *Proc. ODP, Sci. Results, 138,* 839-847, 1995.

Pisias, N., L. Mayer, and A. Mix, Paleoceanography of the eastern equatorial Pacific during the Neogene: synthesis of Leg 138 drilling results, In Pisias, N. et al. (Eds.), *Proc. ODP, Sci. Results, 138,* 5-21, 1995.

Shackleton, N., M. Hall, and D. Pate, Pliocene stable isotope stratigraphy of Site 846, In In Pisias, N. et al. (Eds.), *Proc. ODP, Sci. Results, 138,* 337-353, 1995.

# DIPLOMATIC DANCING IN THE DEEP SEA: BACKSTAGE AT THE U.S. STATE DEPARTMENT

contributed by Andrea Johnson

As scientists, we study natural processes that ignore national borders. These borders generally conform to physical boundaries, and evolve as governments dictate. The often times confusing drawing of political lines, and their frequent and rapid shifts, can be nuisances to geoscientists. Nevertheless, they demarcate power, resources and access, so we can't disregard them.

Although the ODP is a model for international scientific collaboration, we occasionally face bureaucratic and diplomatic challenges when taking *JOIDES Resolution* to drill in regions owned, occupied, or simply claimed by various nations. We must have permission to enter the waters. Plain and simply, no authorization from the political entities, no drilling, no science.

The JOIDES advisory structure focuses on the scientific merit of oceanographic drilling and leaves the logistics to the ODP Science Operator (TAMU) and the ODP Program Manager (JOI). Making each drilling leg a reality is no small feat. Fortunately, ODP has received great support from the U.S. Department of State as they've lead us through the many steps of the diplomatic dance. Sometimes it's a waltz and other times—like with Leg 184 to the South China Sea—it's more like break dancing, and everyone works up a sweat.

Who are these dauntless diplomats serving ODP behind the scientific scene? W. Thomas Cocke leads the effort with able assistance from Elizabeth Maruschak. Tom and Liz may not be familiar names to the ODP community-at-large, but they should be. They play a vital role in making ODP a success.

Tom is the Research Vessel Clearance Officer in the Office of Oceans Affairs within the Bureau of Oceans and International Environmental and Scientific Affairs at the U.S. Department of State in Washington, D.C. In this position, he secures "clearance," which is formal permission from political entities to operate in waters over which they claim jurisdiction. Tom also provides diplomatic advice to scientists on U.S. vessels conducting research in foreign Exclusive Economic Zones (EEZs). If you've sailed on a U.S. research vessel in a foreign EEZ, then Tom was probably the one who arranged clearance for you.

Tom understands the nature and importance of oceanographic research and this inspires him to go the extra mile to avoid delaying a cruise. For instance, one Christmas Eve, he found himself interrupting his holiday travels to conduct business from a NJ Turnpike telephone booth. Fortunately, Tom doesn't recall any situations where a clearance was not eventually obtained or where one was reneged on. But, there have been some close calls. For ODP Leg 155, Amazon Fan, the Brazilian clearance was obtained so late that the Brazilian naval observer missed the ship when it left Barbados. He was flown back to Brazil before eventually boarding via a naval launch.

Tom's appreciation for his role is rooted in his diverse background. He was trained as a geological engineer, then worked as an oceanographer in the U.S. Naval Oceanographic Office and as a mineral commodity specialist in the Department of the Interior's Bureau of Mines. In the latter position, he focused on ocean minerals and developed many marine science contacts that ultimately led to his current job at the State in 1983. In his broad role at the Department of State, Tom continues to work closely with many agencies, especially NOAA and DOD-Navy.

Liz Maruschak has a BA degree from Eckerd College in Environmental Policy and Marine Sciences. The Research Vessel Clearance Assistant position lured her to Washington nearly a year ago from an environmental consulting firm in Cleveland. In her new role, Liz enjoys expanding her knowledge of marine policy issues and contributing to the efficiency of the clearance process. Although Liz works with Tom, she is an employee of the Consortium for Oceanographic Research and Education (CORE). Funding for her position is provided by NSF, ONR, and NOAA. Liz has been a welcome addition, because State has been downsizing by attrition, despite a growing workload. To organizations with research vessels, Liz and Tom are invaluable because they help avoid costly delays by obtaining ship clearances in a timely manner.

The 1982 Law of the Sea Treaty, which delineated a 200-mile-wide EEZ for each nation, provides the baseline for Tom's and Liz's work. Although the U.S. has not signed the Treaty, it supports many aspects that are accepted as customary international law. A specific protocol for research vessels is outlined in the Treaty[1]. For instance, researchers are required to share the data, post-cruise, with the country whose EEZ has been sampled. There are sharing guidelines with the science bureaus of various countries. Because ODP publishes all data in volumes, it's easy to give it to the science bureaus and thus "receive credit" for acquiescence.

Tom and Liz monitor vessel compliance with both general requirements and special conditions that may accompany clearances from certain countries[2]. For hundreds of vessels per year, this information is recorded in the Research Vessel Tracking System database that is currently being redesigned in Microsoft Access by Liz. She also tracks non-U.S. research vessel activity through a similar database management system.

Although *JOIDES Resolution* is not registered in the U.S., Tom has been securing clearances for her at the request of ODP since the program's inception. He has enjoyed his interaction with all the ODP personnel, especially those individuals with whom he's had the most contact—Lou Garrison, Tim Francis, and Jack Baldauf. He also fondly recalls Patsy Brown. She left ODP to take a job with JOI and ended up as Tom's assistant (Liz's predecessor) at the Department of State where she was a key member of the Research Vessel Clearance Team.

So what's the process, exactly? Once ODP drilling legs are scheduled, the JOIDES cruise prospectus is sent to State's Research Vessel Clearance Office where Tom alerts ODP to any drilling that's planned in politically sensitive areas. Given Tom's long memory and broad experience, he makes the process seem deceptively easy.

Months before the leg is scheduled to depart, the dance begins. Most clearances are routine. However, others may involve special conditions, such as shipboard observers, safety equipment, escort vessels, and icebreaker support, to name a few. The strangest request was from a country—to remain unnamed—that wanted ODP to compensate the shipboard observers for their lost moonlighting income while they were at sea.

Returning to the process, Tom and Liz manage the diplomatic exchange and facilitate communication. When a request is received, they check the package for completeness, then create a telegram which directs an embassy to take action on the request. But before the message can be forwarded to the embassies, the telegram must be approved by the desk officer, in-house (State Dept) experts that provide up-to date information on the sensitivity of a clearance country. Once the desk officer approves the cable, it is sent to the embassies where it is generally directed to the science and technology officers (although due to "downsizing," many embassies no longer staff science officers). The embassy serves as the liaison between the State Department and the clearance country. As necessary, clearance countries have special requests, which are passed to the embassy, which forwards them to Tom and Liz, who contact ODP in a hurry. ODP has little choice but to comply—which is a future "behind the scenes" story in and of itself.

Once the embassy formally approves the clearance, Tom and Liz convey this information to ODP. From there, it's transmitted to the Captain, who has the final authority at sea as to where *JOIDES Resolution* sails.

Tom and Liz have found that U.S. embassies, foreign embassies and particularly foreign governments rarely understand the financial importance of ship deadlines. Therefore, communicating the rigidity of ship deadlines at the Bureaucracy Ball is one of their major challenges. Although the Law of the Sea Treaty has "implied consent" clauses, formal consent is always the goal. Other times, things are sticky simply because a country may have some other issue with the U.S. In these cases, to avoid the legal banter and shows of plumage, Tom and Liz promote the scientific merit and benefit of multinational ODP drilling. This strategy is often successful, because the country understands that it will receive the valuable ODP data.

ODP does not hold claim to the toughest situation that Tom has faced but we still keep him busy. Leg 184, for instance, may have been the most challenging leg clearance ODP has ever needed, and it certainly highlights why we depend on Tom and Liz. The southernmost drill site (Site 1143) was of great scientific value, but it was within the expansive Spratly Island region, which has six claimants (Brunei, China, Malaysia, Philippines, Chinese Taipei, and Vietnam). Brunei and Malaysia did not claim the specific location of Site 1143, but the other four did and no one knew *what* to expect. Ultimately, permission was granted by all four entities, and the site was drilled. Tom and Liz patiently sought approval from each, set up meetings for ODP personnel with appropriate officials, and drew upon the expertise of their colleagues. At times like this, even the Director of the Office of Oceans Affairs, R. Tucker Scully, and the Deputy Director, Raymond Arnaudo, go to bat for ODP.

The Leg 184 excitement didn't end with vessel clearances because of the very real threat of pirates in the region. Yes, pirates, and not the Captain Hook type. Fortunately, the *JOIDES Resolution* didn't have to fly the skull and crossbones, because the State team stepped in to provide ODP with necessary information, including procedures and contacts, to operate as safely as possible in pirate-infested waters.

Thank you Tom, Liz, and the rest of the U.S. Department of State crew. We couldn't do it without you.

## THE AUTHOR

Andrea Johnson is a Senior Program Associate at Joint Oceanographic Institutions.

[1]See United Nations Convention on the Law of the Sea, Part XIII Marine Scientific Research (United Nations Publication Sales No. E.83.V.5) or visit www.un.org/Depts/los/

[2] Country-specific requirements for requests and post-cruise obligations can be found within the Notices to Research Vessel Operators, at www.state.gov/www/global/oes/oceans/notices.html

# ANNOUN

## JOI/USSAC* OCEAN DRILLING FELLOW

**Brandon Dugan**
**The Pennsylvania State University**
Sediment loading, lateral fluid flow, and erosion of the continental slope in offshore New Jersey, ODP Leg 174A (one year, shorebased)

*Now named the Schlanger Ocean Drilling Fellowship

## JOI/USSSP SUPPORTED SHIPBOARD PARTICIPANTS

**Leg 184: East Asia Monsoon**
U.S. Co-Chief: Warren Prell, Brown U.
ODP Staff Scientist: Peter Blum, TAMU
JOIDES Logging Scientist: Jian Lin, WHOI
Steven Clemens, Brown U.
Peter Clift, WHOI
John Farrell, JOI
Joel Leventhal, Diversified Geochemistry
Katherine McIntyre, UCSB
Stephen Nathan, U. Massachusetts, Amherst
Peter Solheid, U. Minnesota, Minneapolis

**Leg 185: Mariana-Izu**
U.S. Co-Chief: Terry Plank, Boston U.
ODP Staff Scientist: Carlota Escutia, TAMU
JOIDES Logging Scientist: Roger Larson, URI
JOIDES Logging Scientist: Robert Pockalny, URI
LDEO Logging Scientist: Gilles Gurein, LDEO
Lewis Abrams, UNC, Wilmington
Jeffrey Alt, U. Michigan
Martin Fisk, OSU
Katherine Kelley, U. Kansas
Richard Murray, Boston U.
David Smith, URI
Arthur Spivack, UNC, Wilmington
Hubert Staudigel, SIO
Maureen Steiner, U. Wyoming
Robert Valentine, Washington U.*

*JOI/USSAC Fellow

## U.S. APPLICATIONS FOR ODP PANEL AND COMMITTEE MEMBERSHIP

JOI/USSSP seeks to fill U.S. positions on the following ODP-related panels and committees.

- **JOIDES Science Committee** (SCICOM)
- **JOIDES Science Steering and Evaluation Panels** (SSEPs)
  - Dynamics of Earth's Interior (ISSEP)
  - Dynamics of Earth's Environment (ESSEP)
- **JOIDES Scientific Measurements Panel** (SCIMP)
- **JOIDES Technology and Engineering Development Committee** (TEDCOM)
- **JOIDES Site Survey Panel** (SSP)

For more information about the responsibilities of these groups see the JOIDES web site at www.joides.geomar.de or contact John Farrell at the JOI Office at (202) 232-3900 ext. 211.

If you are interested in serving on one of the committees or panels, please send a CV (no more than two pages) and a letter of interest to Dr. John Farrell, Program Director, JOI/USSSP, Joint Oceanographic Institutions, 1755 Massachusetts Avenue, NW, Suite 800, Washington, DC 20036-2102, fax: (202) 232-8203. Applications are due May 21, 1999. Positions will become available throughout the coming year. Membership terms are typically three years.

## SCHLANGER* OCEAN DRILLING FELLOWSHIP PROGRAM

JOI/USSAC is seeking graduate students of unusual promise and ability who are enrolled in U.S. institutions to conduct research compatible with that of the Ocean Drilling Program. Both one- and two-year fellowships are available. The award is up to $22,000 per year to be used for stipend, tuition, benefits, research costs, and incidental travel, if any. Masters and doctoral degree candidates are encouraged to propose innovative and imaginative projects. Research may be directed toward the objectives of a specific leg or to broader themes.

**DEADLINES:**
Shorebased work: 11/15/99 and 4/15/00
Shipboard work (Legs 194-199): 4/15/00

**MORE INFORMATION:**
Andrea Johnson
Schlanger Ocean Drilling Fellowship Program
Joint Oceanographic Institutions
1755 Massachusetts Ave., NW, Suite 800
Washington, DC 20036-2102
Tel: (202) 232-3900 ext. 213
Fax: (202) 462-8754
E-mail: ajohnson@brook.edu

* Formerly the JOI/USSAC Ocean Drilling Fellowship Program

# CEMENTS

## A GUIDE TO THE ODP

*A Guide to the ODP*, which will provide you with the latest versions of various ODP policies and procedures, is being distributed to all regular subscribers to the *JOIDES Journal*. To request a copy, please contact JOI, Suite 800, 1755 Massachusetts Ave., NW, Washington, DC 20036-2102 (e-mail: joi@brook.edu). The *Guide* will also be available on the JOIDES Office web site: www.joides.geomar.de.

## CALL FOR NOMINATIONS TO USSAC

JOI is seeking nominations for U.S. positions on the U.S. Science Advisory Committee (USSAC). USSAC provides guidance to JOI in managing the JOI/U.S. Science Support Program (JOI/USSSP), which in turn provides support for U.S. involvement in ODP. New members of USSAC will be appointed by the JOI Board of Governors in mid-1999. The three-year term for the new USSAC members will begin October 1, 1999.

If you are interested in serving on USSAC, please send a CV (no more than two pages) and a letter of interest to Dr. John Farrell, Director, JOI/U.S. Science Support Program, Joint Oceanographic Institutions, 1755 Massachusetts Avenue, NW, Suite 800, Washington, DC 20036-2102. Scientific leadership and a keen interest in ODP science and related activities must be demonstrated. The deadline for nominations is May 21, 1999.

For more information about JOI/USSSP and USSAC duties and responsibilities visit www.joi-odp.org/USSSP or contact Dr. Michael Arthur, USSAC Chair, at arthur@geosc.psu.edu or (814) 863-6054.

## SCHEDULE FOR ODP LEGS 184-193

| LEG | REGION | CO-CHIEFS | DEPARTURE PORT | DEPARTURE DATE | SCIENTIFIC OBJECTIVES |
|---|---|---|---|---|---|
| 184 | E Asia Monsoon | Prell, Wang | Fremantle | 2/99 | To investigate the interrelationships among uplift, monsoon evolution, and global cooling. |
| 185 | Mariana-Izu | Ludden<br>Plank | Hong Kong | 4/99 | To investigate crustal recycling by determining the net fluxes of material at the Mariana-Izu subduction zone by mass balance of inputs and outputs. |
| 186 | W Pac Seismic Net/Japan Trench | Sacks<br>Suyehiro | Tokyo | 6/99 | To establish long-term borehole geophysical observatories in the western Pacific to provide information about subduction zone earthquakes and the mechanics of the subduction process. |
| 186T | Transit | ----- | Tokyo | 8/99 | ---------- |
| ----- | Dry Dock | ----- | TBN | 8/99 | ---------- |
| 186E | HD Engineering | ----- | TBN | 10/99 | ---------- |
| 187 | Aus-Ant Discordance | Christie<br>TBN | Sydney | 11/99 | To investigate relationships of crustal and mantle composition, spreading, and magma supply rates in an area suspected to have unusual mantle dynamics and profound magma supply differences. |
| 188 | Prydz Bay | TBN<br>TBN | Fremantle | 1/00 | To link Antarctic Ice Sheet events with Southern Ocean changes, to recover a record of Antarctica's Plio-Pleistocene glacials and Paleogene environment, to date the first glacial evidence in Prydz Bay. |
| 189 | Southern Gateways | TBN<br>TBN | Hobart | 3/00 | To document paleocean/climatic changes related to the tectonic opening of the Tasmanian Seaway and Drake Passage which thermally isolated Antarctica and spawned the Circumpolar Current. |
| 189T | Transit | ----- | Hobart | 4/00 | ---------- |
| 190 | Nankai | TBN<br>TBN | Guam | 5/00 | To model of fluid-linked diagenetic and tectonic processes in a rapidly deforming accretionary prism by comparing two different wedge tapers and structural geometries within the Nankai Trough. |
| 191 | W Pacific Ion | TBN<br>TBN | Tokyo | 7/00 | To emplace a permanent observatory (downhole seismometer) in the tectonically active Western Pacific at a high-priority area identified by the International Ocean Network (ION). |
| 192 | Manus Basin | TBN<br>TBN | Guam | 8/00 | To understand the chemical fluxes, fluid pathways, and ore deposition of felsic volcanic-hosted polymetallic massive sulfides by probing the active PACMANUS hydrothermal system. |
| 193 | Ontong-Java | TBN<br>TBN | Guam | 10/00 | To determine the Ontong-Java Plateau's age, paleolatitude, emplacement duration, vertical tectonic history, the effects of rift-related tectonism, and the range and diversity of magmatism. |

# HYDROGEOLOGY OF THE OCEANIC LITHOSPHERE

contributed by Keir Becker, Earl Davis, Harry Elderfield, and Jon Martin

Together, ridge flanks and ocean basins represent the majority of the Earth's surface. Ridge flanks are also generally accepted to host by far the greatest proportion of the total flux of fluid through the seafloor but they remain relatively understudied. In an attempt to address this situation, we convened a workshop to review present knowledge on the hydrogeology of the ridge flanks and basins and to articulate plans for future research. The workshop, titled "Hydrogeology of the Oceanic Lithosphere," was held on December 11 and 12, 1998, at the University of California, Santa Cruz. This international effort was cosponsored by JOI/USSSP and the International Lithosphere Program.

Spreading center and subduction zone hydrogeology are also very important scientific issues, but they were not included in the recent workshop, because they are well-developed foci of the RIDGE and MARGINS programs and their international counterparts. In our workshop, we concentrated on the ridge flanks because they are relevant to seafloor fluid flux and, given present technology, these features represent the scientific communities' best opportunities to use ocean drilling for hydrogeological experiments in the oceanic crust.

The meeting was attended by a diverse group of 45 international geoscientists representing disciplines such as geophysics, geochemistry, petrology, alteration, continental and submarine hydrogeology, and microbiology. The first day of the workshop began with invited presentations summarizing the state of our understanding in these fields, and then moved on to open, panel-led discussions of unresolved and new problems in ocean crustal hydrogeology. The second day began with presentations of the contributions from modeling studies and long-term borehole and seafloor observatories, then evolved to discussions of poorly explored environments, new tools and techniques, and new possibilities for multi-disciplinary experiments in the future.

Workshop attendees participated freely and actively in all the discussions, which were illuminating and fruitful. A workshop report is in preparation and will include the following observations and recommendations:

- Significant advances have been made recently in approaching the overall goal of understanding the history of mass and heat transport through the oceanic crust.
- The most useful work has involved truly inter-disciplinary studies including geochemistry, geophysics, numerical modeling, and long-term observatories.
- Recent advances underscore both the pivotal role played by ocean drilling in providing *in situ* samples and experimental capabilities as well as the emerging importance of including microbiology in crustal hydrogeological studies.
- Future work must be truly interdisciplinary (i.e., spanning fields from microbiology to geophysics), and should generally focus on two approaches:

  (1) detailed studies at a few select sites to understand ocean crustal hydrogeological processes, and

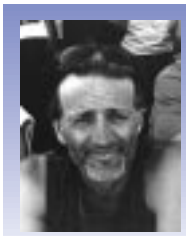
  (2) efficient reconnaissance surveys in "representative" but poorly understood settings, particularly in older ridge flank and ocean basin environments, to assess the levels of hydrologic activity and hence to improve quantitative estimates of global fluxes.

The sampling and long-term sub-seafloor observatory capabilities represented in scientific ocean drilling are crucial to these future objectives. The workshop report will be finalized in time for the Conference on Multi-Platform Exploration (COMPLEX) in May 1999, to provide input on ocean crustal hydrogeology. In particular, we hope this will be of use to the COMPLEX Working Group on Evolution of the Crust and Lithosphere. In addition, the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) Science Committee (SCICOM) is considering establishing a Hydrogeology Program Planning Group. It is our hope that such a group would find our report useful in planning hydrogeological drilling objectives in ridge flank and ocean basin environments.

## THE AUTHORS

Keir Becker is at the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami. Earl Davis is at the Geological Survey of Canada, Pacific. Harry Elderfield is at the University of Cambridge. Jon Martin is at the University of Florida, Gainesville.

# Miocene Evolution of Atmospheric Carbon Dioxide



**Mark Pagani**

**Ph.D. Institution:**
**The Pennsylvania State University**

**Faculty Advisor:**
**Michael A. Arthur**

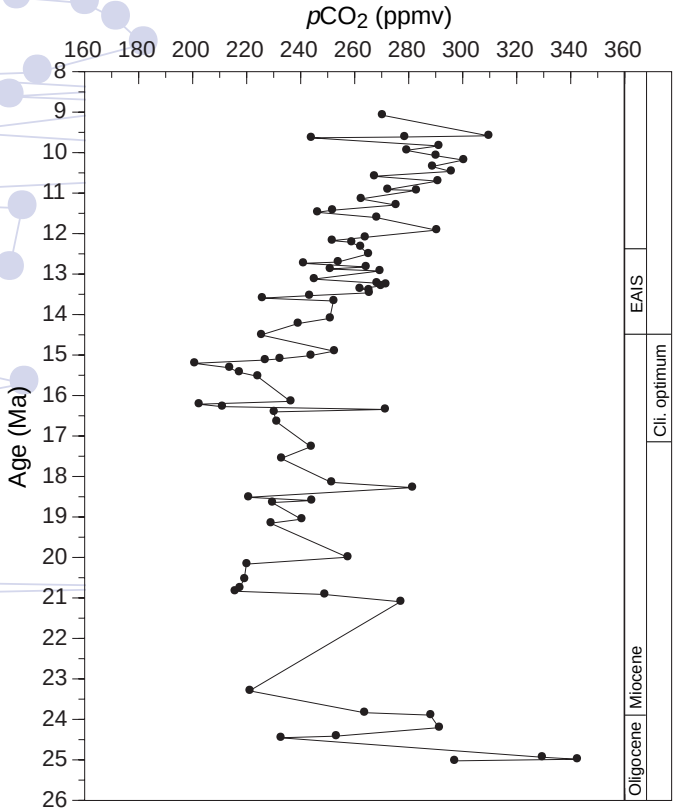



Fig. 1: Maximum $pCO_2$ estimates using $\varepsilon_p$ values from DSDP Site 588. Cli. optimum = climatic optimum. EAIS = expansion of the East Antarctic Ice Sheet.

The JOI/USSAC Ocean Drilling Fellowship Program funded my investigation of the role that atmospheric carbon dioxide played in forcing climate change during the early to middle Miocene. I used the carbon isotopic composition of organic biomarkers and stable isotopic compositions of planktonic foraminifera to assess surface-water chemistry and oceanographic variability.

The late early Miocene is distinguished as an episode of global warming which was terminated by rapid high-latitude cooling and by expansion of the East Antarctic Ice Sheet (EAIS) in the middle Miocene. This middle Miocene climate transition is considered a significant change in the climatic state of Earth, and is thought to have resulted from critically low levels of $pCO_2$ and/or changes in ocean circulation.

Miocene $pCO_2$ was reconstructed by developing records of the isotopic fractionation which occurred during marine photosynthesis ($\varepsilon_p$). The carbon isotope composition of photosynthetic marine organic carbon is a function of surface water [$CO_{2aq}$], growth rate, and cell geometry. $\varepsilon_p$ records were established by measuring the carbon isotopic composition of diunsaturated alkenones; biomarkers exclusively derived from some haptophyte algae, in conjunction with $\delta^{13}C$ values from coeval planktonic foraminifera. Furthermore, sampling was restricted to marine sediments from oligotrophic-type settings. In this way, the effects of cell geometry and growth rate were minimized, thereby leaving [$CO_{2aq}$] as the dominant control on $\varepsilon_p$.

My results provide no evidence for a rise in $pCO_2$ during global warming in the late early Miocene, nor a large decrease in $pCO_2$ associated with EAIS expansion. Instead, Miocene $pCO_2$ appears much lower than anticipated (~ 290-180 ppmv), and thus emphasizes the role of ocean circulation in forcing climate during this time. Although $pCO_2$ was not the primary agent controlling Miocene climate change, low $pCO_2$ could have primed the climate system to respond sensitively to tectonically-driven changes in heat and vapor transport.

# Deep-Ocean Ostracodes and Paleogene Climate Events: Geochemical and Biological Aspects

**Stephen A. Schellenberg**

**Ph.D. Institution:**
**U. of Southern California**

**Faculty Advisor:**
**David J. Bottjer**

For my JOI/USSAC Ocean Drilling Fellowship, I investigated the response of deep-ocean ostracodes to two Paleogene climate events, the Eocene-Oligocene transition and the Late Paleocene Thermal Maximum (LPTM). Ostracodes provide an important perspective on these events because they are the only commonly preserved metazoans in the deep-ocean.

The Eocene-Oligocene climate transition from "greenhouse" to "icehouse" involved significant glacial growth and oceanic cooling, recorded as a ~1.5‰ increase in foram $\delta^{18}O$ (Figure 1a; Zachos et al., 1996). To examine the relative magnitudes of these two climate parameters, I used the Mg/Ca paleothermometry equation for ostracodes (Dwyer et al., 1995) to estimate relative temperature change atop the Kerguelen Plateau (ODP Site 744). The Mg/Ca record shows no clear trend during the $\delta^{18}O$ increase, thus supporting the hypothesis of a largely ice volume effect (Figure 1b). Intra-sample Mg/Ca ratios show higher variability than Neogene records, yet no diagenesis is suggested by Sr/Ca ratios, cathodoluminescence, or scanning electron microscopy (SEM). I am currently conducting morphometric and taxonomic analyses on archival *Krithe* SEM images to examine possible species-level effects on this Mg/Ca record.

In a study of deep-ocean ostracode assemblages across the Eocene to Oligocene transition, Benson et al. (1984) documented lower abundances, greater diversity, and lower provinciality. To better understand the tempo and mode of this event in the Southern Ocean, high-resolution (~22 kyr) ostracode faunal analyses were conducted on Site 744. Valve abundance is greatest prior to the $\delta^{18}O$ event, decreases rapidly at its onset, and then increases during the next ~500 kyr (Figure 1c). Diversity fluctuates strongly during two $\delta^{18}O$ relative maxima (Figure 1d). An ecological turnover, particularly the increase of *Henryhowella*, coincides with the $\delta^{18}O$ event and is associated with ~12% increase in biogenic opal (Salamy and Zachos, 1999) (Figure 1e, f). Whether the Site 744 ostracode record relates to decreased bottom temperatures or to increased surface productivity is being tested by its congruence to stable isotope, paleoproductivity, and faunal events at Maud Rise (Site 689). This inter-site comparison will also provide insight on the applicability of Mg/Ca paleothermometry to Paleogene *Krithe*.

Similar faunal and geochemical analyses are being applied to the LPTM event at Kerguelen Plateau (Site 738) and Maud Rise (690). For both Paleogene events, I will examine how changing environmental conditions affected the valve architecture of selected taxa, and whether architectural responses were transient or retained.

## References:

Benson, R.H., et al., *Science, 224,* 1334-1336, 1984.
Dwyer, G.S., et al., *Science, 270,* 1347-1351, 1995.
Salamy, K.A. and Zachos, J.C., Palaeogeography, Palaeoclimatology, *Palaeoecology, 145,* 61-77, 1999.
Zachos, J.C., et al., *Paleoceanography, 11,* 251-266, 1996.

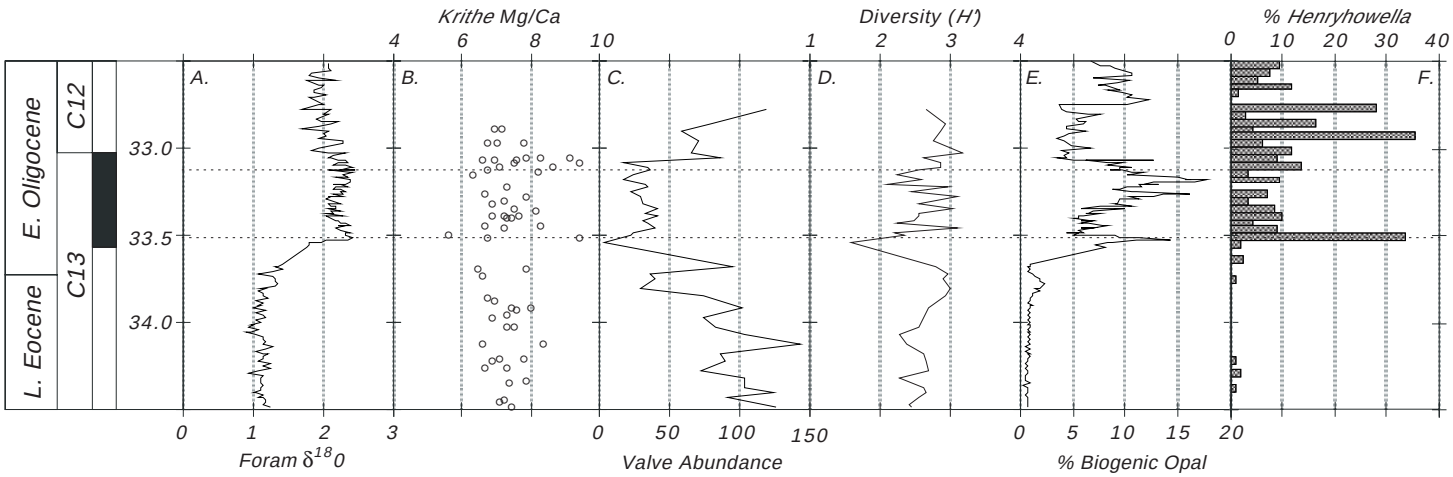



Fig. 1: Paleoenvironmental and ostracode faunal events during the Eocene-Oligocene transition at Site 744 (Kerguelen Plateau). Horizontal lines mark stratigraphic position of two relative maxima in foram $\delta^{18}O$. Stable isotope data from Zachos et al., 1996. Ostracode Mg/Ca data reported in mmol/mol as determined by ICP-MS (RSD < ~1.5%). Biogenic opal data from Salamy and Zachos, 1999.

# AND TO ALL THE SHIPS AT SEA...

Michael Arthur is Professor at the Department of Geosciences, Pennsylvania State University

In a few weeks, the Conference on Multi-Platform Exploration (COMPLEX) will provide an opportunity for over 300 ocean scientists to influence the future, by identifying fundamental Earth system problems that can best be solved by drilling the seafloor. This conference will emphasize "non-riser" objectives, and, I suspect, there will be interest in other platforms. The embryonic program—presently dubbed the Integrated Ocean Drilling Program (IODP)—is envisioned as a "multiplatform" venture. It is to have at least two vessels: one operating somewhat like *JOIDES Resolution* but employing new, updated or enhanced techniques, and a second deep-drilling vessel capable of deploying a riser and other well-control methods. The COMPOST-II document, however, intended "multiplatform" to be even broader. Can two vessels, in concept, satisfy all the major scientific objectives that have been espoused in many extant workshop reports, JOIDES "white papers," etc., and which will be further elucidated at COMPLEX? I urge the scientific community to continue to think big programmatically.

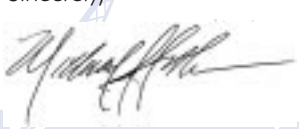
The U.S Science Advisory Committee (USSAC), which is broadly representative of the scientific interests of the community, acts as a steering committee for JOI, responsible for the overall long-term scientific direction and continuity of the U.S. Science Support Program (USSSP). I reiterate this because USSAC must be sensitive to the needs, perceived or explicit, of the U.S. ocean drilling community, and the community must communicate their needs to USSAC. One of my roles as Chair of USSAC is "cheerleader," ("Hey, hey, whaddya' say, let's get the ships and drill today!!"), and I encourage the U.S. community to provide ideas and guidance to USSAC in program development. We will ensure that the needs are conveyed to the appropriate committees or agencies.

So, once again, I pose a question. What facilities or platforms are needed to address fundamental scientific problems? Although we enthusiastically acknowledge Japan's plans to construct a deep-drilling riser vessel, the extent and cost of those capabilities remains unclear. The U.S. community would like to help define the mode of operation of this new vessel and the needs for facilities. Based on the CONCORD document, this vessel will likely prove useful in attacking a certain class of objectives, such as penetrating the seismogenic zone. It is unlikely that its usefulness will extend to the drilling objectives of the paleoclimate/paleoceanography community, which requires numerous high-quality and continuous cores of the upper several hundred meters of pelagic and hemipelagic sequences—hence the requirement for a second platform with *Resolution*-like capabilities.

As John Farrell has noted in his article, there may be a perception that the U.S. contribution to the costs of a two-ship operation would tax the ability of the funding agencies (e.g., NSF) to supply those funds without impacting other science. Although a possibility, it is my view that we must shed this self-limiting perception. As a community, we must have confidence that our scientific objectives are compelling enough to justify substantial increases over present funding levels, and we must continue to push for these resources. This may include not only a two-ship program, but also the addition of other platforms as the needs arise. Strong arguments can be made for adding the occasional jack-up rig for shallow-water drilling objectives, for alternative drilling technologies for recovering zero-age crust, and for deploying special vessels to ice-prone regions, such as the Arctic. In IODP we will have to plan well ahead for such multiplatform efforts, and, in this respect, the advisory structure will face a challenge. Nonetheless, as a community we should continue to embrace all exciting science related to ocean drilling and maintain a positive outlook on the future. We won't get what we don't ask for. So, there's the cheer. I look forward to hearing from you.

Yours truly will be busy teaching a geology/biology field and laboratory course on the Virginia coast during COMPLEX. I deeply regret that I will not be able to participate (or lead cheers), but I will read the conference report and abstracts with relish. Kudos to Nick Pisias and Asahiko Taira (COMPLEX Co-Chairs), Larry Mayer, Marcia McNutt, Hisatake Okada, and Rainer Zahn for organizing this significant event.

Sincerely,



Michael A. Arthur
Chair, USSAC

# ELECTRIFYING ODP PUBLICATIONS

contributed by Ann Klaus

ODP concluded its plans for reformatting the *Proceedings of the Ocean Drilling Program* volumes in December 1997, following three years of deliberations. The two primary reasons for changing the format from paper to electrons were to decrease publication costs and to distribute the science to a broader audience. ODP Publication Services Department began developing an electronic format for the *Initial Reports* (IR) volumes in 1998. The design allows authors to exploit the capabilities of electronic publishing and enables readers to easily print the volume content or view it on-screen.

Beginning with Leg 176, the IR will consist of (a) a spiral-bound, hard-cover printed booklet that contains a 50-page summary of the leg, (b) a CD-ROM, and (c) a user's guide. The CD will include the leg summary chapter as well as other familiar content, such as site chapters, visual core descriptions, digital core images, smear-slide and thin-section tables, and data tables.

All IR volume files on the CD will be in PDF format. This format is accessible on Macintosh, PC, and Unix platforms. The files may be viewed and printed with Adobe Acrobat Reader, freeware that will be included on the CD. The new electronic volumes may also contain data sets in text format and supplementary files, such as MicroSoft Excel documents.

The volume format is designed so that the contents can be both viewed on screen and printed to commonly available black-and-white or color laser printers. The volume files will be constructed with active links from text-to-figures and -tables within a chapter, from chapter-to-chapter, or from chapter-to-text data files. Color graphics and movies will be standard. Core photo images will be presented as 300 dpi color digital images. The ODP Data Librarian at TAMU will make available higher-resolution versions of the core photos for those performing image analyses.

The first volumes published in the new format, IR volumes 176, 177, and 178, are being released this year. ODP will continue its free distribution of volumes to member countries/consortia, scientific party members, and to certain libraries and institutions. Researchers from non-member countries can purchase the new volumes. Availability and pricing of the volumes, along with lots of other information can be found at www-odp.tamu.edu/publications. For instance, all CD content also will be available via this Internet site after CD distribution begins. Leg-related citation lists will be published on the Internet with links to abstracts and/or full manuscripts whenever possible.

## FASTER PUBLICATION OF POST-CRUISE RESEARCH

Beginning with Leg 160, the ODP Publication Policy was changed to allow investigators who receive samples during the moratorium (the one-year period after a leg) to publish in a peer-reviewed, English-language journal or book prior to a specified deadline. Starting with Leg 169, there will be another fast way to publish results. Scientists choosing to publish in the *Scientific Results* (SR) volume may submit manuscripts for peer review as early as 13 months post-cruise. The Editorial Review Board (ERB) will conduct the review upon receipt, and the Publications Department will electronically publish papers on the ODP web site after acceptance. All publications will ultimately be reproduced on a CD volume four years post-cruise.

## EXTENDING ACCESS TO PRINTED PUBLICATIONS

*ODP Proceedings* volumes, which appear in full-print format, are also available on CD and on the Internet for: IR-150X Supplement, 166-175; SR-150X, 152, 154-161 (see www-odp.tamu.edu/publications). When we recently inventoried back issues of the *ODP Proceedings* stored at TAMU, we discovered about 100 copies of most DSDP volumes and almost 300 copies of most ODP volumes. To meet the goal of broadening the dispersal of program-related scientific results, and to reduce inventory, we began a new distribution initiative. Any academic institution or department that does not have direct access to ODP and DSDP volumes, but would like a set, is invited to send a letter of request to Ann Klaus, Manager of ODP Publication Services (Ann_Klaus@odp.tamu.edu). The letter should include a request for the volumes and an explanation of your request. ODP will send a set of volumes for the cost of shipping. ODP will also place the recipient on the free distribution list for future publications. This offer is available "while supplies last" and does not apply to industrial or for-profit organizations.


## Unified Policies for Publication and the Distribution of Samples and Data

This month an integrated sample, data, and publications policy was released. The policy includes some new components. The full policy is available at www-odp.tamu.edu/publications/sdp_pol.html.

**Changes Beginning with Leg 169:**

- The Editorial Review Board remains in effect for 42 months post-cruise. Editorial handling of manuscripts submitted to the SR volume after 42 months post-cruise are coordinated by the ODP Staff Scientist.
- Some submission deadlines have been extended by two weeks. The new schedule is:
  Papers & Data Reports
  - Initial submission: 28 mo. post-cruise (p.c.)
  - Revised submission: 34 mo. p.c.

  Synthesis Papers
  - Initial submission: 35 mo. p.c.
  - Revised submission: 40 mo. p.c.
- Manuscripts intended for the SR volume may be submitted for peer review between 13 and 28 months post-cruise. The ERB will coordinate the review process following preliminary approval of the manuscript by the Staff Scientist. Upon acceptance and revision, SR volume manuscripts will be processed for publication on the Internet. The SR volume will be reprinted on CD four years post-cruise.

**Changes Beginning with Leg 175:**

- All formally invited shipboard and shorebased scientific party members who participate on an ODP leg incur an obligation to ODP to conduct post-cruise research and publish the results.
- Authors must publish (a) a paper or a data report in the SR volume, or (b) a paper in any other peer-reviewed English language publication.
- The initial submission of manuscripts not intended for publication in the SR volume must be within 28 months post-cruise.

ODP Publication Services has met the goals of the publication format change. In FY 1999, savings will be achieved by producing five IR volumes in the new format and by reducing staff because of decreases in SR volume contribution rates. By FY 2001, when all volumes are produced in the new format, we anticipate additional saving. By tracking requests for copies of existing volumes on CD-ROM and hits to the volumes replicated on the Internet, we can see that scientists from around the world are anxious to access ODP publications in electronic formats. In addition, they are taking advantage of the new versatility offered by electronic publications.

ODP Publication Services will continue evolving to meet the changing needs of the scientific community. One of our most important goals is to make the transition to electronic publication as easy as possible for you the user. We encourage you to review the new *Initial Reports* volumes when they're released and give us feedback. You can send your comments or questions to pub_production @odp.tamu.edu or call us at (409) 845-2729 (Ann Klaus, Publication Services Manager) or (409) 845-1160 (Jennifer Rumford, Electronic Publications Specialist).

## The Author

Ann Klaus is the Manager of Publications Services for the ODP Science Operator at Texas A&M University.

# Stepping Towards the Future

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

Plans for a new, international, Integrated Ocean Drilling Program (IODP) to replace the present Ocean Drilling Program when it ends in 2003 have been, and will continue to be, the subject of much discussion in this newsletter. In the vision for IODP, as expressed through numerous planning documents, the scientific drilling community would primarily utilize two vessels. One vessel would employ new, updated or enhanced techniques and operate in a manner similar to the present *JOIDES Resolution*, and a second deep drilling vessel would be capable of deploying a riser and other well-control methods.

A major step toward making this vision a reality occurred at the January meeting of the JOIDES Executive Committee (EXCOM). As part of the Japanese Ocean Drilling in the 21st Century Program (OD21), officials of the Japanese Science and Technology Agency (STA) reported approval of the Ministry of Finance to include funds in their 1999 budget for the initial design and construction of a deep drilling, riser-equipped vessel. The Japanese Diet has since given its final approval. Initial operation of the vessel is planned for the 2004-2005 period, with the vessel becoming available for full international operation soon thereafter. EXCOM (which represents senior leadership from 10 of the 11 JOI institutions) unanimously approved the following motion in response to the Japanese announcement:

> "EXCOM congratulates our Japanese colleagues on the funding in its FY '99 draft budget for the construction of a new drillship with riser capability. This represents the successful culmination of nine years of effort by STA/JAMSTEC, in cooperation with MONBUSHO and ORI, and a potential investment of over $500M (U.S.) in the future of scientific ocean drilling. We commend Japan on the vision and leadership it has shown in pursuing the OD21 initiative, and look forward to incorporating the unique new capabilities of this drillship into a post-2003 IODP."

With this substantial step toward realizing IODP, attention needs to be focused on defining the scientific and technical requirements for the non-riser vessel. An important event in this ongoing process is the major international meeting, the Conference on Multi-Platform Exploration (COMPLEX), which has been scheduled by JOIDES for 25-29 May in Vancouver, Canada (see additional references to this meeting elsewhere in this newsletter and previous issues).

Another major step taken at the January 1999 EXCOM meeting was the formation of an IODP Planning Subcommittee (IPSC) within the JOIDES structure. IPSC will guide the detailed planning activities that will address the scientific objectives, technical and operational issues, and the financial and management requirements for the future drilling program. The committee's chairs and membership will be in place this spring.

Other news of interest to the ocean drilling community is that last October NSF issued an announcement of opportunity for an annual proposal competition addressing the scientific objectives of the MARGINS program with a submittal deadline of January 15 (www.nsf.gov/pubs/nsf9816.html). The Marine Geology and Geophysics Program and Ocean Drilling Program (in the Ocean Sciences Division) and the Continental Dynamics Program (in the Earth Sciences Division) are cooperating in this initiative. Proposals can be submitted to any of the three NSF programs that are named above, depending on their degree of relevance to marine or on-land work. Proposals submitted for support from the Ocean Drilling Program should contain a section that addresses the potential of the proposed research to enhance the effectiveness or planning of proposed drilling activities. This fiscal year (FY 99) approximately $4M will be available for initial funding of MARGINS research proposals. A panel for this first competition will meet in May of 1999. The planning office for MARGINS is presently located at the University of Hawaii under the direction of Dr. Brian Taylor at the University of Hawaii (www.soest. hawaii.edu/margins/).

Finally, we are happy to announce that Jamie Allan has extended for an additional year as an associate Program Director in the Ocean Drilling Program at OCE/NSF.

# THE U.S. SCIENCE ADVISORY COMMITTEE

## MEMBERS

**Dr. John M. Armentrout**
Mobil E&P Technical Center
300 Pegasus Park Drive
Dallas, TX 75265-0232
tele: (214) 951-2865; fax: (214) 951-2265
john_m_armentrout@email.mobil.com

**Dr. Michael Arthur, Chair***
Department of Geosciences
Pennsylvania State University
503 Deike Building
University Park, PA 16875
tele: (814) 863-6054; fax: (814) 863-7823
arthur@geosc.psu.edu

**Dr. Rodey Batiza***
Department of Geology and Geophysics
University of Hawaii
POST Building
Honolulu, HI 96822
tele: (808) 956-5036; fax: (808) 956-5512
rbatiza@soest.hawaii.edu

**Dr. Tim Byrne**
Department of Geology and Geophysics
University of Connecticut
345 Mansfield Road
Storrs, CT 06269-2045
tele: (806) 486-1384; fax: (806) 486-1383
byrne@geol.uconn.edu

**Dr. Steve Carey**
University of Rhode Island
Graduate School of Oceanography
South Ferry Road
Narragansett, RI 02882
tele: (401) 874-6209; fax: (401) 874-6811
scarey@gsosun1.gso.uri.edu

**Dr. Nicholas Christie-Blick**
Lamont-Doherty Earth Observatory of
Columbia University
Palisades, NY 10964-8000
tele: (914) 365-8821; fax: (914) 365-8150
ncb@ldeo.columbia.edu

**Dr. Margaret Delaney***
Ocean Sciences Department
University of California, Santa Cruz
1156 High Street
Santa Cruz, CA 95064-1077
tele: (831) 459-4736; fax: (831) 459-4882
delaney@cats.ucsc.edu

**Dr. Robert B. Dunbar***
Geological and Environmental Sciences
Stanford University
Stanford, CA 94305-2115
tele: (650) 725-6830; fax: (650) 725-0979
dunbar@stanford.edu

**Dr. Gregor Eberli**
Marine Geology and Geophysics
University of Miami/RSMAS
4600 Rickenbacker Causeway
Miami, FL 33149
tele: (305) 361-4678; fax: (305) 361-4632
geberli@rsmas.miami.edu

**Dr. Tim Herbert**
Department of Geological Sciences
Brown University
Providence, RI 02912-1846
tele: (401) 863-1207; fax: (401) 863-2058
timothy_herbert@brown.edu

**Dr. Marvin Lilley**
Box 357940
School of Oceanography
University of Washington
Seattle, WA 98195
tele: (206) 543-0859; fax: (206) 543-0275
lilley@ocean.washington.edu

**Dr. Richard Murray**
Boston University
Department of Earth Sciences
685 Commonwealth Avenue
Boston, MA 02215
tele: (617) 353-6532; fax: (617) 353-3290
rickm@bu.edu

**Dr. David Naar**
University of South Florida
Marine Science Department
140 Seventh Avenue, South
St. Petersburg, FL 33701-5016
tele: (727) 553-1637; fax: (727) 553-1189
naar@marine.usf.edu

**Dr. Lisa Tauxe**
Scripps Institution of Oceanography
University of California
Geosciences Research Division
La Jolla, CA 92093-0220
tele: (619) 534-6084; fax: (619) 534-0784
ltauxe@ucsd.edu

**Dr. Mike Underwood**
Department of Geological Science
University of Missouri
101 Geology Building
Columbia, MO 65211
tele: (573) 882-4685; fax: (573) 882-5458
geoscmbu@showme.missouri.edu

Membership term is three years

* USSAC Executive Committee

## LIAISONS

**Dr. J. Paul Dauphin**
Associate Program Director
Ocean Drilling Program
National Science Foundation
4201 Wilson Boulevard, Room 725
Arlington, VA 22230
tele: (703) 306-1581; fax: (703) 306-0390
jdauphin@nsf.gov

**Dr. John Farrell**
Program Director, JOI/USSSP
Joint Oceanographic Institutions
1755 Massachusetts Avenue, NW, Suite 800
Washington, DC 20036-2102
tele: (202) 232-3900 x211; fax: (202) 232-8203
jfarrell@brook.edu

**Dr. Thomas Davies**
Manager, Science Services
Ocean Drilling Program
Texas A&M University
1000 Discovery Drive
College Station, TX 77845-9547
tele: (409) 862-2283; fax: (409) 845-0876
tom_davies@odp.tamu.edu

JOI/USSAC NEWSLETTER

Editors: John Farrell and Andrea Johnson
Layout and Design: Johanna Adams

The *JOI/USSAC Newsletter* is issued three times a year by Joint Oceanographic Institutions (JOI) and is available free of charge. JOI manages the international Ocean Drilling Program (ODP) and the U.S. Science Support Program (USSSP) which supports U.S. participation in ODP. Funding for JOI/USSSP is provided through a cooperative agreement with the National Science Foundation (NSF).

Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of NSF or JOI. Please contact the editors for more information or to subscribe: *JOI/USSAC Newsletter*, Joint Oceanographic Institutions, 1755 Massachusetts Avenue, NW, Suite 800, Washington, DC 20036-2102; tele: (202) 232-3900; fax: (202) 462-8754; e-mail: joi@brook.edu

JOI/USSAC NEWSLETTER

Joint Oceanographic Institutions
1755 Massachusetts Avenue, NW, Suite 800
Washington, DC 20036-2102 USA

PRE-SORTED
FIRST CLASS MAIL
U.S. POSTAGE
PAID
SUBURBAN, MD
PERMIT NO. 3905

# OCEAN GEOSCIENCE LECTURES

The Joint Oceanographic Institutions/U.S. Science Advisory Committee (JOI/ USSAC) Distinguished Lecturer Series brings the results of Ocean Drilling Program research to students at the undergraduate and graduate levels and to the earth science community in general. During the 1999-2000 season, JOI/USSAC accepted applications from U.S. colleges, universities, and nonprofit organizations to host talks given by the speakers listed below. Institutions chosen to recieve lecturers will be announced in the next issue of the newsletter.

### Building the Ocean Crust: Easy as 1,2,3?
Dr. Rodey Batiza, University of Hawaii

### Recovery from the Cretaceous-Tertiary Mass Extinction
Dr. Steven D'Hondt, University of Rhode Island

### Magnetization of the Oceanic Crust: Applications to Crustal Formation and Earth's Magnetic Field
Dr. Jeffrey Gee, Scripps Institution of Oceanography

### Deformation and Fluid Flow in Subduction Zones: Toward an Understanding of the Seismogenic Zone
Dr. Gregory Moore, University of Hawaii

### The Link Between Ocean Circulation and Global Warmth of the Early Pliocene
Dr. Ana Christina Ravelo, UC Santa Cruz

### Drilling for Methane Ice: Gas Hydrates in Continental Margins
Dr. Carolyn Ruppel, Georgia Institute of Technology