FOURTH

PERFORMANCE EVALUATION

OF THE

OCEAN DRILLING PROGRAM

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EXECUTIVE SUMMARY

The report of the Fourth Performance Evaluation Committee for the Ocean Drilling Program (PEC IV) is relatively brief, and most of our recommendations and suggestions are set in boldfaced type.

ODP continues to be an excellent program and we commend it as a model for how other international geoscience programs might be organized. However, we note that past success does not guarantee the future. Much will depend upon the challenges generated by the Long Range Plan now being developed. The bulk of this report addresses ways in which we believe ODP can be improved.

JOI: New relationships between JOI and its subcontractors are being forged as a result of the reorganization of JOI and the change in its personnel. A proper balance in management style between the extremes of "passive acquiescence" and "micromanagement" is needed. A key measure of the success of ODP is leg success. We urge JOI to periodically review leg success as a quality control diagnostic.

JOIDES: The JOIDES panel structure is mature and functions well, but we are concerned about the amount of material funneling through PCOM and the PCOM Chair. JOIDES must continue to guard against panel members using their inside position to address their own objectives.

TAMU-ODP: As a service organization TAMU-ODP generally gets high marks, but there are a number of concerns. We recommend rigorous and regular personnel reviews at all levels. A number of our specific recommendations address a feeling in the community that TAMU-ODP is sometimes arrogant, that they know best what needs doing and how to do it. Given the recent PCOM recommendations on publications, we do not address that issue specifically, except to note our concern that quality of the existing publications not be sacrificed during this transition.

Although we are generally pleased with the TAMU-ODP response to the recommendations of the Engineering Development Review Committee, we are concerned with the slowness in appointments of top managerial personnel. We strongly urge that JOI and TAMU-ODP closely monitor the JANUS project. We do not need another diamond coring system fiasco.

LDEO-WLS: We are pleased with the community acceptance of downhole logging and the progress of the LDEO Wireline Logging Services operator. Now that the French and UK Borehole Research Groups are in full operation, we believe JOI should review the distribution of funding.

INTRODUCTION

The Ocean Drilling Program (ODP) uses deep ocean drilling to learn about Earth and its history. Its "clientele" is the international community of earth scientists whose representatives are the JOIDES panel structure. ODP is large, complex and expensive. The primary task of the fourth Performance Evaluation Committee (PEC IV) was to evaluate how successful ODP has been in providing the necessary services to its international clientele, the community of earth scientists (see Appendix C for the PEC IV Program of Work and Appendix D for Terms of Reference). The first section of this report is a brief evaluation of the overall program; the second is a review of the component parts and suggestions on how the program might be improved.

GENERAL EVALUATION

The Present and the Recent Past

The Ocean Drilling Program has been a most successful international earth science program. In the light of upcoming reviews on the future of ODP into the next century, we believe it useful to begin this report by noting some of the things about ODP that has made it, and its earlier incarnations, DSDP and IPOD, so successful.

The ODP facility is unique. It consists of a drillship, onboard laboratories, downhole tools and equipment, along with shore-based support. The drillship has proven to be a remarkably effective and flexible platform, from relatively shallow hydraulic piston coring to quite deep penetration. The maximum penetration to date of 2.5 km has been limited by hole conditions, not ship capability, and the multiple casing string system that has been developed may relieve that limitation. The ship has a unique multi-parameter core measurement and analysis laboratory, probably the best single such laboratory in scope and quality in the world. It also has the capability for a unique suite of downhole tools, measurements and experiments. Execution of the program by Joint Oceanographic Institutions, Inc., Texas A&M University, the Lamont-Doherty Earth Observatory and other sub-contractors has been efficient, professional and marked by a drive for continued improvement and innovation.

Development of program objectives and decisions on how these objectives can best be obtained are made by an international community of working scientists and engineers. The program is driven by proposals from individuals and teams of scientists within participating countries (a "bottom up" approach). The JOIDES advisory structure solicits, assists in the development, and prioritizes the proposals. To a remarkable degree, the JOIDES advisory panel structure builds scientific consensus on objectives and priorities.

The program continues to attract many of the best earth scientists. Many give generously of their time to ensure ODP's continued success, strong evidence of the high regard with which the program continues to be held. The program brings together a multidisciplinary, multi-institutional scientific party and

generates integrated geoscience with success that appears unequaled. Participation in a two-month shipboard leg often forges cooperative relationships that last a lifetime.

ODP uses co-mingled funds to develop a single, integrated program to a degree that is rare, if not unique, in international science. No attempt is made to account for precisely how national funds are used to contribute to national objectives, insofar as one can define "national objectives" in such an integrated program. Each member has a significant financial stake in the success of the program, and its ability to guide and participate in the program is approximately proportional to its financial contribution. However, the program that emerges through the JOIDES panel structure is an integrated program. Formal approval of the program by the JOIDES Executive Committee is nearly always by consensus, and the decisions of the JOIDES Executive Committee have never been appealed.

ODP has always been multinational in scientific participation, but is steadily becoming multinational in operation with increasing operational components outside the United States. This has resulted in small but manageable losses of efficiency and increases in cost. However, it has been of great value in spreading the scientific benefits to the participating countries. Further devolution is expected in the future.

The formal governance of the program provides a flexibility of operation not often found in inter-governmental programs. The recent discussions about bringing both a consortium of Tawain universities and China into JOIDES is a current example.

The Future

The future of any program should not be judged solely by its past. The success of any program is dependent upon its ability to improve and renew. Constant renewal and development must be a part of its culture and built into its structure. Although deep ocean drilling has made significant contributions to our knowledge of the earth, in particular to plate tectonics and to paleoceanography, one should not automatically assume that deep ocean drilling will make comparable contributions in the future. Future success will require continuing to attract the best global geoscientists, and this, in turn, requires an innovative and challenging science program closely integrated with well managed technical capability and technical development.

The JOIDES community is now developing its next Long Range Plan. New scientific challenges in the earth sciences may require new and different tools and modes of operation. The Terms of Reference for PEC IV do not call upon us to comment on these plans, which in any event are not fully formulated. In light of our review of the past, however, we do wish to make a recommendation about the future.

Whatever the future of ODP, we believe its structure and philosophy could and should serve as a model for future international geoscience programs.

No program run by humans is perfect. The remainder of this report is a review of the component parts of ODP and suggestions and recommendations in areas in which we believe improvements can, and should, be made.

EVALUATION OF ODP COMPONENTS

Joint Oceanographic Institutions, Inc. (JOI)

JOI is the prime ODP contractor of the National Science Foundation and is responsible for overall program management of ODP. JOI supervises and controls the business functions of the program such as budget development and control, reporting, accountability, and strategic planning.

To an outsider the administrative structure of the Ocean Drilling Program strikes one as convoluted. The direction and final decisions for the program would appear to reside in the JOIDES Executive Committee whose members represent those nations and international partnerships that provide the financial support for the program. Representation on the JOIDES Executive Committee is approximately proportional to the financial contribution of each contributing unit. In fact, formal decision and contracting authority rests with a subset of the JOIDES Executive Committee, the JOI Board of Governors. JOI is a US corporation whose Board of Governors are the US members of the JOIDES Executive Committee.

It is our understanding that the non-US members of the JOIDES Executive Committee prefer this mode of operation, at least in part because of concerns about financial liability. We also understand that there has never been an instance of a JOI decision concerning ODP that was not in concert with a previous JOIDES Executive Committee decision. The system works and we are not aware of any present concerns amongst the members of the JOIDES Executive Committee.

The JOI charter is broad and it was envisaged at its inception that JOI might someday expand its role in the ocean community beyond ocean drilling. For a number of years JOI had a full plate as its role evolved from adviser to manager and the Ocean Drilling Program changed from IPOD to ODP. Although JOI was marginally involved in US ocean science programs not associated with ODP, the situation changed dramatically in 1993 with the selection of a new JOI President whose charge included making JOI a major Washington focal point for the ocean community. We believe the JOI decision to form a separate corporation, the Consortium for Oceanographic Research and Education (CORE), to develop this latter role was good from the point of view of those whose major concern is ocean drilling. Although we recognize that it is not a difficult financial accounting procedure to ensure that funds for ocean drilling are not commingled with other JOI activities, we are concerned about perception. Separate corporations with separate boards and, insofar as it is efficient, separate

personnel, does much to defuse any concern about funds for ocean drilling being diverted to other JOI interests.

Several key personnel now wear two hats; for example, the President and the Chief Financial and Administrative Officer serve those roles in both JOI and CORE, which seems appropriate given the history, size and resources of the two groups. As CORE further develops, the sharing of chief executives may not be appropriate. We wish to emphasize that ODP is a very large, very expensive and very complex program. It is imperative that those in charge of JOI/CORE not let their enthusiasm and excitement for getting CORE up and running lead them to neglect the continuing needs of ODP. As the operation of ODP becomes more international, it becomes increasingly important that there be at least one senior person within JOI whose full time task is the monitoring of all aspects of the ODP operation. We believe the choice of a non-US citizen as the new JOI Ocean Drilling Program Director contributes to the sense that the energies of JOI will not be diverted to the agenda of CORE.

The recent change in key JOI personnel has led to a change in management style. The previous style could be described as "passive acquiescence." Some of JOI's subcontractors are concerned that the new style might be described as "micromanagement." Good management practice calls for something in between.

We urge JOI to find middle ground between passive acquiescence and micromanagement in its relations with its subcontractors.

One of the contributions of PEC III was a leg-by-leg evaluation of the extent to which scientific goals were reached. We have made a similar evaluation of a number of recent *JOIDES Resolution* legs (Appendix A). Reasons for the relative success or failure vary considerably between legs and include quality of site surveys, weather, adequacy of drilling equipment and instrumentation, serendipity, and luck. It is unwise to draw performance evaluation conclusions on the basis of any given leg, but we do believe such evaluations might be drawn from a careful analysis of a series of legs if, for example, success or failure could be attributed to the same reasons. Since the primary *raison d'être* of the entire ODP infrastructure is to generate successful drilling legs,

We recommend as a method of quality control that JOI conduct systematic post-cruise evaluations of the *JOIDES Resolution* drilling legs on an annual basis.

It has been suggested to members of PEC IV that in spite of leg-by-leg *Initial Reports, Scientific Results* and brief summaries in *Eos,* the ODP accomplishments are not as widely appreciated by the geoscience community not directly associated with JOIDES as one might hope. At one time there was support for multiple leg synthesis reports which were widely appreciated. Continuing support for ODP requires wide-spread support from the international geoscience community.

We urge JOI to investigate ways to make the results of ODP more widely

known and appreciated and to consider the reinstitution of funding multileg syntheses.

The Ocean Drilling Program must be one of the most reviewed programs in the National Science Foundation. Reviews range from periodic "program evaluations," such as this one, to the highly focused, such as the recent Engineering Development Review Committee (EDRC) evaluation of the engineering development effort at TAMU-ODP. In addition, the JOIDES service panels, such as the Downhole Measurements Panel and the Shipboard Measurements Panel, provide a continuing review function to portions of the program. Reviews are important, but they are not cost free. The largest cost is probably the time required by the reviewee in preparation for the review, but the time donated by the "free" committee members is not trivial. The members of PEC IV are strong advocates of periodic program review, but are aware of the intensity of review that ODP components undergo,

We suggest JOI evaluate ODP reviews in an effort to determine review cost effectiveness.

For example, JOI should review the recommendations of PEC III, and possibly PEC II—and those of PEC IV a year from now—to determine what number of PEC recommendations have been implemented. If the percentage is low, JOI and NSF may wish to give up the practice of routine PEC reviews to save money and significant time and effort of both the reviewers and the reviewees.

JOIDES Science Advisory Structure

The members of the JOIDES Science Advisory Structure (JSAS) are the ODP representatives of the international science and engineering community. JSAS consists of a Planning Committee (PCOM), four thematic panels, five service panels, and a varying number of ad hoc planning groups and working groups.

The JOIDES Science Advisory Structure plays a critical role in the success of the Ocean Drilling Program. It provides a large pool of expertise to ODP both in scientific program development and in technical operations. It has a secondary role of carrying back to the community the results, achievements, and importance of the program. Specific comments on the committee structure and the Long Range Plan are provided below.

Committee Structure

Planning Committee (PCOM): For all members of the JOIDES panel structure save one, service is voluntary and part time. Only the PCOM Chair devotes full time to JOIDES, and the task is enormous. All panel and working group recommendations flow through PCOM. Formally, all recommendations flow from PCOM to JOI and then to the subcontractors. In fact, many recommendations (particularly from the service panels) follow an informal,

direct path to the relative subcontractor group. This practice is both effective and efficient, but can cause difficulty when the budget consequences of panel recommendations have been inadequately evaluated. We understand that the JOI ODP Director and the PCOM Chair are planning a systematic review of all recommendations and action items after each PCOM meeting. Such a review should flag potential conflicts and budget implications. However, PEC IV continues to be concerned that the PCOM plate is often too full. Since the continuing success of the program depends significantly on the wisdom and decisions of PCOM, we urge JOIDES to continue to search for ways to provide PCOM sufficient time to concentrate on key ODP issues.

Much depends upon the effectiveness and efficiency of the PCOM Chair. A strong Planning Committee Chair with good administrative skills and a strong sense of the recent history of ODP and JOIDES recommendations is vital to the success of the program. Finding a PCOM Chair with strong familiarity with the program is easier than finding one with the requisite administrative abilities. Not all good scientists are good administrators. For even the most experienced scientist, there is a steep learning curve as PCOM Chair. Two years may be too short a term, but if one expects the PCOM Chair to be an active scientist, two years is about as long as one can expect such a person to take leave from his or her research. The present system of rotation has been in place since the first days of DSDP, and one could argue that if "it ain't broke why fix it?" PEC IV could not reach a consensus recommendation on this issue other than suggesting that EXCOM may wish to revisit its long standing practice of automatic two-year rotation of the JOIDES office and the PCOM Chair, and consider using an international competitive process for future selection of the PCOM Chair and JOIDES office with a term of perhaps longer than two years. Such a process could mean a decoupling of the present arrangements whereby the EXCOM and PCOM Chairs come from the same institution in the US and from the same country when the office is outside the US.

Thematic panels: These panels have developed a largely mature structure of reviewing and prioritizing drilling proposals, but one consequence of the change from regional to thematic panels is that the overworked Planning Committee now has greater responsibility in packaging and scheduling a series of legs. JOIDES must continue to strive for a balance between rotation of members (to keep the program open to new ideas) and retention of a corporate memory of panel deliberations and recommendations. This corporate memory is needed in order to provide a mechanism for planning multiple-leg science projects and to avoid resurgence of second order objectives and regional targets following panel rotation (e.g., return to the Iberian continental margin for the fourth—and unsuccessful—time). Member rotation also reduces concern that the JOIDES panel structure is a closed community. Adding a few senior members of the international science community, who are not actively involved with ocean drilling, would also help reduce that concern.

Based on a non-exhaustive review, it would appear that JOIDES panel members, as well as PCOM members, are well connected with other national and international geoscience programs that might interact with ODP, and appear to

be more aware of how ODP might assist other programs rather than the reverse. Given the maturity and extensive JOIDES panel structure, this dichotomy is not unexpected. Finally, we note,

JOIDES must continue to strive for a culture that emphasizes panel member integrity to avoid using members' "insider position" as a vehicle for advancing mainly their own objectives.

Service panels: These panels have been extremely successful in promoting and initiating, together with the science operator, a "permanent revolution" of the scientific and technical facilities on board the *JOIDES Resolution* and at TAMU-ODP. We are concerned, however, that too many panel recommendations funnel through the Planning Committee. Given the mature state of the program,

We suggest that JOIDES combine certain service panels into sub-panels that report through a single Technical Services Panel (TECHCOM).

TECHCOM membership could be a subset of the members of IHP, SMP, DMP, and TEDCOM, and these four service panels could meet at the same time at TAMU-ODP when practical. Our primary reason for making this recommendation is for TECHCOM to review advice for potentially conflicting items and to establish priorities before recommendations are transmitted to PCOM. In our review of this program it did not appear that PCOM had either the time or the energy to be the necessary filter before passing recommendations forward. The work of PPSP and SSP is unaffected by this recommendation.

Long Range Plan

Revision of the Long Range Plan is the most critical task presently before JOIDES. The Long Range Plan provides the scientific vision for the future and is vital to the justification and renewal of the program. The plan needs to focus on the key scientific issues for which ocean drilling can play a significant role in expanding our knowledge. As the new Long Range Plan is in an evolving state, it is not appropriate for PEC IV to comment on the specific contents of the new plan. We offer the following considerations in the development of the new Long Range Plan:

Although the Long Range Plan may push technological improvements, the plan should not have major components that are dependent upon unproved tools or present tools not adequate to the tasks.

Although PEC IV is concerned about a Long Range Plan that requires unproved technology, we also note that mature programs often become conservative.

Consideration and evaluation of new platforms and alternative methods of operation should be a part of any future Long Range Plan and contain scientific challenges worthy of the past.

When the new Long Range Plan is completed, the JOIDES committee structure should be reviewed to ensure that the structure is appropriate for meeting the goals of the plan.

Leadership

We recognize that the strength of ODP is its "bottom up" approach to scientific planning and it is not our intention to recommend any significant change in the process. However, ODP is a large program with a significant amount of inertia. We believe there is merit in having the key, full-time administrative/science leaders of this program meet regularly.

We recommend the PCOM Chair, the Director, Ocean Drilling Programs of JOI, and the Director, Science Operations of TAMU-ODP meet regularly to focus jointly on long-term management issues of ODP.

The results of their deliberations would be transmitted to PCOM, JOI, or EXCOM as appropriate.

Texas A&M University-ODP

The Texas A&M University-Ocean Drilling Program (TAMU-ODP) is a part of the Texas A&M Research Foundation (TAMRF) and it is TAMRF that is the by far the largest subcontractor to JOI. TAMU-ODP responsibilities include operation of the JOIDES Resolution *and associated activities of cruise staffing, logistics, engineering development and operations, curation and distribution of core samples and data, operation of shipboard laboratories, and publication of scientific results.*

The TAMU-ODP operation is neither fish nor fowl, it is partly service and partly scientific academic. In its scientific academic side it is housed in an academic institution and its director reports to an academic dean. A few TAMU-ODP staff hold academic appointments and some TAMU-ODP staff are expected to contribute to the ODP and other scientific literature. TAMU-ODP is also a service organization whose task is to satisfy the needs and desires of the international science community. Tasks range from overseeing the operation of the drillship, selecting the shipboard scientists, getting scientists to the ship on time, ensuring that ship laboratories are both well staffed and well equipped, developing specialized equipment, archiving data and core material, and ensuring timely publication of results.

Service organizations are judged by their ability to satisfy client needs. TAMU-ODP gets generally high marks from its clients, but there are a number of potential problems of which JOI, TAMRF and TAMU-ODP should be aware:

Service organizations must be sensitive to their client's needs and keep their client happy, even when the client appears to be unreasonable, and even when they believe they know better than the client. TAMU-ODP's scientific clientele is continually changing. After 11 years there is often more historic memory in

TAMU-ODP than can be found in JOIDES panels, and it is perhaps not unexpected that TAMU-ODP sometimes thinks it knows its client's needs better than the client itself. To the client that is often considered arrogance.

Management of TAMU-ODP is critical to the success of the program. It is not unusual in an academic organization for a key administrator to have such heavy collateral duties as to require neglect of his primary function for some months. Nor is it unusual for a university or government laboratory to take several months, or even a year, to fill key administrative positions. Absentee leadership and taking that long to find a new CEO or key division leader is unusual in industry and should be so in an organization such as TAMU-ODP. The long delay in appointing a Director is not satisfactory.

Formal written and face-to-face annual personnel reviews are standard in many organizations, and we understand that such is the practice at TAMU-ODP, although such reviews at the most senior level are relatively new. We commend the practice, but also note that in organizations where everyone is busy and where there is general agreement that all is going well, there is an all too human tendency to make such reviews mostly *proforma.* From a random sampling by members of PEC IV during our visit, we would urge TAMU-ODP not to fall into such a trap. Formal review of university faculty generally includes outside recommendations at time of promotion. We believe periodic soliciting of outside evaluations of senior members of the TAMU-ODP staff would be appropriate. We understand the the Director of Science Operations is not evaluated as a part of the formal review process. We believe he or she should be.

As a service organization TAMU-ODP has no competition. In a highly competitive service industry any one of the concerns expressed in the three paragraphs above could lead to bankruptcy court. At of the time of the writing of this report, the new TAMU-ODP Director of Science Operations had not yet been chosen after a three-month vacancy.

We urge TAMU-ODP and the new TAMU-ODP Director of Science Operations to note the concerns listed above and to take appropriate action as necessary and so inform JOI and JOIDES EXCOM.

A cursory review of the TAMU-ODP organization charts suggest a high degree of over-management. For example, of the fourteen full time members of the Science Services Department eight carry administrative titles. We understand that this "title inflation" is a consequence of Texas A&M University salary schedules. The titles are necessary to provide adequate compensation to the incumbents and do not adequately describe the work performed. We are satisfied that this is indeed the case in most, if not all, circumstances, and

We urge TAMU-ODP to explain this situation to others, particularly to those non-US members who pay the bills, and who may not be familiar with this quaint US practice.

However, even after allowing for "title creep" to satisfy salary needs, there was some continuing concern on the part of PEC IV that the ratio of real managers to real workers might be high in some parts of the organization.

We recommend that the new TAMU-ODP Director of Science Operations undertake a formal desk audit of personnel job descriptions and actual duties to determine if PEC IV's unease is justified.

Since the primary task of TAMU-ODP is to provide an effective and efficient drilling platform we believe it important that senior and middle management personnel go to sea on a regular basis. Short transit trips are a poor substitute.

We recognize that taking two months off from a key administrative position can be difficult, but we believe taking the necessary time to go on an operational leg is time well invested, and we urge all TAMU-ODP senior and middle level managers to do so on a regular two-to-three year schedule.

TAMU-ODP Science Services

This department provides two quite separate services. The first is the provision of editorial, art and photographic services for cruise related scientific/technical publications. The second is the maintenance of four operational core repositories, each staffed with a repository superintendent and curatorial scientists.

Publications: The publication unit of the Science Services department operates under a number of constraining factors, most notably declining budgets and recent JOIDES policy recommendations that limit their editing role. Changes in the publication process have resulted in budgetary savings and increased timeliness of *Initial Reports* (IR) and *Scientific Results* (SR) publication. Careful review of ODP publications by JOIDES panels and the dedication of Editorial Review Board members and ODP publications staff has resulted in significant strides toward the goal of changing the perception of ODP *Scientific Results* publications as "gray literature."

As a result of the recent JOIDES recommendations, we are perhaps the first Performance Evaluation Committee with no significant recommendations on publication policy; we endorse the JOIDES recommendations. We note, however, that these recommendations will result in significant changes in the status quo and for this reason we have certain concerns and recommendations. We believe there is no substitute for carefully edited, quality publications such as the *Scientific Results.* These will remain the legacy of ODP.

We urge that continued attention be paid to the technical review and editing of the SR volume to ensure that the strides against the "gray literature" perception are maintained.

We note that the attitudes in the Publications department range from trying to produce the highest quality publications in all respects to "It's just a book," as

recently posted on an office door. As a result of these constraining factors and attitudes, we are concerned that the attention that is focused on assuring a high quality book in terms of physical and archival characteristics is not equally focused on assuring high quality in all other aspects of production and editing. Recent improvements in communications among units in this department is a very positive step.

We recommend the leadership within TAMU-ODP, the Science Services Department, and the Information Handling Panel (IHP) send a strong and coherent message to all within the department that ODP publications are the legacy of ODP science and that publications must continue to reflect that legacy.

JOIDES publications policies and Science Services management need to maintain some flexibility in working with Co-Chief Scientists and Staff Scientists in order to produce the best volume to convey the scientific results, in keeping with overall timelines and general policies.

Finally, we note that the goals of the leg Co-Chief Scientists and Science Services management are the same: the production of high quality, timely reports. We fully recognize the need and the difficulty in maintaining both deadlines and standards, but ODP publication efforts should, if at all possible, be a cooperative venture.

We urge that JOIDES policies allow for some flexibility in working with Co-Chief Scientists and Staff Scientists in the joint effort to produce the best possible volume of scientific results in a timely manner.

Curation: With the founding of the Bremen Core Repository, ODP has further advanced the internationalization of the program to a new level. This split-up into different core repositories may appear at first view more costly and inefficient. However, we believe that whatever loss there may be in efficiency is more than compensated by enlarging the group of scientists actively involved in using the material which, in turn, brings additional funds into the program. Although e-mail and conference telephone calls can do much to insure uniformity of management, there is no substitute for occasional face-to-face meetings.

We urge TAMU-ODP to arrange annual or bi-annual meetings of the curatorial employees for discussions, introduction of new techniques, comparison of notes, etc.

There appears to be some overlap in activities and responsibilities between those in the Technical and Logistics Support department and those responsible for curation, a problem that especially affects the Marine Laboratory Specialists (formerly referred to as Marine Technicians) on board the drillship.

We suggest that TAMU-ODP look into this "boundary problem" and make whatever adjustments necessary.

Recent advances in our knowledge of the rapid changes possible in paleoceans has resulted in an increased demand by paleoceanographic groups for high-resolution sampling which in turn may require some reconsideration of the general sampling policy.

We urge the appropriate JOIDES panels to consider this problem and make whatever recommendations appropriate.

Finally, we note the heavy and often time consuming requirements for those on board ship for sampling on paleoceanographic legs. Shore based sampling parties have been used on some legs and we believe such a practice should be institutionalized to reduce the workload on the shipboard scientific party.

We recommend that the responsibility for sampling for shore-based proponents be shifted to shore-based sampling parties.

TAMU-ODP Information Services

This department maintains and develops ODP databases and archives and is responsible for maintaining and upgrading ODP computer services.

The creation of the Information Services department in 1992 seems to have been a very positive action. The group has a clearly defined role in support of TAMU-ODP operations and a common future vision. Since the beginning of ODP there has been an explosion of computer systems aboard the *JOIDES Resolution* and the group has effectively modernized the shipboard computer systems in concert with IHP advice. We note that one unit of the Information Services Group, the Marine Computer Specialists, reports to the Technical and Logistics Support department when at sea. Although such a dual reporting structure is not considered good management practice, the system appears to be working, but it does require continuing good communication at the supervisor level between the two groups.

The amount and types of data collected by ODP has grown over the years, and there has been growing concern about the ability to recall data and formats from earlier periods. The JANUS project is an outgrowth of the recognition by JOIDES panels and TAMU-ODP of the need to create an integrated, modern, and flexible database that will increase data availability and ease of use. To many in the JOIDES community it has taken much too long to get this program up and running, but the resulting project appears well thought-out. The goal is a database that is sufficiently flexible in design to allow data collection from new systems, and is designed for both maximum access and ease of access and retrieval. The timeline for the project is aggressive and the budget estimates optimistic.

We strongly recommend that JOI as well as TAMU-ODP monitor closely the JANUS budget, schedule, and progress toward multiple goals.

The task of migrating existing ODP and DSDP data from current databases to the new database is not a part of the JANUS project as currently planned and budgeted. Eventually these tasks must be completed.

We recommend the JANUS Steering Committee consider the need, cost and relative priority of these various tasks and make appropriate recommendations.

TAMU-ODP Science Operations

Science Operations has the responsibility for all TAMU-ODP involvement with scientific affairs, from liaison with JOIDES Panels to, and including, all shipboard activities, implementation of procedures and policies, pre- and post-cruise meetings and publication of results. They are also responsible for ensuring that the ship and shorebased scientific equipment meet the needs of the science community.

Staff Scientists are key to the day-to-day success of the program. They participate in all phases of the legs to which they are assigned from the pre-cruise preparations to the completion of the final report. Aboard ship, they are the TAMU-ODP representatives and must work with the Co-Chiefs and other scientists to ensure that the required activities are performed and the data and results are recorded according to ODP regulations. The table of organization calls for seven Staff Scientists. Reported past problems of low morale seem largely to have disappeared, but we note that recently the full complement of seven has not been maintained. Given their range of responsibilities,

We urge the full complement of seven Staff Scientists be maintained to meet the needs of the six-leg annual schedule.

We note that there is only one grade of Staff Scientist although there seems a wide range in their experience and scientific credentials. Some members of PEC IV thought this difference should be recognized by differentiation in title, but we reached no consensus. We did agree that much of the success of Staff Scientists depends on their ability to relate to the scientific party and in this regard, their scientific credentials are influential.

We believe publication of papers by Staff Scientists in recognized international journals should be encouraged by TAMU-ODP management and performance in this category should be given substantial emphasis in assigning merit raises and other forms of recognition.

TAMU-ODP Technical and Logistics Support

This department is responsible for shipboard technical support for core handling, for safe and proper operation and maintenance of shipboard equipment, and for the upkeep and maintenance of shipboard laboratories.

The Technical and Logistics Support department forms a significant part of the backbone of the day-to-day operation of the shipboard laboratories. The group has an excellent performance record over nearly 60 drilling legs in the last 11 years. The re-establishment of the Alternate Sea Pay Policy (staff work only on alternate legs, and may live anywhere they choose) program has helped to improve the morale of the Marine Specialists (formerly referred to as Marine Technicians). PEC IV found no major problems that required addressing but did find a number of issues that we believe could improve the operation.

We suggest that although it may split managerial responsibility, it may be appropriate for the Core Curator (in Science Services) be given some supervisory role, since many of the day-to-day issues faced by the Marine Laboratory Specialists are associated with core sampling.

We suggest establishing a pro-active flexible training program for Marine Laboratory Specialists who take care of the increasingly difficult and expensive high-tech equipment on board.

We suggest TAMU-ODP management develop a more structured program for the Marine Laboratory Specialists working at TAMU-ODP during their "off legs," perhaps by encouraging participation in post-cruise science under the guidance of a Staff Scientist.

We suggest that at pre-cruise meetings the Co-Chief scientists be urged to give more recognition to the important contribution of the Marine Laboratory Specialists; for example, citation and/or acknowledgment in published papers.

As one member of PEC IV phrased it, too frequently the scientists treat the Marine Laboratory Specialists as gray mice.

TAMU-ODP Drilling Operations and Development Engineering

The Drilling Operations group is responsible for the planning and implementation of the shipboard drilling and coring program. This task includes the implementation of new hardware, techniques and tools.

The Development Engineering group is responsible for supporting the requirements of the Drilling Operations group including the development of technology required to successfully accomplish the scientific mandated goals.

The drilling and coring operations are run by skilled and motivated professionals, many of whom come from the oil industry with considerable experience and broad backgrounds, and they have adapted their expertise to the special requirements of the ODP scientific enterprise. A review of the Operations Reports and interviews conducted aboard ship indicate that a very important set of tools and techniques have been developed, successfully deployed, and improved leg after leg.

The Drilling Operations and Development Engineering staffs work closely together on the design, adaptation and improvement of drilling and coring tools and components to improve the effectiveness of the ODP program. A striking recent example of this work was the special operations and engineering effort required by the difficult conditions encountered on Leg 158.

Although the Drilling Operations and Development Engineering have much to be proud of, we continue to be concerned about the lack of communication at various levels between those charged with Drilling Operations and Development Engineering and those responsible for meeting science objectives. For example, engineering development would be improved if the group was given longer lead time. Preparation of drilling operations would be made easier by management providing more time to plan complex operations, which in turn reduces the risk of the staff "working on edge" and "being burned out."

We urge the Science Operations department to work more closely with the Drilling Operations and Development Engineering department in order to provide the maximum time possible to develop or adapt the necessary tools and equipment.

The science community should have a variety of information ranging from brochures to detailed reports that identify and assess tools, components and techniques available to them on the drilling ship and how this equipment performs under various conditions. The science community has benefited from similar type material prepared by the Wireline Logging Services group at LDEO. Although the Drilling Operations and Development Engineering department has prepared some material about the different tools, we believe more can be done.

We recommend that the Drilling Operations and Development Engineering department, working with Staff Scientists, prepare such brochures and reports that could be made widely available to scientists who are potential ship users.

A continuing problem faced by the development engineering group is the opportunity to field test its tools in ocean bottom conditions for which they are designed. The occasional engineering leg is helpful, but it would be much more effective and efficient if, on occasion, a few days of a regular drilling leg could be dedicated to tool and equipment testing.

We recommend that JOIDES work closely with the TAMU-ODP Development Engineering group to arrange suitable opportunities for tool and equipment testing on regular ODP legs.

Diamond Coring System. Although the Drilling Operations and Development Engineering department has an enviable record of successes, it has had one large and expensive recent failure, the diamond coring system (DCS). The analysis of that problem has been covered in some detail by the report of the Engineering Development Review Committee (EDRC). We are pleased to see that TAMU-ODP has responded positively to the EDRC recommendations. Reorganization of the Development Engineering group following EDRC report

recommendations has resulted in an improved organizational structure and improved morale, but the appointment of a manager is still urgently needed.

We recommend that TAMU-ODP management make a high priority the filling of the position of Manager, Drilling Operations and Development Engineering.

The revised DCS project is still in the feasibility study phase and is being carefully monitored by a TEDCOM subcommittee as recommended in the EDRC report. It is important to have soon a realistic budget estimate for the full development of the DCS in order to assess whether or not ODP can afford it.

Based on recent experience with the development of the diamond coring system, we are concerned that should the ODP Long Range Plan contain objectives that require a major engineering development, TAMU-ODP might not have the capability and budget to undertake such a development.

JOIDES Resolution

The outstanding ODP scientific results would not have been achieved without the excellent performance of the *JOIDES Resolution* drillship. The officers and crew of the ship are professional and dedicated. The ship is well maintained. It is remarkably successful at maintaining its schedule and loses little leg time to operational problems. Those who have sailed on her are impressed with the concern shown about safety.

A continuing danger of a mature program is a hardening of the arteries which can manifest itself in a number of ways. One is increasing bureaucracy. Several who have participated on *JOIDES Resolution* legs or have otherwise been active in the program have noted what appears to be an increasing number of regulations and policies. Maybe all such regulations are necessary, but a periodic review can be useful. Those best able to pinpoint the most annoying are those who have recently participated on a leg.

We recommend as part of the post-cruise meetings for the next few legs that TAMU-ODP solicit advice and suggestions about rules, regulations and policies that range from annoying to onerous, and make whatever changes it can.

We also note that legs are long, laboratories cramped and living quarters crowded. For those whose sea-going is regular rather than occasional, these conditions can become oppressive. We recognize that given all the constraints, significant improvement in this situation is unlikely, but as one scientist who has sailed aboard *JOIDES Resolution* said, "even a few more port holes would help."

We urge that TAMU-ODP, in cooperation with SEDCO, review the options available for improving living and laboratory conditions.

Lamont-Doherty Earth Observatory

The Lamont-Doherty Earth Observatory of Columbia University is a subcontractor to JOI and is responsible for Wireline Logging Services (LDEO-WLS) as well as JOIDES Site Survey Data Bank services.

Through a subcontract from Columbia University, Schlumberger provides basic logging services on the drillship. Two other subcontracts provide a part of the log processing and some research analysis: Institut Méditerranéen de Technologié (IMT) in Marseille, France, and Leicester University (LU) in the UK. LDEO-WLS provides several special tools not available routinely through the Schlumberger contract and has been involved in tool development through several external sources.

TAMU-ODP provides some downhole tools and is responsible for much of the downhole operations requirements while LDEO-WLS manages the Schlumberger subcontract and provides some additional tools as well as external data collection and management. Close cooperation between TAMU and LDEO is necessary and some friction is inevitable. The cooperation appears to work adequately, but could be further improved. Integration would be facilitated if the LDEO-WLS logging was a subcontract through TAMU-ODP (this was the DSDP model). However, there are advantages in spreading the ODP contracts more widely around the community and the current, more open model of multiple contracts through JOI seems preferred.

LDEO-Wireline Logging Services Operator

The Wireline Services Operator is responsible for providing a full suite of geophysical and geochemical logging services, involving acquisition, processing, and interpretation of logging measurements.

The LDEO-Wireline Logging Services Operator (LDEO-WLS) has progressed from a development, selling and ODP community education mode, to a more stable operational mode. This is in part reflected by the change of director. The routine suite of logs now employed are generally the most complete and advanced in the industry, and many more logs and higher quality logs are now being obtained than in DSDP and earlier ODP years. Logs and other downhole measurements are becoming more used and better appreciated by the ODP scientific community. LDEO-WLS provides most of the training of individual scientists.

Optimum data processing, quality control and data management appear to be receiving increasing attention. The database system, although still being developed, appears to be operating effectively. Most digital log data is readily available to the scientific community and the access and number of requests for data is steadily increasing (an average of more than 200/yr over past the four years).

In the opinion of PEC IV, the overall operation (including the subcontracts) is effective and efficient.

As part of the recent rebidding of the logging services contract, LDEO-WLS arranged a cooperative proposal with IMT in France and LU in the UK, which was accepted by JOI. The IMT subcontract provides for the processing and analysis of Formation Micro Scanner and electromagnetic logging data for ODP and shipboard participation of logging scientists. The LU subcontract provides for processing and analysis of geochemical and sonic waveform logging data for ODP and shipboard participation of logging scientists.

The original proposal by the two non-US institutions was for an equal or near equal partnership with LDEO-WLS. However, the final arrangement was for IMT and LU to be subcontractors to LDEO-WLS and to receive only a small part of the contract funding ($0.25 million each, compared to $1.8 million for LDEO-WLS, after the Schlumberger contract is subtracted out).

LDEO-WLS pays a variety of common costs, however, the IMT and LU groups provide a substantial part of the services, i.e., each providing 1/3 of onboard log scientists and each a major part of the routine systematic log processing. After initial start up problems (such as LDEO-WLS concern with poor quality control and timeliness in processing by the IMT and LU groups, and IMT and LU concern that they had too much work and too little budget) the overall system seems to be working reasonably effectively. The three groups are meeting more often, further training has been arranged for IMT and LU staff, and the three groups have jointly sponsored a successful symposium at the 1994 AGU meeting in San Francisco.

Although the relatively small IMT and LU budgets units may have been appropriate until they established creditability,

We recommend that JOI undertake a review of funding and downhole logging roles responsibilities of LDEO-WLS and LU and IMT.

Several issues are identified. There are insufficient funds to provide sea pay for IMT and LU staff, but LDEO-WLS staff do receive sea pay. There appear to be inadequate funds for processing (especially at LU). We understand that the IMT and LU subcontracts are only a year in duration. Some external form of subcontract tenure of more than one year is required to allow staff and operational stability at IMT and LU. Quality control standards should be agreed upon and specified in the subcontract.

PEC IV recognizes that this type of multi-institution arrangement is operationally difficult and to some degree inefficient. However, the extra cost seems to be outweighed by the very substantial communication of expertise and information to the international ODP community. PEC IV was impressed that both IMT and LU have leveraged the small LDEO-WLS contract funds to develop significant log research groups including a number of research students. They have also brought appreciation of the potential of ODP and other research logging to their

local geoscience communities. This type of internationalization of ODP operations requires careful development but may be a model for the future.

Schlumberger

Although there are a number of suppliers of logging services to industry, Schlumberger dominates this market and has the largest research and development capability. It has received the logging subcontract (renewed annually) since the start of ODP. A problem exists in that the tool suite and the Schlumberger log engineer must remain on the ship for each two-month leg although he may be active for only a few days. There was earlier some indication that the service provided was not of the highest quality, but apparently with representation to the more senior management in Schlumberger that ODP has a high international profile, there appears to have been improvement. Based on a visit to Schlumberger headquarters in Paris by a sub-group of this committee, the company appears to be quite open to joint development agreements and other cooperation (they were reported to be rather closed in earlier years). Such cooperation needs to be negotiated with the senior management not the log services contact office in Houston. The Schlumberger staff recognize that ODP full coring (very rare in industry) provides a unique opportunity for calibration of logging tools and of processing, and that there is substantial log research being done in the ODP log units that is of interest to them. Although the availability of other log services suppliers should be monitored, Schlumberger performance is too good to contemplate a change. Cooperative development with the company has the potential of being very beneficial to both ODP and the company. In summary: PEC IV believes that ODP was getting good value from the Schlumberger subcontract.

The Future

The LDEO-WLS, its subcontractors and TAMU-ODP appear to appreciate that increasing logability of holes and data quality are top priority for ongoing improvement (i.e., keeping holes open for logging and the problem of highly variable hole diameter from washout because there is no mud to stabilize). However, it is essential that new tools and other capabilities be encouraged. LDEO-WLS has undertaken a number of subcontracted tool developments and improvements. Some have been very successful and are now used extensively. However, some were very unsuccessful experiences. Well defined contract specifications are needed as well as close management of such efforts.

Third party tool development by outside scientists is an important avenue for innovation and should be strongly supported. Procedures for acceptance and assistance have recently been defined. However, these are necessarily complex and difficult. LDEO-WLS should be prepared to assist potential proponents in satisfying ODP technical and safety requirements. However, the costs (sometimes hidden) to LDEO-WLS and TAMU-ODP operations also must be recognized and budgeted. As with the development of tools by outside

contractors, there have been some great success and some complete failures. The development and testing needs to be monitored carefully.

Long-term downhole monitoring and later measurement (after departure of the drillship) have an important role, e.g., seismographs, CORK observatories etc., and reentry without the drillship.

Finally, PEC IV noted that most current downhole tools will not work in holes drilled with the diamond coring system (DCS). LDEO-WLS estimates $600K to $1M will be needed to acquire and develop a reasonable suite of downhole logging tools for this facility.

LDEO-Site Survey Data Bank

The Site Survey Data Bank prepares information packages for pre-cruise pollution prevention and safety review of designated sites, and supplies each shipboard scientific party with the geophysical data necessary for proper conduct of scheduled drilling cruises.

The Site Survey Data Bank is a three person operation. As often happens in operations of this size there are times when the staff is very busy (generally spring and summer) and there are other times of relative slack. It appears to be a mature system with a manager who has been with the Data Bank for almost three years. In addition to providing an early warning system to the Pollution Prevention and Safety Panel, the Data Bank also provides information to leg proponents. The Data Bank has been successful in getting proprietary data from the oil industry on occasion.

Although we sympathize with the request for additional help, at least during part of the year, we recognize this is an unlikely proposition given future budget projections.

LEG EVALUATIONS

These evaluations of recent ODP legs have been prepared by individual members of the Fourth Performance Evaluation Committee for the Ocean Drilling Program, and they have not been reviewed by the committee as a whole.

LEGS 137, 140 AND 148 - HOLE 504B

These three legs were all located at Hole 504B, the deepest hole ever drilled into oceanic crust. The hole is located in 5.9 m.y.-old crust formed at the Costa Rica Rift. All three legs relate to the ODP Long Range Plan 1989-2002 objective of exploring the structure and composition of the lower oceanic crust and upper mantle (pp. 70-71).

LEG 137

Scientific Objectives

The primary objective of Leg 137 was to clean out Hole 504B prior to deepening the hole on a subsequent leg. Specific objectives:

1. Measure temperature and obtain fluid samples in the hole prior to clean-out operations. Because the hole had been undisturbed for nearly 4.5 years since Leg 111, it was anticipated that it would provide excellent conditions for conducting an equilibrium temperature log.

2. Use standard milling and/or fishing operations to clean out hardware (parts of an experimental diamond coring assembly) lost in the hole on Leg 111.

3. Inspect and possibly repair the casing.

4. Test a coring system that may improve deep drilling performance.

Results

1. Prior to clean-out operations, temperature in the hole was successfully logged. A linear temperature gradient was measured in the lower kilometer of the hole, consistent with values logged during Leg 111. Depressed temperatures in the upper 350 m suggested downhole flow of ocean bottom water into the upper levels of basement. Eight fluid samples were obtained from the hole at depths ranging from 350 to 1540 mbsf.

2. In six days of fishing and milling operations, the primary objective of cleaning out the hole was achieved.

3. Operations throughout the leg showed no indication of the supposed problems with the casing; a borehole televiewer inspection did show flaws in the lower 30 to 40 meters of casing.

4. Two coring systems were tested to determine penetration and recovery rates for use on the upcoming scientific legs. The standard ODP rotary core barrel (RCB) drilled successfully at a rate of 1.0 to 1.5 m/hr; recovery was in the range of 10 to 15%. A conventional oilfield diamond core barrel (Christensen core barrel) obtained higher recovery (about 50%); however, penetration was extremely slow. Only two hours of rotation resulted in extreme wear of the bits. Drilling on Leg 137 resulted in deepening Hole 504B by 59 m to a total depth of 1621 mbsf.

LEG 140

Scientific Objectives

The primary objective of Leg 140 was to deepen Hole 504B through the dike/gabbro and (or) Layer 2/3 transition. A vertical seismic profile (VSP) conducted during Leg 111 suggested that the next major transition, thought to represent the Layer 2C/Layer 3 transition, lies about 100 to 300 m below the depth of the hole at the start of the leg. Prior to beginning drilling operations, junk left in the hole at the end of Leg 137 needed to be fished or milled from the hole. Based on the coring tests during Leg 137, the RCB was chosen for Leg 140 with specially hardened bits. Although recovery rates were low, based on previous legs, they were deemed acceptable. The prospectus called for deepening the hole by 300 to 400 m.

Results

Operations during Leg 140 deepened Hole 504B by 379 m to 2000 mbsf. Recovery was about 13%. This leg penetrated through the range of the seismic reflector (1660 to 1860 mbsf) which was interpreted as the transition between sheeted dikes of Layer 2C and gabbros in Layer 3. Rocks recovered from Leg 140, however, showed that this reflector was not the transition from dikes to gabbros. Changes in alteration were observed in recovered samples around 1750 mbsf; these changes may produce an impedance contrast which resulted in the reflector observed in the vertical seismic profile. Rocks recovered on Leg 140 suggest that the leg had reached the lower part of the sheeted dike section, based on alteration mineralogy, grain size, and amphibole abundance.

General Comments

Although operationally this leg was successful both in coring and recovering at the rate planned in the prospectus and in penetrating through the reflector thought to represent the Layer 2C/Layer 3 transition, the leg did not accomplish the primary objective of drilling into the gabbro section of oceanic crust.

LEG 148

Scientific Objectives

Like Leg 140, the primary objective of Leg 148 was to deepen Hole 504B through the dike/gabbro and (or) Layer 2/3 transition in order to clarify the relationship between lithologic and seismic crustal structures.

Results

An additional 111 m of penetration in Hole 504B, deepening the hole to 2111 mbsf, was obtained before encountering a fault where the drill string became stuck. Fishing and milling operations removed part of the stuck material, but a small amount of junk remained in the hole. At the end of the leg, it was judged that this junk could likely be removed and the hole deepened with suitable stabilization.

Rocks recovered near the base of the hole are fine grained diabase dikes. Various logs, including sonic velocity, and a vertical seismic profile (VSP) indicate that the hole penetrated into material typical of Layer 3 seismic velocities, suggesting that the transition to seismic Layer 3 may begin within sheeted dikes rather than represent the top of the gabbro section. The VSP results show that there is not an extensive reflector than could be associated with Layer 3.

General Comments

Although these legs have not penetrated the gabbro layer of oceanic crust, they have provided new information about the nature of the lower crust and the relationship between seismic and lithologic crustal structures. Results from these legs show that deep drilling in oceanic crust is possible with current technologies, but it is slow and recovery is low. With low core recovery, integration of log and core results is even more important.

LEG 139 - SEDIMENTED RIDGES I

Scientific Objectives

To characterize fluid flow and geochemical fluxes within a sedimented rift hydrothermal system and to investigate the processes involved with hydrothermal discharge and associated alteration and mineralization.

Drilling Strategy

Two-leg program, initially an array of several holes to characterize the hydrothermal regime on a basin scale and begin detailed drilling in two zones of mineralization and discharge. The proposed program included detailed logs and a number of special measurements such as downhole temperature and the CORK long-term observatory. Reentry was required at several sites.

Site Survey and Preparation

Very comprehensive site survey data available, including multichannel and single channel seismic, swath bathymetry, SeaMARC I & II, detailed heat flow, coring, etc. Leg 139 was a carefully planned drilling program.

Results

General success - main objectives were realized; considered an outstanding leg.

Highlights

1. Results allowed excellent constraints on hydrothermal and associated geochemical regime of a sedimented rift.

2. Long core of continuous sulfides had high publicity value in mining community (sedimented rift may be environment for sedimented-hosted sulfides).

Technical Aspects

The drilling and logging were generally successful. The core recovery and downhole logging were much better than expected for this difficult environment. The success was partly a consequence of special procedures adopted for the high temperature environment. ODP did extensive special analysis and development for the drilling and logging on this leg.

General Comments

This leg was very successful; this is reflected in the recent decision of PCOM to include a Phase II Juan de Fuca Sedimented Ridge drilling leg in the future schedule. The drilling and measurement program was well planned and what

was carried out was close to that proposed. The constraints on sedimented rift hydrothermal systems sought were, in general, achieved. There were also some exciting surprise discoveries.

LEG 141 - CHILE TRIPLE JUNCTION

Scientific Objectives

To investigate the effects on the margin associated with the subduction of an active spreading ridge off Southern Chile, including:

1. rapid uplift and subsidence, and tectonic erosion;
2. regional forearc metamorphism;
3. forearc magmatism and deformation; and
4. hiatus in arc magmatism.

A secondary objective was the study of gas-hydrates (Bottom Simulating Reflectors or BSRs).

Drilling Strategy

Two transects of holes in the ridge/trench collision zone (includes three sites where there are BSRs) and one hole into prominent shallow ridge that may represent ophiolite obduction. No reentry holes, but detailed logging and some downhole measurements, especially temperature.

Site Survey and Preparation

Quite complete site surveys were made. Although generally adequate, they were not as extensive and detailed as for some other subduction zone margins that have been drilled (Nankai, Cascadia, Barbados).

Results

General Success - Important results were obtained on the consequences of ridge subduction to the margin. Useful but not definitive information was obtained on the gas hydrate BSR; the results were limited partly because the BSR was at very shallow subtotal depth in very unconsolidated sediments.

General Comments

This was a moderately successful leg. What was carried out was close to that proposed. There was no results summary chapter in the *Initial Reports* volume, and very little summary information in the individual site chapters.

LEGS 143 AND 144 - ATOLLS AND GUYOTS

Scientific Objectives

Legs 143 and 144 were an ambitious campaign designed to address a series of fundamental questions regarding Cretaceous reef-bearing guyots of the Western Pacific. These edifices of shallow-water sediments and reefs, together with their volcanic foundations, were the principal target of the two legs that focused on the following problems:

- Timing and causes of platform drowning.
- Timing and amplitude of relative changes in sea level and their relation to regional tectonics and to sea-level changes recorded in other parts of the globe.
- Seamount latitude changes, as recorded in the paleomagnetism of lagoon sediments as well as in the underlying volcanics.
- Ages of the volcanic edifices, as clues to the direction and rates of age progression.
- Longevity of the mantle source for Dupal lavas.
- Bioprovinciality of Cretaceous reefal organisms and post-reefal paleoceanographic reconstruction.

  (From Legs 143 and 144 *Scientific Prospectus,* p. 6, 1992)

Drilling Problems

Both legs were handicapped by the poor recovery of limestone by the *JOIDES Resolution.* The heave of the drillship is such that, with present technology, recovery is seldom more than 5% and often less than a few percent. On Leg 143, recovery of the limestone sections was generally poor, less than 5%, but there were sections in the two deeper holes where recoveries of 15-20% were attained. In the holes that penetrated the basaltic foundations, recovery was significantly better, often 50% or more.

Leg 143 Results

The generally poor recovery in the shallow-water Cretaceous carbonates prevented the scientific party from achieving reliable identifications of sea level fluctuations and dating them with some precision. However, through the skillful use of the FMS downhole log, whose lithologic meanings were calibrated in intervals where there was some core recovery, it was possible to infer a series of meter-scale fluctuations of sea-level similar to many other Cretaceous carbonates. The proxy log was also used to suggest a series of depositional sequences.

The basaltic foundations were dated in two of the holes, adding data points to those established previously from dredged samples.

Using the configuration of the surface of two guyots and diagenetic features of the uppermost limestone, it was possible to establish that a period of subaerial exposure preceded the drowning. However, the date of drowning could only be established as being prior to the Mid Turonian, the age of the overlying pelagics. No new information was developed on the possible cause(s) of drowning.

The results of Leg 143, supplemented by the considerable body of information from previous dredging and seismic profiling, were used to develop a regional geologic synthesis for the Mid-Pacific Mountains.

Leg 144 Results

Only the *Initial Report* and a Co-Chief's summary for PCOM are currently available and are probably inadequate to fully evaluate this leg.

The objectives of this leg were similar to those of Leg 143 regarding Cretaceous carbonates, i.e., stratigraphy and age of drowning. An additional objective was to develop high-resolution stratigraphy of the pelagic cap.

Liquefaction of the pelagic cap sediments, except in one hole, is a serious limitation to the development of a high-resolution stratigraphy.

Cretaceous shallow-water carbonates were absent in holes drilled on two guyots, and where they were penetrated, poor recovery hampered interpretations.

Evaluations of the Results of Legs 143 and 144

Neither of the Scientific Reports of these legs have been published and the following comments must be considered as tentative and subject to revision. Given that the poor recovery of limestones was well-established in advance of these legs, the objectives were clearly well-beyond what could be expected. Indeed, this preliminary review finds that very little of the objectives given in the Prospectus were realized as of this writing. On the other hand, the Scientific Report for Leg 143 evidences a most skillful use of what little limestone samples were recovered, supplemented by a proxy log. In addition, the results were integrated with existing data to provide a most useful regional synthesis. Perhaps the *Scientific Report* for Leg 144 will also take full advantage of their recovered material.

General Comments

ODP legs are exploratory, and it is to be expected that they do not find what was anticipated in the prospectuses, and must take advantage of unexpected opportunities and adjust to drilling problems. Nevertheless, it appears that the competition to have a proposal accepted encourages exaggeration of expected results.

Given the considerable review that a proposal receives, it is surprising that the problem of poor recovery in limestones did not receive more attention as it turned out to be a serious limitation to both these legs.

LEG 145 - NORTH PACIFIC TRANSECT

Scientific Objectives

(From Leg 145 *Scientific Prospectus,* p. 4)

1. High-resolution Neogene record of the subarctic region.
2. The nature and history of formation of North Pacific Deep Water.
3. The middle Miocene onset of silica deposition - the "silica shift" problem.
4. The Late Cretaceous and Cenozoic record of atmospheric circulation.
5. The Late Cretaceous and Cenozoic record of ocean chemistry.
6. The records of Northern Hemisphere continental climate.
7. Paleoceanography of the late Mesozoic superocean.
8. Tephrochronology of the Kuril and Aleutian arcs.
9. Age and nature of basement in regions where it is poorly understood.

Site Survey and Preparation

- Excellent preparations.
- Clearly defined scientific questions and alternative problem solutions to be tested.
- Good pre-site survey/excellent high-resolution seismic lines for Cenozoic objectives.
- Lower quality seismic evidence for Mesozoic objectives.
- A number of proposed alternate site locations provided a lot of flexibility to the leg program.

Achievements vs. Scientific Objectives

All proposed sites were successfully drilled. The core material obtained enabled the scientific party to contribute to most of the above outlined objectives as following:

1. O.K.

2. Partially O.K.; partially unsolved questions (driving currents of Meiji Drift).

3. O.K.; in part, a "new" mechanism found, different from that expected.

4. Largely a failure.

5. Partly a failure, partly a success: new CCD curve constructed for N. Pacific, new high-latitude site found with exposure of K/T boundary

6. O.K.

7. Failure.

8. O.K.; confirmation of old model of Kennett & Thunnell (1975) .

9. Failure - new unexpected problems (Sites 885/6).

Why Results did not Achieve Scientific Objectives

3. Model of shifting Sub Antarctic Front was shown to be insignificant: Little surface water forcing of the variations in SiO_2 and $CaCO_3$ accumulation rates but a dominant forcing by changes in the upwelling of deepwater at the terminus of the global salinity conveyor belt, hence:

3. Atlantic type $CaCO_3$ preservation signal (interglacial $CaCO_3$ maxima) instead of Pacific type signal (glacial $CaCO_3$ maxima) found.

4, 5, 7. Little or no early Cenozoic and late Cretaceous carbonate record: CCD was significantly shallower than expected, except for Late Eocene and Oligocene.

Slumping has destroyed the Eocene records at sites at Detroit Seamount.

Because of too shallow position of CCD in the Neogene. It turned out to rise to less than 3,300-2,500 m in higher latitudes because of the strong flux of remineralized organic carbon below North Pacific high-productivity belt.

9. Age of basaltic crust in central North Pacific (Site 885/6) is much younger than expected (about 80 Ma instead of middle Cretaceous)

7, 9. No record of Mesozoic gateways to the Arctic Ocean at NW Pacific Site 881 (in part because of wrong assessment of seismic records?).

General Comments

Lack of success on Leg 145 with regard to the Cretaceous and the modest gain with regard to the Paleogene and plate tectonic objectives resulted mainly from:

1. unexpected downslope redepositional processes;

2. overly optimistic expectations about the depth of the CCD;

3. wrong assessment of seismic reflectors; and

4. and an unexpected basalt age.

LEG 146 - CASCADIA MARGIN

Scientific Objectives

1. To investigate the relationship between fluid flow and tectonics in the accretionary wedge formed at the convergent plate boundary, including diffuse and fault-focused flow.

2. To determine the source and nature of the Bottom Simulating Reflector (BSR) at the base of a gas hydrate zone.

Drilling Strategy

Two transects of holes were drilled across the continental slope, one off Vancouver Island to examine diffuse flow and one off Oregon to examine fault-focused fluid expulsion. Several reentry holes were planned as well as detailed logging, extensive downhole measurements, and the emplacement of two CORK long-term borehole observatories.

Site Survey and Preparation

Very detailed and complete site surveys, including grids of multichannel seismic lines, heat flow, swath bathymetry and acoustic imagery, coring, sampling, submersible surveys and experiments, etc. Detailed scientific background studies. There was a Detailed Planning Group (DPG) that appeared to work well.

Results

General success - main objectives realized, although results compromised by poor hole conditions and bad weather.

Highlights

Thermal and chemical disturbance associated with fault fluid flow were documented. Good evidence for high pore pressures were obtained. A reasonable calibration of velocity-porosity relations was obtained (used to obtain porosity from MCS interval velocities). First good logs and VSP through gas hydrate BSRs and underlying gas (although not deep enough below BSR to obtain reference no-hydrate values). An improved calibration of the BSR temperature-pressure and thus gas hydrate stability field was obtained. Hydrogen sulfide was encountered at a very shallow subbottom depth.

Technical Aspects

Drilling conditions were unusually difficult, presumably because of unconsolidated sandy sections in the drilled turbidites, high pore pressures, and bad weather. Coring had low to average recovery. Logging had average success, but the critical BSR sections were logged and VSP was measured at two sites. Other extensive downhole measurements were made. Two CORKs were installed, but one was damaged in bad weather conditions.

Problems

Operations were significantly impeded by poor weather, especially off Vancouver Island; the October drilling schedule was much past the optimum weather period. No new methods were devised to deal with poor hole conditions.

General Comments

This was a generally successful leg. What was carried out was close to that proposed. Although difficult hole conditions and bad weather impeded operations, most objectives were met. The results were perhaps not as definitive as hoped, but important new constraints were achieved on accretionary prism fluid expulsion and on the origin and nature of gas hydrate BSRs.

The Vancouver Island and Oregon margin objectives were complementary, but spreading one leg over the two transects allowed minimal time on each one (especially with the late addition of the small California margin program). Combining fluid flow and hydrate objectives in one leg was also probably too much (although related). Although initially proposed as a two leg program, a proposal for the second phase of Cascadia margin drilling has not as yet been prepared.

LEG 149 - IBERIAN ABYSSAL PLAIN

Background and Scientific Objectives

Leg 149 was the first of a multi-leg series designed by the North Atlantic Rifted Margin Planning Group to develop basic data on the ocean-continent transitions across rifted margins. The Iberian margin, the focus of Leg 149, was selected to represent a non-volcanic margin. "The principal objective of Leg 149 is to sample the crust within the Oceanic-Continetal Transition (OCT) of the Iberian Abyssal Plain to establish the nature of the upper crust and test some of the predictions based on geophysical observation." (Leg 149 *Scientific Prospectus,* p. 9).

The plans for Leg 149 passed all the ODP hurdles, but were tripped-up by PCOM. At the PCOM review, a strong argument was advanced for a single deep hole instead of the transect of holes planned. The arguments for the single hole were made with sufficient force and reason that PCOM voted for the single hole. The co-proponents of the multi-hole plan rebutted this decision so vigorously that PCOM's chair, Jamie Austin, had to poll committee members by mail to reconsider their decision; they did reverse themselves and supported the original plan.

Drilling Problems

The loss of 3,500 m of drill string on the second hole seriously limited further penetrations of the crust. Drilling at the third site had to be stopped when the drillstring got stuck. At the next site, drilling had to be suspended when the drillbit wore out.

Results

The salient successes of the leg are the recovery of nearly 200 m of serpentenized peridotite and an enigmatic igneous rock. One hole had not been planned; seismic profiling during transit of the *Resolution* discovered a prospect where acoustic basement was shallow enough to be reached by the depth-limited drillstring. The peridotite recovered in this hole occurred in three unusual mass-flow breccias.

The significant contribution of the leg is to extend the previously-known occurrence of peridotite to a zone some 19 km wide, and to apparently disprove the proposed model that posited the existence of a transition to continental crust. Interestingly, this contribution came through the good luck of finding a seismic high during the cruise! An additional result is the discovery of the Tithonian sediments over basement, this finding changes the age of rifting by some 30 My.

General Comments

If judged by attaining its pre-drilling objectives, Leg 149 results are a disappointment as they produced only limited information on the crust. On the

positive side however, the drilling expanded the occurrence of peridotite to some 19 km: therefore it called into question the proposed model of OCT on this rifted margin, and it revealed how difficult it is to infer basement composition from seismic profiles.

LEG 150 - NEW JERSEY SEA LEVEL

Scientific Objectives

The sea-level objectives of Leg 150 form a "centerpiece" of the COSOD II program and the postulates of the ODP Sea Level Working Group. The program of Leg 150 tried to combine (1) the opportunities of dating the sequence stratigraphy at the especially well-suited geological setting of the eastern U.S. continental margin, with (2) the deep-sea $\partial^{18}O$ records of glacial eustasy. In particular, the leg had the following objectives:

- The timing of sea-level change at <1 m.y. This includes finding a sequence geometry below the depositional base level that relates to the nearshore stratal geometry documenting sea-level control.

- To estimate the amplitudes and rates of sea-level change. This includes:

    (1) measuring the differential subsidence history of the continental margin by narrow sampling along its dipline, and

    (2) paleobathymetry estimates based on microfaunas.

- To evaluate the response of sediment facies and transport to sea-level change along the passive margin, including the response of deep-sea sedimentation.

- To decipher the causal mechanisms of sea-level change during the "Ice-house World," when glacial eustastic forcing dominated, and the "Doubt-house World," for which the effects of ice sheets are under debate.

To reach these objectives, Leg 150 encompassed drilling four different physiographical settings: the onshore coastal plain, and the continental shelf, slope and rise.

Site Survey and Preparation

Leg preparations comprised a tremendous, almost unprecedented effort to produce and integrate the evidence and expertise of:

- SEABEAM maps;

- an immense set of multichannel seismic profiles;

- sections from onshore and offshore drill holes and industrial wells;
- holes from previous DSDP cruises;
- samples collected by *Alvin* submarine dives; and
- a substantial body of microfossil data from shallow and deeper marine environments.

Achievements vs. Scientific Objectives

The onshore sites and the sites on the continental slope were successfully drilled as planned. Based on excellent core recovery and logging records it was possible to recognize and successfully date the reflectors of sequence stratigraphy as stratal surfaces. Special highlights are the precise dating of canyon formation tied to the Middle Miocene event of Antarctic glacial advance and the documentation of sea-level highstands and regressive cycles onshore. In contrast, Site 905 on the continental rise was only a partial success and did not reach the intended target of a reflector near the Eocene-Oligocene boundary because the risks of hydrocarbon pollution were too high.

Nevertheless, despite partial success, its intensive preparation efforts, and well-defined objectives, the main sea-level questions of Leg 150 will remain essentially unsolved over the next several years. This negative result derives from an initially somewhat casual approach to the safety risks of shallow gas potentially occurring in the shelf sections. Hence the TAMU-ODP safety panel was not in a position to provide permission to drill the shelf holes until the pollution and safety concerns are removed. Therefore, the link between nearshore stratal geometry and the sequence geometry below the depositional base level—a link that is crucial for dating the sea-level change, has not yet been established—except for preliminary evidence from some industrial wells.

This partial failure, however, also had a significant positive feedback on the ODP project, leading to a new definition of clear hazard guidelines for shelf drilling (M. Ball and T. Francis, in *JOIDES Journal,* October 94). Based on these guidelines further ship surveys on the shelf will investigate shallow gas and seafloor hazards in 1995 and 1996. These results will be evaluated by professional industrial consultants and, hopefully, will enable ODP to complete the project in two to three years from now.

FOURTH ODP PERFORMANCE EVALUATION COMMITTEE MEMBERSHIP

Dr. John Knauss, Chairman
Graduate School of Oceanography
University of Rhode Island
Narragansett, RI USA

and

Scripps Institution of Oceanography
University of California, San Diego
La Jolla, CA USA

Mr. Jacques Delacour
Member, French National Research Council
for Civil Engineering

and

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University of Kiel
Kiel, Germany

Dr. Paul Worthington
Gaffney, Cline and Associates
Hampshire, United Kingdom

FOURTH ODP PERFORMANCE EVALUATION COMMITTEE PROGRAM OF WORK

2-3 November 1994 - JOI Office, Washington, DC
Meeting with JOI staff, presentations also made by NSF
All members attended

17 November - JOI Office, Washington, DC
Long Range Planning Subcommittee Meeting
Morton attended

30 November - 2 December - TAMU-ODP, College Station, TX
JOIDES Drilling Options, Panel Chair and Planning Committee Meetings
Members attending all or part of meetings: Knauss, Hyndman, Sarnthein, Worthington

6 December - AGU Meeting, San Francisco, CA
Meeting with several ODP Co-Chief Scientists
Members attending: Knauss, Hyndman

23-24 January 1995 - Lamont-Doherty Earth Observatory, Palisades, NY
Meetings with: Borehole Research Group, JOIDES Site Survey Data Bank, ODP East Coast Core Repository
Members attending: Delacour, Ginsburg, Morton, Knauss, Hyndman, Sarnthein, Worthington

8 March - Paris, France
Meeting with Schlumberger representatives and visit to Schlumberger-Riboud Product Centre, Clamart.
Members attending: Delacour and Hyndman

9-10 March, Marseille, France
Visit to JOIDES Resolution and meeting with Borehole Research Group of Laboratoire de Mesures en Forage, Institut Mediteraneen de Technologie (IMT)
Members attending: Delacour and Hyndman

16 March, Leicester, UK
Meeting with Borehole Research Group of Leicester University
Member attending: Worthington

27 - 31 March - TAMU-ODP, College Station, TX
Meeting with TAMU-ODP Staff
All members attended

Additionally, members individually contacted a number of those presently or formerly involved in ODP activities.

FOURTH ODP PERFORMANCE EVALUATION COMMITTEE TERMS OF REFERENCE

(August 1994)

During the life of the Ocean Drilling Program JOI, Inc. will periodically evaluate the management of the program and the performance of its subcontractors. This evaluation will be accomplished at 2-3 year intervals by a committee of experts appointed by the President of JOI. The President will consult with NSF, the JOIDES EXCOM, PCOM, and others as appropriate in the formation of the evaluation committee. The Performance Evaluation Committee (PEC) will report to the Board of Governors through the President of JOI. Terms of Reference for the evaluation will embody the following general procedures and criteria:

(1) The committee membership will consist of experts in the fields of engineering, management, and science to be appointed by the President of JOI in consultation with NSF, the JOI Board of Governors, JOIDES and others. The committee should be chaired by an eminent scientist who should be knowledgeable about ODP but not currently active in the program.

(2) The committee will review and evaluate the performance of Texas A&M, Lamont-Doherty, and other subcontractors in accordance with a schedule to be developed by the PEC chairman and approved by the President of JOI. JOI will provide for sufficient funds in the Performance Evaluation Committee for staff support.

(3) The committee will be briefed by the Chairman of the JOI Board of Governors and/or the President in advance of any scheduled performance evaluation. Following completion of the evaluation and receipt of subcontractor comments and plans, the committee will report its results to the JOI Board of Governors.

(4) The committee will transmit in writing to the subcontractor being evaluated the scope and procedures of the evaluation together with any questionnaires or questions to be answered. Copies of such correspondence will be furnished to the President of JOI who will keep the Board of Governors informed.

(5) The committee will conduct its evaluation at the headquarters site of the principal contractor and subcontractors. Sufficient time shall be allocated for a thorough review. The drillship also will be visited for evaluation when appropriate and convenient. If scheduling is impractical, interviews will be conducted with members of recent past crew and past scientific parties.

(6) The committee will evaluate the principal items of performance, including accomplishment of scope of work in the contract, particularly with regard to achievement of scientific objectives; program plan management and adherence; personnel policies and personnel management; overall management effectiveness and efficiency, including cost consciousness; subcontract management, reports and report management; public information, particularly in regard to scientific dissemination of data; liaison and relationships with JOIDES, JOI, NSF, and national and international scientific bodies; engineering maintenance, development and adherence to environmental impact statements; safety procedures and safety record; staff morale, and other items considered important by the committee.

(7) After completion of each evaluation, the Chairman of the PEC will discuss the committee's findings with the senior official of the subcontractor and/or the subcontractor's staff, as is mutually agreed. This discussion and its content shall be communicated to the President of JOI, who shall in turn inform the Board of Governors.

(8) Within two months of completion of site visits, the Chairman of the PEC will submit the performance evaluation report to the President of JOI, who will discuss with and transmit the report to the subcontractors with a request for written comments, including plans for any action required.

(9) The President of JOI, after receiving the subcontractors' comments and plans, will arrange with the Chairman of the PEC to present the final report and implementing recommendations to the Board of Governors. The President will then transmit a copy of the report and implementation plans to NSF, the JOIDES EXCOM and PCOM. This should occur within two months after receipt of the report from the Performance Evaluation Committee. Those recommendations requiring consultation with EXCOM and NSF will be reviewed with these organizations prior to implementing action.

The foregoing procedures for performance evaluation will be refined and/or modified as experience is gained. The ultimate objective is to achieve a reliable and effective evaluation system that will best serve the scientific community, NSF, and JOI.

General Guidance

(1) The PEC will visit JOI Headquarters in Washington, DC and the subcontractors at LDEO, TAMU and the JOIDES Office. The PEC will visit the *JOIDES Resolution* should the vessel be in a convenient part of the world.

(2) The PEC will interview selected members of EXCOM and PCOM.

(3) The PEC will determine the type and style of paperwork to be provided, again in advance of interviews.

(4) The PEC will decide on its own interview process. It may be necessary, occasionally, for people to be interviewed privately or on a group basis, e.g., marine technicians, etc.

(5) The PEC will have the right to call for any papers or information which it deems necessary.

(6) The PEC should have the right to propose specific studies of ODP and its operations by professional consultants, as appropriate.

(7) The report should consist of a descriptive section outlining activities, a section dealing with observation and impressions, and a section on conclusions and recommendations. The report will be accompanied by an executive summary. It may be necessary to convene a special PEC meeting to discuss the final report. The final report shall be submitted within two months following completion of site visits.