IODP Operations Review Task Force Meeting

Expedition 329
South Pacific Gyre
Subseafloor Life

August 30th – 31st, 2011
Lamont-Doherty Earth Observatory of Columbia University
Palisades, NY, USA

EXPEDITION 329 OPERATIONS REVIEW TASK FORCE (ORTF)

PARTICIPANTS

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MEETING FORMAT

The IODP-MI Operations Review Task Force (ORTF) met on August 30th - 31st at the Lamont-Doherty Earth Observatory (LDEO), New York (USA) to review the operational aspects of IODP Expedition 329 South Pacific Gyre Subseafloor Life. The review concentrated on "lessons learned" from the expedition with an emphasis on "what should be done differently in the future." ORTF review was based upon confidential reports submitted by the U.S. Implementing Organization (USIO) and the Expedition 329 Co-Chief Scientists, as well as on expedition daily and weekly reports available on-line.

The meeting began with oral presentations by the Co-Chief Scientist (Fumio Inagaki) and the Expedition Project Manager (EPM: Carlos Alvarez Zarikian), summarizing the Co-Chief Scientists' and USIO reports, respectively. The Co-Chief Scientist also presented Co-chiefs' joint recommendations. Following the presentations, External Reviewers and IODP-MI personnel had an Executive Session to identify specific pre-expedition, expedition, and post-expedition phase topics for the discussion and to formulate a number of draft recommendations. On the second day of the meeting, ORTF reviewed the draft recommendations from the Executive Session and finalized it. These recommendations are presented in this report.

EXPEDITION SUMMARY

Expedition 329: October 9th – December 13th, 2010
Co-Chief Scientists: Steven D'Hondt, Fumio Inagaki
Expedition Project Managers: Carlos Alvarez Zarikian
USIO Operations Superintendent (OSI): Stephen Midgley

IODP Expedition 329 was implemented to address the scientific objectives presented in IODP Proposal 662-Full3, "Life beneath the sea-floor of the South Pacific Gyre". Proposal 662 was first submitted to IODP in 2004. In 2007, after its 3rd version, the proposal was forwarded to the Operations Task Force (OTF) for scheduling.

The primary scientific objectives of Expedition 329 were to (1) document the habitats, activities, composition and biomass of microbial communities in subseafloor sediments with very low total activity; (2) improve our understanding of how oceanographic factors (i.e, surface ocean chlorophyll content and organic flux to the seafloor) control variation in subseafloor sedimentary habitats, activities and communities from the gyre center to the gyre margin; (3) quantify the availability of dissolved hydrogen throughout the sediment column and (4) determine how basement habitats, potential activities and communities vary with crustal age and hydrologic regime in a region of fast seafloor spreading and thin sediment cover. The expedition made great progress in achieving all these primary objectives.

Expedition 329 cored and drilled 42 holes at seven sites along two transects, hinged in the center of the South Pacific Gyre. Total 1321.81m of sediment were cored with 1168.81m

recovered (average recovery 88.4%). The first transect progresses from the western edge of the gyre (Site U1365) to the gyre center (Site U1368). The second transect goes from the gyre center (Site U1368) through the southern gyre edge (Site U1370) to the northern edge of the upwelling region south of the gyre (Site U1371). The sites collectively underlie the full range of surface-ocean productivity conditions present in the South Pacific Gyre, ranging productivity conditions of the gyre center (U1368, proposed Site SPG-6A) to the moderately high (for open ocean) productivity at the southern edge of the gyre (U1371, proposed Site SPG-12A, at the northern edge of the Antarctic Convergence). The entire sediment column was cored multiple times at each of the seven sites and the upper basement was cored at three sites.

Because the primary scientific objectives of this expedition entailed an unprecedented amount, range and precision of biogeochemical and microbiological analyses, core processing required complex and flexible core handling, curatorial and sampling procedures. By carefully following these procedures and carrying out a well-coordinated as well as unprecedented amount of shipboard sampling for a wide range of biogeochemical and microbiological analytical work, the expedition made great progress in achieving all the primary objectives.

See http://iodp.tamu.edu/scienceops/expeditions/south_pacific_gyre_microbio.html for more details regarding the background and objectives, the preliminary scientific results, and conclusions of Expedition 329.

RECOMMENDATIONS OF THE EXPEDITION 329 ORTF

Overall, the Expedition 329 ORTF found that the South Pacific Gyre Expedition was a major success. This success resulted from a combination of factors including the refurbishment of the *JOIDES Resolution* and its equipment, close collaboration and communication between science party and operators, and professionalism, willingness and the concerted effort shown by all parties to work through issues as they arose at sea and onshore. All parties involved in this operation are to be congratulated on a successful expedition. In particular, carrying operations in very deep-water and over very long transects, conducting an unprecedented complex and extensive biogeochemistry and microbiology program that required many non-standard supplies and third party instruments.

> **Acknowledgement 329-01: Successful Expedition**
> ORTF Exp.329 acknowledges Expedition 329 was a success. It met all its scientific objectives. A total of 7 sites could be visited, covering two transects across the South Pacific Gyre. Core recovery was high. The cores could be analyzed with the planned instrumentation, including many third party tools.
> The success of the operation is attributable to a very good preparation from USIO and to the high qualifications of the science party and USIO personnel.

ORTF also identified several areas for future *JOIDES Resolution* operational improvement, particularly pre-expedition planning/preparation and during-expedition operations.

Many of the issues discussed during this review were related to shipboard scientific measurements of the *JOIDES Resolution*. Although the primary focus of the review was on USIO operations during Expedition 329, the recommendations in this report are equally valuable for other IODP operators, IODP management, Science Advisory Structure and to the Program Member Offices. As such, some recommendations are also directed to these entities.

Pre-Expedition

Recommendation 329-01: Staffing

ORTF Exp.329 recommends that staffing of shipboard scientists should be more flexible in order to meet expedition objectives. ORTF Exp.329 recommends that all PMOs supply a sufficiently large pool of qualified applicants across all needed specialties so as to provide IOs with flexibility for adequate scientific staffing.

Routing: PMOs, IODP-MI

Background: This expedition was the first expedition in IODP dedicated to study of subseafloor life and habitability in an ultra-oligotrophic oceanographic setting. Therefore, it required primarily a broad range and experienced team of biogeochemists and microbiologists. Understandably, all PMOs supplied applicant pools with high-priority nominations being dominated by microbiologists and geochemists. Although the focus of the expedition was this, other specialties were needed and had to be staffed with at least one experienced scientist in each. However, few, if any, applications were provided in other specialties. As a result, the Co-chiefs and EPM faced great difficulty in finding the suitable applicants to fill in all needed shipboard specialties. The situation was further complicated by a limited flexibility on number of berth when trying to balance shipboard scientific priorities and PMO's interests for national (IODP partner) representation. IODP-MI should take proactive educational activities to inform all IODP member countries that they should provide scientists nominations with a broader pool of specialties to provide greater flexibility for expedition staffing.

Recommendation 329-02: Sample Request

ORTF Exp.329 recommends that sample request forms should be simplified, so that participants with no previous IODP experience can easily fill them out and provide the essential information necessary for evaluating their sample requests and research plans and for considering staffing priorities for the expedition. Science party members should be greatly encouraged to provide as much detail as possible on their research objectives and analytical techniques by the time sample requests are due prior to an expedition.

ORTF Exp.329 recommends IODP-MI to improve and simplify the forms and instructions for filling in sample requests.

Routing: IODP-MI
Background: Although most sample requests were submitted prior to the ship's departure, several requests did not describe enough information, such as scientific objectives and research methods/techniques, mainly due to complicated sample request forms and the lack of written instructions for filling the form. To complete and approve the sample/research plans, the Sample Allocation Committee (SAC) needed to ask the researchers to revise and re-submit their sample requests. Although this process is routine in all IODP expeditions, the nature of Exp 329 required a different degree of research coordination to ensure that all expedition objectives were met and to maximize the use of limited material collected. The quality of science planning as well as the quantity of requested samples vary among shipboard scientists, likely due to the different number of nominees and hence the number of experienced researchers/supervisors from PMOs, statistically. This relates to the issue of staffing flexibility as documented at Recommendation 329-01. The great overlap between scientists' interests caused considerable conflict among the Science Party, and the coordination of research became much more difficult. To avoid such difficult and non-productive coordination, the expedition management team should ensure that all sample requests are submitted at the same time and the research proposals clearly state and describe the scientific objectives and the analytical schemes. IODP-MI should revise and simplify the sample request form, the fill-in instructions, and the Sample Request web site (SMCS). SACs should request more expedition relevant details from the scientists when they submit their proposed research plans before an expedition.

Recommendation 329-03: Pre-Cruise Training
ORTF Exp.329 recognizes the importance of providing pre-cruise training of the shipboard database system and shipboard software for data entry and other measurement to the shipboard scientists. ORTF Exp.329 endorses the pre-cruise training activity, which was just started for more recent USIO expeditions. Some opportunities already exist, but perhaps need more promotion, more detailed introduction to shipboard practices.

Routing: USIO
Background: Japanese shipboard scientists had pre-cruise training and communications (e.g., Core School at Kochi Core Center) for Exp.329 and were highly helpful for smoothly adjusting to the routine shipboard work, such as core description and some standard measurements, as well as the shipboard life on the *JOIDES Resolution*. USIO also started to provide pre-cruise training on its core description application from FY11. But its frequency and variety of training objectives are limited.

Recommendation 329-04: Non-Standard and Third Party Supplies
ORTF Exp.329 recommends to IODP-MI, IOs and STP to discuss the use of non-standard third party instrumentation and supplies and define IODP limitations on purchasing supplies in order to provide clear and consistent guidance to the scientists for future expeditions.

Routing: IODP-MI, IOs
Background: In Expedition 329, a large volume of non-standard and third party instruments and supplies were required because of priority of the expedition scientific objectives. However, there were no clear and consistent guidelines for non-standard third party supplies in IODP. Most of them were prepared and paid by only with USIO, for which it needed large efforts and time.

During Expedition

Recommendation 329-05: Lab Technician Arrangement
ORTF Exp.329 recommends the laboratory space on the ship should be flexibly used for multiple purposes according to the expedition objectives.

Routing: USIO
Background: USIO arranged or customized several additional Laboratories on the *JOIDES Resolution* for Expedition 329. For example, USIO converted the Paleontology Preparation Laboratory into a second Microbiology Laboratory during Expedition 329, and was very convenient and useful for the time-sensitive operations as well as some third party instrumentation (e.g. installed and set up flow cytometer, centrifuge, hydrogen measuring equipment, etc).

Recommendation 329-06: PFT Measurement Approach
ORFT Exp.329 recommends that when a new analytical method is used onboard the *JOIDES Resolution*, it should be tested before an expedition starts and a back-up method should be secured.

Routing: IOs
Background: Microbial contamination assessment using perfluorocarbon tracer (PFT) was a critical measurement required by Expedition 329 scientists. USIO employed a new PFT method using iso-octane for contamination assessment for the expedition. However, the instrument was shipped to the *JOIDES Resolution* with the method standardization being incomplete, and it was later determined by the science party that the new PFT method was insufficient for their needs. Moreover, there was no readily available backup plan for PFT measurement during the expedition and the shipboard scientists had to do the measurement as a post-expedition analysis using with previously established method.

Recommendation 329-07: Laboratory Experience Transfer
ORTF Exp.329 recommends the USIO to keep the summary of duration effect evaluation on the geochemical sampling processing result from Expedition 329 as a relevant section in the IODP reports. And document it in hard copy and inform the chemistry staff of it so if geochemists get involved with sample storage on a given expedition, they can decide if they wish to pursue it further for their own samples.

Routing: IOs
Background: During Expedition 329, scientists evaluated the duration need for each sample processing (including sample delivery, storage, squeezing, etc.) and the time effect on porewater geochemical data for validate duration effect.
The results of these evaluations demonstrated that there were none or very little effects of the sampling duration on the nitrate profile and many other chemical species. However, dissolved species of the carbonate system as well as some dissolved species related to high microbial activity possibly show the effect in certain situations (for example, depending on the sample type: acetate concentration may increase in high-activity shallow sediment even during the short duration for the sample processing [see Wellsubry et al., *Nature* 1997]). Scientists summarized the evaluation and made report of these issues for future expedition.

Recommendation 329-08: Formation Factor
Resistivity measurements (i.e., formation factor) should be a routine measurement of IODP and the instrument should be available on all IODP platforms. ORTF Exp.329 recommends IOs to investigate automated resistivity instrumentation, for instance induction method already available on some MSCL.

Routing: STP
Background: The formation factor measurement was carried out through a third party resistivity tool. The measurements required the insertion of electrodes on the soft sediment cores, which was a time and manpower consuming effort; yet the results were very useful for multiple scientific aspects.

Recommendation 329-09: Gamma Ray Measurement
ORTF Exp.329 encourages IOs to provide spectral gamma ray measurement on cores as a routine measurement.

Routing: STP
Background: Measurement of spectral gamma ray provides quantitative data directly comparable to spectral gamma ray logs. It is a powerful tool for core-log integration. The USIO has already its own prototype. Some spectral gamma-ray sensors are also available from commercial MSCL providers. However spectral gamma ray measurement on cores is not a routine measurement on current expeditions.

Recommendation 329-10: Internet Connectivity
ORTF Exp.329 recommends an improvement in internet connectivity onboard, bandwidth should be increased and the scientist's personal computer should connect to the internet. To ensure the most efficient use of the available bandwidth, a connection policy should be implemented onboard.

Routing: USIO
Background: Internet connection was only available for the shared computers and personal laptops were not allowed to use internet. In addition, internet in the lab areas as well as the shared computer room was overall very slow. Scientists sometimes needed to download important scientific papers or manuals, but the download took significant time and needed the help of a computer specialists. Also, because commonly used mailing software was not acceptable for shipboard scientists, they often need to use very slow internet for e-mail communication (e.g., Gmail), making the connection speed subsequently slower.

Recommendation 329-11: Science System in Lab
The LIMS database and all shipboard science systems have been improved so far. But there is still much room for further improvement. ORTF Exp.329 recommends to keep improving and simplifying all science systems in an effort to increase robustness, make them easy to learn and use, and work safely and consistently.

Routing: USIO
Background: During the Expedition.329, some scientists had difficulties when using onboard science systems and instrumentation. For example, a scientist reported that some science systems were overly complicated, inconsistent and there was a serious design problem with the lack of flexibility to adapt the systems to new and different situations.

Recommendation 329-12: Anti-Vibration Stage
Given the importance of microscopic image acquisition onboard, ORTF Exp.329 recommends deploying anti-vibration stage and high sensitivity camera systems for microscopes on all IODP platforms, especially for high-magnification microscopes.

Routing: IOs, STP
Background: Scientists consistently had difficulties to take good photomicrographs (of microbial cells) during onboard Expedition 329. Because all microscopes are located directly on the table and ship heaves prevents a stable z-focus of the image. Also there was no high sensitivity camera onboard that enables taking of multiple images with high-shutter speed. This issue fundamentally affected not only to some routine measurement tasks, such as the image acquisition of fine-scale textures from smear slides, but also to do manual cell count and the fluorescent image acquisition.