IODP Operations Review Task Force Meeting

Expeditions 314-316
NanTroSEIZE Stage 1

January 8th-9th, 2009
Washington, D.C.

Roster for NanTroSEIZE Stage 1 Operations Review Task Force

IODP Management International
Thomas Janecek -- Vice President, Operations / Meeting Chair
Manik Talwani -- President/CEO
Greg Myers – Manager of Engineering and Operations
Kelly Oskvig -- Operations Coordinator

NanTroSEIZE Co-Chief Scientists
Masa Kinoshita – Expedition 314
Harold Tobin -- Expedition 314
Ashi Juro -- Expedition 315
Gaku Kimura -- Expedition 316
Liz Screaton -- Expedition 316

Specialty Coordinators
Toshi Kanamatsu -- Biostratigraphy and Paleomagentics
Greg Moore -- Core-Log Seismic Integration
Demian Saffer -- Geotechnical Properties and Hydrogeology
Mike Underwood – Lithostratigraphy and Sedimentary Petrology
Geoff Wheat -- Geochemistry

CDEX particpants
Yoshi Kawamura -- Director, IODP Department
Shin'ichi Kuramoto -- IODP Expedition Manager, Program Operation Group
Shomei Kobayashi -- Group Leader, Drilling Planning and Coordination Group
Tsuyoshi Abe -- Operations Superintendent
Ikuro Sawada -- Operations Superintendent
Nobu Eguchi -- Group Leader, Planning and Lab Mgmt, Program Operation Group
Moe Kyaw Thu, -- Exp 314 Project Manager (Staff Scientist), Program Operation Group
Hideki Masago -- Exp 315 Project Manager (Staff Scientist), Program Operation Group
Toshikatsu Kuramoto -- Lab Officer, Marine Works Japan
Satoshi Hirano – Curator, Marine Works Japan

External members
Keir Becker -- RSMAS, University of Miami, FL
Warner Brueckman --IFM-GEOMAR, Germany
David Huey -- Stress Engineering, Houston, TX

Observers
Jamie Allan -- National Science Foundation
Toshi Oshima -- MEXT liaison to the National Science Foundation
Catherine Mevel -- ECORD Management Agency
David Divins -- USIO Representative
Dan Evan -- ESO Representative

I. INTRODUCTION

A) Meeting Format

The IODP-MI Operations Review Task Force met on January 8th-9th at the offices of the Consortium for Ocean Leadership in Washington D.C. to review the operational aspects of the NanTroSEIZE Stage 1 expeditions (314-316). The review concentrated on "lessons learned" from the expedition, with an emphasis on "what should be done differently in the future." The committee review was based upon confidential reports submitted by Center for Deep Earth Exploration (CDEX), Expedition 314-316 co-chief scientists, and the NanTroSEIZE specialty coordinators.

The meeting began with summary oral presentations by the co-chief scientists of each expedition, a single presentation summarizing the five specialty coordinator reports, and a series of presentations by CDEX representatives summarizing *Chikyu* drilling operations, achievements, operational issues and mitigation strategies. Following these oral presentations, the Task Force examined the issues that were identified in the written and oral reports and developed a series of recommendations for implementation by CDEX and other IODP entities. This report contains these recommendations.

B) Expedition Summaries

Integrated Ocean Drilling Program (IODP) Expeditions 314-316 represent not only the first scientific expeditions aboard *Chikyu* but also the first step in the multistage Nankai Trough Seismogenic Zone Experiment (NanTroSEIZE), an ambitious, coordinated, multiplatform, and multi-expedition drilling project designed to investigate fault mechanics and seismogenesis along subduction megathrusts through direct sampling, in situ measurements, and long-term monitoring. Below are short summaries of the expeditions. The reader is referred to http://www.iodp.org/scientific-publications/ for detailed reports of the expeditions.

Expedition 314

The primary objectives of Expedition 314 were to obtain a comprehensive suite of geophysical logs and other downhole measurements at six sites using state-of-the-art logging-while-drilling (LWD) technology. These six sites were designed to ultimately accomplish the principal goals of the NanTroSEIZE Science Plan, including documenting the material inputs to the subduction conveyor (fluid, solids, and heat), the properties of major thrust faults and their wall rocks at depths shallower than ~1.4 km, and the geology of the accretionary prism and overlying slope basin sediments. Four of these six sites were slated for continuous core sampling during the two subsequent Expeditions 315 and 316, In actuality, two of the sites (the Inputs area NT1-01 and NT1-07) were not attempted due to lost time during the expedition. Two additional sites in the general NT2-01 region (C0004 and C0005) were added during the expedition in attempts to find a location where we could successfully penetrate the mega-splay thrust sheet to the splay fault itself, after the lost BHA experience at Site C0003 (see below).

Drilling and logging was successfully completed at four sites, ranging in depth below the seafloor from 400 to 1400 m, with partial success at a fifth site. These sites included the frontal thrust and toe region of the outer accretionary prism near the trench, the fault zone and associated thrust sheet of a major out-of-sequence thrust system (the "megasplay" fault), 1 km thick forearc basin deposits, and highly deformed rocks of the interior of the accretionary prism. The principal goals of the LWD program were to document in situ physical properties; stratigraphic and structural features; sonic to seismic scale velocity data for core-log-seismic integration; and stress, pore pressure, and hydrological parameters through both scalar and imaging log measurements. All four sites were cored either on Expeditions 315 & 316, or are slated for continuous core sampling in future stages.

Logging included the measurement of natural gamma radiation, azimuthal gamma ray density, neutron porosity, full waveform sonic velocity, azimuthal resistivity imaging, zero-offset vertical seismic profile, ultrasonic caliper, and annular fluid pressure, though not all logs in this suite were collected at all sites.

Expedition 315

Expedition 315 was designed to obtain geotechnical information needed for well planning of future riser drilling at the Mega Splay site (C0001) to 3500 mbsf. The expedition was originally scheduled as a short expedition: 21 days for coring and 12 days for riser top-hole casing. The postponement of riser hole casing due to Kuroshio current conditions compelled a major revision of the scientific operations during the expedition and allowed for coring operations at another planned riser site in the forearc basin (Site C0002).

The location of Site C0001 was critical for understanding the nature of the shallow portions of splay faults. The scientific objectives for this site are to determine stress regime and deformation mechanics, fault-related fluid source and migration pathways, and correlations between fault activity and slump deposits on the trench slope. Coring revealed that the slope basin is composed mainly of Quaternary to late Pliocene silty clay and clayey silt with numerous intercalations of volcanic ash layers. The bottom of the basin is composed of a thick sand layer which overlays the late Pliocene to late Miocene transparently and probably belongs to the accretionary prism unit. The beginning of the slope basin sedimentation defines the age of the change from the active compressional deformation in the accretionary prism deformation around Site C0001 to an extensional deformation mode.

Minor faults, mostly recognized as dark-color seams, were pervasive in clayey sediments and mudstone of entire intervals. Preliminary results suggest that the direction of the maximum horizontal compressive stress remains northwest–southeast throughout the entire interval; changes of vertical stress exhibit normal faults in the shallow formation and reversed and strike-slip faults in the deep formation, consistent with results from the northeast–southwest borehole breakouts observed by LWD during Expedition 314.

Site C0002 (NT3-01), the contingency site, is located at the southern margin of the Kumano forearc basin. Age determination of the forearc basin sedimentation overlying the accretionary prism is critical to the estimation of the beginning and activities of the splay fault. Site C0002 penetrated Quaternary alternation of fine-grained sandstone and mudstone and basal Pliocene mudstone and cored the late Miocene accretionary prism rock to 1057 m. Biostratigraphy and facies analyses revealed rapid sedimentation (~112 m/Ma) in the forearc basin during the Quaternary and sediment-starved conditions in the basal slope basin during the Pliocene.

Pore fluid geochemistry showed that concentrations of most analyzed elements were strongly controlled by lithologic boundaries. Deformation structures such as steepened bedding, faults, breccia, shear zones, and vein structures were observed. Although the number of fault analyses was limited because of low core recovery, three deformation phases were recognized by fault analyses. The earliest phase is a thrust fault (and possibly a strike-slip fault) and exhibits northwest–southeast shortening. Two phases of normal faulting occurred subsequent to thrusting. The first is recorded in shear zones and indicates northeast–southwest extension. The second is recorded in normal faults and indicates north–south extension, consistent with the present stress direction acquired from LWD results.

Expedition 316

Expedition 316 was designed to evaluate the deformation, inferred depth of detachment, structural partitioning, fault zone physical characteristics, and fluid flow at the frontal thrust and at the shallow portion of the megasplay system. To accomplish these objectives, drilling was conducted at two sites in the megasplay region, one within the fault zone and one in the slope basin seaward of the megasplay. Two sites were also drilled within the frontal thrust region. Site C0004 is located along the slope of the accretionary prism landward of the inferred intersection of the megasplay fault zone with the seafloor. Drilling at this site examined the youngest sediments on the slope overlying the accretionary prism; these sediments consist of slowly deposited marine sediments and redeposited material from upslope. This redeposited material provides information about past slope failures, which may be related to past megasplay movement, earthquakes, and tsunamigenesis. The accretionary prism was sampled and the megasplay fault zone was successfully drilled. Structural observations of core material from the fault zone and two age reversals suggested by nannofossils indicate a complex history of deformation. The sediments under the fault zone were sampled to understand their deformation, consolidation, and fluid flow history. Drilling at Site C0008 targeted the slope basin seaward of the megasplay fault. This basin records the history of fault movement. In addition, sediment layers within this basin provide a reference for sediment underthrusting at Site C0004. Drilling at Sites C0006 and C0007 allowed examination of the frontal thrust region. At Site C0006, several fault zones within the prism were penetrated before drilling was stopped because of poor conditions. The plate boundary frontal thrust was successfully drilled and thrust fault material ranging from breccia to fault gouge was successfully recovered at Site C0007.

II. Recommendations

Expeditions 314-316 were the first scientific drilling operations on *Chikyu*, and the first IODP operations undertaken by CDEX. CDEX was asked to execute an ambitious riserless drilling program targeting active faults in inherently unstable geology, all in a region affected by the main axis of the Kuroshio Current, one of the planet's major western boundary currents. These factors all contributed to a project that was operationally very difficult. The onboard teams of scientists and operations staff had to learn how to work together, literally inventing shipboard management systems "on the fly" as the expeditions progressed, while battling the borehole conditions, the current, and sometimes uncooperative mechanical systems. These initial expeditions were clearly a learning process. Indeed the Task Force found that many issues that arose on Expedition 314 were adequately addressed during Expedition 315 and 316.

The expeditions had both successes and setbacks. However, the expeditions achieved the majority of the drilling objectives, and the Task Force believes the NanTroSEIZE Stage 1 expeditions must be counted as a resounding scientific and operational success. This success was due to the outstanding efforts of the shipboard and shore-based teams, including the CDEX Well Planning Group (WPG), the CDEX IODP Department, SeaDrill staff, GODI, Marine Works Japan (MWJ), Schlumberger engineers, and other groups. In general, these groups that had not previously worked together on scientific ocean drilling came together, worked very hard, persevered in the face of setbacks, and continually improved the operations during Stage 1. The IODP community is very grateful for the hard work and achievements of the whole team during NanTroSEIZE Stage 1, which have set an excellent precedent for future *Chikyu* expeditions.

The Operations Review Task Force identified several main areas of improvement for future operations including:

- Expedition planning
- Drilling Operations
- Communications
- Staffing
- Publications
- Safety
- Laboratory
- Sampling
- Data dissemination
- Miscellaneous

Many of the issues discussed during this review are inter-related and could easily fit into more than one category. However these categories helped in focusing the meeting discussion and developing recommendations. While the primary focus of this review was on CDEX operations during Expeditions 314-316, some of the recommendations in this report are equally valuable for other IODP operators and several recommendations were directed at IODP management and one to the Program Member Offices.

A) Expedition Planning

As with any new start-up venture, problems will arise as to the efficiency of the planning process. Some issues merited specific recommendations, while the Review Task Force thought other topics had been adequately addressed during the course of the three NanTroSEIZE expeditions and thus did not merit specific recommendations.

1) Contingency Planning

The Operations Review Task Force found that the contingency options identified by the NanTroSEIZE Project Management Team and the expedition co-chief scientists were not always realistic or possible. Several times, co-chief scientists learned only after the expedition had begun that the contingencies identified in the expedition prospectus required mobilization of staff and equipment that were not on board (and which could not quickly be brought onboard). For example, the lead-time for casing and/or coring contingencies on Expedition 314 was actually 2-3 weeks, because the ship was not staffed with the core techs, curators, techs, etc., nor the 3rd party contractors required for casing efforts. Therefore, these operations were not really viable contingency options. The Task Force found that better communication among the co-chief scientists/Project Management Team (PMT), the CDEX Well Planning Group, and the CDEX IODP science group before the expedition would have made contingency expectations clearer to all groups. In particular, it is important that all these groups understand the lead-time requirements and priority of each contingency option to ensure that realistic contingencies are developed.

> ***Recommendation ORTF314-316_01:*** *The Operations Review Task Force recommends that the CDEX pre-cruise planning process include a specific contingency site/operation identification discussion that incorporates input and feedback from the co-chief scientists, the CDEX Well Planning Group, the CDEX Science Planning Group and representatives from the PMT. Discussion points should include the identification of lead-time and logistical requirements for gear and/or personnel and a specific priority for the contingency operations.*

2) Operational plan development

The Task Force discussed difficulties encountered in the operational planning of the expeditions, in particular between co-chief scientists/PMT and CDEX. There seemed to be a culture of "one-way" communication with the CDEX-WPG working internally on a detailed operational plans developed from a set of objectives for the proposed drill sites (location, TD, coring, logging, etc) provided by co-chief scientists /PMT, with little (if any) iteration between the groups, often for months. Finally, a complete operations plan would be presented to the science team, often with significant changes. This new operations plan would start another slow and inefficient round of planning preparation.

The production of the final NanTroSEIZE operational plan (*CDEX Technical Report Volume 3: Summary of Drilling Program NanTroSEIZE Stage 1: Expedition 314, 315,* *and 316* -- Kobayashi et al., 2007) was a case in point. It was not provided to the expedition co-chief scientists until four days before the first expedition. The Technical Report contained major operational changes in plans that had <u>not</u> been discussed with the co-chief scientists during the period when the book was in production.

As scientific decision-making and operations cannot be separated, the Task Force consensus was that required changes to operational plans should be clearly communicated by the operator to the co-chief scientists/PMT during the development phase of the plan, not when a plan is completed. This frequent iteration of draft plans is essential to ensure that scientific objectives are respected by the operator and operational realities understood by the scientific staff. To ensure that this iterative planning happens in a timely matter, it is essential that (1) the operator have appropriate operations personnel at all planning meetings (e.g., PMT meetings, pre-cruise meetings) and (2) the operator task a specific person to act as the link between the Well Planning Group and Co-Chief Scientists.

> **Recommendation ORTF314-316_02:** *The Operations Review Task Force recommends that CDEX provide appropriate operations personnel at all PMT and pre-cruise meetings. In addition, the Task Force recommends that the Expedition Project Manager be tasked with ensuring that all proposed operational changes are communicated and discussed with the co-chief scientists.*

3) Past Scientific Drilling experience

Operations in the NanTroSEIZE area were clearly very difficult. Issues associated with the Kuroshio Current, borehole stability, and new rig and mechanical systems presented a very challenging environment. The Task Force recognized that everyone from CDEX, SeaDrill, Schlumberger, MWJ, GODI, etc., worked very hard to overcome these conditions.

However, from the submitted reports and comments that arose at the meeting, it seemed to the Task Force that IO operations team was unaware of "lessons learned" from previous DSDP/ODP drilling in Nankai by the *JOIDES Resolution.* Nearly all of the environmental challenges encountered on the NanTroSEIZE expeditions were experienced before on the *JOIDES Resolution* expeditions, and strategies were developed to overcome them in the past.

> ***Recommendation ORTF314-316_03:*** *The Operations Review Task Force recommends that the CDEX operations teams identify and familiarize themselves with similar operational scenarios experienced in previous DSDP/ODP/IODP operations, making use of lessons learned from both past successes and failures.*

4) Medical Forms

The specialty coordinator oral and written reports identified lead-time issues associated with medical forms supplied by CDEX. Several Task Force participants noted that in the United States it was often difficult to schedule medical examinations on short notice. It can take several weeks to months to schedule an examination and get the relevant information back to CDEX. The Task Force identified a simple remedy for this problem – providing medical forms to participants at the time of their invitation.

> ***Recommendation ORTF314-316_04:*** *In order to provide adequate time for medical examinations, The Operations Review Task Force recommends that CDEX provide relevant medical forms to participants when issuing expedition invitation letters.*

5) Shipping of Personal cargo/luggage

Travel across Japan and shipment of personal cargo/luggage can be a confusing and difficult process for non-Japanese, especially those with limited travel experience (e.g., students). As such, it is essential that the CDEX office provide lots of help with logistical details (which they did). The written directions and maps were indispensible for travel to and from the ship (or heliport), but it is equally important to have a bilingual logistics assistant available to answer questions by phone and E-mail and to help solve problems as they arise. Akiko Fuse did an excellent job in this regard but is no longer in that position. Her position needs to be filled before Expeditions 319 and 322 begin.

> ***Recommendation ORTF314-316_05:*** *The Operations Review Task Force recommends that CDEX find an appropriate replacement for the travel support role supplied by Akiko Fuse during Expeditions 314-316.*

6) Operational Time updates

Expedition 314 co-chief scientists found that the pre-cruise plan was quite accurate in predicting the hours spent in the hole on actual drilling, hole cleaning, etc., but was always too optimistic on the preparation for spud-in (which took many hours or days longer than planned or anticipated). As the expedition continued, the OSI and CDEX-Yokohama did not always provide updated plans with new time estimates based on actual experience gained during Expedition 314. As a result the co-chiefs spent a lot of time generating more accurate time estimates in order to determine remaining time for operations (and contingencies). Clearly, the key shipboard team (OSI and drilling engineer, OIM, Captain, co-chief scientists) should all be involved in the development of realistic time estimates, and these estimates should be continuously updated <u>on board</u>. In fact, this is what happened on subsequent expeditions (315 and 316) and is good example of "lessons learned" and applied in a timely fashion. Thus no specific recommendation was made by the Task Force on this issue.

B) Operational issues

1) Efficiency of riserless drilling operations

Beacon deployment during the first three (riserless) expeditions was frustratingly slow at every site. The beacon type, installation procedures, and general dynamic positioning location sensing procedures used on the first three *Chikyu* scientific drilling expeditions were based on the demands and risks associated with shallow water, oil and gas drilling conditions. For much of riserless scientific drilling, this approach of setting and surveying 4-8 beacons by ROV is excessively time-consuming, weather sensitive, very expensive, and inflexible. In addition, short rig moves (often necessary in riserless drilling) are inhibited.

For riser drilling on *Chikyu*, this investment of resources and time is justified. While *Chikyu* will mainly be utilized for riser drilling in the future, current projections indicate that riserless operations will also be conducted from time to time as primary operations and contingency sites. Thus the positioning approach utilized by CDEX should be re-examined.

> ***Recommendation ORTF314-316_06:*** *The Operations Review Task Force recommends that JAMSTEC/CDEX meet with the new drilling contractor (MantleQuest) to discuss alternate dynamic positioning practices taking into account the basic types of scientific drilling, including:*
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> - *riser drilling in regions of possible over-pressured hydrocarbons, shallow water,*
> - *riser drilling in regions of possible over-pressured hydrocarbons, deep water,*
> - *riser drilling in geologic regions with no pressured hydrocarbons and*
> - *riserless, open hole drilling*
>
> *For the first category the existing beacon type and usage is expected/reasonable. For the other three categories, it would benefit all parties to examine alternate vessel positioning procedures and equipment including:*
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> - *GPS only*
> - *GPS with back-up, low cost, disposable seafloor beacons launched from the ship.*

2) Core Liner Failures during NanTroSEIZE Expeditions 315-316

During Expeditions 315 and 316 a number of liner failures were reported, especially when using the HPCS, the hydraulic piston corer. Sporadic failure of the plastic core liners has always been a reality in DSDP and ODP coring operations. Although the exact reasons for the liner failures reported during NanTroSEIZE cannot be accurately determined at this time, it is doubtful that the liners that failed during coring operations onboard *Chikyu* were in any way different from many similar experiences in DSDP and ODP. The plastic core liners used in the *Chikyu* coring tools (RCB, HPCS, and ESCS) are identical to the core liners used throughout DSDP and ODP operations. They are the same size and specification as the USIO counterparts and have been supplied by the same custom plastics extruder in California.

Dave Huey (Task Force member) supplied this background of core liner history and problems for the Task Force:

> The core liners that are accepted as an integral and necessary part of wireline core recovery, core examination, and core storage in scientific drilling operations have evolved over time to the specifications in use today on the *JOIDES Resolution* and *Chikyu*. Scientists wanted liners that were simultaneously: light weight, clear, non-contaminating, reasonably tough, dimensionally stable, easily cut and sectioned, inexpensive, and disposable. The evolutionary design resulted in the cellulose acetate butyrate liners of today. The vast majority of the time those liners perform their function without failure. And they are designed in identical dimensions to work in all three primary coring systems. However, it should not be forgotten that they are just weak plastic components, roughly 30-ft long, and can be bent by hand and cut with a razor blade. The fact that they occasionally fail in service is less amazing than the fact that they normally do not fail.
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> Liner failures come in an astounding variety of forms, several of which were observed during *Chikyu* operations. Each mode of failure has been identified during DSDP and ODP operations and specific design elements have been added to each of the coring systems to help avoid such failures, at least as much possible. It is incumbent on the coring tool operators (core techs) to be aware of the liner-protection design features in the three types of coring tools, as well as the most probable causes of each type of liner failure (cracking, bursting due to internal pressure, collapse due to external pressure, axial collapse, peeling, etc). There was some conjecture during the NanTroSEIZE operations that core liners were failing due to internal pressure caused by expanding gases from the cores. Neither the lack of success of mitigating steps (drilling relief holes in the liners) nor the headspace measurements appear to support the gas expansion failure theory in those cases, although trapped pressure, in general, is known to be one of the possible failure mechanisms for the liners.
>
> The core techs assigned to the various stages of Expeditions 315 and 316 were well-chosen individuals with experience in coring operations onboard the *JOIDES Resolution*. There is no reason to believe they were not aware of liner failure causes and proper mitigation practices during the expeditions. It is likely that the core liner failures experienced on *Chikyu* would have happened if the *JOIDES Resolution* had been operating there instead.
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> Inherently weak plastic parts working in conjunction with steel components in a hostile environment will fail now and then. Much depends on luck and coring conditions, which have always been less than ideal in previous Nankai Trough drilling experiences. The best solution to achieving maximum core quality is to be aware of potential liner failure problems, maintain the coring tools in peak condition, diagnose liner failures as they occur, attempt to take precautions on upcoming cores, and if possible, plan redundant holes to have more than one chance to get critical cores where liner failures might cause core damage or loss.

Based upon the above information and discussion, there were no specific recommendations by the Task Force for core liner improvement. However, two aspects of this discussion merited recommendations. First, as discussed above, *"....The best solution to achieving maximum core quality is to be aware of potential liner failure problems, maintain the coring tools in peak condition, diagnose liner failures as they occur and attempt to take precautions on upcoming cores.....".* These solutions require experienced core-tech personnel that can repeatedly be assigned to coring expeditions for the benefit of long-term continuity and operational/science optimization. The recommendation in the next section (Core Technician Training) addresses this issue.

A critical aspect of diagnosing core liner failure is monitoring the coring process, especially the extraction process. Scientists and operators should be aware of what is occurring on the rig floor with respect to the coring and extraction process and take time to document issues with each core.

> ***Recommendation ORTF314-316_07:*** *The Operations Review Task Force recommends that each operator develop a monitoring procedure to document coring issues, especially those associated with abnormalities in the coring process (e.g., incomplete stroke) and the extraction process (e.g., twisting of liner to remove it from core barrel).*

3) Core Technicians Aboard Chikyu During Scientific Drilling Expeditions

During the first three expeditions, the IO gained considerable operational experience with respect to coring. The use of *Chikyu* coring tools, and guidance of drilling holes to maximize core recovery for scientific benefit, is presently arranged by the coring subcontractor, Aumann and Assoc. However, personnel who act as core techs are variable in availability and level of training. Optimized results of the coring systems are achieved with the invaluable assistance of trained, experienced core techs. The Task Force recognizes that it would be very desirable to have full time, experienced core techs available on every scientific coring expedition where coring is a significant component. The core tech model (job description, duties, responsibilities, training level) should follow the successful experience on the *JOIDES Resolution.* In theory, the extra personnel cost and bunk space problems can be mitigated by using the core techs in place of sub-contractors that are now required. This type of staffing could result in actual cost savings, as well as increased flexibility, by saving operational time and by eliminating sub-contractor mobilization/demob requirements.

> ***Recommendation ORTF314-316_08:*** *JAMSTEC/CDEX should meet with the new drilling contractor (Mantle Quest) to discuss the possibility of adding core techs to the Mantle Quest crew. These personnel should be repeatedly assigned to coring expeditions for the benefit of long-term continuity and operational/science optimization. The following possibilities and benefits should be thoroughly examined:*

- *Core techs (2 people to cover 24 hr operations if necessary) assigned to each expedition*
- *Core techs as MQJ employees*
- *Core techs who maintain coring tool inventory, including ordering and maintenance*
- *Core techs with driller rank and training so that they can relieve drillers during meal hours, etc.*
- *Core techs whose role will naturally create a better rig floor-to-science party communication path about drilling and coring parameters and hole conditions for the benefit of scientific decisions and results*
- *Core techs also trained as casing crews sufficient to eliminate the need of hiring casing crew sub-contractors, similar to JR model*
- *Core techs also trained as severing system operators, sufficient to implement pipe severing procedures, after explosives are brought out to the ship in an emergency situation, similar to JR model*

4) ECSC core recovery and core quality

ESCS coring was attempted during Expedition 315. However, efforts were abandoned after two cores because of severe "biscuiting" in the recovered material. The Task Force briefly discussed the issue, particularly to determine if the poor quality of the cores was the result of inherent defects in the ESCS, the experience level of the drill crew and core techs, or simply a function of lithology. No specific cause (and hence no solution) arose during this review. The Extended Coring System on the *JOIDES Resolution* frequently experiences these biscuiting problems and the Task Force recognized that this tool needs improvement as part of a long-range technical plan by IODP. In addition, the Task Force recognized that the quality and quantity of core recovery of any of the tools is very dependent on Core Tech experience. Thus, the Task Force reiterated, that a first step toward addressing these coring issues is to maintain an experienced Core Tech crew (see recommendation **ORTF314-316_08)**, as well as a database of coring operations (**Recommendation ORTF314-316_07)**.

5) Vortex-Induced Vibration (VIV) Problems – Chikyu Drillstring and Riser Operating in Kuroshio Current, Nankai Trough

The Operations Review Task Force heard commentary about the serious VIV responses of the drillstring that were repeatedly observed during Expeditions 314-316. Dave Huey (Task Force member) supplied the following information and thoughts regarding VIV:

> Kuroshio Current velocities were high (> than 2.5 kts at surface) throughout the time span of the expeditions. The violent vibrations caused a number of hardware-related problems including, most likely, coring tool and sinker bar assembly failures, logging tool problems, loosening fasteners in the derrick and hoisting systems, as well as possibly contributing to drillstring and/or BHA threaded connection failures. Because of high

current drag, as well as VIV, the deployment and retrieval of the drillstring had to be done with various drift-on-site approaches, all of which consumed operations time. Not specifically mentioned but also true is that the continuous vibrations cause cumulative damage to the guidehorn and result in accelerated fatigue-cycle accumulations to the drillstring. This suggests that drillstring and guidehorn inspection for small fatigue cracks must be scheduled more frequently than normal.

When riser operations commence in upcoming expeditions, the drilling riser will be subjected to similar handling problems and rapid fatigue life consumption, as well as possible isolated failures of riser components and accessories due to loosening of fasteners, damage to buoyancy modules, etc.

The fact that VIV responses could be expected was well understood in advance. CDEX/JAMSTEC worked with experts and analysts on the analysis of potential VIV responses of the drillstring for many months in advance of the expeditions. The problem, as acknowledged by all, is that there is very little that can be done to mitigate these VIV problems when drilling with an exposed drillstring in strong currents. Drifting-on-site techniques reduce fatigue exposure problems during deployment and retrieval of the drillstring but do not help when the pipe is in the hole. Vessel positioning down-current when the pipe is in the hole can help to reduce localized wear on the guidehorn, not only due to VIV but also simple current drag and side loads. *Chikyu* personnel were aware of all of these things and had taken what steps were possible in advance.

Future operations with the riser connected to a wellhead will be more tolerable because the riser will be equipped with fairings over the critical sections near the top of the riser. This will reduce, although not eliminate, VIV motions of the riser. Not all riser vibration motions will be universally transmitted to the drillstring, so coring and logging tools should be operable at a reduced risk of vibration-related failure. CDEX/JAMSTEC has done a good job of pre-analyzing the riser VIV responses and determined the most appropriate steps to mitigate VIV damage to the riser. However, adding a riser with fairings also will lead to slow deployment-retrieval operations of the riser and significant fatigue-damage accumulations to the riser itself if high currents are prevalent. These trade-offs must be accepted if riser-drilling operations are to be conducted in the Kuroshio Current. The realities of such VIV-intensive operations in high current areas are well-known to the offshore oil and gas industry, and CDEX/JAMSTEC has already taken advantage of that body of industry experience in planning the upcoming NanTroSEIZE riser operations.

Although the VIV responses and associated problems were a recurring theme in the evaluation of the operational success of the first three expeditions, there was no specific recommendation from the Task Force regarding the situation. The Task Force encourages vigilance in future expeditions when high currents are present, especially in taking measures to reduce the likelihood of vibratory loosening of threaded connections in the drillstring, hoisting equipment, guidehorn, logging tools, and coring tools. Baker-lock, thread-locking compound should be used wherever appropriate and reasonable. More significant locking mechanisms like tack welds and lock pins should be considered for any components at high risk, even at the expense of the time required to install and remove them.

C) Communications

1) Lines of communication - too complex, not well understood

A consistent theme heard throughout the meeting was that that lines of communication seemed too complex or were not well understood. Issues arose during the period leading up to the beginning of the expeditions (including the formal pre-expedition meetings and Project Management Team meetings) and during the expeditions. As discussed above, there seemed to be a culture of "one-way" communication, especially between the CDEX Well Planning Group and the science side of the project, with long periods of time between responses and/or requests for input.

During the expeditions there was some uncertainty as to how the leaders of various teams should interact, especially in how the co-chief scientists and EPM, as leaders of the science effort, were to be integrated into the shipboard operations. Because there were many different organizational representatives on board, it was not very clear at the beginning of the operations where the lines of communication lay. At times, this confusion resulted in unnecessarily long lines of communication (e.g., interaction between scientists and Schlumberger engineers) and a negative atmosphere.

The timing and duration of many operations on *Chikyu*, which is not optimized for rapid drilling of riserless holes, were often frustrating to scientists used to the operational environment aboard the *JOIDES Resolution*. Many scientists, the co-chief scientists included, needed some time to understand why certain operations worked differently on board *Chikyu* compared to the *JOIDES Resolution*. Once this information was communicated effectively, the frustration level at the pace of operations eased. However, there is still room for improved efficiency in this area (see, for example, the discussion and recommendations regarding beacon installation).

As with many start-up ventures (especially with the myriad of organizational entities on board), the situations described above were not unexpected and did improve as experience was gained in daily operations. Indeed, in many cases, as experience was gained, lines of communication and roles and responsibility became clearer (see also **Section D – Staffing**, below, for more recommendations on roles and responsibilities).

A major "lesson learned" in this context was that frequent communication across organizational lines is extremely important. The establishment of an "executive committee" (*CCs, OSI, OIM, Captain, and EPM)* on Expedition 314 and generally utilized on the subsequent two expeditions helped immensely and should continue. Along these lines, the Task Force had two specific recommendations:

> ***Recommendation ORTF314-316_09:*** *The Operations Review Task Force recommends that all future Chikyu expeditions continue to use the shipboard "Executive Committee" model (including CCs, OSI, OIM, Captain, and EPM) as a routine daily forum to address operational, scientific and other issues.*

> ***Recommendation ORTF314-316_10:*** *The Operations Review Task Force recommends that CDEX, as part of standard HSE training, conduct a formal*

workshop prior to each expedition on communication issues associated with the interaction of different cultures.

2) Internet Technology

The Task Force heard that science and operations were adversely affected by the slow speed and unreliability of the internet connection on *Chikyu*. The adverse internet connections affected video conferencing, real-time transmission of data, conference calls, etc. As *Chikyu* operations are guided from the headquarters in Yokohama on a daily basis, reliable internet communication is absolutely essential.

The Task Force felt that in this day and age, anything less than high-speed, broadband internet connections for an operation like IODP is ***completely unacceptable.*** Although *Chikyu* has the necessary infrastructure for high-speed internet connections, apparently Japanese telecom restrictions prevent *Chikyu* from utilizing this infrastructure in Japanese territorial waters.

CDEX personnel informed the Task Force that communication speed will increase for future expeditions but this increase is still an order of magnitude below what is needed. The Task Force feels that it necessary for CDEX/JAMSTEC and MEXT to lobby the appropriate Japanese agencies to either work for change in the telecom restriction or obtain a waiver to operate at communication levels expected by the international scientific community.

> ***Recommendation ORTF314-316_11:*** *The Operations Task Force recommends that CDEX/MEXT lobby the appropriate Japanese agencies to either work for change in the telecom restriction or obtain a waiver to operate at standards expected by the international scientific community.*

D) Staffing

1 - Roles and Responsibilities

<u>CDEX/*Chikyu* Personnel</u>

An issue that arose from the initial *Chikyu* expeditions (as it did with the early *JOIDES Resolution* IODP expeditions) was that concerning the roles and responsibilities of the operator's staff. The roles of the Well Site Geologist (WSG) and Technical Advisor were the subject of much discussion at this particular Task Force meeting. The WSG role on *Chikyu* was not well understood by Task Force members. Normally, the WSG (in industry applications) would produce the geologic prognosis for the operations superintendent and drilling engineer for the various sites. On *Chikyu*, the WSG's functions apparently also include acting in a liaison role between the Schlumberger logging team and the scientists, managing the mud logging program, and assisting the drilling engineer. These *Chikyu* geological and geophysical WSG roles highlighted a basic issue. With 15-25 PhD geologists and geophysicists on board each expedition sailing as experts in the geology of area – *why is a Well Site Geologist staffed on riserless expeditions (particularly in the role of providing geologic prognoses)?* The Task Force did not feel it was in their purview to dictate specific staffing roles, but felt that this issue highlighted one seen before with the *JOIDES Resolution* and the USIO --- a clear definition of the roles and responsibilities of all personnel on *Chikyu* is required. In addition, in light of limited berth space on *Chikyu*, these roles and responsibilities need to be examined with respect to the expertise that can be provided by scientific staff. Obvious redundancies need to be eliminated.

The Task Force also discussed several other specific roles including that of the EPM and Lab officer, as well as IT and ET support. In these particular cases, the issue was not with redundancy with scientist roles but with the amount of duties or the number of staff. In the case of the EPM and Lab Officer, the Task Force found that they had too many duties and that the consistency of EPMs from expedition to expedition was lacking. IT and ET support was deemed insufficient for a 24/7 operation (e.g., at times there was no IT expert on board).

> ***Recommendation ORTF314-316_12:*** *The Operations Review Task Force recommends that CDEX develop (and supply to all shipboard participants) a detailed description of responsibilities of all positions on Chikyu. As part of this task, CDEX should specifically:*
>
> - *examine the role of the Well Site Geologist and Technical Advisor in riser and riserless operations (in light of potential redundancy with shipboard scientific staff)*
> - *examine the use of the Yeoperson to assist the EPM with administrative duties*
> - *provide cross-training with USIO EPMs to develop consistent approach for all IODP EPMs*
> - *provide 24/7 IT and ET support*

<u>Specialty Coordinators</u>

The role of the specialty coordinator is a new one to IODP and Scientific Ocean Drilling. In an operation like NanTroSEIZE, with expeditions spread over many years, the intent of the specialty coordinators is to provide a long-term link to improve the integration and coordination of scientific results between and among all of the individual expeditions. As with many other roles on *Chikyu*, the Task Force found that this group was essentially still learning their shipboard roles and that these roles were not communicated very well to the co-chief scientists and scientific staff. Thus more definition of responsibilities and communication pathways is in order. In addition, the Task Force discussed mechanisms to improve the role of the specialty coordinator, including the establishment of formal shorebased face-to-face crossover meetings when scientific staff rotates off the platform. Finally, like the EPMs, the specialty coordinators need to develop a more consistent approach to the their duties.

It was clear to the Task Force that the specialty coordinators had a good understanding of the issues before them and the tasks they need to address. However, in order to provide a more consistent and clear approach, they also need to better educate the community to their roles and responsibilities

> ***Recommendation ORTF314-316_13:*** *The Operations Review Task Force recommends that the NanTroSEIZE Specialty Coordinators develop a more detailed document of their roles/responsibilities and determine the best mechanism(s) to explain this important role and its responsibilities clearly to the science party prior to each expedition.*

2) CDEX Crew rotation

Crew rotation on *Chikyu* is very different than previously experienced by scientists during IODP/ODP. High rotation rates (days to several weeks) of members from the operations/drilling/ well planning groups (e.g., OSI, WSG, drilling engineer) and the CDEX science group (e.g., Publications, IT, laboratory technicians) resulted in a loss of continuity from the various operations. In contrast, it was very clear to the Task Force that staff that stayed on for the whole expedition (e.g., EPM and Logging Staff Scientist) worked much better with the science team than ones that changed too often.

The Task Force members understand that most crew rotation rates are subject to Japanese labor laws and thus are very difficult to change. While the Task Force did not have a specific recommendation as to how CDEX could address this issue, the Task Force felt that it was incumbent on CDEX to address this issue of continuity with CDEX staff on future expeditions.

3) Pre Cruise Staffing Issues

Several pre-cruise related staffing issues were brought up in the Briefing Books, oral presentations, and general discussion during the meeting, including, but not limited to, (1) the timing of the Call for Applications, (2) ESSAC consortium member quota issues, (3) shortages of particular disciplines, and (4) the need to consider contingency operations when choosing scientific staff.

These issues are intimately tied to the Program Member Offices as well as the implementing organization. As such, the Task Force felt that these issues should be brought forward to the next Program Member Office meeting (in March) for discussion.

> ***Recommendation ORTF314-316_14:*** *The Operations Review Task Force recommends that IODP-MI bring forth the specific pre-cruise staffing issues discussed in the Expedition 314-316 ORTF Briefing Book to the March 2009 Program Member Office meeting.*

4) Cross-Over Briefings

A major role of the specialty coordinator is to provide continuity between expeditions and/or other mid-expedition changes in scientific crew. The cross-overs (especially those made by helicopter) were ineffective as there was little time allocated for extended face-to-face meetings with oncoming and off-going staff (especially if the specialty coordinator was on the platform). During future rotations of the scientific party, the Task Force believes that the specialty coordinators should spend enough time in Japan (i.e., not necessarily on the platform itself) to brief all of the arriving scientists and debrief all of the departing scientists.

Recommendation ORTF314-316_15: *The Operations Review Task Force recommends that for future Chikyu expeditions like NanTroSEIZE the specialty coordinators conduct formal onshore briefing/debriefing meetings. The length and typical agenda for these meetings should be specified in the specialty coordinator roles and responsibility document (see also* ***Recommendation ORTF314-316_13)***

E) Publications

The publications process for Expeditions 314-316 was of mixed success. There was a general consensus that the post-expedition editorial meetings at TAMU were well handled by a very experienced and patient group. However, the Task Force heard of numerous issues related to the timing and involvement level of specialty coordinators in the process, the level of initial shipboard editing, the coordination and consistency of prospectus content between expeditions, the timing of prospectus development, access to draft reports, the timing of synthesis papers, understanding of timetables/deadlines, and migration of VCD data from J-CORES to Strater.

In general, although the whole publication process worked well, there are numerous areas that need improvement. The Task Force members believe that the best mechanism to address the issues would be to have an Ad Hoc Task Force review the CDEX publication process in detail and work with CDEX/TAMU to make modifications where necessary.

> ***Recommendation ORTF314-316_16:*** *The Operations Review Task Force recommends that IODP-MI form a small ad hoc task force to review and address the specific issues identified in the Expedition 314-16 operations review and modify the CDEX/TAMU publication process accordingly.*

F) Safety

The Task Force found that the SeaDrill – GODI safety culture in general was excellent. Ship operations seemed to be safe and well run and the observation card system was a success. There were two areas of concern, however, to the Task Force. The first was related to language: many members of the ships crew, including those responsible for safety, could not communicate in English. The most worrisome example was that one of the ship's nurses did not speak any English, presenting a potential problem in case of an emergency. The use of interpreters is always an option, but that option does pose risks with improper translation and confidentiality issues.

> ***Recommendation ORTF314-316_17:*** *The Operations Review Task Force recommends that CDEX examine the delivery of medical services aboard Chikyu to ensure that this important safety/health function meets the needs of the scientific staff.*

One of the specialty coordinator reports identified specific safety equipment issues within the laboratories. The Task Force believed these issues should be corrected immediately.

> ***Recommendation ORTF314-316_18:*** *The Operations Review Task Force recommends the CDEX address the specific safety equipment issues identified in the Briefing Book.*

G) Sample requests

The Task Force briefly discussed some issues that arose during the implementation of Sample Requests, including the Whole Round sampling protocols, the lack of flexibility to deal with sampling contingencies or variable recovery, the timing of Sample Allocation Committee (SAC) decisions, and bugs in the Sample Management software. In general, though, the Task Force felt that the majority of the issues would be rectified if the various groups (SAC, the specialty coordinators, curators) simply did their jobs as defined in their respective roles and responsibilities documents (see, for example, **Recommendation ORTF314-316_13)**. As such, the Task Force had no specific recommendation with respect to Sample Requests.

H) Laboratories

The specialty coordinators, in particular, discussed numerous issues of varying complexity in the *Chikyu* laboratories related to equipment, software, analytical procedures and protocols, calibration standards, and the roles of MWJ technicians. The laboratories specifically mentioned in the Briefing Book and during the meeting included the Core Lab/core flow, the Geochemistry, Physical Properties, and Paleomagnetics.

As with the Publications, the spectrum of issues to be resolved was beyond the expertise of the Task Force members. The Task Force, therefore, recommended that IODP-MI compile the laboratory issues identified in the Briefing Book and meeting discussion and task CDEX to provide a formal response to IODP-MI (via the Scientific Technology Panel) as to how they will address these issues with respect to the upcoming FY09 NanTroSEIZE expeditions and beyond.

__Recommendation ORTF314-316_19:__ Operations Review Task Force recommends that IODP-MI compile the laboratory issues identified in the Briefing Book and meeting discussion and task CDEX to provide a formal response to IODP-MI (via the Scientific Technology Panel) as to how they will address these issues with respect to the upcoming FY09 NanTroSEIZE expeditions and beyond.

I) Data Dissemination

1) Shorebased party rights to shipboard data

The multi-expedition nature of the NanTroSEIZE program, along with Stage 1 participants from three expeditions comprising a single scientific party, introduced new aspects to data dissemination. Not only do data need to be shared between co-chief scientists and shipboard scientists but also with Chief Project scientists, shipboard and shorebased specialty coordinators, Project Management Team members, and shorebased participants in the various disciplines (e.g., lithostratigraphy, structural geology, physical properties, etc). During the first three NanTroSEIZE expeditions, tension arose in some working groups over shorebased participants receiving shipboard data. Shipboard members of the working group seemingly did not understand plans to share data and/or how to divide the load of shore-based analytical work.

The Task Force discussed numerous mechanisms to help change the attitude from "my expedition versus your expedition" to "our expedition". In the end, though, resolution of this issue comes down to (1) clear documentation of how a single science party works across multiple expeditions and (2) clear documentation of what data is required and when it is to be distributed to the shorebased science party participants, and (3) clear, consistent, and frequent explanation by the specialty coordinators, co-chief scientists, and EPM of how Items 1 and 2 work.

The specialty coordinators are a key aspect to making this multi-expedition science party function properly. The policies are mostly in place, what is needed is education. A consistent and frequent message (at participant acceptance, pre-cruise meetings, and cross-over meetings) will help to alleviate this problem in future expeditions.

__Recommendation ORTF314-316_20:__ The Operations Review Task Force recommends that the specialty coordinators utilize their role and responsibility document (See Recommendation __ORTF314-316_13)__ to design a consistent model to educate the expedition participants to the data sharing responsibilities incumbent upon all in multi-expedition single-science party programs. In addition, the Task Force recommends that the co-chief scientists and EPM explicitly remind the shipboard participants (several times during an expedition) of their data sharing responsibilities.

2) J-CORES issues

The Task Force heard numerous complaints related to J-CORES, the shipboard data acquisition and handling system on *Chikyu*. As early as the 2006 shakedown cruise, the J-CORES database was described as inflexible, not allowing specific data queries. These issues re-emerged both during and immediately after the Stage 1 expeditions. They still persist. Data entry and retrieval are very difficult with graphical capabilities far below publication-quality standards. Formatting inflexibility makes it difficult to plot the data for figures using external graphing software, which is generally needed to produce publication-quality figures for expedition reports and journal articles. The scientists found it is still not possible to make queries by data type or intervals, or to add new data type. The lack of a functional search or sorting capability for data queries will be a barrier to the long-term utility of the data archive beyond the moratorium period.

The Task Force recognized that these basic functionality issues described above need to be addressed by CDEX. It also recognized that there were ongoing efforts by IODP-MI and CDEX to address many of the J-CORES issues. Given that the Task Force did not know the extent of these ongoing efforts to improve data access, it was difficult for the group to make specific recommendations in this area. As such, the first step was to ask IODP-MI (which oversees IODP data management) how current and future programming efforts will address these efforts. If the issues are not being addressed, the Task Force requested information as to how IODP-MI/CDEX will address the issues for future *Chikyu* expeditions.

> ***Recommendation ORTF314-316_21:*** *The Operations Review Task Force recommends that IODP-MI provide a summary report to the Task Force describing what current (and future) programming efforts will be utilized to address the myriad of J-CORES issues described in the Briefing Book reports. If the current (or future) efforts will not address the major issues described in the reports (the most pressing being the ability to make data type/interval queries), the Task Force requests information from IODP-MI/CDEX as to how they will address these issues for upcoming Chikyu expeditions.*

An ancillary data management issue involved the migration of visual core description (VCD) from J-CORES to Strater (for the final publication of the core description graphics). The lithology specialty coordinator report provided a very detailed summary of the problems associated with the data migration and editing process. Armed with the knowledge of all that went wrong, a new "cookbook" or primer can be developed to guide this process. Mike Underwood (Lithostratigraphy Specialty Coordinator), Debbie Partain (TAMU) and Yusuke Kubo (CDEX) have agreed to draft that document before Expedition 319 begins. They simply request that the USIO and CDEX support the efforts, especially with respect to the time requirements for the TAMU and CDEX personnel.

> ***Recommendation ORTF314-316_22:*** *Operations Review Task Force recommends that the USIO and CDEX fully support the efforts of the small VCD working group to develop a primer for VCD data entry, migration, editing, and publication.*

J) Miscellaneous

1) Software / equipment training

The Task Force discussed the need for more improved software and equipment training by scientists prior to the expedition, especially for graduate students who may not be as familiar with methodologies and/or equipment as more senior level scientific staff. Previous ORTF reports (for the USIO operations) identified a very useful first step in this respect – the development of on-line tutorials and/or manuals for each piece of equipment/software operated by scientists. In addition, CDEX may need to address, on a case-by-case basis, the need to bring scientists to CDEX or other appropriate venues for additional training.

> ***Recommendation ORTF314-316_23:*** *The Operations Review Task Force recommends that CDEX develop on-line tutorials and/or manuals for each piece of equipment/software operated by scientists. In addition, CDEX may need to address, on a case-by-case basis, the need to bring in scientists to CDEX or other appropriate venues for additional training.*